USDOE Hanford Site

First Five Year Review Report

Prepared by:
The U.S. Environmental Protection Agency
Region 10, Hanford Project Office

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USDOE HANFORD SITE
FIRST FIVE YEAR REVIEW REPORT

CERTIFICATION AND APPROVAL

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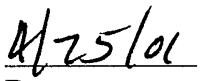


Date

Table of Contents

300 Area

1100 Area

Foreword

General

The U.S. Department of Energy's (DOE's) Hanford Site, which was established to produce nuclear materials for national defense, covers approximately 586 square miles adjacent to the City of Richland in Benton County of Washington State. When the Hanford Site was placed on the National Priorities List (NPL) in 1989, it was divided into four NPL sites: the USDOE Hanford 100 Area, 200 Area, 300 Area, and 1100 Area. Each NPL site was further divided into operable units to simplify the response. An operable unit is a grouping of individual sites based primarily on geographic area or common waste sources; soil and groundwater contamination are usually in separate operable units. In anticipation of the NPL listing, DOE entered into the *Hanford Federal Facility Agreement and Consent Order* (also known as the Tri-Party Agreement or TPA) with the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology). The TPA established the legal framework and schedule for the cleanup at Hanford. For each operable unit, the TPA designates either EPA or Ecology as the lead regulatory agency.

EPA Region 10 has conducted the first five-year reviews of the remedial actions implemented at the four NPL sites at the Hanford Site. The purpose of a five-year review is to determine whether the remedy at a site is protective of human health and the environment. The methods, findings, and conclusions of those five-year reviews are documented in this five-year review report. This five-year review report also identifies deficiencies found during the review, if any, and identifies recommendations to address them.

These reviews of the Hanford Site are required by statute. EPA must implement five-year reviews in a manner consistent with the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) and the *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP). CERCLA §121(c), as amended, states:

> If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented.

The NCP part 300.430(f)(4)(ii) of the Code of Federal Regulations (CFR) states:

> If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

This report documents the results of the five-year reviews that were conducted from February 2000 through September 2000. The four NPL sites are discussed in separate sections. The scope of the TPA is broader than this five-year review because the TPA addresses regulated *Resource Conservation and Recovery Act* (RCRA) units, as well as the cleanup of past practice

units required under RCRA and/or CERCLA. Only operable units listed as past-practice units in the TPA are covered in this five-year review report. Removal of radiologically-contaminated structures, if conducted pursuant to the 1995 *Policy on Decommissioning Department of Energy Facilities Under CERCLA*, is also included. Active treatment, storage, or disposal units, such as the Hanford tank farms, are not part of this review.

100 Area

The 100 Area consists of six nuclear reactor areas that are principally contaminated with radionuclides and metals and, to a lesser extent, with other contaminants such as organic chemicals and asbestos. In addition to the reactor areas, there are outlying waste sites whose principal contaminants are metals and organic chemicals. The 100 Area five-year review covers eleven decision documents that have resulted, or will result, in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure. The primary cleanup actions that will be performed in the 100 Area are removal of contaminated soil, decontamination and/or demolition of contaminated buildings, removal of underground contaminated pipes and other engineered structures, capture and treatment of contaminated groundwater that would otherwise flow into the Columbia River, and removal of spent nuclear fuel and associated waste from water-filled basins that have a history of leaks. Institutional controls are an additional component of the selected remedies.

Several of the cleanup actions that were reviewed (namely removal of contaminated soil, decontamination and/or demolition of buildings, removal of underground pipes and other structures, and clean-out of the spent nuclear fuel basins) have achieved or are on track to achieve the "protection of human health and the environment" criteria that was set forth in the decision documents. Several minor recommendations for those cleanup actions are provided in this review. The principal deficiency is that the pump-and-treat remedial action for capturing and treating several chromium-contaminated groundwater plumes has not achieved the required protectiveness criteria because of insufficient capture of the plume. The five-year review recommends optimizing and running the extraction/treatment system more reliably.

200 Area

The 200 Area of the Hanford Site was used for chemical processing and for waste management. These activities generated radioactive, hazardous, and mixed wastes that were disposed of into the soil column and resulted in large amounts of contaminated soil and groundwater in the 200 Area. This five-year review is focused on the inactive soil disposal area, inactive facilities, contaminated groundwater, and the Environmental Restoration Disposal Facility (ERDF). Ongoing waste management activities, active treatment, storage, or disposal facilities and tank farm operations are not included in this review.

The 200 Area is divided into 23 soil operable units. These units contain approximately 700 soil waste sites and associated structures, as well as numerous facilities requiring decontamination and decommissioning. In addition to the 23 soil operable units, the 200 Area

NPL site contains four groundwater operable units, two of which (200-ZP-1 and 200-UP-1) are in 200 West Area and two of which (200-BP-5 and 200-PO-1) are in 200 East Area.

The 23 soil operable units are in various stages of the remedial investigation/feasibility study process and are currently on schedule for the completion of all required investigations by 2008. Only two soil operable units have had a remedy selected. One of these, the Environmental Restoration Disposal Facility (ERDF), has also been constructed. The review of ERDF indicated that the facility is operating in an environmentally protective manner and no change to current operations is needed. There are no issues associated with the cleanup of the 233-S Plutonium Concentration Facility.

Review of the 200-ZP-1/200-ZP-2 carbon tetrachloride project revealed several areas of concern that will need to be addressed to ensure protection of human health and the environment. Soil vapor extraction has been used to remove carbon tetrachloride from the soil for the past 8 years. Vapor extraction was highly successful during the first several years of the project, removing more than 150,000 pounds of carbon tetrachloride. However, during the past 3 years, removal efficiency has dropped significantly and little carbon tetrachloride has been removed. DOE and EPA are currently reviewing applicable technologies that will enhance removal of carbon tetrachloride from both soil and groundwater.

A review of the 200-UP-1 Pump-and-Treat System for removing uranium and Technetium-99 from 200 West Area groundwater revealed that the system has been partially successful in removing the technetium but has had little effect on uranium concentrations. DOE and Ecology need to develop a strategy to enhance removal of uranium from the 200 Area groundwater in order to ensure protection of human health and the environment.

300 Area

The 300 Area consists of three operable units. The 300-FF-1 and 300-FF-2 Operable Units address contamination at soil waste sites and burial grounds associated with operations in the 300 Area. The primary cleanup actions involve the removal of contaminated soils and debris; treating the material, as appropriate; and disposing of the material in an appropriate facility. Institutional controls are an additional component of the selected remedies. The 300-FF-5 Operable Unit addresses groundwater contamination beneath the soil waste sites and burial grounds. The current decision for contaminated groundwater in the 300 Area is to monitor the groundwater plumes to ensure that they are attenuating to acceptable concentrations through natural processes. Part of the cleanup includes controlling use of the cleanup areas and the groundwater.

In general, the 300 Area cleanups are proceeding in a protective and effective manner. EPA still considers the cleanup goals and remedy selection decisions appropriate at the time of this review. However, the review outlines a number of action items that DOE must perform in order to ensure that (1) the remedy remains protective, and (2) appropriate information is being gathered to document that the remedy is achieving the goals established in the Record of Decision. For example, an active and enforceable institutional controls plan is required. In

addition, DOE must demonstrate that soil cleanup levels are protective of groundwater, that biological resources are not being adversely impacted, and that contaminated groundwater plumes are attenuating to acceptable concentrations through natural processes in a reasonable length of time.

1100 Area

The 1100 Area was divided into four operable units. All of the remedies have been completed, and the 1100 Area has been deleted from the NPL. The remedies at three of the operable units (1100-EM-2, 1100-EM-3, and 1100-IU-1) allow for unrestricted use and unlimited exposure. Hazardous substances remain in one operable unit (1100-EM-1) at levels that do not allow for unlimited use and unrestricted exposure. The Horn Rapids Landfill was used for asbestos disposal and was closed in accordance with asbestos regulations. Also, the groundwater in the vicinity of the Horn Rapids Landfill is contaminated with trichloroethene; the remedy was to allow the contamination to attenuate. Institutional controls are a component of the selected remedies, specifically to maintain the landfill fence and cap and to prevent use of the contaminated groundwater. The only deficiency found during the review was that the fence around the landfill needs some repair.

Action Items

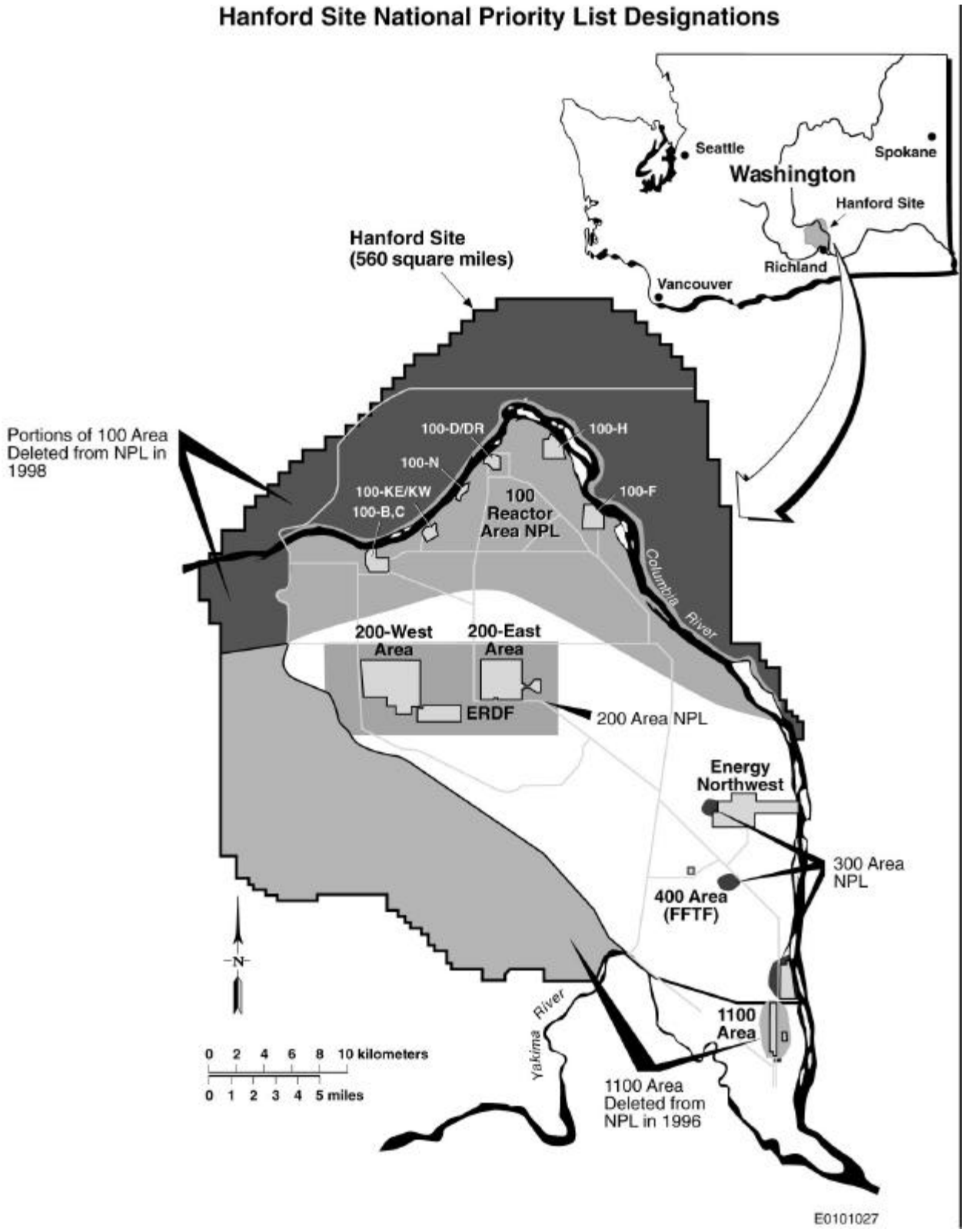
The following table is a summary of the action items to address deficiencies identified during the reviews. The first action item, SW-1, is a site-wide issue that crosscuts each of the NPL sites. Each section contains a complete list of the action items and additional recommendations for an NPL site. Some of the action items may represent new work, as defined by the TPA, and therefore the due date and the subsequent schedule to implement those requirements will be subject to negotiation.

Action Item	Description	Due Date
SW-1	DOE shall develop a site-wide institutional controls plan for the Hanford Site. EPA will initiate modifications to appropriate remedy selection decision documents to incorporate the requirements.	July 2001

Action Item	Description	Due Date
100-1	DOE shall optimize and complete system enhancements to the 100-HR-3 and 100-KR-4 groundwater pump-and-treat systems for chromium to run more reliably and achieve the required cleanup levels. • The overall system up-time must improve. • The downtime for individual wells must be dramatically reduced. • A much higher percentage of the targeted plume must be captured. For 100-KR-4, the plan to achieve these enhancements is the following: • Complete the design for system enhancements by September 2001. • Acquire an additional treatment skid and support systems. • Build and annex or additional building to house the new treatment skid. • Install an extraction well to bridge the gap between existing extraction wells K-120A and K-119A. • Install a new injection well. For 100-HR-3, the plan to achieve these enhancements is the following: • Complete the design for system enhancements by September 2001. • Upgrade treatment and support systems to increase capacity and reliability. • Install an additional extraction well in the 100-D Area.	May 2002
100-2	DOE shall investigate alternative remedial action technologies for the removal, mass reduction, and/or attenuation of Strontium-90 from the 100-NR-2 aquifer sediments and to further reduce the net flux of Strontium-90 to the river. This investigation will be documented in a letter report to support a ROD amendment. The letter report will include a recommendation and schedule for a path forward based on the ITRD conclusions and agreement from Ecology.	December 2001
200-1	DOE shall evaluate enhancements to the 200-PW-1 soil vapor extraction system in order to remove carbon tetrachloride from the vadose zone, and shall provide this information to EPA.	December 2001

Action Item	Description	Due Date
200-2	The Tri-Parties should continue to investigate applicable dense non aqueous phase liquid (DNAPL) detection technologies and enhancements to the current pump-and-treat system.	December 2001
200-3	DOE shall install at least one monitoring/production well within the high-concentration area of the carbon tetrachloride plume near PFP. This well shall be installed by DOE in FY 2001 to support characterization needs, enhancement to pump-and-treat and/or vapor extraction system operations, and DNAPL investigations.	September 2001
200-4	The Tri-Parties shall develop a monitoring network for the entire 200-ZP-1 Operable Unit. Currently, the monitoring network for the 200-ZP-1 Operable Unit only focuses on the area affected by the pump-and-treat operations. The monitoring network will be documented in a sampling and analysis plan that will be submitted to EPA, the lead regulatory agency for 200-ZP-1, for approval.	March 2002
200-5	DOE shall comply with the 200-UP-1 RAO of 50 gallons per minute by utilizing additional extraction well[s] by December 2001. DOE shall also initiate pumping from well 299-W23-19 to meet the RAO of 10 times the MCL for Technetium-99. DOE shall complete evaluation of the capability of 299-W23-19 to achieve RAOs, and if that well is not capable of meeting the cleanup level, DOE shall establish a path forward by December 2001 to achieve the goal of the interim remedial action.	December 2001
200-6	The Tri-Parties shall develop a monitoring network for the entire 200-UP-1 Operable Unit. Currently, the monitoring network for the 200-UP-1 Operable Unit only focuses on the area affected by the pump-and-treat operations. The monitoring network will be documented in a sampling and analysis plan that will be submitted to Ecology, the lead regulatory agency for 200-UP-1, for approval.	March 2002
200-7	The Tri-Parties shall develop a monitoring well network for the 200-PO-1 Operable Unit. The monitoring network will be documented in a sampling and analysis plan that will be submitted to Ecology, the lead regulatory agency for 200-PO-1, for approval.	December 2002
200-8	The Tri-Parties shall develop a monitoring well network for the 200-BP-5 Operable Unit. The monitoring network will be documented in a sampling and analysis plan that will be submitted to EPA, the lead regulatory agency for 200-BP-5, for approval.	December 2002

Action Item	Description	Due Date
200-9	DOE shall complete the Phase III Feasibility Study for the Canyon Disposition Initiative to support the development of a September 2002 ROD.	September 2001
300-1	DOE shall propose an updated structure for the 300 Area cleanup verification packages (CVPs) and a path forward to closing out the CVPs by the due date. The 300-FF-1 Remedial Design/Remedial Action work plan may need to be updated at a later date to reflect new requirements. Supplemental information may have to be documented in the file for completed CVPs as well.	June 2001
300-2	DOE will submit a path forward for the 618-4 burial ground to EPA. The path forward will address: (1) options for treatment and disposal of excavated drums, (2) options for continued storage of drums if treatment is not imminent, and (3) plans for completing the excavation of the burial ground.	June 2001
300-3	DOE shall submit options to EPA for expedited response actions to address contaminant releases from the 618-11 Burial Ground as well as an assessment of the need for interim action based on the results of the 618-11 groundwater investigation. The options for interim action and assessment of their need shall be submitted to EPA by September 2001.	September 2001
300-4	DOE shall update and expand the operations and maintenance (O&M) plan for the 300-FF-5 Operable Unit. The revised O&M plan shall be submitted to EPA for approval and shall address: 1) requirements for monitoring groundwater and river springs in the 300-FF-5 operable unit; 2) requirements for monitoring any impacts that may be associated with contaminated groundwater and river spring discharges; 3) requirements for evaluation of groundwater data including an assessment of the effectiveness of the natural attenuation remedy; and 4) regulatory reporting requirements. DOE shall submit a revised O&M plan by September 2001. DOE shall implement the revised O&M plan as approved by EPA.	September 2001
1100-1	DOE shall replace the loose fenceposts around the Horn Rapids Landfill.	April 2001
1100-2	DOE shall replace missing asbestos warning signs around the Horn Rapids Landfill.	March 2001


Hanford Site National Priority List Designations
Seattle
Spokane
Washington
Hanford Site
Richland
Vancouver
Hanford Site
(560 square miles)
Portions of 100 Area
Deleted from NPL in
1998
100-D/DR
100-H
100-N
100-KE/KW
100-B,C
100
Reactor
Area NPL
100-F
Columbia River
200-West
Area
200-East
Area
ERDF
200 Area NPL
Energy
Northwest
300 Area
NPL
400 Area
(FFTF)
N
0 2 4 6 8 10 kilometers
0 1 2 3 4 5 miles
Yakima River
1100
Area
1100 Area
Deleted from
NPL in 1996
E0101027

List of Acronyms

ARAR	applicable or relevant and appropriate requirement
BEHP	bis(2-ethylhexyl)phthalate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CVP	cleanup verification package
DCG	derived concentration guide
D&D	decontamination and decommissioning
DDT	dichlorodiphenyltrichloroethane
DNAPL	dense, non aqueous phase liquid
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
ESD	explanation of significant difference
FY	fiscal year
HASP	health and safety plan
HRL	Horn Rapids Landfill
IC	institutional control
ISRM	in-situ redox manipulation
IU	isolated unit
MCL	maximum contaminant level
MEI	maximally exposed individual
MTCA	Model Toxics Control Act
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPL	National Priorities List
O&M	operation and maintenance
OU	operable unit
PCB	polychlorinated biphenyl
ppm	parts per million
RA	remedial action
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
ROD	record of decision
RTD	remove, treat, dispose
TCE	trichloroethene
TPH	total petroleum hydrocarbon
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
USDOE	U.S. Department of Energy
VOC	volatile organic compound
WAC	Washington Administrative Code
WDOH	Washington State Department of Health

USDOE Hanford 100 Area
First Five-Year Review Report

I. Introduction

This is the first five-year review of the USDOE Hanford 100 Area. The triggering action for this review is the start of remedial action in 100-BC-1, which occurred on July 15, 1995, as shown in EPA's WasteLAN database. Because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unrestricted use and unlimited exposure, another five-year review will be required.

There have also been two major removal actions that fit the CERCLA and NCP criteria for a five-year review except that they are removal rather than remedial actions. These two removal actions (namely the one signed in 1997 for 100-C Reactor waste disposal, ancillary facilities, and the 108-F Lab, and the one signed in 1998 for 100-DR and 100-F reactor interim safe storage) are included in this five-year review.

A list of the 17 CERCLA decision documents for the 100 Area is presented in Table 100-1. The documents included in this five-year review are noted in the table. The two 1993 Action Memos, the 1994 Action Memo for 100-IU-3, and the no-action decision for 100-IU-5 led to the 1996 no-action ROD that allows unrestricted use and unlimited exposure. Therefore, they are not included in the five-year review. The 1996 Action Memo is not specifically addressed in the five-year review because that action was included in the 1999 ROD for 100-NR-2 and is addressed in the ROD. The 1996 Action Memo for 100-IU-3 is not included because it allows unrestricted use and unlimited exposure.

Table 100-1. CERCLA Decision Documents for the 100 Area.

Decision Type	Descriptive Title	In 5-year Review	Signature Date
Action Memo	100-IU-4, Sodium Dichromate Drums		1993
Action Memo	100-IU-1, Riverland		6/93
Action Memo	100-IU-3, North Slope		1994
Action Memo	100-NR-2, N Springs		9/26/94
ROD	100-BC-1, 100-DR-1, 100-HR-1; 37 Soil Sites Contaminated by Liquid Effluents	X	9/28/95
ROD* No Action	100-IU-1, 100-IU-3, 100-IU-4, and 100-IU-5		2/2/96

Decision Type	Descriptive Title	In 5-year Review	Signature Date
ROD	Groundwater at 100-HR-3 and 100-KR-4	X	4/1/96
Action Memo	100-C Reactor Waste Disposal, Ancillary Facilities, and 108-F Lab	X	1/28/97
Action Memo	100-DR and 100-F Reactor Interim Safe Storage	X	7/10/98
ROD Amendment	Additional 34 Soil Sites Contaminated by Liquid Effluents	X	4/04/97
Action Memo	100-IU-3, North Slope 2-4-D Burial Site		8/97
ROD	"Remaining Sites ROD" for Buildings, Structures, and Remaining Soil Sites Contaminated by Liquid Effluents	X	7/15/99
ROD	K Basins	X	9/17/99
ROD	100-NR-1 and 100-NR-2 (81 Sites in NR-1, Groundwater and Shoreline Site in NR-2)	X	9/29/99
ROD Amendment	100-HR-3, Groundwater In-Situ Treatment	X	10/24/99
ROD	100-NR-1, Three Sites with Two Treatment, Storage, Disposal Units	X	1/25/00
ROD ESD	Amend Remaining Sites ROD to Add Two Formerly 300 Area Sites to 100-IU-6	X	

* This 1996 ROD is the only final 100 Area ROD. All other RODs are interim action.

The 100 Area five-year review was led by Laurence Gadbois, Remedial Project Manager for the Hanford Site. The following team members assisted in the review:

- David Einan, EPA Remedial Project Manager
- Dennis Faulk, EPA Remedial Project Manager
- Rick Bond, Washington State Department of Ecology
- Craig Perkins, Duratek Federal Services
- Wayne Soper, Washington State Department of Ecology
- Steve Weiss, Bechtel Hanford Inc.
- Joe Zoric, Bechtel Hanford Inc.

This five-year review consisted of the following activities: a review of relevant documents, review of groundwater monitoring data, a National Priorities List (NPL) site visit, discussions with the site-specific advisory board, a tribal consultation, and discussions with the Natural Resource Trustee Council. Input from the public was solicited during a 30-day comment period which ran from January 29 through February 27, 2001. Responses to the comments that were received are attached in Appendix B.

II. Site Background and Chronology

The 100 Area was listed in the NPL on October 4, 1989, as one of four NPL sites at Hanford. Since then, 17 CERCLA decision documents for the 100 Area have been approved; these are listed in Table 100-1. Remedial action has started on all of these decision documents and has been completed on about half. The work scope of these existing decision documents and the remaining work needed to complete the 100 Area (principally the 100-Area burial grounds) will be done over many years, and the schedule is included in the Tri-Party Agreement. The date for Milestone M-16-00F to "establish date for completion of all 100 Area remedial actions" is December 31, 2001. The date to be established is bounded by Milestone M-16-00 to "complete remedial actions for all non-tank farm operable units. Complete decontamination and decommissioning (D&D) of all 100 Area buildings and structures (except 105-B, 105-C, 105-D, 105-DR, 105-F, 105-H, 105-KE, 105-KW, and 105-N Reactor buildings)" by September 2018.

The 100 Area is the northern portion of the Hanford Site. It encompasses approximately 26 square miles and is bisected by the Columbia River. The portion north and east of the river is the North (or Wahluke) Slope, which contained contaminants remaining from anti-aircraft missile bases. The portion south and west of the river is the site of six reactor areas (100-B/C, 100-D/DR, 100-F, 100-H, 100-K East/K West, and 100-N) and numerous other waste sites primarily associated with the first decade or so of Hanford construction.

There are nine nuclear reactors spread among the six reactor areas (two each at 100-B/C, 100-D/DR, and 100-K East/K West). The first eight reactors, which were constructed between 1944 and 1955, used Columbia River water in a single-pass process for cooling. Water was then discharged back to the river or to onshore liquid waste disposal sites. The discharged cooling water contained radioactive materials and hazardous waste constituents. Onshore discharge of this liquid waste created contaminated soil sites and groundwater.

The 100-N Reactor differed from the other eight reactors in that it had the dual purpose of producing electricity and special nuclear material. The process of using the heat for electricity generation eliminated the need for large volumes of cooling water to be discharged to the Columbia River. Cooling water was recirculated via a feed-and-bleed process. This process caused the recirculation water to accumulate much higher concentrations of radionuclides than the other 100 Area reactors, so the soil that received the discharges from the feed-and-bleed system had higher concentrations of contaminants than the liquid waste soil sites in the other 100 Areas.

Other contamination and cleanup needs in the 100 Area include contaminated structures such as buildings, buried pipelines, buried and exposed disposal cribs, and trenches. Spent nuclear fuel from the reactors in the 100 Area is currently in storage in two water-filled basins in the 100-K Area.

The contaminated groundwater in the 100 Area has been grouped into five operable units, namely 100-BC-5, 100-KR-4, 100-NR-2, 100-HR-3, and 100-FR-3. The remaining "source" contamination is grouped geographically into 17 source operable units, namely 100-BC-1, 100-BC-2, 100-KR-1, 100-KR-2, 100-NR-1, 100-DR-1, 100-DR-2, 100-HR-1, 100-HR-2, 100-FR-1, 100-FR-2, 100-IU-1, 100-IU-2, 100-IU-3, 100-IU-4, 100-IU-5, and 100-IU-6. These source operable units contain about 400 waste sites, each of which can be categorized as one of four different types of sites: contaminated soil, structures, debris, or burial grounds. The waste sites are, for the most part, undergoing similar remedial actions with similar remedial action objectives and cleanup standards.

Because the 100 Area remedial strategy is largely based on type of remedial action, so is this five-year review. In this review, the decision documents are discussed (Table 100-1 and Section IV), the 22 operable units are identified and described (Table 100-2), and the decision documents relevant to each type of remedial action are identified in the discussion of each type of remedial action. With the exception of operable units that are designated “isolated units” (IUs), the 100 Area operable units are associated with the reactor areas.

Table 100-2. 100 Area Operable Units.

Operable Unit	Short Description
100-IU-1	Riverland Railroad Wash Station
100-IU-2	White Bluffs Townsite Area
100-IU-3	North Slope (also known as Wahluke Slope)
100-IU-4	Buried Sodium Dichromate Drums
100-IU-5	Pickling Acid Cribs
100-IU-6	Hanford Townsite Area
100-BC-1	Soil, Buildings, and Burial Grounds in the 100-BC Reactor Area
100-BC-2	Soil, Buildings, and Burial Grounds in the 100-BC Reactor Area
100-BC-5	Groundwater under the 100-BC Area
100-KR-1	Principally Soil Sites Contaminated by Liquid Discharges
100-KR-2	Soil, Buildings, and Burial Grounds in the 100-K Reactor Area

Operable Unit	Short Description
100-KR-4	Groundwater under the 100-K Area
100-NR-1	Soil, Buildings, and Burial Grounds in the 100-N Reactor Area
100-NR-2	Groundwater under the 100-N Area and the Shoreline Site
100-DR-1	Soil, Buildings, and Burial Grounds in the 100-D Reactor Area
100-DR-2	Soil, Buildings, and Burial Grounds in the 100-D Reactor Area
100-HR-1	Soil, Buildings, and Burial Grounds in the 100-H Reactor Area
100-HR-2	Soil, Buildings, and Burial Grounds in the 100-H Reactor Area
100-HR-3	Groundwater under and Between the 100-D/DR and 100-H Reactor Areas
100-FR-1	Principally Soil Sites Contaminated by Liquid Discharges
100-FR-2	Soil, Buildings, and Burial Grounds in the 100-F Reactor Area
100-FR-3	Groundwater under the 100-F Reactor Area

Operable Unit Background

100-BC. The B Reactor, which was constructed in 1943, operated from 1944 through 1968. The C Reactor, which was constructed in 1951, operated from 1952 until 1969. Currently, the only active facilities in the 100-BC-1 Operable Unit are those that extract and treat water from the Columbia River and transport that water to other 100 Area and 200 Area facilities. The 100-BC-1 and 100-BC-2 Operable Units, which are located in the 100-BC Area, include contaminant sources, while the 100-BC-5 Operable Unit located in that area includes contamination present in the underlying groundwater.

100-N. The N Reactor operated from 1963 until 1987. In 1991, the final decision to retire the N Reactor from service was issued. The 100-NR-1 Operable Unit, which is located in the 100-N Area, includes contaminant sources, while the 100-NR-2 Operable Unit located in that area includes contamination present in the underlying groundwater.

100-D. The 100-D/DR Area contains two reactors; the D Reactor associated with the 100-DR-1 Operable Unit, and the DR Reactor associated with the 100-DR-2 Operable Unit. The D Reactor operated from 1944 to 1967. The DR Reactor operated from 1950 to 1964. 100-DR-1 and 100-DR-2 are source operable units in the D Area; 100-HR-3 is the groundwater operable unit for the 100-D/DR and 100-H Areas. Currently, sanitary and fire protection water is provided to the 100-H and 100-F Areas from the 100-D Area.

100-H. The H Reactor complex was constructed after World War II. The H Reactor operated from 1949 to 1965. Currently, there are no active facilities, operations, or liquid discharges within the 100-HR-1 Source Operable Unit. The 100-HR-1 and 100-HR-2 Source Operable Units, which are located in the 100-H Area, include contaminant sources, while the 100-HR-3 Groundwater Operable Unit located in that area includes the contamination present in the underlying groundwater.

100-F. The F Reactor was constructed from 1943 to 1945 and operated from 1945 to 1965. Most of the facilities associated with F Reactor, other than the biological research facilities, were also retired in 1965. The 100-FR-1 and 100-FR-2 Source Operable Units, which are located in the 100-F Area, include contaminant sources, while the 100-FR-3 Groundwater Operable Unit located in that area includes the contamination in the underlying groundwater.

100-K. The KW reactor operated from 1955 to 1970, and the KE Reactor operated from 1955 to 1971. The 100-KR-1 and 100-KR-2 Source Operable Units, which are located in the 100-K Area, include contaminant sources, while the 100-KR-4 Groundwater Operable Unit located in that area includes contamination in the underlying groundwater. Currently, there are several active facilities within the 100-K Area. They include the 105-KE and 105-KW fuel storage basins, which are used to store spent nuclear fuel from the N Reactor.

III. Remedial Actions

A. Remedy Selection

There have been 17 CERCLA decision documents for the 100 Area (Table 100-1). The review of 11 of those decision documents was included as part of this five-year review. Several action memos from Table 100-1 do not fit the criteria for a statutory five-year review; however, they are included in this five-year review by policy because they are significant elements of the overall protective strategy for the 100 Area. This section discusses the 11 decision documents that were included in this five-year review. These decision documents form the basis for the six types of cleanup actions that are evaluated in the remaining sections of the 100 Area five-year review.

1995 ROD as Amended in 1997

There are 71 sites covered by this amended ROD. The implementation of the selected remedy generally includes the following steps.

1. Remove contaminated soil, structures, and debris from 100 Area source waste sites using the "Observational Approach." The observational approach utilizes analytical screening during remediation to guide the extent of excavation. Remediation proceeds until it can be demonstrated through a combination of field screening and confirmational sampling that cleanup goals have been achieved.

2. Treat the waste as required to meet applicable waste disposal criteria.

3. Dispose of contaminated materials at the Environmental Restoration Disposal Facility (ERDF).

4. Backfill excavated areas and revegetate.

This approach will be referred to as the remove-treat-dispose (RTD) remedy. The principal cleanup levels for surface soil to 15 feet below ground surface are 15 millirem above background for radionuclides and the Washington State *Model Toxics Control Act* (MTCA) Method B for chemicals (based on unrestricted surface and groundwater use), plus protection of groundwater and the Columbia River. The cleanup levels for deeper soil are based on protection of groundwater and the Columbia River. DOE is required to maintain access and use controls at the 100 Area during the cleanup. Institutional controls (ICs) and long-term monitoring are required for sites where wastes are left in place, including sites where the concentration of contaminants below 15 feet results in restrictions against deep excavation or drilling.

1996 ROD for Groundwater at 100-HR-3 and 100-KR-4

The remedy involves plume capture and removing hexavalent chromium from groundwater via a pump-and-treat system. Groundwater is extracted via wells near the river, the chromium is removed, and the treated water is discharged to the upgradient aquifer. The principal threat being addressed is the ecological risk to bottom-dwelling organisms in the Columbia River. The cleanup standard of 11 µg/L was the Washington State ambient water quality standard for chronic exposure, which was more stringent than would be needed for protection of human health. Groundwater nearby the Columbia River, which discharges into the river, has been measured at over 2000 µg/L. Porewater within the bottom gravel (at depths of 18 inches which corresponds to the depth that may be used by salmon for egg laying) has been measured at over 600 µg/L.

1997 Action Memo for 100-C Reactor Waste Disposal, Ancillary Facilities, and 108-F Lab

The remedy involves the decontamination and demolition of structures, and the disposal of the resulting wastes. Where hazardous substances are present, cleanup progresses with the same depth criteria as for the soil sites.

1998 Action Memo for 100-DR and 100-F Reactor Interim Safe Storage

This action memo is to decontaminate and demolish the contaminated reactor buildings (except for the reactor blocks) and the ancillary facilities, and disposal of the waste. The action memo required a safe storage enclosure over the reactor blocks to ensure containment of the hazardous substances.

1999 ROD for Remaining Sites (Includes 2000 Explanation of Significant Difference [ESD] for 100-IU-6)

This ROD was designed to be inclusive of all other past practice waste sites in the 100 Area not already covered by an existing CERCLA document, with the exception of the 100 Area solid waste burial grounds. Cleanup levels are consistent with the 1995 ROD. The 1999 ROD identified 46 sites for the remove-treat-dispose remedy. The 2000 ESD has increased this to 48 sites. In addition to the observational approach to characterization during RTD remediation, this ROD uses a "plug-in approach." The plug-in approach applies to more than 160 additional waste sites (and future discovery waste sites) with little or no characterization data. These sites are candidates for RTD remediation; however, further sampling is required to determine if there is a need for remedial action. If remediation is needed, they will be plugged-in to the RTD remedy.

1999 ROD for the K Basins

This ROD covers the removal of the spent nuclear fuel, sludge, water, and debris, as well as the deactivation of the two water-filled spent nuclear fuel storage basins in the 100-K Area. Fuel will be packaged, removed from the basins, dried, and placed in storage in the 200 Area. Sludge will be packaged, removed, and placed in storage in the 200 Area. Debris will be removed, treated, and disposed primarily to ERDF. Water contaminated with radionuclides will be removed, treated, and disposed of at Hanford. Deactivation waste will principally be disposed of at ERDF. This ROD does not contain specific cleanup levels. The emptied and deactivated basins resulting from this remedial action will then be remediated under the 1999 ROD for Remaining Sites.

1999 ROD for 100-NR-1 and 100-NR-2

The remedial action for 100-NR-1 consists of RTD for 37 radioactive sites, 6 inorganic waste sites, 6 burn pits, and 9 surface solid waste and miscellaneous source waste sites; excavate, treat using *ex-situ* bioremediation and dispose of the treated soils for 20 near-surface petroleum sites; *in-situ* bioremediation for two deep petroleum sites; and institutional controls for 1 shoreline site. The remedial action for 100-NR-2 is the continuation of a pump-and-treat system for Strontium-90, which was begun as a removal action in 1995, and the disposal of free-floating petroleum from any monitoring wells. Remediation of these 81 waste sites is scheduled to begin in 2002 and will require about 10 years to complete.

The principal contaminants of concern for the 100-NR-1 Operable Unit are radionuclides, metals, and petroleum hydrocarbons. The shoreline site consists of the N-Springs (riverbank seeps) along the Columbia River, as well as the associated soil that has been contaminated. 100-NR-1 also contains diesel fuel-contaminated soil from an interceptor trench built to collect diesel/fuel oil leaked to the groundwater.

1999 ROD Amendment to 100-HR-3

The remedy is for *in-situ* treatment of a chromium plume in the 100-D Area that is not being captured by the pump-and-treat system. This remedial action will install a permeable reactive barrier upgradient to groundwater discharge to the Columbia River.

2000 ROD for 100-NR-1

The remedy for the three waste sites in this ROD is RTD. Cleanup levels and ICs, both during and after remediation, are consistent with the other 100 Area RODs. Remediation at these sites began in July 2000 and will require about 3 years to complete.

