This document was too large to scan as a single document. It has been divided into smaller sections.

Section 1 of 2

Document Information			
Document #	FOIA2009-0054		
Title	FREEDOM OF INFORMATION REQUEST (FOI 2009-0054)		
Date	09/09/2009		
Originator	D. RIEHLE	Originator Co.	DOE-RL
Recipient	R. JARVIS	Recipient Co.	HEART OF AMERICA
References	97-EAP-577, 02-RCA-0411, DOE/RL-88-20-R2, 08-AMCP-0063		
Keywords	OCE, FOIA, SENSITIVE		
Projects			
Other Information			

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

September 9, 2009

CERTIFIED MAIL

Mr. Ryan Jarvis
Heart of America Northwest
1314 N.E. 56th Street Suite 100
Seattle, Washington 98105

Dear Mr. Jarvis:

FREEDOM OF INFORMATION ACT REQUEST (FOI 2009-0054)

This letter is a partial response to your letters dated June 22, 2009, and July 15, 2009. On August 5, 2009, we provided a response to items 1, 4e, 4f, 4g, 4h, 6a, 6b, 6c, 6d, 6e, 7a, 9a and 9b. On September 2, 2009, we provided a response to items 4a, 4b, 4c, and 5.

We have completed our search and review of the remaining items of your request and in response to item 1a, a copy of a letter dated November 6, 2008, from the State of Washington Department of Ecology, and a copy of a U.S. Department of Energy (DOE) letter dated July 25, 1997, (DOE Letter 97-EAP-577) have been deemed responsive. Both of these documents were provided to you by this office on August 5, 2009, in response to item 1.

In response to item 2 for "any correspondence between the USDOE and the Washington Department of Ecology concerning the RCRA permit for the mixed waste disposal trenches 31 and 34," enclosed are the following documents, see Attachment I: DOE letter 02-RCA-0411, dated June 27, 2002, entitled, "Transmittal of the Hanford Facility Dangerous Waste Part B Permit Application, Low-Level Burial Grounds (LLBG) DOE/RL-88-20, Revision 2, Working Draft," (this document is also responsive to item 4c of your request), DOE letter 08-AMCP-0063, dated December 19, 2007, entitled, "Hanford Facility Dangerous Waste Part B Permit Application, Low-Level Burial Grounds (LLBG) DOE/RL-88-20, Revision 2," (this document is also responsive to item 4c of your request), an e-mail dated October 2, 2008, entitled, "LLBG Process Chapter Questions," (this is also responsive to item 4c of your request), an e-mail dated February 23, 2009, entitled, "LLBG Permitting," (this document is also responsive to items 4c and 4h of your request), Additional documents responsive to this item were provided to you on September 2, 2009, in response to items 4a, 4b and 4c of your requests.

In response to item 3 for "Authorization from the Washington Department of Ecology for USDOE or any of its contractors to construct and operate mixed waste disposal trenches 31 and 34," enclosed as Attachment II is a copy of a letter dated March 6, 1997, entitled, "Approval of Low-Level Burial Grounds, Part A, Revision 9." This document is also responsive to item 4a of your request where you ask for "authorization of construction and operation, including legal bases for authorization to proceed with construction and operation."

Enclosed as Attachment III is a copy of an e-mail dated February 24, 2009, entitled, "CWC Addendum G Training Matrix," and a copy of an e-mail dated February 24, 2009, same subject as above. Both of these documents have been deemed responsive to item 4c of your request. In addition, we responded to items 4a, 4b, and 4c on September 2, 2009, and 4e, 4f, 4g, 4h on August 5, 2009. In response to item 4d you requested "performance or risk assessments conducted as part of the authorization or permitting processes" we have conducted a thorough search and no documents were located.

In a letter dated September 2, 2009, we provided the response to item 5 of your request. In response to item 5a, "any correspondence between the USDOE and the Washington Department of Ecology concerning the closure plan for the mixed waste disposal trenches 31 and 34 located in the 200 West area of Hanford." In a letter dated September 2, 2009, this office provided you with a listing of documents that were provided to you. These documents are also responsive to item 5a of your request.

Documents responsive to items 6a, 6b, 6c, 6d, and 6e were provided to you in our letter dated August 5, 2009. In response to items 7a and 7c (this should be 7b, however, in your request a typographical error was made), documents were provided to you on August 5, 2009. In response to items 9a and 9b, a response was provided to you on August 5, 2009.

We continue to search and review documents responsive to item 8 of your request. As you may know, the FOIA provides that an agency respond to requests within twenty working days. However, the FOIA permits an agency to extend the time limit to respond to a request in certain circumstances. These circumstances include the need to collect records from other locations, review large number of records, and consult with other offices. Due to the large amount of information requested, additional time will be needed to review the documents. We will notify you when our search and review is complete.

We will provide you with appeal rights when your request is complete. If you have any questions regarding your request, please contact me at our address above or on (509) 376-6288.

Sincerely,

Dorothy Riehle
Freedom of Information Act Officer
Office of Communications
and External Affairs

OCE:DCR

Attachments

ATTACHMENT I

ENVIRONMENTAL PORTAL DISTRIBUTION COVERSHEET

REGULATORY INFORMATION

Author	Addressee	Correspondence No.
J. B. Hebdon/RL	M. A. Wilson/DOEC	0203062 DOE-RL: 02-RCA-0411 CC Recd: 07/01/2002 Ref: FH-0202314

Subject: **TRANSMITTAL OF THE HANFORD FACILITY DANGEROUS WASTE PART B PERMIT APPLICATION, LOW-LEVEL BURIAL GROUNDS (LLBG) DOE/RL-88-20, REVISION 2, WORKING DRAFT**

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		L. M. Culley	B3-70	X
		T. T. Daniels	B3-70	X
		B. J. Dixon	R3-32	X
		R. H. Gurske	H8-73	X
		K. A. Hadley	T5-57	X
		J. W. Hales	A1-14	X
		J. S. Hertzel	A1-14	X
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		R. E. Piippo	A1-14	X
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		D. J. Watson	X3-79	X
		L. F. Willis	H8-73	X
		U. S. Department of Energy, Richland Operations Office		
		A. P. Larsen	A5-15	X
		A. C. McKarns	A5-15	X
		H. M. Rodriguez	A5-15	X
		G. H. Sanders	A6-38	X
		B. D. Williamson	A4-52	X

ENVIRONMENTAL PORTAL

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Contact: 376-8111 or 372-3931

A-6001-538S (02/98)

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

0203062
CC Recd: 07/01/2002

02-RCA-0411

JUN 27 2002

Mr. Michael A. Wilson, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
1315 West Fourth Avenue
Kennewick, Washington 99336

Dear Mr. Wilson:

TRANSMITTAL OF THE HANFORD FACILITY DANGEROUS WASTE PART B PERMIT APPLICATION, LOW-LEVEL BURIAL GROUNDS (LLBG) DOE/RL-88-20, REVISION 2, WORKING DRAFT

Enclosed is the Part B Permit Application Document, DOE/RL-88-20, Revision 2, Working Draft. The LLBG are located in the 200 East and 200 West Areas of the Hanford Facility. The LLBG include areas for storage and disposal of mixed waste, as described in the enclosed Part B Permit application. The submittal date for the LLBG Part B Permit Application Working Draft of June 28, 2002, is documented in the "Fact Sheet for the Hanford Facility Resource Conservation and Recovery Act Permit for the Hanford Site for the Treatment, Storage, and Disposal of Dangerous Waste, Revision 7, Modification E Appeal Resolution."

The workshop schedule for this draft document and transmittal schedule for the final certified Part B Permit Application for the LLBG will follow the Hanford Federal Facility Agreement and Consent Order, Figure 9-2, as requested by the State of Washington Department of Ecology in a letter from M. Mills to G. L. Sinton, RL, " Resuming the Permitting Process for the Hanford Facility Dangerous Waste Permit Application, Low Level Burial Grounds (LLBG), DOE/RL-88-20, Revision 1," dated February 13, 2002.

If you have any questions, please contact Greg Sinton, Waste Management Division, on (509) 373-7939.

Sincerely,

for Joel Hebdon, Director
Regulatory Compliance and Analysis Division

RCA:GLS

Enclosure

cc: See page 2

JUN 27 2002

cc w/encl:
L. E. Gadbois, EPA
R. Gay, CTUIR
R. Jim, YN
M. Mills, Ecology
A. L. Prignano, FHI
D. G. Saueressig, FHI
P. Sobotta, NPT
Environmental Portal, LMSI

cc w/o encl:
W. Christensen, NRRO-Puget
R. H. Engelmann, FHI
R. H. Gurske, FHI
D. Hemry, PSNS
J. F. Williams Jr., FHI

DOE/RL-88-20
Revision 2
Draft

Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds

Draft

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management
Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

United States
Department of Energy
P.O. Box 550
Richland, Washington 99352

Clearance process not performed.

DOE/RL-88-20
Revision 2

Draft

Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds

Date Published
June 2002

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

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

United States Department of Energy
P.O. Box 550
Richland, Washington 99352

Clearance process not performed.

HANFORD FACILITY DANGEROUS WASTE PERMIT APPLICATION, LOW-LEVEL BURIAL GROUNDS

FOREWORD

The *Hanford Facility Dangerous Waste Permit Application* is considered to be a single application organized into a General Information Portion (document number DOE/RL-91-28) and a Unit-Specific Portion. The scope of the Unit-Specific Portion is limited to Part B permit application documentation submitted for individual, 'operating' treatment, storage, and/or disposal units, such as the Low-Level Burial Grounds (this document, DOE/RL-88-20).

Both the General Information and Unit-Specific portions of the *Hanford Facility Dangerous Waste Permit Application* address the content of the Part B permit application guidance prepared by the Washington State Department of Ecology (Ecology 1987 and 1996) and the U.S. Environmental Protection Agency (40 Code of Federal Regulations 270), with additional information needs defined by the *Hazardous and Solid Waste Amendments* and revisions of Washington Administrative Code 173-303. For ease of reference, the Washington State Department of Ecology alpha-numeric section identifiers from the permit application guidance documentation (Ecology 1996) follow, in brackets, the chapter headings and subheadings.

Documentation contained in the General Information Portion is broader in nature and could be used by multiple treatment, storage, and/or disposal units (e.g., the glossary provided in the General Information Portion). Wherever appropriate, the Low-Level Burial Grounds permit application documentation makes cross-reference to the General Information Portion, rather than duplicating text.

Information provided in this Low-Level Burial Grounds permit application documentation is current as of June 2002.

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DOCUMENT CONTENTS

FOREWORD

GLOSSARY

APPLICATION CHECKLIST

1.0 PART A [A]

2.0 FACILITY DESCRIPTION AND GENERAL PROVISIONS [B AND E]

3.0 WASTE ANALYSIS [C]

4.0 PROCESS INFORMATION [D-1 THROUGH D-8]

5.0 GROUNDWATER MONITORING FOR LAND-BASED UNITS [D-10]

6.0 PROCEDURES TO PREVENT HAZARDS [F]

7.0 CONTINGENCY PLAN [G]

8.0 PERSONNEL TRAINING [H]

9.0 EXPOSURE INFORMATION REPORT

10.0 WASTE MINIMIZATION [D-9]

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3A WASTE ANALYSIS PLAN FOR LOW-LEVEL BURIAL GROUNDS

4A CONSTRUCTION QUALITY ASSURANCE REPORT

4B DEFINITIVE DESIGN

CONTENTS (cont)

4C RESPONSE ACTION PLAN

4D REQUEST FOR EXEMPTION FROM LINED TRENCH REQUIREMENTS AT 218-E-12B BURIAL GROUND TRENCH 94

4E SITE INVESTIGATION REPORT

4F 9090A TEST RESULTS

4G SOIL LINER PERFORMANCE CALCULATIONS

5A SELECTED GROUNDWATER CONTAMINANT PLUME MAPS IN THE 200 AREAS

5B SUMMARIZED RESULTS OF GROUNDWATER MONITORING (1988-2001)

5C WELL CONSTRUCTION DATA (AS-BUILT DIAGRAMS)

5D MONITORING EFFICIENCY MODEL OUTPUT

5E LETTER FROM WASHINGTON STATE DEPARTMENT OF ECOLOGY

5F DETAILED GROUNDWATER FLOW CHARACTERIZATION WITHIN LOW-GRADIENT AREAS: INITIAL RESULTS FOR LOW-LEVEL WASTE MANAGEMENT AREA 1

7A BUILDING EMERGENCY PLAN FOR LOW-LEVEL BURIAL GROUNDS

GLOSSARY

ALARA	as low as reasonably achievable
ASTM	American Society for Testing and Materials
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FML	flexible membrane liner
GCL	geosynthetic clay liner
HF	Hanford Facility
LDR	land disposal restrictions
LLBG	Low-Level Burial Grounds
PNNL (PNL)	Pacific Northwest National Laboratory (Pacific Northwest Laboratory)
RCRA	*Resource Conservation and Recovery Act of 1976*
SWMU	solid waste management unit
TSD	treatment, storage, and/or disposal
VLDPE	very low density polyethylene
WAC	Washington Administrative Code
WHC	Westinghouse Hanford Company

METRIC CONVERSION CHART

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	millimeters	millimeters	0.03937	inches
inches	2.54	centimeters	centimeters	0.393701	inches
feet	0.3048	meters	meters	3.28084	feet
yards	0.9144	meters	meters	1.0936	yards
miles (statute)	1.60934	kilometers	kilometers	0.62137	miles (statute)
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.09290304	square meters	square meters	10.7639	square feet
square yards	0.8361274	square meters	square meters	1.19599	square yards
square miles	2.59	square kilometers	square kilometers	0.386102	square miles
acres	0.404687	hectares	hectares	2.47104	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.34952	grams	grams	0.035274	ounces (avoir)
pounds	0.45359237	kilograms	kilograms	2.204623	pounds (avoir)
tons (short)	0.9071847	tons (metric)	tons (metric)	1.1023	tons (short)
Volume			**Volume**		
ounces (U.S., liquid)	29.57353	milliliters	milliliters	0.033814	ounces (U.S., liquid)
quarts (U.S., liquid)	0.9463529	liters	liters	1.0567	quarts (U.S., liquid)
gallons (U.S., liquid)	3.7854	liters	liters	0.26417	gallons (U.S., liquid)
cubic feet	0.02831685	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.7645549	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
Energy			**Energy**		
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
kilowatt	0.94782	British thermal unit per second	British thermal unit per second	1.055	kilowatt
Force/Pressure			**Force/Pressure**		
pounds (force) per square inch	6.894757	kilopascals	kilopascals	0.14504	pounds per square inch

06/2001

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Third Ed., 1990, Professional Publications, Inc., Belmont, California.

Application Checklist

Complete this checklist by providing the facility name and indicating where the listed material has been placed in the application. This is particularly important when the application does not closely follow the outline of the checklist and guidance.

Include the completed checklist with the Dangerous Waste Permit application.

Facility name Low-Level Burial Grounds

Date Application Received _____

State of Washington
Part B Permit Application Review Checklist for
Treatment, Storage, and Disposal Facilities

		Technically Adequate?	Location in Application
A.	Part A Form		Chapter 1.0
B.	Facility Description and General Provisions		Chapter 2.0
B-1	General Description		2.1
B-1(a)	Facility Description		2.1
B-1(b)	Construction Schedule		2.1.2
B-2	Topographic Map		2.2
B-2a	General Requirements		2.2
B-2b	Additional Requirements for Land Disposal Facilities		2.2
B-3	Seismic Consideration	Not Applicable	Not Applicable
B-4	Traffic Information		2.3
C.	Waste Analysis		Chapter 3.0
C-1	Chemical, Biological and Physical Analyses		3.1
C-1a	Waste In Piles	Not Applicable	Not Applicable
C-1b	Landfilled Wastes		3.2
C-1c	Wastes Incinerated and Wastes Used in Performance Tests	Not Applicable	Not Applicable
C-2	Waste Analysis Plan		3.3 and Appendix 3A
C-2a	Detailed Chemical, Physical, and/or Biological Analysis		Appendix 3A
C-2a(1)	Parameters and Rationale		Appendix 3A
C-2a(2)	Analytical Methods		Appendix 3A

		Technically Adequate?	Location in Application
C-2a(3)	Generator-Supplied Analyses		Appendix 3A
C-2b	Additional Requirements for Wastes Generated Off-site		Appendix 3A
C-2b(1)	Parameters and Rationale to Confirm Identity of Off-site Waste		Appendix 3A
C-2b(2)	Analytical Methods to Confirm Identity of Off-site Waste		Appendix 3A
C-2b(3)	Representative Sampling of Incoming Off-site Wastes		Appendix 3A
C-2c	Methods for Collecting Samples for Detailed and Confirming Analyses		Appendix 3A
C-2d	Frequency of Analyses		Appendix 3A
C-3	Manifest System		Appendix 3A
C-3a	Procedures for Receiving Shipments		Appendix 3A
C-3b	Response to Significant Discrepancies		Appendix 3A
C-3c	Provisions for Non-acceptance of Shipment		Appendix 3A
C-3c(1)	Non-acceptance of Undamaged Shipment		Appendix 3A
C-3c(2)	Activation of Contingency Plan for Damaged Shipment		Appendix 3A
C-4	Tracking System		Appendix 3A
D.	Process Information		Chapter 4.0
D-1	Containers		4.1
D-1a	Description of Containers		4.1.1
D-1b	Container Management Practices		4.1.1
D-1c	Container Labelling		4.1.1
D-1d	Containment Requirements for Storing Containers		4.1.2
D-1d(1)	Secondary Containment System Design		4.1.2.1
D-1d(1)(a)	System Design		4.1.2.1

		Technically Adequate?	Location in Application
D-1d(1)(b)	Structural Integrity of Base		4.1.2.1
D-1d(1)(c)	Containment System Capacity		4.1.2.2
D-1d(1)(d)	Control of Run-on		4.1.2.3
D-1d(2)	Removal of Liquids from Containment System		4.1.3
D-1e	Demonstration that Containment Is Not Required Because Containers Do Not Contain Free Liquids, Wastes That Exhibit Ignitability or Reactivity, or Wastes Designated F020 - 023, F026, or F027		4.2
D-1f	Prevention of Reaction of Ignitable, Reactive, and Incompatible Wastes in Containers		4.3
D-1f(1)	Management of Certain Reactive Wastes in Containers	Not Applicable	Not Applicable
D-1f(2)	Management of Ignitable and Certain Other Reactive Wastes in Containers	Not Applicable	Not Applicable
D-1f(3)	Design of Areas to Manage Incompatible Wastes	Not Applicable	Not Applicable
D-2	Tank Systems	Not Applicable	Not Applicable
D-2a	Design, Installation and Assessment of Tanks Systems	Not Applicable	Not Applicable
D-2a(1)	Design Requirements	Not Applicable	Not Applicable
D-2a(2)	Integrity Assessments	Not Applicable	Not Applicable
D-2a(3)	Additional Requirements for Existing Tanks	Not Applicable	Not Applicable
D-2a(4)	Additional Requirements for New Tanks	Not Applicable	Not Applicable
D-2a(5)	Additional Requirements for New On-ground or Underground Tanks	Not Applicable	Not Applicable
D-2b	Secondary Containment and Release Detection for Tank Systems	Not Applicable	Not Applicable
D-2b(1)	Requirements for All Tank Systems	Not Applicable	Not Applicable

		Technically Adequate?	Location in Application
D-2b(2)	Additional Requirements for Specific Types of Systems	Not Applicable	Not Applicable
D-2b(2)(a)	Vault Systems	Not Applicable	Not Applicable
D-2b(2)(b)	Double-walled Tanks	Not Applicable	Not Applicable
D-2b(2)(c)	Ancillary Equipment	Not Applicable	Not Applicable
D-2c	Variances from Secondary Containment Requirements	Not Applicable	Not Applicable
D-2d	Tank Management Practices	Not Applicable	Not Applicable
D-2e	Labels or Signs	Not Applicable	Not Applicable
D-2f	Air Emissions	Not Applicable	Not Applicable
D-2g	Management of Ignitable or Reactive Wastes in Tank Systems	Not Applicable	Not Applicable
D-2h	Management of Incompatible Wastes in Tank Systems	Not Applicable	Not Applicable
D-3	Waste Piles	Not Applicable	Not Applicable
D-4	Surface Impoundments	Not Applicable	Not Applicable
D-5	Incinerators	Not Applicable	Not Applicable
D-6	Landfills		4.5
D-6a	List of Wastes		4.5.1
D-6b	Liner System Exemption Requests		4.5.2
D-6b(1)	Exemption Based on Existing Portion	Not Applicable	Not Applicable
D-6b(2)	Exemption Based on Alternative Design and Location		4.5.2
D-6b(3)	Exemption From Groundwater Protection Requirements Based on Design and Operation	Not Applicable	Not Applicable
D-6b(3)(a)	Double-lined Landfill	Not Applicable	Not Applicable
D-6b(3)(b)	Response to Liquids in Leak Detection System	Not Applicable	Not Applicable
D-6c	Liner System, General Items		4.5.3
D-6c(1)	Liner System Description		4.5.3.1
D-6c(2)	Liner System Location Relative to High Water Table		4.5.3.2
D-6c(3)	Loads on Liner System		4.5.3.3

		Technically Adequate?	Location in Application
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D-6d	Liner System, Foundation		4.5.4
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D-6d(3)	Laboratory Testing Data		4.5.4.3
D-6d(4)	Engineering Analyses		4.5.4.4
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D-6d(4)(b)	Bearing Capacity		4.5.4.4.2
D-6d(4)(c)	Stability of Landfill Slopes		4.5.4.4.3
D-6d(4)(d)	Potential for Excess Hydrostatic or Gas Pressure		4.5.4.4.4
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D-6e(1)	Synthetic Liners		4.5.5.1
D-6e(1)(a)	Synthetic Liner Compatibility Data		4.5.5.2
D-6e(1)(b)	Synthetic Liner Strength		4.5.5.3
D-6e(1)(c)	Synthetic Liner Bedding		4.5.5.4
D-6e(2)	Soil Liners		4.5.5.5
D-6e(2)(a)	Material Testing Data		4.5.5.5.1
D-6e(2)(b)	Soil Liner Compatibility Data		4.5.5.5.2
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D-6f(2)	Equivalent Capacity		4.5.6.2
D-6f(3)	Grading and Drainage		4.5.6.3
D-6f(4)	Maximum Leachate Head		4.5.6.4
D-6f(5)	System Compatibility		4.5.6.5
D-6f(6)	System Strength		4.5.6.6
D-6f(6)(a)	Stability of Drainage Layers		4.5.6.6.1
D-6f(6)(b)	Strength of Piping		4.5.6.6.2
D-6f(7)	Prevention of Clogging		4.5.6.7
D-6g	Liner System, Construction and Maintenance		4.5.7
D-6g(1)	Material Specifications		4.5.7.1
D-6g(1)(a)	Synthetic Liners		4.5.7.1.1
D-6g(1)(b)	Soil Liners		4.5.7.1.2
D-6g(1)(c)	Leachate Collection and Removal Systems		4.5.7.1.3
D-6g(2)	Construction Specifications		4.5.7.2
D-6g(2)(a)	Liner System Foundation		4.5.7.2.1
D-6g(2)(b)	Soil Liners		4.5.7.2.2

		Technically Adequate?	Location in Application
D-6g(2)(c)	Synthetic Liners		4.5.7.2.3
D-6g(2)(d)	Leachate Collection and Removal Systems		4.5.7.2.4
D-6g(3)	Construction Quality Control Program		4.5.7.3
D-6g(4)	Maintenance Procedures for Leachate Collection and Removal Systems		4.5.7.4
D-6g(5)	Liner Repairs During Operations		4.5.7.5
D-6h	Run-on and Run-off Control Systems		4.5.8
D-6h(1)	Run-on Control System		4.5.8.1
D-6h(1)(a)	Design and Performance		4.5.8.1.1
D-6h(1)(b)	Calculation of Peak Flow		4.5.8.1.2
D-6h(2)	Run-off Control System		4.5.8.2
D-6h(2)(a)	Design and Performance		4.5.8.2
D-6h(2)(b)	Calculation of Peak Flow		4.5.8.2
D-6h(3)	Management of Collection and Holding Units		4.5.8.2
D-6h(4)	Construction		4.5.8.3
D-6h(5)	Maintenance		4.5.8.4
D-6i	Control of Wind Dispersal		4.5.9
D-6j	Liquids in Landfills		4.5.10
D-6j(1)	Bulk or Noncontainerized Free Liquids	Not Applicable	Not Applicable
D-6j(2)	Containers Holding Free Liquids	Not Applicable	Not Applicable
D-6j(3)	Restriction to Small Containers	Not Applicable	Not Applicable
D-6j(4)	Labpacks	Not Applicable	Not Applicable
D-6j(4)(a)	Inside Containers	Not Applicable	Not Applicable
D-6j(4)(b)	Overpack	Not Applicable	Not Applicable
D-6j(4)(c)	Absorbent Material	Not Applicable	Not Applicable
D-6j(4)(d)	Incompatible Wastes	Not Applicable	Not Applicable
D-6j(4)(e)	Reactive Wastes	Not Applicable	Not Applicable
D-6k	Containerized Wastes		4.5.11
D-61	Special Waste Management Plan for Landfills Containing Wastes FO20, F021, F022, F023, F026, and F027	Not Applicable	Not Applicable

		Technically Adequate?	Location in Application
D-61(1)	Wastes Description	Not Applicable	Not Applicable
D-61(2)	Soil Description	Not Applicable	Not Applicable
D-61(3)	Mobilizing Properties	Not Applicable	Not Applicable
D-61(4)	Additional Management Techniques	Not Applicable	Not Applicable
D-6m	Prevention of Reaction of Ignitable, Reactive, and Incompatible Wastes in Landfills	Not Applicable	Not Applicable
D-6m(1)	Management of Ignitable or Reactive Wastes Placed in Landfills	Not Applicable	Not Applicable
D-6m(2)	Management of Incompatible Wastes Placed in Landfills	Not Applicable	Not Applicable
D-7	Land Treatment	Not Applicable	Not Applicable
D-8	Air Emissions Control	Not Applicable	Not Applicuable
D-8a	Process Vents	Not Applicable	Not Applicable
D-8a(1)	Applicability of Subpart AA Standards	Not Applicable	Not Applicable
D-8a(1)(a)	Process Vents Subject to Subpart AA Standards	Not Applicable	Not Applicable
D-8a(1)(b)	Process Vents Not Subject to Subpart AA Standards	Not Applicable	Not Applicable
D-8a(1)(c)	Re-evaluating Applicability of Subpart AA Standards	Not Applicable	Not Applicable
D-8a(2)	Process Vents - Demonstrating Compliance	Not Applicable	Not Applicable
D-8a(2)(a)	The Basis for Meeting Limits/Reductions	Not Applicable	Not Applicable
D-8a(2)(b)	Demonstrating Compliance via Selected Method	Not Applicable	Not Applicable
D-8a(2)(c)	Design Information and Operating Parameters for Closed Vent Systems and Control Devices	Not Applicable	Not Applicable
D-8a(2)(d)	Re-evaluating Compliance with Subpart AA Standards	Not Applicable	Not Applicable
D-8b	Equipment Leaks	Not Applicable	Not Applicable
D-8b(1)	Applicability of Subpart BB Standards	Not Applicable	Not Applicable

		Technically Adequate?	Location in Application
D-8b(1)(a)	Equipment Subject to Subpart BB	Not Applicable	Not Applicable
D-8b(1)(b)	Re-evaluating Applicability of Subpart BB Standards	Not Applicable	Not Applicable
D-8b(2)	Equipment Leaks - Demonstrating Compliance	Not Applicable	Not Applicable
D-8b(2)(a)	Procedures for Identifying Equipment Location and Method of Compliance, Marking Equipment, and Ensuring Records are Up-to-date	Not Applicable	Not Applicable
D-8b(2)(b)	Demonstrating Compliance with D-8b(1)(a) and (2)(a) Procedures	Not Applicable	Not Applicable
D-8b(2)(c)	Closed Vent Systems or Control Devices: Showing Compliance with Emission Reduction Standards	Not Applicable	Not Applicable
D-8c	Tanks and Containers	Not Applicable	Not Applicable
D-8c(1)	Applicability of Subpart CC Standards	Not Applicable	Not Applicable
D-8c(2)	Tank Systems and Container Areas - Demonstrating Compliance	Not Applicable	Not Applicable
D-9	Waste Minimization		Chapter 10.0
D-10	Groundwater Monitoring for Land-based Units		Chapter 5.0
E.	Releases from Solid Waste Management Units		Chapter 2.0
E-1	Solid Waste Management Units and Known and Suspected Releases of Dangerous Wastes or Constituents		2.4
E-1a	Solid Waste Management Units		2.4
E-1b	Releases		2.4
E-2	Corrective Actions Implemented		2.4
F.	Procedures to Prevent Hazards		Chapter 6.0
F-1	Security		6.1
F-1a	Security Procedures and Equipment		6.1.1

		Technically Adequate?	Location in Application
F-1b	Waiver		6.1.2
F-2	Inspection Plan		6.2
F-2a	General Inspection Requirements		6.2.1
F-2b	Inspection Log		6.2.1
F-2c	Schedule for Remedial Action for Problems Revealed		6.2.2
F-2d	Specific Process or Waste Type Inspection Requirements		6.2.3
F-2d(1)	Container Inspections		6.2.3.1
F-2d(2)	Tank System Inspections and Corrective Actions	Not Applicable	Not Applicable
F-2d(2)(a)	Tank System Inspections	Not Applicable	Not Applicable
F-2d(2)(b)	Tank Systems - Corrective Actions	Not Applicable	Not Applicable
F-2d(3)	Storage of Ignitable or Reactive Wastes	Not Applicable	Not Applicable
F-2d(4)	Air Emissions Control and Detection - Inspections, Monitoring, and Corrective Actions	Not Applicable	Not Applicable
F-2d(4)(a)	Process Vents	Not Applicable	Not Applicable
F-2d(4)(b)	Equipment Leaks	Not Applicable	Not Applicable
F-2d(4)(c)	Tanks and Containers	Not Applicable	Not Applicable
F-2d(5)	Waste Pile Inspection	Not Applicable	Not Applicable
F-2d(6)	Surface Impoundment Inspection	Not Applicable	Not Applicable
F-2d(7)	Incinerator Inspection	Not Applicable	Not Applicable
F-2d(8)	Landfill Inspection		6.2.3.2
F-2d(8)(a)	Run-on and Run-off Control System		6.2.3.2.1
F-2d(8)(b)	Leak Detection Systems		6.2.3.2.2
F-2d(8)(c)	Wind Dispersal Control System		6.2.3.2.3
F-2d(8)(d)	Leachate Collection and Removal System		6.2.3.2.4