2000 ESD for 100-IU-6

The Explanation of Significant Difference to the remaining sites added two waste sites, which were formerly part of the 300 Area, to the 100-IU-6 Operable Unit. These two waste sites were moved to the 100 Area via a change to the Tri-Party Agreement. These sites will be remediated by the RTD remedy for soil sites.

B. Remedy Implementation

Several of the decision documents listed in Table 100-1 are specific to several waste sites or groundwater plumes. Most of the 100 Area decision documents, however, address types of waste sites, of which there may be many instances. Therefore, remedy implementation is reviewed in Section IV by waste site type rather than individual waste sites.

IV. Findings and Recommendations

The various cleanup decision documents in the 100 Area can be grouped into six types of cleanup actions. These include the following.

- **Soil sites**. This cleanup action consists of the excavation of soil contaminated by the discharge of liquid effluents, the pipelines that transported the liquid waste, and debris that was part of the engineered structure or otherwise deposited at the site.

- **D&D of buildings**. This cleanup action consists of the D&D of buildings, and may include demolition.

- **Pump-and-treat for chromium**. This cleanup action consists of the remediation of chromium in groundwater via pump-and-treat.

- **In-situ treatment for chromium**. This cleanup action consists of the remediation of chromium in groundwater via in-situ treatment.

- **Pump-and-treat for Strontium-90**. This cleanup action consists of the remediation of Strontium-90 in groundwater at the 100-N Area.

- **K Basins**. This cleanup action consists of the removal of the contents and deactivation of the K Basins.

A. Soil Sites

The following decision documents address remediation of contaminated soil sites:

- 1995 ROD as amended in 1997
- 1999 ROD for 100-NR-1 and 100-NR-2
- 1999 ROD for Remaining Sites
- 2000 ROD for 100-NR-1
- 2000 ESD for 100-IU-6.

As of July 10, 2000, there have been 35 waste sites remediated with completion of remedial action approved by the lead regulator. (Approval is documented through approval of a cleanup verification package.) The 35 sites are listed in Table 100-3. Approximately 2.6 million tons of soil and debris was removed from these 35 sites, representing 26 percent of the estimated 10 million tons to eventually be removed from the 100 Area. The observational approach that uses data collected during the remedial action to guide the extent of the excavation has been used very successfully at these waste sites. This data is compared to cleanup levels to determine the physical extent of excavation required to meet the remedial action goals. In many of the waste sites, the extent of soil contamination that was above cleanup levels (and thus in need of remedial action) has been more extensive than was estimated in the ROD and during remedial design. As a result, Tri-Party Agreement milestones that were based on an assumed rate of waste removal and disposal have been extended to match revised estimates of the volume that will need remediation. Although the volume of soil requiring excavation is larger than anticipated, the cost per volume is smaller. Therefore, the overall remedy cost remains within the ROD estimates.

The cleanup verification packages contain a discussion of the results of laboratory analyses of samples collected during cleanup verification sampling at the conclusion of excavation. The process for verification of attainment of the remedial action objectives uses both field screening and laboratory analysis of samples. These documents present the evaluations that verify attainment of the cleanup standards for both the direct surface exposure pathway and the groundwater and Columbia River pathways. The Model Toxics Control Act (MTCA) cleanup levels and the MTCA evaluation methodology are typically used for verifying cleanup of chemical contaminants. The computer model RESRAD-SOIL is being used to model residual risk from radionuclides. Based on these methods and models, all 35 waste sites have achieved the remedial action goals set forth in the ROD.

Chromium was discharged to the groundwater via soil sites, which resulted in initial soil and groundwater contamination. The reactors, except for 100-N, have not operated for 30 years or more. Since shutdown of the reactors, the once-large groundwater chromium plumes are now

discrete plumes downgradient of the soil discharge sites. Test pits and boreholes in the 100 Area have documented that chromium is present in low concentrations in the deep vadose zone. It is a typical 100 Area phenomenon that, following sustained high Columbia River water levels that in turn raise the groundwater level which re-wets portions of the deep vadose zone, a pulse of chromium is seen in many groundwater monitoring wells. This suggests that these deep vadose zone chromium residues continue to act as a reserve for future contamination of the groundwater. The Tri-Parties will address residual chromium in the deep vadose zone (immediately adjacent to the aquifer) as part of developing final remedial actions for groundwater.

The Hanford Natural Resource Trustee Council has prepared an assessment plan for the 100 Area. One ongoing study pursuant to that plan is for injury to salmon resulting from chromium exposure. Salmon are one of the aquatic receptors that are intended beneficiaries of the soil and groundwater remedial actions. Initial laboratory data using non-local fish suggest that chinook salmon may not be as sensitive to chromium as previously thought. The results of these studies, however, indicate that concentrations of chromium from 54 to 120 µg/L caused changes in DNA strand breakage, histology, and lipid peroxidation. The health of salmon studied was significantly impaired at these concentrations. Growth of salmon was significantly reduced at 120 µg/L and survival was significantly effected at 266 µg/L. The avoidance-preference response to aqueous chromium indicated that chinook salmon were capable of detecting and avoiding concentrations as low as 54 µg/L. All of these effects occurred at concentrations that potentially occur in or near chinook salmon spawning areas. The highest concentration of chromium recorded in the Columbia River in pore water from near-shore areas was 632 µg/L. These studies indicate that the current cleanup plan to achieve the ambient water quality criteria (AWQC) of 10 µg/L for chromium entering the Columbia River would most likely be protective of developing chinook salmon. The EPA supports expansion of the previous work to include local organisms (including endangered species or surrogates as appropriate) under in-situ conditions.

DOE currently has an active presence on site. DOE's access restrictions have prevented public exposure during this review period. As DOE continues to complete remedial actions and demobilize from portions of the 100 Area, IC must be maintained to continue to protect the public from exposure. The decision documents covered in this review have been written over a five-year period. Experience with the effectiveness of IC approaches, foreseeable changes in DOE's presence on site, and recent EPA Region 10 guidance on IC for federal facilities indicates that the decision documents should be reviewed to determine if an ESD should be produced to bring these documents into alignment with current expectations for IC. It is anticipated that IC requirements in the ESD would be similar to the IC requirements in the 100 Area Burial Grounds ROD that was signed in September 2000. (The September 2000 ROD will be included in the next 100 Area five-year review.)

By Presidential proclamation on June 9, 2000, a portion of the Hanford Site was declared a national monument. Part of the 100 Area was included in the proclamation. The proclamation does not affect the responsibility of DOE for remediation of hazardous substances, nor DOE's statutory authority of DOE to control public access. Therefore, IC requirements under CERCLA are not altered by the monument designation.

Monitoring for emissions of radionuclides to the air is an important element of monitoring for short-term protectiveness during remedial activities. Air monitoring is also done as part of building D&D activities. The monitoring results for both soil sites and D&D activities are presented in a combined discussion in Section G.

100-NR-1 is different from the other operable units because it has soil sites that are contaminated with petroleum and sites contaminated with both petroleum and hazardous substances. Remediation of the non-petroleum waste sites has begun, but none have been completed. The petroleum-only contaminated sites will be either in-situ or ex-situ bioremediated. The sites with hazardous substances will be remediated as described earlier for soil sites throughout the 100 Area. These remedies are expected to be protective of human health and the environment. The recommendation at this time is to implement the RTD and bioremediation remedial actions as specified in the ROD.

Table 100-3. Approved Cleanup Verification Packages for the 100 Area.

Waste Site	CVP* Approval Date
116-B-5 Crib, Trench	1/8/97
116-C-1 Process Effluent Trench	1/21/99
116-B-13 South Sludge Trench	7/22/99
116-B-14 North Sludge Trench	7/22/99
116-B-1 Process Effluent Trench	12/8/99
116-C-5 Retention Basin	12/8/99
116-B-11 Retention Basin	12/8/99
116-B-6A Crib	5/11/00
116-B-6B Crib	5/11/00
116-B-16 Fuel Examination Tank	5/17/00
116-B-9 French Drain	2/24/00
116-B-2 Fuel Storage Basin Trench	2/24/00
116-B-3 Crib	2/24/00
116-B-4 French Drain	2/24/00
116-B-10 Dry Well	2/24/00
116-B-12 Crib	2/24/00
116-C-2A/B/C & OB Crib/Pump Station	3/15/00
100-D-25 Unplanned Release	1/6/99

Waste Site	CVP Approval Date
116-DR-9 Retention Basin	1/6/99
1607-D2:1 Abandoned Tile Field	3/25/99
100-D-4 Sludge Pit	3/25/99
100-D-20 Sludge Pit	3/25/99
100-D-21 Sludge Pit	3/25/99
100-D-22 Sludge Pit	3/25/99
120-D-1 100-D Ponds	8/27/99
1607-D-2 Septic Tank	11/23/99
100-D/DR Group 2 Pipeline Overburden Piles	3/30/00
116-D-3 French Drain	4/6/00
116-D-7 Retention Basin	8/15/00
100-D-18 Sludge Disposal Trench	9/26/00
116-DR-1&2 Trenches	9/26/00
1607-D2 Septic Tank	9/26/00
100-D-48:2/49:2 Group 2 East and West Pipelines	9/26/00
116-DR-7 Inkwell Crib	9/26/00
116-H-6 Solar Evaporation Basins	5/13/97

***CVP=Cleanup Verification Package**

There has been one change in a standard that was identified as an Applicable or Relevant and Appropriate Requirements (ARAR) in the RODs. The Washington State Ambient Water Quality Standard for chronic exposure to chromium has changed from 11 µg/L to 10 µg/L. The soil cleanup standard for protection of groundwater/Columbia River has been changed as a result. The soil standard has been changed to 2.0 mg/kg from 2.2 mg/kg. (Note that the soil cleanup standard is based on the MTCA 100-times rule using the ambient water quality standard and a 2-to-1 dilution in the near-river environment. The 2-to-1 dilution was based on comparison of chromium measured in near-river groundwater with adjacent river-bottom porewater.) The new 2.0 mg/kg soil cleanup standard was applied to all sites not yet remediated, irrespective of when the ROD authorizing the cleanup was signed. Adopting the newer standard results in consistent and efficient cleanup design, implementation, and verification processes. This change in cleanup standard for the soil is very small compared to the standard used for the earlier soil cleanups in the 100 Area and is not believed by EPA to call into question the protectiveness of the cleanups that used the 2.2 mg/kg cleanup standard.

In order to minimize the generation of dust that results in release of airborne radioactivity, water has been applied during remedial actions. Several years ago, water was applied in what appears to have been excessive amounts, based on observed flushing of contaminants into the groundwater. Examples include tritium found downgradient of the remedial actions around the 100-C Reactor and Strontium-90 found downgradient of the 116-C-1 Process Trench. The remedial action contractors are now applying dust-suppression water in a more conservative manner to help prevent flushing into the groundwater. It is recommended that water continue to be applied in a conservative manner to achieve the dual purposes of dust suppression and groundwater protection.

Recommendations for Soil Sites

Based on the review, the following recommendations, which do not require action items, are made:

- Water applied for dust suppression should be limited to achieve the purposes of dust control. Excessive watering and ponding of water should be avoided as part of a groundwater protection strategy.

- DOE should continue to monitor groundwater in order to identify any near-term impacts to groundwater resulting from the remedial actions. Long-term groundwater monitoring is also needed to determine the effectiveness of the soil cleanup actions on improving groundwater quality.

B. Decontamination & Decommissioning of Buildings

The following decision documents address decontamination and decommissioning of buildings:

- 1997 Action Memo for 100-C Reactor Waste Disposal, Ancillary Facilities, and 108-F Lab.
- 1998 Action Memo for 100-DR and 100-F Reactor Interim Safe Storage.
- 1999 ROD for Remaining Sites.

D&D activities have been completed at the 100-C Reactor, and the reactor has been placed into interim safe storage. The corresponding cleanup verification package has been approved by EPA. The other D&D activities in the 100 Area are either ongoing or, if the cleanup continued into the underlying soil, are addressed in the section on soil sites.

During D&D activities, the air is monitored for releases of radionuclides. Monitoring for emissions of radionuclides to the air is an important element of monitoring for short-term protectiveness during remedial activities. The monitoring results for both D&D activities and soil sites is presented in a combined discussion that follows.

It is recommended that the D&D of buildings, including interim safe storage of reactors, continue as directed by the Action Memos and the ROD.

There has been one change in a standard that was identified as an ARAR in the decision documents. The Washington State Ambient Water Quality Standard for chronic exposure to chromium has changed from 11 µg/L to 10 µg/L. The cleanup standard for protection of groundwater/Columbia River has been changed as a result. The old cleanup standard of 2.2 mg/kg has been changed to 2.0 mg/kg. (Note that the cleanup standard is based on the MTCA 100-times rule using the ambient water quality standard and a 2-to-1 dilution in the near-river environment.) This change in cleanup standard is very small compared to the standard used for the earlier cleanups in the 100 Area and is not believed by EPA to call into question the protectiveness of the cleanups that used the 2.2 mg/kg cleanup standard.

C. Pump-and-Treat for Chromium

There is one decision document that addresses pump-and-treat remediation of groundwater contaminated with chromium: the 1996 ROD for Groundwater at 100-HR-3 and 100-KR-4. This ROD was amended in 1999 to include in-situ treatment for chromium in the 100-HR-3 groundwater (see Section D). Remedial actions started in 100-HR-3 in July 1997 and in 100-KR-4 in September 1997.

One of the remedial action objectives in the ROD is the protection of human health by preventing exposure to contaminated groundwater. DOE's active presence at the 100 Area has

been effective in preventing human exposure. As discussed in the section on soil sites, an ESD for IC will be prepared as appropriate to bring this ROD into alignment with current expectations for decision documents for federal facilities.

One of the requirements in the ROD for the protection of aquatic receptors in the Columbia River is reducing chromium concentration in compliance monitoring wells. The ROD establishes 22 µg/L as the standard for those wells. The cleanup standard has not been met, as explained below.

For the 100-H Area, which is part of 100-HR-3, compliance wells had lower average chromium concentrations in 1999 than in 1998. The decrease in concentration may be attributed to the impact of the pump-and-treat system in reducing contaminant mass and to a higher river stage in 1999 partially diluting the plume in the zone where the river water and groundwater co-mingle within the aquifer adjacent to the river. The four compliance wells at 100-H had average chromium concentrations of 44 µg/L, 89 µg/L, 43 µg/L, and 35 µg/L, respectively. Average extraction well concentrations were also lower in 1999 than in 1998.

For the 100-D Area, which is the other portion of the 100-HR-3 remedial action, compliance wells also had lower average chromium concentrations in 1999 than in 1998. Here, too, the decrease in concentration may be attributed to the impact of the pump-and-treat system on reducing contaminant mass and to a higher river stage in 1999 partially diluting the plume in the zone where the river water and groundwater co-mingle within the aquifer adjacent to the river. The three compliance wells at 100-D had average chromium concentrations of 92 µg/L, 69 µg/L, and 104 µg/L, respectively. Average extraction well concentrations were also lower in 1999 than in 1998.

For 100-KR-4, three of the five compliance wells had higher average chromium concentrations in 1999 than in 1998. The 1998 average concentrations in the compliance wells were 40 µg/L, 100 µg/L, 83 µg/L, 107 µg/L, and 113 µg/L. The 1999 average concentrations were 70 µg/L, 115 µg/L, 98 µg/L, 64 µg/L, and 32 µg/L.

The pump-and-treat systems are beneficial to the environment because they are intercepting chromium that would otherwise flow into the Columbia River. For 100-HR-3, as of May 2000, 832.4 million liters of groundwater had been treated, removing 82.1 kilograms of chromium. For 100-KR-4, as of May 2000, 714.8 million liters of groundwater had been treated, removing 91.3 kilograms of chromium. The treatment systems have met treatment standards for their discharge, except for a one-week period at 100-KR-4 during July/August 2000, when the treatment columns were incorrectly configured.

A premise of achieving the remedial action objectives is operation of the pump-and-treat system so as to capture the entire plume. This requires sufficient operating time and extraction rate. When the complete extraction and treatment system is not operating, the chromium plume is not captured. The ROD required that the extraction and treatment system run on an essentially continuous basis. The 100-HR-3 treatment system was operating 89 percent of the time in 1999, and 82 percent of the time in 1998. The 100-KR-4 treatment system was operating 98 percent of

the time in 1999, and 87 percent of the time in 1998. If one well in the 100-KR-4 or 100-HR-3 system is being pumped, DOE considers the system to be operating. However, there have been extended periods of down time for many of the individual wells that are not reflected in the overall operating statistics for the system. An individual well that is not operating creates a gap in the chromium capture zone. If this hole persists, chromium passes through the gap, and can discharge to the Columbia River.

To reach the cleanup standards in the compliance wells, extraction well coverage must be adequate to intercept nearly all the plume above the cleanup standards. This has not been happening. 100-KR-4 can be used as an example. The relative effectiveness of the hydraulic capture was evaluated by tracking 50 flowlines through the capture zone. This series of 50 flowlines was placed upgradient of the 116-K-2 Trench, which is the origin of the chromium plume. When all the extraction wells were operating at 1999 flow rates, 38 of the 50 flowlines converged on the extraction wells. Thus, when in full operation, the pump-and-treat system captured 76 percent of the targeted plume. A similar analysis has been performed for the 100-HR-3 system. That analysis shows that 90 percent of the 100-D Area targeted plume is in the capture zone, as is 86 percent of the 100-H Area targeted plume.

Action Item 100-1: Optimize the Chromium Pump and Treat Systems. DOE shall optimize and complete system enhancements to the 100-HR-3 and 100-KR-4 groundwater pump-and-treat systems for chromium to run more reliably and achieve the required cleanup levels.

- The overall system up-time must improve.
- The downtime for individual wells must be dramatically reduced.
- A much higher percentage of the targeted plume must be captured.

For 100-KR-4, the plan to achieve these enhancements is the following:

- Complete the design for system enhancements by September 2001.
- Acquire an additional treatment skid and support systems.
- Build and annex or additional building to house the new treatment skid.
- Install an extraction well to bridge the gap between existing extraction wells K-120A and K-119A.
- Install a new injection well.

For 100-HR-3, the plan to achieve these enhancements is the following:

- Complete the design for system enhancements by September 2001.
- Upgrade treatment and support systems to increase capacity and reliability.
- Install an additional extraction well in the 100-D Area.

There has been one change in a standard that was identified as an ARAR in the ROD. The Washington State Ambient Water Quality Standard for chronic exposure to chromium has changed from 11 µg/L to 10 µg/L. Although this is the key ARAR used to set the cleanup standard for the remedial action, this small change does not significantly affect the protectiveness of the remedy. The primary deficiency with the chromium pump-and-treat systems is that they are not achieving the required cleanup levels at the near-river point of compliance wells. This

change in cleanup standard is very small compared to the standard selected in the ROD. EPA does not believe that this change calls into question the protectiveness of the selected cleanup standard.

D. In-Situ Treatment for Chromium

This ROD Amendment discusses the deployment of a recently developed, passive, groundwater treatment technology called In Situ Redox Manipulation (ISRM). ISRM is the selected remedy for a recently characterized chromium-contaminated groundwater plume west of the 100-D/DR Reactors (100-D Area) within the 100-HR-3 Groundwater Operable Unit. This plume is not within the treatment zone for the operating 100-HR-3 pump-and-treat system.

During ISRM, a reagent is injected into the groundwater. In this case, the reagent is sodium dithionite, and it reacts with iron in the soil to produce a highly reduced zone in the aquifer that functions as a permeable treatment barrier. The treatment reagent is then withdrawn. Once the barrier is in place, as groundwater contaminated with toxic hexavalent chromium flows through the barrier, the hexavalent chromium is reduced to much less toxic trivalent chromium, which precipitates out of the groundwater.

The ISRM barrier will be installed in three phases. One phase will be completed each of the next 3 years. Approximately 200 to 250 meters of the barrier will be installed each year. The first phase was installed by October 2000. After the barrier is in place, its performance will be monitored by downgradient compliance wells. It will take approximately 1 to 2 years, based on the groundwater gradient, to assess the performance of the barrier. Barrier performance will be assessed in the next five-year review. At that time the full barrier will be in place, and there will be monitoring data from the compliance wells.

There have been no changes in standards that were identified as ARARs for this remedial action.

Recommendations for In-Situ Treatment for Chromium

- Monitoring of the groundwater should continue in order to define a baseline prior to implementation of the barrier.

- Actual costs and hexavalent chromium removal effectiveness should be closely monitored to compare ISRM to other technologies. To date, ISRM appears to be more effective than groundwater pump-and-treat systems. If it proves successful, the technology could be deployed at other chromium plumes in the 100 Area.

E. Pump-and-Treat for Strontium-90

The pump-and-treat system at 100-NR-2 began operation in September 1995 and has been operating for 5 years. Table 100-4 presents the annual groundwater pumping rates, total

volume of groundwater pumped, and curies of Strontium-90 removed for fiscal years (FY) 1996 through 1999 (through September 30, 1999), and the totals for all 4 years. Through May 2000, the 100-NR-2 pump-and-treat system has extracted a total of 490 million liters of groundwater and has removed 0.826 curies of Strontium-90.

Table 100-4. 100-NR-2 Annual Groundwater Pumping and Strontium-90 Removal.

Fiscal Year	Extraction Rate (L/min)	Total Groundwater Extracted (million liters)	Curies of ^{90}Sr Removed (Ci)
1996	189	85	0.2
1997	227	102.3	0.17
1998	233	110.1	0.1
1999	233	113.9	0.2
Total thru May 2000	-	490	0.826

The 100-NR-2 pump-and-treat system has always had an excellent performance history. For FY 1999, the system availability was 93.6 percent, and the average removal rate was 90 percent. There were no significant outages in FY 1999. The performance numbers for the first 3 years of operation are very similar to the FY 1999 numbers.

Three extraction wells have been operating for most of the life of the system. In FY 1999, the average extraction rates for the three wells were 51.6 L/min, 67.5 L/min, and 113.9 L/min. The treated water was injected upgradient. The average influent concentration for Strontium-90 during FY 1999 was 2,276 pCi/L (FY 1998 = 2,392 pCi/L, FY 1997 = 1,943 pCi/L). The average effluent concentration during FY 1999 was 382 pCi/L (FY 1998 = 473 pCi/L, FY 1997 = 285 pCi/L).

The pump-and-treat interim action continues to reduce the hydraulic gradient toward the river. The Strontium-90 distribution pattern in the vicinity of the pump-and-treat system has remained essentially unchanged in recent years. The highest groundwater concentration, 19,500 pCi/L (March 16, 1999), is located at the site that has long had the highest observed concentration in the 100-N Area. The high concentration area is centered around the 116-N-1 Crib and Trench and extends toward the Columbia River where the Strontium-90 concentration in groundwater is about 5,000 pCi/L. The Strontium-90 concentration in other monitoring wells has decreased since 1996. Other contaminants found in the groundwater in the vicinity of the 116-N-1 and 116-N-3 Cribs and Trenches are tritium, chromium, manganese, nitrate, sulfate, and total petroleum hydrocarbons. There were no observed significant changes in the concentrations and distribution patterns of these contaminants over the past several years.

The pump-and-treat interim action continues to reduce the hydraulic gradient toward the river, thereby reducing the flow of Strontium-90-contaminated groundwater toward the river. The pump-and-treat system is reducing the net flux of groundwater by approximately 96 percent, based on the comparison of measured data and previous modeling results.

Strontium-90 is difficult to remove from the aquifer sediments. Approximately 0.8 Ci of Strontium-90 has been removed since startup more than 4 years ago through May 2000, as compared to an estimated total inventory of 76 to 88 Ci in groundwater and adsorbed on the sediments. During this same period, approximately 8 Ci of Strontium-90 have been removed due to natural decay. Therefore, the pump-and-treat system does not appear to be an effective method for reducing Strontium-90 concentrations in the aquifer relative to natural decay. However, as stated above, the pump-and-treat system has been effective in reducing the groundwater gradient to the river and thereby reducing the rate of plume migration to the river. Other technologies for removing or reducing Strontium-90 concentrations in the aquifer are currently being evaluated by the 100-N-Springs Innovative Technology Remediation Demonstration Program. The technologies currently being considered are (1) soil flushing using a potassium chloride/bicarbonate lixiviant to make the Strontium-90 more mobile so it can be flushed from the soil, and (2) soil stabilization using a phosphatic material, specifically trisodium phosphate, to stabilize Strontium-90 in soils. Bank stability has been assessed to determine if it is feasible to implement a remedial action adjacent to the river, and modeling studies have been conducted to study the impact of the rise and fall of the river elevation on the flux of Strontium-90 to the river. DOE should continue to operate the interim action pump-and-treat system using the current well configuration to reduce the net flux of Strontium-90 contaminated groundwater to the Columbia River. DOE should also continue the current groundwater monitoring program to assess the extent of contamination and the flux of Strontium-90 to the river.

There have been no changes in standards that were identified as ARARs for this remedial action. The primary deficiency with the 100-NR-2 pump-and-treat system is that Strontium-90 at concentrations comparable to those that prompted the removal and remedial action are still present in groundwater immediately adjacent to the Columbia River.

> **Action Item 100-2: Propose Alternative Remedial Action for Strontium-90**. DOE shall investigate alternative remedial action technologies for the removal, mass reduction, and/or attenuation of Strontium-90 from the 100-NR-2 aquifer sediments and to further reduce the net flux of Strontium-90 to the river. This investigation will be documented in a letter report to support a ROD amendment. The letter report will include a recommendation and schedule for a path forward based on the ITRD conclusions and agreement from Ecology.

F. K Basins

There are two decision documents that address the K Basins: the 1999 ROD for the removal of the contents of the K Basins and deactivation, and the 1999 ROD for the remaining sites that directs remediation of the basins and underlying contaminated soil.

Since the K Basin ROD was signed, nearly all the efforts have been in preparation for removal of the spent nuclear fuel from the basins. However, one waste removal activity has begun. In late June 2000, the first waste from the K Basins removed under the direction of that ROD was disposed to ERDF. This project is proceeding as identified in the K Basin ROD and on the schedule contained in the Tri-Party Agreement. There is no indication that the selected remedy, when completed, will not be protective of human health and the environment. The K Basin ROD is not the complete remedial action for these waste sites. Upon removal of the fuel, sludge, water, and debris from the basins according to that ROD, the waste sites will then be remediated as directed under the 1999 ROD for the remaining sites.

There have been no changes in standards that were identified as ARARs for this remedial action. There are no deficiencies noted for the K Basins remedial action as of this review. It is recommended to continue to implement the K Basins remedial action as directed in the K Basin ROD.

G. Air Releases During Remediation

Part of ensuring protection of the public from exposure during remedial actions is the use of air monitoring for radionuclide emissions. The remediation of soil sites and the D&D of buildings pose a risk from contaminated dust if that dust is released. Air monitors are placed in the vicinity of these remedial actions. The resulting data is used to calculate the potential dose of the maximally exposed individual (MEI) off-site. The MEI off-site is considered to be the exposure an individual would receive if standing next to the Columbia River at the Hanford boundary in the direction of the prevailing wind (i.e., north, northwest). EPA and the State of Washington require that the cumulative impact from all emissions (both from these removal and remedial actions, as well as from permitted stacks, such as the major stack at the K-West basin) be less than 10 mrem/year to the MEI off site. The cumulative site data is reported in an annual report.

The air monitoring data shows that, during remedial actions, dust and other sources of airborne radioactivity are being controlled in a manner that is protective of human health. Air monitoring data for the past 5 years (where it exists) through 1999 for the six reactor areas (B/C, K, N, D, H, and F) were examined for this five-year review. The radionuclides with the greatest likelihood of becoming airborne were monitored--typically total alpha, total beta, gamma emitters via gamma energy analysis, Strontium-90, plutonium isotopes, and uranium isotopes. Radionuclides that were detected at least once in at least one reactor area are shown in Table 100-5; the data in this table indicate that numerous radionuclides have been detected in all the reactor areas. The next step in evaluating the protectiveness of the remedy is to look at the concentration of these radionuclides relative to risk limits.

Annual average concentrations for the detected radionuclides were less than 1/100th of the 10 mrem/year limit for all radionuclides in all reactor areas for all years. This is based on data for 100-B/C (1996-1999), 100-K (1995-1999), 100-N (1995-1999), 100-D (1996-1999), 100-H (July-December 1999), and 100-F (1998-1999). The 100-K Area had the greatest number of detections, but the concentrations were generally the lowest of the reactor areas. The 100-D Area had the second greatest number of radionuclide detections, the most field monitoring locations (8), both soil site remediations and building D&D activities underway, and annual average activities comparable to the other reactor areas. Therefore, the 100-D Area shows typical reactor area air impacts during full-scale remedial action. The data for 100-D Area is shown in Figure 100-1.

Table 100-5. Detected Radionuclides in Air During 100 Area Remedial Actions*

100-B/C Area	
Number of Isotopic Analyses:	20
Radionuclides Detected	# Detects
^{90}Sr	10
^{137}Cs	9
^{152}Eu	2
^{234}U	20
^{235}U	14
^{238}U	20
^{238}Pu	1
$^{239,240}Pu$	12

100-D Area	
Number of Isotopic Analyses:	42
Radionuclides Detected	# Detects
^{90}Sr	19
^{137}Cs	8
^{152}Eu	2
^{234}U	41
^{235}U	33
^{238}U	37
^{238}Pu	1
$^{239,240}Pu$	17

100-F Area	
Number of Isotopic Analyses:	12
Radionuclides Detected	# Detects
^{90}Sr	7
^{234}U	11
^{235}U	5
^{238}U	11
$^{239,240}Pu$	4

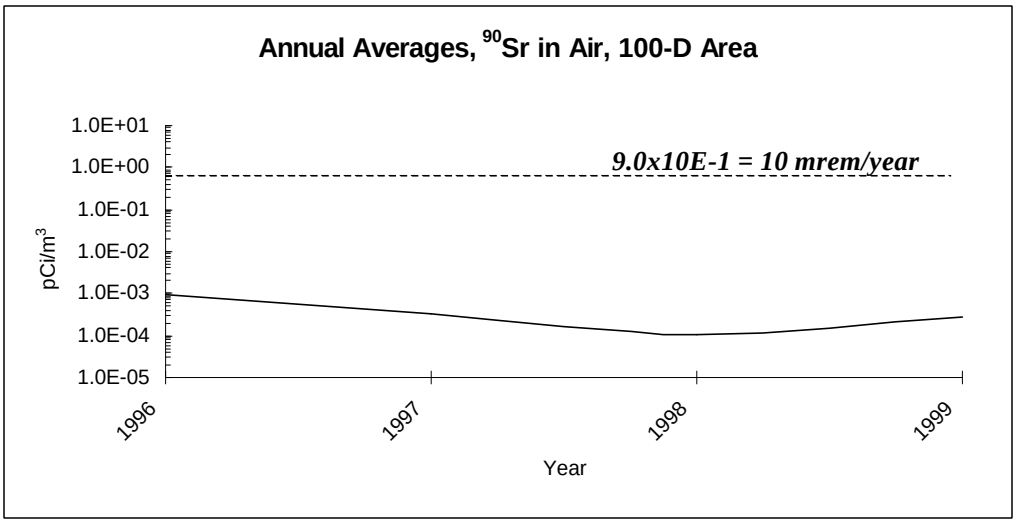
100-H Area	
Number of Isotopic Analyses:	8
Radionuclides Detected	# Detects
^{90}Sr	3
^{137}Cs	1
^{152}Eu	1
^{234}U	8
^{235}U	2
^{238}U	8
$^{239,240}Pu$	3

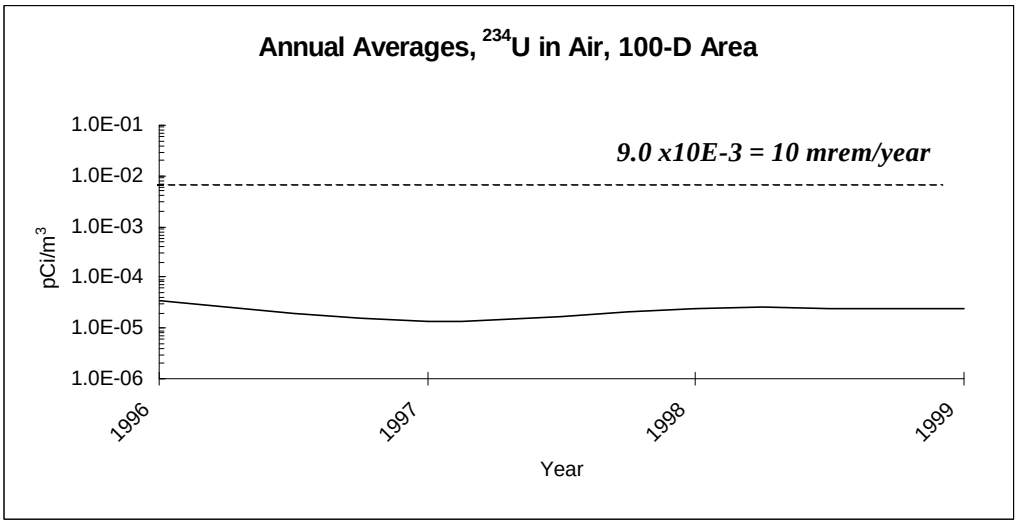
100-K Area	
Number of Isotopic Analyses:	48
Radionuclides Detected	# Detects
^{90}Sr	30
^{137}Cs	23
^{152}Eu	2
^{234}U	43
^{235}U	29
^{238}U	43
^{238}Pu	5
$^{239,240}Pu$	25
^{241}Pu	5
^{241}Am	42

100-N Area	
Number of Isotopic Analyses:	38
Radionuclides Detected	# Detects
^{60}Co	17
^{90}Sr	22
^{137}Cs	7
^{154}Eu	2
^{155}Eu	2
^{234}U	29
^{235}U	17
^{236}U	26
^{238}Pu	1
$^{239,240}Pu$	16

*Isotopes shown highlighted in shaded boxes were detected in more than 33 percent of their analyses.

Figure 100-1. Radionuclides in Air During 100 Area Remedial Actions. (Page 1 of 2)





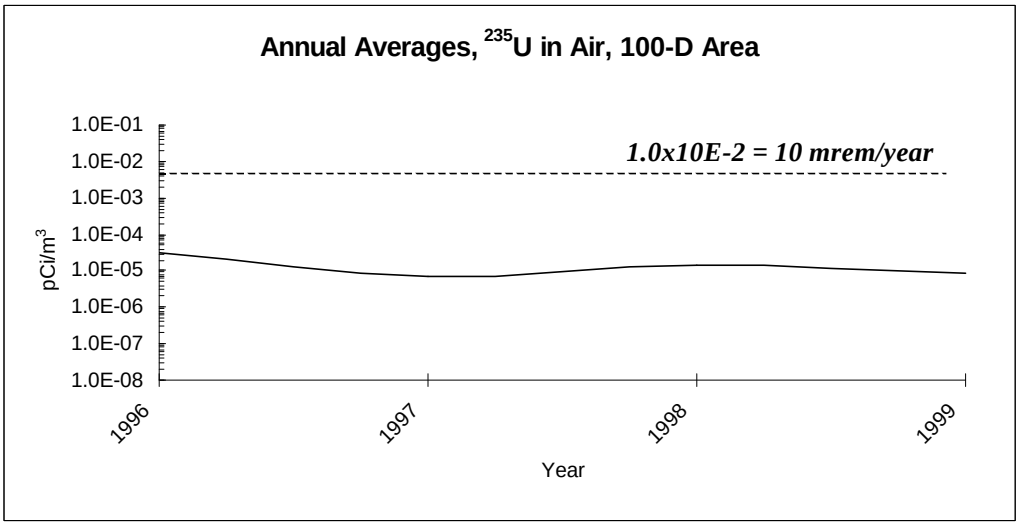
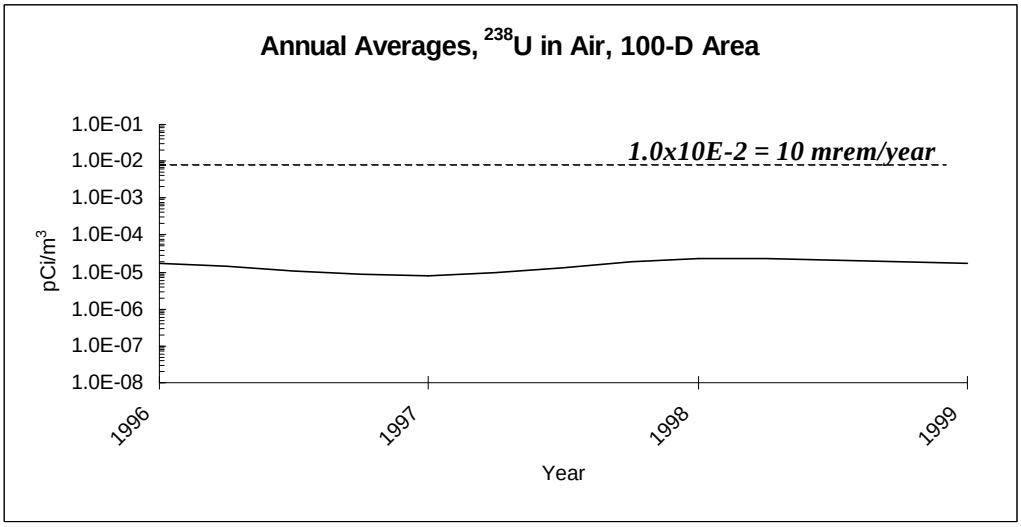
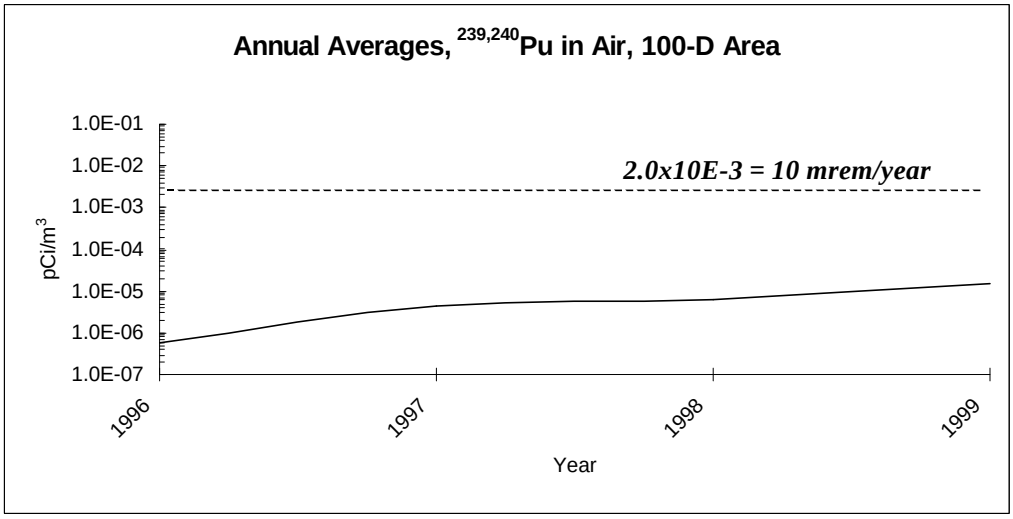


Figure 100-1. Radionuclides in Air During 100 Area Remedial Actions. (Page 2 of 2)





V. Action Items

This section contains the action items resulting from the 100 Area five-year review.