		Technically Adequate?	Location in Application
F-2d(9)	Land Treatment Facility Inspection	Not Applicable	Not Applicable
F-3	Preparedness and Prevention Requirements		6.3
F-3a	Equipment Requirements		6.3
F-3b	Aisle Space Requirement		6.3.5
F-4	Preventive Procedures, Structures, and Equipment		6.4
F-5	Prevention of Reaction of Ignitable, Reactive, and/or Incompatible Wastes		6.5
F-5a	Precautions to Prevent Ignition or Reaction of Ignitable or Reactive Waste		6.5.1
F-5b	Precautions for Handling Ignitable or Reactive Waste and Mixing Incompatible Wastes		6.5.2
F-5b(1)	Ignitable or Reactive Wastes In Tanks	Not Applicable	Not Applicable
F-5b(2)	Incompatible Wastes In Containers or Tanks	Not Applicable	Not Applicable
G.	Contingency Plan		Chapter 7.0
G-1	General Information		Appendix 7A
G-2	Emergency Coordinators		Appendix 7A
G-3	Circumstances Prompting Implementation		Appendix 7A
G-4	Emergency Response Procedures		Appendix 7A
G-4a	Notification		Appendix 7A
G-4b	Identification of Dangerous Materials		Appendix 7A
G-4c	Hazard Assessment and Report		Appendix 7A
G-4d	Prevention of Recurrence or Spread of Fires, Explosions, or Releases		Appendix 7A
G-4e	Additional Requirements for Surface Impoundments		Appendix 7A
G-4f	Post-Emergency Actions		Appendix 7A

		Technically Adequate?	Location in Application
G-5	Emergency Equipment		Appendix 7A
G-6	Coordination Agreements		Appendix 7A
G-7	Evacuation Plan		Appendix 7A
G-8	Required Reports, Recordkeeping, and Certifications		Appendix 7A
G-8(1)	General Requirements		Appendix 7A
G-8(2)	Requirements for Tank Systems	Not Applicable	Not Applicable
H.	Personnel Training		Chapter 8.0
H-1	Job Title/Job Description		Chapter 8.0
H-2	Outline of Training Program		Chapter 8.0
H-3	Implementation of Training Program		Chapter 8.0
I.	Closure and Financial Assurance		Chapter 11.0
I-1	Closure Plan/Financial Assurance for Closure		11.1
I-1a	Closure Performance Standard		11.2
I-1b	Closure Activities		11.3
I-1b(1)	Maximum Extent of Operation		11.4
I-1b(2)	Removing Dangerous Wastes	Not Applicable	Not Applicable
I-1b(3)	Decontaminating Structures, Equipment, and Soil		11.5
I-1b(4)	Sampling and Analysis to Identify Extent of Decontamination/ Removal and to Verify Achievement of Closure Standard	Not Applicable	Not Applicable
I-1b(4)(a)	Sampling to Determine Extent of Contamination	Not Applicable	Not Applicable
1-1b(4)(b)	Sampling to Confirm Decontamination of Structures and Soils	Not Applicable	Not Applicable
I-1b(5)	Other Activities	Not Applicable	Not Applicable
I-1c	Maximum Waste Inventory	Not Applicable	Not Applicable

		Technically Adequate?	Location in Application
I-1d	Closure of Waste Piles, Surface Impoundments, Incinerators, Land Treatment, and Miscellaneous Units	Not Applicable	Not Applicable
I-1e	Closure of Landfill Units		11.6
I-1e(1)	Disposal Impoundments	Not Applicable	Not Applicable
I-1e(1)(a)	Elimination of Liquids	Not Applicable	Not Applicable
I-1e(1)(b)	Waste Stabilization	Not Applicable	Not Applicable
I-1e(2)	Cover Design		11.6.1
I-1e(3)	Minimization of Liquid Migration	Not Applicable	Not Applicable
I-1e(4)	Maintenance Needs		11.6.1
I-1e(5)	Drainage and Erosion		11.6.1
I-1e(6)	Settlement and Subsidence		11.6.1
I-1e(7)	Cover permeability		11.6.1
I-1e(8)	Freeze/Thaw Effects		11.6.1
I-1f	Schedule for Closure		11.7
I-1g	Extension for Closure Time		11.8
I-1h	Closure Cost Estimate	Not Applicable	Not Applicable
I-1i	Financial Assurance Mechanism for Closure	Not Applicable	Not Applicable
I-2	Notice in Deed of Already Closed Disposal Units	Not Applicable	Not Applicable
I-3	Post-Closure Plan		11.9
I-4	Liability Requirements	Not Applicable	Not Applicable
I-4a	Coverage for Sudden Accidental Occurrences	Not Applicable	Not Applicable
I-4b	Coverage for Nonsudden Accidental Occurrences	Not Applicable	Not Applicable
I-4c	Request for Variance	Not Applicable	Not Applicable
J.	Other Federal and State Laws		Chapter 13.0
K.	Part B Certification		Chapter 14.0

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1.0 PART A [A]

The following is a chronology of the regulatory history of the Low-Level Burial Grounds (LLBG).

The *RCRA Part B Permit Application Low-Level Burial Grounds and Retrievable Storage,* submitted November 6, 1985 included a Part A, Form 3, that identified the LLBG and the retrievable storage units.

The LLBG, operating under interim status, were classified as landfills (D81) and the retrievable storage units were classified as container storage (S01). Reserved areas were included for future disposal. The following locations were included in the 1985 submittal:

- LLBG: 218-W-2A, 218-W-3AE, 218-E-10, 218-W-5, 218-W-4C, 218-W-3A, 218-E-12B, 218-C-9
- Reserved: 218-W-6, 218-E-10B
- Retrievable Storage Units: 218-W-4C, 218-W-3A
- Individual trench locations within these burial grounds were not identified.

On August 15, 1987, Revision 1 of the Part A, Form 3, was issued to incorporate comments received from the Washington State Department of Ecology (Ecology). The 1985 Part A was divided into two Part A, Form 3's, that consisted of the 'LLBG' and the 'retrievable storage units,' without designating specific locations for the burial grounds.

In November 1987, the two Part A, Form 3's, were revised (Revision 2) to incorporate the required signature process in which the U.S. Department of Energy, Richland Operations Office (DOE-RL) signed as owner/operator and Westinghouse Hanford Company (WHC) signed as co-operator. The retrievable storage units also were reclassified as landfills (D81) at the request of the U.S. Environmental Protection Agency (EPA). Specific burial grounds were named only for the retrievable storage units.

On May 19, 1988, the two Part A, Form 3's, were combined into one and issued as Revision 3. Revision 3 of the Part A consisted of LLBG, retrievable storage units, and a future mixed waste disposal unit. Revision 3 included graphic representations of the trenches and identified the following LLBG:

200 West Area	200 East Area
218-W-3A	218-E-10
218-W-3AE	218-E-12B.
218-W-4B	
218-W-4C	
218-W-5	
218-W-6	

The LLBG Part A, Form 3 (Revision 3) had the following changes:

Deleted: 218-W-2A, 218-E-10B, and 218-C-9
Added: 218-W-4B.

The 218-W-2A and 218-C-9 Burial Grounds were deleted, as it was determined that mixed waste was not disposed in these sites [*Consent Agreement and Compliance Order* between Ecology and the U.S. Department of Energy, October 1, 1986 (Ecology 1986)]. The 218-E-10B Burial Ground was deleted because the area was designated for another use before any waste disposal occurred. The 218-W-4B Burial Ground was added because dangerous waste is contained in caisson alpha 4.

Revision 4 of the Part A, Form 3, submitted to Ecology on October 18, 1989, had the following changes.

- The 'date operation began' was changed from 1944 to 1960 to reflect the earliest date that the oldest burial ground (216-E-10) began receiving waste.

- Waste numbers F020, F021, F022, F023, F026, and F027 were deleted as these waste types are not put into the LLBG.

- Following the addition of the decommissioned Shippingport reactor pressure vessel and the U.S. Navy defueled reactor compartments, the estimated annual quantity of waste for waste number D008 was increased from 100,000 pounds to 18,000,000 pounds and for waste number WT01 from 800,000 to 18,800,000 pounds.

- The burial ground number within the caption of a photograph of a "Typical Radioactive Retrievable Storage Facility--Liquid Organics" was changed from the "218-W-46/200 W Area" to the "218-W-4C/200 W Area."

- The President of WHC was changed from William M. Jacobi to John E. Nolan.

Revision 5 of the Part A, Form 3, submitted to Ecology on October 20, 1989, had the following change.

- The estimated annual quantity of waste for waste number D008 was reduced from 18,000,000 pounds to 2,000,000 pounds. Based on discussions and correspondence among the U.S. Navy, the EPA, and Ecology, the quantity of lead (16,000,000 pounds) in defueled reactor compartments was considered shielding and was designated as WT01, a state-only waste.

- In addition, no extraction procedure toxicity testing had been performed on reactor compartments; therefore, the defueled reactor compartments were manifested by the U.S. Navy as WT01 only.

Revision 6 of the Part A, Form 3, submitted to Ecology on August 16, 1990, had the following changes.

- Estimated annual quantity of waste for dangerous waste number D008 (lead) was increased from "2,000,000" pounds to "18,000,000" pounds. This increase accounted for lead shielding contained in defueled reactor compartments.

- The description of dangerous wastes (Section IV.E.) was changed to include a description of the metallic lead shielding contained in defueled reactor compartments disposed in trench 94.

Revision 7 of the Part A, Form 3, submitted to Ecology on November 4, 1994, had the following changes.

- Dangerous waste number F039 (multi-source leachate) was added to reflect leachate generation from the startup of trench 31.

- Dangerous waste numbers P035, P079, U231, U241, U242, and WC01 were removed per the revised Washington Administrative Code (WAC) 173-303.

- Section III.C. "Processes" was changed to reflect current operations at the LLBG.

- The President of WHC was changed from Roger C. Nichols to A. LaMar Trego.

Revision 8 of the Part A, Form 3, submitted to Ecology on September 30, 1996 had the following changes.

- Project Hanford Management Contract changed to Fluor Daniel Hanford, Inc.

- Part A, Form 3, was revised to reflect the date that Ecology was given authorization to regulate the dangerous waste portion of mixed waste as identified in 52 Federal Register 35556.

- A new design capacity was identified based on waste forecasts with no lateral expansion of the various burial ground boundaries. Dangerous waste numbers WC02, U175, and P025 were removed per WAC 173-303. The estimated annual quantity of waste was consolidated into one number, "160,000,000" kilograms for all dangerous waste numbers.

- Sections III.C, IV.E., photographs and graphics were updated to reflect current operations.

Revision 9 of the Part A, Form 3, submitted to Ecology on March 4, 1997, had the following changes.

- Comments from Ecology on Revision 8, of the Part A, Form 3, were incorporated.

- The Part A, Form 3, was revised to reflect the date of regulation of the dangerous waste component of mixed waste as August 19, 1987.

- Process code S01 (storage container) was added with a total process design capacity of 10,000,000 liters. The greater-than-90-day container storage is within the lined mixed waste disposal trenches 31 and 34 of the 218-W-5 Burial Ground.

- Dangerous waste numbers D004 through D043, all "U" and "P," and F001 through F005, and F028 were added under process code S01.

- Sections III.C and IV.E of the Part A, Form 3, were revised to include a discussion on process code S01.

- Graphics were updated to reflect current operations and the August 19, 1987 date of regulation of the dangerous waste component of mixed waste.

Revision 10 of the Part A, Form 3, submitted to Ecology on July 25, 1997, had the following changes.

- Updated text in Section IV.E. to account for dangerous waste numbers D001 through D003 being listed for disposal (D81) in Section IV.A.

- Hanford Site Coordinate System points corrected on 218-E-12B Burial Ground Site Plan.

- Call out for mixed fission product caissons corrected on 218-W-4B Burial Ground Site Plan.

- Updated trenches filled with low-level waste on 218-W-4C Burial Ground Site Plan. Following a record search on post-August 19, 1987 mixed waste, the eastern portion of trench 58 was determined not to contain regulated mixed waste.

Revision 10 of the Part A, Form 3 was not approved.

Revision 11 of the Part A, Form 3, submitted to Ecology on December 23, 1998, had the following changes.

- The discussion in Section III.C have been removed for process codes D81 (disposal) and S01 (container storage) and all discussion in Section IV.E because the Part A, Form 3, instructions do not require this information.

- Removed two and added 70 new dangerous waste numbers that either had been removed or added to the federal and/or state regulations or are waste numbers that potentially could be managed at the LLBG.

- Updated the 200 West Area drawing, various burial ground trench drawings, and included a new photograph of the mixed waste trenches (trench 31 and 34).

Revision 11 of the Part A, Form 3 was not approved.

Revision 12 of the Part A, Form 3, has the following changes.

- Additional dangerous waste numbers were added based on updates to WAC 173-303 and 40 CFR 261. The following dangerous waste numbers were added to WAC 173-303-9903 in 1998:

  - U numbers: U271, U278, U279, U280, U364, U367, U372, U373, U387, U389, U394, U395, U404, U409, U410, and U411

  - P numbers: P127, P128, P185, P188, P189, P190, P191, P192, P194, P196, P197, P198, P199, P201, P202, P203, P204, and P205

  - WSC2, F006, F007, F008, F009, F010, and F011 are waste numbers that might be managed in the future.

- Updated site maps and drawings

- Updated photograph for trench 94.

FORM 3	DANGEROUS WASTE PERMIT APPLICATION	I. EPA/State I.D. No.
		W A 7 8 9 0 0 0 8 9 6 7

R OFFICIAL USE ONLY

Application Approved	Date Received (month/ day / year)	Comments

II. FIRST OR REVISED APPLICATION

Place an "X" in the appropriate box in A or B below (mark one box only) to indicate whether this is the first application you are submitting for your facility or a revised application. If this is your first application and you already know your facility's EPA/STATE I.D. Number, or If this is a revised application, enter your facility's EPA/STATE I.D. Number in Section I above.

A. First Application (place an "X" below and provide the appropriate date)

☐ **1. Existing Facility** (See instructions for definition of "existing" facility. Complete item below.)

MO	DAY	YEAR
03	22	1943

*For existing facilities, provide the date (mo/day/yr) operation began or the date construction commenced. (use the boxes to the left)
*The date construction of the Hanford Facility commenced

☐ **2. New Facility** (Complete item below.)

MO	DAY	YEAR

For new facilities, provide the date (mo/day/yr) operation began or is expected to begin

B. Revised Application (Place an "X" below and complete Section I above)

☒ **1. Facility has an Interim Status Permit**

☒ **2. Facility has a Final Permit**

III. PROCESSES – CODES AND DESIGN CAPACITIES

A. Process Code – Enter the code from the list of process codes below that best describes each process to be used at the facility. Ten lines are provided for entering codes. If more lines are needed, enter the codes(s) in the space provided. If a process will be used that is not included in the list of codes below, then describe the process (including its design capacity) in the space provided on the (Section III-C).

B. Process Design Capacity – For each code entered in column A enter the capacity of the process.

1. Amount – Enter the amount.
2. Unit of Measure – For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
STORAGE:		
Container (barrel, drum, etc.)	S01	Gallons or liters
Tank	S02	Gallons or liters
Waste pile	S03	Cubic yards or cubic meters
Surface impoundment	S04	Gallons or liters
	S06	Cubic yards or cubic meters*
DISPOSAL:		
Injection well	D80	Gallons or liters
Landfill	D81	Acre-feet (the volume that would cover one acre to a Depth of one foot) or hectare-meter
Land application	D82	Acres or hectares
Ocean disposal	D83	Gallons per day or liters per day
Surface impoundment	D84	Gallons or liters
TREATMENT:		
Tank	T01	Gallons per day or liters per day
Surface impoundment	T02	Gallons per day or liters per day
Incinerator	T03	Tons per hour or metric tons per hour; gallons per hour or liters per hour
Other (use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundments or incinerators. Describe the processes in the space provided; Section III-C.)	T04	Gallons per day or liters per day

Unit of Measure	Unit of Measure Code	Unit of Measure	Unit of Measure Code	Unit of Measure	Unit of Measure Code
Gallons	G	Liters Per Day	V	Acre-Feet	A
Liters	L	Tons Per Hour	D	Hectare-Meter	F
Cubic Yards	Y	Metric Tons Per Hour	W	Acres	B
Cubic Meters	C	Gallons Per Hour	E	Hectares	Q
Gallons Per Day	U	Liters Per Hour	H		

III. PROCESS – CODES AND DESIGN CAPACITIES (continued)

Example for Completing Section III (shown in line numbers X-1 and X-2 below): A facility has two storage tanks; one tank can hold 200 gallons and the other can hold 400 gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.

Line No.	A. Process Code *(from list above)*			B. Process Design Capacity				For Official Use Only			
				1. Amount *(Specify)*		2. Unit of Measure *(enter code)*					
X-1	S	0	1	600		G					
X-2	T	0	3	20		H					
1	D	8	1	1,740,000		C					
2	S	0	1	10,000		C					
3											
4											
5											
6											
7											
8											
9											
10											

C. Space for additional process codes or for describing other process (code "T04"). For each process entered here include design capacity.

D81

The Low-Level Burial Grounds (LLBG) began waste management operations in January of 1960. The LLBG comprise a landfill disposal unit (D81) and cover a total area of approximately 225 hectares (556 acres). The landfill is divided into eight burial grounds. Six burial grounds are located in the 200 West Area and two in the 200 East Area, as depicted on the attached drawings. The LLBG consist of lined and unlined trenches of various sizes and depths. All mixed waste disposed will meet land disposal restriction requirements. The lined trenches have a double-liner leachate collection and removal system.

The process design capacity for mixed waste in the LLBG is 1,740,000 cubic meters (2,275,920 cubic yards) of which 1,500,000 cubic meters (1,962,000 cubic yards) are dedicated solely for the disposal of U.S. Navy defueled reactor compartments. Additional design capacity has been included to facilitate future lined trench construction. All future mixed waste trenches, designed and constructed to comply with all applicable regulations, will be added to the LLBG through the Hanford Facility Resource Conservation and Recovery Act (RCRA) Permit modification process.

S01

The greater-than-90-day container storage capability in mixed waste trenches 31 and 34 of the 218-W-5 Burial Ground provides a location to store various sized containers of treated mixed waste in a RCRA-compliant manner other than the Central Waste Complex. Mixed waste will meet land disposal restriction requirements. The placement of these containers in Trenches 31 and 34 eliminates the need to construct a mixed waste storage pad. This capability also reduces the need to transfer this waste before disposal. The process design capacity for storage of containers is estimated to be 10,000 cubic meters (13,080 cubic yards).

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IV. DESCRIPTION OF DANGEROUS WASTES

A. Dangerous Waste Number – Enter the digit number from Chapter 173-303 WAC for each listed dangerous waste you will handle. If you handle dangerous wastes which are not listed in Chapter 173-303 WAC, enter the four-digit number(s) that describes the characteristics and/or the toxic contaminants of those dangerous wastes.

B. Estimated Annual Quantity - For each listed waste entered in column A, estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in column A, estimate the total annual quantity of all the non-listed waste(s) that will be handled which possess that characteristic or contaminant.

C. Unit of Measure - For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropriate odes are:

ENGLISH UNIT OF MEASURE	CODE	METRIC UNIT OF MEASURE	CODE
Pounds	P	Kilograms	K
Tons	T	Metric Tons	M

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

D. Processes

1. Process Codes:

For listed dangerous waste: For each listed dangerous waste entered in column A select the code(s) from the list of process codes contained in Section III to indicate how the waste will be stored, treated, and/or disposed of at the facility.

For non-listed dangerous wastes: For each characteristic or toxic contaminant entered in Column A, select the code(s) from the list of process codes contained in Section III to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed dangerous wastes that possess that characteristic or toxic contaminant.

Note: Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of item IV-D(1); and (3) Enter in the space provided on page 4, the line number and the additional code(s).

2. Process Description: If a code is not listed for a process that will be used, describe the process in the space provided on the form.

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

1. Select one of the Dangerous Waste Numbers and enter it in column A. On the same line complete columns B, C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.
2. In column A of the next line enter the other Dangerous Waste Number that can be used to describe the waste. In column D(2) on that line enter "Included with above" and make no other entries on that line.
3. Repeat step 2 for each other Dangerous Waste Number that can be used to describe the dangerous waste.

Example for completing Section IV (shown in line numbers X-1, X-2, X-3, and X-4 below) - A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste.

Line No.	A. Dangerous Waste No. *(enter code)*	B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*	D. Processes	
				1. Process Codes *(enter)*	2. Process Description *(if a code is not entered in D(1))*
[redacted]					

Photocopy this page before completing if you have more than 26 wastes to list.

I.D. Number *(enter from page 1)*	
W A 7 8 9 0 0 0 8 9 6 7	

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
1	D	0	0	1	160,000,000		K		D81				Disposal
2	D	0	0	2			K		D81				Disposal
3	D	0	0	3			K		D81				Disposal
4	D	0	0	4			K		D81				Disposal
5	D	0	0	5			K		D81				Disposal
6	D	0	0	6			K		D81				Disposal
7	D	0	0	7			K		D81				Disposal
8	D	0	0	8			K		D81				Disposal
9	D	0	0	9			K		D81				Disposal
10	D	0	1	0			K		D81				Disposal
11	D	0	1	1			K		D81				Disposal
12	D	0	1	2			K		D81				Disposal
13	D	0	1	3			K		D81				Disposal
14	D	0	1	4			K		D81				Disposal
15	D	0	1	5			K		D81				Disposal
16	D	0	1	6			K		D81				Disposal
17	D	0	1	7			K		D81				Disposal
18	D	0	1	8			K		D81				Disposal
19	D	0	1	9			K		D81				Disposal
20	D	0	2	0			K		D81				Disposal
21	D	0	2	1			K		D81				Disposal
22	D	0	2	2			K		D81				Disposal
23	D	0	2	3			K		D81				Disposal
24	D	0	2	4			K		D81				Disposal
25	D	0	2	5			K		D81				Disposal
26	D	0	2	6			K		D81				Disposal
27	D	0	2	7			K		D81				Disposal
28	D	0	2	8			K		D81				Disposal
29	D	0	2	9			K		D81				Disposal
30	D	0	3	0			K		D81				Disposal
31	D	0	3	1			K		D81				Disposal
32	D	0	3	2			K		D81				Disposal
33	D	0	3	3			K		D81				Disposal
34	D	0	3	4			K		D81				Disposal
35	D	0	3	5			K		D81				Disposal
36	D	0	3	6			K		D81				Disposal
37	D	0	3	7			K		D81				Disposal
38	D	0	3	8			K		D81				Disposal
39	D	0	3	9			K		D81				Disposal
40	D	0	4	0			K		D81				Disposal
41	D	0	4	1			K		D81				Disposal
42	D	0	4	2			K		D81				Disposal

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I.D. Number *(enter from page 1)*

A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
43	D	0	4	3			K		D81				Disposal
44	W	T	0	1			K		D81				Disposal
45	W	T	0	2			K		D81				Disposal
46	W	P	0	1			K		D81				Disposal
47	W	P	0	2			K		D81				Disposal
48	W	P	0	3			K		D81				Disposal
49	W	0	0	1			K		D81				Disposal
50	W	S	C	2			K		D81				Disposal
51	F	0	0	1			K		D81				Disposal
52	F	0	0	2			K		D81				Disposal
53	F	0	0	3			K		D81				Disposal
54	F	0	0	4			K		D81				Disposal
55	F	0	0	5			K		D81				Disposal
56	F	0	0	6			K		D81				Disposal
57	F	0	0	7			K		D81				Disposal
58	F	0	0	8			K		D81				Disposal
59	F	0	0	9			K		D81				Disposal
60	F	0	1	0			K		D81				Disposal
61	F	0	1	1			K		D81				Disposal
62	F	0	1	2			K		D81				Disposal
63	F	0	1	9			K		D81				Disposal
64	F	0	2	8			K		D81				Disposal
65	F	0	3	9			K		D81				Disposal
66	U	0	0	1			K		D81				Disposal
67	U	0	0	2			K		D81				Disposal
68	U	0	0	3			K		D81				Disposal
69	U	0	0	4			K		D81				Disposal
70	U	0	0	5			K		D81				Disposal
71	U	0	0	6			K		D81				Disposal
72	U	0	0	7			K		D81				Disposal
73	U	0	0	8			K		D81				Disposal
74	U	0	0	9			K		D81				Disposal
75	U	0	1	0			K		D81				Disposal
76	U	0	1	1			K		D81				Disposal
77	U	0	1	2			K		D81				Disposal
78	U	0	1	4			K		D81				Disposal
79	U	0	1	5			K		D81				Disposal
80	U	0	1	6			K		D81				Disposal
81	U	0	1	7			K		D81				Disposal
82	U	0	1	8			K		D81				Disposal
83	U	0	1	9			K		D81				Disposal
84	U	0	2	0			K		D81				Disposal

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I.D. Number *(enter from page 1)*	
W A 7 8 9 0 0 0 8 9 6 7	

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
85	U	0	2	1			K		D81				Disposal
86	U	0	2	2			K		D81				Disposal
87	U	0	2	3			K		D81				Disposal
88	U	0	2	4			K		D81				Disposal
89	U	0	2	5			K		D81				Disposal
90	U	0	2	6			K		D81				Disposal
91	U	0	2	7			K		D81				Disposal
92	U	0	2	8			K		D81				Disposal
93	U	0	2	9			K		D81				Disposal
94	U	0	3	0			K		D81				Disposal
95	U	0	3	1			K		D81				Disposal
96	U	0	3	2			K		D81				Disposal
97	U	0	3	3			K		D81				Disposal
98	U	0	3	4			K		D81				Disposal
99	U	0	3	5			K		D81				Disposal
100	U	0	3	6			K		D81				Disposal
101	U	0	3	7			K		D81				Disposal
102	U	0	3	8			K		D81				Disposal
103	U	0	3	9			K		D81				Disposal
104	U	0	4	1			K		D81				Disposal
105	U	0	4	2			K		D81				Disposal
106	U	0	4	3			K		D81				Disposal
107	U	0	4	4			K		D81				Disposal
108	U	0	4	5			K		D81				Disposal
109	U	0	4	6			K		D81				Disposal
110	U	0	4	7			K		D81				Disposal
111	U	0	4	8			K		D81				Disposal
112	U	0	4	9			K		D81				Disposal
113	U	0	5	0			K		D81				Disposal
114	U	0	5	1			K		D81				Disposal
115	U	0	5	2			K		D81				Disposal
116	U	0	5	3			K		D81				Disposal
117	U	0	5	5			K		D81				Disposal
118	U	0	5	6			K		D81				Disposal
119	U	0	5	7			K		D81				Disposal
120	U	0	5	8			K		D81				Disposal
121	U	0	5	9			K		D81				Disposal
122	U	0	6	0			K		D81				Disposal
123	U	0	6	1			K		D81				Disposal
124	U	0	6	2			K		D81				Disposal
125	U	0	6	3			K		D81				Disposal
126	U	0	6	4			K		D81				Disposal

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I.D. Number *(enter from page 1)*

A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
127	U	0	6	6			K		D81				Disposal
128	U	0	6	7			K		D81				Disposal
129	U	0	6	8			K		D81				Disposal
130	U	0	6	9			K		D81				Disposal
131	U	0	7	0			K		D81				Disposal
132	U	0	7	1			K		D81				Disposal
133	U	0	7	2			K		D81				Disposal
134	U	0	7	3			K		D81				Disposal
135	U	0	7	4			K		D81				Disposal
136	U	0	7	5			K		D81				Disposal
137	U	0	7	6			K		D81				Disposal
138	U	0	7	7			K		D81				Disposal
139	U	0	7	8			K		D81				Disposal
140	U	0	7	9			K		D81				Disposal
141	U	0	8	0			K		D81				Disposal
142	U	0	8	1			K		D81				Disposal
43	U	0	8	2			K		D81				Disposal
144	U	0	8	3			K		D81				Disposal
145	U	0	8	4			K		D81				Disposal
146	U	0	8	5			K		D81				Disposal
147	U	0	8	6			K		D81				Disposal
148	U	0	8	7			K		D81				Disposal
149	U	0	8	8			K		D81				Disposal
150	U	0	8	9			K		D81				Disposal
151	U	0	9	0			K		D81				Disposal
152	U	0	9	1			K		D81				Disposal
153	U	0	9	2			K		D81				Disposal
154	U	0	9	3			K		D81				Disposal
155	U	0	9	4			K		D81				Disposal
156	U	0	9	5			K		D81				Disposal
157	U	0	9	6			K		D81				Disposal
158	U	0	9	7			K		D81				Disposal
159	U	0	9	8			K		D81				Disposal
160	U	0	9	9			K		D81				Disposal
161	U	1	0	1			K		D81				Disposal
162	U	1	0	2			K		D81				Disposal
163	U	1	0	3			K		D81				Disposal
164	U	1	0	5			K		D81				Disposal
35	U	1	0	6			K		D81				Disposal
166	U	1	0	7			K		D81				Disposal
167	U	1	0	8			K		D81				Disposal
168	U	1	0	9			K		D81				Disposal

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I.D. Number *(enter from page 1)*	
W A 7 8 9 0 0 0 8 9 6 7	

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
169	U	1	1	0			K		D81				Disposal
170	U	1	1	1			K		D81				Disposal
171	U	1	1	2			K		D81				Disposal
172	U	1	1	3			K		D81				Disposal
173	U	1	1	4			K		D81				Disposal
174	U	1	1	5			K		D81				Disposal
175	U	1	1	6			K		D81				Disposal
176	U	1	1	7			K		D81				Disposal
177	U	1	1	8			K		D81				Disposal
178	U	1	1	9			K		D81				Disposal
179	U	1	2	0			K		D81				Disposal
180	U	1	2	1			K		D81				Disposal
181	U	1	2	2			K		D81				Disposal
182	U	1	2	3			K		D81				Disposal
183	U	1	2	4			K		D81				Disposal
184	U	1	2	5			K		D81				Disposal
185	U	1	2	6			K		D81				Disposal
186	U	1	2	7			K		D81				Disposal
187	U	1	2	8			K		D81				Disposal
188	U	1	2	9			K		D81				Disposal
189	U	1	3	0			K		D81				Disposal
190	U	1	3	1			K		D81				Disposal
191	U	1	3	2			K		D81				Disposal
192	U	1	3	3			K		D81				Disposal
193	U	1	3	4			K		D81				Disposal
194	U	1	3	5			K		D81				Disposal
195	U	1	3	6			K		D81				Disposal
196	U	1	3	7			K		D81				Disposal
197	U	1	3	8			K		D81				Disposal
198	U	1	4	0			K		D81				Disposal
199	U	1	4	1			K		D81				Disposal
200	U	1	4	2			K		D81				Disposal
201	U	1	4	3			K		D81				Disposal
202	U	1	4	4			K		D81				Disposal
203	U	1	4	5			K		D81				Disposal
204	U	1	4	6			K		D81				Disposal
205	U	1	4	7			K		D81				Disposal
206	U	1	4	8			K		D81				Disposal
207	U	1	4	9			K		D81				Disposal
208	U	1	5	0			K		D81				Disposal
209	U	1	5	1			K		D81				Disposal
210	U	1	5	2			K		D81				Disposal

Photocopy this page before completing if you have more than 26 wastes to list.