Action Item	Description	Due Date
100-1	DOE shall optimize and complete system enhancements to the 100-HR-3 and 100-KR-4 groundwater pump-and-treat systems for chromium to run more reliably and achieve the required cleanup levels. • The overall system up-time must improve. • The downtime for individual wells must be dramatically reduced. • A much higher percentage of the targeted plume must be captured. For 100-KR-4, the plan to achieve these enhancements is the following: • Complete the design for system enhancements by September 2001. • Acquire an additional treatment skid and support systems. • Build and annex or additional building to house the new treatment skid. • Install an extraction well to bridge the gap between existing extraction wells K-120A and K-119A. • Install a new injection well. For 100-HR-3, the plan to achieve these enhancements is the following: • Complete the design for system enhancements by September 2001. • Upgrade treatment and support systems to increase capacity and reliability. • Install an additional extraction well in the 100-D Area.	May 2002
100-2	DOE shall investigate alternative remedial action technologies for the removal, mass reduction, and/or attenuation of Strontium-90 from the 100-NR-2 aquifer sediments and to further reduce the net flux of Strontium-90 to the river. This investigation will be documented in a letter report to support a ROD amendment. The letter report will include a recommendation and schedule for a path forward based on the ITRD conclusions and agreement from Ecology.	December 2001

VI. Protectiveness Statements

I certify that remediation of the soil sites, D&D of buildings, in-situ treatment of chromium, and K Basins remedial actions in the 100 Area are protective of human health and the environment. The 100 Area pump-and-treat actions for chromium are not achieving the criteria for protection of the environment. While the N Area pump-and-treat system is currently containing much of the plume and removing mass, high concentrations of Strontium-90 in the groundwater adjacent to the river continue to pose a risk to human health and the environment. Existing ICs, along with the ICs resulting from the implementation of the recommendations in this five-year review, will be protective of human health and the environment. I also certify that those remedial activities that are not completed, or are still in the design or investigation stage, do not require immediate response actions to protect human health and the environment.

VII. Next Review

The USDOE Hanford 100 Area is a statutory site that requires ongoing five-year reviews. The next review will be conducted within five years of the completion of this five-year review report. The completion date is the date of the signature shown on the signature cover attached to the front of the report.

USDOE Hanford 200 Area
First Five-Year Review Report

I. Introduction

The 200 Area of the Hanford Site was used for chemical processing and for waste management. These activities generated radioactive, hazardous, and mixed wastes that were disposed of into the soil column and resulted in large amounts of contaminated soil and groundwater in the 200 Area. This five-year review is focused on the inactive soil disposal area, inactive facilities, contaminated groundwater, and the Environmental Restoration Disposal Facility (ERDF). Ongoing waste management activities, active treatment, storage, or disposal facilities and tank farm operations are not included in this review.

The USDOE Hanford 200 Area is divided into 23 soil operable units. These units contain approximately 700 soil waste sites and associated structures, as well as numerous facilities requiring decontamination and decommissioning. The 23 operable units were consolidated from the original 32 geographically-based source operable units; several are still referred to by their original operable unit designations. The operable units were organized by discharge types and waste site types. Examples of discharge types include solid waste, cooling water, process water, and uranium-rich waste. Examples of waste site types include pond, crib, ditch, and burial ground. The switch to process-based waste groups was made in February 1997.

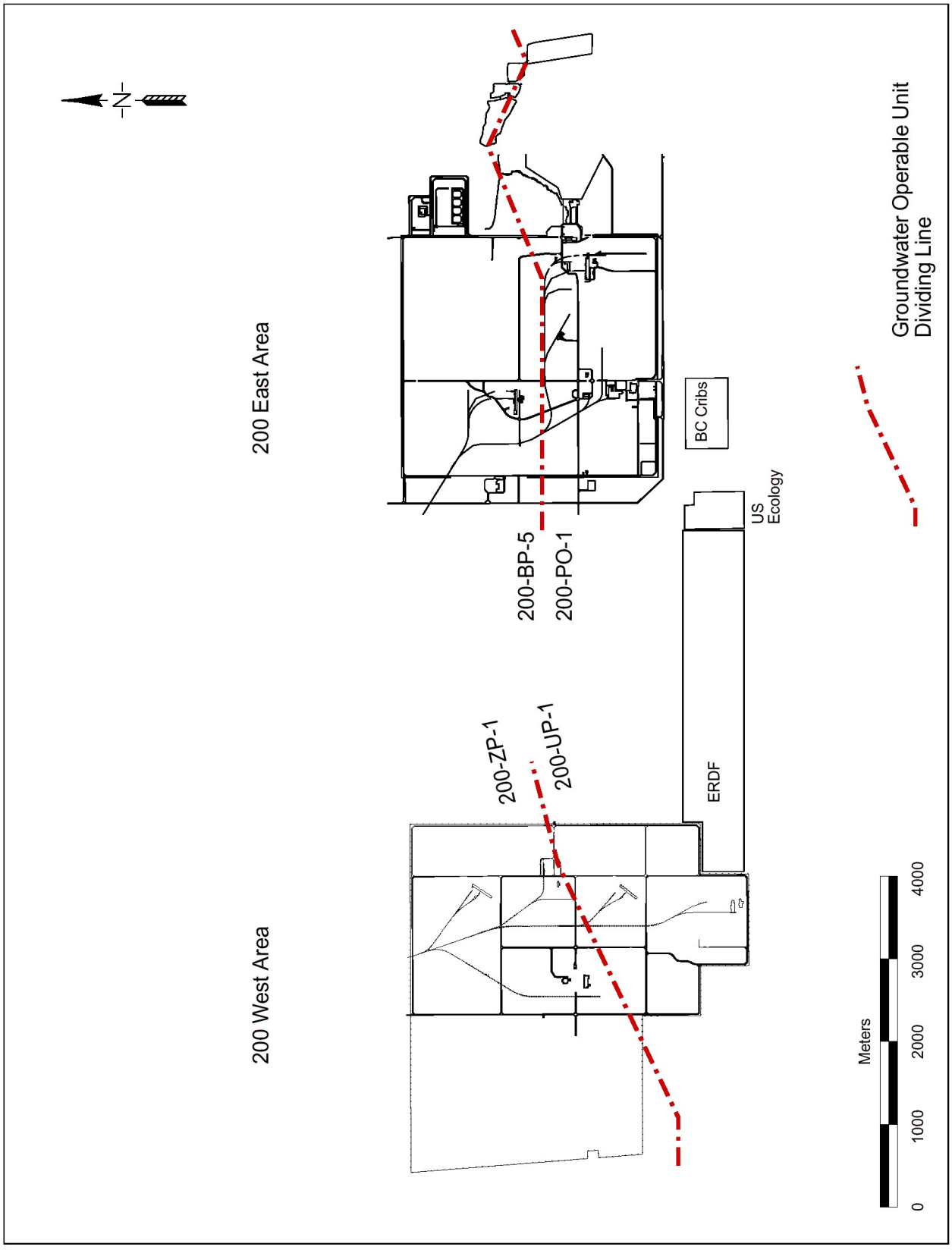
In addition to the 23 soil operable units, the 200 Area National Priorities List (NPL) site consists of four groundwater operable units. The 200 West Area contains the 200-ZP-1 Operable Unit and the 200-UP-1 Operable Unit. The 200 East Area contains the 200-BP-5 Operable Unit and the 200-PO-1 Operable Unit (see Figure 200-1).

The USDOE Hanford 200 Area five-year review was led by Dennis Faulk, Remedial Project Manager for the site. The following team members assisted in the review:

- Craig Cameron, EPA Project Manager
- Dib Goswami, Ecology Project Manager
- Zelma Jackson, Ecology Project Manager
- Arlene Tortoso, DOE Project Manager
- Fred Roeck, Bechtel Hanford.

This five-year review consisted of the following activities: a review of relevant documents, review of groundwater monitoring data, an NPL site visit, discussion with the site-specific advisory board, a tribal consultation, and discussion with the Natural Resource Trustee Council. Input from the public was solicited during a 30-day comment period which ran from January 29 through February 27, 2001. Responses to the comments that were received are attached in Appendix B.

Figure 200-1. 200 Area Groundwater Operable Units.



This is the first five-year review for the USDOE Hanford 200 Area. The triggering action for this statutory review is the remedial action start for the ERDF, which occurred on May 5, 1995, as shown in EPA's WasteLAN database. Because hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unrestricted use and unlimited exposure for the foreseeable future, additional five-year reviews will be required.

Other decisions in the 200 Area include a 1995 interim Record of Decision (ROD) for the 200-ZP-1 Operable Unit, a 1999 decision for the 200-CW-3 Operable Unit (included in the Remaining Sites ROD), and the 1997 interim action Record of Decision for the 200-UP-1 Operable Unit.

In addition, two action memos have been issued in the 200 NPL site, including a 1992 action memo for the 200-ZP-2 Operable Unit and a 1997 action memo for the 233-S Plutonium Concentration Facility. Action memos are the decision documents used for CERCLA removal actions as specified in 40 CFR Part 300-415.

II. Site Background and Chronology

The Hanford 200 Area NPL Site consists of the East and West Areas, along with a smaller North Area, all located in the central plateau portion of the Hanford Site. The 200 Area covers more than 21 square miles (33.6 square kilometers). The 200 East Area is located 17 miles (27 kilometers) northeast of the City of Richland.

The 200 Area was listed on the NPL on October 4, 1989. Remedial investigations began in the 200 Area in 1992 per schedules established under Milestone M-13 of the Tri-Party Agreement. These initial investigations pointed to the need for remedial action for the carbon tetrachloride plume located in the 200-ZP-1 and 200-ZP-2 Operable Units, as well as an action for uranium and technetium contamination in the 200-UP-1 groundwater. All investigations in the 200 Area were scheduled to be completed by 2005. However, in 1995, greater emphasis was placed on cleanup of the 100 Area, and the date for completion of all 200 Area investigations was deferred to 2008. DOE is currently on schedule to meet the requirement to complete all remedial investigation/feasibility study (RI/FS) work by December 2008. The current Tri-Party Agreement milestone for completion of cleanup of all non-tank farm operable units in the 200 Area is set at 2018. The current DOE baseline schedule for tank farm closures is 2046.

This review focuses on four types of sites/media including soil waste sites, contaminated groundwater, the Environmental Restoration Disposal Facility (ERDF), and buildings undergoing decontamination and decommissioning.

III. Remedial Actions

A. Soil Sites

Below is a list of each of the 23 soil operable units and a brief description of each.

Process Condensate/Process Waste Category	
200-PW-1	Plutonium/Organic-Rich Waste
200-PW-2	Uranium-Rich Process Waste
200-PW-3	Organic-Rich Process Waste
200-PW-4	General Process Waste
200-PW-5	Fission Product-Rich Process Waste
200-PW-6	Plutonium Process Waste
Steam Condensate/Cooling Water/Chemical Sewer Category	
200-CW-1	Gable Mountain/B-Ponds and Ditches Cooling Water
200-CW-2	S Pond And Ditches Cooling Water
200-CW-3	200 North Cooling Water
200-CW-4	T Pond And Ditches Cooling Water
200-CW-5	U Pond/Z Ditches Cooling Water
200-SC-1	Steam Condensate
200-CS-1	Chemical Sewer
Chemical Waste Category	
200-LW-1	300 Areas Chemical Laboratory Waste
200-LW-2	200 Areas Chemical Laboratory Waste
Miscellaneous Waste Category	
200-MW-1	Miscellaneous Waste
Tank/Scavenged Waste Category	
200-TW-1	Scavenged Waste
200-TW-2	Tank Waste

Tanks/Lines/Pits/Diversion Boxes Category	
200-IS-1	Tanks/Lines/Pits/Boxes
Unplanned Releases Category	
200-UR-1	Unplanned Releases
Septic Tank and Drain Fields Category	
200-ST-1	Septic Tank and Drain Fields
Landfills and Dumps Category	
200-SW-1	Non-Radioactive Landfills and Dumps
200-SW-2	Radioactive Landfills and Dumps

At this time, one soil operable unit, 200-CW-3, has had a ROD issued. Waste sites within 200-CW-3 were included in the 1999 Interim Action ROD for the 100 Area Remaining Sites. The reason for inclusion was that the waste sites located in 200-CW-3 contained similar contaminants and were constructed in the same manner as the 100 Area sites. The waste sites in 200-CW-3 will be included in the 100 Area Remedial Action Work Plan after cleanup schedules are negotiated per Milestone M-16-00F, which is due by December 31, 2001. Milestone M-16-00F is the milestone to establish a date for completion of all 100 Area remedial actions.

Currently, there are five operable units in various stages of the RI/FS process. At this time, no waste sites appear to require a removal action or an interim action to ensure near-term protection of human health and the environment. As investigations continue, the need for early action will be assessed.

200-CW-3 200 North Cooling Water Operable Unit. Interim Action ROD signed on July 15, 1999.

200-CW-1 Gable Mountain/B-Ponds and Ditches Cooling Water Operable Unit. ROD projected for 2004.

200-CS-1 Chemical sewer waste sites. ROD projected for 2006.

200-CW-5 U Pond/Z Ditches Cooling Waste Sites. ROD projected for 2005.

200-TW-1 Scavenged Waste Operable Unit. RI/FS Work plan submitted August 2000. ROD projected for 2007

200-TW-2 Tank Waste Operable Unit. RI/FS Work plan submitted August 2000. ROD projected for 2007.

DOE is currently on schedule to meet the Tri-Party Agreement commitment to complete all RI/FS activities by 2008.

In 1992, an action memo was issued requiring operation of a soil vapor extraction system in the 200-ZP-2 Operable Unit (now named 200-PW-1) to remove carbon tetrachloride from the vadose zone. The primary goal of the soil vapor extraction system was to remove the source of carbon tetrachloride to prevent further degradation of the groundwater. Three soil vapor extraction systems were operated from 1992 to 1997, and more than 75,000 kg of carbon tetrachloride was removed. The carbon tetrachloride was captured on granulated activated carbon and sent off site for regeneration. The total mass of carbon tetrachloride removed represents an estimated 10 percent of the original carbon tetrachloride inventory (approximately 750,000 kg) discharged to the soil column. Over time, the rate of contaminant removal dropped. In late 1997, based on observations of a rebound study, EPA and DOE agreed to begin operating the systems in a cyclic mode. In 1998 and 1999, the vapor extraction system was run for 6 months at the 216-Z1A and 216-Z-18 sites and then was moved to the 216-Z-9 location for 6 months of operations, resulting in the removal of an additional 1,600 kg of contaminants. The system has been shut down during the year 2000 as EPA and DOE investigate enhancements to the system.

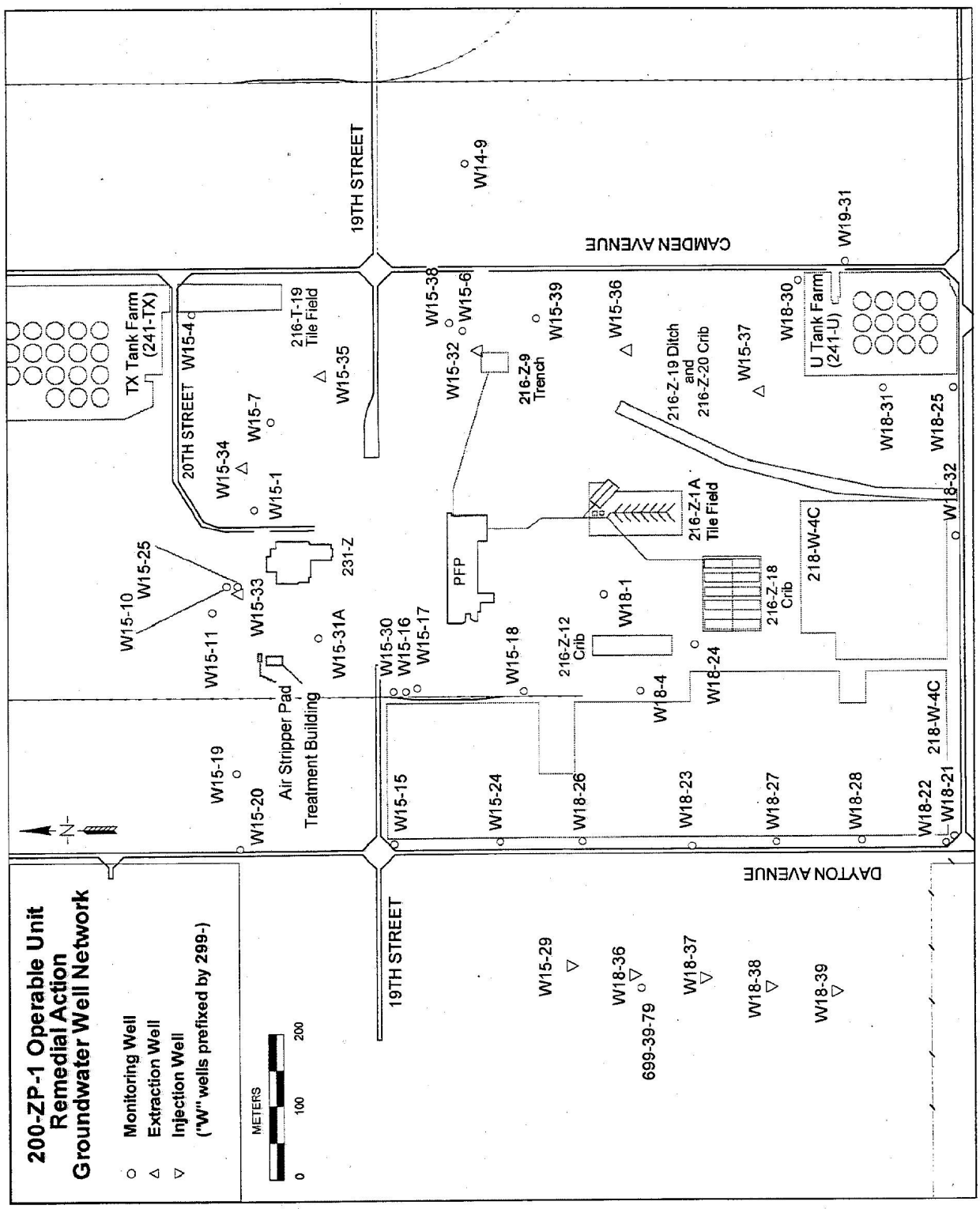
B. Groundwater Units

200-ZP-1

RI/FS complete	5/24/95
Interim Action ROD Signature	5/24/95
Remedial Design (RD) Start	6/7/95
RD Complete	7/23/96
Actual Remedial Action (RA) Start	8/26/96

This operable unit includes groundwater contamination from sources in the northern portion of the 200 West Area. The pump-and-treat system for this operable unit, located north of the Plutonium Finishing Plant (PFP), was implemented as an interim action to prevent further movement of carbon tetrachloride groundwater contamination from the high-concentration portion of the carbon tetrachloride plume and to reduce contaminant mass (see Figure 200-2). The other contaminants of concern are chloroform and trichloroethene. The need for action is supported by a 1996 report titled *Hanford Sitewide Remediation Strategy and Groundwater Contaminant Predictions*. This effort resulted in preliminary modeling results which indicated that within 200 years the carbon tetrachloride plume had the potential to reach the Columbia River above drinking water standards.

Figure 200-2. Pump-and-Treat Site Showing Extraction, Injection, and Monitoring Well Locations.



Specific Remedial Action Objectives (RAOs) for this project are as follows.

- Prevent further movement of contaminants from the highest concentration area of the plume (2,000 to 3,000 ppb carbon tetrachloride contour interval).

- Reduce contamination in the area of highest concentration of carbon tetrachloride.

- Provide information that will lead to the development of a final remedy that will be protective of human health and the environment.

In addition to the RAOs listed above, the ROD also required DOE to investigate the potential for carbon tetrachloride as a dense nonaqueous phase liquid (DNAPL) and, if confirmed, take appropriate remedial actions.

The pump-and-treat system and operations were implemented in a three-phased approach. Phase I operations consisted of a pilot-scale treatability test that ran from August 29, 1994, to July 19, 1996. During that period, contaminated groundwater was removed from a single extraction well at a rate of 150 L/min, treated using granular activated carbon, and returned to the aquifer through an injection well. Phase II operations ran from August 5, 1996, until August 8, 1997. The well-field configuration consisted of three extraction wells, pumping at a combined rate of 570 L/min, and a single injection well. Groundwater was treated using an air stripper, followed by granular-activated carbon treatment of the air stream. Phase III operations were initiated on August 29, 1997, and included six extraction wells, pumping at a combined rate of 720 L/min, and five injection wells. The treatment system is the same as for Phase II. The system continues to operate as designed. The pump and treat system has been operated in compliance with all applicable regulations. The treated groundwater, which is discharged back into the aquifer, meets the drinking water standard of 5 ppb.

Since 1994, well over 950 million liters of water have been treated and over 3300 kg of carbon tetrachloride have been removed. The high concentration areas of the plume are being contained by the pump-and-treat system which has helped reduce potential adverse impacts to human health and the environment (see Figure 200-3).

200-UP-1

RI/FS complete	2/24/97
ROD Signature	2/24/97
RD Start	2/24/97
RD Complete	11/19/97

The 200-UP-1 Operable Unit contamination resulted from discharges to five primary liquid waste disposal sites (see Figure 200-4). These sites are in cribs 216-U-1, 216-U-2, 216-U-8, 216-U-12, and 216-U-16. The principal contaminants of concern in the waste stream

Figure 200-3. Carbon Tetrachloride Remediation Area Plume as of July 1999.

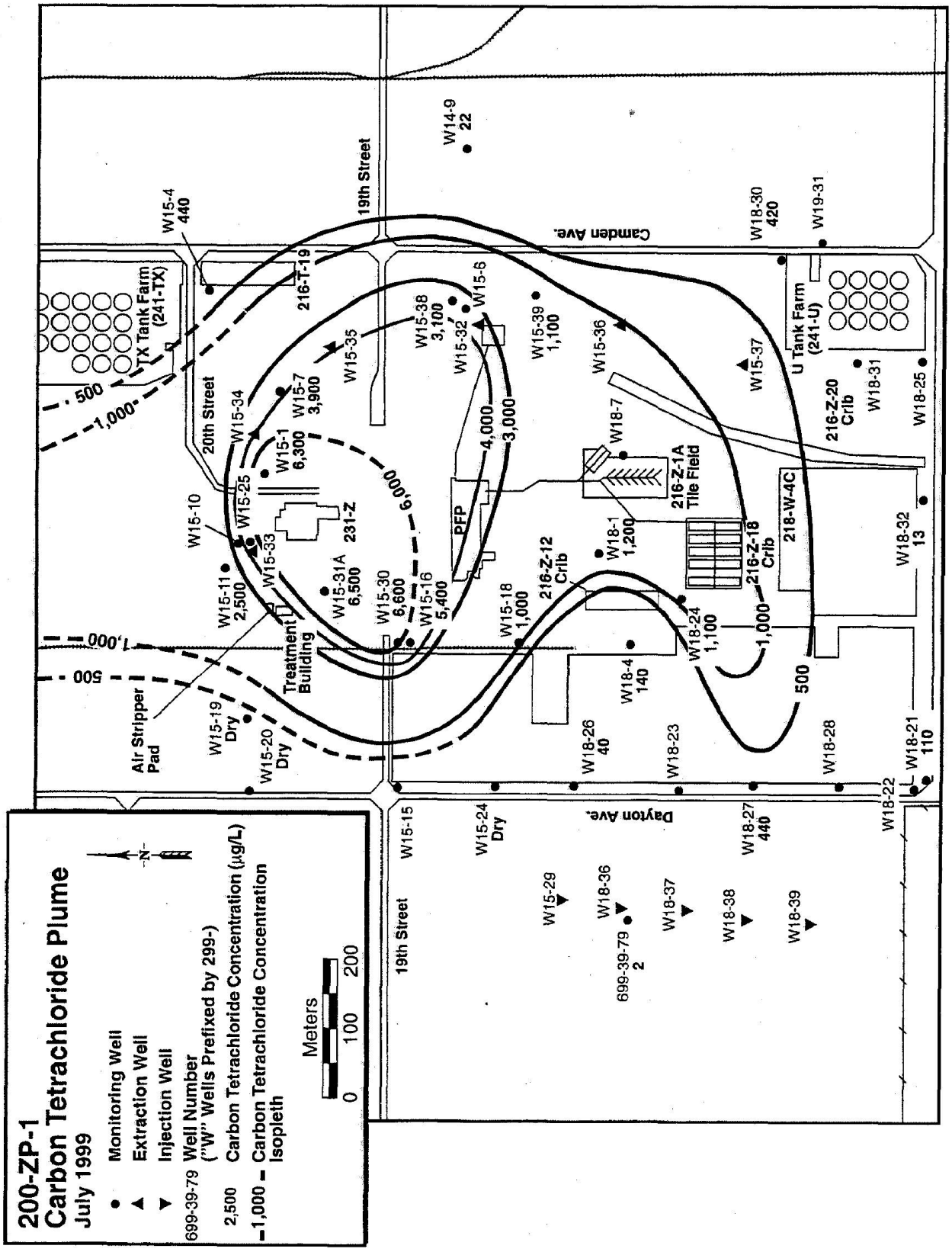
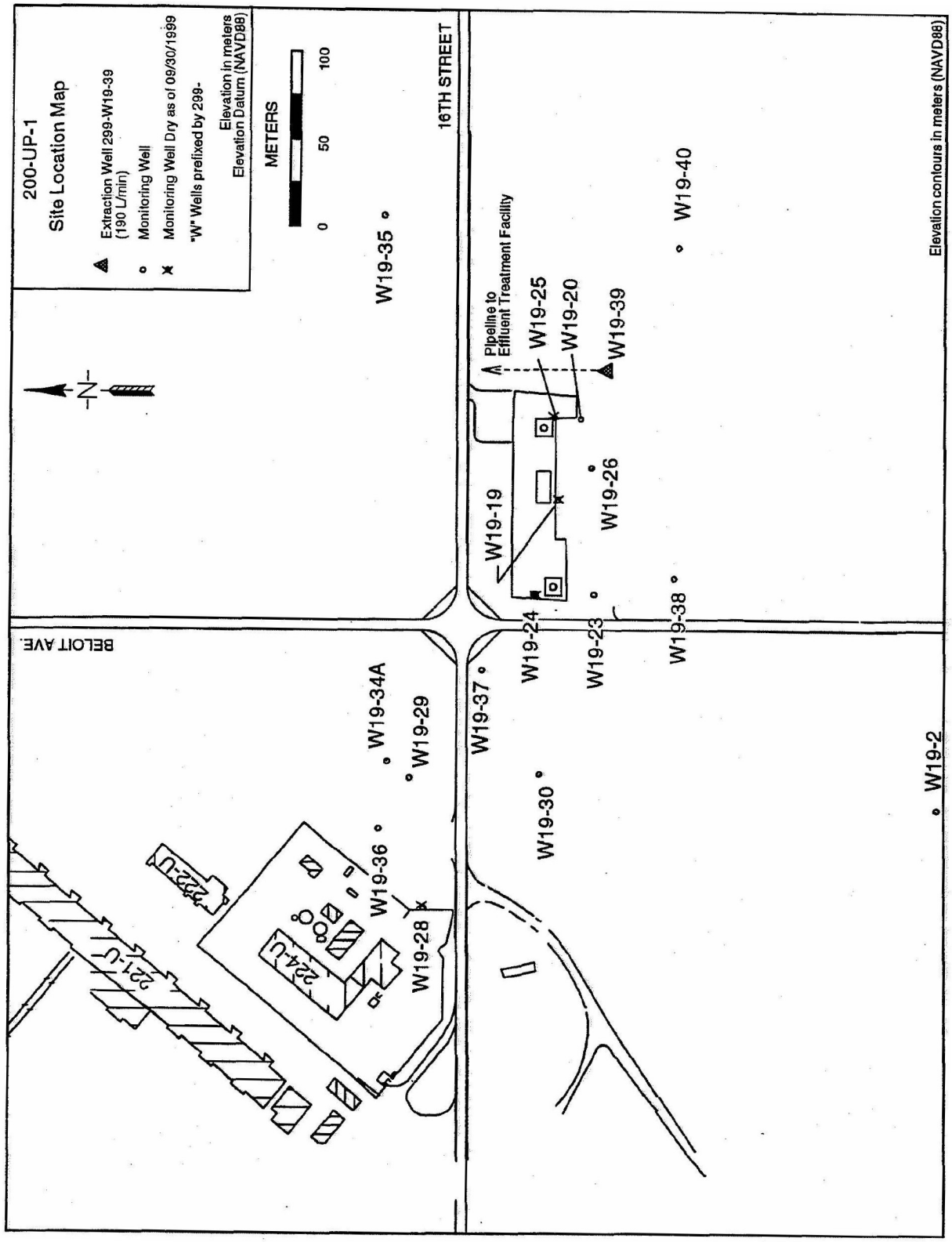


Figure 200-4. 200-UP-1 Site Map.



were uranium and Technetium-99. Secondary contaminants were carbon tetrachloride, nitrate, chromium, trichloroethylene, tritium, and Iodine-129. These contaminants were discharged within high volumes of water and resulted in large plumes of contamination. The interim action in the 1997 ROD involved removing the primary contaminants of uranium and Technetium-99 and secondary contaminants of nitrate and carbon tetrachloride. The process involves pumping the groundwater from the operable unit, piping the groundwater to the Effluent Treatment Facility located in the 200 East Area for treatment, and then discharging the treated groundwater to the state-approved land disposal site north of the 200 West Area. All discharges from treatment of 200-UP-1 groundwater to the land disposal site have been in compliance with discharge limits for the contaminants of concern.

The specific RAOs are as follows.

- Reduce contamination in the areas of highest concentration of uranium and Technetium-99 to below 10 times the cleanup level (i.e., below 480 μg/L) under the *Model Toxics Control Act* (MTCA) *(Washington Administrative Code* [WAC] 173-340) for uranium, and to below 10 times the maximum contaminant level (MCL) (i.e., below 9,000 pCi/L) for Technetium-99.

- Reduce potential adverse human health risks through reduction of contaminant mass.

- Prevent further movement of these contaminants from the highest concentration area.

- Provide information that will lead to the development and implementation of a final remedy that will be protective of human health and the environment.

As of July 1999, the portions of the original plume with high Technetium-99 concentrations were hydraulically contained, but were not entirely reduced to the RAO of 9,000 pCi/L. Significant progress was made in reducing the size and concentrations of the technetium plume. The July 1999 plume only exceeds the RAO at well 299-W19-26 (near the extraction well) and well 299-W19-29 (near the former injection well). However, concentrations are increasing rapidly at former injection well 299-W19-36. The technetium concentration is more than 8,000 pCi/L in this well. The most likely explanation for this is that during pump-and-treat operation, this well acted as a hydraulic barrier, preventing upgradient contamination from moving downgradient past this well. Since shutdown of 299-W19-36, upgradient contamination is now moving past this well, resulting in increasing technetium concentrations.

The pump-and-treat system has had limited success in remediating the uranium plume to the RAO of 480 μg/L. The overall size of the high-concentration portion of the uranium plume may have decreased slightly between June 1995 and July 1999, particularly in the area of the former injection well. However, the plume appears to have migrated somewhat toward

extraction well 299-W19-39. The lack of success is likely due to the tendency of uranium to sorb to soil particles (see Figure 200-5).

An additional Technetium-99 plume has been discovered southwest of the original uranium/Technetium-99 plume. Since October 1999, Technetium-99 concentrations have increased from 39,000 pCi/L to 72,300 in December 1999. This plume was detected in new well 299-W23-19.

200-PO-1 Operable Unit

The 200-PO-1 Operable Unit was investigated in 1992 as part of study of the entire 200 East Area groundwater system. Contaminants present in the 200-PO-1 Groundwater Operable Unit in the 200 East Area of the Hanford Site originated from historical liquid waste disposal during operations of the Plutonium/Uranium Extraction (PUREX) Plant and B-Plant in the 200 East Area. The liquid discharges are the product of chemical processing activities, which resulted in disposal of radionuclides, heavy metals, and organic solvents directly to the soil column via cribs, trenches, and ponds. Due to the high volume of discharge, some of the constituents have impacted the groundwater in the 200 East Area. These constituents are transported to the southeast towards the Columbia River. The contaminants identified that exceed groundwater quality criteria (i.e., the MTCA, the Safe Drinking Water Act, and the MCL) include arsenic, chromium, Iodine-129, manganese, Strontium-90, tritium, vanadium, and nitrate. Out of these, tritium and Iodine-129 are the principal contaminants of concern because of their high mobility and the large area of the aquifer that is above the MCL. The following text will address the issues associated with these two contaminants.

The tritium plume covers the largest area of the PO-1 Operable Unit contaminants, approximately 190 sq km (73 sq mi). The plume has reached the Columbia River, and the concentration at the riverbank is greater than the drinking water standard of 20,000 pCi/L for almost the entire length of where the plume intersects the shoreline. At the point near Hanford town site, the concentration increases to 200,000 pCi/L. A riverbank spring at this location contains an average tritium concentration of 142,000 pCi/L (see Figure 200-6).

DOE committed to evaluate remedial technologies for tritium on a biannual cycle under Milestone M-26-5B. The latest report was submitted in August 1999. Efforts to develop unique methods for separating low levels of tritium in large feed volumes have not been fruitful. None of these methods are presently deemed appropriate for separating tritium from groundwater because estimated capital and operating costs are too high. The most used process, a combination of electrolysis and catalytic exchange, was evaluated for potential in separating tritium in high-feed volumes. A number of other technologies such as bithermal catalytic exchange, laser isotope separation, and membrane separation have also been looked at. These technologies are at various stages of development, however, and are not presently developed to levels that would be feasible for low-level tritium treatment.

The Iodine-129 plume is large, covering approximately 75 sq km (29 sq mi), and diffuse, with areas of higher activity located near the original disposal sites (see Figure 200-6). The

Figure 200-5. 200-UP-1 Area of Capture Through September 1999.