I.D. Number *(enter from page 1)*

A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
211	U	1	5	3			K		D81				Disposal
212	U	1	5	4			K		D81				Disposal
213	U	1	5	5			K		D81				Disposal
214	U	1	5	6			K		D81				Disposal
215	U	1	5	7			K		D81				Disposal
216	U	1	5	8			K		D81				Disposal
217	U	1	5	9			K		D81				Disposal
218	U	1	6	0			K		D81				Disposal
219	U	1	6	1			K		D81				Disposal
220	U	1	6	2			K		D81				Disposal
221	U	1	6	3			K		D81				Disposal
222	U	1	6	4			K		D81				Disposal
223	U	1	6	5			K		D81				Disposal
224	U	1	6	6			K		D81				Disposal
225	U	1	6	7			K		D81				Disposal
226	U	1	6	8			K		D81				Disposal
227	U	1	6	9			K		D81				Disposal
228	U	1	7	0			K		D81				Disposal
229	U	1	7	1			K		D81				Disposal
230	U	1	7	2			K		D81				Disposal
231	U	1	7	3			K		D81				Disposal
232	U	1	7	4			K		D81				Disposal
233	U	1	7	6			K		D81				Disposal
234	U	1	7	7			K		D81				Disposal
235	U	1	7	8			K		D81				Disposal
236	U	1	7	9			K		D81				Disposal
237	U	1	8	0			K		D81				Disposal
238	U	1	8	1			K		D81				Disposal
239	U	1	8	2			K		D81				Disposal
240	U	1	8	3			K		D81				Disposal
241	U	1	8	4			K		D81				Disposal
242	U	1	8	5			K		D81				Disposal
243	U	1	8	6			K		D81				Disposal
244	U	1	8	7			K		D81				Disposal
245	U	1	8	8			K		D81				Disposal
246	U	1	8	9			K		D81				Disposal
247	U	1	9	0			K		D81				Disposal
248	U	1	9	1			K		D81				Disposal
249	U	1	9	2			K		D81				Disposal
250	U	1	9	3			K		D81				Disposal
251	U	1	9	4			K		D81				Disposal
252	U	1	9	6			K		D81				Disposal

Photocopy this page before completing if you have more than 26 wastes to list.

I.D. Number *(enter from page 1)*	
W A 7 8 9 0 0 0 8 9 6 7	

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
253	U	1	9	7			K		D81				Disposal
254	U	2	0	0			K		D81				Disposal
255	U	2	0	1			K		D81				Disposal
256	U	2	0	2			K		D81				Disposal
257	U	2	0	3			K		D81				Disposal
258	U	2	0	4			K		D81				Disposal
259	U	2	0	5			K		D81				Disposal
260	U	2	0	6			K		D81				Disposal
261	U	2	0	7			K		D81				Disposal
262	U	2	0	8			K		D81				Disposal
263	U	2	0	9			K		D81				Disposal
264	U	2	1	0			K		D81				Disposal
265	U	2	1	1			K		D81				Disposal
266	U	2	1	2			K		D81				Disposal
267	U	2	1	3			K		D81				Disposal
268	U	2	1	4			K		D81				Disposal
269	U	2	1	5			K		D81				Disposal
270	U	2	1	6			K		D81				Disposal
271	U	2	1	7			K		D81				Disposal
272	U	2	1	8			K		D81				Disposal
273	U	2	1	9			K		D81				Disposal
274	U	2	2	0			K		D81				Disposal
275	U	2	2	1			K		D81				Disposal
276	U	2	2	2			K		D81				Disposal
277	U	2	2	3			K		D81				Disposal
278	U	2	2	5			K		D81				Disposal
279	U	2	2	6			K		D81				Disposal
280	U	2	2	7			K		D81				Disposal
281	U	2	2	8			K		D81				Disposal
282	U	2	3	0			K		D81				Disposal
283	U	2	3	1			K		D81				Disposal
284	U	2	3	2			K		D81				Disposal
285	U	2	3	3			K		D81				Disposal
286	U	2	3	4			K		D81				Disposal
287	U	2	3	5			K		D81				Disposal
288	U	2	3	6			K		D81				Disposal
289	U	2	3	7			K		D81				Disposal
290	U	2	3	8			K		D81				Disposal
291	U	2	3	9			K		D81				Disposal
292	U	2	4	0			K		D81				Disposal
293	U	2	4	2			K		D81				Disposal
294	U	2	4	3			K		D81				Disposal

Photocopy this page before completing if you have more than 26 wastes to list.

I.D. Number *(enter from page 1)*

A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
295	U	2	4	4			K		D81				Disposal
296	U	2	4	6			K		D81				Disposal
297	U	2	4	7			K		D81				Disposal
298	U	2	4	8			K		D81				Disposal
299	U	2	4	9			K		D81				Disposal
300	U	2	7	1			K		D81				Disposal
301	U	2	7	7			K		D81				Disposal
302	U	2	7	8			K		D81				Disposal
303	U	2	7	9			K		D81				Disposal
304	U	2	8	0			K		D81				Disposal
305	U	3	2	8			K		D81				Disposal
306	U	3	5	3			K		D81				Disposal
307	U	3	5	9			K		D81				Disposal
308	U	3	6	4			K		D81				Disposal
309	U	3	6	5			K		D81				Disposal
310	U	3	6	6			K		D81				Disposal
11	U	3	6	7			K		D81				Disposal
312	U	3	7	2			K		D81				Disposal
313	U	3	7	3			K		D81				Disposal
314	U	3	7	5			K		D81				Disposal
315	U	3	7	6			K		D81				Disposal
316	U	3	7	7			K		D81				Disposal
317	U	3	7	8			K		D81				Disposal
318	U	3	7	9			K		D81				Disposal
319	U	3	8	1			K		D81				Disposal
320	U	3	8	2			K		D81				Disposal
321	U	3	8	3			K		D81				Disposal
322	U	3	8	4			K		D81				Disposal
323	U	3	8	5			K		D81				Disposal
324	U	3	8	6			K		D81				Disposal
325	U	3	8	7			K		D81				Disposal
326	U	3	8	9			K		D81				Disposal
327	U	3	9	0			K		D81				Disposal
328	U	3	9	1			K		D81				Disposal
329	U	3	9	2			K		D81				Disposal
330	U	3	9	3			K		D81				Disposal
331	U	3	9	4			K		D81				Disposal
332	U	3	9	5			K		D81				Disposal
33	U	3	9	6			K		D81				Disposal
334	U	4	0	0			K		D81				Disposal
335	U	4	0	1			K		D81				Disposal
336	U	4	0	2			K		D81				Disposal

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I.D. Number *(enter from page 1)*	
W A 7 8 9 0 0 0 8 9 6 7	

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
337	U	4	0	3			K		D81				Disposal
338	U	4	0	4			K		D81				Disposal
339	U	4	0	7			K		D81				Disposal
340	U	4	0	9			K		D81				Disposal
341	U	4	1	0			K		D81				Disposal
342	U	4	1	1			K		D81				Disposal
343	P	0	0	1			K		D81				Disposal
344	P	0	0	2			K		D81				Disposal
345	P	0	0	3			K		D81				Disposal
346	P	0	0	4			K		D81				Disposal
347	P	0	0	5			K		D81				Disposal
348	P	0	0	6			K		D81				Disposal
349	P	0	0	7			K		D81				Disposal
350	P	0	0	8			K		D81				Disposal
351	P	0	0	9			K		D81				Disposal
352	P	0	1	0			K		D81				Disposal
353	P	0	1	1			K		D81				Disposal
354	P	0	1	2			K		D81				Disposal
355	P	0	1	3			K		D81				Disposal
356	P	0	1	4			K		D81				Disposal
357	P	0	1	5			K		D81				Disposal
358	P	0	1	6			K		D81				Disposal
359	P	0	1	7			K		D81				Disposal
360	P	0	1	8			K		D81				Disposal
361	P	0	2	0			K		D81				Disposal
362	P	0	2	1			K		D81				Disposal
363	P	0	2	2			K		D81				Disposal
364	P	0	2	3			K		D81				Disposal
365	P	0	2	4			K		D81				Disposal
366	P	0	2	6			K		D81				Disposal
367	P	0	2	7			K		D81				Disposal
368	P	0	2	8			K		D81				Disposal
369	P	0	2	9			K		D81				Disposal
370	P	0	3	0			K		D81				Disposal
371	P	0	3	1			K		D81				Disposal
372	P	0	3	3			K		D81				Disposal
373	P	0	3	4			K		D81				Disposal
374	P	0	3	6			K		D81				Disposal
375	P	0	3	7			K		D81				Disposal
376	P	0	3	8			K		D81				Disposal
377	P	0	3	9			K		D81				Disposal
378	P	0	4	0			K		D81				Disposal

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I.D. Number *(enter from page 1)*

A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
379	P	0	4	1			K		D81				Disposal
380	P	0	4	2			K		D81				Disposal
381	P	0	4	3			K		D81				Disposal
382	P	0	4	4			K		D81				Disposal
383	P	0	4	5			K		D81				Disposal
384	P	0	4	6			K		D81				Disposal
385	P	0	4	7			K		D81				Disposal
386	P	0	4	8			K		D81				Disposal
387	P	0	4	9			K		D81				Disposal
388	P	0	5	0			K		D81				Disposal
389	P	0	5	1			K		D81				Disposal
390	P	0	5	4			K		D81				Disposal
391	P	0	5	6			K		D81				Disposal
392	P	0	5	7			K		D81				Disposal
393	P	0	5	8			K		D81				Disposal
394	P	0	5	9			K		D81				Disposal
95	P	0	6	0			K		D81				Disposal
396	P	0	6	2			K		D81				Disposal
397	P	0	6	3			K		D81				Disposal
398	P	0	6	4			K		D81				Disposal
399	P	0	6	5			K		D81				Disposal
400	P	0	6	6			K		D81				Disposal
401	P	0	6	7			K		D81				Disposal
402	P	0	6	8			K		D81				Disposal
403	P	0	6	9			K		D81				Disposal
404	P	0	7	0			K		D81				Disposal
405	P	0	7	1			K		D81				Disposal
406	P	0	7	2			K		D81				Disposal
407	P	0	7	3			K		D81				Disposal
408	P	0	7	4			K		D81				Disposal
409	P	0	7	5			K		D81				Disposal
410	P	0	7	6			K		D81				Disposal
411	P	0	7	7			K		D81				Disposal
412	P	0	7	8			K		D81				Disposal
413	P	0	8	1			K		D81				Disposal
414	P	0	8	2			K		D81				Disposal
415	P	0	8	4			K		D81				Disposal
416	P	0	8	5			K		D81				Disposal
17	P	0	8	7			K		D81				Disposal
418	P	0	8	8			K		D81				Disposal
419	P	0	8	9			K		D81				Disposal
420	P	0	9	2			K		D81				Disposal

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I.D. Number *(enter from page 1)*											
W	A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
421	P	0	9	3			K		D81				Disposal
422	P	0	9	4			K		D81				Disposal
423	P	0	9	5			K		D81				Disposal
424	P	0	9	6			K		D81				Disposal
425	P	0	9	7			K		D81				Disposal
426	P	0	9	8			K		D81				Disposal
427	P	0	9	9			K		D81				Disposal
428	P	1	0	1			K		D81				Disposal
429	P	1	0	2			K		D81				Disposal
430	P	1	0	3			K		D81				Disposal
431	P	1	0	4			K		D81				Disposal
432	P	1	0	5			K		D81				Disposal
433	P	1	0	6			K		D81				Disposal
434	P	1	0	7			K		D81				Disposal
435	P	1	0	8			K		D81				Disposal
436	P	1	0	9			K		D81				Disposal
437	P	1	1	0			K		D81				Disposal
438	P	1	1	1			K		D81				Disposal
439	P	1	1	2			K		D81				Disposal
440	P	1	1	3			K		D81				Disposal
441	P	1	1	4			K		D81				Disposal
442	P	1	1	5			K		D81				Disposal
443	P	1	1	6			K		D81				Disposal
444	P	1	1	8			K		D81				Disposal
445	P	1	1	9			K		D81				Disposal
446	P	1	2	0			K		D81				Disposal
447	P	1	2	1			K		D81				Disposal
448	P	1	2	2			K		D81				Disposal
449	P	1	2	3			K		D81				Disposal
450	P	1	2	7			K		D81				Disposal
451	P	1	2	8			K		D81				Disposal
452	P	1	8	5			K		D81				Disposal
453	P	1	8	8			K		D81				Disposal
454	P	1	8	9			K		D81				Disposal
455	P	1	9	0			K		D81				Disposal
456	P	1	9	1			K		D81				Disposal
457	P	1	9	2			K		D81				Disposal
458	P	1	9	4			K		D81				Disposal
459	P	1	9	6			K		D81				Disposal
460	P	1	9	7			K		D81				Disposal
461	P	1	9	8			K		D81				Disposal
462	P	1	9	9			K		D81				Disposal

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I.D. Number *(enter from page 1)* A 7 8 9 0 0 0 8 9 6 7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes 1. Process Codes *(enter)*				D. Processes 2. Process Description *(if a code is not entered in D(1))*
463	P	2	0	1			K		D81				Disposal
464	P	2	0	2			K		D81				Disposal
465	P	2	0	3			K		D81				Disposal
466	P	2	0	4			K		D81				Disposal
467	P	2	0	5			K		D81				Disposal
468	D	0	0	4	10,000,000		K		S01				Storage- Container
469	D	0	0	5			K		S01				Storage- Container
470	D	0	0	6			K		S01				Storage- Container
471	D	0	0	7			K		S01				Storage- Container
472	D	0	0	8			K		S01				Storage- Container
473	D	0	0	9			K		S01				Storage- Container
474	D	0	1	0			K		S01				Storage- Container
475	D	0	1	1			K		S01				Storage- Container
476	D	0	1	2			K		S01				Storage- Container
477	D	0	1	3			K		S01				Storage- Container
478	D	0	1	4			K		S01				Storage- Container
479	D	0	1	5			K		S01				Storage- Container
480	D	0	1	6			K		S01				Storage- Container
481	D	0	1	7			K		S01				Storage- Container
482	D	0	1	8			K		S01				Storage- Container
483	D	0	1	9			K		S01				Storage- Container
484	D	0	2	0			K		S01				Storage- Container
485	D	0	2	1			K		S01				Storage- Container
486	D	0	2	2			K		S01				Storage- Container
487	D	0	2	3			K		S01				Storage- Container
488	D	0	2	4			K		S01				Storage- Container
489	D	0	2	5			K		S01				Storage- Container
490	D	0	2	6			K		S01				Storage- Container
491	D	0	2	7			K		S01				Storage- Container
492	D	0	2	8			K		S01				Storage- Container
493	D	0	2	9			K		S01				Storage- Container
494	D	0	3	0			K		S01				Storage- Container
495	D	0	3	1			K		S01				Storage- Container
496	D	0	3	2			K		S01				Storage- Container
497	D	0	3	3			K		S01				Storage- Container
498	D	0	3	4			K		S01				Storage- Container
499	D	0	3	5			K		S01				Storage- Container
500	D	0	3	6			K		S01				Storage- Container
501	D	0	3	7			K		S01				Storage- Container
502	D	0	3	8			K		S01				Storage- Container
503	D	0	3	9			K		S01				Storage- Container
504	D	0	4	0			K		S01				Storage- Container

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I.D. Number *(enter from page 1)*	
W A 7 8 9 0 0 0 8 9 6 7	

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
505	D	0	4	1			K		S01				Storage- Container
506	D	0	4	2			K		S01				Storage- Container
507	D	0	4	3			K		S01				Storage- Container
508	W	T	0	1			K		S01				Storage- Container
509	W	T	0	2			K		S01				Storage- Container
510	W	P	0	1			K		S01				Storage- Container
511	W	P	0	2			K		S01				Storage- Container
512	W	P	0	3			K		S01				Storage- Container
513	W	0	0	1			K		S01				Storage- Container
514	W	S	C	2			K		S01				Storage- Container
515	F	0	0	1			K		S01				Storage- Container
516	F	0	0	2			K		S01				Storage- Container
517	F	0	0	3			K		S01				Storage- Container
518	F	0	0	4			K		S01				Storage- Container
519	F	0	0	5			K		S01				Storage- Container
520	F	0	0	6			K		S01				Storage- Container
521	F	0	0	7			K		S01				Storage- Container
522	F	0	0	8			K		S01				Storage- Container
523	F	0	0	9			K		S01				Storage- Container
524	F	0	1	0			K		S01				Storage- Container
525	F	0	1	1			K		S01				Storage- Container
526	F	0	1	2			K		S01				Storage- Container
527	F	0	1	9			K		S01				Storage- Container
528	F	0	2	8			K		S01				Storage- Container
529	U	0	0	1			K		S01				Storage- Container
530	U	0	0	2			K		S01				Storage- Container
531	U	0	0	3			K		S01				Storage- Container
532	U	0	0	4			K		S01				Storage- Container
533	U	0	0	5			K		S01				Storage- Container
534	U	0	0	6			K		S01				Storage- Container
535	U	0	0	7			K		S01				Storage- Container
536	U	0	0	8			K		S01				Storage- Container
537	U	0	0	9			K		S01				Storage- Container
538	U	0	1	0			K		S01				Storage- Container
539	U	0	1	1			K		S01				Storage- Container
540	U	0	1	2			K		S01				Storage- Container
541	U	0	1	4			K		S01				Storage- Container
542	U	0	1	5			K		S01				Storage- Container
543	U	0	1	6			K		S01				Storage- Container
544	U	0	1	7			K		S01				Storage- Container
545	U	0	1	8			K		S01				Storage- Container
546	U	0	1	9			K		S01				Storage- Container

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I.D. Number *(enter from page 1)*

A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
547	U	0	2	0			K		S01				Storage- Container
548	U	0	2	1			K		S01				Storage- Container
549	U	0	2	2			K		S01				Storage- Container
550	U	0	2	3			K		S01				Storage- Container
551	U	0	2	4			K		S01				Storage- Container
552	U	0	2	5			K		S01				Storage- Container
553	U	0	2	6			K		S01				Storage- Container
554	U	0	2	7			K		S01				Storage- Container
555	U	0	2	8			K		S01				Storage- Container
556	U	0	2	9			K		S01				Storage- Container
557	U	0	3	0			K		S01				Storage- Container
558	U	0	3	1			K		S01				Storage- Contalner
559	U	0	3	2			K		S01				Storage- Container
560	U	0	3	3			K		S01				Storage- Container
561	U	0	3	4			K		S01				Storage- Container
562	U	0	3	5			K		S01				Storage- Container
563	U	0	3	6			K		S01				Storage- Container
564	U	0	3	7			K		S01				Storage- Container
565	U	0	3	8			K		S01				Storage- Container
566	U	0	3	9			K		S01				Storage- Container
567	U	0	4	1			K		S01				Storage- Container
568	U	0	4	2			K		S01				Storage- Container
569	U	0	4	3			K		S01				Storage- Container
570	U	0	4	4			K		S01				Storage- Container
571	U	0	4	5			K		S01				Storage- Container
572	U	0	4	6			K		S01				Storage- Container
573	U	0	4	7			K		S01				Storage- Container
574	U	0	4	8			K		S01				Storage- Container
575	U	0	4	9			K		S01				Storage- Container
576	U	0	5	0			K		S01				Storage- Container
577	U	0	5	1			K		S01				Storage- Container
578	U	0	5	2			K		S01				Storage- Container
579	U	0	5	3			K		S01				Storage- Container
580	U	0	5	5			K		S01				Storage- Container
581	U	0	5	6			K		S01				Storage- Container
582	U	0	5	7			K		S01				Storage- Container
583	U	0	5	8			K		S01				Storage- Container
584	U	0	5	9			K		S01				Storage- Container
585	U	0	6	0			K		S01				Storage- Container
586	U	0	6	1			K		S01				Storage- Container
587	U	0	6	2			K		S01				Storage- Container
588	U	0	6	3			K		S01				Storage- Container

Photocopy this page before completing if you have more than 26 wastes to list.

I.D. Number *(enter from page 1)*	
W A 7 8 9 0 0 0 8 9 6 7	

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
589	U	0	6	4			K		S01				Storage- Container
590	U	0	6	6			K		S01				Storage- Container
591	U	0	6	7			K		S01				Storage- Container
592	U	0	6	8			K		S01				Storage- Container
593	U	0	6	9			K		S01				Storage- Container
594	U	0	7	0			K		S01				Storage- Container
595	U	0	7	1			K		S01				Storage- Container
596	U	0	7	2			K		S01				Storage- Container
597	U	0	7	3			K		S01				Storage- Container
598	U	0	7	4			K		S01				Storage- Container
599	U	0	7	5			K		S01				Storage- Container
600	U	0	7	6			K		S01				Storage- Container
601	U	0	7	7			K		S01				Storage- Container
602	U	0	7	8			K		S01				Storage- Container
603	U	0	7	9			K		S01				Storage- Container
604	U	0	8	0			K		S01				Storage- Container
605	U	0	8	1			K		S01				Storage- Container
606	U	0	8	2			K		S01				Storage- Container
607	U	0	8	3			K		S01				Storage- Container
608	U	0	8	4			K		S01				Storage- Container
609	U	0	8	5			K		S01				Storage- Container
610	U	0	8	6			K		S01				Storage- Container
611	U	0	8	7			K		S01				Storage- Container
612	U	0	8	8			K		S01				Storage- Container
613	U	0	8	9			K		S01				Storage- Container
614	U	0	9	0			K		S01				Storage- Container
615	U	0	9	1			K		S01				Storage- Container
616	U	0	9	2			K		S01				Storage- Container
617	U	0	9	3			K		S01				Storage- Container
618	U	0	9	4			K		S01				Storage- Container
619	U	0	9	5			K		S01				Storage- Container
620	U	0	9	6			K		S01				Storage- Container
621	U	0	9	7			K		S01				Storage- Container
622	U	0	9	8			K		S01				Storage- Container
623	U	0	9	9			K		S01				Storage- Container
624	U	1	0	1			K		S01				Storage- Container
625	U	1	0	2			K		S01				Storage- Container
626	U	1	0	3			K		S01				Storage- Container
627	U	1	0	5			K		S01				Storage- Container
628	U	1	0	6			K		S01				Storage- Container
629	U	1	0	7			K		S01				Storage- Container
630	U	1	0	8			K		S01				Storage- Container

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I.D. Number *(enter from page 1)*

A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes 1. Process Codes *(enter)*				D. Processes 2. Process Description *(if a code is not entered in D(1))*
631	U	1	0	9			K		S01				Storage- Container
632	U	1	1	0			K		S01				Storage- Container
633	U	1	1	1			K		S01				Storage- Container
634	U	1	1	2			K		S01				Storage- Container
635	U	1	1	3			K		S01				Storage- Container
636	U	1	1	4			K		S01				Storage- Container
637	U	1	1	5			K		S01				Storage- Container
638	U	1	1	6			K		S01				Storage- Container
639	U	1	1	7			K		S01				Storage- Container
640	U	1	1	8			K		S01				Storage- Container
641	U	1	1	9			K		S01				Storage- Container
642	U	1	2	0			K		S01				Storage- Container
643	U	1	2	1			K		S01				Storage- Container
644	U	1	2	2			K		S01				Storage- Container
645	U	1	2	3			K		S01				Storage- Container
646	U	1	2	4			K		S01				Storage- Container
47	U	1	2	5			K		S01				Storage- Container
648	U	1	2	6			K		S01				Storage- Container
649	U	1	2	7			K		S01				Storage- Container
650	U	1	2	8			K		S01				Storage- Container
651	U	1	2	9			K		S01				Storage- Container
652	U	1	3	0			K		S01				Storage- Container
653	U	1	3	1			K		S01				Storage- Container
654	U	1	3	2			K		S01				Storage- Container
655	U	1	3	3			K		S01				Storage- Container
656	U	1	3	4			K		S01				Storage- Container
657	U	1	3	5			K		S01				Storage- Container
658	U	1	3	6			K		S01				Storage- Container
659	U	1	3	7			K		S01				Storage- Container
660	U	1	3	8			K		S01				Storage- Container
661	U	1	4	0			K		S01				Storage- Container
662	U	1	4	1			K		S01				Storage- Container
663	U	1	4	2			K		S01				Storage- Container
664	U	1	4	3			K		S01				Storage- Container
665	U	1	4	4			K		S01				Storage- Container
666	U	1	4	5			K		S01				Storage- Container
667	U	1	4	6			K		S01				Storage- Container
668	U	1	4	7			K		S01				Storage- Container
39	U	1	4	8			K		S01				Storage- Container
670	U	1	4	9			K		S01				Storage- Container
671	U	1	5	0			K		S01				Storage- Container
672	U	1	5	1			K		S01				Storage- Container

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I.D. Number *(enter from page 1)*	
W A 7 8 9 0 0 0 8 9 6 7	

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
673	U	1	5	2			K		S01				Storage- Container
674	U	1	5	3			K		S01				Storage- Container
675	U	1	5	4			K		S01				Storage- Container
676	U	1	5	5			K		S01				Storage- Container
677	U	1	5	6			K		S01				Storage- Container
678	U	1	5	7			K		S01				Storage- Container
679	U	1	5	8			K		S01				Storage- Container
680	U	1	5	9			K		S01				Storage- Container
681	U	1	6	0			K		S01				Storage- Container
682	U	1	6	1			K		S01				Storage- Container
683	U	1	6	2			K		S01				Storage- Container
684	U	1	6	3			K		S01				Storage- Container
685	U	1	6	4			K		S01				Storage- Container
686	U	1	6	5			K		S01				Storage- Container
687	U	1	6	6			K		S01				Storage- Container
688	U	1	6	7			K		S01				Storage- Container
689	U	1	6	8			K		S01				Storage- Container
690	U	1	6	9			K		S01				Storage- Container
691	U	1	7	0			K		S01				Storage- Container
692	U	1	7	1			K		S01				Storage- Container
693	U	1	7	2			K		S01				Storage- Container
694	U	1	7	3			K		S01				Storage- Container
695	U	1	7	4			K		S01				Storage- Container
696	U	1	7	6			K		S01				Storage- Container
697	U	1	7	7			K		S01				Storage- Container
698	U	1	7	8			K		S01				Storage- Container
699	U	1	7	9			K		S01				Storage- Container
700	U	1	8	0			K		S01				Storage- Container
701	U	1	8	1			K		S01				Storage- Container
702	U	1	8	2			K		S01				Storage- Container
703	U	1	8	3			K		S01				Storage- Container
704	U	1	8	4			K		S01				Storage- Container
705	U	1	8	5			K		S01				Storage- Container
706	U	1	8	6			K		S01				Storage- Container
707	U	1	8	7			K		S01				Storage- Container
708	U	1	8	8			K		S01				Storage- Container
709	U	1	8	9			K		S01				Storage- Container
710	U	1	9	0			K		S01				Storage- Container
711	U	1	9	1			K		S01				Storage- Container
712	U	1	9	2			K		S01				Storage- Container
713	U	1	9	3			K		S01				Storage- Container
714	U	1	9	4			K		S01				Storage- Container

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I.D. Number *(enter from page 1)*	
A 7 8 9 0 0 0 8 9 6 7	

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
715	U	1	9	6			K		S01				Storage- Container
716	U	1	9	7			K		S01				Storage- Container
717	U	2	0	0			K		S01				Storage- Container
718	U	2	0	1			K		S01				Storage- Container
719	U	2	0	2			K		S01				Storage- Container
720	U	2	0	3			K		S01				Storage- Container
721	U	2	0	4			K		S01				Storage- Container
722	U	2	0	5			K		S01				Storage- Container
723	U	2	0	6			K		S01				Storage- Container
724	U	2	0	7			K		S01				Storage- Container
725	U	2	0	8			K		S01				Storage- Container
726	U	2	0	9			K		S01				Storage- Container
727	U	2	1	0			K		S01				Storage- Container
728	U	2	1	1			K		S01				Storage- Container
729	U	2	1	2			K		S01				Storage- Container
730	U	2	1	3			K		S01				Storage- Container
31	U	2	1	4			K		S01				Storage- Container
732	U	2	1	5			K		S01				Storage- Container
733	U	2	1	6			K		S01				Storage- Container
734	U	2	1	7			K		S01				Storage- Container
735	U	2	1	8			K		S01				Storage- Container
736	U	2	1	9			K		S01				Storage- Container
737	U	2	2	0			K		S01				Storage- Container
738	U	2	2	1			K		S01				Storage- Container
739	U	2	2	2			K		S01				Storage- Container
740	U	2	2	3			K		S01				Storage- Container
741	U	2	2	5			K		S01				Storage- Container
742	U	2	2	6			K		S01				Storage- Container
743	U	2	2	7			K		S01				Storage- Container
744	U	2	2	8			K		S01				Storage- Container
745	U	2	3	0			K		S01				Storage- Container
746	U	2	3	1			K		S01				Storage- Container
747	U	2	3	2			K		S01				Storage- Container
748	U	2	3	3			K		S01				Storage- Container
749	U	2	3	4			K		S01				Storage- Container
750	U	2	3	5			K		S01				Storage- Container
751	U	2	3	6			K		S01				Storage- Container
752	U	2	3	7			K		S01				Storage- Container
53	U	2	3	8			K		S01				Storage- Container
754	U	2	3	9			K		S01				Storage- Container
755	U	2	4	0			K		S01				Storage- Container
756	U	2	4	2			K		S01				Storage- Container

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I.D. Number *(enter from page 1)*	
W A 7 8 9 0 0 0 8 9 6 7	

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
757	U	2	4	3			K		S01				Storage- Container
758	U	2	4	4			K		S01				Storage- Container
759	U	2	4	6			K		S01				Storage- Container
760	U	2	4	7			K		S01				Storage- Container
761	U	2	4	8			K		S01				Storage- Container
762	U	2	4	9			K		S01				Storage- Container
763	U	2	7	1			K		S01				Storage- Container
764	U	2	7	7			K		S01				Storage- Container
765	U	2	7	8			K		S01				Storage- Container
766	U	2	7	9			K		S01				Storage- Container
767	U	2	8	0			K		S01				Storage- Container
768	U	3	2	8			K		S01				Storage- Container
769	U	3	5	3			K		S01				Storage- Container
770	U	3	5	9			K		S01				Storage- Container
771	U	3	6	4			K		S01				Storage- Container
772	U	3	6	5			K		S01				Storage- Container
773	U	3	6	6			K		S01				Storage- Container
774	U	3	6	7			K		S01				Storage- Container
775	U	3	7	2			K		S01				Storage- Container
776	U	3	7	3			K		S01				Storage- Container
777	U	3	7	5			K		S01				Storage- Container
778	U	3	7	6			K		S01				Storage- Container
779	U	3	7	7			K		S01				Storage- Container
780	U	3	7	8			K		S01				Storage- Container
781	U	3	7	9			K		S01				Storage- Container
782	U	3	8	1			K		S01				Storage- Container
783	U	3	8	2			K		S01				Storage- Container
784	U	3	8	3			K		S01				Storage- Container
785	U	3	8	4			K		S01				Storage- Container
786	U	3	8	5			K		S01				Storage- Container
787	U	3	8	6			K		S01				Storage- Container
788	U	3	8	7			K		S01				Storage- Container
789	U	3	8	9			K		S01				Storage- Container
790	U	3	9	0			K		S01				Storage- Container
791	U	3	9	1			K		S01				Storage- Container
792	U	3	9	2			K		S01				Storage- Container
793	U	3	9	3			K		S01				Storage- Container
794	U	3	9	4			K		S01				Storage- Container
795	U	3	9	5			K		S01				Storage- Container
796	U	3	9	6			K		S01				Storage- Container
797	U	4	0	0			K		S01				Storage- Container
798	U	4	0	1			K		S01				Storage- Container

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I.D. Number *(enter from page 1)*

A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*		D. Processes				
								1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
799	U	4	0	2			K	S01				Storage- Container
800	U	4	0	3			K	S01				Storage- Container
801	U	4	0	4			K	S01				Storage- Container
802	U	4	0	7			K	S01				Storage- Container
803	U	4	0	9			K	S01				Storage- Container
804	U	4	1	0			K	S01				Storage- Container
805	U	4	1	1			K	S01				Storage- Container
806	P	0	0	1			K	S01				Storage- Container
807	P	0	0	2			K	S01				Storage- Container
808	P	0	0	3			K	S01				Storage- Container
809	P	0	0	4			K	S01				Storage- Container
810	P	0	0	5			K	S01				Storage- Container
811	P	0	0	6			K	S01				Storage- Container
812	P	0	0	7			K	S01				Storage- Container
813	P	0	0	8			K	S01				Storage- Container
814	P	0	0	9			K	S01				Storage- Container
15	P	0	1	0			K	S01				Storage- Container
816	P	0	1	1			K	S01				Storage- Container
817	P	0	1	2			K	S01				Storage- Container
818	P	0	1	3			K	S01				Storage- Container
819	P	0	1	4			K	S01				Storage- Container
820	P	0	1	5			K	S01				Storage- Container
821	P	0	1	6			K	S01				Storage- Container
822	P	0	1	7			K	S01				Storage- Container
823	P	0	1	8			K	S01				Storage- Container
824	P	0	2	0			K	S01				Storage- Container
825	P	0	2	1			K	S01				Storage- Container
826	P	0	2	2			K	S01				Storage- Container
827	P	0	2	3			K	S01				Storage- Container
828	P	0	2	4			K	S01				Storage- Container
829	P	0	2	6			K	S01				Storage- Container
830	P	0	2	7			K	S01				Storage- Container
831	P	0	2	8			K	S01				Storage- Container
832	P	0	2	9			K	S01				Storage- Container
833	P	0	3	0			K	S01				Storage- Container
834	P	0	3	1			K	S01				Storage- Container
835	P	0	3	3			K	S01				Storage- Container
836	P	0	3	4			K	S01				Storage- Container
37	P	0	3	6			K	S01				Storage- Container
838	P	0	3	7			K	S01				Storage- Container
839	P	0	3	8			K	S01				Storage- Container
840	P	0	3	9			K	S01				Storage- Container

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I.D. Number *(enter from page 1)*											
W	A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes 1. Process Codes *(enter)*				D. Processes 2. Process Description *(if a code is not entered in D(1))*
841	P	0	4	0			K		S01				Storage- Container
842	P	0	4	1			K		S01				Storage- Container
843	P	0	4	2			K		S01				Storage- Container
844	P	0	4	3			K		S01				Storage- Container
845	P	0	4	4			K		S01				Storage- Container
846	P	0	4	5			K		S01				Storage- Container
847	P	0	4	6			K		S01				Storage- Container
848	P	0	4	7			K		S01				Storage- Container
849	P	0	4	8			K		S01				Storage- Container
850	P	0	4	9			K		S01				Storage- Container
851	P	0	5	0			K		S01				Storage- Container
852	P	0	5	1			K		S01				Storage- Container
853	P	0	5	4			K		S01				Storage- Container
854	P	0	5	6			K		S01				Storage- Container
855	P	0	5	7			K		S01				Storage- Container
856	P	0	5	8			K		S01				Storage- Container
857	P	0	5	9			K		S01				Storage- Container
858	P	0	6	0			K		S01				Storage- Container
859	P	0	6	2			K		S01				Storage- Container
860	P	0	6	3			K		S01				Storage- Container
861	P	0	6	4			K		S01				Storage- Container
862	P	0	6	5			K		S01				Storage- Container
863	P	0	6	6			K		S01				Storage- Container
864	P	0	6	7			K		S01				Storage- Container
865	P	0	6	8			K		S01				Storage- Container
866	P	0	6	9			K		S01				Storage- Container
867	P	0	7	0			K		S01				Storage- Container
868	P	0	7	1			K		S01				Storage- Container
869	P	0	7	2			K		S01				Storage- Container
870	P	0	7	3			K		S01				Storage- Container
871	P	0	7	4			K		S01				Storage- Container
872	P	0	7	5			K		S01				Storage- Container
873	P	0	7	6			K		S01				Storage- Container
874	P	0	7	7			K		S01				Storage- Container
875	P	0	7	8			K		S01				Storage- Container
876	P	0	8	1			K		S01				Storage- Container
877	P	0	8	2			K		S01				Storage- Container
878	P	0	8	4			K		S01				Storage- Container
879	P	0	8	5			K		S01				Storage- Container
880	P	0	8	7			K		S01				Storage- Container
881	P	0	8	8			K		S01				Storage- Container
882	P	0	8	9			K		S01				Storage- Container

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I.D. Number *(enter from page 1)*

W	A	7	8	9	0	0	0	8	9	6	7

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
883	P	0	9	2			K		S01				Storage- Container
884	P	0	9	3			K		S01				Storage- Container
885	P	0	9	4			K		S01				Storage- Container
886	P	0	9	5			K		S01				Storage- Container
887	P	0	9	6			K		S01				Storage- Container
888	P	0	9	7			K		S01				Storage- Container
889	P	0	9	8			K		S01				Storage- Container
890	P	0	9	9			K		S01				Storage- Container
891	P	1	0	1			K		S01				Storage- Container
892	P	1	0	2			K		S01				Storage- Container
893	P	1	0	3			K		S01				Storage- Container
894	P	1	0	4			K		S01				Storage- Container
895	P	1	0	5			K		S01				Storage- Container
896	P	1	0	6			K		S01				Storage- Container
897	P	1	0	7			K		S01				Storage- Container
898	P	1	0	8			K		S01				Storage- Container
899	P	1	0	9			K		S01				Storage- Container
900	P	1	1	0			K		S01				Storage- Container
901	P	1	1	1			K		S01				Storage- Container
902	P	1	1	2			K		S01				Storage- Container
903	P	1	1	3			K		S01				Storage- Container
904	P	1	1	4			K		S01				Storage- Container
905	P	1	1	5			K		S01				Storage- Container
906	P	1	1	6			K		S01				Storage- Container
907	P	1	1	8			K		S01				Storage- Container
908	P	1	1	9			K		S01				Storage- Container
909	P	1	2	0			K		S01				Storage- Container
910	P	1	2	1			K		S01				Storage- Container
911	P	1	2	2			K		S01				Storage- Container
912	P	1	2	3			K		S01				Storage- Container
913	P	1	2	7			K		S01				Storage- Container
914	P	1	2	8			K		S01				Storage- Container
915	P	1	8	5			K		S01				Storage- Container
916	P	1	8	8			K		S01				Storage- Container
917	P	1	8	9			K		S01				Storage- Container
918	P	1	9	0			K		S01				Storage- Container
919	P	1	9	1			K		S01				Storage- Container
920	P	1	9	2			K		S01				Storage- Container
921	P	1	9	4			K		S01				Storage- Container
922	P	1	9	6			K		S01				Storage- Container
923	P	1	9	7			K		S01				Storage- Container
924	P	1	9	8			K		S01				Storage- Container

Photocopy this page before completing if you have more than 26 wastes to list.

I.D. Number *(enter from page 1)*	
W A 7 8 9 0 0 0 8 9 6 7	

IV. DESCRIPTION OF DANGEROUS WASTES *(continued)*

Line No.	A. Dangerous Waste No. *(enter code)*				B. Estimated Annual Quantity of Waste	C. Unit of Measure *(enter code)*			D. Processes				
									1. Process Codes *(enter)*				2. Process Description *(if a code is not entered in D(1))*
925	P	1	9	9			K		S01				Storage- Container
926	P	2	0	1			K		S01				Storage- Container
927	P	2	0	2			K		S01				Storage- Container
928	P	2	0	3			K		S01				Storage- Container
929	P	2	0	4			K		S01				Storage- Container
930	P	2	0	5			K		S01				Storage- Container

IV. DESCRIPTION OF DANGEROUS WASTE (continued)

Use this space to list additional process codes from Section D(1) on page 3.

Mixed waste disposed in the LLBG consists of toxicity characteristic waste (D001 through D043), state-only (WT01, WT02, WP01, WP02, WP03, WSC2, and W001), and listed waste from nonspecific sources (F001 through F012, F019, F028, and F039), and all "U" and "P" dangerous waste numbers.
The defueled reactor compartments in trench 94 of the 218-E-12B Burial Ground contain shielding constructed of metallic lead (state-only D008).

Toxicity characteristic waste (D001, D002, and D003) does not apply to the mixed waste unit trenches (trenches 31, 34 and 94).

Before starting final disposal activities, any mixed waste stored in trenches 31 and 34 of the 218-W-5 Burial Ground could consist of toxicity characteristic waste (D004 through D043), state-only waste (WT01, WT02, WP01, WP02, WP03, WSC2, and W001), listed waste from nonspecific sources (F001 through F012, F019, and F028), and all "U" and "P" dangerous waste numbers.

V. FACILITY DRAWING Refer to attached drawing(s).

All existing facilities must include in the space provided on page 5 a scale drawing of the facility (see instructions for more detail).

VI. PHOTOGRAPHS Refer to attached photograph(s).

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

II. FACILITY GEOGRAPHIC LOCATION This information is provided on the attached drawings and photos.

LATITUDE *(degrees, minutes, & seconds)*	LONGITUDE *(degrees, minutes, & seconds)*

VIII. FACILITY OWNER

☒ A. If the facility owner is also the facility operator as listed in Section VII on Form 1, "General Information," place an "X" in the box to the left and skip to Section IX below.

B. If the facility owner is not the facility operator as listed in Section VII on Form 1, complete the following items:

1. Name of Facility's Legal Owner	2. Phone Number *(area code & no.)*

3. Street or P.O. Box	4. City or Town	5. St.	6. Zip Code

IX. OWNER CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Name *(print or type)*	Signature	Date Signed
Keith A. Klein, Manager U.S. Department of Energy, Richland Operations Office		

X. OPERATOR CERTIFICATION

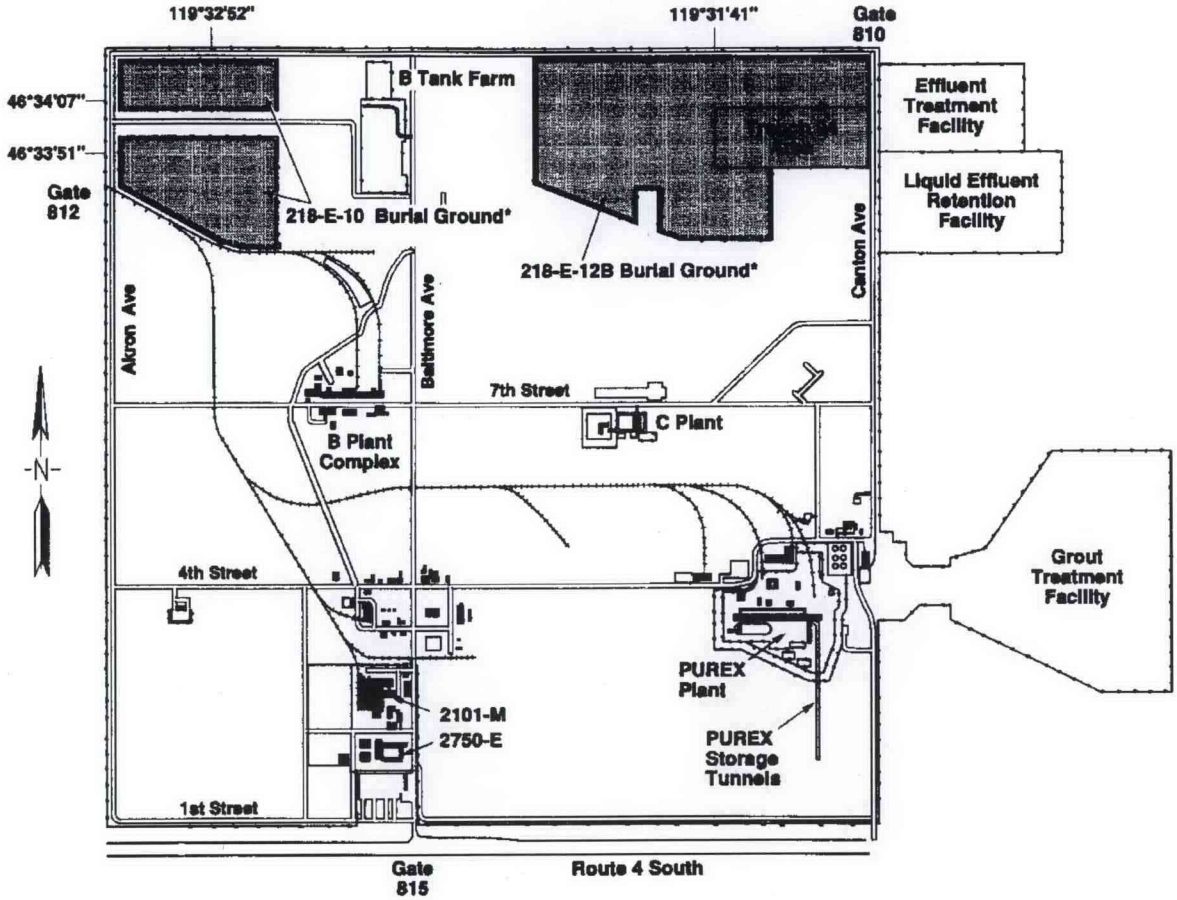
I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

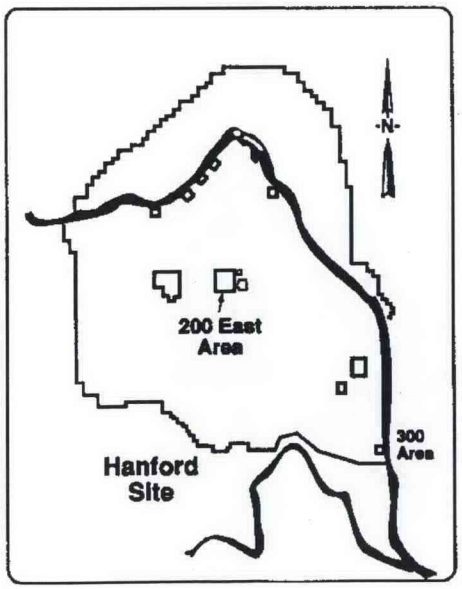
Name *(Print Or Type)*	Signature	Date Signed
See attachment		

X. OPERATOR CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Owner/Operator Keith A. Klein, Manager U.S. Department of Energy, Richland Operations Office	Date
E. Keith Thomson President and Chief Executive Officer Fluor Hanford	Date