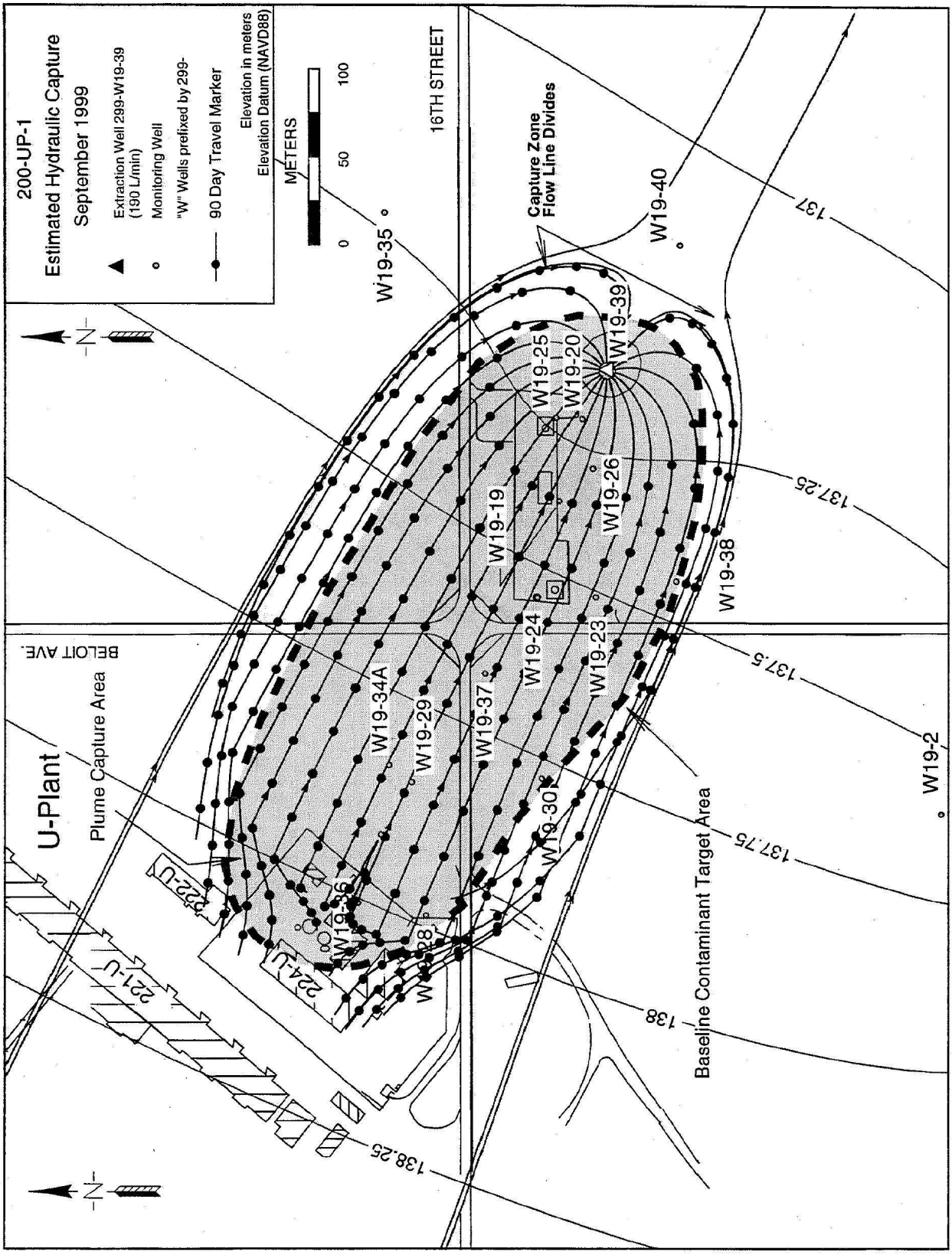
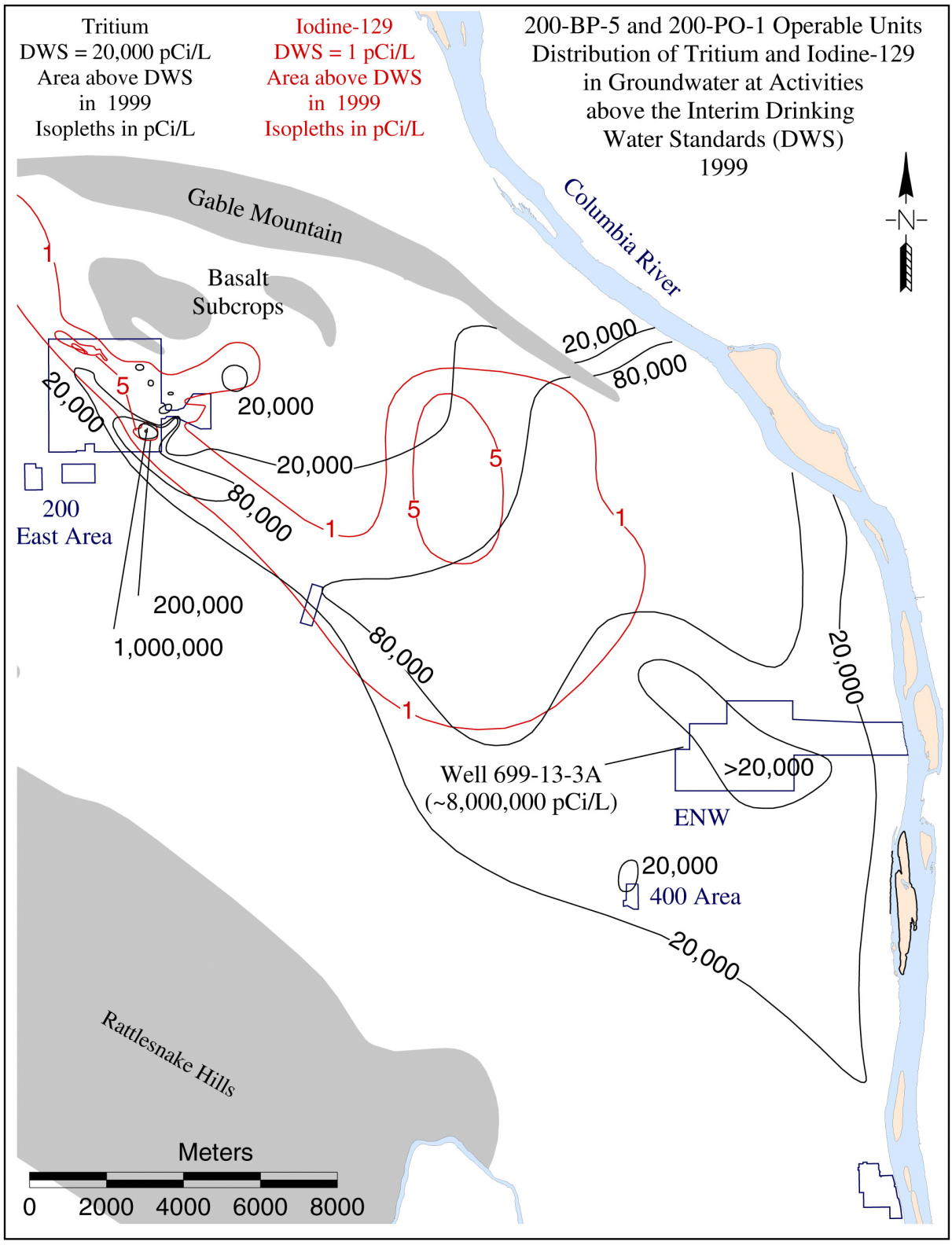


Figure 200-6. Tritium and Iodine-129 Plumes from the 200-PO-1 Operable Unit.



highest groundwater activity for the 200 East Area plume is 12.4 pCi/L. The National Primary Drinking Water Standard MCL is 0.48 pCi/L (Title 40, CFR, part 141).

Trend plots shows a general decline of Iodine-129 concentration, due mainly to natural attenuation through plume movement. Iodine-129 is a mobile, long-lived radionuclide with a half-life of 15.7 million years; therefore, natural decay is not a significant factor in reduction of concentrations. The Iodine-129 will continue to move towards the river; however, dispersion and mixing will further reduce concentrations.

A 1996 report, prepared to meet Tri-Party Agreement Milestone M-15-81B, addressed the feasibility of remediation of Iodine-129 at the Hanford Site. More than 300 wells were sampled to clearly define these plumes. Review of the technical literature and contacts with groundwater equipment manufacturers produced no case study information on attempts to remediate groundwater contaminated with Iodine-129. Groundwater extraction and treatment with ion exchange, activated carbon, reverse osmosis, or precipitation technologies have theoretical potential for the removal of Iodine-129 contamination; however, the ability to treat groundwater to the low concentrations required to reintroduce the treated effluent to the aquifer has not been demonstrated.

The 1998 *Screening Assessment and Requirements for a Comprehensive Assessment (Columbia River Comprehensive Impact Assessment)* concluded that there is no current adverse impacts to human health or ecological receptors from either tritium or Iodine-129.

There is currently no decision document in place for this operable unit, and at this time there are no viable technologies to remediate the tritium or Iodine-129 plumes. In addition, there is currently no regulator-approved monitoring network for this operable unit. Monitoring data for this operable unit is currently presented in an annual groundwater report produced by the Pacific Northwest National Laboratory for DOE.

200-BP-5 Operable Unit

The 200-BP-5 Operable Unit was investigated in 1992 as part of a study of the entire 200 East Area groundwater system. 200-BP-5 is located in the 200 East Area, and contaminated plumes are associated with B-Plant operations. The three major groundwater plumes within the 200-BP-5 Operable Unit are the 216-BY crib plume, the 216-B-5 reverse well, and the Gable Mountain pond plume (see Figures 200-7, 200-8, and 200-9, respectively). The direction of groundwater flow for this unit is north by northeast through the hydrogeologic gap between Gable Mountain and Gable Butte towards the Columbia River. Contaminants of concern include Technetium-99 and Cobalt-60 for the 216-BY cribs; Strontium-90, Cesium-137, and Plutonium-239/240 for the 216-B-5 reverse well; and Strontium-90 for the Gable Mountain pond plume.

Investigations were conducted in 1993, leading to recommendations that interim remedial measures be taken for the 216-BY cribs and the 216-B-5 reverse well. A treatability test plan

Figure 200-7. 216-BY Cribs Baseline Contamination Distribution Map.

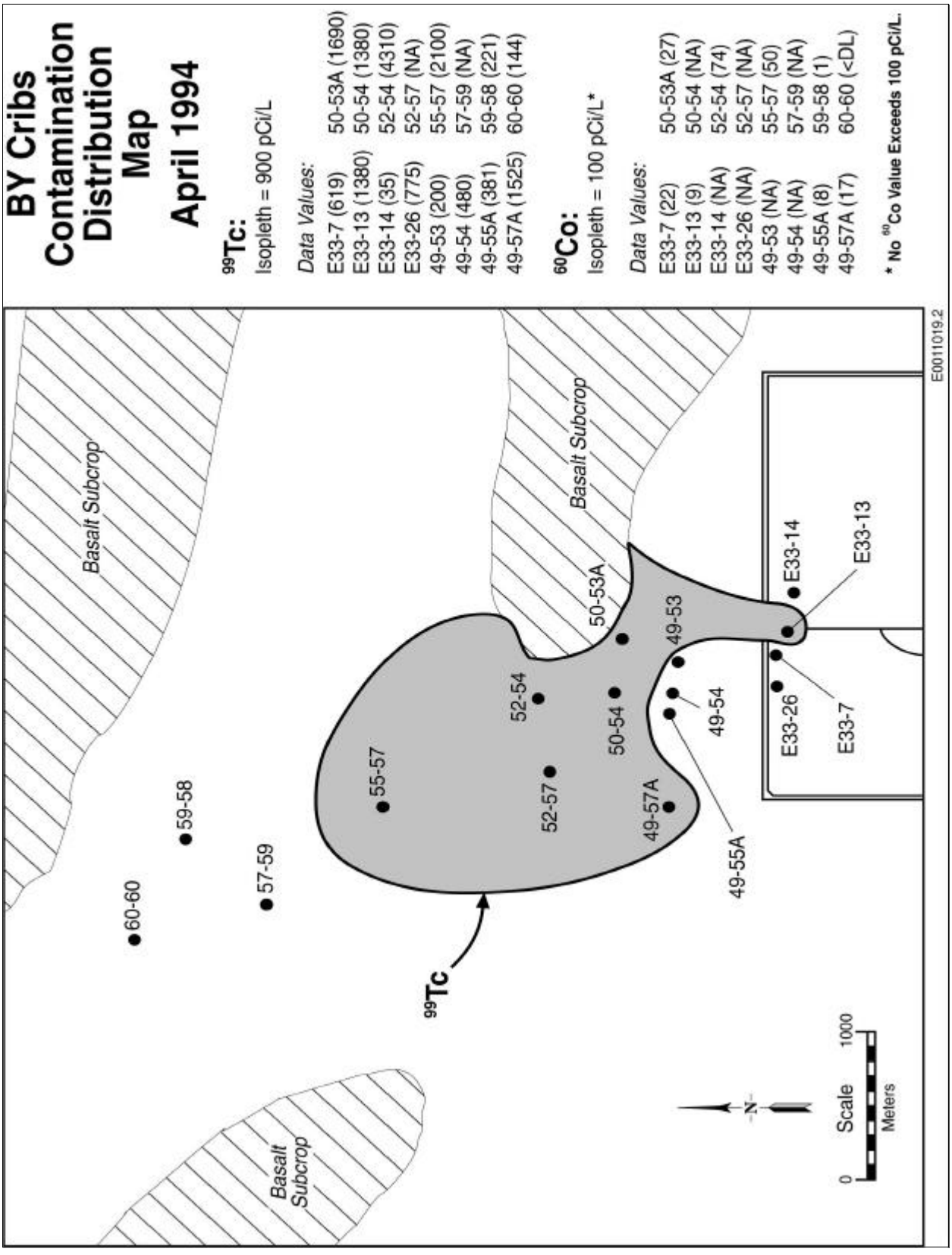


Figure 200-8. 216-B-5 Reverse Well Baseline Contamination Distribution Map.

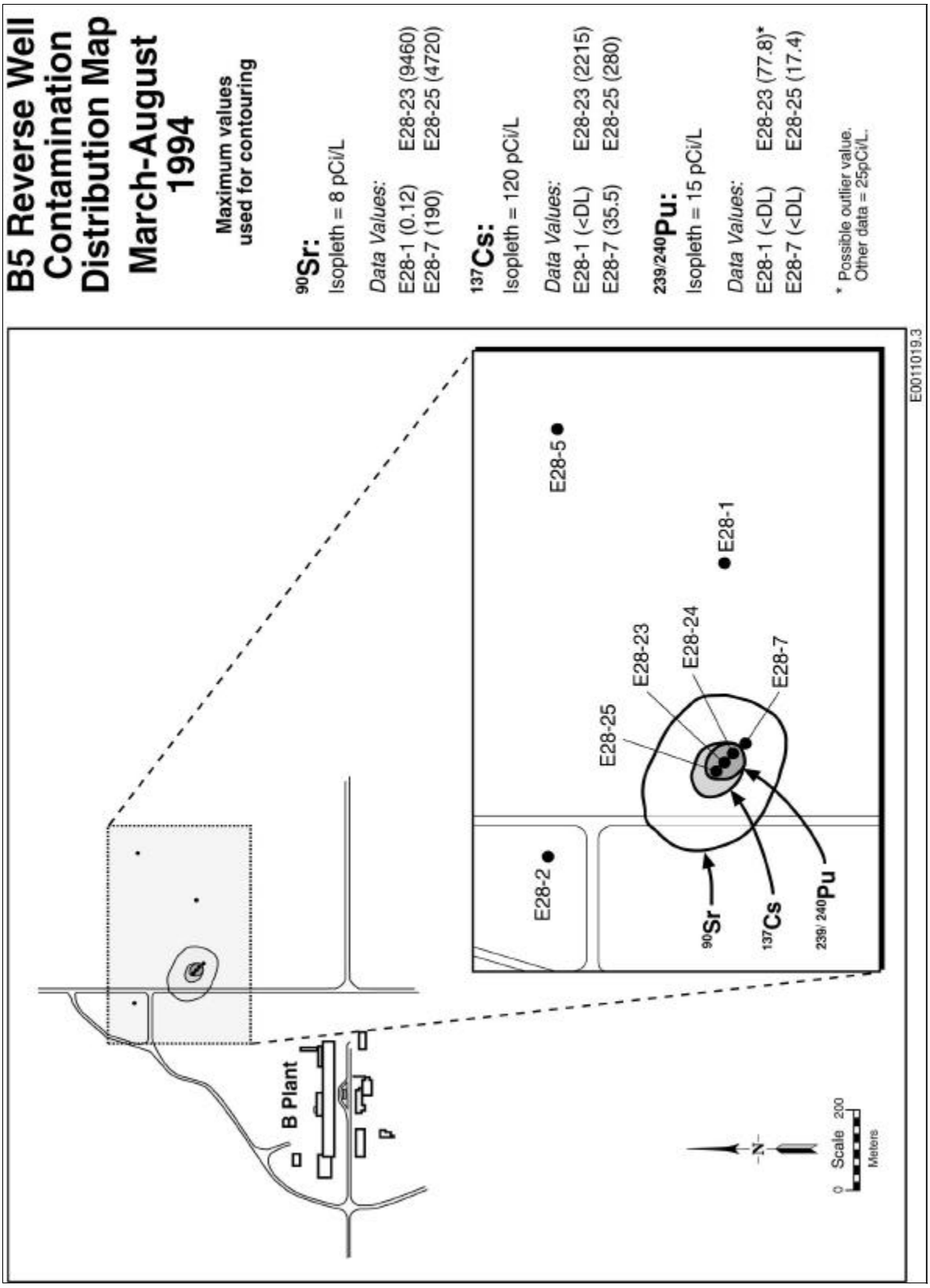
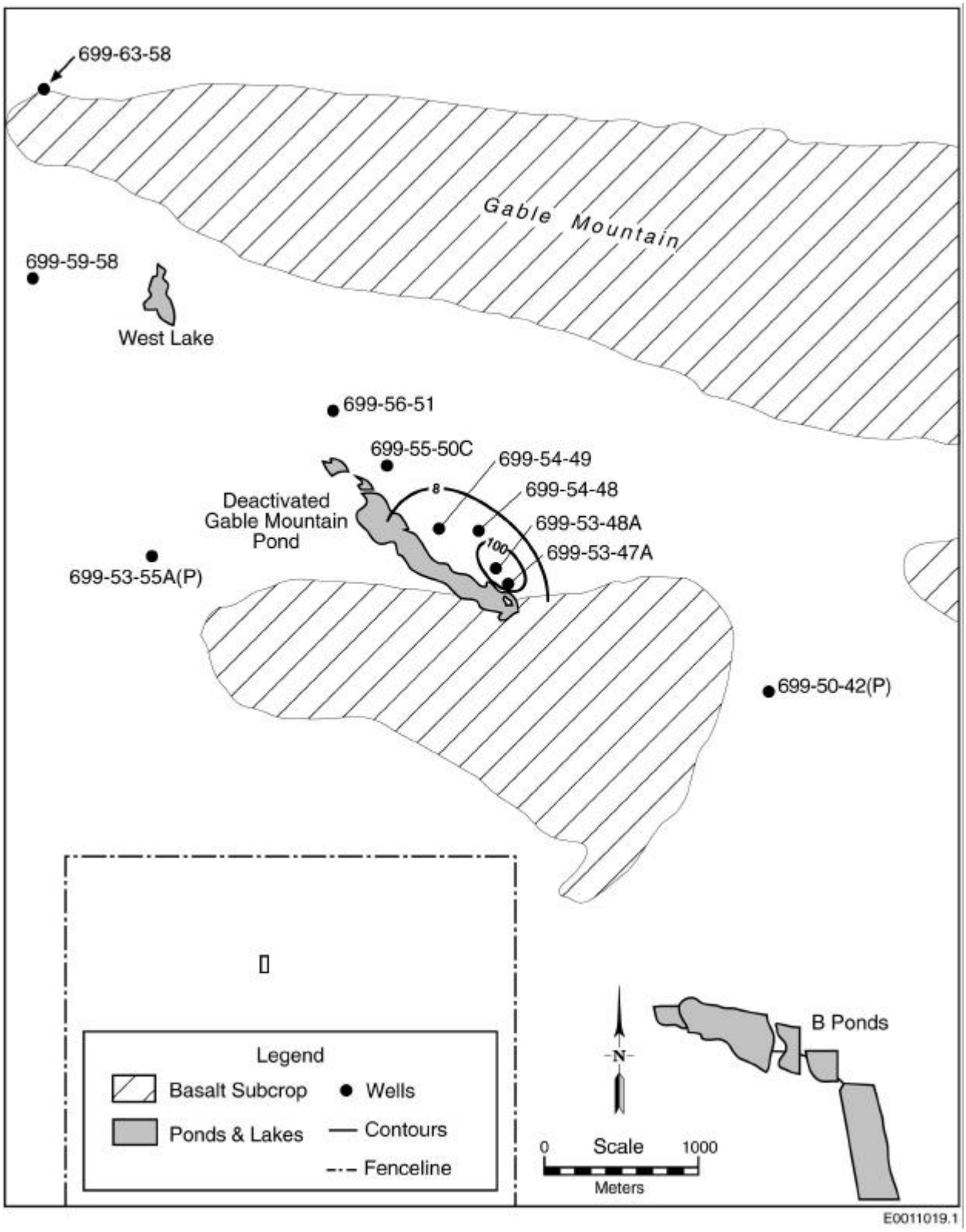


Figure 200-9. Gable Mountain Pond Baseline Strontium-90 Contours.



was produced by January 1994, and a pilot-scale pump-and-treat treatability test was initiated in August 1994. Operations ceased in May 1995.

DOE issued the 200-BP-5 Operable Unit Treatability Test Report in April 1996 with the following conclusions.

- The treatment system for the 216-B-5 reverse well performed satisfactorily for removal of all three contaminants. Aquifer pumping easily provided substantial quantities of groundwater containing significant concentrations of Cesium-137 and Strontium-90. However, the concentrations of Plutonium-239/240 in the extracted groundwater were small relative to the quantities discharged to the ground, confirming that the soil adsorbs plutonium to the extent that the groundwater is not excessively impacted. The future risks are predicted to be low from this plume because both the Cesium-137 and the Strontium-90 decay to negligible levels long before the plumes migrate off the Central Plateau and the Plutonium-239/240 is immobile. For this reason, EPA and DOE discontinued the treatability test/pilot-scale pump-and-treat study at the 216-B-5 reverse well plume.

- The treatability test regarding the technetium plume associated with the 216-BY cribs concluded that the ion exchange system worked well to remove the technetium, but poor groundwater extraction rates (3 to 4 gallons per minute) due to a very thin aquifer led EPA and DOE to terminate the test.

- The Gable Mountain pond received waste water and cooling water from 1957 to 1987. Although discharge began more than 35 years ago, the Strontium-90 plume has not migrated very far downgradient from the disposal site. Strontium-90 has a half-life of 29 years and, based on transport modeling results, this plume is not predicted to move off site above risk-based standards.

Current monitoring data indicates that the contaminant concentrations in the groundwater have not changed significantly since the termination of the treatability tests and groundwater monitoring should continue. Currently, there is no regulator-approved monitoring network for this operable unit. Monitoring data for this operable unit is currently presented in an annual groundwater report produced by the Pacific Northwest National Laboratory for DOE.

C. Disposal Facility

ERDF

RI/FS complete	**10/31/94**
ROD Signature	**1/20/95**

Remedial Design Start	**1/23/95**
Remedial Design Complete	**3/28/95**
Actual RA Start Cells 1&2	**5/5/95**
Expansion ROD Amendment	**9/25/97**
Remedial Design Phase II Start	**11/13/97**
Remedial Design Phase II Complete	**2/24/98**
Actual RA Start Cells 3&4 Construction	**8/19/98**
Delisting ROD Amendment	**3/25/99**

In January 1995, the Tri-Parties signed a CERCLA ROD authorizing the construction of ERDF to provide waste disposal capacity for cleanup of contaminated areas on the Hanford Site. The ERDF ROD provides the overall plan for construction of the facility and disposal of remediation waste from the Hanford Site.

ERDF is located just southeast of the 200 West Area on the central plateau and was constructed using a double liner and a leachate collection system that meet RCRA Subtitle C technical requirements. ERDF is used to dispose of hazardous/dangerous waste and low-level radioactive waste, as well as mixed wastes that meet, or have been treated to meet, land disposal restrictions and ERDF waste acceptance criteria.

A subsequent Explanation of Significant Difference (ESD) to the ERDF ROD was issued in July 1996. The ESD allows for the disposal of investigation-derived waste; decontamination and decommissioning (D&D) wastes; waste from RCRA past-practice operable units and closures; and non-RCRA waste from inactive treatment, storage, and disposal (TSD) facilities. The ESD also authorized the conditional use of ERDF leachate for dust suppression and waste compaction.

Two ROD amendments have been issued for ERDF. The first amendment was issued in September 1997 to authorize expansion of the facility by constructing two new disposal cells and to allow for limited waste treatment at the ERDF. The second amendment was issued in March 1999 authorizing the delisting of ERDF leachate. Delisting the ERDF leachate was done to allow for implementation of more cost-effective and appropriate leachate handling techniques. The basis for the delisting is leachate analytical results that show no significant level of contaminants to be present.

Since beginning operation on July 1, 1996, more than 2 million tons of remediation waste have been successfully disposed at ERDF. Approximately 3 million gallons of ERDF leachate have been treated or recycled, and approximately 800 tons of waste have been treated at ERDF prior to disposal. The two initial disposal cells reached their operational capacity in August 2000

and an interim cover has been installed. Two additional disposal cells have been constructed, one of which has been placed into operation.

D. Decontamination and Decommissioning of Facilities

233-S Plutonium Concentration Facility

The 233-S Plutonium Concentration Facility was built in 1955 to expand production and further concentrate the plutonium nitrate product solution from the REDOX Facility. The 233-S Facility was decommissioned in 1967. The facility is contaminated from normal operations, a control air line contamination (1956), and a fire in the process hood (1963). The facility has endured over 30 years of freeze-thaw cycles and has deteriorated significantly. In 1997, it was decided that surveillance and maintenance activities could no longer adequately protect against the threat of release of radiological and hazardous contaminants. An action memo signed by EPA and DOE on March 26, 1997, authorized the decontamination and dismantlement of the facility.

The majority of the non-process areas of the facility have been decontaminated. The pipe trench, the load-out hood, and the process hood viewing room have been decontaminated. The process hood has been decontaminated to the point where work may begin on dismantling the process vessels within. Progress has been slow due to the high levels of airborne contamination and the discovery of more source material in the process hood than was previously estimated. The increased source material triggered several nuclear and criticality safety questions that needed to be resolved before safe D&D operations within the process areas could resume.

The original schedule had decontamination and dismantlement of the building and below-grade structure (down to 3 feet) being completed by February 2001. The present schedule is to decontaminate and dismantle the building by 2003 and the below-grade structure by 2004.

Canyon Disposition Initiative

The U-Plant is one of five former chemical processing facilities in Hanford's 200 Area. The facility is undergoing characterization through a pilot project for the Canyon Disposition Initiative (CDI). The term "canyon" refers to the large interior space which runs the length of the building (800 feet). The CDI project involves determining options for final disposition of the five canyon facilities. Some of the options being investigated for the U-Plant include use of part or all of the facility for disposal of low-level radioactive waste, including long-length equipment that would be awkward to dispose of in hazardous waste landfills due to compaction requirements. The CDI project is in the RI/FS stage. A Phase I Feasibility Study was completed, as well as some preliminary structural studies. A Phase III Feasibility Study is scheduled for completion in September 2001, and the planned date for the ROD is September 2002.

The CDI project could lead to cost savings of up to $1 billion for the five facilities. The savings would be realized by the difference in cost between demolition and building new landfill space versus leaving the building intact and disposing of waste in the building and possibly along

the exterior. A large engineered barrier would prevent rainwater infiltration and would add an extra layer of protection from human and animal intrusion, along with the thick concrete structure, if the site is used for disposal. There is potential for more savings throughout the entire DOE national complex if this method is used elsewhere.

Characterization has proceeded successfully despite consistent difficulties in obtaining full funding. There have been several technology deployment examples during characterization. Robots were used to investigate the ventilation tunnel, the drain pipes below the process cells, and the railroad tunnel. A remote concrete coring machine was used to obtain core samples from cells representing each of four processes used during uranium recovery operations. A three-dimensional gamma camera recorded conditions in the cells including contamination associated with equipment originating from various other facilities. Infrared and sonic detectors were used to determine if liquids were present in equipment stored in cells and on the canyon deck.

IV. Findings and Recommendations

A. Soil Sites

There are no deficiencies regarding the 200-CW-3 Operable Unit. It is recommended that the Tri-Parties complete negotiations per Tri-Party Agreement Milestone M-16-00F by December 31, 2001, and include sites from the 200-CW-3 Operable Unit within the 100 Area Remedial Action Work Plan.

It is believed that the main reason removal efficiency has dropped for the vapor extraction system is because the primary source of remaining available carbon tetrachloride appears to be the relatively low-permeability zone from approximately 38 to 45 m in depth. As carbon tetrachloride from this lower-permeability source zone migrates into the overlying and underlying higher-permeability zones, it can be removed using soil vapor extraction. At many monitoring locations, including ones within the higher-permeability zones, the relatively low carbon tetrachloride rebound concentrations indicate that the readily accessible mass (carbon tetrachloride already in the vapor phase or volatilizing directly from residual non aqueous-phase liquid) has been removed. At these locations, the availability of additional mass for removal using soil vapor extraction is controlled by desorption and diffusion of carbon tetrachloride adsorbed within soil particle micropores and dissolved in soil moisture.

DOE is currently evaluating enhancements to the soil vapor extraction system in order to remove carbon tetrachloride from the low-permeability zone. DOE will complete this evaluation by December 2001 and provide this information to EPA to support required decision document revisions. It is recommended that the carbon tetrachloride soil project be combined with the carbon tetrachloride groundwater action, and that any modifications needed to the soil cleanup action be documented in a ROD amendment or ESD to the 200-ZP-1 interim action ROD.

Action Item 200-1: Evaluate Enhancements to the 200-PW-1 Soil Vapor Extraction System. DOE shall evaluate enhancements to the 200-PW-1 soil vapor extraction system

in order to remove carbon tetrachloride from the vadose zone, and shall provide this information to EPA by December 2001.

The primary ARARs associated with this action are air release criteria defined in WAC 173-460 and well construction regulations found in WAC 173-160. In addition, this action must comply with the substantive portions of WAC 173-303, the Washington State dangerous waste regulations. The systems have been operated in compliance with air release requirements. Wells have been installed in a manner consistent with the requirements of WAC 173-160, and waste has been handled in accordance with applicable regulations.

In order to ensure protectiveness, the vapor extraction system should continue to operate in a cyclic mode to help prevent movement of carbon tetrachloride from the vadose zone into the groundwater. In addition, vapor concentration monitoring should continue in accordance with the monitoring plans that have already been agreed upon.

B. Groundwater Units

200-ZP-1 Operable Unit

In the 200-ZP-1 Operable Unit contaminant distribution and concentrations have been influenced by the pump-and-treat operations. In general, pump-and-treat operations are causing the plume to move in a northeasterly direction, which was the original groundwater flow direction prior to Hanford operations. In addition, contaminant concentrations are estimated to have increased from 2,000 to 3,000 ppb to approximately 4,000 ppb to 6,000 ppb in the center of the plume. This increase could be attributed to the fact that the pump-and-treat operation is pulling the plume from beneath the Plutonium Finishing Plant (PFP), although there are no monitoring wells in this portion of the plume to confirm this, or carbon tetrachloride may potentially be present in the form of DNAPL.

DOE and EPA are currently investigating DNAPL detection methods, as well as potential technology enhancements for the pump-and-treat system and the soil vapor extraction system. These evaluations are expected to be complete by December 2001.

Action Item 200-2: Complete DNAPL Evaluation. The Tri-Parties should continue to investigate applicable dense non aqueous phase liquid (DNAPL) detection technologies and enhancements to the current pump-and-treat system. The evaluation should be completed by December 2001.

There is a need to install at least one monitoring/production well within the high-concentration area of the plume near PFP. This well shall be installed by DOE in fiscal year 2001 to support characterization needs, enhancement to pump-and-treat and/or vapor extraction system operations, and DNAPL investigations.

Action Item 200-3: Install an Additional Well Near PFP. DOE shall install at least one monitoring/production well within the high-concentration area of the carbon

tetrachloride plume near PFP. This well shall be installed by DOE by September 2001 to support characterization needs, enhancement to pump-and-treat and/or vapor extraction system operations, and DNAPL investigations.

The remedial design report for 200-ZP-1 requires DOE to submit an annual summary report for the pump-and-treat operation. This document also contains information regarding the pump-and-treat monitoring network. To date, DOE and EPA have not developed a comprehensive monitoring network for the entire 200-ZP-1 Operable Unit. Groundwater monitoring information for the remaining portion of the operable unit is reported in an annual report produced by the Pacific Northwest National Laboratory for DOE. It is important to develop a well network that covers the entire operable unit. Therefore, the Tri-Parties shall develop a monitoring network for the entire 200-ZP-1 Operable Unit by March 2002. The monitoring network will be documented in a sampling and analysis plan, which will be submitted to EPA, the lead regulatory agency for 200-ZP-1, for approval.

Action Item 200-4: Develop a Well Network for the 200-ZP-1 Operable Unit. The Tri-Parties shall develop a comprehensive monitoring network for the entire 200-ZP-1 Operable Unit. Currently, the monitoring network for the 200-ZP-1 Operable Unit only focuses on the area affected by the pump-and-treat operations. The monitoring network will be documented in a sampling and analysis plan that will be submitted to EPA, the lead regulatory agency for 200-ZP-1, for approval.

Since the inception of this pump-and-treat system, no ARARs identified in the ROD have changed. In general, the operations of the 200-ZP-1 system have been in compliance with the ARARs. Occasional process upsets have resulted in discharges into the aquifer slightly above the MCL of 5 ppb at the injection wells. The protectiveness of the remedy was not affected by these process upsets. In addition, there have been two violations regarding secondary waste handling. One violation resulted in EPA issuing a fine to DOE. Overall protectiveness of the remedy was not jeopardized by these waste handling violations.

The 200-ZP-1 and 200-UP-1 RODs required DOE to maintain institutional controls (ICs) on the 200 Area NPL. The language in the RODs was limited to statements that DOE will continue to maintain access restrictions to the Hanford Site. Experience with the effectiveness of ICs at Hanford and other federal facilities led EPA Region 10 to develop guidance on applying ICs at federal facilities, and also to recommend that decision documents be reviewed to determine if an ESD is warranted to bring these documents into alignment with current expectations for ICs. EPA will prepare an ESD to update IC language consistent with EPA Region 10 guidance. DOE shall implement the requirements set forth in the ESD. See Appendix A of this document for specific details regarding ICs.

200-UP-1 Operable Unit

In the original uranium/Technetium-99 plume of the 200-UP-1 Operable Unit, uranium concentrations have generally remained stable in the monitoring wells and have declined slightly in the extraction well. Technetium-99 contamination has been contained by the pump-and-treat

system, but cleanup levels have not been achieved. Modeling results indicate that the pump-and-treat system has removed at least one pore volume of water from the targeted baseline plume area. It appears that the original modeling performed in support of design of the pump-and-treat system contained several assumptions that are proving to be incorrect, including the number of pore volumes required to achieve RAOs. As modeled, it was predicted that the pump-and-treat would reach all RAOs by this point in time.

Data indicate that the inventories of uranium present in the groundwater are higher than DOE predicted. Further, the pump-and-treat system has been operating below the ROD-required 50 gallons per minute (gpm). A higher rate of extraction or other enhancements to the pump-and-treat system are required to meet the RAOs. Because of the drop in the water table and the higher-than-predicted concentrations, new monitoring wells and extraction wells are needed to evaluate performance and allow for increased pumping capacity.

For the recently-identified Technetium-99 plume, which has the highest Technetium-99 concentrations in the Hanford groundwater, DOE shall begin extraction of peak concentrations of Technetium-99 from 299-W23-19 (the other location within the 200-UP-1 Operable Unit which exceeds the action level of 10 times the MCL for Technetium-99). Initial efforts will focus on determining whether pumping rates from the existing well can achieve 200-UP-1 RAOs. If this approach proves to be inadequate, DOE shall initiate additional well installation[s] to ensure compliance with RAOs in a timely manner.

Action Item 200-5: Enhance the 200-UP-1 Pump-and-Treat System to meet RAOs. DOE shall comply with the 200-UP-1 RAO of 50 gallons per minute by installing additional extraction well[s] by December 2001. DOE shall also initiate pumping from well 299-W23-19 to meet the RAO of 10 times the MCL for Technetium-99. DOE shall complete evaluation of the capability of 299-W23-19 to achieve RAOs, and if that well is not capable of meeting the cleanup level, DOE shall establish a path forward by December 2001 to achieve the goal of the interim remedial action.

The groundwater table in 200-UP-1 has been declining since the discharge of large volumes of water to the soil ceased in 1994. Because of this decline, several monitoring wells are no longer able to produce water and have been dropped from the monitoring network. Additionally, the declining water table has meant that several wells have had to be bailed by hand in order to gather enough water to perform analysis.

The remedial design report for 200-UP-1 requires DOE to submit an annual summary report for the pump-and-treat operation. This document also contains information regarding the pump-and-treat monitoring network. To date, DOE and Ecology have not developed a comprehensive monitoring network for 200-UP-1. Groundwater monitoring information for the remaining portion of the operable unit is reported in an annual report produced by the Pacific Northwest National Laboratory for DOE. Therefore, the Tri-Parties shall develop a monitoring network for 200-UP-1 by March 2002. The monitoring network will be documented in a

sampling and analysis plan that will be submitted to Ecology, the lead regulatory agency for 200-UP-1, for approval.

> **Action Item 200-6: Develop a Well Network for the 200-UP-1 Operable Unit**. The Tri-Parties shall develop a monitoring network for the entire 200-UP-1 Operable Unit. Currently, the monitoring network for the 200-UP-1 Operable Unit only focuses on the area affected by the pump-and-treat operations. The monitoring network will be documented in a sampling and analysis plan that will be submitted to Ecology, the lead regulatory agency for 200-UP-1, for approval.

There are no changes to the ARARs identified in the ROD that would call into question the protectiveness of the remedy.

EPA will prepare an ESD to update IC language in a manner consistent with EPA Region 10 guidance. DOE shall implement the requirements set forth in the ESD. See Appendix A of this document for specific details regarding IC.

200-PO-1 Operable Unit

There is no decision document in place for this operable unit, and at this time there are no viable technologies to remediate the tritium or Iodine-129 plumes.

DOE should continue periodic review on the feasibility of remedial alternatives for tritium as required by M-26-5 milestone series. In addition, a follow-on milestone to M-15-81B should be developed requiring DOE to assess any new developments in Iodine-129 technologies.