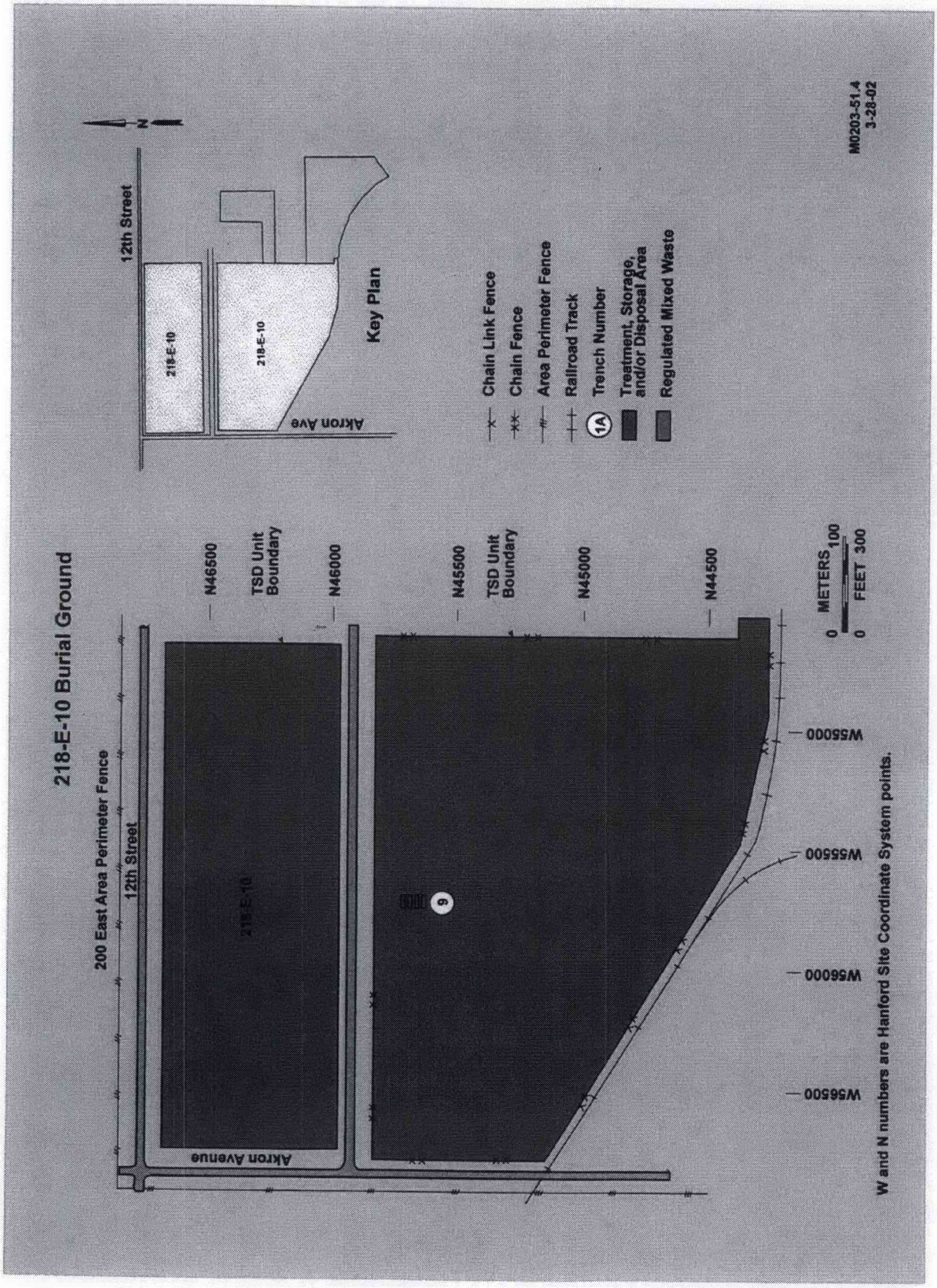
0 1,525 3,050 Feet
0 465 930 Meters

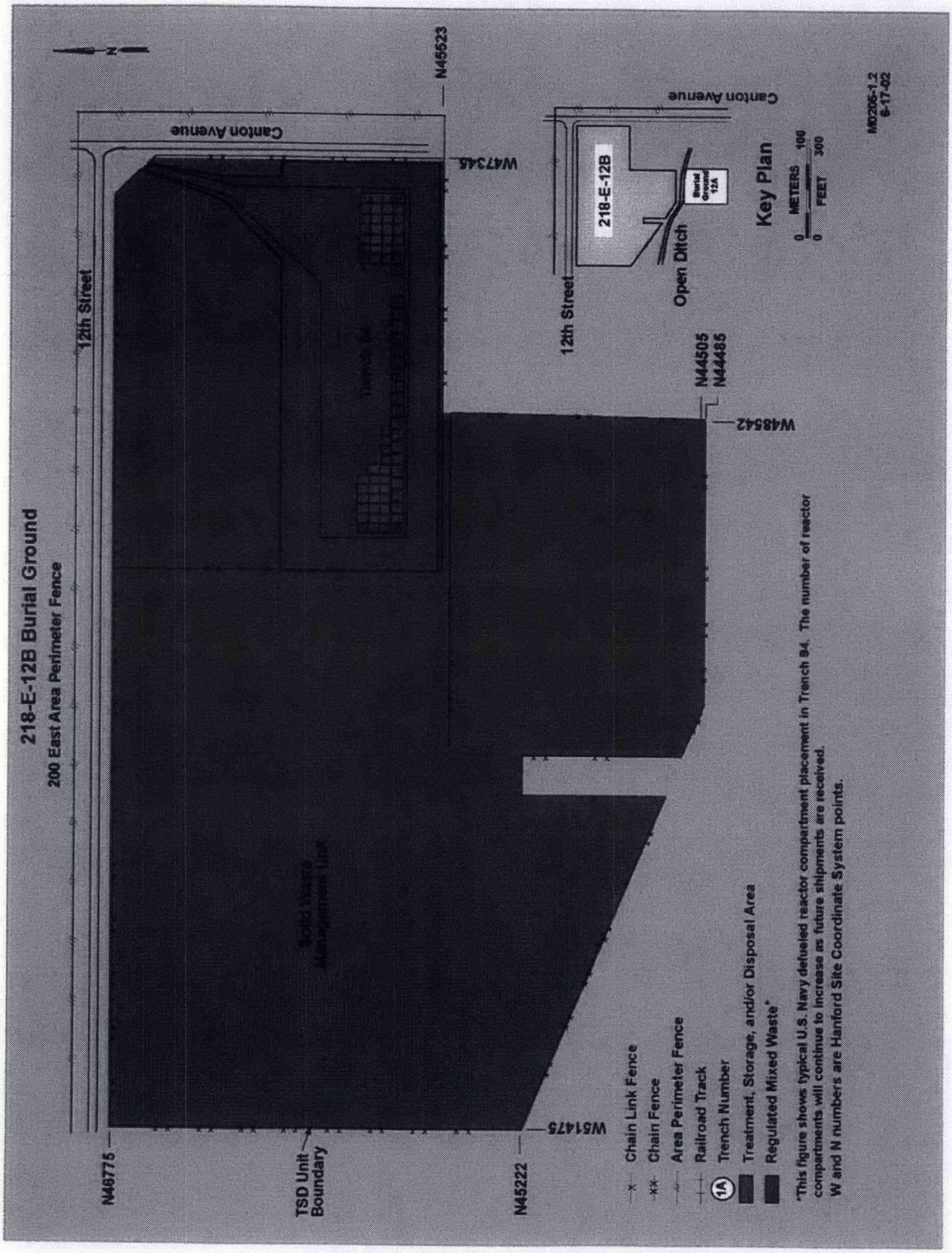
Treatment, Storage and/or Disposal Unit

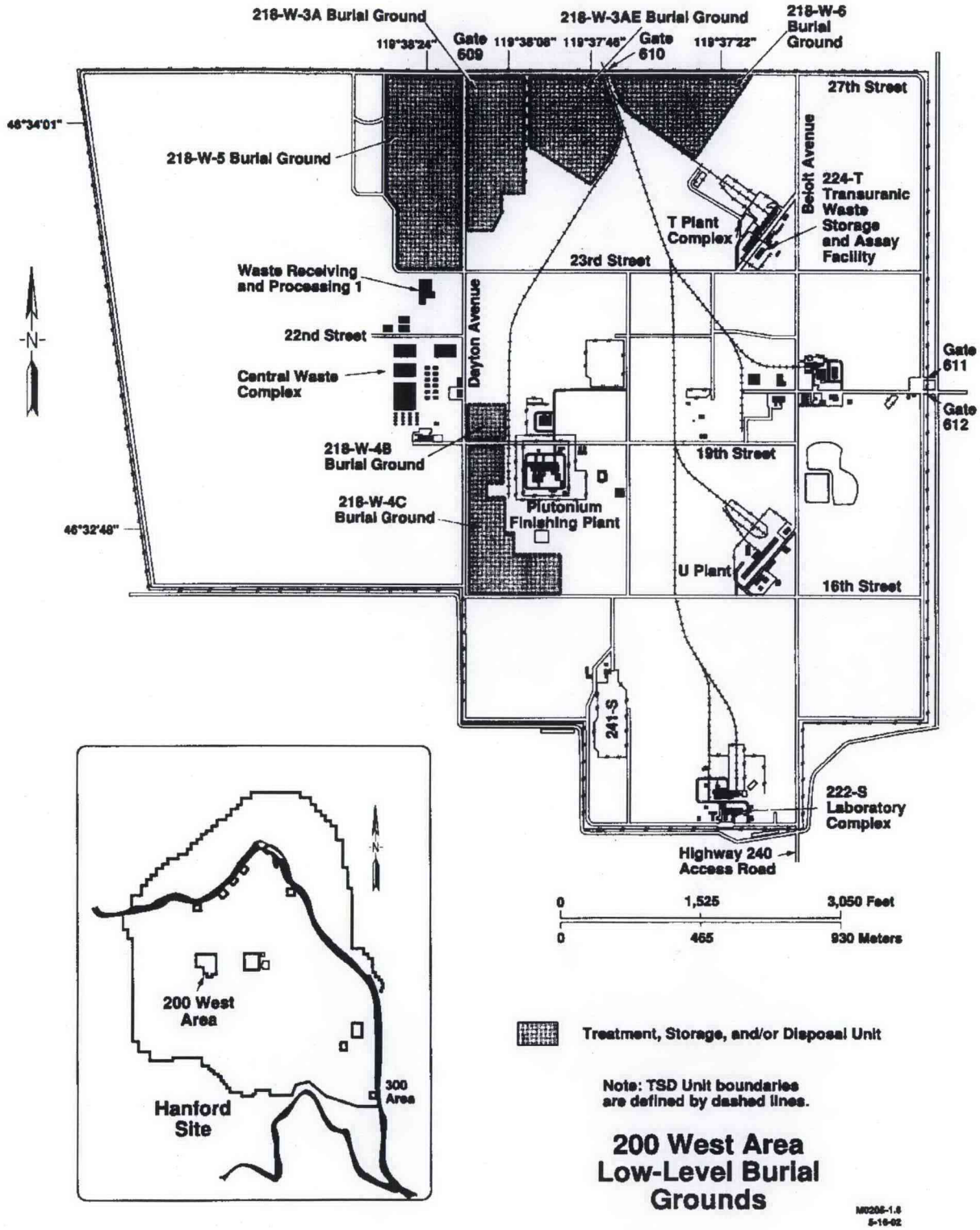
200 East Area Low-Level Burial Grounds

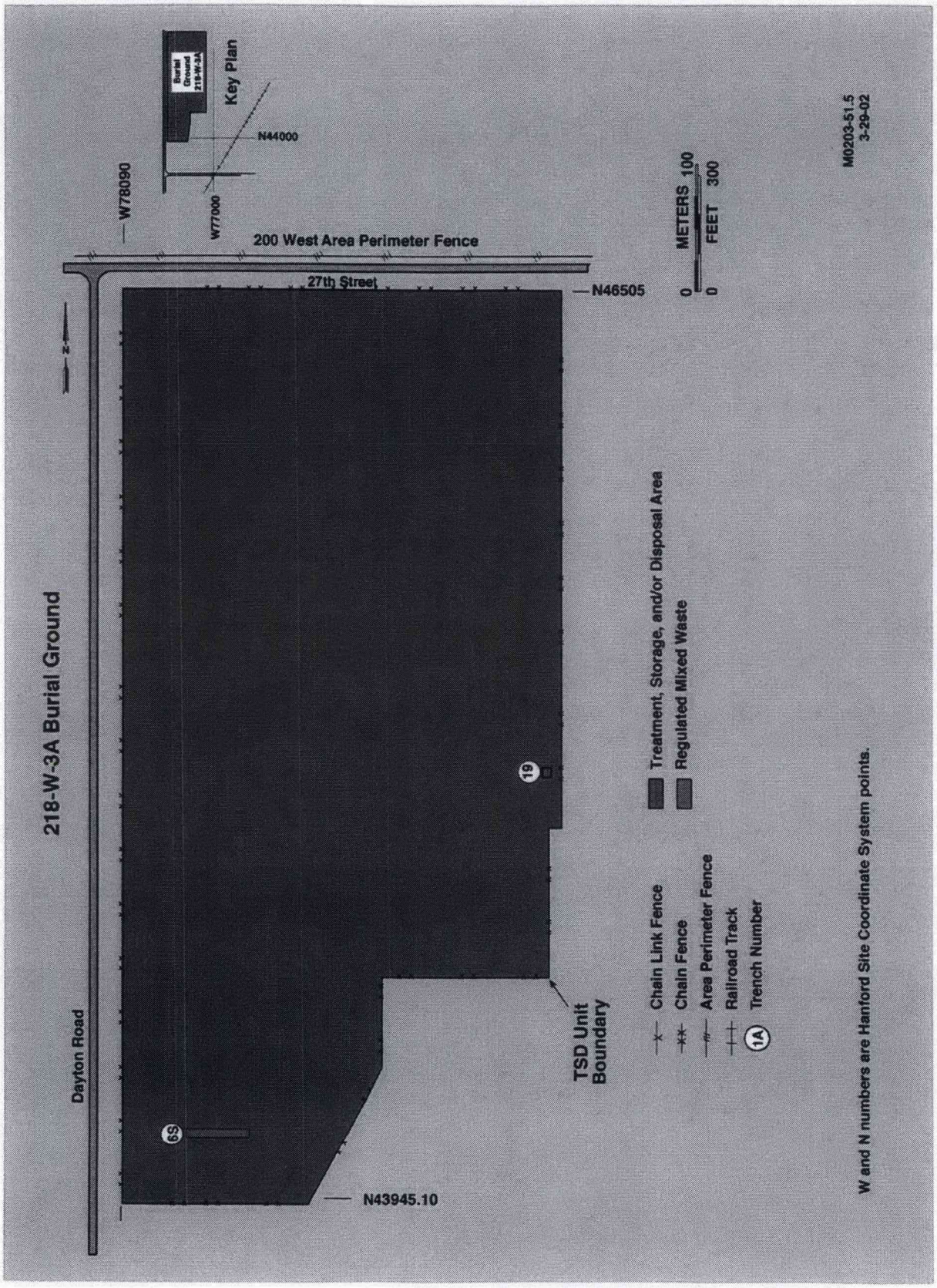
M0305-1.5
5-16-02

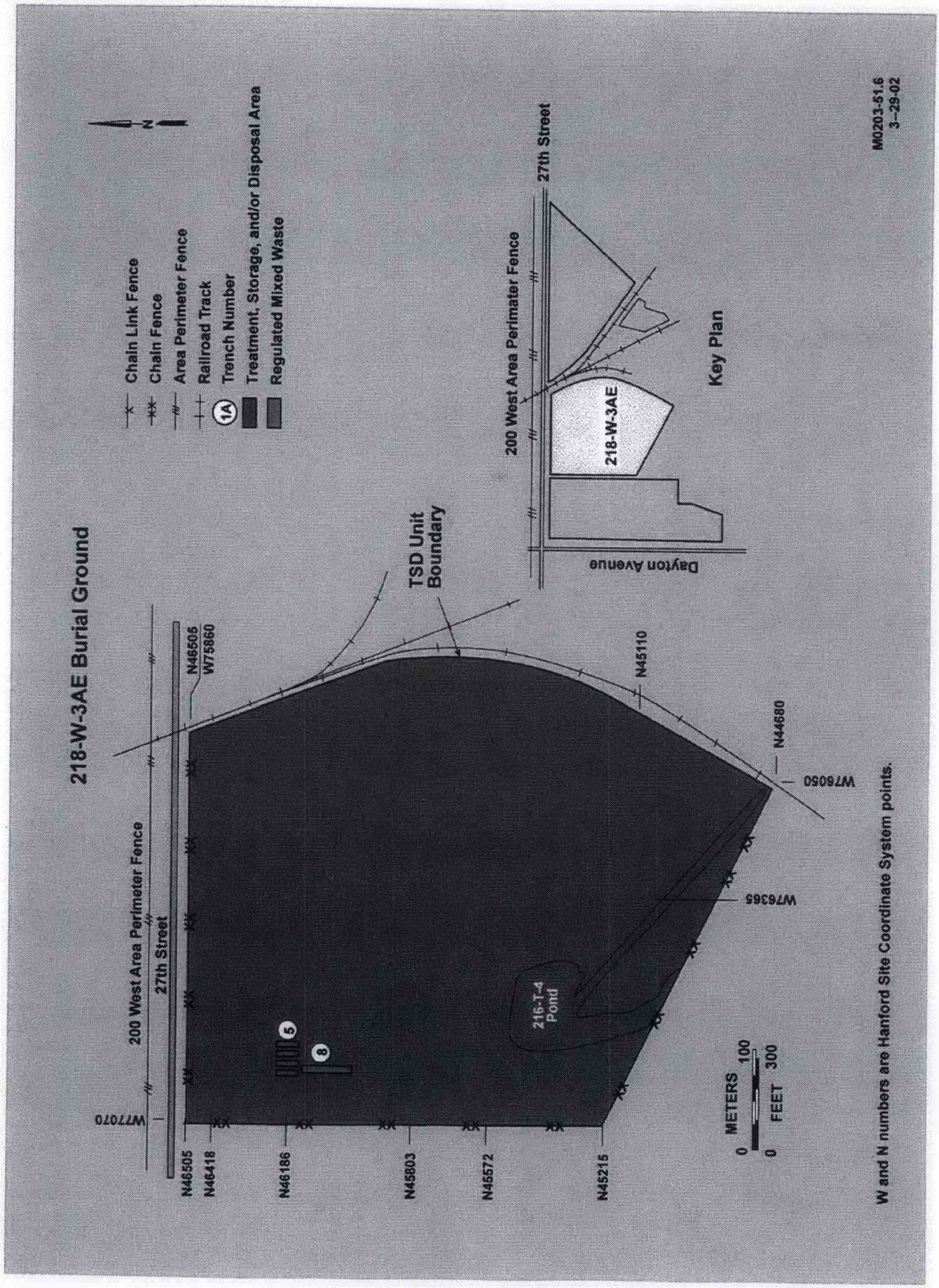
BEST AVAILABLE COPY

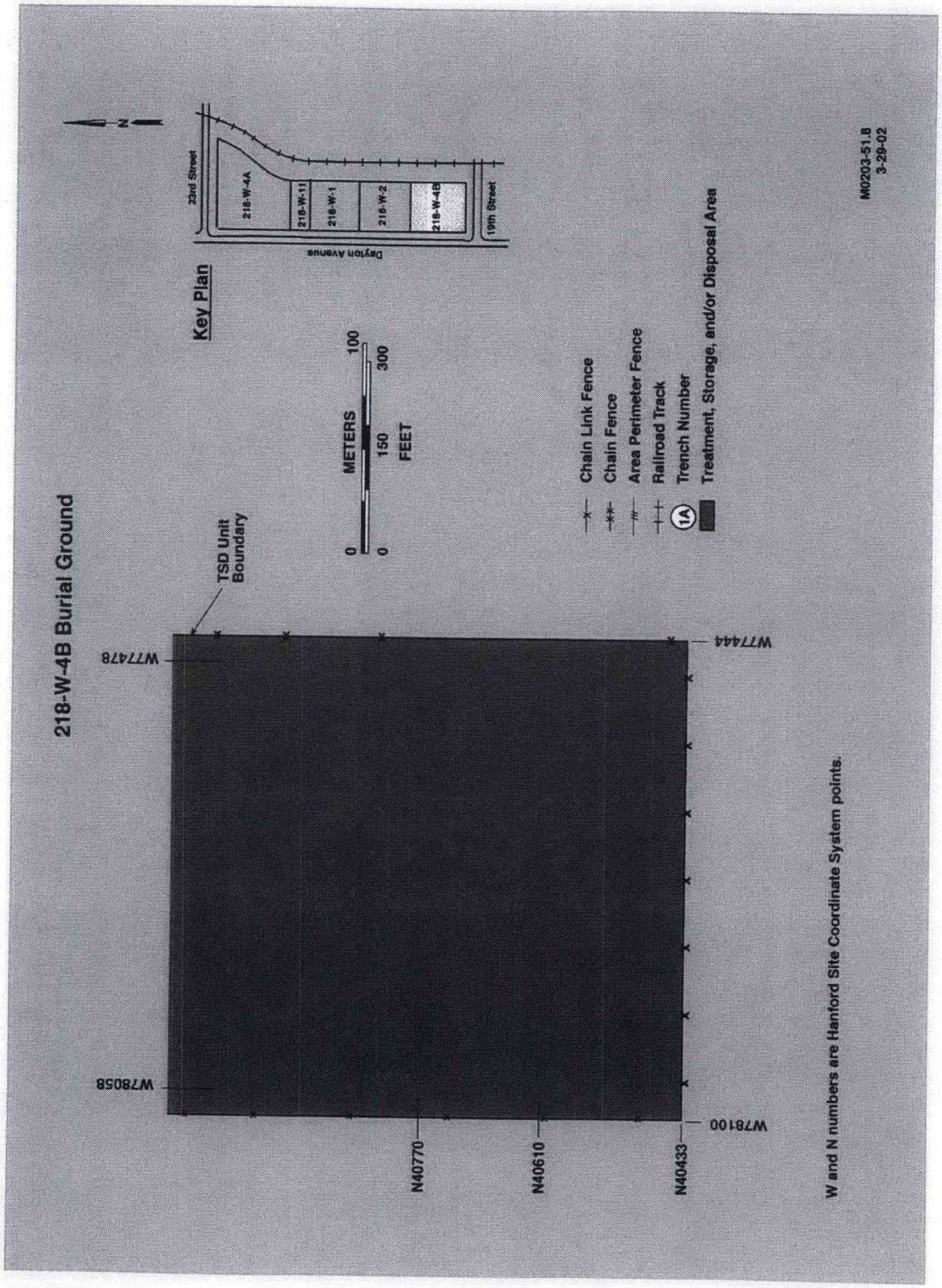

218-E-10 Burial Ground
200 East Area Perimeter Fence
12th Street
Akron Avenue
218-E-10
N46500
TSD Unit Boundary
N46000
N45500
TSD Unit Boundary
N45000
N44500
W56500
W56000
W55500
W55000
0 METERS 100
0 FEET 300
W and N numbers are Hanford Site Coordinate System points.
12th Street
218-E-10
218-E-10
Akron Ave
Key Plan
N
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Treatment, Storage, and/or Disposal Area
Regulated Mixed Waste
M0203-51.4
3-28-02

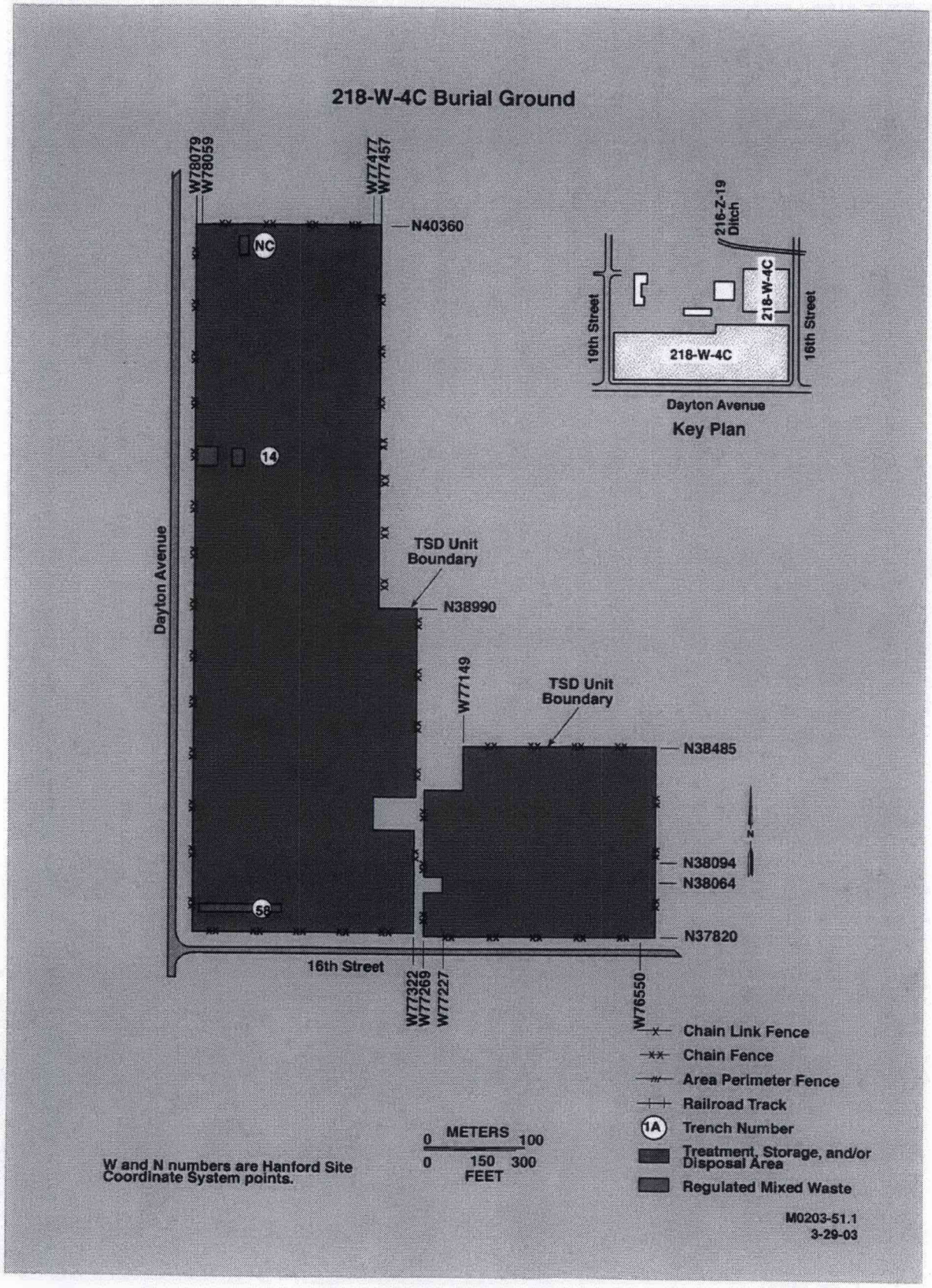

218-E-12B Burial Ground
200 East Area Perimeter Fence
12th Street
Canton Avenue
N46775
TSD Unit Boundary
N45222
W51475
W47345
N45523
Solid Waste Management Unit
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Treatment, Storage, and/or Disposal Area
Regulated Mixed Waste*
*This figure shows typical U.S. Navy defueled reactor compartment placement in Trench 94. The number of reactor compartments will continue to increase as future shipments are received.
W and N numbers are Hanford Site Coordinate System points.
Canton Avenue
12th Street
218-E-12B
Open Ditch
Burial Ground 12A
N44505
N44485
W48542
Key Plan
METERS 0 100
FEET 0 300
M0206-1.2
6-17-02

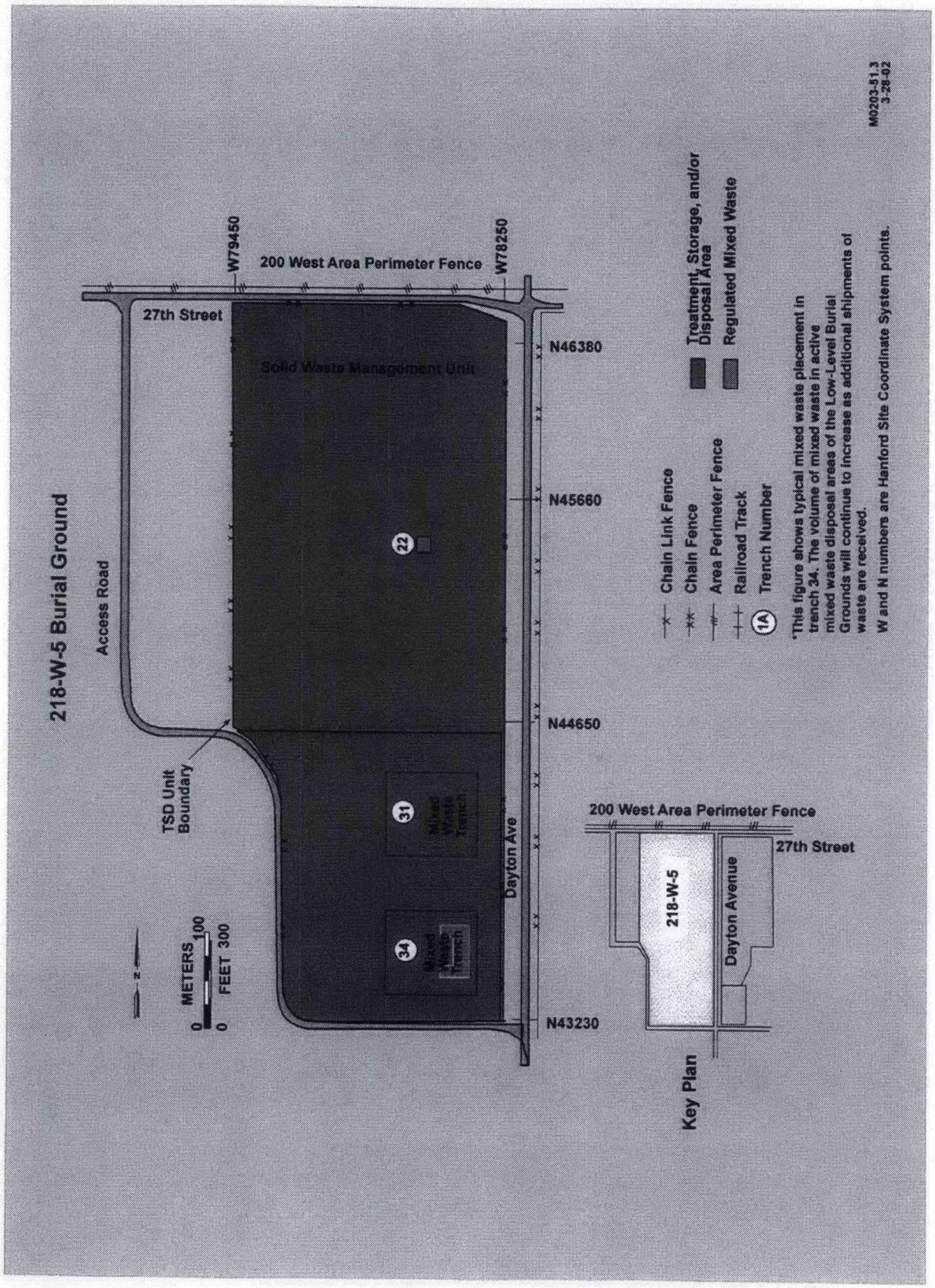

218-W-3A Burial Ground
218-W-3AE Burial Ground
218-W-6 Burial Ground
119°38'24"
Gate 609
119°38'08"
119°37'46"
Gate 610
119°37'22"
46°34'01"
218-W-5 Burial Ground
27th Street
Beloit Avenue
224-T Transuranic Waste Storage and Assay Facility
T Plant Complex
23rd Street
Waste Receiving and Processing 1
Dayton Avenue
22nd Street
Central Waste Complex
Gate 611
Gate 612
218-W-4B Burial Ground
19th Street
218-W-4C Burial Ground
Plutonium Finishing Plant
46°32'48"
U Plant
16th Street
241-S
222-S Laboratory Complex
Highway 240 Access Road
0
1,525
3,050 Feet
0
465
930 Meters
200 West Area
300 Area
Hanford Site
Treatment, Storage, and/or Disposal Unit
Note: TSD Unit boundaries are defined by dashed lines.
200 West Area Low-Level Burial Grounds

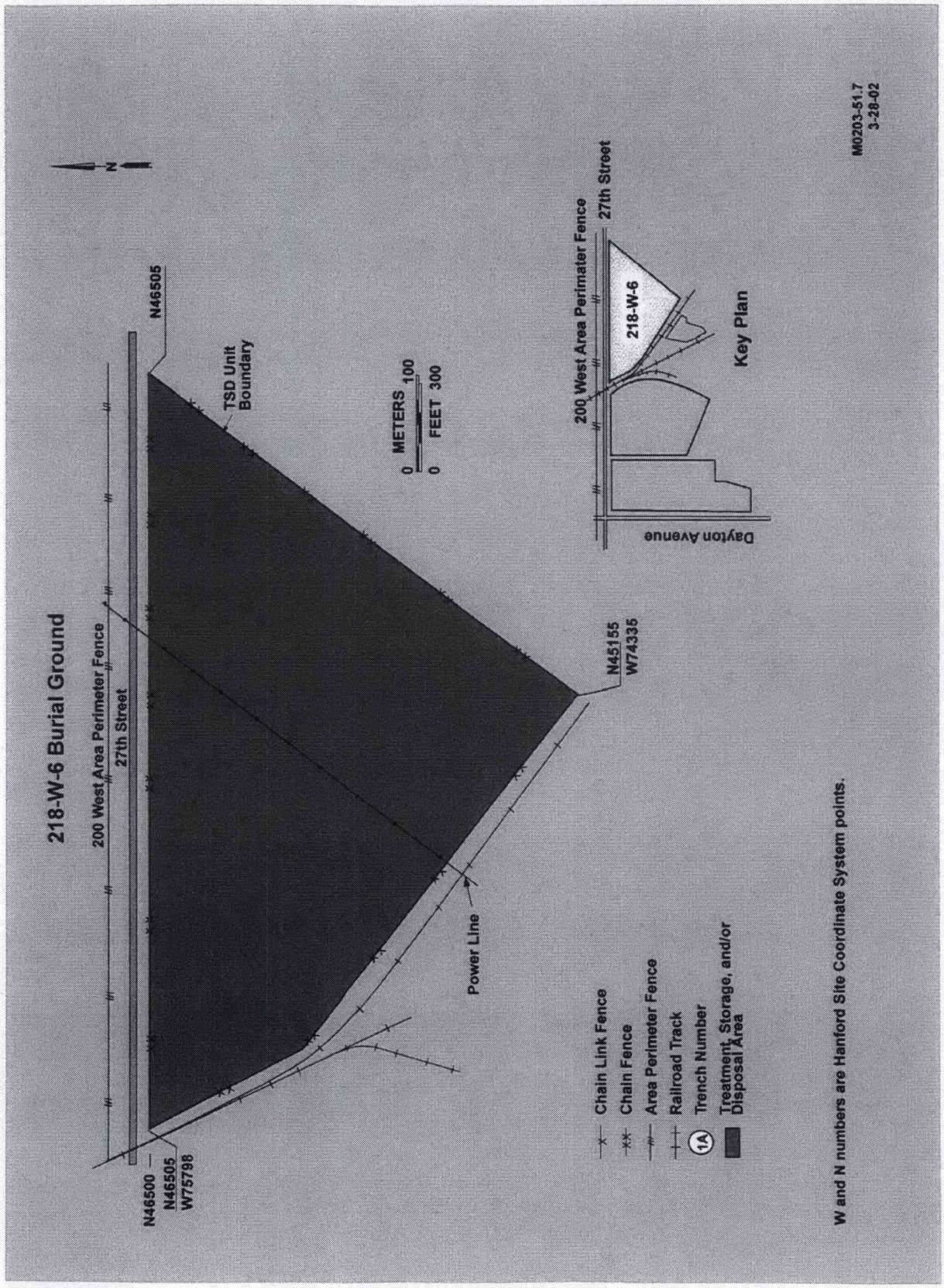

218-W-3A Burial Ground
Dayton Road
27th Street
200 West Area Perimeter Fence
W78090
W77000
N46505
N43945.10
N44000
Key Plan
Burial Ground 218-W-3A
TSD Unit Boundary
19
59
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
1A
Trench Number
Treatment, Storage, and/or Disposal Area
Regulated Mixed Waste
0 METERS 100
0 FEET 300
M0203-51.5
3-29-02
W and N numbers are Hanford Site Coordinate System points.


218-W-3AE Burial Ground
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Treatment, Storage, and/or Disposal Area
Regulated Mixed Waste
N
200 West Area Perimeter Fence
27th Street
W77070
N46505
N46418
N46186
N45803
N45572
N45215
N46505
W75860
TSD Unit Boundary
N45110
N44680
W76050
W76365
216-T-4 Pond
5
8
0 METERS 100
0 FEET 300
W and N numbers are Hanford Site Coordinate System points.
200 West Area Perimeter Fence
27th Street
218-W-3AE
Dayton Avenue
Key Plan
M0203-51.6
3--29-02


218-W-4B Burial Ground
TSD Unit Boundary
W77478
W78058
W77444
W78100
N40770
N40610
N40433
Key Plan
23rd Street
Dryton Avenue
19th Street
218-W-4A
218-W-11
218-W-1
218-W-2
218-W-4B
N
0 METERS 100
0 150 300
FEET
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Treatment, Storage, and/or Disposal Area
W and N numbers are Hanford Site Coordinate System points.
M0203-51.8
3-29-02


218-W-4C Burial Ground
W78079
W78059
W77477
W77457
N40360
NC
14
58
Dayton Avenue
TSD Unit Boundary
N38990
W77149
TSD Unit Boundary
N38485
N38094
N38064
N37820
16th Street
W77322
W77269
W77227
W76550
216-Z-19 Ditch
218-W-4C
19th Street
218-W-4C
16th Street
Dayton Avenue
Key Plan
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Treatment, Storage, and/or Disposal Area
Regulated Mixed Waste
0 METERS 100
0 150 300
FEET
W and N numbers are Hanford Site Coordinate System points.
M0203-51.1
3-29-03


218-W-5 Burial Ground
Access Road
27th Street
W79450
200 West Area Perimeter Fence
W78250
Solid Waste Management Unit
22
31
Mixed Waste Trench
34
Mixed Waste Trench
TSD Unit Boundary
Dayton Ave
N46380
N45660
N44650
N43230
N
0 METERS 100
0 FEET 300
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
1A Trench Number
Treatment, Storage, and/or Disposal Area
Regulated Mixed Waste
*This figure shows typical mixed waste placement in trench 34. The volume of mixed waste in active mixed waste disposal areas of the Low-Level Burial Grounds will continue to increase as additional shipments of waste are received.
W and N numbers are Hanford Site Coordinate System points.
M0203-51.3
3-28-02
Key Plan
200 West Area Perimeter Fence
27th Street
218-W-5
Dayton Avenue


218-W-6 Burial Ground
200 West Area Perimeter Fence
27th Street
N46500
N46505
W75798
N46505
TSD Unit Boundary
Power Line
N45155
W74335
0 METERS 100
0 FEET 300
N
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Treatment, Storage, and/or Disposal Area
W and N numbers are Hanford Site Coordinate System points.
200 West Area Perimeter Fence
27th Street
218-W-6
Key Plan
Dayton Avenue
M0203-51.7
3-28-02

Lined Mixed Waste Trench
218-W-5/200 West Area

46°33'36"
119°38'24"

98030102-22CN
(Photo Taken 1998)

Reactor Compartment Trench 94

46°33'58"
119°31'06"

99110141-03CN
(Photo Taken 1999)

CONTENTS

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APPENDIX

2A TOPOGRAPHIC MAPS ..... APP 2A-i

FIGURES

Figure 2-1. Low-Level Burial Grounds in the 200 East Area. F2-1
Figure 2-2. Low-Level Burial Grounds in the 200 West Area F2-2

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2.0 FACILITY DESCRIPTION AND GENERAL PROVISIONS [B AND E]

The LLBG are a land-based unit consisting of eight burial grounds located in the 200 East Area and 200 West Area (Figures 2-1 and 2-2). Mixed waste is and has been received from onsite generating units and from offsite generators and is and will be disposed in mixed waste trenches. Leachate collected from lined trenches is transferred to leachate collection tanks that are located in proximity to the lined trenches.

A more detailed discussion of waste types and the identification of the processes and equipment are provided in Chapters 3.0 and 4.0 respectively. Although the treatment, storage, and/or disposal (TSD) of radioactive waste (i.e., source, special nuclear, and by-product materials as defined by the *Atomic Energy Act of 1954*) are not within the scope of the *Resource Conservation and Recovery Act* (RCRA) *of 1976* or WAC 173-303, information is provided for general knowledge.

Low-level waste and transuranic waste continues to be placed in the solid waste management unit (SWMU) portions of the LLBG. Transuranic mixed waste has not been placed in the LLBG since August 19, 1987. Soil is placed over some of the waste containers to provide radiological protection. Transuranic waste was placed in a manner that allows for retrieval and/or removal in the future if necessary. Any waste retrieved and/or removed will be processed and disposed in accordance with current federal and state requirements.

2.1 LOW-LEVEL BURIAL GROUNDS DESCRIPTION [B-1]

The 218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, and 218-W-6 Burial Grounds are classified as a landfill (D81) and the 218-W-5 Burial Ground is classified as a landfill (D81) and for greater-than-90-day container storage (S01). The regulated portions of the LLBG cover a total area of approximately 49 hectares.

The 218-E-10 and 218-E-12B Burial Grounds are located in the 200 East Area. The 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6 Burial Grounds are located in the 200 West Area. The LLBG consist of various sizes and depths of lined and unlined disposal trenches. All mixed waste destined for disposal meets land disposal restriction (LDR) requirements [WAC 173-303-140 and 40 Code of Federal Regulations (CFR) 268] or other regulatory alternatives. The lined trenches (trenches 31 and 34 in the 218-W-5 Burial Ground) have leachate collection and removal systems. The less-than-90-day leachate collection tanks are operated in accordance with the generator provisions of WAC 173-303-200. The less-than-90-day leachate collection tanks have a current design capacity of 37,850 liters; however, future leachate collection tank capacity might change to accommodate various sized lined trenches. The precise dimensions of leachate collection tanks for trenches 31 and 34 are provided in the construction quality assurance reports identified in Chapter 4.0.

Future mixed waste trench development and configuration within a burial ground are subject to change as disposal techniques improve or as waste management needs dictate and will be subject to an approved permit modification in accordance with the Hanford Facility (HF) RCRA Permit (Ecology 1994). Mixed waste is disposed in lined or in unlined trenches. Disposal of mixed waste in unlined trenches requires an exemption from the liner/leachate collection system requirements. This permit application documentation includes an exemption request for trench 94 for the disposal of U.S. Navy defueled reactor compartments (refer to Chapter 4.0, Section 4.3.2).

The following provides a brief description and identifies the generic types of waste disposed in the LLBG. An electronic database is maintained that documents each waste receipt, type of waste, and disposal location.

- The 218-E-10 Burial Ground is approximately 36.1 hectares in size (Chapter 1.0) and began receiving waste in 1960. Examples of waste placed in this burial ground include failed equipment, rags, paper, rubber gloves, disposable supplies, and broken tools. The 218-E-10 Burial Ground, with the exception of a few small areas that contain post-August 19, 1987 RCRA/WAC 173-303 regulated waste, is a SWMU and continues to receive only low-level waste.

- The 218-E-12B Burial Ground is approximately 68 hectares in size (Chapter 1.0) and began receiving waste in 1967. The 218-E-12B Burial Ground, with the exception of trench 94, contains no RCRA/WAC 173-303 regulated waste. The majority of this burial ground, with the exception of trench 94, is a SWMU and continues to receive only low-level waste. This burial ground also contains retrievable transuranic waste. Currently it is planned that this transuranic waste will be removed and the trenches will be used only for low-level waste disposal.

- The 218-W-3A Burial Ground is approximately 20.4 hectares in size (Chapter 1.0) and began receiving waste in 1970. Examples of waste placed in this burial ground include ion exchange resins, failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, accessories, and retrievable transuranic waste. The 218-W-3A Burial Ground, with the exception of a few small areas that contain post-August 19, 1987 RCRA/WAC 173-303 regulated waste, is a SWMU and continues to receive only low-level waste. This burial ground also contains retrievable transuranic waste. Currently it is planned that this transuranic waste will be removed and trenches used only for low-level waste disposal.