There is no regulator-approved monitoring network for this operable unit. Monitoring data for this operable unit are presented in an annual groundwater report produced by the Pacific Northwest National Laboratory for DOE. The Tri-Parties shall develop a comprehensive monitoring well network for 200-PO-1 by December 2002. The monitoring network will be documented in a sampling and analysis plan that will be submitted to Ecology, the lead regulatory agency for 200-PO-1, for approval.

> **Action Item 200-7: Develop a Well Network for the 200-PO-1 Operable Unit**. The Tri-Parties shall develop a monitoring well network for the 200-PO-1 Operable Unit. The monitoring network will be documented in a sampling and analysis plan that will be submitted by December 2002 to Ecology, the lead regulatory agency for 200-PO-1, for approval.

200-BP-5 Operable Unit

This operable unit does not have a decision in place. Data from initial investigations and treatability tests indicate that the contamination in the 200-BP-5 groundwater does not presently pose an unacceptable risk to human health or the environment, as the groundwater is not used as a drinking water source and impacts to the Columbia River are negligible.

There is not an approved well network for 200-BP-5. The Tri-Parties shall develop a comprehensive monitoring well network for 200-BP-5 by December 2002 The monitoring network will be documented in a sampling and analysis plan that will be submitted to EPA, the lead regulatory agency for 200-BP-5, for approval.

> **Action Item 200-8: Develop a Well Network for the 200-BP-5 Operable Unit**. The Tri-Parties shall develop a monitoring well network for the 200-BP-5 Operable Unit. The monitoring network will be documented in a sampling and analysis plan that will be submitted by December 2002 to EPA, the lead regulatory agency for 200-BP-5, for approval.

C. Disposal Facility

Environmental monitoring for ERDF is done for both air and groundwater. The groundwater monitoring network for ERDF consists of one upgradient well and three wells downgradient. The wells are sampled and tested semiannually. This monitoring, combined with leachate collection data, has indicated no impact to groundwater from the facility. Air monitors are set up similarly to groundwater monitoring wells, consisting of one upwind and three downwind monitors. Air samples are collected and tested bi-weekly, and are composited and analyzed semiannually. Air monitoring results have indicated that ERDF operates well below established air emission criteria. There are no action items associated with ERDF.

A Notice of Violation (NOV) was issued by EPA and the Washington State Department of Health (DOH) in 1998. ERDF was cited for leaving a leachate tank in operation while leaking leachate from the primary to the secondary liner system. There was no evidence that leachate leaked to the environment from the secondary containment system. The tank was subsequently taken out of service and repaired. Guidelines for dealing with leaking tanks were developed and agreed upon.

A second citation in the NOV was for failure to notify EPA/DOH of a modification to operations that increased the potential for air emissions. The ERDF had been operating with an active disposal area that was larger than that postulated in potential-to-emit calculations. The NOV was closed within one month, after calculations were completed showing that ERDF was still well below established requirements for protection of human health and the environment when utilizing a larger active area of operations within the trench. There have been no other violations regarding ERDF operations, and the facility is operating in an environmentally protective manner.

EPA recommends that the facility continue to operate in its current mode through the next five-year period.

D. Decontamination and Decommissioning of Facilities

The 233-S Plutonium Concentration Facility D&D project should remain on the present schedule, which calls for decontamination and dismantling of the building by 2003 and the below-grade structure by 2004.

DOE should continue on schedule to complete the Phase III Feasibility Study for the CDI by September 2001 in support of the development of a September 2002 ROD.

Action Item 200-9: Complete the Phase III Feasibility Study for the CDI. DOE shall complete the Phase III Feasibility Study by September 2001 for the Canyon Disposition Initiative, in order to support the development of a September 2002 ROD.

V. Action Items

Action Item	Description	Due Date
200-1	DOE shall evaluate enhancements to the 200-PW-1 soil vapor extraction system in order to remove carbon tetrachloride from the vadose zone, and shall provide this information to EPA.	December 2001
200-2	The Tri-Parties should continue to investigate applicable dense, non-aqueous phase liquid (DNAPL) detection technologies and enhancements to the current pump-and-treat system.	December 2001
200-3	DOE shall install at least one monitoring/production well within the high-concentration area of the carbon tetrachloride plume near PFP. This well shall be installed by DOE in FY 2001 to support characterization needs, enhancement to pump-and-treat and/or vapor extraction system operations, and DNAPL investigations.	September 2001
200-4	The Tri-Parties shall develop a monitoring network for the entire 200-ZP-1 Operable Unit. Currently, the monitoring network for the 200-ZP-1 Operable Unit only focuses on the area affected by the pump-and-treat operations. The monitoring network will be documented in a sampling and analysis plan that will be submitted to EPA, the lead regulatory agency for 200-ZP-1, for approval.	March 2002

Action Item	Description	Due Date
200-5	DOE shall comply with the 200-UP-1 RAO of 50 gallons per minute by utilizing additional extraction well[s] by December 2001. DOE shall also initiate pumping from well 299-W23-19 to meet the RAO of 10 times the MCL for Technetium-99. DOE shall complete evaluation of the capability of 299-W23-19 to achieve RAOs, and if that well is not capable of meeting the cleanup level, DOE shall establish a path forward by December 2001 to achieve the goal of the interim remedial action.	December 2001
200-6	The Tri-Parties shall develop a monitoring network for the entire 200-UP-1 Operable Unit. Currently, the monitoring network for the 200-UP-1 Operable Unit only focuses on the area affected by the pump-and-treat operations. The monitoring network will be documented in a sampling and analysis plan that will be submitted to Ecology, the lead regulatory agency for 200-UP-1, for approval.	March 2002
200-7	The Tri-Parties shall develop a monitoring well network for the 200-PO-1 Operable Unit. The monitoring network will be documented in a sampling and analysis plan that will be submitted to Ecology, the lead regulatory agency for 200-PO-1, for approval.	December 2002
200-8	The Tri-Parties shall develop a monitoring well network for the 200-BP-5 Operable Unit. The monitoring network will be documented in a sampling and analysis plan that will be submitted to EPA, the lead regulatory agency for 200-BP-5, for approval.	December 2002
200-9	DOE shall complete the Phase III Feasibility Study for the Canyon Disposition Initiative in order to support the development of a September 2002 ROD.	September 2001

VI. Protectiveness Statement

The 200 Area NPL site is in the early stages of the CERCLA process. Given the status of investigations and remedial actions, I certify that no soil waste sites or buildings undergoing decontamination and decommissioning in the 200 NPL site require immediate response actions to protect human health and the environment. I certify that the 200-BP-5 and 200-PO-1 Operable Units do not require immediate response actions to protect human health and the environment. I certify that, for the 200-ZP-1 Operable Unit and the 200-UP-1 Operable Unit, additional actions are required to ensure protection of human health and the environment.

VII. Next Review

This is a statutory site that requires ongoing five-year reviews. The next review will be conducted within five years of the completion of this five-year review report. The completion date is the date of the signature shown on the signature cover attached to the front of the report.

USDOE Hanford 300 Area
First Five-Year Review Report

I. Introduction

The 300 Area is located along the Columbia River north of the Richland, Washington, city limits in the southeastern portion of the Hanford Site (see Figure 300-1). The 300 Area consists of a 0.25-square-mile industrial complex area that was used for uranium fuel fabrication and research and development activities for the Hanford Site; unlined liquid disposal areas north of the industrial complex area; and burial grounds, landfills, and miscellaneous disposal sites associated with operations in the industrial complex.

This is the first Five-Year Review for the 300 Area National Priorities List (NPL) site. The review covers all three operable units and any associated remedy selection decision documents. The triggering action for this review is the start of remedial actions in July 1997. Future five-year reviews will be required because hazardous substances, pollutants, or contaminants will remain at the site above levels that allow for unrestricted use and unlimited exposure.

The 300 Area five-year review was led by Mike Goldstein, EPA Remedial Project Manager for the 300 Area NPL site. The following people assisted in the review:

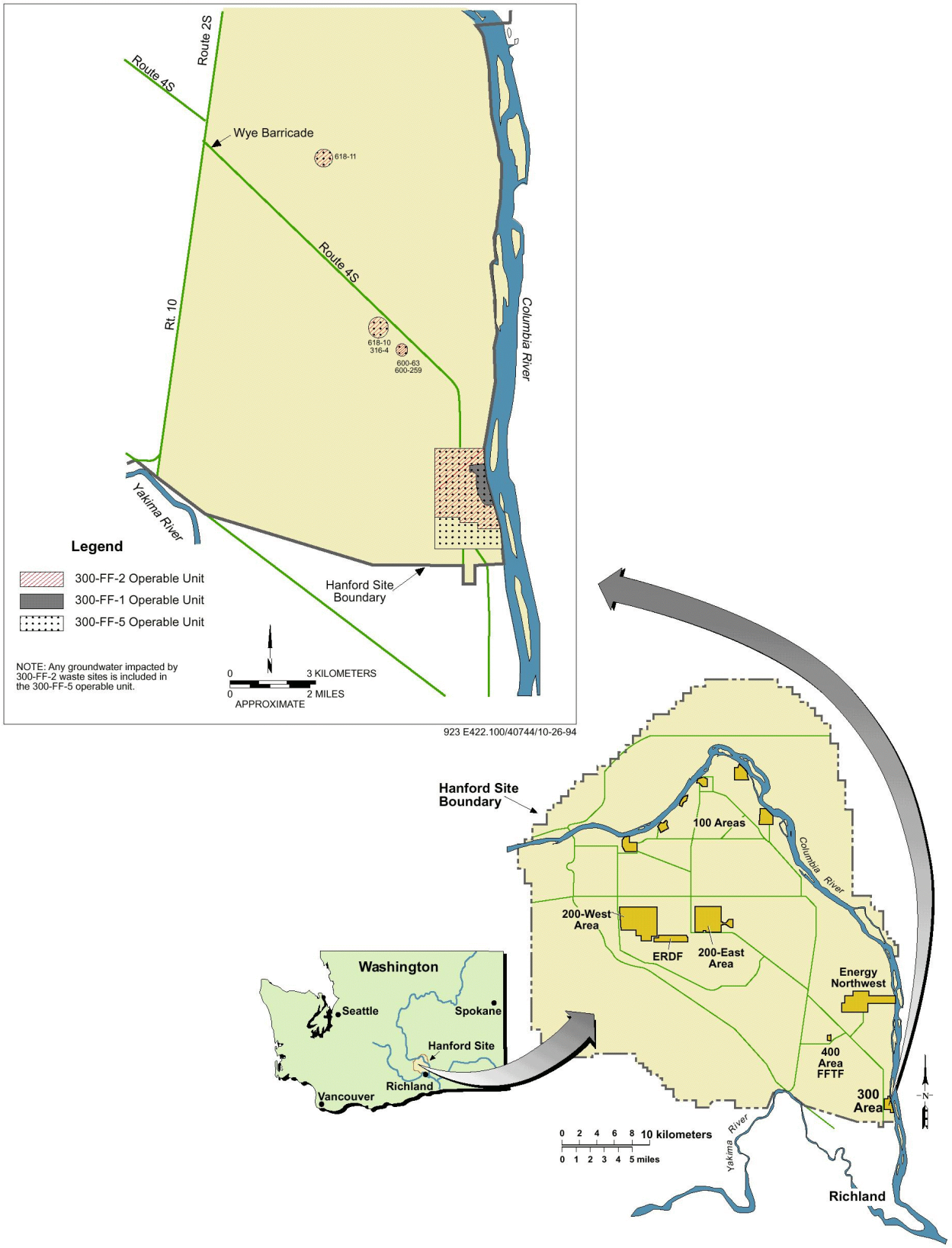
- Richard Jaquish, Washington State Department of Health
- Jon Lindberg, Pacific Northwest National Laboratory.

The main types of documents that were reviewed were:

- Closeout verification packages
- Annual sitewide monitoring reports
- Records of Decision (RODs), action memos, remedial design documents
- Databases with environmental sample results, waste site remediation status, and air monitoring data.

In addition, a site inspection was performed by EPA on July 10, 2000, to evaluate emergency preparedness procedures and to review the status of the 300-FF-1 remedial actions.

Figure 300-1. Location of the 300 Area.



II. Site Background and Chronology

Use of the 300 Area began in 1943, and facilities were primarily associated with reactor fuel fabrication and research and development activities for the Hanford Site. Over the years, fuel fabrication and laboratory facilities located in the 300 Area released contaminants to the surface, soil column, and groundwater. Waste from 300 Area operations was also disposed of in designated landfills/burial grounds and discharged to unlined surface ponds/trenches.

The 300 Area was listed on EPA's NPL in 1989 and consists of three operable units. Figure 300-2 depicts the boundaries of the 300 Area operable units. The 300-FF-1 and 300-FF-2 Operable Units address soil contamination areas and burial grounds associated with operations in the 300 Area. The 300-FF-5 Operable Unit addresses groundwater contamination beneath the burial grounds and soil waste sites (Figure 300-3) The primary contaminant in the 300 Area is uranium from the fuel fabrication process. However, other potential contaminants exist for individual waste sites because of the diverse uses of the 300 Area. The primary cleanup actions involve the removal of contaminated soils and debris; treating the material, as appropriate, to reduce the toxicity, mobility, or volume of wastes; and disposing of the material in an appropriate long-term waste management facility. The majority of waste from cleanup of the 300 Area will be disposed of at the Environmental Restoration Disposal Facility (ERDF) in the 200 Area of the Hanford Site. An industrial exposure scenario is being used as the basis for evaluating risk and establishing cleanup levels in the 300 Area, consistent with the reasonably anticipated future land use for this portion of the Hanford Site. The 300-FF-5 Operable Unit includes groundwater contamination beneath the soil waste sites and burial grounds. The current decision for contaminated groundwater in the 300 Area is to monitor the groundwater to ensure that contamination levels are attenuating through natural processes in a reasonable time frame.

Cleanup/monitoring activities have been initiated on all remedial actions authorized through RODs, and cleanup has been completed on all removal actions authorized through action memos. The work scope of these existing decision documents and remaining work needed to complete the 300 Area NPL site (principally 300-FF-2) will be done over the next two decades, and the schedule will be included in the Tri-Party Agreement (TPA). DOE must establish by June 30, 2002 a schedule and date for completing all 300 Area remedial actions(TPA Milestone M-16-03A). According to TPA Milestone M-16-00, all non-tank farm remedial actions are to be complete by September 30, 2018.

A list of the seven CERCLA decision documents for the 300 Area is presented in Table 300-1. The list includes all removal actions and remedial actions performed in the 300 Area since it was added to the NPL in 1989.

Figure 300-2. 300 Area Operable Unit Boundaries.

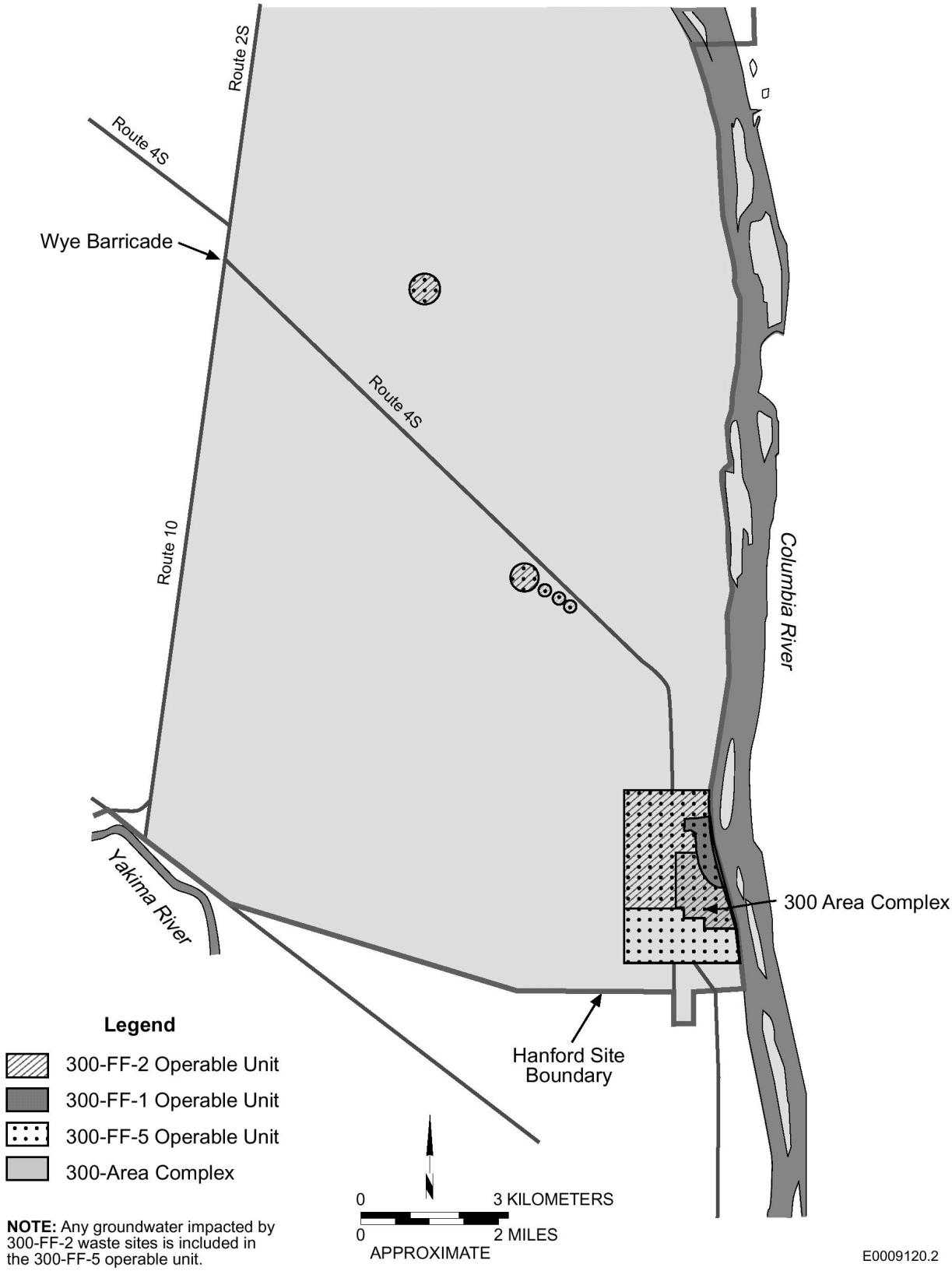


Figure 300-3. Relationship of the 300 Area Operable Units.

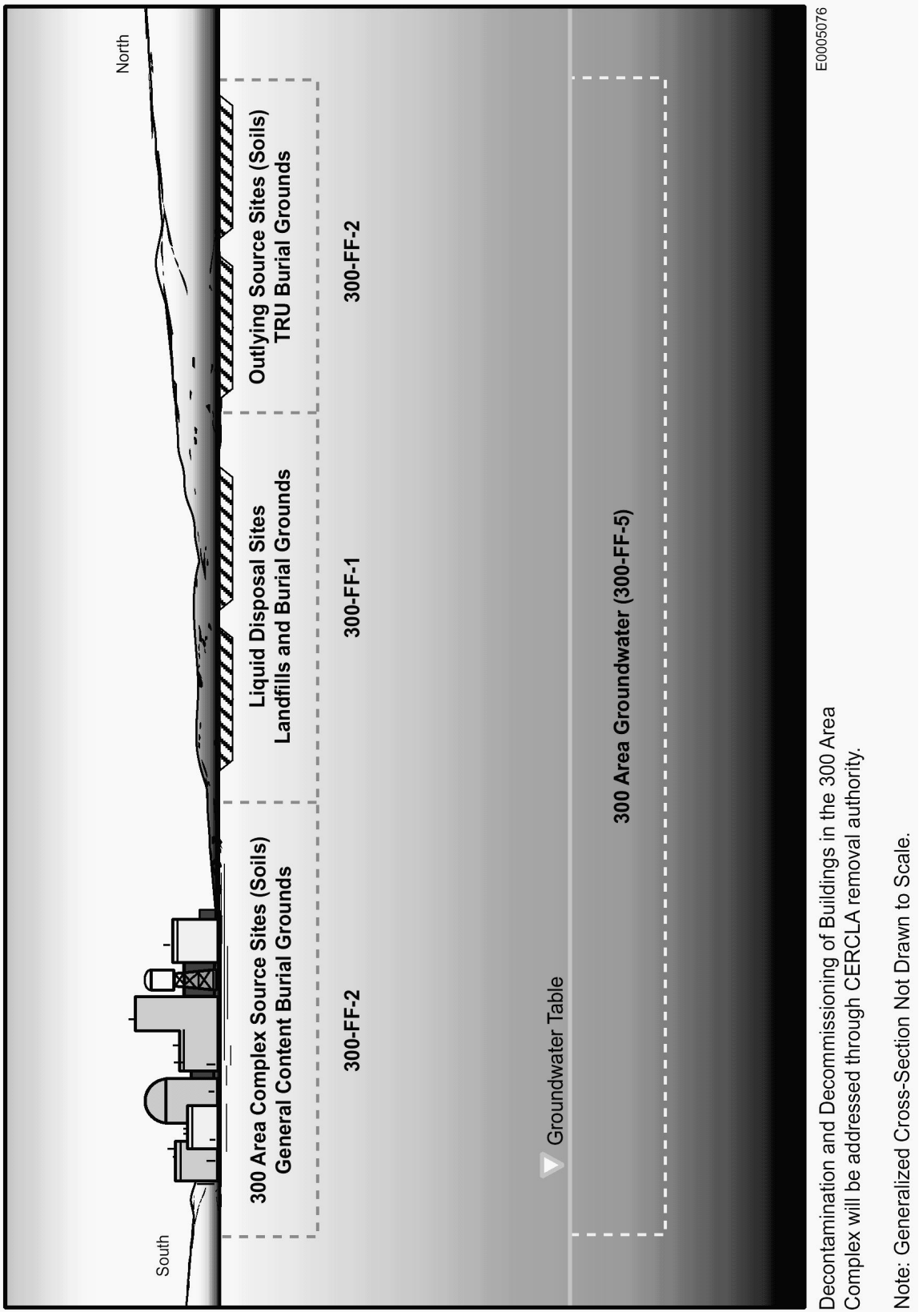


Table 300-1. CERCLA Decision Documents for the 300 Area.

Decision Type	Descriptive Title	Date
Removal Action	Expedited Response Action (ERA) for the 618-9 Burial Ground (Remove and dispose of drums containing uranium-contaminated hexone.)	1991
Removal Action	Action Memo for the 316-5 Process Trenches (ERA to remove soil from the 300 Area Process Trenches)	July 1991
Remedial Action	ROD for the 300-FF-1 and 300-FF-5 Operable Units (Remove, treat as appropriate, and dispose of contaminated soil and debris. Monitor natural attenuation for groundwater.)	July 1996
Remedial Action	Explanation of Significant Differences (ESD) for 300-FF-1 (land disposal restriction treatability variance)	December 1999
Removal Action	331-A Virology Laboratory Building Action Memo (demolition, removal, and disposal of building)	February 2000
Remedial Action	ESD for the 300-FF-5 ROD (Additional groundwater monitoring required.)	June 2000
Remedial Action	ROD for the 300-FF-2 Operable Unit	*

* This action has not yet been finalized. A public comment period was held for the Proposed Plan in July/August 2000, and a ROD is targeted for completion in 2001.

III. Remedial Actions

ERA to Remove Hexone Drums from the 618-9 Burial Ground (Action Memo - 1991)

In 1991, approximately 700 gal. of methyl isobutyl ketone (also known as hexone) and 900 gal. of kerosene solvent was removed from 120 drums that had been buried at the western end of the 618-9 Burial Ground. Additional materials (e.g., empty waste drums, construction debris, and soil) were also removed from the remainder of the burial ground. The cleanup actions at the 618-9 Burial Ground allow for unrestricted use and unlimited exposure of the site.

ERA at the 300 Area Process Trenches (Action Memo - 1991)

The 300 Area Process Trenches received wastewater from operations in the 300 Area. In 1991, an ERA was performed to reduce the migration of radioactive and inorganic (heavy metals) contaminants to groundwater. This was accomplished by excavating contaminated sediments from the inlet end of the trenches, using them to fill in the north end of the trenches, and immobilizing them. The ERA uniformly excavated approximately 1 ft of contaminated soil from the sides and 4 ft of contaminated soil from the bottom of each trench. The contaminated

material was stockpiled in the northwest corner of the west trench and the north end of the east trench (collectively referred to as the spoils area). The spoils area was covered with plastic and aggregate to allow continued operation of the trenches without flushing residual contaminants into the groundwater. Post-excavation sample results indicated that the ERA successfully reduced contamination in all areas of the trenches other than the spoils area. The spoils pile and the remainder of the process trenches were cleaned up as part of the 300-FF-1 remedial action (see below).

Decontamination and Decommissioning of the 331-A Virology Laboratory (Action Memo - 2000)

A small, one-story concrete block building in the 300 Area was decontaminated and decommissioned (D&D) in February/March 2000. The building, known as the 331-A Virology Laboratory, was part of the 331 Life Sciences Laboratory Complex operated by the Pacific Northwest National Laboratory. The facility began operations in 1972 for the purpose of animal, bacterial, and viral research on the effects of exposure to radiation. Because of radioactive contamination, the building could not be demolished and disposed in an off-site landfill. Therefore, an engineering evaluation/cost analysis (EE/CA) was performed to evaluate options for performing the D&D under CERCLA. EPA authorized the D&D of the facility in an Action Memo dated February 15, 2000. The scope of the removal action was to remove the above-ground structure (i.e., walls and roof). The floor slab and any contaminated below-ground structures or soils associated with the building will be assessed and removed as part of the 300-FF-2 Operable Unit.

300-FF-1 Operable Unit (Record of Decision - 1996)

The 300-FF-1 Operable Unit includes the major 300 Area liquid/process waste disposal sites, the 618-4 Burial Ground, and three small landfills. The liquid/process waste disposal sites were unlined trenches and ponds that routinely received discharges of millions of gallons of contaminated wastewater from 300 Area operations between 1943 and 1994. These liquid/process waste disposal sites are suspected to be the primary source of uranium contamination in the groundwater beneath the 300 Area.

A ROD for 300-FF-1 was approved in July 1996. The remedy selected in the 300-FF-1 ROD was to remove contaminated soil and debris, treat as necessary, and dispose of the waste in ERDF. Soil cleanup levels established in the ROD are based on a reasonably-anticipated future land use of industrial. Institutional controls are required as part of the remedy because the cleanup will not allow for unrestricted use and unlimited exposure. The status of remedial actions is provided in Table 300-2. The goals of the remedial action are as follows.

1. Protect human and ecological receptors from exposure to contaminants in soils and debris by exposure, inhalation, or ingestion of radionuclides, metals or organics.

2. Protect human and ecological receptors from exposure to contaminants in the groundwater and control the sources of groundwater contamination in 300-FF-1 to minimize future impacts to groundwater resources.

3. Protect the Columbia River such that contaminants in the groundwater or remaining in the soil after remediation do not result in an impact to the Columbia River that could exceed the Washington State Surface Water Quality Standards.

Table 300-2. Summary of 300-FF-1 Progress (as of August 2000)

Year	Amount of material moved to ERDF (US Tons)	Amount of material moved to ERDF (Loose Cubic Yards)	Cost
FY97	30,000 tons	18,927 LCY	$ 2.5 million
FY98	117,000 tons	73,815 LCY	$ 6.1 million
FY99	232,000 tons	146,369 LCY	$ 5.9 million
FY00	155,000 tons	97,790 LCY	$ 4.4 million
Total	534,000 tons	336,901 LCY	$ 18.9 million

In December 1999, EPA issued an ESD to the ROD for 300-FF-1 to grant a site-specific treatability variance for a small quantity of soil and debris (925 cubic meters) in one 300-FF-1 waste site (Landfill 1D) so that it could be removed from the 300 Area and disposed of in ERDF. The soils met the criteria for a *Resource Conservation and Recovery Act* (RCRA) Land Disposal Restriction (LDR) treatability variance under 40 CFR 268.44(h), and the ESD resulted in a reduction in cleanup cost and complexity, while maintaining protection for human health and the environment. This is the only modification to the remedy selection decision document that has occurred since the ROD was signed.

300-FF-2 Operable Unit (Record of Decision - planned in 2001)

The 300-FF-2 Operable Unit contains 56 waste sites, including 40 waste sites located in the 300 Area industrial complex beneath existing facilities and/or covered areas, 7 waste sites outside the industrial complex, 7 general content burial grounds in the vicinity of the 300 Area industrial complex (one is actually beneath a building in the complex area), and 2 burial grounds containing transuranic-contaminated material north of the 300 Area complex.

Cleanup activities for waste sites within the 300 Area complex will need to be conducted after the D&D of structures above and adjacent to the waste sites. Buildings and associated above-ground structures within the 300 Area complex are not included within the scope of 300-FF-2. D&D activities will be evaluated in engineering evaluation/cost analysis (EE/CA)

documents and authorized in CERCLA action memos (i.e., CERCLA removal authority). Approximately 150 buildings and structures will have to be removed from the 300 Area before the cleanup of nearly 40 waste sites beneath them can be completed.

The preferred alternative is to remove, treat (as necessary), and dispose of the contaminated material from 300-FF-2 waste sites and burial grounds was presented in a Proposed Plan on July 3, 2000, for public comment. The public comment period was closed on September 5, 2000. Comments are currently being analyzed and addressed, and it is anticipated that the ROD will be finalized in March 2001.

300-FF-5 Operable Unit (Record of Decision - 1996)

The 300-FF-5 Operable Unit consists of contaminated groundwater beneath the 300-FF-1 and 300-FF-2 Operable Units. Based on information that was available at the time when the ROD was developed, the following conclusions were made.

- Uranium was the primary contaminant of concern in 300 Area groundwater, although smaller amounts of Trichloroethene (TCE) and 1,2-Dichloroethene (DCE) were also detected above action levels.

- 300-FF-1 liquid disposal sites were a primary source of the groundwater contamination.

- Elevated uranium concentrations in groundwater were estimated to dissipate in 3 to 10 years from late 1993.

- TCE levels were declining below action levels at the time, and DCE was expected to remain in the unconfined aquifer above action levels for "an undetermined period of time." Both compounds were localized.

- Two groundwater plumes are entering the 300 Area from other parts of the Hanford Site. A tritium plume is entering from the north and a TCE plume is entering from the southwest.

Given this information, the remedy selected was monitored natural attenuation with institutional controls to prevent human exposure to groundwater. The ROD required continued groundwater monitoring to verify modeled predictions of contamination attenuation and to evaluate the need for active remedial measures. Institutional controls were required to prevent groundwater use while contaminant plumes were still present above drinking water standards.

The remedial action objectives (RAOs) defined in the ROD were to protect human and ecological receptors from exposure to contaminants in the groundwater and protect the Columbia River such that contaminants in the groundwater do not result in an impact to the Columbia River that could exceed the Washington State Surface Water Quality Standards. The operation and maintenance (O&M) plan for 300-FF-5 defined three primary activities to accomplish these

goals: (1) groundwater monitoring, (2) near-shore river monitoring, and (3) posting warning signs.

An ESD to the 300-FF-5 ROD was developed by EPA in June 2000. The ESD expands the scope of 300-FF-5 to include groundwater beneath all 300-FF-2 waste sites and burial grounds (i.e., the original 300-FF-5 boundary as it was defined in the 1996 ROD was expanded). The ESD also requires an update to the O&M plan for 300-FF-5 to ensure that adequate groundwater monitoring requirements and institutional controls are in place. The ESD did not make any fundamental changes to the 1996 remedy selection decision.

IV. Findings and Recommendations

A. 300-FF-1

Evaluation of remedy goals. The selected remedy and RAOs established in the ROD for the 300-FF-1 Operable Unit are still appropriate at this point in time. In addition, there have been no changes to the Applicable or Relevant and Appropriate Requirements (ARARs) established in the ROD that call into question the protectiveness of the remedy.

Evaluation of remedy implementation. The selected remedy of remove, treat, and dispose is being performed in an effective and protective manner consistent with the procedures established in the 300-FF-1 Remedial Design Report/Remedial Action (RD/RA) Work Plan.

- Air Releases During Remediation. Extensive air monitoring is conducted in and around the 300 Area to evaluate ambient air quality and potential air releases from waste sites as they are being excavated. The 300-FF-1 Remedial Action Project established an air monitoring network that ran continuously during the duration of the project. The air monitoring network in the 300 Area has historically shown elevated levels of uranium in air concentrations. The 300-FF-1 project-specific monitors also show these elevated levels. The 300 Area uranium concentrations are higher than levels measured in air on the rest of the Hanford Site (e.g., 100 and 200 Areas) and in a distant community off site that is monitored for comparison purposes. However, trend analysis does not indicate that elevated levels are a result of remedial action activities. These uranium concentrations are low, as they are less than 1 percent of the National Emission Standards for Hazardous Air Pollutants standard, designed to be protective of the maximum exposed individual.

- Water Releases During Remediation. Water is routinely applied to excavation sites as a means of controlling the mobility of airborne contaminants during remediation. A review of groundwater monitoring data was inconclusive with respect to evaluating whether or not the water added during remediation was resulting in an impact to groundwater quality. Although it is unlikely that application of dust suppression water results in additional groundwater contamination, water should be limited to the minimum volume needed to

achieve the purposes of dust control. Excessive watering and ponding of water should be avoided as part of a groundwater protection strategy.

- Cleanup verification documentation. The cleanup verification documentation for the 300 Areas is contained in Cleanup Verification Packages (CVPs). The CVPs need to provide more information on site completion. They are stand-alone documents that describe the remediation that was performed and how the RAOs were met. Sufficient detail is required in the report so that an independent analysis would verify that the RAOs have been met. The CVP process at Hanford has evolved since the original 300 Area CVPs were prepared. Earlier CVPs provided enough information to verify that the RAOs were met, but recent 100 Area CVPs contain more information regarding how the RAOs were met (e.g., the risk and dose from residual contamination). Future CVPs for the 300 Area should use these more recent documents as templates.

  Action Item 300-1: Expand Cleanup Verification Packages. DOE shall propose an updated structure for the 300 Area cleanup verification packages (CVPs) and a path forward to closing out the CVPs by the due date. The 300-FF-1 Remedial Design/Remedial Action work plan may need to be updated at a later date to reflect new requirements. Supplemental information may have to be documented in the file for completed CVPs as well.

Evaluation of completed cleanup activity. Seven waste sites have been remediated and have approved CVPs. These seven sites are the 300 Area Ash Pits, 300-10, 300-44, 300-45, the 316-5 Process Trenches, and the North Process Pond/Scraping Disposal Area (316-2/618-12, 2 waste sites). The CVPs document that the soil cleanup levels for chemicals and radionuclides established in the ROD are being achieved. In practice, the contaminant concentrations at these sites when the cleanup was completed were actually well below the cleanup standards. Therefore, 300-FF-1 cleanups are protective of human health, given the exposure assumptions used in the 300 Area industrial use scenario. Institutional controls are required to maintain land uses that are consistent with these exposure scenarios in order for the remedy to remain protective (i.e., land uses other than industrial may be appropriate if institutional controls limit human activities appropriately). Soil cleanup levels protective of human health in the 300 Area are also considered to be protective of the environment (based on ecological risk analyses performed in support of 300-FF-1).

Protection of groundwater and river pathways is demonstrated in CVPs based on modeling. In an effort to demonstrate that the soil cleanup level (350 pCi/g) used for uranium in ongoing cleanups is protective of groundwater quality, DOE has initiated a leach/sorption study to evaluate the fate and transport mechanism for uranium in the 300 Area. The results of this study may cause the Tri-Parties to reevaluate the soil cleanup standard used for uranium in future cleanup actions. If a change is necessitated as a result of the study, EPA will modify the appropriate remedy selection decision documents and evaluate the impact on completed and ongoing cleanup actions.

Evaluation of ongoing cleanup activity. Four sites have undergone remediation except for final approval of CVPs. These sites are as follows: (1) the South Process Pond (316-1), (2) Landfill 1A (300-49), (3) Landfill 1B (300-50), and (4) Landfill 1D (628-4). Once CVPs are approved, the sites will be backfilled and regraded in preparation for revegetation activities. CVPs will reflect new structure and content as defined by Action Item 300-1.

Cleanup of the 618-4 Burial Ground was initiated in October 1997, but was stopped in May 1998 because of complications associated with the lack of a treatment technology for wastes that were discovered in the burial ground. Treatment is necessary to meet the criteria for disposal. Approximately 338 drums containing powdered uranium oxide, or depleted uranium metal shavings and oil, were excavated. One hundred and forty-nine of the removed drums were stabilized by being placed in overpack drums with mineral oil (to prevent a potential self-ignition). The remaining drums were considered stable in their existing state and were overpacked without oil. An estimated 1200 additional drums remain buried in 618-4, with approximately 58 percent of the burial ground remaining to be excavated.

From June 26, 2000 to July 10, 2000, the 338 drums were reconfigured into discrete staging areas with a maximum of 133 drums per area and a 15-foot distance between areas. This activity resulted from a recommendation based on a risk analysis. Major accidents considered in the safety documentation for 300-FF-1 include a seismic event, range fire, drum fire, and high winds.

Due to the proximity of the Hanford wildfire which started on June 27, 2000 and was contained by Route 4 approximately 270 meters west of the burial ground, DOE must submit a comprehensive path forward for the 618-4 Burial Ground by June 2001.