- The 218-W-3AE Burial Ground is approximately 20 hectares in size (Chapter 1.0) and began receiving waste in 1981. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, and broken tools. The 218-W-3AE Burial Ground, with the exception of a few small areas that contain post-August 19, 1987 RCRA/WAC 173-303 regulated waste, is a SWMU and continues to receive only low-level waste. This burial ground also contains retrievable transuranic waste. Currently it is planned that this transuranic waste will be removed and the trenches used only for low-level waste disposal.

- The 218-W-4B Burial Ground is approximately 3.5 hectares in size (Chapter 1.0) and began receiving waste in 1968. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, and broken tools. The 218-W-4B Burial Ground contains no RCRA/WAC 173-303 regulated waste. This burial ground is full and no longer receives waste. However, this burial ground also contains retrievable transuranic waste. Currently it is planned that this transuranic waste will be removed and the trenches used only for low-level waste disposal.

- The 218-W-4C Burial Ground is approximately 20 hectares in size (Chapter 1.0) and began receiving waste in 1978. Examples of waste placed in this burial ground include contaminated soil, decommissioned pumps, and pressure vessels. The 218-W-4C Burial Ground, with the exception of a few small areas that contain post-August 19, 1987 RCRA/WAC 173-303 regulated waste, is a SWMU and continues to receive only low-level waste. This burial ground also contains retrievable transuranic waste. Currently it is planned that this transuranic waste will be removed and the trenches used only for low-level waste disposal.

- The 218-W-5 Burial Ground is approximately 37.2 hectares in size Chapter 1.0) and began receiving waste in 1986. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, and broken tools. This burial ground currently contains double-lined mixed waste trenches (trenches 31 and 34). Trenches 31 and 34 also are designated as a greater-than-90-day container storage unit. Waste to be placed in trenches 31 and 34 for storage purposes predominately will be macro-encapsulated long-length contaminated equipment and other containerized waste that has been treated to meet LDR requirements. Adjacent to the double-lined mixed waste trenches are leachate collection tanks. Examples of waste to be placed in the double-lined mixed waste trenches include mixed waste that has been treated to meet LDR requirements (including bulk waste), and macro-encapsulated long-length contaminated equipment. There are two small areas in the northern two-thirds of this burial ground that contains post-August 19, 1987 RCRA/WAC 173-303 regulated waste. The majority of this burial ground is a SWMU and continues to receive only low-level waste.

- The 218-W-6 Burial Ground is approximately 16 hectares in size (Chapter 1.0), has not received any waste, and is reserved for future mixed waste disposal.

2.1.1 Other Environmental Permits

All environmental permits that are required to support operation of the LLBG are identified in the *Annual Hanford Site Environmental Permitting Status Report* (e.g., DOE/RL-96-63).

2.1.2 Construction Schedule

Any proposed new construction for mixed waste trenches will be managed as described in the HF RCRA Permit.

2.2 TOPOGRAPHIC MAP [B-2]

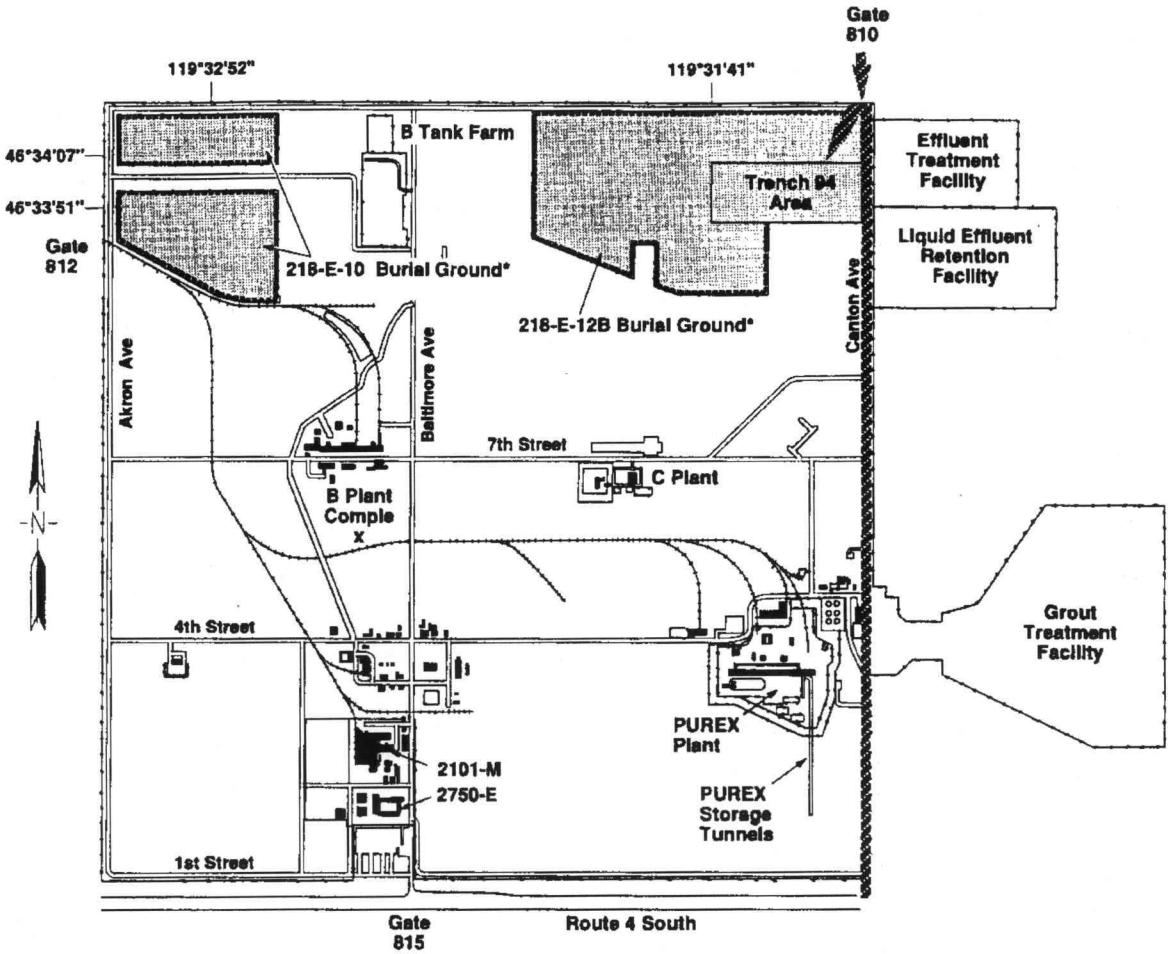
In addition to the topographic maps, several maps at various scales have been included in this permit application documentation. Small-scale maps generally are included with the text. Appendix 2A contains topographic maps of 200 East and 200 West Areas.

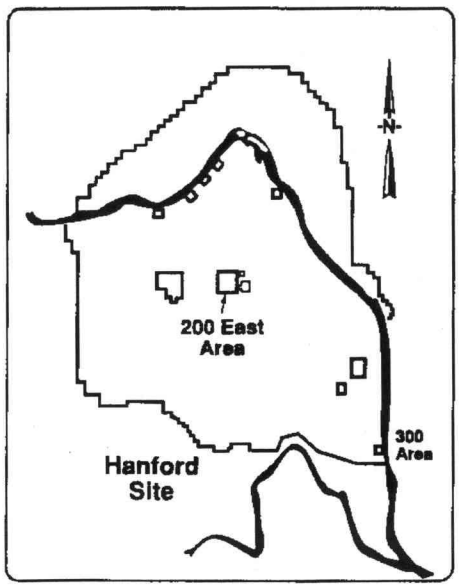
2.3 ROADWAY TRAFFIC INTO THE LOW-LEVEL BURIAL GROUNDS [B-4]

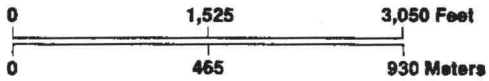
General traffic information for the Hanford Facility is presented in the General Information Portion (DOE/RL-91-28). Public access to the LLBG is restricted. Figure 2-1 depicts the normal transportation routes within the 200 East Area. Waste transported to the 200 West Area LLBG is routed through Gates 609 or 611 (Figure 2-2). Trucks typically are used to transport waste to the LLBG and range in size from heavy duty pickup trucks to tractor-trailer rigs, depending on the size and weight of the load. In some cases, special equipment such as transporters are used for unusual or unique loads. When special equipment is used, an evaluation ensures that the equipment does not damage the roadways.

2.4 RELEASE FROM SOLID WASTE MANAGEMENT UNITS [E]

Information concerning releases from SWMUs is discussed in the General Information Portion (DOE/RL-91-28). However, no known releases have been detected from the LLBG since the installation of the groundwater monitoring network (refer to Chapter 5.0).







Waste Routes

Treatment, Storage and/or Disposal Unit

200 East Area Low-Level Burial Grounds

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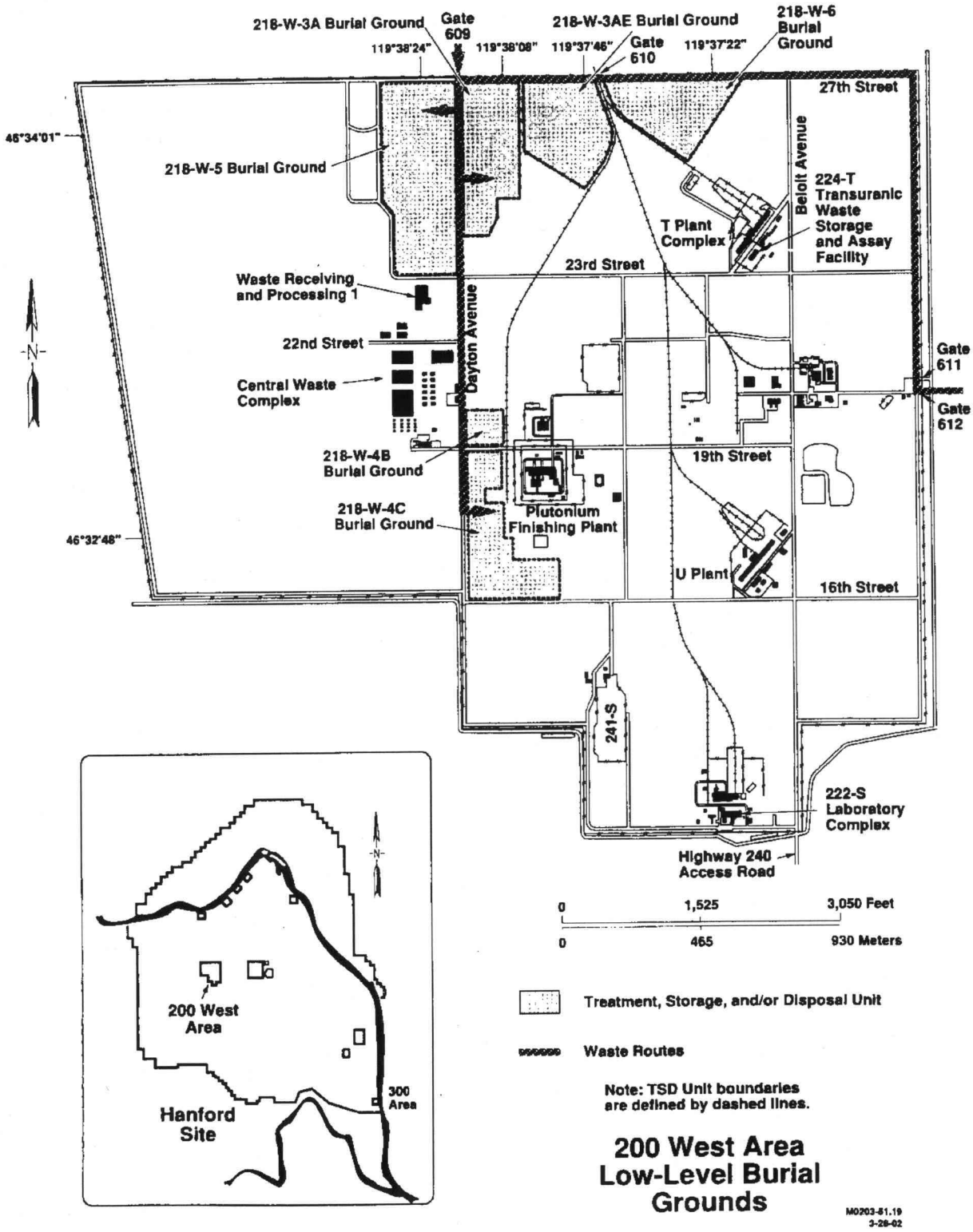
Figure 2-1. Low-Level Burial Grounds in the 200 East Area.



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3.0 WASTE CHARACTERISTICS [C]

This chapter provides information on the chemical, biological, and physical characteristics of the waste placed in the LLBG. The information includes descriptions required by WAC 173-303-300(5) contained in the *Low-Level Burial Grounds Waste Analysis Plan* (Appendix 3A).

3.1 CHEMICAL, BIOLOGICAL, AND PHYSICAL ANALYSIS [C-1]

Only a relatively small fraction of the waste placed in the LLBG is classified as mixed waste. Mixed waste is defined as waste that contains both a dangerous waste component and a radioactive component. The radioactive component of mixed waste is interpreted by the U.S. Department of Energy to be regulated under the *Atomic Energy Act*; the nonradioactive dangerous waste component of mixed waste is interpreted to be regulated under RCRA and WAC 173-303. Information on the radioactive component of mixed waste is provided for information only. Mixed waste placed in the LLBG includes waste designated as dangerous and extremely hazardous per WAC 173-303. Mixed waste received at the LLBG is assigned dangerous waste numbers found in Chapter 1.0. The LLBG also receive low-level waste for disposal. The waste analysis plan (Appendix 3A) applies to mixed waste and is not applicable to low-level waste that never was designated as mixed waste. Low-level waste that used to be designated as mixed waste could be subject to the waste analysis plan provisions depending on the applicable treatment standard(s) and LDR requirements.

3.2 LANDFILLED WASTES [C-1b]

Free liquids are not accepted if the liquid is in excess of 1 percent of the volume of the waste or if the sorbent to potential liquid waste ratio is less than 2 to 1.

3.3 WASTE ANALYSIS PLAN [C-2]

The *Low-Level Burial Grounds Waste Analysis Plan* (Appendix 3A) summarizes waste acceptance processes and contains the following information: description of processes and activities, confirmation process, selection of waste analysis parameters, selection of sample processes, selection of a laboratory and quality assurance/quality control, re-evaluation of waste profiles, special procedural requirements, and recordkeeping requirements.

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FIGURE

Figure 4-1. Example Liner System F4-1

4.0 PROCESS INFORMATION [D]

This chapter discusses the processes used to store and/or dispose mixed waste in the LLBG and includes a discussion of the design and function of the following.

- Containers
- Disposal trenches
- Leak detection system
- Leachate collection and removal system.

4.1 CONTAINERS [D-1]

All newly generated mixed waste accepted for storage at the LLBG is packaged in approved containers (U.S. Department of Transportation and/or U.S. Department of Energy), unless alternate packages are dictated by the size, shape, or form of waste (49 CFR 173) (e.g., metal boxes).

Mixed waste disposed in containers might not contain free liquids and the containers might not be less than 90 percent full. There are waste containers that contain condensed liquid vapor and are less than 90 percent full that require disposal. These waste containers meet a performance standard for packaging to prevent releases to the environment. Free liquids are addressed further in Appendix 3A, Section 1.2. If any container is less than 90 percent full, the container must be crushed, shredded, or similarly reduced in volume to the maximum practical extent before burial in the landfill.

4.1.1 Description of Containers [D-1a, D-1b, and D-1c]

Containers vary in shape, size, and strength depending on the form and weight of the waste. The most common containers are galvanized or aluminized 208-liter containers. Nominal 1.2-meter by 1.2-meter by 2.4-meter steel boxes are used frequently. Usually waste containers are lined to further contain the mixed waste. Liners consist of coatings to the interior of the containers, e.g., minimum 4 mil plastic liners or 90 mil polyethylene liners. Selection of the liner is driven by the chemical characteristics of the waste.

If the void space in containers of mixed waste exceeds 10 percent of the container volume, the containers must be crushed or repacked before storage.

Mixed waste containers stored are labeled and marked to indicate the dangerous and radioactive characteristics of the waste. The hazard labels are affixed, as required, to the sides of the containers, and each mixed waste container has a hazardous waste identification sticker attached in accordance with Ecology requirements. Marking and labeling requirements are discussed in Chapter 3.0, Appendix 3A.

Before receipt for storage at trench 34 (and trench 31, if needed to support waste management needs), all containers are closed by the onsite generating unit or offsite generator by means of a neoprene gasket, steel lid, locking ring, locking ring bolt, and a lock nut torqued tight or by other available methods to meet requirements. On receipt, each container is inspected by LLBG operations personnel before acceptance for damage, proper closure, marking, and proper accompanying documentation.

The container packaging and container handling for trench 34 (and trench 31, if needed to support waste management needs) are designed to maintain containment of the waste, limit storage intrusion, and limit

human exposure to mixed waste. During storage, containers might be placed on pallets or other support devices. Heavier containers are rotated to the bottom of the stack to ensure a stable center of gravity for each stack. Aisle space requirements are provided (Chapter 6.0, Section 6.3.5). Other unusual sized containers such as macro-encapsulated long-length contaminated equipment are handled by using cranes or other appropriate equipment.

For container disposal operations, container management practices are not applicable. However, if a container is disposed in the LLBG, the container must be 90 percent full. Alternatively, the container can be crushed, repacked, shredded, or similarly reduced in volume to the maximum practical extent before the container is buried (40 CFR 264.315).

On receipt, each container is inspected by operations personnel to confirm appropriate documentation and compliance with the waste acceptance criteria before the container is placed in the LLBG (refer to Chapter 3.0, Appendix 3A).

If containerized mixed waste must be opened (i.e., for confirmation sampling, repackaging, etc.), the container typically would be removed to an onsite treatment and/or storage unit or other permitted location before being opened. The container would be sealed before being returned to the LLBG.

4.1.2 Containment Requirements for Storing Containers [D-1d]

The following sections describe secondary containment systems.

4.1.2.1 Secondary Containment System Design and Operation [D-1d(a) and (b)]

Section 4.5.3 provides a discussion on secondary containment system design and construction for trenches 31 and 34.

4.1.2.2 Containment System Capacity [D-1d(1)(c)]

Section 4.5.6 provides a discussion on containment system capacity for trenches 31 and 34.

4.1.2.3 Control of Run-On [D-1d(1)(d)]

Section 4.5.8 provides a discussion on control of run-on for trenches 31 and 34.

4.1.3 Removal of Liquids from Containment System [D-1d(2)]

Section 4.5.6 provides a discussion on containment system capacity for trenches 31 and 34.

Within a trench, storage and disposal of waste could take place at the same time. Waste could be stored temporarily in the trench during the acceptance process. As all waste accepted meets LDR requirements, any spills or releases identified while waste is being stored could be stabilized and left in place. Equipment spills or releases would be handled as described in the following.

In the event of a spill or release within a trench operating solely in the storage configurations, the following is performed.

1. Containers affected by the spill are inspected for signs of leakage. Leaking containers are repackaged and identified in the LLBG operating logbook.

2. Spills threatening human health or the environment are managed according to Chapter 7.0, Contingency Plan.

3. Inspection reports are reviewed to identify any waste releases for which remedial actions have not been completed.

4. The containerized waste is handled as follows.

   - If the waste has been altered during stabilization and cleanup actions (absorbed, mixed, diluted, etc.), the containerized waste is managed in accordance with the provisions of the waste analysis plan (Chapter 3.0, Appendix 3A).

   - The LLBG inventory is updated to reflect the changes in waste description, volume, and storage location.

   - If the waste was not altered during stabilization and cleanup activities, the containerized waste is placed for disposal at another onsite TSD unit, depending on waste designation results. The LLBG inventory is altered to reflect any changes.

5. Cleanup soil (operations layer) is removed and containerized; operations layer is replaced.

6. Soil samples might be taken from the operations layer (Section 4.5.3.1) and analyzed to verify cleanup adequacy. The operations layer is replaced in a timely manner to ensure protection of the underlying liner.

Specific actions to be taken in response to a spill or discharge are detailed in the contingency plan (Chapter 7.0, Appendix 7A).

4.2 CONTAINERS WITHOUT FREE LIQUIDS [D-1e]

Containers without free liquids that do not exhibit ignitability or reactivity are discussed in the following sections.

4.2.1 Test For Free Liquids

Testing for free liquids is performed in accordance with the waste analysis plan (Chapter 3.0, Appendix 3A) for mixed waste accepted for disposal in the LLBG.

4.2.2 Description of Containers

The description of containers is the same as is described in Section 4.1.1.

4.2.3 Container Management Practices

Container management practices are the same as are described in Section 4.1.1.

4.2.4 Container Storage Area Drainage

The description of the storage area drainage is the same as is described in Section 4.5.3.1.2.

4.3 PREVENTION OF REACTION OF IGNITABLE, REACTIVE, AND INCOMPATIBLE WASTE IN CONTAINERS [D-1f]

Confirmation and verification processes to ensure that ignitable, reactive, and incompatible waste is not stored or disposed in the LLBG are described in the waste analysis plan (Chapter 3.0, Appendix 3A).

4.4 LEACHATE COLLECTION TANKS

Each lined LLBG mixed waste disposal trench is supported by an aboveground less-than-90-day leachate collection tank. The information contained in Appendix 4A, construction quality assurance report, and Appendix 4B, definitive design report, provides specific details for the leachate collection tank installation for trenches 31 and 34 of the 218-W-5 Burial Ground. The less-than-90-day leachate collection tanks are operated in accordance with the generator provisions of WAC 173-303-200.

4.5 LANDFILLS [D-6]

This permit application documentation addresses the following types of trenches located in the LLBG:

- Regulated mixed waste trench (trench 94) for which a waiver to the liner/leachate collection system requirements has been requested (Appendix 4D)
- Unlined trenches (Section 4.5.2.2)
- Lined trenches.

4.5.1 List of Wastes [D-6a]

Mixed waste disposed in the LLBG consists of listed waste, characteristic waste, state-only dangerous waste, and waste from nonspecific sources (Chapter 1.0). Examples of waste disposed in the LLBG include containerized or bulk waste such as contaminated soil, decommissioned pumps, pressure vessels, macro-encapsulated debris and macro-encapsulated long-length contaminated equipment, defueled reactor compartments, and mixed waste that has been treated to meet LDR requirements.

4.5.2 Liner System Exemption Requests [D-6b and D-6b(2)]

This permit application documentation seeks an exemption to liner system requirements for the reactor compartment disposal trench (trench 94).

4.5.2.1 218-E-12B Burial Ground (Trench 94)

Appendix 4D, "*Request for Exemption from Lined Trench Requirements at 218-E-12B Burial Ground Trench 94*", updates the exemption request submitted to Ecology on October 9, 1992 (DOE/RL-88-20, Supplement 1, Revision 1). The defueled reactor compartments are managed as a state-only dangerous waste based on specific agreement between the U.S. Navy and Ecology because of the presence of lead shielding (Appendix 4D, Attachment 2). The following is a summation of the content of the exemption request.

Defueled reactor compartment disposal packages are a unique integrated waste form that is both containment and waste. The welded steel structure of the package forms a sealed containment barrier for the materials contained within the waste matrix. This steel structure includes a combination of existing ship hull and structure, and installed bulkhead structure and/or exterior plating. The minimum thickness of this structure is typically 1.9 centimeters but is 1.3-centimeters thick over small penetrations through the hull of older reactor compartments. The packages are designed to be water tight at higher hydraulic pressures than would be experienced after disposal. The first potential generation of contaminated leachate would occur when general corrosion, in combination with soil pressure, causes the containment structure to rupture allowing lead in the packages to be exposed. This is not expected to occur for about 2,000 years and should not occur for about 600 years at the minimum. These times are based on conservative estimates of the general corrosion rate of carbon steel in trench 94 of 0.0015 centimeter per year for the maximum rate.

Each defueled reactor compartment contains elemental lead used as shielding, chromium and nickel in corrosion-resistant steel alloys, and small amounts of cadmium and asbestos for thermal insulation. The reactor compartments comply with WAC 173-303 requirements for removal of free liquids from waste. Before a defueled reactor compartment is sealed, liquids are removed to the maximum extent practical while keeping worker radiation exposure as low as reasonably achievable (ALARA). Therefore, some residual liquids remain in the defueled reactor compartments because removing all the residual liquids would entail significant personnel radiation exposure. Where practical, absorbent is added to the reactor compartments to absorb residual liquids.

Lead is the only dangerous constituent present in quantities requiring regulation under WAC 173-303. Lead is not expected to migrate to an aquifer below the burial site for at least 240,000 years (conservative bounding case) and more likely over 2 million years (best estimate) (PNL-8356).

The exemption request (Appendix 4D) concludes that the reactor compartment waste form prevents the generation of any contaminated leachate beyond the expected lifetime of the minimum technological liner/leachate system design. A liner/leachate collection system should not be required for the reactor compartment disposal trench because the thickness of the package structure prevents intrusion of precipitation into the compartment where waste is located. In addition, with an average annual rainfall of 15.2 to 17.8 centimeters, it is doubtful liquids would penetrate the 3.1 meters of soil covering the reactor compartments. Most of the precipitation is lost to evapotranspiration. The potential for liquids reaching the reactor compartments would be reduced further when the 218-E-12B Burial Ground is covered (Chapter 11.0).

4.5.2.2 Unlined Trenches

The EPA published the "Final Authorization of State Hazardous Waste Management Program; Washington" (52 FR 35556). Although this authorization became effective on November 23, 1987, and included the authorization to regulate mixed waste, an agreement was reached with Ecology that the

actual date for regulating mixed waste is August 19, 1987. An exemption from the liner system requirements for mixed waste is requested for all mixed waste that has been received for disposal in various unlined trenches since August 19, 1987.

4.5.3 Liner System, General Items [D-6c]

This section provides a general description of the liner systems used for mixed waste lined trenches.

The liner system is designed to prevent migration of leachate out of the lined trench during its active life. The active life consists of the operational period and the closure period. The liner system is designed to meet the EPA requirements, as identified in RCRA Subtitle C requirements for hazardous waste disposal facilities (40 CFR 264), technical guidance documents (e.g., EPA 1985), and WAC-173-303. In addition, the liner system incorporates the following general functional requirements:

- Range of Operating Conditions--year-round operation, withstand construction and long-term stresses

- Degree of Reliability--function safely and effectively throughout operating and postclosure period with minimum maintenance

- Intended Life--operational phase plus 30 years postclosure monitoring phase.

4.5.3.1 Liner System Description [D-6c(1)]

The trench liner systems comply with RCRA requirements for hazardous waste landfills (refer to Appendix 4A and 4B for specific design information on liner systems). Figure 4-1 shows a typical design and includes the following components (from top to bottom).

- Operations layer: nominal amount (0.9-meter thick) of native soil. This layer provides a working surface for equipment, protects the liner from mechanical damage, and prevents freezing of the underlying low-permeability soil layer.

- Primary leachate collection system that contains at least one of the following:

  1. A geotextile/geonet composite, with a minimum transmissivity value of 3×10^{-5} square meters per second

  2. A minimum 0.3-meter-thick drainage gravel layer with a hydraulic conductivity of at least 1×10^{-2} centimeters per second (sometimes including drainage pipes)

  3. A geonet, with a minimum transmissivity value of 3×10^{-5} square meters per second.

The primary leachate collection system collects and conveys leachate to the primary sump for removal and includes the following components.

- Primary geomembrane liner: generally consisting of high-density polyethylene because of its excellent resistance to chemicals. Minimum 60-mil thickness; can be textured (to improve stability against sliding) or smooth. The geomembrane acts as a moisture barrier. The primary leachate collection system includes perforated pipe that helps collect and guide water into the primary sump.

- Primary admix liner (optional; not required by regulations): a minimum 0.46-meter-thick layer of compacted soil/bentonite admixture with a permeability of 1×10^{-7} centimeter per second or less. This layer acts as an additional primary moisture barrier directly under the primary geomembrane.

- Secondary leachate collection system: same as primary system, except that pipes are not needed because very high flow capacities are not required. The purpose of this system is to collect any leachate that leaks through the primary liner system and convey the leachate to the secondary sump for removal. The secondary leachate collection system also serves as the leak detection system.

- Secondary geomembrane liner: same as primary geomembrane liner.

- Secondary admix liner: a minimum 0.9-meter-thick layer of compacted soil/bentonite admixture with a permeability of 1×10^{-7} centimeter per second or less. This layer acts as an additional moisture barrier directly under the secondary geomembrane.

4.5.3.1.1 Rain Cover

The rain covers for mixed waste disposal trenches (e.g., trenches 31 and 34 and potential future lined trenches) would intercept the majority of precipitation before encountering the disposed mixed waste. Removing this precipitation as clean rainwater versus managing the precipitation as multi-source leachate (F039) would implement waste minimization to the extent practical. The rain covers would include a geosynthetic membrane, flexible piping, and pumps necessary to ensure a complete system to collect and remove precipitation. Because the rain cover would be installed over the slopes of the trench, significant quantities of precipitation would be collected and removed. Rain covers are an optional item that will not necessarily be used on all trenches.

4.5.3.1.2 Operations Layer

The purpose of the operations layer is to protect the underlying liner components from damage by equipment during lined trench construction and operation. On the sideslopes, this layer also protects the admix layer from freezing and desiccation cracking.

Previous research and experience has shown that desiccation cracks can occur under geomembrane liners when either the liner is not in close contact with the compacted admix or when the liner is subjected to wide temperature fluctuations (Corser and Cranston 1991). The operations layer acts as a weight to keep the geomembrane in contact with the admix, thereby reducing the potential for water vapor to form in an underlying airspace. The operations layer also acts as an insulating layer, together with the dead air space trapped in the geocomposite drainage layers.

The operations-layer material typically consists of onsite granular soil that is reasonably well graded and conforms to one of the following Unified Soil Classification System designations, ASTM D2487: GM, GC, SW, SM, SP, or SC. Material has a maximum particle size limit of 10.2 centimeters or less, depending on the strength of the underlying layers.

4.5.3.1.3 Primary Leachate Collection System

The primary leachate collection system is located below the operations layer and provides a flow path for the leachate flowing into the primary sump. Although any of the options presented in Section 4.5.3.1 are acceptable in the LLBG, the following is a description of the system used in the existing mixed waste disposal trenches.

Between the operations layer and the underlying drainage gravel, a geotextile layer functions as a filter separation barrier. The geotextile prevents migration of fine soil and clogging of the drainage gravel. The gravel is a minimum 0.3-meter-thick layer of washed, rounded to subrounded stone, with a permeability of at least 1×10^{-2} centimeter per second, as required by RCRA regulations. In addition, perforated high-density polyethylene drainage pipe is placed within the drainage gravel to accelerate leachate transport into the primary sump during high precipitation events. The gravel layer is underlain by a geotextile/geonet drainage layer resting on the primary high-density polyethylene geomembrane. The geonet provides additional drainage capacity for high-precipitation events and acts as a redundant drainage system.

On the lined trench sideslopes, the primary leachate collection system has a geocomposite drainage layer composed of a geonet, with a layer of geotextile thermally bonded to each side. This geocomposite drainage layer has a transmissivity at least as high as a 0.3-meter-thick gravel layer with a permeability of 1×10^{-2} centimeters per second. Geocomposite is used on the sideslopes to avoid problems associated with placement of clean granular material on slopes, and thereby minimizing the potential for damaging the underlying liner system.

4.5.3.1.4 Primary Geomembrane Liner

The primary geomembrane liner acts both as an impermeable leachate barrier and as a flow surface, routing leachate to the primary sump. High-density polyethylene is used because of its high resistance to chemical deterioration. However, other materials are acceptable provided these materials can achieve or exceed the performance specifications established for high-density polyethylene. Generally, textured (roughened) geomembrane is used to maximize shear strength along adjacent interfaces and to reduce the potential for sliding of the liner system.

4.5.3.1.5 Primary Admix Liner

A primary admix liner, consisting of a minimum 0.46-meter-thick compacted soil/bentonite admixture, could be installed immediately beneath the primary high-density polyethylene liner on the floor of the lined trench only. The purpose of this liner is to provide extra protection in the case of deterioration (such as stress cracking) of the primary geomembrane in those lined trenches that might be open for several years. In lined trenches that are closed after only a few years, this layer might not be necessary. The need for this layer is evaluated on a case-by-case basis during detailed design of the particular lined trench.

When used, the admix liner typically consists of silty sand from local borrow sources mixed with a nominal 12-percent sodium bentonite, by dry weight. The in-place permeability of the admix liner is 1×10^{-7} centimeter per second or less, consistent with RCRA requirements for secondary soil liners. The upper surface of the admix liner is trimmed to the design grades and tolerances as shown on the construction drawings (Appendices 4A and 4B). To prepare a smooth uniform surface on which to place the overlying geomembrane liner, the surface is rolled with a smooth steel-drum roller to remove all ridges and irregularities.

4.5.3.1.6 Secondary Leachate Collection System

The secondary leachate collection system provides the flow path for the leachate flowing into the secondary sump. Although any of the options presented in Section 4.5.3.1 are acceptable in the LLBG, the following is a description of the system used in the existing mixed waste disposal trenches.

The secondary leachate collection system has drainage gravel on the floor, with an additional geotextile/geonet layer and a geocomposite layer on the sideslopes. These materials and their configuration are similar to the primary leachate collection system described in Section 4.5.3.1.2, except for the absence of a perforated drainage pipe system on the floor of the lined trench. The secondary leachate collection system channels leachate that penetrates the primary liner system into the secondary sump.

The secondary leachate collection system also serves as the leak detection system. Leachate collected in the secondary sump is measured to determine the leakage rate through the primary liner. Appendix 4C contains the response action plan(s) for the mixed waste disposal trenches.

4.5.3.1.7 Secondary Geomembrane Liner

The secondary high-density polyethylene liner, located underneath the secondary leachate collection system, is placed directly against the secondary compacted admix liner. The secondary liner is similar to the primary geomembrane described in Section 4.5.3.1.3.

4.5.3.1.8 Secondary Admix Liner

The secondary admix liner has a minimum 0.9-meter-thick compacted soil/bentonite admixture located immediately beneath the secondary high-density polyethylene liner, as required by RCRA regulations. The secondary admix liner typically consists of silty sand from local borrow sources mixed with a nominal 12 percent sodium bentonite, by dry weight. The in-place permeability of the admix liner is 1×10^{-7} centimeter per second or less, consistent with RCRA requirements for secondary soil liners. The upper surface of the admix liner is trimmed to the design grades and tolerances as shown on construction drawings (Appendix 4A and 4B). The surface is rolled with a smooth, steel-drum roller to remove all ridges and irregularities. The result is a smooth uniform surface on which to place the overlying geomembrane liner.

4.5.3.1.9 Subgrade/Liner System Foundation

The lined trenches in the LLBG are founded in undisturbed native soils, generally ranging from silty sands to well-graded gravels. The liner system foundation is discussed in further detail in Section 4.5.4.

4.5.3.1.10 Access Ramp

Each lined trench has an access ramp. The access ramp also includes the liner system components previously described. However, some of the components are thickened and a top-course layer is installed to support traffic. These enhancements prevent damage to the liner system from vehicle traffic into the lined trench. Access ramp design can vary depending on the location of a trench and the type and frequency of traffic into the trench.

4.5.3.1.11 Truck Unloading Area Liner System

A truck unloading area is located at the top of the access ramp to provide an area for transfer of containerized waste from over-the-road trucks to forklifts or other vehicles/equipment that place the waste in the lined trench. The truck unloading area is lined with a high-density polyethylene geomembrane. Typically, a geotextile cushion and top-course aggregate is placed over the geomembrane. The high-density polyethylene drainage pipe can be included at the base of the aggregate to enhance drainage. The truck unloading area is paved with asphaltic concrete to facilitate cleanup of

any accidental spills. Both the asphaltic concrete surface and the underlying drainage system of the unloading area direct all surface run-off into the primary leachate collection system of the lined trench.

4.5.3.2 Liner System Location Relative to High Water Table [D-6c(2)]

The groundwater level (seasonal high water table) is located 61.0 to 91.4 meters below the ground surface in the LLBG (Chapter 5.0). It is anticipated that the deepest point of the liner system will be no greater than 21.3 meters below ground surface. Consequently, the liner systems are at least 39.7 meters above groundwater. The liner systems are not affected by the water table because of this large elevation difference.

4.5.3.3 Loads on Liner System [D-6c(3)]

The liner system experiences several types of stresses during construction, operation, and postclosure periods. These stresses are analyzed during the detailed design of each lined trench (Appendices 4A and 4B). The following sections discuss the types of stresses and potential analytical methods.

4.5.3.3.1 Stresses From Installation or Construction Operations

The sideslope geosynthetic liner components experience some stress during installation and before placing waste in the lined trench. A high-density polyethylene liner is temperature sensitive, expanding and contracting as liner temperatures increase and decrease. Thermally induced stresses can develop in the liner if deployment and anchoring occur just before a significant decrease in the liner temperature. The maximum potential liner thermal stress typically occurs during construction before placement of the operations layer. The high-density polyethylene liner is sufficiently thick so that this stress remains well below the yield strain and stress.

The drainage gravel has the potential to produce localized stress on the geomembrane liner during gravel placement with construction equipment. A geotextile cushion (and possibly a geonet) is placed at the base of the drainage gravel to the underlying geomembrane. A puncture analysis is performed to select a sufficiently thick geotextile. This analysis incorporates expected construction vehicle ground pressures and assumed drainage gravel gradation listed in the construction specifications. A safety factor of three is used when evaluating puncture stress.

Tension induced by liner-component load transfer is not anticipated to occur, because the liner interface coefficients of friction are higher than the sideslope angles. The liner component interface strengths are determined by laboratory direct shear tests. Both static and dynamic stability analyses are performed, using standard methods, design accelerations, and factors of safety.

Stresses on the geomembrane in the anchor trench also are evaluated during detailed design. Wind uplift and thermal expansion and contraction can cause stress in the geomembrane during construction. However, these stresses are not a problem, because these stresses are relatively low as compared to the tensile strength of the liner. The stresses are not present after construction, because of the weight and insulating properties of the operations layer.

4.5.3.3.2 Stresses Resulting From Operating Equipment

Loads on the liner system due to operating equipment are expected to be less severe than those generated by construction equipment for two reasons. One, operations equipment typically is lighter than construction equipment, and two, the 0.9-meter-thick operations layer dissipates stresses produced by the operating equipment.

The lined trenches are filled in a way that maintains adequate factors of safety against sliding. Stability analyses are performed during detailed design, once the lined trench geometry and liner system properties have been determined. The analyses establish operational parameters such as waste lift thickness and temporary operating slope angles.

Stability of the liner system components under the access ramp is analyzed separately. The analysis considers both static and dynamic (moving vehicle) conditions.

4.5.3.3.3 Stresses From Maximum Quantity of Waste, Cover, and Proposed Postclosure Land Use

When the lined trench is full and the cover system is in place, the liner system experiences a static load from the overlying waste, backfill, and cover materials. No significant increase in stresses on the liner system is anticipated from postclosure land use. The maximum design load of material overlying the liner system includes an allowance for the cover system (Chapter 11.0). Analyses include puncture resistance of the geomembranes and decrease in transmissivity of geocomposite drainage layers. Materials are specified based on the ability of the materials to perform adequately under postclosure loading conditions.

Dynamic stresses on the liner system result primarily from ground accelerations during seismic events. Both static and dynamic analyses are performed on the subgrade and liner components based on the finished configuration of the empty trench. Under postclosure conditions, the waste, backfill, and cover materials will tend to buttress the liner system, resulting in greater stability relative to the operational phase.

4.5.3.3.4 Stresses Resulting From Settlement, Subsidence, or Uplift

The subgrade settlement produced by waste loading is essentially elastic because of the coarse-grained, noncohesive, and drained nature of the soil. The subgrade rebounds during the excavation phase of construction and settles as the trench is filled. The compacted admix liner consolidates under waste loads. The total settlement is a combination of the subgrade elastic and the admix consolidation settlements. These settlements are analyzed with standard methods during detailed design of each lined trench. In general, differential settlements are expected to occur primarily across the lined trench sideslopes as the thickness of waste decreases from maximum to zero. Because geosynthetic liner components are highly elastic, the anticipated strains are not likely to produce any appreciable stresses in the liner system.

The potential for subsidence-induced stress is believed to be negligible based on the following information.

- The soils underlying the LLBG tend to be coarse-grained sands and gravels that are not subject to piping effects that can transport soil resulting in subsidence.

- The groundwater level is deep, at least 39.7 meters below the base of the deepest lined trenches, and does not affect bearing soils.

- No mining or tunneling has been noted. If the groundwater level was lowered substantially and consolidation occurred in the aquifer, local site-specific subsidence would be negligible because of the depth of the groundwater below the lined trenches.

- The native soils are well graded and relatively dense.

The potential for stresses resulting from uplift on the liner system also is expected to be negligible. The seasonal groundwater level is very deep, and higher-elevation perched groundwater is unlikely to develop because of the absence of aquitards in the coarse-grained Hanford formation underlying the LLBG. The coarse-grained nature of the Hanford formation also promotes rapid, primarily vertical, infiltration, which means it is unlikely that infiltration from outside the lined trench boundary will be transported laterally underneath the trench liner. Gas pressures are similarly unlikely to develop because of the absence of any noted subsurface gas generation (from organic material decomposition) and the coarse-grained, highly permeable sands and gravels underlying the landfill.

4.5.3.3.5 Internal and External Pressure Gradients

Pressure gradients across the liner caused by liquids or gases are expected to be negligible. Internal pressures due to liquids are controlled by the leachate collection and removal systems. Because leachate is removed from the sump in a timely manner, there is minimal liquid head on the liner (less than 30.5 centimeters according to RCRA regulations). Any gas that is generated internally before closure is vented either through the waste or the leachate collection system. The closure cover design will consider gas venting.

External pressures on the liner system are expected to be minimal. Gas pressures are negligible because the subgrade soil contains no gas producing materials and is highly permeable, readily venting any potential gas to the atmosphere. External pressure from liquids is not anticipated because of the deep groundwater table and the highly permeable foundation soils.

4.5.3.4 Liner System Coverage [D-6c(4)]

The liner system covers all soils underlying the lined trench and extends over the crest of the sideslopes into the anchor trenches. In addition, the truck unloading areas at the top of the access ramps are lined with 90-mil high-density polyethylene geomembranes. All surface water run-off from the truck unloading areas drains into the primary leachate collection systems.

4.5.3.5 Liner System Exposure Prevention [D-6c(5)]

No geosynthetic or admix components of the liner system are exposed to the atmosphere. The minimum 0.9-meter-thick operations layer covers the entire lined trench surface. This layer serves both as a physical protective barrier and as thermal insulation, protecting the admix layer from desiccation and frost damage.

The operations layer is inspected weekly for erosion. Excessive erosion, such as gullying, is repaired by replacing the eroded soil. Dust suppression agents could be used to prevent excessive wind erosion. The dust suppression agents bind the surface of the operations layer and minimize wind entrainment of soil.

4.5.4 Liner System, Foundation [D-6d]

The following sections discuss the foundations beneath the liner systems.

4.5.4.1 Foundation Description [D-6d(1)]

Surficial deposits within the LLBG generally consist either of Recent eolian sands or the coarse-grained glaciofluvial flood sequence of the Hanford formation, which has an interstratified deposit of coarse sand, gravelly sand, and/or sandy gravel. Where eolian sands are present, these sands are underlain by the Hanford formation. Subsequent units underlying the Hanford formation are the early-Palouse soil, the Plio-Pleistocene unit, the middle Ringold unit, and the Elephant Mountain Member of the Columbia River Basalt Group (DOE/RL-91-28, Chapter 5.0).

The two geologic units pertinent to the LLBG lined trenches are summarized as follows.

- Recent eolian sand: The sand is light olive gray in color and has a density that is loose at the surface but becomes compact with depth. The sand has a fine to medium grain size and includes little to some nonplastic silt-sized fines. The deposit is homogeneous except for a distinguishable layer of volcanic ash in some locations.

- Glaciofluvial flood deposit: This deposit has well graded mixtures of sands and gravels with trace to little nonplastic silt-sized particles. The density of the deposit ranges from compact to very dense. The gravel content can vary with depth, and the deposit predominantly can become gravel. This coarse-grained deposit is part of the Cold Creek Bar, which was formed during the Pleistocene Epoch by glacial outburst flooding.

Liner system elevations are shown on the design documents for each lined trench (Appendix 4A and 4B).

4.5.4.2 Subsurface Exploration Data [D-6d(2)]

Geotechnical site investigations are used to support the detailed design of each lined trench. The investigations consist of a review of historical data, including well logs (Chapter 5.0), and test pit data (Appendix 4E). Because the foundation soils are relatively consistent over broad areas, the need for borings and geophysical investigations are determined on a case-by-case basis. If boreholes are drilled, penetration test data are collected to determine the strength of the foundation materials in situ.

4.5.4.3 Laboratory Testing Data [D-6d(3)]

Laboratory testing is performed on soil samples from test pits and borings, both from the lined trench site and from potential borrow source locations. Testing is performed to classify soils, provide input parameters for engineering analyses, and for preparing material and construction specifications. The following tests are performed on the soil samples:

- Visual classification (ASTM D2487)--to classify soils

- Natural moisture content (ASTM D22/6)--for input to engineering analyses and preparing construction specifications

- Particle size analysis (ASTM D422 or D1140/C136)--for classification and input to engineering analyses

- Moisture-density relationships (ASTM D698 or D1557)--for preparing compaction specifications

- Triaxial strength (ASTM D4767)--for input to engineering analyses.

Laboratory testing is performed according to the most recent versions of ASTM procedures or other recognized standards. Additional tests are performed as needed.

Chemical analyses also are performed to screen for organic materials (both volatile and semivolatile) and hazardous metals. This is done to prevent incorporating contaminated material into the trench liner. Standard EPA methods are used for this screening.

4.5.4.4 Engineering Analyses [D-6d(4)]

The subgrade is required to support the liner system and overlying materials (waste, fill, and cover) without excessive settlement, compression, or uplift that could damage the liner system. This section describes the design approach used to satisfy these criteria.

4.5.4.4.1 Settlement Potential [D-6d(4)(a)]

The subgrade settlement produced by waste loading is essentially elastic because of the coarse-grained, noncohesive, and drained nature of the soil. The subgrade rebounds during the excavation phase of construction and settles as the trench is filled. An elastic settlement analysis using standard methods is performed to determine the magnitude of the total and differential settlement.

4.5.4.4.2 Bearing Capacity [D-6d(4)(b)]

The bearing capacity of the subgrade soil needs to support structures such as leachate collection tanks. The construction specifications typically require that the upper portion of the subgrade soil and all structural fill be moisture conditioned and compacted to at least 95 percent of the maximum modified Proctor dry density (ASTM D1557). Maximum allowable bearing capacities for foundations are established using standard geotechnical methods. Bearing capacities for the types of soils expected in the LLBG are typically greater than the maximum expected loads from the support structures.

4.5.4.4.3 Stability of Lined Trench Slopes [D-6d(4)(c)]

The lined trenches are constructed in eolian sand and the underlying coarse-grained Hanford formation. In granular, cohesionless, and drained soils such as these, the stability of the slope is related primarily to the maximum slope angle. Therefore, an infinite slope or other suitable analysis method is used to determine both static and dynamic sideslope stability. A more detailed discussion on lined trench slope stability is provided in Appendix 4B.

4.5.4.4.4 Potential for Excess Hydrostatic or Gas Pressures [D-6d(4)(d)]

Because the seasonal high-water level is at least 39 meters below the base of the deepest lined trench, no external hydrostatic pressure is expected from this source. Because of the coarse-grained nature of the foundation soils, any infiltration of surface water around the perimeter of the lined trench is expected to travel primarily downward. Therefore, infiltration should not cause substantial pressure on the exterior of the liner system. Internal hydrostatic pressure from leachate is negligible because the leachate is removed from the lined trench to limit head on the liner.

Gas pressure exerted externally on the liner system is expected to be negligible, because no gas-generating material (i.e., organic material) is expected in the foundation soils. If any gas were generated below the liner system, little pressure buildup would occur because of the unsaturated coarse-grained nature of the foundation soils, which would vent the gas to the atmosphere. Internal gas

pressure buildup is not anticipated, because the leachate collection system is vented to the atmosphere and dissipates any gas.

4.5.4.4.5 Seismic Conditions

Potential hazards from seismic events include faulting, slope failure, and liquefaction. Disruption of the lined trench by faulting is not considered a significant risk because (1) no major faults have been identified in the LLBG (DOE/RW-0164) and (2) only one central fault at Gable Mountain on the Hanford Site shows evidence of movement within the last 13,000 years (WHC-SD-ER-TI-0003). The potential for slope failure is considered low, because granular materials typically have high strengths relative to the maximum sideslope angles expected for the lined trenches. Liquefaction occurs in loose, poorly graded granular materials that are subjected to shaking from seismic events. Saturated soils are most susceptible because of high dynamic pore pressures that temporarily lower the effective stress. During this process, the soil particles are rearranged into a more dense configuration, with a resulting decrease in volume. The foundation materials at the LLBG are not considered susceptible to liquefaction because the materials are well graded, unsaturated, and relatively dense.

4.5.4.4.6 Subsidence Potential

Subsidence of undisturbed foundation materials is generally the result of dissolution, fluid extraction (water or petroleum), or mining. The potential for subsidence is negligible based on the following.

- Soils underlying the LLBG are coarse-grained sands and gravels, which are not subject to piping that can cause transport of soil and resulting subsidence.
- The groundwater level is deep, at least 39.7 meters below the base of the lined trenches, and does not affect bearing soils.
- Soil and rock types below the LLBG are not soluble.
- No mining or tunneling has been noted. If the groundwater level were lowered substantially and consolidation occurred in the aquifer, local site-specific subsidence would be negligible because of the depth of the groundwater table below the lined trenches.
- Soils are well graded and relatively dense.

4.5.4.4.7 Sinkhole Potential

Extensive borings in and around the LLBG (Chapter 5.0) have not identified any soluble materials in the foundation soils or underlying sediments. Consequently, the potential for any sinkhole development is negligible.

4.5.5 Liner System, Liners [D-6e]

The following sections discuss the individual components of the LLBG liner systems.

4.5.5.1 Synthetic Liners [D-6e(1)]

As described in Section 4.5.3, the synthetic liners act as an impermeable barrier for leachate migration (Figure 4-1). The synthetic liners consist of high-density polyethylene material, which makes the liners

resistant to chemical deterioration. Section 4.5.3 describes the synthetic liner system in greater detail. Additional detail is contained in Appendices 4A and 4B for each lined trench.

4.5.5.2 Synthetic Liner Compatibility Data [D-6e(1)(a)]

During detailed design of a lined trench, the composition of the expected leachate is estimated. Expected leachate composition is based on known waste composition, process information, leachate from operating lined trenches, and similar sources of data. Leachate constituents are compared to manufacturers' chemical compatibility data for synthetic liner components. In addition, the results of previous chemical compatibility testing and studies are evaluated against leachate composition. Information gained from this evaluation is used to select a liner that will be compatible with the expected leachate.

During landfill operation, the compatibility of waste receipts with the liner is ensured by the waste analysis plan (Chapter 3.0, Appendix 3A). The compatibility of the waste constituents with the liner material is established by laboratory testing. Such tests follow the procedures of EPA Method 9090A or other appropriate methods. Test results are evaluated using statistical methods and industry-accepted criteria for liner/leachate compatibility.

A waste constituent not listed in the waste acceptance criteria can be accepted into the LLBG, provided the 9090A test results or other analytical data are provided that demonstrates the waste constituent is compatible with the liner. Appendix 4F contains 9090A test results for suitability of synthetic liners.

4.5.5.3 Synthetic Liner Strength [D-6e(1)(b)]

As discussed in Section 4.5.3.3, the liner system experiences loads from several sources. During the detailed design process for each lined trench, the strength of liner system materials is evaluated against these loads. If an analysis shows an inadequate factor of safety, a stronger material is specified or the design is modified. These strength analyses are included as part of the design document package (Appendices 4A and 4B).

Seams in geomembranes are a critical area. However, with correct installation methods the seams are stronger than the surrounding material. Detailed installation requirements are included in the construction specifications to ensure that the most appropriate methods are used. In addition, procedures are established to demonstrate adequate seam strength is achieved during installation (Appendix 4A).

Seaming requirements for the geotextiles, geonet, and geocomposite drainage materials are not as critical. These materials are overlapped sufficiently to provide complete areal coverage, and relatively light seams are used to hold the panels in position during construction. After the lining system has been completed, seam strength requirements for these materials are negligible.

4.5.5.4 Synthetic Liner Bedding [D-6e(1)(c)]

The synthetic liner system is in contact with the compacted admix, drainage gravel, and operations layers.

The secondary flexible membrane liner is in direct contact with the compacted admix layer. This type of fine-grained material typically is used for clay liners overlain by flexible membrane liners. No problems related to the mechanical integrity of the flexible membrane liner are expected in this application.

With respect to the drainage gravel and operations layers, the geomembranes are protected by overlying geotextile/geonet or geocomposite layers. These geotextiles are designed to provide adequate protection during construction and operation to withstand the loads discussed in Section 4.5.3.3.

4.5.5.5 Soil Liners [D-6e(2)]

The LLBG mixed waste lined trenches are lined with a minimum (0.9-meter thick) layer of compacted soil/bentonite mixture (admix) under the secondary flexible membrane liner. This layer has an in-place permeability of less than 1×10^{-7} centimeter per second. The soil component of the admix is silty fine eolian sand or similar material from areas near the LLBG. Approximately 12 percent bentonite by dry weight added to the fine soil to achieve sufficiently low permeability; however, the percent might vary depending upon design. Construction of the liner is discussed in Section 4.5.7.

4.5.5.5.1 Material Testing Data [D-6e(2)(a)]

Laboratory testing is performed on soil liner materials to provide input parameters for engineering analyses and for preparing material and construction specifications. The following tests are performed:

- Particle size distribution (ASTM D422)
- Atterberg limits (ASTM D4318)
- Permeability (ASTM D5084)
- Moisture-density relationships (ASTM D698 or D1557)
- Strength (ASTM D4767)
- Consolidation (ASTM D2435).

Other types of tests might be performed if determined necessary for design or specification purposes.

Before constructing the lined trench, a full-scale test fill of the admix material is constructed (Appendix 4A). The primary purpose of the test fill is to verify that the specified soil density, moisture content, and permeability values can be consistently achieved using proposed compaction equipment and procedures. In-place density is measured using both the nuclear gauge (ASTM D2922) and rubber balloon (ASTM D2167) or sand cone (ASTM D1556) methods. In-place permeability is determined from a sealed double-ring infiltrometer test (ASTM D5093), which measures infiltration over a 27.6 square meter area. Admix permeability is estimated from thin-wall tube samples (ASTM D1587) obtained from the test fill and tested in the laboratory (ASTM D5084). Details of the test fill are developed during detailed design. During construction, field density (e.g., ASTM D2922, D2/67, and/or D1556) and moisture content (ASTM D2216) periodically are measured. Thin-wall tube samples (ASTM D1587) are taken at regular intervals and tested for permeability (ASTM D5084). Additional details of field testing during construction are developed during the design process.

Dispersion and piping in the admix are not considered likely, because the permeability, and thus the flow velocity, is very low, making it difficult to move the soil particles or otherwise disrupt the soil fabric. In addition, the admix is well graded, so the component particles tend to hold each other in place. Therefore, testing for these characteristics is not necessary.

4.5.5.5.2 Soil Liner Compatibility Data [D-6e(2)(b)]

As discussed in Section 4.5.5.2, expected leachate composition is determined as part of detailed trench design (Appendix 4A). The results of previous chemical compatibility testing and studies are evaluated against leachate composition to determine the effect of leachate on soil liner composition or permeability. If potential problems are indicated, the need for leachate specific compatibility tests is

evaluated. The tests follow the procedures of (ASTM D5084) (flexible wall parameter) and California State guidelines (CSWRCB 1984), and consider the effects of radiation on the soil liner materials. If necessary, the composition of the soil liner admix is modified until satisfactory performance is achieved.

4.5.5.5.3 Soil Liner Thickness [D-6e(2)(c)]

Calculations have been performed to evaluate the effectiveness of the soil liner as a barrier to leachate. The following assumptions were used in the analysis.

- The soil liner is 0.9-meter thick and has a permeability of 1×10^{-7} centimeter per second.
- The average annual precipitation entering the lined trench is the difference between the total precipitation and the moisture lost by evapotranspiration. These values were derived from HELP modeling (WHC-MR-0376; EPA 1989) and are considered conservative because no run-off is allowed and no vegetation is assumed (i.e., bare ground conditions). On this basis, the net infiltration to the lined trench is 4.11 centimeters per year.
- The net infiltration acts immediately on the soil liner. This is a very conservative assumption, as travel time through and storage within the cover soil and waste are ignored.
- There is no flexible membrane liner (this is a very conservative assumption).
- The primary and secondary leachate collection and removal systems stop functioning after the lined trenches have been filled (this is also a very conservative assumption).
- The lined trench is exposed to infiltration for 10 years before a cover is constructed.
- Darcian flow occurs within the soil liner. Diffusion and adsorption mechanisms are not considered.

The analysis shows that leachate penetrates about 7.62 centimeters into the soil liner over the 10 year period. This is less than 10 percent of the total thickness of the secondary liner and suggests that the liner has a significant margin of excess performance, particularly given the conservative assumptions, noted previously. Supporting calculations are presented in Appendix 4G.

4.5.5.5.4 Soil Liner Strength [D-6e(2)(d)]

The expected loads on the liner system are discussed in Section 4.5.3.3. Significant stresses in the soil liner that must be considered are (1) internal stresses from the weight of the liner system, (2) stresses on the interface with the overlying materials, and (3) stresses during construction.

Internal stresses are present on the sideslopes from the weight of the operations layer and soil liner itself. Using material properties determined from laboratory testing, the stability of the soil liner is evaluated under both static and dynamic loading conditions. Standard methods of slope stability analysis are used. Interface strength is evaluated using laboratory test data and slope stability methods.

The primary concern during construction is bearing failure caused by the weight of overlying soil components of the liner system (e.g., drainage gravel on the floor) and the construction equipment used to spread these materials. Strength parameters developed from laboratory testing and standard analytical methods are used to determine bearing capacity.

If any of these analyses indicate unacceptable performance, the soil liner or geosynthetic design is changed to increase factors of safety to acceptable levels.

4.5.5.5.5 Engineering Report [D-6e(2)(e)]

An engineering report is prepared for each lined trench as part of the definitive design document package (Appendix 4B). The report describes the design of the liner system and includes supporting calculations. The engineering report is prepared and signed by a professional civil engineer registered in Washington State. Lined trench construction and material properties are provided in Appendix 4A.

4.5.6 Liner System, Leachate Collection and Removal System [D-6f]

The purpose of the leachate collection and removal system is to provide sufficient permeability and storage volume to collect, retain, and dispose of, in a timely manner, fluids falling on or moving through the waste. The primary leachate collection and removal system provides the preferential path along which the leachate flows into the primary sump. The secondary leachate collection and removal system (also called the leak detection system) is located between the primary and secondary geomembranes. The secondary leachate collection and removal system provides the preferential path along which any fluids leaking through the primary liner system flow to the secondary sump.

The collected leachate is pumped to a leachate collection tank, screened and/or sampled, and transferred to tanker trucks using methods and equipment developed to avoid accidental spills. The tanker truck is parked on an epoxy coated tanker loadout pad designed to capture and contain any possible spill of leachate. During loading operations, the leachate level in the leachate collection tank is monitored with level indicating equipment. The tanker trucks subsequently transport the leachate to a TSD unit.

4.5.6.1 System Operation and Design [D-6f(1)]

The lined trenches are operated in a way that ensures the bottom liner is maintained as dry as possible, and the head on the top liner is less than 30.5 centimeters. In extreme conditions (i.e., a 25-year storm event), the head on the top liner could exceed 30.5 centimeters for short durations. However, even in extreme conditions, the head on the bottom liner will not exceed 30.5 centimeters. The operating methodology, described in the following paragraphs, ensures that liquids on the bottom liner are removed continuously before the liquids can accumulate.

Both leachate collection systems can be operated either manually or automatically. When operated automatically, liquid level sensors cycle the pumps on and off, in response to rising and falling leachate levels. At least once a week, the leakage rate through the top liner is calculated to demonstrate that the leakage rate is less than the 'action leakage rate' (Appendix 4C). Data to support the leakage rate calculations can be obtained either from the flow totalizer in the secondary leachate collection pump discharge line or from the liquid level gauges. Collected leachate from the secondary leachate collection system can be either pumped back to the primary leachate collection system or to the leachate collection tank.