> **Action Item 300-2: Submit Path Forward for 618-4 Burial Ground**. DOE will submit a path forward to EPA for the 618-4 Burial Ground. The path forward will address: (1) options for treatment and disposal of excavated drums, (2) options for continued storage of drums if treatment is not imminent, and (3) plans for completing the excavation of the burial ground.

B. 300-FF-2

Fifty-six soil/debris waste sites exist in the 300-FF-2 Operable Unit. EPA is currently analyzing and addressing comments received on the proposed plan for the 300-FF-2 Operable Unit. A ROD will document the remedy selection decision in winter 2000. As soon as the ROD is complete, DOE will initiate the development of an RD/RA workplan and establish by June 30, 2002 a date for completion of all 300 Area remedial actions, including decontamination and decommissioning of 300 Area facilities (Milestone M-16-03A).

At the current time, 55 out of 56 of the waste sites in 300-FF-2 do not appear to require immediate response actions to protect human health and the environment based on available information. However, they will present an imminent and substantial endangerment to human health and the environment in the future if active response measures are not implemented.

One of the 56 waste sites in the 300-FF-2 Operable Unit, the 618-11 Burial Ground may present a current threat and may require early action. Data are still being gathered to determine the nature and extent of tritium releases from the burial ground. In FY 99 and FY 00, significant tritium releases have been measured in the groundwater and the vadose zone. The preferred alternative in the Proposed Plan calls for removal, treatment, and disposal of the wastes in this burial ground. However, because of funding and technology constraints, DOE does not include plans for implementation of this remedy in the next 12 years. Based on the groundwater and vadose zone tritium releases that have been documented to date, it is important that engineering studies and technology development initiatives be initiated as quickly as possible. Interim measures may be required as well.

> **Action Item 300-3: Submit Analysis of Expedited Response Actions for 618-11 Burial Ground**. DOE shall submit options to EPA for expedited response actions to address contaminant releases from the 618-11 Burial Ground as well as an assessment of the need for interim action based on the results of the 618-11 groundwater investigation. The options for interim action and assessment of their need shall be submitted to EPA by September 2001.

C. 300-FF-5

Evaluation of remedy goals. The selected remedy and remedial action objectives established in the ROD for the 300-FF-5 Operable Unit are still appropriate at this point in time. In addition, there have been no changes to the Applicable or Relevant and Appropriate Requirements (ARARs) established in the ROD that call into question the protectiveness of the remedy.[1]

Although groundwater contamination still exists in the 300 Area, it is too early to assess the impacts that remediation of soil sites is having on groundwater quality. Even though attenuation was predicted to occur for the uranium plume in 3 to 10 years from late 1993, several factors could be causing the continued existence of that plume above drinking water standards (e.g., the continued presence of soil/debris waste sites, water applied for dust control, and/or complicating factors in the deep vadose zone). By September 2001, all of the liquid disposal sites will be excavated and backfilled, and revegetation efforts will be underway. By Summer of 2004, there will be three years' worth of groundwater monitoring data to support the next formal assessment of the remedy in the 2005 Five-Year Review. This will be a more appropriate time to reevaluate the effectiveness of the natural attenuation remedy for this plume. DOE must ensure that the O&M plan for 300-FF-5 requires gathering the data necessary to evaluate whether or not natural attenuation is occurring, and whether active response measures should be initiated (see Action Item 300-4, below).

[1]On December 7, 2000, a new MCL for uranium was published. The new MCL is 30 µg/L. The ROD selected 20 µg/L, based on the proposed MCL.

As for outlying 300-FF-2 waste sites that have impacted groundwater (i.e., the 316-4 Crib and the 618-11 Burial Ground), groundwater monitoring networks are currently inadequate to demonstrate plume attenuation. DOE must enhance these groundwater monitoring networks to gather the appropriate data to evaluate whether or not attenuation is occurring and assess whether or not active response measures should be initiated. The O&M plan for 300-FF-5 must be updated to reflect these requirements (see Action Item 300-4, below).

The environmental impact of the 300 Area is extensively monitored by the Pacific Northwest National Laboratory and the Washington State Department of Health. Routine monitoring of groundwater and surface water support EPA's determination that this remedy is protective at the current point in time. Contamination has not been detected above levels of concern in the Columbia River downstream from the 300 Area or in the City of Richland's water intake system (the nearest public water supply system). In 1999, the average annual concentration of uranium in the Columbia River at the Priest Rapids Dam (up-river from the Hanford Site) and at the Richland pumphouse were not statistically different. However, this protectiveness determination cannot be applied to 300 Area springs that discharge groundwater to the Columbia River at levels that are equivalent to or greater than the groundwater concentrations. Signs and other measures to ensure that people are aware of the hazards associated with these discharge points will have to be addressed in the site-wide institutional controls plan.

Evaluation of remedy implementation. The existing O&M plan for the 300-FF-5 Operable Unit is being implemented by DOE. However, a number of issues need to be addressed in an update to the O&M plan for 300-FF-5.

A key assumption of a remedy that relies on natural attenuation is that the contaminant plumes are, or will be, attenuating through either physical or biological processes to achieve drinking water standards throughout the entire groundwater plume within a reasonable time period. The selected remedy for the 300-FF-5 ROD required continued groundwater monitoring to verify modeled predictions of contamination attenuation and to evaluate the need for active remedial measures. It is not clear if the uranium plume in the 300 Area is attenuating, and the O&M plan is not adequate to demonstrate that other plumes in 300-FF-5 are attenuating, either. Monitoring data must be routinely analyzed and presented to EPA to assess whether or not contaminant plumes are attenuating and, if they are not, an assessment of active remedial measures must be presented to EPA. This assessment will consider the factors described in "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites" (EPA OSWER Directive 9200.4-17P, April 1999) and address all groundwater contamination issues identified in the 300-FF-5 operable unit, including uranium in the 300 Area and 316-4 Crib/618-10 Burial Ground area; TCE, DCE, tetrachloroethene, and Strontium-90 in the 300 Area; tributyl phosphate in the 316-4 Crib/618-10 Burial Ground area; and tritium at the 618-11 Burial Ground.

In addition, groundwater monitoring and soil site investigation/remediation are not being coordinated in the 300 Area. For example, a tremendous amount of waste site characterization data is being gathered during the cleanup activities for the 300-FF-1 Operable Unit. But this

information has not been reflected in updated groundwater monitoring activities to ensure that the appropriate contaminants of concern are being analyzed in the appropriate monitoring wells. For example, drums containing liquid wastes have been uncovered in the 618-4 Burial Ground. These may have contributed additional contamination to groundwater. Therefore, additional wells or additional samples may be required downgradient of this source to evaluate groundwater impacts. Another example is that the conceptual site model used to support CVPs for soil sites in 300-FF-1 does not conform to the interpretations of groundwater plume fate and transport that have been made by the site-wide monitoring program (e.g., RESRAD modeling uses an uncontaminated vadose zone assumption, while groundwater monitoring data seem to indicate that residual contamination exists in the vadose zone). These issues need to be addressed in an update of the 300-FF-5 O&M plan.

Finally, no fish or aquatic biota were sampled in the 300 Area of the Columbia River in 1999. More extensive river monitoring is needed in this area to evaluate the impact of uranium and other 300 Area contaminants entering the river through groundwater discharge, especially in the vicinity of springs. Although the original O&M plan did not address these issues, an updated O&M plan should address environmental monitoring associated with the discharge of contaminated groundwater to the Columbia River.

> **Action Item 300-4: Update and Expand Operations & Maintenance Plan for 300-FF-5**. DOE shall update and expand the operations and maintenance (O&M) plan for the 300-FF-5 Operable Unit. The revised O&M plan shall address: (1) requirements for monitoring groundwater and river springs in 300-FF-5; (2) requirements for monitoring any impacts that may be associated with contaminated groundwater and river spring discharges; (3) requirements for evaluation of groundwater data, including an assessment of the effectiveness of the natural attenuation remedy; and (4) regulatory reporting requirements. DOE shall submit a revised O&M plan by September 2001. DOE shall implement the revised O&M plan as approved by EPA.

Evaluation of remedy completeness. Cleanup in the 300 Area is based on the assumption that land and groundwater use will be restricted. Cleanup levels are based on an industrial exposure scenario, which does not include exposure to radionuclides or chemical contaminants through the drinking water pathway. DOE has ensured that there are no current users of groundwater in the 300 Area or in the areas where outlying sites have impacted groundwater quality. Therefore, the remedy is protective at this point in time. However, an institutional controls plan needs to describe how groundwater use restrictions will be maintained by DOE or a subsequent land owner in the future until groundwater is clean enough for unlimited use and unrestricted exposure. In addition, the plan needs to address other exposure points where humans can come into contact with contaminated groundwater above drinking water standards (i.e., river springs and seeps). Warning signs will be required until these areas are no longer discharging contaminants. A documented and enforceable institutional controls plan is still required for the 300 Area. See Appendix A for specific details regarding IC.

V. Action Items

Table 300-3. Action Items for the 300 Area NPL Site.

Action Item	Title	Description	Due Date
300-1	Expand Cleanup Verification Packages	DOE shall propose an updated structure for the 300 Area cleanup verification packages (CVPs) and a path forward to closing out the CVPs by the due date. The 300-FF-1 Remedial Design/Remedial Action work plan may need to be updated at a later date to reflect new requirements. Supplemental information may have to be documented in the file for completed CVPs as well.	June 2001
300-2	Submit Path Forward for 618-4 Burial Ground	DOE will submit a path forward for the 618-4 burial ground. The path forward will address: (1) options for treatment and disposal of excavated drums, (2) options for continued storage of drums if treatment is not imminent, and (3) plans for completing the excavation of the burial ground.	June 2001
300-3	Submit Analysis of Expedited Response Actions for 618-11 Burial Ground	DOE shall submit options to EPA for expedited response actions to address contaminant releases from the 618-11 Burial Ground as well as an assessment of the need for interim action based on the results of the 618-11 groundwater investigation. The options for interim action and assessment of their need shall be submitted to EPA.	September 2001

Action Item	Title	Description	Due Date
300-4	Update and Expand Operations & Maintenance Plan for 300-FF-5	DOE shall update and expand the O&M plan for the 300-FF-5 Operable Unit. The O&M plan shall address: (1) requirements for monitoring groundwater and river springs in the 300-FF-5 operable unit; (2) requirements for monitoring any impacts that may be associated with contaminated groundwater and river spring discharges; (3) requirements for evaluation of groundwater data, including an assessment of the effectiveness of the natural attenuation remedy; and (4) regulatory reporting requirements. DOE shall submit a revised O&M plan by September 2001. DOE shall implement the revised O&M plan as approved by EPA.	September 2001

VI. Protectiveness Statement

I certify that remediation of the soil sites and groundwater in the 300 Area NPL site are protective of human health and the environment. Existing institutional controls, plus those resulting from implementing the action items in this five-year review, will ensure protection of human health in the future. I also certify that those remedial activities that are not completed, or are still in the design or investigation stage, do not require immediate response actions to protect human health and the environment.

VII. Next Review

This is a statutory site that requires ongoing five-year reviews. The next review will be conducted within five years of the completion of this five-year review report. The completion date is the date of the signature shown on the signature cover attached to the front of the report.

USDOE Hanford 1100 Area
First Five-Year Review Report

I. Introduction

The USDOE Hanford 1100 Area was divided into four operable units to simplify the remedial investigation and response. The remedies at three of the operable units allow for unrestricted use and unlimited exposure. Hazardous substances remain in one operable unit at levels that do not allow for unlimited use and unrestricted exposure.

This is the first five-year review for the USDOE Hanford 1100 Area. The triggering action for this statutory review is the actual start of remedial action at the one operable unit where hazardous substances remain, which occurred on January 15, 1995, as shown in EPA's WasteLAN database. Because hazardous substances, pollutants, and/or contaminants remain at the site above levels that allow for unrestricted use and unlimited exposure, future five-year reviews will be required.

The USDOE Hanford 1100 Area five-year review was led by David Einan, Remedial Project Manager for the site. The following team members assisted in the review:

- Laurence Gadbois, EPA Remedial Project Manager
- Glenn Goldberg, DOE Project Manager.

This five-year review consisted of the following activities: a review of relevant documents, a review of groundwater monitoring data, discussion with the site-specific advisory board, a tribal consultation, discussion with the Natural Resources Trustee Council, and a site inspection. Input from the public was solicited during a 30-day comment period which ran from January 29 through February 27, 2001. Responses to the comments that were received are attached in Appendix B. The completed report is available in the information repository.

II. Site Background and Chronology

The Hanford Site, which is operated by the U.S. Department of Energy (DOE), was established in 1943 to produce nuclear material for national defense. The Hanford 1100 Area National Priorities List (NPL) Site consists of two non-adjacent areas located in the southern portion of the Hanford Site and covers less than 5 square miles. The majority of the NPL Site is located adjacent to the City of Richland. The other portion is located on the Fitzner-Eberhardt Arid Lands Ecology (ALE) Reserve, approximately 15 miles northwest of Richland. The 1100 Area NPL Site was divided into four operable units. Three of the operable units (1100-EM-1, 1100-EM-2, and 1100-EM-3) are located adjacent to the City of Richland, and one (1100-IU-1) is located on the ALE Reserve.

The area occupied by the 1100-EM-1, 1100-EM-2, and 1100-EM-3 Operable Units contained the central warehousing, vehicle maintenance, and transportation distribution center for the entire Hanford Site. The ALE Reserve was set aside as a natural resource research area in 1967. The facilities that comprise the 1100-IU-1 Operable Unit are a former NIKE missile base and control center, and are now used for the ALE headquarters.

The 1100 Area was listed on the NPL in October 1989 based on two factors: (1) the proximity of the 1100-EM-1, 1100-EM-2, and 1100-EM-3 Operable Units to groundwater wells used by the City of Richland to supply drinking water; and (2) the disposal of up to 15,000 gallons of waste battery acid in a sand pit in the 1100-EM-1 Operable Unit. As a result of the listing, DOE conducted a remedial investigation/feasibility study (RI/FS) to determine the nature and extent of contamination at the 1100 Area and to evaluate alternatives for cleanup of contaminated areas.

Remedial Investigation/Feasibility Study

The RI/FS activities at 1100-EM-1 were initiated in 1989 and included the collection and chemical analysis of surface and subsurface soil and groundwater in an effort to characterize the nature and extent of contamination. The first phase of the investigation was complete in August 1990. In the fall of 1992, EPA, DOE, and Ecology decided to accelerate the study and evaluation of the other three operable units (1100-EM-2, 1100-EM-3, and 1100-IU-1) so that all remedial actions in the 1100 Area could proceed as a single project.

1100-EM-1. The 1100-EM-1 RI addressed potential soil contamination at ten different waste sites in the 1100 Area. The 1100-EM-1 RI also investigated groundwater beneath these waste sites. Of the seven areas, only the following three sites and the groundwater required remedial action.

- **Discolored Soil Site**. At this site, bis(2-ethylhexyl)phthalate (BEHP) was identified as the contaminant of concern. BEHP is considered to be carcinogenic. The source of the BEHP was an unrecorded spill. The highest level detected during the RI was 25,000 mg/kg.

- **Ephemeral Pool**. This is an elongated depression adjacent to a parking area where runoff water collects and evaporates. Polychlorinated biphenyls (PCBs) from an unknown release resulted in the Ephemeral Pool being contaminated up to 42 mg/kg.

- **Horn Rapids Landfill**. This landfill was used primarily for the disposal of office and construction waste, asbestos, sewage sludge, and fly ash. The contaminants of concern are the asbestos distributed throughout the landfill and a localized area of soil contaminated with PCBs. The highest PCB concentration identified was 100 mg/kg.

- **Groundwater**. Groundwater in the vicinity of the Horn Rapids Landfill was found to be contaminated with trichloroethene (TCE). TCE was found both upgradient and downgradient of the landfill. The maximum concentration of TCE was 110 µg/L, although current concentrations are less than 10 µg/L.

1100-EM-2, 1100-EM-3, and 1100-IU-1. In place of extensive field investigations, these operable units were evaluated by analysis of existing waste information, by detailed visual inspections, and through interviews with site personnel. Eighteen waste sites within 1100-EM-2 and 1100-EM-3 were identified as candidates for remedial actions. Thirty-two waste sites were identified within 1100-IU-1 as candidates for remedial action. In all three operable units, the waste sites primarily consist of spills, disposal areas, electrical transformers and pads, and tanks that were used for fuel and chemical solvent storage.

The cleanup alternatives evaluated for these sites included excavation with off-site disposal of contaminated soil and debris, and excavation with a combination of on-site incineration and off-site disposal. Both alternatives included sampling and chemical analysis to ensure that soil and debris contaminated above cleanup levels were removed.

Event	Date
NPL Listing	10/04/1989
RI/FS complete	9/24/1993
ROD Signature	9/24/1993
Remedial Design Start (EM-1, EM-2, EM-3)	6/13/1994
Remedial Design Complete (EM-1, EM-2, EM-3)	4/28/1995
Remedial Design Start (IU-1)	6/13/1994
Remedial Design Complete (IU-1)	8/15/1994
Actual RA Start (IU-1)	8/15/1994
Actual RA Start (EM-1, EM-2, EM-3)	1/15/1995
Construction dates (IU-1)	8/15/1994 to 9/30/1994
Construction dates (EM-1, EM-2, EM-3)	1/03/1995 to 11/14/1995
Construction Complete date	12/12/1995
Final Closeout Report	7/25/1996
NPL Deletion	9/30/1996

III. Remedial Actions

A. Remedy Selection

The Record of Decision (ROD) for the 1100 Area was signed on September 30, 1993, and all remedial actions were completed by December 1995. The cleanup levels were based on the requirements of the *Model Toxics Control Act* (MTCA). At the Discolored Soil Site, a residential cleanup level of 71 mg/kg for BEHP was determined via the MTCA procedures. For the Ephemeral Pool, a cleanup level of 1 mg/kg was selected for the PCB contamination. Because the Horn Rapids Landfill would require closure as an asbestos landfill, a cleanup level of 5 mg/kg for the PCB-contaminated soil was selected. For the sites in 1100-EM-2, 1100-EM-3, and 1100-IU-1, the cleanup levels were based on MTCA residential standards. The major components of the selected remedies included the following.

- **Discolored Soil Site**. Excavation and off-site incineration of contaminated soil.
- **Ephemeral Pool**. Excavation and off-site disposal of PCB-contaminated soil.
- **Horn Rapids Landfill**. Excavation and off-site disposal of PCB-contaminated soil, followed by capping appropriate to an asbestos landfill and institutional control.
- **Waste sites in the 1100-EM-2, 1100-EM-3, and 1100-IU-1 Operable Units**. Excavation and off-site disposal of soil and debris which were found to be contaminated above cleanup levels.

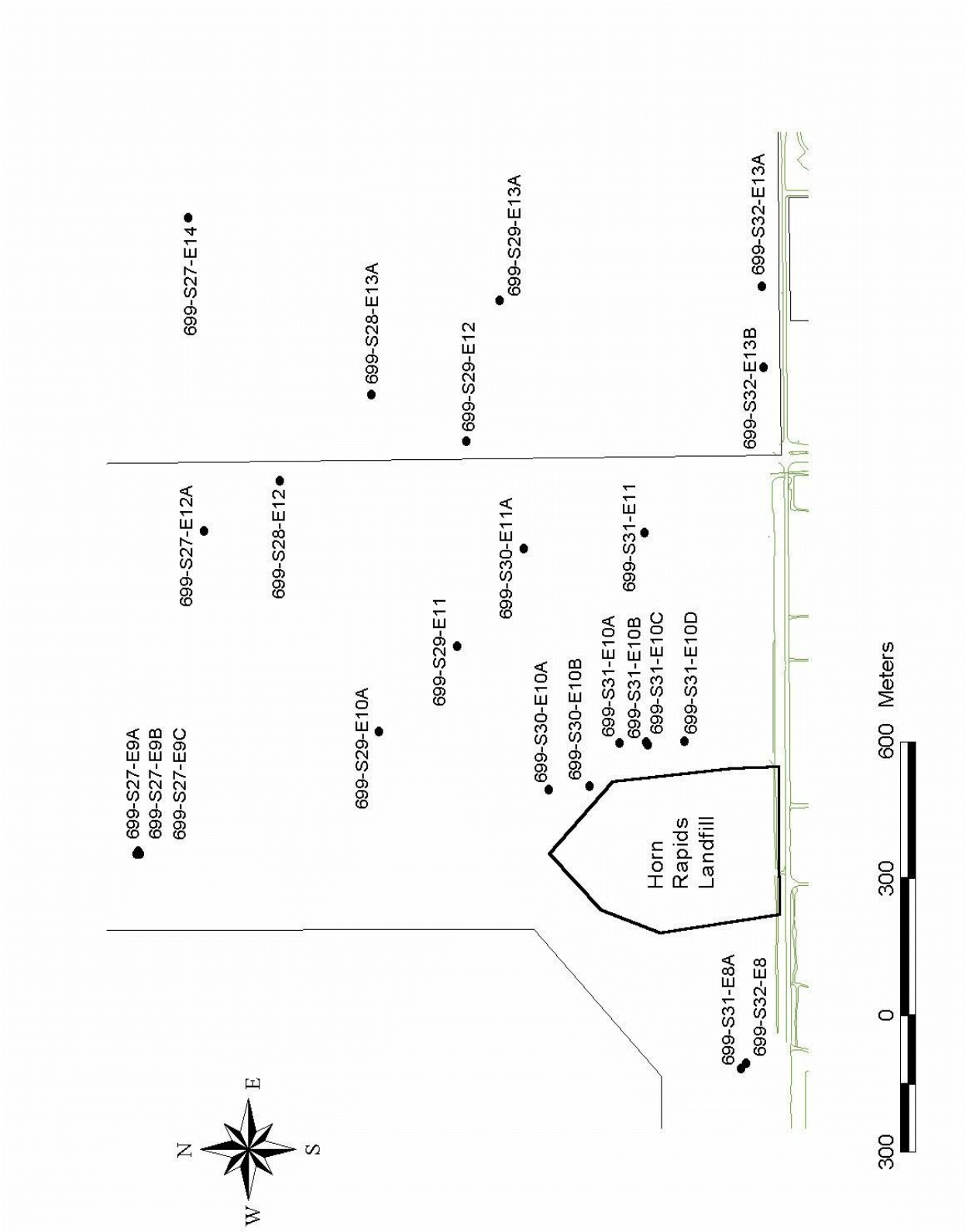
Groundwater concentrations of TCE and nitrate exceeded the maximum contaminant levels (MCLs). The RI concluded that the TCE plume was attenuating and would be below MCLs in 25 years or less. The ROD also required that the groundwater in the vicinity of the Horn Rapids Landfill be monitored for TCE and nitrate. If, however, TCE concentrations did not continue to attenuate or they exceeded the MCL in a group of early warning wells, additional remedial actions would be considered. The location of the early warning wells is shown in Figure 1100-1.

B. Remedy Implementation

1100-EM-1

Discolored Soil Site. Remediation of the Discolored Soil Site consisted of the excavation and stockpiling of 90 cubic yards of waste material (principally BEHP). Confirmation sampling indicated that the removal action met the cleanup levels established in the ROD. The site was regraded to a smooth, uniform surface. The BEHP-contaminated soil was transported and disposed of by incineration at Aptus, Incorporated, in Aragonite, Utah.

Figure 1100-1. Horn Rapids Landfill Wells.



Ephemeral Pool Site. A total of 150 cubic yards of PCB-contaminated soil was removed. Confirmation sampling indicated that the removal action met the requirements based on the cleanup levels established in the ROD. The site was regraded to a smooth, uniform surface. The PCB-contaminated soil was disposed of at the Chemical Waste Management Facility in Arlington, Oregon.

Horn Rapids Landfill. Remedial actions for the Horn Rapids Landfill began with clearing and road pioneering work. Excavation of the PCB-contaminated soil continued until field sampling determined that residual concentrations were less than the established cleanup level (5 mg/kg).

The results of confirmation sampling indicated that some contamination remained that exceeded the cleanup criteria for PCBs. Additional removal was performed. A total of 1600 cubic yards of petroleum-contaminated soil was excavated and stockpiled. Following excavation, confirmation sampling indicated that the removal actions met the requirements based on cleanup-levels established in the ROD. The site was regraded to a smooth, uniform surface. The petroleum-contaminated soil was disposed of at the Columbia Ridge Disposal Facility, which is a permitted waste disposal facility.

1100-EM-3

1262 Solvent Tanks. Upon excavation of the tanks, it was observed that the site consisted of two tanks with vertical orientation and conical bases. One tank was filled with fluid, and the other tank had only a residual amount of fluid. The fluids were sampled; the contents were found to be nonhazardous water. The fluids were removed and discharged to the City of Richland's sanitary sewer. The tanks were cleaned and removed to Twin City Metals, Inc., of Kennewick, Washington. Confirmation sampling was conducted, with samples collected from the soil below the tanks and the sides of the excavation, and no hazardous contaminants were detected.

Suspect Spill Site. Remediation of the suspect spill site began with the excavation and stockpiling of 70 cubic yards of lead-contaminated soil. Confirmation sampling indicated that the cleanup levels were met. The site was regraded to a smooth condition, and 6 in. of base materials were spread over the disturbed area. The contaminated soil was stabilized (to meet the disposal requirements for lead) and disposed of at the Chemical Waste Management Facility in Arlington, Oregon.

French Drain. Remediation began with the excavation and stockpiling of 80 cubic yards of soil contaminated with TPH, lead, and chromium. Confirmation sampling indicated that the cleanup levels were met. The site was regraded to a smooth condition, and 6 in. of base materials were spread over the disturbed area. The contaminated soil was disposed of at the Chemical Waste Management Facility in Arlington, Oregon.

1100-IU-1

Fuel Tanks. Two 2,000-gal. fuel tanks were discovered and removed. Soils from beneath these tanks were sampled, and results indicated that these soils were clean and that no further actions were required. Six cubic yards of soil were discovered within one of the tanks. Analysis of this soil indicated the presence of petroleum hydrocarbons above regulatory limits. This soil was disposed of at the DOE petroleum-contaminated soil treatment site in the 100 Area.

Horse Shoe Landfill. Approximately 2,500 cubic yards of soil contaminated with the pesticide DDT and its breakdown products were discovered. These soils were shipped to the Chemical Waste Management hazardous waste landfill in Arlington, Oregon. No other contaminants were detected above regulatory cleanup levels. After remediation, the U.S. Fish and Wildlife Service (USFWS) conducted sampling and analysis of biota from a number of waste sites. DDT and its degradation products (collectively referred to here as DDT) were detected at several ppm, plus one outlying datum of 45 ppm found in one bird egg shell. The USFWS data prompted an additional sampling by DOE. The DOE data were consistent with the USFWS except for the outlying egg shell datum. The soil cleanup level selected in the ROD was 1 ppm. DDT can bioconcentrate and biomagnify to very high ratios. The biota data is reasonable, given the 1 ppm soil cleanup standard.

Burn Pits. Soil analyses indicated the presence of lead above regulatory limits in two of five burn pits on top of Rattlesnake Mountain. The burn pits were excavated into the basalt formation of the mountain and were associated with the former Nike Missile Control Center. Because of concern for cultural and ecological resources at this site, a concrete cap (approximately 4 ft in diameter) was placed over the two burn pits that contained lead.

Above-Ground Fuel Tank. Contamination was discovered at the former location of an above-ground fuel storage tank on top of Rattlesnake Mountain. Diesel-contaminated soil above regulatory limits was discovered to a depth of 1.4 ft within a circular area with a radius of approximately 3 ft; basalt bedrock was encountered at this depth. Approximately 0.5 cubic yards of contaminated material was excavated and disposed of at the petroleum-contaminated soil treatment site in the 100 Area. Excavation was guided by field screening methods specific to petroleum hydrocarbons and was stopped when field screening indicated that regulatory levels were met. Because soil was removed down to bedrock, confirmatory sampling was not performed.

Lysimeter Plots. Samples were taken at two ALE Reserve lysimeter plots previously used by the Pacific Northwest National Laboratory for radiological experiments. These samples were analyzed for the specific radioisotopes associated with the individual lysimeters. All but one sample had activities of less than 1.2 pCi/g. The one exception was a sample that had 53 pCi/g of the Pu-238 isotope. This sample was taken from an area within the lysimeter plot where insects may have compromised certain lysimeters and may have brought small amounts of contamination to the surface. DOE excavated approximately 0.25 cubic yards of material to further mitigate any exposure risks. The material was taken to the low level radioactive burial grounds in the 200 Areas.

IV. Findings and Recommendations

A. Site Inspection

A site inspection was conducted on June 13, 2000. The inspection of the cap and fence at the Horn Rapids Landfill revealed that the fence needs minor repair (several fence posts were pulling out) and asbestos warning signs need to be replaced along the fenceline bordering the road. Inspection of the groundwater wells showed they were all marked and their caps were locked.

B. Risk Information Review

The following standards, identified as applicable or relevant and appropriate requirements (ARARs) in the ROD, were reviewed for changes that could affect protectiveness:

- *Safe Drinking Water Act* (40 CFR Parts 141-146) Maximum Contaminant Levels (MCLs) for public drinking water supplies were used to set groundwater cleanup levels.

- *Model Toxics Control Act* Cleanup Regulations (Chapter 173-340 WAC) contains risk-based cleanup levels which were used to establish soil cleanup levels.

- *National Emission Standards for Hazardous Air Pollutants* (NESHAP) (40 CFR 61.151) contains asbestos landfill closure requirements for the Horn Rapids Landfill.

There have been no changes in the standards identified in the ROD that would call into question the protectiveness of the selected remedy. Action-specific requirements (i.e., the NESHAP) have not changed. The cleanup levels selected in the ROD are still protective.

The following conclusions support the determination that the remedy at the USDOE Hanford 1100 Area is protective of human health and the environment.

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

- ***Implementation of Institutional Controls and Other Measures:*** The fence needs to be maintained. DOE maintains an active presence on site, and there are no current or planned changes in land use at the site. However, there is no written IC plan to ensure that access and exposure to the Horn Rapids Landfill contaminants are controlled. Appendix A contains greater detail on the IC plan requirements.

- ***Remedial Action Performance:*** The landfill cover system has been effective in isolating waste and contaminants.

- ***Early Indicators of Potential Remedy Failure:*** No early indicators of potential remedy failure were noted during the review.

Question B: Are the assumptions used at the time of remedy selection still valid?

- ***Changes in Standards and To Be Considereds:*** There have been no changes in the standards identified in the ROD that would call into question the protectiveness of the selected remedy, nor any newly promulgated standards that might be applicable. The cleanup levels selected in the ROD are still protective.

- ***Changes in Exposure Pathways:*** No changes in the site conditions that affect exposure pathways were identified as part of the five-year review. First, there are no current or planned changes in land use. Second, no new contaminants, sources, or routes of exposure were identified as part of this five-year review. Finally, there is no indication that hydrologic/hydrogeologic conditions are not adequately characterized. The rate of decrease of contaminant levels in groundwater is consistent with expectations at the time of the ROD.

- ***Changes in Toxicity and Other Contaminant Characteristics:*** Toxicity and other factors for contaminants of concern have not changed.

- ***Changes in Risk Assessment Methodologies:*** Changes in risk assessment methodologies since the time of the ROD do not call into question the protectiveness of the remedy.

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

No additional information has been identified that would call into question the protectiveness of the remedy.

Minor deficiencies were discovered during the five-year review and are noted in the following table.

Deficiency	Currently Affects Protectiveness (Y/N)
Fence posts pulling out	N
Warning signs missing	N

V. Action Items

For the past several years, the Hanford Natural Resource Trustee Council has discussed ongoing residual injury from the residual DDT at the Horse Shoe Landfill. The EPA has been a participant in many of those discussions and will remain involved.

Action Item	Description	Due Date
1100-1	DOE shall replace the loose fenceposts around the Horn Rapids Landfill.	April 2001
1100-2	DOE shall replace missing asbestos warning signs around the Horn Rapids Landfill.	March 2001

VI. Protectiveness Statements

The protection of human health and the environment by the remedial actions at 1100-EM-1, 1100-EM-2, 1100-EM-3, and 1100-IU-1 are discussed below. Because the remedial actions at the operable units are protective of human health and the environment, the remedy for the site is expected to be protective of human health and the environment.

1100-EM-1

The remedy at 1100-EM-1 is protective of human health and the environment. The cap is effective at containing the asbestos fibers. The vegetation has taken hold and is preventing wind erosion of the cap. The groundwater contamination continues to attenuate throughout the plume and the current trend in TCE concentrations indicate that TCE should meet cleanup values (the MCL of 5 µg/L) in 5 to 7 years.

1100-EM-2

The remedy at 1100-EM-2 is protective of human health and the environment. The remedial actions allow for unrestricted use and unlimited exposure.

1100-EM-3

The remedy at 1100-EM-3 is protective of human health and the environment. The remedial actions allow for unrestricted use and unlimited exposure.

1100-IU-1

The remedy at 1100-IU-1 is protective of human health and the environment. The remedial actions allow for unrestricted use and unlimited exposure.

VII. Next Review

This is a statutory site that requires ongoing five-year reviews. Only the Horn Rapids Landfill and the groundwater plume nearby is subject to the statutory five-year review and hence the next review will be limited to those issues. The next review will be conducted within five years of the completion of this five-year review report. The completion date is the date of the signature shown on the signature cover attached to the front of the report.

APPENDIX A. INSTITUTIONAL CONTROLS

Institutional Controls

Most of the decision documents addressed in this review contained requirements for IC. Many, but not all, of the requirements have been implemented, but generally not in a way that has been reviewed and approved by EPA and Ecology. Most of the decision documents preceded EPA Region 10 policy for IC in federal facility decision documents. Experience with the effectiveness of IC approaches, foreseeable changes in DOE's presence on site, and recent EPA Region 10 guidance on IC for federal facilities indicate that the decision documents should be reviewed to determine if an ESD should be produced to bring these documents into alignment with current expectations for IC. It is anticipated that IC requirements in the ESD would be similar to the IC requirements in the 100 Area Burial Grounds ROD signed in September 2000. If an ESD is needed to clarify IC expectations for these RODs, it shall include the interface with EPA and Ecology. It is recommended than a single ESD be written, if needed, by EPA with assistance from DOE and Ecology to modify/add IC requirements to be consistent with EPA Region 10 policy. It is recommended that the ESD be completed within 6 months of the five-year review. Not withstanding the need for the ESD, DOE's active presence on site has resulted in controls on human access to contaminated areas so that the protectiveness of the remedies has not been compromised. But DOE's mission is to complete the active portion of the cleanup work and demobilize from the site at which time the IC will become a more important element of the remedies' protectiveness.

Institutional Control Requirements in the September 2000 Burial Grounds ROD

The ROD for the burial grounds in the 100 Area was signed in September 2000. It is expected that the ESD for the existing 100 Area decision documents that need to be revised will be similar to the following institutional control requirements that are in the selected remedy of the burial grounds ROD.

(Begin quote from 100 Area Burial Grounds ROD.)

Institutional controls selected as part of this remedy are designed consistent with the interim action nature of this ROD. Additional measures may be necessary to ensure long-term viability of institutional controls if the final remedial action selected for the 100 Area NPL site does not allow for unrestricted land use. Any additional controls will be specified as part of the final remedy. The following institutional controls are required as part of this interim action:

- DOE will continue to use a badging program to control access to the associated sites for the duration of the interim action. Visitors entering any of the sites associated with this Interim Action ROD are required to be escorted at all times.

- Well drilling is prohibited, except for monitoring or remediation wells authorized in EPA and Ecology-approved or Ecology-approved documents. Groundwater use is prohibited, except for monitoring and treatment, as approved by EPA or Ecology.

- No intrusive work is allowed on or near the waste sites covered in this ROD without prior approval of EPA or Ecology.

- DOE shall maintain signs which warn river users of potential hazards along the shoreline from 100 Area waste sites.

- DOE shall post and maintain in good condition "No Trespassing" signs along the 100 Area shoreline.

- DOE shall maintain signs along access roads that warn site visitors and workers of potential hazards from 100 Area waste sites.

- DOE shall report trespass incidents to the Benton County Sheriff's Office for investigation and evaluation for possible prosecution.

Sitewide Institutional Controls Requirements

- DOE shall submit a sitewide institutional controls plan that includes the applicable institutional controls for the 100 Area operable units. This sitewide plan will be submitted to EPA and Ecology for approval as a primary document under the Tri-Party Agreement by July 2001. This plan shall be updated by DOE periodically at the request of EPA or Ecology. At a minimum, the plan shall contain the following:

    - Include a comprehensive facility-wide list of all areas or locations covered by any and all decision documents at Hanford that have or should have institutional controls for protection of human health or the environment. The information on this list will include, at a minimum, the location of the area, the objectives of the restriction or control, the time frame that the restrictions apply, the tools and procedures DOE will use to implement the restrictions or controls and to evaluate the effectiveness of these restrictions or controls;
    - Cover, and legally bind where appropriate, all entities and persons, including, but not limited to, employees, contractors, lessees, agents, licensees, and visitors. In areas where DOE is aware of routine trespassing, trespassers must also be covered;
    - Cover all activities, and reasonably anticipated future activities, including, but not limited to, any future soil disturbance, routine and non-routine utility work, well placement and drilling, recreational activities, national monument-related uses, groundwater withdrawals, paving, construction, renovation work on structures, tribal use, or other activities;
    - Include a tracking mechanism that identifies all land areas under restriction or control;

- Include a process to promptly notify both EPA and Ecology prior to any anticipated change in land use designation, restriction, land users or activity for any institutional controls required by a decision document.

- DOE will notify EPA and Ecology immediately upon discovery of any activity that is inconsistent with the operable unit-specific institutional controls objectives for the site, or of any change in the land use or land use designation of a site. DOE will work together with EPA and Ecology to determine a plan of action to rectify the situation, except in the case where DOE believes the activity creates an emergency situation, DOE can respond to the emergency immediately upon notification to EPA and Ecology and need not wait for EPA or Ecology input to determine a plan of action. DOE will also identify deficiencies with the institutional controls process, evaluate how to correct the process to avoid future problems, and implement these changes after consulting with EPA and Ecology.

- DOE will identify a point of contact for implementing, maintaining, and monitoring institutional controls for the 100 Area, as well as the Hanford Site.

- DOE will comply with Tri-Party Agreement requirements to request and obtain funding to institute and maintain institutional controls as a compliance requirement under the Tri-Party Agreement.

- DOE will notify EPA and Ecology at least 6 months prior to any transfer, sale, or lease of any property subject to institutional controls required by a CERCLA decision document so that EPA and Ecology can be involved in discussions to ensure that appropriate provisions are included in the conveyance documents to maintain effective institutional controls. If it is not possible for DOE to notify EPA and Ecology at least 6 months prior to any transfer, sale, or lease, then DOE will notify EPA and Ecology as soon as possible, but no later than 60 days prior to the transfer, sale, or lease of any property subject to institutional controls.

- DOE will not delete or terminate any institutional controls unless EPA and Ecology have concurred in the deletion or termination.

- DOE will evaluate the implementation and effectiveness of institutional controls for the Hanford Site and the 100 Area operable units on an annual basis. The annual institutional controls monitoring report shall be written by DOE and submitted to EPA and Ecology as a primary document under the Tri-Party Agreement. The report shall be consistent with the requirements established in the sitewide institutional controls plan. Justification will be provided for any information that is not included as required by the sitewide plan. The annual monitoring report will be due on September 30 of each year and will summarize the results of the evaluation for the preceding calendar year. In addition, after the comprehensive sitewide approach is well established and DOE has demonstrated its effectiveness, the frequency of future monitoring reports may be modified

subject to approval by EPA and Ecology. The institutional controls monitoring report, at a minimum, must contain:

- a description of how DOE is meeting the sitewide institutional controls requirements;
- a description of how DOE is meeting the operable unit-specific objectives, including results of visual field inspections of all areas subject to operable unit-specific restrictions;
- an evaluation of whether or not all operable unit-specific and sitewide institutional controls requirements are being met;
- a description of any deficiencies and what efforts or measures have been or will be taken to correct problems.

(End quote from 100 Area Burial Grounds ROD.)

An ESD is recommended to cover all decision documents that have explicit or implicit IC requirements. EPA should write the ESD with input and assistance from DOE and Ecology. This should be completed within six months of the five-year review. The ESD will include operable unit-specific and facility-wide IC requirements listed below. Unit-specific IC requirements include the geographic location where IC apply, the objectives of the control or restriction and, if appropriate, a description of the types of restrictions which need to be in place. An example are signs along the river and roads that describe contamination in the area. Facility-wide IC requirements are described below. Together, both of these components establish the standards by which EPA will determine whether or not DOE has taken the appropriate actions to implement and maintain IC. The IC requirements should clarify those that apply prior to cleanup, during cleanup, and after cleanup, and site-specific requirements may change depending on the cleanup stage a site is in.

To the extent that existing procedures, processes, orders, instructions, plans or any other system in place meets the requirements to create and maintain IC, their use is encouraged. Where established procedures are not sufficient, DOE will need to supplement existing facility-wide procedures.

The facility-wide requirements are as follows:

A. The DOE will develop a comprehensive facility-wide approach for establishing, implementing, enforcing, and monitoring IC at Hanford. This approach could include a Base Master Plan or a facility-wide land use plan, installation maps, a comprehensive permitting system, or other installation policies and orders. This comprehensive facility-wide approach will:

   • Include a comprehensive facility-wide list of all areas or locations covered by any and all decision documents at Hanford that have or should have IC for protection of human health or the environment. The information on this list will include, at a minimum, the location of the area, the objectives of the restriction or control, the

time frame that the restrictions apply, the tools and procedures DOE will use to implement the restrictions or controls and to evaluate the effectiveness of these restrictions or controls;

- Cover, and legally bind where appropriate, all entities and persons, including, but not limited to, employees, contractors, lessees, agents, licensees, and visitors. In areas where DOE is aware of routine trespassing, trespassers must also be covered;

- Cover all activities, and reasonably anticipated future activities, including, but not limited to, any future soil disturbance, routine and non-routine utility work, well placement and drilling, recreational activities, national monument-related uses, groundwater withdrawals, paving, construction, renovation work on structures, tribal use, or other activities;

- Include a tracking mechanism that identifies all land areas under restriction or control;

- Include a process to promptly notify both EPA and Ecology prior to any anticipated change in land use designation, restriction, land users or activity for any IC required by a decision document.

- Within 6 months of signature of the ESD, DOE will submit to EPA and Ecology a monitoring report on the status of DOE's IC for Hanford. Thereafter an IC monitoring report will be submitted by DOE to EPA and Ecology annually, or on an alternate schedule approved by EPA and Ecology. The IC monitoring report, at a minimum, must contain:

    - a description of how DOE is meeting the facility-wide IC requirements;
    - a description of how DOE is meeting the operable unit-specific objectives, including results of visual field inspections of all areas subject to operable unit-specific restrictions;
    - an evaluation of whether or not all the operable unit-specific and facility-wide IC requirements are being met;
    - a description of any deficiencies and what efforts or measures have been or will be taken to correct problems.

EPA and Ecology review of the IC monitoring report will follow Tri-Party Agreement procedures for primary documents.

- DOE will notify EPA and Ecology immediately upon discovery of any activity that is inconsistent with the operable unit-specific IC objectives for the site, or of any change in the land use or land use designation of a site. DOE will work together with EPA and Ecology to determine a plan of action to rectify the situation, except in the case where DOE believes the activity creates an emergency situation, DOE can respond to the

emergency immediately upon notification to EPA and Ecology and need not wait for EPA or Ecology input to determine a plan of action. DOE will also identify what went wrong with the IC process, evaluate how to correct the process to avoid future problems, and implement these changes after consulting with EPA and Ecology.

- DOE will identify a point of contact for implementing, maintaining, and monitoring IC.

- DOE will comply with Tri-Party Agreement requirements to request and obtain funding to institute and maintain IC as a compliance requirement under the Tri-Party Agreement.

- DOE will notify EPA and Ecology at least six months prior to any transfer, sale, or lease of any property subject to IC required by a CERCLA decision document so that EPA and Ecology can be involved in discussions to ensure that appropriate provisions are included in the conveyance documents to maintain effective IC. If it is not possible for DOE to notify EPA and Ecology at least six months prior to any transfer, sale, or lease, then DOE will notify EPA and Ecology as soon as possible but no later than 60 days prior to the transfer, sale, or lease of any property subject to IC.

- DOE will not delete or terminate any IC unless EPA and Ecology have concurred in the deletion or termination.

In recognition that IC are as necessary a component of the remedy as an engineered remedy, the same level of enforceability is warranted. Like the performance standards in a decision document for the engineered portion of the remedy, the facility-wide IC requirements included in a decision document are enforceable by EPA. EPA will generally comment on and suggest changes and improvements to the installation-specific procedures, as necessary to protect human health and the environment. However, it is not EPA's intention to directly enforce specific installation policies, procedures, or processes that are developed by DOE to meet the IC requirements**.** Those will normally be directly enforceable by DOE against its personnel, employees, agents and assigns, because it is expected that the IC will have been issued as orders, directives or other formal facility-wide systems that are binding on facility personnel, employees, assigns, contractors and agents. However, EPA reserves its right to take whatever other enforcement action necessary to ensure compliance with the IC requirements and to protect human health and the environment.

APPENDIX B. RESPONSES TO COMMENTS

Comments were received from two private citizens and three organizations. The responses to those comments are found on the pages that follow. The responses to the private citizens' comments are on Pages B-2 and B-3. The responses to the U.S. Fish and Wildlife Service's comments are on Pages B-4 through B-15. The responses to the Nez Perce Tribe's comments are on Pages B-16 through B-20. The responses to the Washington State Department of Fish and Wildlife's comments are on Pages B-21 through B-33.

Responses to Citizens' Comments on the Draft Five-Year Review Report

1. First, the second paragraph on page 100-3 (and perhaps the fifth paragraph on page 200-3) probably should acknowledge RL's proposed 2012 plan. A reasonable way might be in a footnote after the 2018 date(s) referencing DOE/RL-2000-62, Rev.2, *Hanford 2012: Accelerating Cleanup and Shrinking the Site,* along with a statement that Congress has not yet funded this plan.

   Response: Currently, the 2012 plan is a DOE initiative and not part of the Tri-Party Agreement. At this time, it is unknown whether this plan will be implemented and therefore the reference is not appropriate.

2. Second, the paragraph split between pages 100-3 and 100-4 references only SNF from the 100-N Reactor currently in storage in two water-filled basins in the 100-K Area. The last information that I had indicated some irradiated single-pass reactor fuel was also present in the K-Basins. More is likely to be discovered while F-Basin and H-Basin are being cleaned out. This information could be added to the referenced paragraph.

   Response: The document has been changed as suggested.

3. The Action Items contain a great number of Due Dates of March 2001. Since the report probably cannot be released and transmitted to DOE until March, it would seem reasonable to advance the dates at least until April or May 2001.

   Response: The dates have been revised appropriately.

4. Action Item 100-1, second bullet: Change improved to reduced.

   Response: This action item has been changed as suggested.

5. It is not clear what the rationale is for DOE being responsible for some Items and the Tri Parties being responsible for others.

   Response: DOE is responsible for most of the action items. In some cases, such as the action items regarding developing monitoring well networks in the 200 Areas, the responsibility is shared by the Tri-Parties.

6. Item 200-9 has conflicting dates.

Response: The action item requires the production of the Phase III Feasibility Study for the Canyon Disposition Initiative by September 2001. The date was chosen to support development of a ROD by September 2002. There is no conflict in the action item, however the way the item read was ambiguous and was clarified.

7. Page 100-17, Recommendation for in-situ Treatment for Chromium, second bullet: Insert and CR^{+6} removal effectiveness after Actual costs.

Response: The document has been changed as suggested.

8. Page 100-19, Action Item 100-2: Is it possible to provide some sort of fencing and warning signs on the shoreline at the N springs to prevent idiots from sipping groundwater from the seeps? I know what the law requires; but there must be some way to use the money spent on pump and treat to better advantage while preventing injury to people.

Response: Appropriate signs to warn of contamination is part of the institutional controls recommendation.

9. Page 300-14, first ¶, line 10: Insert or greater than after equivalent to.

Response: The suggested edit was made.

Responses to the U.S. Fish and Wildlife Service's Comments on the Draft Five-Year Review Report

We have reviewed the subject USDOE Hanford Site, First Five Year Review Report, and have the following general and section specific comments regarding the documents. The report purpose is confusing because the five year review for the 100 area, 200 area and 300 area includes discussions of operable units for which final ROD's have not been issued. The cleanup for these units is also in various stages of planning or implementation. The summary document for the 100, 200, 300 and 1100 area does not provide enough level of detail regarding the levels of contaminant in the environment to make reasonable determinations of risk to the environment. The reports do not provide a complete disclosure of all contaminants present in the environment and cleanup levels which will be protective for unrestricted future public use which is likely to occur due to the designation of the Hanford Reach as a National Monument. An overriding concern for all of the areas is the complete lack of biological data for making decisions regarding cleanup levels that are protective of the environment. There have been limited laboratory studies looking at impacts from hexavalent chromium releases upon aquatic resources, concentrating on chinook salmon. There has been no research on the Columbia River ecosystem and organisms that support salmon and Steelhead trout. As we have requested in the past, baseline biological sampling for terrestrial and aquatic species needs to be conducted in order to determine if cleanup is successful. Specific comments on the reports follow;

General Response: A five-year review is performed on the basis of an entire National Priorities List site, including operable units where remedies are not currently in place. The broad scope of the five-year review provides a complement to the numerous focused analyses associated with specific risk assessment documents, cleanup decision documents, cleanup verification packages for individual waste sites, databases of sample data, and other data-rich documents in the administrative record. The five-year review did not re-evaluate and document each step in the process from identification of sufficient risk to justify a cleanup action, through completion and close-out of the action. That is documented through the Administrative Record which is available on the internet at http://www2.hanford.gov/arpir/.

Regarding the baseline biological sampling of terrestrial and aquatic species, the need for biological sampling is mentioned in the opening comment above, and is reiterated in the specific comments that follow. DOE, Ecology, and EPA agree. DOE has monitored terrestrial and aquatic species since inception of the Hanford site. Monitoring has continued with the arrival of EPA and Ecology as regulators and Tri-Party Agreement activities.

1. Page iv, 2nd paragraph. It is stated that "The purpose of a five-year review is to determine whether the remedy at a site is protective of human health and the environment." That purpose does not appear to be adequately documented in this Five-Year Review Report. It seems like this "purpose" would be very difficult to do without investigating the biota

that inhabits the environment. We suggest that a biomonitoring program be established to determine if indeed the remedy is protective of the environment.

Response: This comment correctly recapitulates and highlights the purpose of the five-year review. The reader should be aware that the broad scope of the five-year review provides a complement to the numerous focused analyses associated with specific risk assessment documents, cleanup decision documents, cleanup verification packages for individual waste sites, databases of sample data, and other data-rich documents in the administrative record. The five-year review did not re-evaluate and document each step in the process from identification of sufficient risk to justify a cleanup action, through completion and close-out of the action. That is documented through the Administrative Record which is available on the internet at http://www2.hanford.gov/arpir/

The comment correctly notes that investigating the biota and biomonitoring are important elements in ensuring protectiveness. Towards that end the biota at the Hanford site have been monitored since the early 1940s. In recent years this data has been reviewed and presented in an annual monitoring report.

There is an effort underway for the 100-BC Area to do a post-remediation evaluation of human health and ecological risk using data collected during the remedial action including cleanup verification samples, plus biota data collected at the site. The earliest radioactive waste site cleanups covered in this five-year review are in the 100-BC Area. This is the first opportunity to collect post-remedial action biota data from radioactive waste sites that have completed an interim remedial action, been backfilled, revegetated, and have some early successional use by native species. Scoping for the appropriate risk assessment is underway.

2. Page vi, 200 Area, 1st full paragraph. The statement is made that the ERDF is operating in an environmentally protective manner and no change in operation is needed. In the section that discusses the waste disposal facility it is mentioned that construction consisted of using a double liner and a leachate collection system that met minimal RCRA standards. Are there monitoring systems in place for the existing cells to determine if cell integrity will be maintained for ever or will this site be the next huge DOE cleanup project.

   Response: ERDF was constructed in accordance with RCRA standards, which are quite rigorous. The term “minimum standards” is a colloquial term and will be deleted. The monitoring program is designed to detect all of the contaminants that could result from ERDF operations.

3. Page vi, 300 Area, There is not any mention made of requiring collection of biological baseline data for operable units in this area.

Response: The draft five-year review stated that "DOE must demonstrate that soil cleanup levels are protective of groundwater, that biological resources are not being adversely impacted...". Biological data has been collected for many years around the Hanford site, including the 300 Area, before cleanup actions began, during cleanup actions, and will continue following cleanup to document protectiveness.

4. Page vii, 1100 area. The DDT problems that continue at the Horseshoe Landfill are not discussed. The biological data that the Fish and Wildlife Service and the DOE collected that document elevated levels of DDT/DDE in biota should be mentioned. The data from soil samples collected and analyzed by the State of Washington Department of Ecology that indicated that DDT/DDE residues were above the cleanup criteria level of 1ppm should also be mentioned. To state that the only deficiency found during the review was a bad fence is an affront to the efforts of the Trustee Council to resolve this issue.

Response: This comment was made regarding the foreword and the information was discussed in the full 1100 Area section of the document.

5. Page vii, 3rd paragraph, 2nd line. Editorial error: "that crosscuts each all of the..." Delete "each" or "all"

Response: The suggested change was made.

6. Page vii, Action Items Table. This table should be amended to include action items for all Areas, adding biological baseline studies for impacts to terrestrial and aquatic resources. The presence of runs of federally endangered Upper Columbia River Steelhead (*Oncorhynchus mykiss)* and biological studies for all areas that are impacted by contaminated ground water in the 100, 200 and 300 areas require Endangered Species Act, Section 7 consultation with the National Marine Fishery Service. An Action Item that includes biological studies to determine impacts to aquatic invertebrates, benthic organisms and other food chain organisms that may be affected by hazardous material releases to the aquatic environment is needed. An action item to resolve impacts to migratory birds from elevated levels of DDT/DDE at landfills on ALE and the North Slope needs to be added.

Response: As mentioned in other comment responses, biological studies are important, and many have been conducted in Hanford plants and animals. There is routine biological monitoring and numerous special studies that look at specific contaminant and ecological exposure issues. CERCLA cleanup actions at Hanford are major federal actions and may trigger ESA Section 7 consultation requirements. The DOE, the action agency as per the ESA, is responsible for ESA Section 7 consultations, and has provided information to the National Marine Fishery Service. The Hanford Natural Resource

Council continues to work towards resolution of the DDT/DDE issues at ALE and the North Slope.

7. Page 100-3, 4th paragraph, 1st line. Editorial error: "The are nine nuclear reactors..."

Response: The editorial error was corrected.

8. Page 100-4, 1st paragraph. There have not been any biological baseline studies conducted at the over 400 waste sites that were mentioned. These studies are needed for determining impacts to and success of cleanup remedies for terrestrial species particularly for the burial ground sites. The report does not identify all of the potential contaminants that are present and the levels that occur in the environment. The implication is that if the reviewer wants this information we should all go and read the documents used to write the report. The value of this report then becomes similar to a public relations document.

Response: The EPA does not agree with the opening statement of the comment. There are numerous programs at Hanford that collect biological baseline data. These include "near-field" sampling for waste sites, that provides bioavailability and uptake information into plants and animals. There is also site-wide environmental monitoring that provides a ecological community scale assessment of contaminant uptake. There are ecological risk assessments as part of the cleanup planning process. There are many in-depth studies of specific contaminant-receptor risks. These documents are available to the public. The five-year review is a review and not a recapitulation of all the supporting data and analyses that underpin the conclusions presented in the five-year review. The goal of the five-year review was to determine the protectiveness of the CERCLA cleanup actions. To determine protectiveness, it is not necessary to quantify the impact present prior to the cleanup action. It is necessary to verify that the cleanup levels chosen were appropriate, and that the cleanup actions achieved the required cleanup level. Generally the selected cleanup levels involved models and assumptions that have uncertainty. There are CERCLA cleanup and restoration activities that have been completed, and the opportunity now exists to document the post-cleanup conditions via biological studies. Some studies have already taken place and were identified in the draft five-year review (e.g., the contaminant studies on the North Slope and ALE). The Tri-Parties have begun planning a biological assessment of the 100 BC Area, where active remedial action – including restoration – has been completed.

As correctly noted in the comment, the five-year review does not identify all of the potential contaminants that are present and the levels that occur in the environment. There are many hundreds of potential contaminants at Hanford, and their levels in the environment are highly variable, depending on the location. The implication expressed in the comment, i.e., if the reviewer wants this information, the reviewer must read many other documents, is correct. The value of this report is that it presents a summary level analysis of a very complex contaminated site.

9. Page 100-7, 1st paragraph, last sentence. It is stated that "...long term monitoring are required for sites where wastes are left in place..." Does this mean biomonitoring? Please explain the monitoring requirements. The paragraph which describes the 1996 ROD for groundwater at 100-HR-3 and 100-KR-4 states that the principle threat being addressed is ecological risk to bottom dwelling organisms in the Columbia River via the cleanup standard of 11µg/l for hexavalent chromium. There have not been any studies conducted however that evaluates the actual impact to benthic organisms in the vicinity of up welling groundwater (porewater) that has over 600µg/l of hexavalent chromium.

Response: The Tri-Parties expect to continue groundwater monitoring for the foreseeable future. In addition, a baseline risk assessment will be conducted and it is anticipated that biomonitoring may be a component of that assessment.

The comment correctly states that there have not been any studies of actual impact to benthic organisms in the area of where river bottom porewater has been documented at over 600 µg/L. The Tri-Parties have decided a bias-for-action was appropriate and set a cleanup standard of 11 µg/L to be protective of the Columbia River salmon population.

10. Page 100-8, 1999 ROD for K Basin. What is meant by the statement "Water will be removed, treated and disposed of at Hanford"? What is the water contaminated with, nuclear waste?, and where at Hanford will it be disposed?

Response: The water will be pumped out of the basins, transported by truck to the effluent treatment facility in the 200 Area, treated to remove essentially all the contaminants except tritium, and then discharged to the ground north of the 200 Area. The principal contaminants in the water are radionuclides. This information has been added to the document.

11. Page 100-10, 2nd paragraph, last sentence. It is stated that "Based on the methods and models, all 35 waste sites have achieved the remedial action goals set forth in the ROD." None of the models assess or analyze biotic indicators and thus the remedy may not be protective of the environment. The contaminants that were present prior to and levels after cleanup are not provided. A summary of the verification data that is referenced to claim remedial action goal attainment should be included.. There have been no baseline biological studies conducted at these sites to determine if cleanup has been protective of the environment (terrestrial resources). The observational approach is used to guide cleanup, however if hazardous materials have not been disposed in a homogenous manner, materials that are discontinuous might not be removed.

Response: The cleanup decision documents used evaluations of risk to both ecological receptors and human health to set cleanup levels. The cleanup levels had to be protective of both upland human and ecological users of the site, plus ecological and human users of

the downgradient Columbia River, therefore protection of the environment is built into the remedy. Cleanup verification is a process of taking post-cleanup data and comparing the data to cleanup levels set forth in the cleanup decision document. Protection of human health was the more stringent criteria for most of the contaminants. For radionuclides, the cleanup standard for human health was many times for stringent for human health protection than for ecological protections. Therefore, cleanup verification contained more human health analysis than ecological. The comment states that "none of the models assess or analyze biotic indicators," which is an incorrect statement.

The comment correctly states that "the contaminants that were present prior to and levels after cleanup are not provided." The concentrations of contaminants prior to cleanup is not relevant to documenting the protectiveness of the remedy when it is completed. With so many waste sites, so many contaminants, and so many measurements collected as part of the close-out process, it is not feasible to reproduce the cleanup verification data for this five-year review, except to summarize it by saying the remedial actions goals were attained. The issue of baseline biological studies has been discussed in other responses. Cleanup must be planned to minimize the possibility that if hazardous materials have not been disposed in a homogenous manner, materials that are discontinuous might not be removed. This has not been a challenge for the liquid effluent disposal sites. For the burial grounds, this will be a greater concern. The recently approved burial grounds record of decision requires that the burial grounds be exhumed. This will better support the process of sorting contaminated material that needs disposal from uncontaminated soil that can be placed back into the excavation.

12. Page 100-11, 2nd paragraph. Insufficient explanation of the chromium/salmon studies. Suggest adding text before the last sentence to explain the results better. It is also important to note that the studies conducted to date have not addressed the impact of hexavalent chromium upon benthic or invertebrate food chain organisms essential to chinook salmon and Steelhead trout. The suite of studies proposed by the Trustee Council in the Aquatic Assessment document through Phase III have not been completed. We recommend the following language to describe the results of the studies that have been conducted thus far:

The results of these studies, however, indicate that concentrations of chromium from 54 to 120 µg/L caused changes in DNA strand breakage, histology, and lipid peroxidation. The health of salmon studied was significantly impaired at these concentrations. Growth of salmon was significantly reduced at 120 µg/L and survival was significantly effected at 266 µg/L. The avoidance-preference response to aqueous chromium indicated that chinook salmon were capable of detecting and avoiding concentrations as low as 54 µg/L. All of these effects occurred at concentrations that potentially occur in or near chinook salmon spawning areas. The highest concentration of chromium recorded in the Columbia River in pore water from near-shore areas was 632 µg/L. These studies indicate that the current cleanup plan to achieve the ambient water quality criteria

(AWQC) of 10 µg/L for chromium entering the Columbia River would most likely be protective of developing chinook salmon.

Response: The suggested paragraph was be added with the minor change that the reference to 10 µg/L is a standard rather than a criteria.

13. Page 100-11, third paragraph. The establishment of the Hanford National monument will change the ability of the DOE to restrict public exposure to radiological and organic contaminants in the future. Information on the monument should be updated.

Response: Additional information on the monument was added as requested.

14. Page 100-11, last paragraph, 4th line. Editorial error: Two periods (..) are present. The release of petroleum contaminants into the Columbia River aquatic environments has never been addressed by either DOE or the other Tri-Party agencies and it needs to be, due to the occurrence of endangered Steelhead runs.

Response: The editorial error was corrected. The comment "the release of petroleum contaminants into the Columbia River aquatic environments has never been addressed by either DOE or the other Tri-Party agencies" is incorrect. There have been cleanup actions for the petroleum, and petroleum-contaminated soil is addressed in the 1999 100 N Area ROD, and the petroleum cleanup was addressed in the draft five-year review.

15. Page 100-15, 2nd paragraph, 2nd line. Editorial error: "Columbia" is misspelled.

Response: The editorial error was corrected.

16. Page 100-15, 6th paragraph. It is stated that 82.1 kilograms and 91.3 kilograms of chromium have been removed from two wells. Can these values be put into the context of how much chromium is estimated to be in the groundwater (similar to the discussion of the inventory of strontium-90)?

Response: The mass of chromium in the groundwater plumes being treated by the pump-and-treat systems has been estimated at 590 kg for 100 D Area, 42-250 kg for the 100 H Area, and 250 kg in the 100 K Area. This can be compared to the mass of chromium that has been removed by the pump-and-treat system, which is 103 kg for 100 D Area, 20 kg for the 100 H Area, and 80 kg in the 100 K Area. Removal by the pump-and-treat systems should not be interpreted as progress proportional to the estimated total inventory because the groundwater plume is sustained by chromium that enters from the deep vadose zone. This is evidenced by the fact that chromium concentrations throughout most of the plumes in these areas, which are upgradient from the extraction systems, have

not declined during this period. This underscores the necessity of addressing deep vadose zone chromium to attain the final remedial action goals for these plumes.

17. Page 100-17, Table 100-4 and associated text. Is it accurate to report the "mass" of strontium-90 as "curies"? Isn't "curies" a measure of radioactivity?

Response: The comment is correct. The document has been changed to use "curies" and not "mass".

18. Page 100-18, last paragraph. The text states that "...8 Ci of strontium-90 have been removed due to natural decay." What is the product of decay? Is it a non-toxic substance?

Response: Strontium-90 undergoes a beta decay to Yttrium-90. Yttrium-90 itself is radioactive, with a half life of 64 hours, and it undergoes a beta decay to Zirconium-90 which is not radioactive and is not listed as a CERCLA hazardous substance.

19. Page 100-19, second paragraph. The statement is made that no changes in standards that were identified in the ARARs have been made. The release of Strontium-90 to the Columbia river and it's impact upon endangered Steelhead runs has not been adequately addressed. To date only one early life stage study using chinook salmon smolts has been conducted. There have not been adequate studies done to determine if there are impacts to benthic organisms in the vicinity of groundwater discharge points. The 5 year report needs to include this as an action item.

Response: The EPA believes that there have been adequate studies to justify taking remedial action for the Sr-90 plume. the Department of Energy has prepared the "Salmon and Steelhead Threatened and Endangered Species Management Plan," (DOE/RL-2000-27, dated April 2000). This document was the culmination of efforts by the Department of Energy to consult with NMFS, pursuant to ESA. This plan was prepared in response to the 1998 and 1999 listing of Steelhead and Spring Chinook Salmon within the Columbia River system in the lower Columbia Basin for protection under the ESA. The Tri-Parties will continue to work with members of the Hanford Natural Resources Trustee Council, to ensure that appropriate expertise is factored into the Hanford cleanup process in a constructive manner. A complete risk assessment that evaluates the impact of residual contamination on all human and ecological exposure pathways will also be performed in support of the final ROD for the 100-NR-2. No action item is required in the Five-Year Review.

20. Page 100-24, Protectiveness Statements. Missing from the 5 Year review is any discussion of the landfills on the North Slope and the residual DDT/DDE contamination.

The USFWS does not agree that the remedy for cleanup of these landfill has been protective of the environment. Studies conducted by the USFWS indicate elevated levels of DDT/DDE in biota associated with these landfills.

Response: Reviewers of the five-year review are encouraged to read the full citations from CERCLA and the NCP provided in the first (general) portion of the forward, which identify the scope for five-year reviews. The North Slope was cleaned up to support unlimited used and unrestricted exposure, which means it is not subject to 5 year review.

21. Page 200-6, 200-TW-2. The groundwater and vadose zone are contaminated with carbon tetrachloride however no discussion is provided whether this plume may reach the Columbia River. There is also no discussion regarding a need for an action item to establish an aquatic baseline for carbon tetrachloride impacts.

Response: Text was added to the 200-ZP-1 section that discusses preliminary modeling results and potential impacts to the river. Currently there are no plans to set an aquatic baseline because one of the primary goals of the carbon tetrachloride interim action is to assure that the plume remains on the central plateau.

22. Page 200-6, 200-ZP-1. This unit has carbon tetrachloride, chloroform and trichloroethene in the groundwater and vadose zone however no discussion is provided whether this plume may reach the Columbia River. There is also no discussion regarding a need for an action item to establish an aquatic baseline for carbon tetrachloride, chloroform and trichloroethene impacts.

Response: Text was added to discuss preliminary modeling results and potential impacts to the river. Currently there are no plans to set an aquatic baseline as one of the primary goals of the carbon tetrachloride interim action is to assure that the plume remains on the central plateau.

23. Page 200-8, 200-UP-1. The principle contaminants are described as uranium, Technetium with secondary contaminants consisting of carbon tetrachloride, nitrate, chromium, trichloroethylene, tritium and Iodine-129. There is no discussion provided whether these plumes may reach the Columbia River. There is also no discussion regarding a need for an action item to establish an aquatic baseline for contaminant and whether there is a possible terrestrial impact associated with cleanup.

Response: As with the 200-ZP-1 system, the goal of this action is to assure that contaminants remain on the central plateau and therefore will not have adverse impacts on the river.

24. Page 200-12, 200-PO-1 Operable Unit. The plume from this unit which is described as being contaminated with arsenic, chromium, Iodine-129, manganese, Strontium-90, tritium, vanadium, and nitrate which has reached the Columbia River. It is not clear whether the other contaminants in other plumes such as carbon tetrachloride, chloroform and trichloroethene are present. There have been no studies initiated by the Tri-Party agencies to determine the biological impact of these contaminants to aquatic and terrestrial resource in the Columbia River. An action item clearly needs to be added to the list to do baseline environmental risk assessment research. Studies should be conducted to look at the impact these compounds have upon benthic organisms and higher level organisms that support endangered Steelhead runs. There are also threatened bald eagles that utilize the Columbia River riparian zone for feeding and perching.

Response: EPA disagrees that an action item for additional baseline environmental risk assessment research is necessary.

25. Page 200-15, 200-BP-5 Operable Unit. Ground and surface water in ponds in the Gable Mountain Area are contaminated with Technetium-99, cobalt- 60, Strontium-90, Cesium-137 and Plutonium-223/240. No biological studies have been conducted or referenced which provide a baseline for cleanup for this unit. This should be added as an action item.

Response: EPA disagrees that an action item for additional baseline environmental risk assessment research is necessary.

26. Page 200-20, Disposal facility. We assume that the life of the ERDF cells is intended to be as close to for ever or until radioactive decay products are gone. This section indicates that a double liner was used in construction of the first two cells and that the minimal standards were used for the RCRA requirements. Does this mean that the cells were built to minimal containment standards? A monitoring program to measure the effectiveness of the containment cells and leachate collection system is mentioned. Is this a long term system that monitors for all of the contaminants disposed? The final comment regarding this facility is that the initial footprint of it's construction upon habitat in the Central Plateau of Hanford has not been mitigated for and needs to be.

Response: ERDF was constructed in accordance with RCRA standards, which are quite rigorous. The term "minimum standards" is a colloquial term and will be deleted. The monitoring program is designed to detect all of the contaminants that could result from ERDF operations. The issue of mitigation for the first two cells of ERDF is still unresolved. The Tri-Parties will be working with the Hanford Natural Resources Trustee Council to resolve this issue.

27. Page 300-6, Remedial Actions. Several remedial actions were discussed in the 5 Year Report for the 300 Area. In all of the instances there is not any reference made to the

collection of any baseline biological data in order to determine if cleanup has occurred that is protective of terrestrial resources. The discussion for the 300 Area Process Trench does not adequately describe the contaminants present or the cleanup levels achieved.

Response: The five-year review did not re-evaluate and document each step in the process from identification of sufficient risk to justify a cleanup action, through completion and close-out of the action. Specifically, those data are in documents in the administrative record. The administrative record also contains cleanup verification reports that document post-excavation site conditions.

28. Page 300-7, 300-FF-1 Operable Unit. The cleanup levels described for this unit indicates that institutional controls will be needed because cleanup technology will not allow for unrestricted or unlimited human exposure. The discussion does not describe what contaminants will remain or the level of exposure that will occur. The goal of remedial action for ecological receptors is to protect them from exposure in soil by inhalation or ingestion of radionuclides, metals or organic chemicals. The goal is also to protect human and ecological receptors from ground water contamination and to protect the Columbia River. As wildlife is not overly skilled at reading and comprehending signs we wonder how this will be accomplished? We need to repeat our request that biological studies for ecological risk assessment of both terrestrial and aquatic species need to be conducted and these studies should be added as an action item.

Response: Remedial actions are designed to be protective of ecological receptors. Also, continued environmental monitoring of the 300 Area is a component of the remedy selected in the 300-FF-2 ROD.

29. Page 300-9, 300-FF-5 Operable Unit. Similar comment as above apply to all of the ground water plumes and the surface contamination in this unit.

Response: The updated operations and maintenance plan for 300-FF-5 will include ecological monitoring requirements.

30. Page 1100-7, 2nd paragraph. Replace "outlying datum" with "very high result". The paragraph titled Horse Shoe Landfill needs to be amended to reflect that the State of Washington, Department of Ecology collected three soil samples at Horseshoe Landfill and that two of the samples exceeded the 1ppm DDT/DDE cleanup standard. We do not believe that a 1ppm cleanup standard is adequate considering the nature of DDT/DDE to bio-accumulate in biota; rather, that cleanup standards for these compounds should be based upon a site specific ecological risk assessment focused upon sensitive species.

Response: Statistically, the high result in the bird egg is an outlier. However, that does not mean that the result is invalid. Regarding Ecology's sample data, DOE and EPA

were not informed of, or coordinated with for the sampling. DOE and EPA were first informed that soil sampling had occurred when the results were shared with us. Where and how the samples were collected, what sort of quality assurance and quality control were used was requested but never provided to the lead regulator (EPA) or the responsible agency (DOE). Thus the quality of the data is unknown.

When the landfill was exhumed, there were discrete pockets of soil highly contaminated with DDT from disposal, which was exhumed and disposed off-site. DDT was routinely used by the Army during the operational years of these landfills, and it would be expected that these sites were treated with DDT for the control of nuisance insects. The top soil from the landfill cap was set aside as the first step of the cleanup actions, because this soil was inoculated with native seeds and cryptogram organisms which was a valuable commodity to return to the top of the site following the cleanup actions. Residual DDT from application would be expected in this soil. Because DDT bioconcentrates to very high proportions, residual DDT from the cleanup level of 1.0 ppm and residual from application to the landfill could be expected in organisms living at the site. The ecological risk portion of the revised MTCA will go into effect on August 15, 2001. These regulations establish a soil concentration for protection of terrestrial plants and animals that is expected to be protective at any MTCA site (WAC 173-340-900, table 749-3). That concentration, based on the most sensitive receptor in the MTCA model – the robin, is 0.75 ppm. Robins are not typically present at Hanford. A Hanford-specific evaluation using the meadowlark resulted in a DDT concentration of 1.5 ppm (Doctor, P.G., K.A. Gano, and N.K. Lane "Evaluation of a Terrestrial Foodweb Model to Set Soil Cleanup Levels", *Environmental Toxicology and Risk Assessment: Recent Achievements in Environmental Fate and Transport: Ninth Volume ASTM STP 1381.* Published 2000). Given the uncertainties associated with the risk information and the sample analyses, it is our conclusion that 0.75 and 1.0 ppm are equally protective.

31. Page 1100-10, 1100-IU-1. We do not agree that the cleanup that has occurred is protective of the environment.

Response: EPA accepts your opinion, but still concludes that the remedy is protective. When the landfill was exhumed, there were discrete pockets of soil highly contaminated with DDT from disposal, which was exhumed and disposed off-site. DDT was routinely used by the Army during the operational years of these landfills, and it would be expected that these sites were treated with DDT for the control of nuisance insects. The top soil from the landfill cap was set aside as the first step of the cleanup actions, because this soil was inoculated with native seeds and cryptogram organisms which was a valuable commodity to return to the top of the site following the cleanup actions. Residual DDT from application would be expected in this soil. CERCLA liability does not apply to authorized application of DDT. Because DDT bioconcentrates to very high proportions, residual DDT from the cleanup level of 1.0 ppm and residual from application to the landfill could be expected in organisms living at the site. The cleanup level of 1.0 ppm assumes that residual amounts of this bioaccumulating chemical could be seen in biota.

Responses to the Nez Perce Tribe's Comments on the Draft Five-Year Review Report

General Comments

1. In the foreword it states that the "*purpose of a five year review is to determine whether the remedy at a site is protective of human health and the environment.*" It is unclear that this is truly being determined at each waste site. We submit that the only way you can be sure that a remedial action is protective of the environment is by sampling some of the biological indicators at selected waste sites to determine if contaminants are being incorporated into the food chain. We contend that in the absence of any such data that it is not possible to ascertain that a given remedial action is truly protective of the environment. The five-year review in its present form seems to rely on educated guesses and visual observations. We feel that this approach is probably inadequate and misleading at many of the waste sites included in the document.

   Response: There is a great deal of biological data available and that information was considered in the five-year review.

2. It appears that insufficient sampling is being conducted to characterize waste sites. Since the transport mechanisms within in the vadose zone are poorly understood, it may be prudent to investigate the soil column of each waste site before remediation begins rather than using the analogous site approach. Further study, to define the waste sites, would aid the remediation workers in anticipating potential hazards, estimating the volume of soil to be excavated, and projecting remediation costs.

   Response: Investigations and remediations conducted have shown that the analogous site approach is valid. Not all hazards can be anticipated and funds are best spent on cleanup.

3. The grouping of waste sites in the 200 Areas by historic process information and waste site type minimizes the importance of subsurface geology and ignores the potential for waste migration and mixing (i.e. waste sites located together in close proximity) in the vadose zone. Subsurface geology and geographic location should be factors in how waste sites are grouped together for characterization and remediation.

   Response: EPA agrees that understanding subsurface geology is key in selecting appropriate remedies. As investigations occur, geologic information is collected. Irrespective of how the waste sites are organized, the same information is being collected. No changes are required in the text.

Specific Comments

1. Page vii
The table that begins at the bottom of the page should be labeled as Table 1 with an appropriate title.

Response: This is the only table in the foreword and therefore a number is not needed.

2. Page 100-7, 1995 ROD as Amended in 1997
In many cases, soil remediation to a depth of only 15 feet will not remove enough of the contaminant inventory to prevent further degradation of groundwater. In these cases, it is unclear how future impacts to groundwater are being prevented. Use of the RESRAD model to establish the criteria for the cleanup levels for the deeper soil is inadequate as RESRAD addresses only impacts on human health. Improper parameter selection and inputs into the model are also a concern.

Response: The contaminant transport (leaching to groundwater resulting from irrigation) portion of the RESRAD model is used to calculate the potential for contaminants to reach groundwater. That resulting potential groundwater contamination is then compared to ecologically-based chronic ambient water quality criteria to determine ecological risk and to drinking water standards to determine human health risk.

Regarding parameter selection and inputs, we understand the concern over inputs to the model. The parameters used reflect the current understanding and the model's parameters are reviewed and modified when appropriate.

3. Page 100-9, A. Soil Sites
Inadequate soil characterization prior to remediation has caused the extent of soil contamination to be underestimated.

Response: The purposes of pre-remedial characterization are to determine whether or not an action is necessary and make a reasonable estimate of the extent of contamination. The characterization performed was adequate for these purposes.

4. Pages 100-14 & 100-15, Pump and Treat for Chromium
The fundamental problem with the chromium pump and treat systems is that the extraction wells were not placed in the areas with the highest concentrations of chromium in the groundwater. Placement of extraction wells in these areas would increase the effectiveness of the pump and treat systems.

Response: The goal of the remedial action was to intercept the chromium before it entered the Columbia River. The problem with the current system is that it isn't

capturing enough of the groundwater flow. Therefore a recommendation of this five-year review is to upgrade the system to eliminate this problem. Pumping from the locations as suggested in this comment would not achieve the goal.

5. Page 200-18, Figure 200-9
The figure should be labeled to make it clear that the contours represent concentrations of strontium-90 in groundwater.

Response: The title on the figure was changed as recommended.

6. Page 200-29, Protectiveness Statement
The statement that the groundwater plumes (200-PO-1 Operable Unit) do not require an immediate response action to protect human health and the environment should be supported within the text. Because of these plumes, groundwater with concentrations of tritium and ^{129}iodine above drinking water standards are entering the Columbia River. Please reference ecological studies that indicate that there is no immediate impact to wildlife resulting from these plumes.

Response: Text has been added to the 200-PO-1 section to support the statements.

7. Page 1100-7 Horse Shoe Landfill
The summary of available information from this site is too brief and not consistent with the level of detail provided throughout the report for other waste sites. There is no mention of the conclusions by the USFWS in their reports and letters that indicate there might be a high risk to wildlife and especially migratory birds. There is no mention of the three soil samples collected by Ecology in the fall of 1999 and the fact that two of those samples exceeded the cleanup level of 1 ppm. The last sentence states that "*the biota data is reasonable, given the 1 ppm soil cleanup standard.*" We think this statement needs more explanation and clarification, especially since we have just heard from DOE that the new MTCA standards for the state of Washington indicate that levels of DDT from 0.7 -1.5 ppm in biota may be cause for concern. We also do not agree with how the 45-ppm of DDT that was found in a bird egg can be characterized as an "*outlying egg shell datum.*" This seems like an attempt commonly made by statisticians to insinuate that if there is only one value that is high that it may not reflect actual site conditions. If more eggs could have been collected we may have found that more than one egg had elevated levels of DDT.

Finally, there is no mention of the 1100 PAD's that were issued by two of the tribes regarding their concerns about Horse Shoe Landfill. It seems that EPA has not recognized the problem or any liability because of an inadequate cleanup. EPA should acknowledge the problem and become proactive in helping to resolve the whole issue.

Response: Regarding Ecology's sample data, DOE and EPA were not informed of, or coordinated with for the sampling. DOE and EPA were first informed that soil sampling had occurred when the results were shared with us. Where and how the samples were collected, what sort of quality assurance and quality control were used was requested but never provided to the lead regulator or the responsible agency. Thus the quality of the data is unknown.

Regarding the revised MTCA regulations, the ecological risk portion of MTCA will go into effect on August 15, 2001. These regulations establish a soil concentration for protection of terrestrial plants and animals that is expected to be protective at any MTCA site (WAC 173-340-900, table 749-3). That concentration, based on the most sensitive receptor in the MTCA model – the robin, is 0.75 ppm. Robins are not typically present at Hanford. A Hanford-specific evaluation using the meadowlark resulted in a DDT concentration of 1.5 ppm (Doctor, P.G., K.A. Gano, and N.K. Lane "Evaluation of a Terrestrial Foodweb Model to Set Soil Cleanup Levels", *Environmental Toxicology and Risk Assessment: Recent Achievements in Environmental Fate and Transport: Ninth Volume ASTM STP 1381*. Published 2000). Given the uncertainties associated with the risk information and the sample analyses, it is our conclusion that 0.75 and 1.0 ppm are equally protective.

Statistically, the high result in the bird egg is an outlier. However, that does not mean that the result is invalid. It may mean that the bird that laid the egg was carrying a burden of DDT from another location, possibly quite distant. The Five-year Review acknowledges that the DDT is an issue being addressed by the natural resource trustees.

8. Page 1100-9 Action Items, First Paragraph
It is true that the EPA has been a participant in the discussions about the Horse Shoe Landfill on the Hanford Natural Resource Trustee Council; however, the EPA has been reluctant to address the issue and has not been proactive in proposing possible solutions at this landfill. EPA determined in 1995 that the site was cleaned up based on only three confirmatory soil samples. We believe that EPA should be more active in proposing a possible resolution to the residual levels of DDT that still remain at the site. EPA has been perfectly content for the trustee council to debate the issue for the last 3 years without any resolution.

Response: The DOE is currently planning, in coordination with the other Hanford trustees, to do additional sampling at the Horseshoe Landfill to help resolve this issue.

9. Page 1100-10 Protective Statements
ERWM strongly disagrees with the statement under 1100-IU-1 that states it "*is protective of human health and the environment and that the remedial actions allow for unrestricted use and unlimited exposure.*" Part of the ALE management plan that is being written has a Tribal Uses Section that is going to allow the tribes to collect plant material from the

site for consumption, ceremonial and medicinal purposes. Under no circumstances could we assure tribal people that it would be perfectly safe to collect such material at the Horse Shoe Landfill given the residual DDT contamination that still exists. We also think that if the public knew about the levels of DDT that may still exist at the site that no one would use this area for recreation or any other purpose. It is inconsistent for EPA to acknowledge elevated levels of DDT at Horse Shoe Landfill (page 1100-7) and then make the comment that all is well.

We do not understand how his conclusion can be reached given the fact that three separate sampling efforts by three different organizations have found elevated levels of DDT at Horse Shoe Landfill. All of these studies should raise a red flag about potential problems at that site that should be taken seriously by EPA. The statements about Horse Shoe Landfill make the credibility of the five year review extremely suspect.

Response: EPA still concludes that the remedy is protective. When the landfill was exhumed, there were discrete pockets of soil highly contaminated with DDT from disposal, which was exhumed and disposed off-site. DDT was routinely used by the Army during the operational years of these landfills, and it would be expected that these sites were treated with DDT for the control of nuisance insects. The top soil from the landfill cap was set aside as the first step of the cleanup actions, because this soil was inoculated with native seeds and cryptogram organisms which was a valuable commodity to return to the top of the site following the cleanup actions. Residual DDT from application would be expected in this soil. CERCLA liability does not apply to authorized application of DDT. Because DDT bioconcentrates to very high proportions, residual DDT from the cleanup level of 1.0 ppm and residual from application to the landfill could be expected in organisms living at the site.

Responses to the Washington State Department of Fish and Wildlife's Comments on the Draft Five-Year Review Report

GENERAL COMMENTS

1. **Ecological Risk**

To date, the Tri-Parties, i.e. EPA, U.S. Department of Energy (USDOE), and Washington Department of Ecology (Ecology), have been using a qualitative ecological risk assessment in the Remedial Investigation/Feasibility Study (RI/FS) process to determine risk to biological receptors. The approach is based on modeling, and the models have never been validated or calibrated. It can not be determined whether a selected remedy is protective of the environment (i.e. fish and wildlife) at a remedial waste site and surrounding areas during the RI/FS and 5-year review process, or whether the remedy is functioning as intended without collecting biological data or validating models.

The qualitative risk assessment failed in the 1100 Area and the 100-IU-3. Exposure routes are being documented after the fact, such as, DDT in biota in the 1100 Area and 100-IU-3. The results of studies assessing effects of hexavalent chromium on fall chinook salmon indicate potential injury. The Tri-Parties knowing this still have not changed to a pre-remedial quantitative ecological assessment in the remaining NPL areas (i.e. 100, 200 and 300 Areas).

A quantitative approach, such as, a pre-remedial ecological exposure/effect assessments, is needed immediately to assist the decision-makers in the RI/FS and future 5-year review processes and in establishing remedial action objectives that are protective of biological receptors. This approach would be consistent with EPA guidance. Without gathering pre-remedial biological data, we are unable to determine whether selected or proposed remedies are/will be protective of the environment (i.e. fish and wildlife).

Response: The comment correctly notes that the Tri-Parties have used what we have termed "qualitative risk assessments" for most of the RI/FSs at Hanford. Some of these "qualitative risk assessments" have used extensive data sets, calculated exposure using multiple pathway models for multiple species, and calculated risk for multiple species. Based on content, those are quantitative risk assessments. (Example: The Qualitative Risk Assessment for the 100-KR-4 Groundwater Operable Unit calculated hazard quotients for six receptors – a plant, a fish, a crustacean, a plant-eating duck, a fish-eating duck, and a heron – from exposure to seven radionuclides and 16 non-rad contaminants.) Although these risk assessments are quantitative in many respects, the Tri-Parties have called them qualitative risk assessments, because at the end of the risk calculations, the numeric calculations are expressed as a qualitative risk such as "very low," "low," "medium," "high," or "above/below" a hazard quotient.

The comment states that the risk models have never been validated or calibrated. The CRITR2 code that was used for the qualitative risk assessments in the early-mid 1990s was not validated or calibrated for the Hanford radionuclides of interest. The Columbia River Comprehensive Impact Assessment document, completed in 1998, was done under Tri-Party Agreement milestone M-15-80. This assessment used a spreadsheet-based model based on the work of Thomann, et al., which has a pedigree of validation and calibration. This assessment was for 52 species exposed to 25 contaminants. The risks identified in the qualitative risk assessments were also identified as risks in the Columbia River Comprehensive Impact Assessment.

The second two paragraphs of the comment focus on the issue of how much information is necessary before taking a remedial action, including how much characterization is appropriate. The purposes of pre-remedial characterization are to determine whether or not an action is necessary and make a reasonable estimate of the extent of contamination. Biological resource surveys are often part of the pre-remedial characterization (either using existing data or with a specific task). The characterization performed was adequate for these purposes. As remedial actions progresses, new information is gained. This was the case with the DDT in the 1100 Area that was discovered during the remedial action. During the characterization phase, there was no reason to suspect DDT was present.

The 1993 "qualitative" risk assessment for 100-KR-4 discussed earlier calculated a hazard quotient greater than 1.0 for chromium, therefore it is not surprising that the recently-completed Trustee's study indicates potential injury. The Tri-Parties were aware of and responded to this issue years earlier by implementing remedial actions.

All of the remedial actions selected thus far have included protection of ecological receptors as remedial action objectives.

2. **New Contaminant Exposure Pathways** [First part of comment]

With the current RI/FS risk assessment approach, no new data have been collected during the RI/FS or 5-year review process to determine if there are any open contaminant exposure pathways to fish and wildlife that may pose unacceptable risk to them. However, in the past several years, several scientific efforts have documented open pathways. These include DDT, ^{90}Sr, and Cr^{+6} and were initiated by U.S. Fish and Wildlife Service (USFWS), Washington Department of Health, and the Hanford Natural Resource Trustee Council (Council), respectively. Unfortunately, it appears that EPA staff failed to recognize and/or act on this information and the need to conduct further evaluations on these contaminants.

Response: The comment opens with the statement, "with the current RI/FS risk assessment approach, no new data have been collected during the RI/FS." The EPA does not agree with this statement, and encourages the commenter to review an RI/FS document. These are available in the administrative record. The comment also mentions

collection of new data as part of the five-year review process. A five-year review is not intended to be a new data collection activity; it is a review.

The comment correctly notes that, "open contaminant exposure pathways to fish and wildlife that may pose unacceptable risk to them" is important scope for the five-year review. Cleanup actions are designed to eliminate or minimize open contaminant exposure pathways to fish and wildlife. The CERCLA decision documents and the ARARs are the benchmarks in the five-year review to define what is an unacceptable risk. Hence the approach in the five-year review to achieve the objective identified in the comment is to review the cleanup action relative to the decision documents and ARARs.

The comment states that recent studies by a number of agencies or organizations have identified open pathways for DDT, Sr-90, and Cr^{+6} . These contaminants were all identified years earlier in the CERCLA RI/FS process as posing a human health or ecological risk. The presence of these contaminants has resulted in remedial actions for DDT on the North Slope and ALE, Sr-90 at N Springs and contaminated soil sites, and for Cr^{+6} in 100 Area groundwater at four plumes and at contaminated soil sites.

New Contaminant Exposure Pathways [Second part of comment]

DDT was documented by USFWS while performing a level III preacquisition survey on the North Slope (100-IU-3) and Arid Lands Ecology Reserve (1100-IU- 1). Concentrations observed in small mammal samples exceeded >5.0 ppm and the ratio of DDT/DDD/DDE in one sample at the H-06-LE site on the North Slope was very close to 1: 1: 1 indicating a relatively unweathered source of DDT still exists there. Contaminant concentrations of ^{90}Sr in biota were substantially higher near the N reactor than at a background site (Vernita Bridge). The hexavalent chromium study is the most extensive study to date at the Hanford Site in terms of documenting ecological exposure and effects. It is still incomplete but initial results indicate potential injury to fall chinook salmon somewhere between 11 ppb and 24 ppb. Upper Columbia River steelhead, which are federally listed, may be more sensitive than fall chinook salmon and additional studies are warranted.

Response: The cleanup level of 1.0 ppm that Ecology, as lead regulator, chose for the North Slope implies residual amounts of this bioaccumulating chemical could be seen in biota with significant exposure to the residual DDT. It is typical in this arid region of Washington state that decades-old DDT and its metabolites are in ratios typical of relatively unweathered sources.

Since Ecology selected 1.0 ppm for the North Slope and concurred on 1.0 ppm for ALE, Ecology has promulgated revisions to the ecological risk portion of MTCA that will go into effect on August 15, 2001. These regulations establish a soil concentration for protection of terrestrial plants and animals that is expected to be protective at any MTCA site (WAC 173-340-900, table 749-3). That concentration, based on the most sensitive receptor in the MTCA model – the robin, is 0.75 ppm. Robins are not typically present at

Hanford. A Hanford-specific evaluation using the meadowlark resulted in a DDT concentration of 1.5 ppm (Doctor, P.G., K.A. Gano, and N.K. Lane "Evaluation of a Terrestrial Foodweb Model to Set Soil Cleanup Levels," *Environmental Toxicology and Risk Assessment: Recent Achievements in Environmental Fate and Transport: Ninth Volume ASTM STP 1381.* Published 2000). Given the uncertainties associated with the risk information and the sample analyses, it is our conclusion that 0.75 and 1.0 ppm are equally protective.

Concentrations of Sr-90 above background near the N reactor is a statement of fact, so no response is needed, except to state that the contaminated waste sites are currently being exhumed and the groundwater plume is subject to a pump-and-treat remedial action. "The hexavalent chromium study" is actually a set of many hexavalent chromium studies. Routine monitoring of groundwater wells have documented groundwater contamination with chromium adjacent to the river. Groundwater is known to discharge into the river. Springs and seeps that discharge to the river have been sampled and show contamination with chromium. Pore water sampled adjacent to and in the river bottom has confirmed the extrapolation of the groundwater data into the river bottom environment with some dilution. There have been many surveys of the salmon spawning areas in the river bottom. This collection of data documents an exposure of early life states of salmon to chromium derived from groundwater. Recently the USGS and Battelle have conducted laboratory studies, in coordination with the Hanford Natural Resource Trustee Council, that show physiological/behavior consequences under laboratory conditions. All the chromium studies have supported the cleanup level used in the remedial actions.

3. **Federally Listed Species**

The authors of this Report failed to consider recent federal listings under the Endangered Species Act. Species listed include: upper Columbia River steelhead (*Oncorhynchus mykiss*) as endangered (8/97), upper Columbia River spring chinook salmon (*0. tshawytscha,*) as endangered (3/99), and bull trout *(Salvelinus confluentus),* as threatened (6/98). These listings occurred after Records of Decisions had been issued for remedial ground water actions in the 100 and 300 Areas. USDOE continues to allow the release, as defined under CERCLA § 101 (22), of hazardous substances that exceed state ambient water quality standards to the Columbia River that may potentially harm these listed species and their critical habitat.

EPA's 5-year review guidance recommends an interagency, multi-disciplinary team approach to ensure a high quality, thorough review, especially at complex sites. It is unknown why EPA's Hanford Project Manager decided against this approach. WDFW believes that it is necessary to utilize other federal agency expertise from the USFWS and National Marine Fisheries Service (NMFS) given the complexity of the site, the multitude of contaminants present, and their potential detrimental affects to biological receptors. In light of the recent listings at a minimum, USFWS and NMFS should be consulted and the ground water Records of Decisions in the 100 and 300 Areas should be modified to reflect the new listings and list ESA as an ARAR. These RODs should be modified to

include language that requires USDOE to gather biological data to determine potential impact to listed species and establish clean-up standards protective of them.

Response: The EPA does not agree with the comment that "the authors of this report failed to consider recent federal listings under the Endangered Species Act." The ESA was identified as an ARAR in the appropriate decision documents. Chromium is the contaminant of concern that has been identified as providing potential risk to the species identified in the comment. The cleanup actions for the groundwater chromium plumes have used the state ambient water quality standard for chronic exposure as the cleanup standard. All recent studies mentioned by this commenter have supported this cleanup standard as protective. The Tri-Parties recognized the risk to these species, and the DOE implemented the pump-and-treat actions prior to any of these species being listed under the ESA. It is unclear in the comment how the pre-emptive actions by the Tri-Parties are considered by the commenter as having "failed to consider recent federal listings." Deficiencies in the groundwater capture of the chromium plumes have been documented by the DOE, identified in this five-year review, and constitute one of the recommendations in this document.

Regarding the second paragraph, EPA has the appropriate staff to conduct this five-year review. Further, DOE did initiate consultation with the NMFS in response to the listing of salmonids in the Hanford portion of the Columbia River. With regards to the comment that "the ground water Records of Decisions in the 100 and 300 Areas should be modified to reflect the new listings and list ESA as an ARAR," these RODs already list ESA as an ARAR which provides for new listings.

With regards to the statement in the comment that "These RODs should be modified to include language that requires USDOE to gather biological data to determine potential impact to listed species and establish clean-up standards protective of them," data has already been gathered, species surveys have documented their presence, so potential impact is established. Quantifying actual injury isn't necessary prior to taking a cleanup action, which is the strategy that has been used by the Tri-Parties. Regarding the cleanup standards portion of the comment, that fact that focused toxicological studies performed for the Hanford Natural Resource Trustees have thus far supported the protectiveness of the selected cleanup standard has already been discussed in the previous response. A complete risk assessment that evaluates the impact of residual contamination on all human and ecological exposure pathways will be performed in support of the final RODs for the 100 and 300 Areas. No action item is required in the Five-Year Review.

4. **Hanford Reach National Monument**

There are waste sites that lie within the Hanford Reach National Monument's boundary. The proclamation signed on June 9, 2000, by the President of the United States included language recognizing the USDOE's responsibility to restore the natural resources at the Hanford facility and within the Monument's boundary. To achieve that goal, it is appropriate and consistent with ESA requirements for EPA to recommend to USDOE that they implement a quantitative ecological risk assessment to ensure remedial actions

are indeed attempting to sever or reduce exposure of hazardous substances to biological receptors. The current qualitative risk assessment approach does not achieve this objective, nor does waiting to conduct an ecological baseline risk assessment after remedial actions are finished achieve this objective. WDFW has concluded that the Tri-Parties are currently unable to document whether selected or proposed remedial actions are/will be protective of biological receptors.

Response: The EPA has recommended and DOE has conducted many quantitative ecological risk assessments at Hanford. As described in another response, many of these have been called "qualitative," which regrettably has mislead those who have judged the document's worth based on the title rather than the content. The DOE is preparing to conduct a post-remedial action human health and ecological risk assessment at the 100-BC Area, the first of the major remedial action areas that has reached the backfill and revegetation stage which allows sampling of post-cleanup ecological receptors. Post-cleanup biomonitoring is also a requirement in the 300 Area. We understand from the last two sentences of the comment that WDFW does not accept this information as documenting protectiveness, and accept that as the WDFW position. The EPA anticipates this baseline risk assessment data will be able to achieve the objective of determining the protectiveness of the remedial action to biological receptors.

SPECIFIC COMMENTS

100 Area

1. This NPL site and associated operable units lack the same quantitative ecological risk assessment as the 200 and 300 Areas. Insufficient scientific data exists to show that selected remedies are indeed protective of the environment. Additional biological data sampling is warranted.

   Response: This specific comment was addressed in the responses to the general comments from WDFW.

2. Although the Tri-Parties foreclosed on conducting a 5-year review for the 100-IU-3 Operable Unit in the *draft Interim Closeout Report North Slope Expedited Response Action,* a review appears appropriate given the assumptions used at the time of the remedy selection. The foreclosure action is also inconsistent with EPA 5-year review guidance that states, "An entire site is subject to a statutory review if any one of its remedial actions is subject to a statutory review. The triggering action for a statutory review at a site with multiple OUs is the initiation of a remedial action at the first OU where hazardous substances, pollutants, or contaminants will remain above levels allowing for unlimited use and unrestricted exposure after completion of the remedial action." We interpret the word "site" to mean the 100 Area NPL site. The guidance

further states, “Five year reviews should address all operable units and remedial actions for which there is a ROD or Action Memorandum.” We believe that the 5-year review should include the Action Memorandums for 100-IU-4, 100-IU- 1, 100-IU-3, 100-IU-3 North Slope 2-4-D Burial Site, and the no action ROD for the 100-IU-1, 100-IU-3, 100-IU-4 and 100-IU-5. These exclusions from the review are not consistent with the way the 5-year review process applied to the 1100-IU-1.

Response: The sites included in the five-year review include those that fit the NCP criteria as explained in the foreword. In addition, because there have been removal actions at Hanford that are larger than envisioned in the NCP (note that the NCP only requires a five-year review for remedial actions), some removal actions have been included (see Table 100-1). Regarding the last comment and 1100-IU-1, this operable unit was included to mention the DDT issue and to acknowledge that it would not be the subject of future reviews.

3. In addition, new ecological exposure pathways and receptors have been identified for waste sites within the 100-IU-3 Operable Unit. The source of this information came from a USFWS preacquisition survey. The contaminant of concern is DDT and its metabolites and receptors include small mammals, insects, and raptors. No ecological risk assessment was conducted prior to the remedial action or prior to the Operable Unit being deleted from the 100 NPL site via a partial deletion. Implementation of a biomonitoring plan is appropriate at this time given that the 100-IU-3 OU lies within the Hanford Reach National Monument.

Response: This comment was addressed in the general comments.

4. The Council's assessment plan (*i.e. Hanford Site 100 Area Assessment Plan, Volume I: Columbia Rivers Aquatic Resources*) is mentioned on page 100-11. Unfortunately, EPA only mentions the Cr^{+6} study. The assessment plan also identified tritium and ^{90}Sr as contaminants of concern and identified potential ^{90}Sr studies involving sculpin. The proposed studies would assist in fulfilling the evaluation of ecological receptor impact requirements as identified in the Interim Remedial Action ROD for the 100-NR-1 and the 100-NR-2 Operable Units. The requirement states, “Obtain information to evaluate technologies for Sr-90 removal and evaluate ecological receptor impacts from contaminated groundwater (by October 2004).” No quantitative ecological assessment studies have been proposed other than those USDOE agreed upon in supporting the Council's 100 Area Assessment Plan (Resolution 99-01).

Response: This comment is correct. The five-year review only mentioned the Cr^{+6} study because that is the only potential study identified in the assessment plan that was implemented. The assessment plan did identify tritium and Sr-90 as contaminants of concern. The highest concentration tritium plume in the 100 Area is downgradient of the 100 K East fuel storage basin. The EPA is overseeing, as lead regulator, the remedial action for the basin. The highest concentration Sr-90 plume is in the 100 N Area. The

Ecology is overseeing, as lead regulator, the groundwater pump-and-treat and soil excavation remedial actions for that contaminant problem.

5. On page 100-18, EPA states "the pump-and-treat system does not appear to be effective method for reducing Strontium-90 concentrations in the aquifer relative to natural decay." This may be the case for ^{90}Sr, but the pump-and-treat may be effective in creating a hydraulic barrier that prevents other contaminants of concern from impacting the Columbia River. Its evaluation as a hydraulic barrier that prevents other contaminants of concern from impacting the Columbia River does not appear to have been performed. In addition, proposals have not been presented to treat these contaminants of concern.

   Response: The comment states "the pump-and-treat may be effective in creating a hydraulic barrier that prevents other contaminants of concern from impacting the Columbia River." That is true. The comment continues "its evaluation as a hydraulic barrier that prevents other contaminants of concern from impacting the Columbia River does not appear to have been performed." That statement is not correct. Please note the following statement in the five-year review: "The pump-and-treat interim action continues to reduce the hydraulic gradient toward the river...reducing the net flux of groundwater by approximately 96 percent."

Recommendations

1. USDOE shall recalculate ecological risk for the 100 NPL site using a quantitative approach for terrestrial and aquatic environments (i.e. biological receptors), and initiate by July 2001. The emphasis of the assessment shall be to gather pre-remedial biological data, and shall be coordinated with the Hanford Natural Resource Trustees.

   Response: This comment is addressed in the general comments.

2. Action item 100-2 needs to be revised to include "USDOE shall initiate a quantitative ecological evaluation of ecological receptor impacts from contaminated ground water by December 2001 and complete by October 2004."

   Response: In essence this requirement was put into the Tri-Party Agreement in 1994 and resulted in the Columbia River Comprehensive Impact Assessment published in final form in January 1998.

3. USDOE shall develop a remedial treatment train that addresses the other ground water contaminants of concern originating from the 100 N-Area by October 2004.

   Response: The comment does not indicate what the other contaminants of concern are.

4. Action item, 100-1, second bullet, needs revised to state that "downtime must be dramatically reduced and the system must achieve an operational efficiency of a minimum of 90%." Efficiency would be comparable to the Strontium-90 pump-and-treat.

   Response: The requirements for the chromium pump-and-treat systems are laid out the ROD and RDR/RAWP, which were designed to be protective. The systems need to be upgraded to achieve those protectiveness standards.

5. All 100 Area interim RODs shall be modified to include ESA and Migratory Bird Treaty Act as ARARs.

   Response: These laws are already included in some of the RODs as ARARs. This comment is partially addressed in the response to WDFW general comment number 3. Also, these laws should not be identified as ARARs when endangered species and migratory birds aren't involved.

200 Area

1. This NPL site and associated operable units lack the same quantitative ecological risk assessment as the 100 and 300 Areas. Insufficient scientific data has been collected to assist in establishing appropriate remedial action objectives. Additional biological sampling is warranted.

   Response: EPA and Ecology are requiring DOE to develop an ecological assessment for the 200 Area NPL site to support remedy evaluation and selection. The evaluation will include data collected as part of the site-wide environmental report. It is anticipated that biological sampling may occur as part of this assessment. No changes are required in the text.

2. WDFW has repeatedly requested a 200 Area quantitative ecological assessment (please reference letters dated 14 January, 1999; 4 August, 1999 and 4 January, 2000 from J. McConnaughey to Bryan Foley of USDOE). It is extremely difficult to properly frame remedial action objectives when insufficient biological data that can assist in determining the extent of a release of a hazardous substance to the environment has been gathered. Without biological data, the remedial project managers are merely speculating that proposed/selected remedies will be protective of the environment.

   Response: EPA and Ecology are requiring DOE to develop an ecological assessment for the 200 Area NPL site to support remedy evaluation and selection. The evaluation will include data collected as part of the site-wide environmental report. It is anticipated that biological sampling may occur as part of this assessment. No changes are required in the text.

3. Given that a conservation land use designation surrounds the industrial exclusive area, as designated in the final Comprehensive Land Use Plan, it is appropriate to gather biological data to assist in the on-going remedial characterization there. Institutional Controls, such as, signs and fencing, will not prevent or hinder avian, insects, or small mammal species from entering waste sites, or the industrial exclusive area.

   Response: EPA and Ecology are requiring DOE to develop an ecological assessment for the 200 Area NPL site to support remedy evaluation and selection. The evaluation will include data collected as part of the site-wide environmental report. It is anticipated that biological sampling may occur as part of this assessment. No changes are required in the text.

Recommendations

1. USDOE shall calculate ecological risk by conducting a quantitative ecological assessment for the 200 NPL site, and initiate by December 2001. The effort shall be coordinated with the Hanford Natural Resource Trustees.

   Response: Agreed. This effort is already underway. No changes are required in the text.

2. USDOE shall include the Migratory Bird Treaty Act as an ARAR in all 200 Area Operable unit RODS.

   Response: Agreed. The Migratory Bird Treaty Act will be included in future remedy evaluations and selections. No changes are required in the text.

300 Area

1. This NPL site and associated operable units lack the same quantitative ecological risk assessment as the 100 and 200 Areas. Insufficient scientific data exists to show that selected remedies are indeed protective of the environment. Additional biological data sampling is warranted.

   Response: Potential impacts to ecological receptors from 300 Area contamination were evaluated in ecological investigation reports performed in support of the 300-FF-1 and 300-FF-5 Record of Decision which was approved in 1996. Information on biota and habitats collected for 300-FF-1 and 300-FF-5 is considered analogous to the 300-FF-2 due to the close proximity of the operable units. Most of the 300 Area waste sites are located in areas that have been highly disturbed by industrial/waste management operations and would be unable to support complete ecological communities represented

by common food webs. Ecological impacts are isolated and can not be tied to an exposure scenario that would result in an adverse impact to a wildlife receptor. There are no data that indicate the need for a full-scale reevaluation of the conclusions of past 300 Area ecological investigations at this point in time. The 300-FF-2 ROD requires ongoing environmental monitoring of the 300 Area as part of the selected remedy. This information will be reviewed in the future in support of five-year reviews to ensure that the selected remedy (i.e., remove, treat, and dispose of contaminated soil and debris) is sufficient to protect both human health and the environment. No changes required.

2. Goals listed on pages 300-7 and 300-8 for the 300-FF- I Operable Unit are unachievable without gathering ecological receptor data.

Response: Data on ecological receptors will be gathered pursuant to the 300-FF-2 ROD. In addition, data will also have to be gathered to support a comprehensive baseline risk assessment that will have to be performed in support of the final RODs for the 300-FF-5 and 300-FF-2 operable units. No change is required

3. A uranium plume that originates from the 300 Area NPL site is reaching the Columbia River. Data indicate that the uranium concentration levels are not attenuating as predicted (reference letter dated 5 September, 2000 and see enclosure from J. McConnaughey of WDFW to Mike Goldstein of EPA). The half-life for uranium radioactive isotopes is hundreds of thousands to millions of years. EPA is currently requiring USDOE to pump and treat a uranium plume in the 200 Area but is not requiring USDOE to pump and treat a plume in the 300 Area that is directly and currently impacting the Columbia River. Containment is cited as justification for pump-and-treat in the 200 Area; the same justification exists in the 300 Area. Furthermore, EPA's policy directive 9200.4-17P and USDOE's guidance document entitled *Decision-Making Framework Guide for the Evaluation and Selection of monitored Natural Attenuation Remedies at Department Of Energy Sites* (USDOE Office of Environmental Restoration, May 13,1999) are not being adhered to. According to Ecology staff, the policy and guidance are not being met, (reference letter dated December 19, 2000 from John Price, Environmental Restoration Project Manager to Mr. Michael Goldstein of EPA). As part of a performance evaluation, a scientific approach to this problem would include a quantitative ecological assessment to determine if the uranium plume is affecting aquatic receptors. Aquatic receptors were not considered during the RI/FS qualitative risk assessment process. Part of the evaluation should include potential effects/harm to federally listed fish species.

Response: EPA's assessment of this issue can be found on page 300-14 of the Five-Year Review Report. Insufficient data exists at the present time to evaluate the effectiveness of the natural attenuation remedy and the current Operations and Maintenance plan for the 300-FF-5 Operable Unit is not adequately addressing this issue. Action item 300-4 will result in a new O&M plan. A complete assessment of the natural attenuation remedy for

all groundwater plumes contained in the 300-FF-5 Operable Unit will be performed in support of EPA's next five-year review. No change is required.

4. Our comments submitted on the 300-FF-2 remain unresolved and applicable. Please reference letter dated 12 January, 2000 from J. McConnaughey to Mike Goldstein of EPA, and letter dated 5 September, 2000 to same addressee.

   Response: The referenced comments are addressed in the responsiveness summary of the 300-FF-2 ROD.

5. Institutional Controls, such as, signs and fencing, will not prevent or hinder fish, insects, burrowing mammals and migratory birds from entering waste sites or contaminated ground water plumes.

   Response: Past 300 Area studies have resulted in the conclusion that ecological impacts are isolated and can not be tied to an exposure scenario that would result in an adverse impact to a wildlife receptor. Continued environmental monitoring will provide necessary data to evaluate this conclusion. No change is required.

Recommendations

1. USDOE shall recalculate ecological risk for the 300 NPL site using a quantitative ecological risk assessment approach for terrestrial and aquatic environments (i.e. biological receptors), and initiate an assessment by July 2001. The emphasis of the assessment shall be to gather pre-remedial biological data, and shall be coordinated with the Hanford Natural Resource Trustees. Evaluation shall include species listed under ESA and the Migratory Bird Treaty Act.

   Response: A complete risk assessment that evaluates the impact of residual contamination on all human and ecological exposure pathways will be performed in support of the final RODs for the 300-FF-2 and 300-FF-5 Operable Units. No action item is required in the Five-Year Review.

2. USDOE shall include quantitative ecological risk assessment language in the 300FF-2 ROD.

   Response: This comment does not apply to the Five-Year Review Report.

3. USDOE shall revisit the 300-FF-5 selected remedy to ensure that it is protective of federally listed fish species and their critical habitat.

Response: Available data supports the interim action described in the ROD. In addition, the Department of Energy has prepared the "Salmon and Steelhead Threatened and Endangered Species Management Plan," (DOE/RL-2000-27, dated April 2000). This document was the culmination of efforts by the Department of Energy to consult with NMFS, pursuant to ESA. This plan was prepared in response to the 1998 and 1999 listing of Steelhead and Spring Chinook Salmon within the Columbia River system in the lower Columbia Basin for protection under the ESA. The Tri-Parties will continue to work with members of the Hanford Natural Resources Trustee Council, to ensure that appropriate expertise is factored into the Hanford cleanup process in a constructive manner. A complete risk assessment that evaluates the impact of residual contamination on all human and ecological exposure pathways will also be performed in support of the final RODs for the 300-FF-2 and 300-FF-5 Operable Units. No action item is required in the Five-Year Review.