The design of the primary and secondary leachate collection systems is described in Section 4.5.3.1. System geometry is completed and material specifications are developed during the detailed design process. The leachate collection and removal system design complies with RCRA Subtitle C requirements and guidance.

Each sump has a thick layer of gravel designed to provide high permeability and storage capacity. Leachate is removed from the sumps by a pump installed in either vertical or sideslope riser pipes. Pressure transducers and/or floats are used to monitor leachate level in the sumps and provide appropriate signals to the pump control system. All pumps, transducers, and/or floats are removable for maintenance, and related activities.

4.5.6.1.1 Primary System

The base of the primary leachate collection and removal system is defined by the primary geomembrane. On the floor of the lined trench, the primary geomembrane is overlain by geonet, geocomposite, and/or granular drainage layers. A granular drainage layer is used and pipes are located at regular intervals to increase flow capacity. Geotextile layers at the top of the leachate collection and removal system prevent migration of fine soil particles into the gravel or geonet, thus prevent clogging. On the sideslopes, a geocomposite layer is used over the geomembrane. The geocomposite includes bonded geotextiles on both sides that increase the interface shear strength, and allow this material to be used on the sideslopes. Because of construction difficulties, no drainage gravel is placed on the sideslopes.

The primary leachate collection and removal system is covered by the operations layer. The layer is a minimum 0.9-meter thick, and provides protection for the underlying liner and drainage materials. The operations layer covers both the trench floor and the sideslopes.

The primary leachate collection and removal system is designed to accommodate the 25-year, 24-hour storm, as required by RCRA regulations. However, the EPA recognizes the need to temporarily store leachate from such rare events (EPA 1985). Should a greater than 25-year, 24-hour storm event occur, the primary leachate collection and removal system sump is designed to temporarily store leachate at a depth greater than 30.5 centimeters, as opposed to the alternative of constructing an excessively large leachate collection tank.

The primary leachate collection and removal system sump is equipped with two sump pumps. One pump is a high capacity pump capable of rapid removal of large volumes of leachate and is suitable for the transfer of batch quantities of leachate and can handle the larger volumes of leachate anticipated from the 25-year, 24-hour storm event. The other pump is a low capacity submersible pump located in the base of the primary sump. The pumps are fabricated from stainless steel or other corrosion resistant material.

4.5.6.1.2 Secondary System

The base of the secondary leachate collection and removal system is formed by the secondary geomembrane. The secondary leachate collection and removal system is similar to the primary leachate collection and removal system except that pipes are not included. The pipes are not needed because high flow capacity is not required for the low leachate volumes.

The secondary leachate collection and removal system drains to the secondary sump, which is located immediately below the primary sump. Because of the low volumes, the secondary leachate collection and removal system is equipped with only one low-capacity submersible pump.

4.5.6.1.3 Response Action Plan

In compliance with regulatory requirements, a response action plan is prepared for each lined trench. As part of this plan, the 'action leakage rate' is developed (Appendix 4C). In accordance with EPA guidance, the action leakage rate is calculated as "the maximum design flow rate that the leak detection system can

remove without the fluid head on the bottom liner exceeding 30.5 centimeters" (EPA 1992). If the action leakage rate is exceeded, the DOE-RL does the following:

- Notifies the appropriate regulatory authority in writing of the exceedence within 7 days of the determination

- Submits a preliminary written assessment to the appropriate regulatory authority within 14 days of the determination, on the amount of liquids, likely sources of liquids, possible location, size, and cause of any leaks, and short-term actions taken and planned

- Determines to the extent practicable the location, size, and cause of any leak

- Determines whether waste receipt should cease or be curtailed, whether any waste should be removed from the unit for inspection, repairs, or controls, and whether the unit should be closed

- Determines any other short-term and/or long-term actions to be taken to mitigate or stop any leaks

- Within 30 days after the notification that the action leakage rate has been exceeded, submits to the appropriate regulatory authority the results of the analyses specified in the following paragraphs, the results of actions taken, and actions planned. Monthly thereafter, as long as the flow rate in the leak detection system exceeds the action leakage rate, the DOE-RL submits to the appropriate regulatory authority, a report summarizing the results of any remedial actions taken and actions planned.

The leachate will be analyzed for chemical compounds. If the analytical results indicate that these constituents are present, and if the constituents can be traced to a particular type of waste placed in a known area of the lined trench, it might be possible to estimate the location of the leak. In addition, waste packages might not undergo enough deterioration during the active life of the trench to permit escape of the contents, it is possible that the leachate might be clean or the composition too general to show a specific source location.

If the source location cannot be identified, large-scale removal of the waste and operations layer to find and repair the leaking area of the liner would be one option for remediation. However, this procedure risks damaging the liner. In addition, waste would have to be handled, stored, and replaced in the trench. Backfill would need to be removed from around any waste packages to accomplish this. If the waste packages are damaged during this process, the risk of accidental release might be high. For these reasons, large-scale removal of waste and liner system materials is not a desirable option and will not be implemented except as a last resort.

The preferred alternative depends on factors such as the amount of waste already in the trench, the rate of waste receipt, the chemistry of the leachate (i.e., is it clean?), the availability of other disposal units, and similar considerations. Therefore, no single approach can be selected at this time. If necessary, an interim solution could be implemented while the evaluation and permanent remediation is performed. Examples of potential approaches include the following.

- The surface of the waste could be graded to direct run-off into a shallow pond. The surface would be covered with the low-hydraulic conductivity layer (geomembrane). Precipitation would be pumped or evaporated from the pond and would not infiltrate the waste already in the lined trench. Waste would be placed only during periods of dry weather, and stored at other onsite TSD units at other times. This type of approach also could be used to reduce leakage immediately after the action leakage rate is exceeded, while other remediation options are evaluated.

- Partial construction of the final closure cover could begin earlier than planned. This would reduce infiltration into the lined trench, and possibly reduce the leakage rate if the cover is constructed over the failed area.

- A layer of low-permeability soil could be placed over the existing waste, perhaps in conjunction with a geomembrane, to create a second 'primary' liner higher in the lined trench. This new liner would intercept precipitation and allow its removal.

- A rigid-frame or air-supported structure could be constructed over the trench to ensure that no infiltration occurs. Although costly, this approach could be less expensive than constructing a new trench.

In general, the selected remediation efforts will be progressive. Those remediation methods that are judged to be the least difficult and the most cost effective will be used first. If these efforts are not effective, more difficult or expensive options would be used.

4.5.6.2 Equivalent Capacity [D-6f(2)]

The geocomposite drainage layers used are commercially available that have equivalent flow capacity to a 30.5-centimeters layer of granular drainage material with a permeability of 1×10^{-2} centimeter per second. The construction quality assurance report (Appendix 4A) contains material specifications developed during detailed design and considers loads imposed by waste and cover materials.

4.5.6.3 Grading and Drainage [D-6f(3)]

In accordance with EPA guidance, all areas of the lined trench floor (except possibly sump bottoms) are graded at a slope of at least 1 percent to facilitate drainage and avoid ponding on the liners. In practice, floor slopes are designed with minimum slopes of 1.5 percent to accommodate slight variations associated with construction techniques. Grading tolerances are established so that the actual slope is at least 1 percent at all locations. For specific details of piping systems, sumps, pumps, etc., used to collect, hold, and transport leachate, refer to Appendices 4A and 4B.

4.5.6.4 Maximum Leachate Head [D-6f(4)]

The maximum head on the primary liner is less than 30.5 centimeters, except for rare storm events as discussed in Section 4.5.6.1. The sump is sized and designed to provide adequate surge storage to prevent leachate build up on the primary liner.

4.5.6.5 System Compatibility [D-6f(5)]

The primary and secondary leachate collection and removal systems are composed of inert geologic materials (sand and gravel), high-density polyethylene, and other geosynthetic materials such as polypropylene. As described in Section 4.5.5.2, the geosynthetics are evaluated for compatibility with the expected leachate. To ensure that the geosynthetics used in the lined trenches are chemically similar to those evaluated, manufacturers are required to submit quality control certificates and other manufacturing information and conformance tests performed on all materials. The results of these tests are presented in Appendix 4A.

Before a waste constituent is allowed in the lined trench, the waste constituent is evaluated for compatibility with the liner (e.g., identified in 9090A test results, testing, etc.). Other materials could contact the leachate, for example:

- Stainless steel, used for piping and wetted parts of pumps
- Rubber coatings for pump impellers and cases
- Polyvinyl chloride and other plastics in miscellaneous uses
- Epoxy or other materials used as tank coatings.

Compatibility of these materials with the expected leachate is considered in the trench liner system design. Compatibility of these materials is of lesser concern, because items that are comprised of these materials are entirely located within the containment area. Failure of these items would not result in a dangerous waste release, and the materials would be replaced or repaired.

4.5.6.6 System Strength [D-6f(6)]

Stability of drainage layer, strength of piping, and prevention of clogging are discussed in the following sections.

4.5.6.6.1 Stability of Drainage Layers [D-6f(6)(a)]

As described in Sections 4.5.3.3 and 4.5.5.3, the stability of the liners and leachate collection and removal system on the sideslopes is evaluated as part of detailed design. To provide sufficiently high shear strengths at the interfaces between geosynthetic components, textured geomembranes and thermally bonded geocomposites can be used.

Bearing capacity of the drainage and sump gravels is expected to be adequate, based on typical strength values for granular materials. Standard bearing capacity analyses are performed during detailed design to verify this assumption.

The transmissivity of the drainage layers under the combined load of the waste and cover was addressed in the design and is adequate to support leachate removal.

4.5.6.6.2 Strength of Piping [D-6f(6)(b)]

The drain pipes in the primary drainage and sump gravel and sideslope riser pipes are high-density polyethylene pipe, or equal. During detailed design, the required wall thickness of the pipe is determined according to the manufacturer's recommendations and standard analytical methods used by the piping industry. In these analyses, the ultimate load (derived from the estimated weight of the waste cover) is used, the allowable deflections are limited to 5 percent, and conservative values for soil modulus and lateral confinement are assumed. The calculations evaluating the pipe loads, required thickness, and strengths are presented in the definitive design report for each lined trench (Appendix 4B).

4.5.6.7 Prevention of Clogging [D-6f(7)]

The geotextiles that separate the drainage layers from adjacent soil layers are selected based on the ability of the geotextiles to retain the soil and prevent the soil from entering the leachate collection and removal system. Standard methods are used to determine the allowable range of opening sizes in the textiles. In addition, the amount of fine material in the drainage and sump gravels is limited by specification to less than a few percent, and is not expected to cause clogging problems. Because the

waste disposed in the lined trench is required to satisfy LDR (40 CFR 268), the amount of organic material is minimal, and consequently biologic clogging is not a problem.

4.5.7 Liner System, Construction and Maintenance [D-6g]

Details relating to the liner system construction and maintenance are discussed in the following sections.

4.5.7.1 Material Specifications [D-6g(l)]

Material specifications are provided in the following sections for each of the materials used in the liner system.

4.5.7.1.1 Synthetic Liners [D-6g(1)(a)]

As described in Section 4.5.3.1, both the primary and secondary geomembrane liners are comprised of high-density polyethylene, or equal. Detailed specifications are prepared for each lined trench as part of the design process (Appendices 4A and 4B).

4.5.7.1.2 Soil Liners [D-6g(1)(b)]

As described in Section 4.5.3.1, the soil liner consists of imported bentonite (expansive clay) blended with fine soil deposits on or next to the LLBG. The fine soil is free of roots, woody vegetation, rocks greater than 2.54 centimeter in diameter, and other deleterious material. The bentonite content depends on the characteristics of fine soil. Mixing is performed under carefully controlled conditions in a pugmill or other approved alternatives. The admix is placed at a saturation of 85 percent or higher, to achieve an in-place permeability of 1×10^{-7} centimeter per second or less. The surfaces of the soil liners are rolled smooth before placing the overlying geomembranes. Additional specifications are prepared for each lined trench as part of the design process.

4.5.7.1.3 Leachate Collection and Removal System [D-6g(1)(c)]

Drainage and sump gravel consists of hard, durable, rounded to subrounded material. The gravel is washed and the amount of fine material (i.e., passing the number 200 sieve) is limited to a few percent. The permeability of the gravel is 1×10^{-2} centimeter per second or greater. Additional specifications are prepared as part of the design process.

For geotextiles and geonets, the composition, thickness, transmissivity, unit weight, apparent opening size, strength, and other properties are determined during detailed design based on results of engineering analyses, experience, and industry standard approaches.

4.5.7.2 Construction Specifications [D-6g(2)]

Construction requirements for major components of the lined trench are summarized in the following sections. Additional detail regarding methods, materials, inspection procedures, etc., are presented in Appendix 4A for each lined trench.

4.5.7.2.1 Liner System Foundation [D-6g(2)(a)]

The excavated subgrade surfaces are moisture conditioned and compacted to a depth of at least 20.3 centimeters before placing the admix layer.

4.5.7.2.2 Soil Liners [D-6g(2)(b)]

The soil and bentonite are blended thoroughly and moisture conditioned so that the admix is uniform and homogeneous throughout. The admix layer is placed in 20.3- to 25.4-centimeter-thick loose lifts and compacted so that the compacted lift thickness is 15.24 centimeters or less, except that the first lift could be up to 30.5-centimeter thick (loose). In the secondary liner, additional thickness might be necessary to prevent incorporation of the sandy subgrade soil into the liner. An admix layer is used in the primary liner system, the additional thickness prevents damage to underlying layers. Each new lift of admix is kneaded into the previously placed lift. The methods for admix preparation, type of compaction equipment, number of passes, and other details of the placement process are determined by constructing a test fill section before placing admix in the lined trench.

4.5.7.2.3 Synthetic Liners [D-6g(2)(c)]

To protect the overlying geomembranes, the admix surface is smooth and free of rocks, stones, sticks, roots, sharp objects, and debris of any kind. In all cases, the high-density polyethylene liners are deployed with the length of the roll parallel to the slope; no horizontal seams are allowed on slopes. Adjacent panels are overlapped 7.6 to 15.2 centimeters and thermally seamed using fusion or extrusion methods. Seams are inspected continuously using a vacuum box and air pressure tests. Destructive seam tests (peel and adhesion) are performed on samples taken at regular intervals. The geomembranes are protected by placing the overlying geosynthetic layers when practicable.

4.5.7.2.4 Leachate Collection and Removal Systems [D-6g(2)(d)]

Drainage and sump gravel are placed and spread carefully over the underlying geosynthetics using suitable equipment to prevent damage. Hauling and placing equipment operate on a minimum thickness of soil above any geosynthetic layer to avoid damage. Geosynthetic layers in the leachate collection and removal system are deployed, overlapped, and joined (e.g., tying for geonets, sewing for geotextiles) according to standard industry practice and the manufacturers' recommendations. Drainage and riser pipes are installed in the trenches. Pipes carefully are bedded and the trenches backfilled to provide adequate lateral support. Pumps and other mechanical components are installed according to manufacturers' recommendations. Appendix 4A contains the construction specifications for placement of all components of leachate collection and removal systems.

4.5.7.3 Construction Quality Control Program [D-6g(3)]

A construction quality assurance plan is prepared for use during lined trench construction and establishes in detail the following:

- The duties, responsibilities, and authority of all individuals and organizations involved in the work, including the engineer, contractors, and third-party construction quality assurance personnel
- Required qualifications and certifications for various technical personnel
- Inspection and sampling activities, both during manufacturing and construction, including sampling frequency and procedures

- Description of test methods, either directly or by reference to standard test methods such as ASTM, etc.

- Documentation requirements, including standard forms and inspection data sheets.

4.5.7.4 Maintenance Procedures for Leachate Collection and Removal Systems [D-6g(4)]

The accessible components of the leachate collection and removal systems are maintained according to preventive maintenance methods. These methods require periodic testing to prove that the equipment, controls, and instrumentation are functional and are properly calibrated. Testing intervals are derived from applicable regulations and manufacturer's recommendations. Instruments are calibrated annually or at intervals suggested by the manufacturer. When applicable, the preventive maintenance methods include calibration instructions. Instruments that require annual calibration are as follows:

- Primary sump level indicator
- Secondary sump level indicator.

Trenches 31 and 34 are equipped with leachate transport tanker loading areas. These tanker loading areas are approximately 6.4 meters wide by 19.5 meters long. Future tanker unloading areas could vary in size, as waste management needs dictate. The tanker loading areas are designed to collect any leachate that might spill during the loading operation. These loading areas contain curbs, sloping floors, and sump areas to channel any spilled liquid to an accumulation area where the liquid is collected and sent to an appropriate treatment and storage unit.

4.5.7.5 Liner Repairs During Operations [D-6g(5)]

Because of the 0.9-meter-thick operations layer, damage to the liner system is not expected. If damage does occur, the operations layer could be removed laterally as far as required. Underlying geosynthetic and gravel layers will be removed until an undamaged layer is encountered. The damaged layers will be repaired and replaced from the lowest layer upwards using similar procedures to those employed during construction. Most repairs to the geomembranes will be performed using a patch, which will be placed, welded, and tested by construction quality assurance personnel. Details of liner construction and inspection procedures in Appendix 4A.

4.5.8 Run-On and Run-Off Control Systems [D-6h]

Because of the sandy soils, small drainage area, and arid climate at the LLBG, storm water run-on and run-off are not expected to require major engineered structures. Interceptor and drainage ditches are adequate for run-on and run-off control. The 25-year, 24-hour precipitation event is the design storm used to size the lined trench systems. Beyond this, surface water evaluation is highly site-specific, and appropriate analyses are performed as part of detailed design for each lined trench.

4.5.8.1 Run-On Control System [D-6h(l)]

Run-on is controlled by drainage ditches or berms around the perimeter of the lined trench. Any overland flow approaching the trench is intercepted by the ditches or berms and conveyed to existing drainage systems or suitable discharge points. All the drainage ditches or berms are designed to handle the peak 25-year flow from the potential drainage area. By using low channel slopes, design flow velocities in the ditches are maintained below established limits for sand channels. Erosion protection (such as riprap) is not required because of the very low velocities.

The drainage for trenches 31 and 34 are designed and constructed such that the paved truck unloading area drains into the trenches and all other areas beyond the crest of the trenches drain outward, away from the trenches. The pavement in the truck staging area drains away from the trenches. Between the trench crest and the perimeter road, the area was graded to provide drainage toward the perimeter road. The perimeter road is sloped outward, at a grade of approximately 1 percent, to provide drainage away from the trenches. On the outside of the perimeter road, on the north and west sides of the trenches, drainage ditches were excavated to provide drainage away from the trenches.

4.5.8.1.1 Design and Performance [D-6h(1)(a)]

Design and performance details are determined for each lined trench as part of the detailed design process (Appendix 4B).

4.5.8.1.2 Calculation of Peak Flow [D-6h(1)(b)]

Computation of design discharge for the drainage ditches or berms is performed using standard analytical methods, such as the Rational Method or the computer program HEC-1 (USACE 1981). The 25-year, 24-hour precipitation depth is 4.0 centimeters, based on precipitation data recorded from 1947 to 1969 (PNL-4622). The tributary area for each section of ditch or berm depends on local topography.

4.5.8.2 Run-Off Control System [D-6h(2)(a and b) and (3)]

There is no run-off from the lined trenches because the trenches are constructed below grade. Any precipitation falling on the trenches is removed by either evapotranspiration or the leachate collection and removal systems. Therefore, a run-off control system is not needed.

4.5.8.3 Construction [D-6h(4)]

The drainage ditches or berms around the lined trenches are constructed with conventional earthmoving equipment such as graders and small dozers.

4.5.8.4 Maintenance [D-6h(5)]

The drainage ditches or berms require periodic maintenance to ensure proper performance. The most frequent maintenance activity, beyond periodic inspection, is cleaning the ditches or berms to remove obstructions caused by windblown soil and vegetation, (e.g., tumbleweeds). After rare storm events, regrading of the ditch bottom or repair of the berm might be required to repair erosion damage. This is expected to occur infrequently, however inspections will be conducted within seven days after significant storm events or at least annually.

4.5.9 Control of Wind Dispersal [D-6i]

The LLBG use varied methods to prevent wind dispersal of mixed waste, depending on the waste form. Methods to prevent wind dispersal include containerizing, stabilizing, grouting, spray fixitants, and backfill. Sometimes the natural form of the waste precludes the need for wind dispersal protection, (i.e., scrap piping and other solid debris). In other instances, the operating contractor implements a wind speed restriction during handling, and immediately backfills the waste to prevent wind dispersal.

4.5.10 Liquids in Landfills [D-6j]

Free liquids, as described in the waste analysis plan (Chapter 3.0, Appendix 3A) are not accepted at the LLBG.

4.5.11 Containerized Waste [D-6k]

Containerized waste received in the LLBG lined trenches is limited to a maximum of 10 percent void space. Several inert materials (diatomaceous earth, sand, lava rock) are used as acceptable void space fillers for waste that does not fill the container. Compliance with the void space restrictions is provided by the representative sampling performed (Chapter 3.0), and the assessments performed (Chapter 3.0, Appendix 3A).

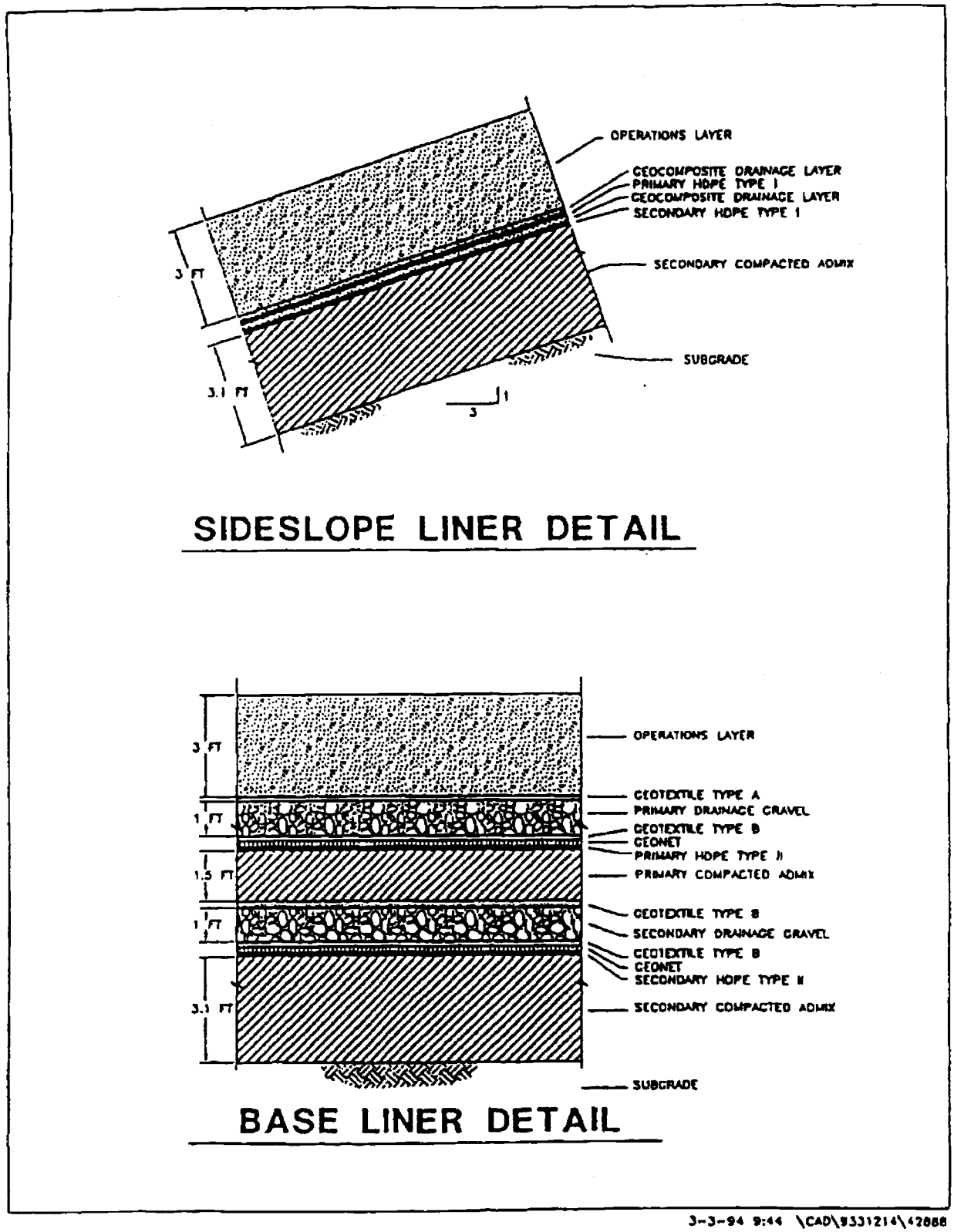

Figure 4-1. Example Liner System.

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5.0 GROUNDWATER MONITORING FOR LAND BASED UNITS [D-10]

The Low-Level Burial Grounds (LLBG) make up five waste management areas. Two of these areas are in the 200 East Area (Figure 5-1) and three areas are in the 200 West Area (Figure 5-2). These burial grounds are subject to regulation under RCRA because of the presence of mixed waste. The hazardous component of this waste is regulated under RCRA.

The groundwater monitoring program for the LLBG was initiated in 1986. At that time, the groundwater monitoring plan for the burial grounds (WHC-SD-EN-AP-015) was based on the interim status monitoring requirements in 40 CFR 265 Subpart F and WAC 173-303-400.

When the final status permit is implemented, the LLBG will be subject to RCRA final status requirements for groundwater monitoring (WAC 173-303-645). This chapter describes the final status groundwater monitoring program for the LLBG, which is designed to detect releases of dangerous waste contaminants from the burial grounds to the uppermost aquifer during the operational period (pre-closure).

The main objectives of this monitoring plan are to propose the following:

- Monitoring well networks
- Monitoring constituents for groundwater
- Statistical methods to be used in determining groundwater impacts.

Until this permit is implemented, monitoring will continue according to interim status requirements (WHC-SD-EN-AP-015).

The groundwater monitoring program described in this chapter was developed using the following assumptions.

- Breakthrough of contaminants to groundwater could occur within a 35-year period under worst-case conditions (refer to conceptual model, Section 5.3.3).

- The site boundaries encompass the entire waste management areas. Therefore, point of compliance wells to detect releases of contaminants are located in the downgradient portions of each waste management area.

- The potential for the development of a vadose characterization/monitoring system will be addressed under the authority of DOE Order 435.1, *Radioactive Waste Management* and is beyond the scope of the RCRA groundwater monitoring program.

As groundwater mounds due to past wastewater discharges continue to dissipate, water levels are dropping and changes in the direction of groundwater flow are occurring. Monitoring networks were designed for the currently-estimated directions of groundwater flow. The program is designed for current knowledge of locations and types of waste present.

This plan addresses groundwater monitoring requirements for the dangerous waste components in the LLBG, i.e., those components regulated under RCRA. Performance monitoring specifically for radionuclides is governed by U.S. DOE Order 435.1 and is described in the *Performance Assessment Monitoring Plan for the Hanford Site Low-Level Burial Grounds* (DOE/RL-2000-72).

Source, special nuclear, and byproduct materials as defined by the *Atomic Energy Act of 1954* are excluded from the RCRA definition of solid waste. Such materials on the Hanford Site are subject to

management under the sole authority of the DOE, even when commingled with a hazardous component that is subject to regulation under the Washington *Hazardous Waste Management Act*. Accordingly, any procedures, methods, data, or information provided to Ecology in Hanford Facility Dangerous Waste Permit Applications that relate solely to the radioactive component of mixed waste are for information purposes only and are outside the scope of Ecology's regulatory authority and the Hanford Facility RCRA Permit (Ecology 2001).

5.1 EXEMPTION FROM GROUNDWATER PROTECTION REQUIREMENT [D-10a]

An exemption is not requested.

5.2 INTERIM STATUS PERIOD GROUNDWATER MONITORING DATA [D-10b]

During the period of RCRA interim status groundwater monitoring, upgradient and downgradient wells were sampled semiannually for contamination indicator parameters (pH, specific conductance, total organic carbon, and total organic halides) as specified in 40 CFR 265.92. Indicator parameter data from downgradient wells were compared to background levels (critical mean values or limits of quantitation) established from upgradient wells.

Based on results from over 13 years of RCRA interim status monitoring, it appears that the LLBG have not contaminated groundwater with dangerous waste constituents. Contamination that does exist is attributed to upgradient sources. Data are stored in the Hanford Environmental Information System (HEIS) database. Indicator parameters are plotted on graphs in Appendix 5B. Results for each waste management area are discussed in the following sections.

5.2.1 Low-Level Waste Management Area 1

The interim status monitoring network for Low-Level Waste Management Area 1 is illustrated in Figure 5-3. Specific conductance in well 299-E28-26, considered downgradient, exceeded the upgradient-downgradient comparison value in 1990, triggering assessment monitoring. However, assessment monitoring concluded that the elevated specific conductance was caused by nitrate and other constituents from upgradient facilities. At the start of RCRA monitoring at Low-Level Waste Management Area 1, the estimated direction of groundwater flow was east to west. Subsequent study indicated that the flow direction was to the northwest. This led to re-evaluating the upgradient-downgradient status of the wells in the monitoring network and revised statistics were calculated. Using the new comparison values, this waste management area returned to detection monitoring in 1994 (WHC-SD-EN-EV-025).

5.2.2 Low-Level Waste Management Area 2

Figure 5-4 illustrates the interim status monitoring network for Low-Level Waste Management Area 2. RCRA monitoring has not shown any contamination related to waste disposal at the burial grounds. No downgradient exceedances have been confirmed. Upgradient well 299-E34-7 has had significant increases in specific conductance in recent years and is now well over the comparison value. This increase is related primarily to an increase in sulfate. Total organic carbon also has been increasing in this well. Analysis for oil and grease (April 2001) reported 1.7 mg/L. This might indicate the constituent class for elevated total organic carbon. Volatile and semivolatile organic analyses were negative for samples taken from this well. Total organic halides also have shown an increase in this well. The source

has not been determined for any of these constituents, but because the constituents are detected in an upgradient well, it is unlikely to be the LLBG.

5.2.3 Low-Level Waste Management Area 3

The interim status monitoring network for Low-Level Waste Management Area 3 is illustrated in Figure 5-5. In 1989, total organic halides in downgradient well 299-W7-4 exceeded the comparison value and a groundwater assessment program (WHC-SD-EN-AP-021) was initiated. Well 299-W7-4 was installed initially as an upgradient monitoring well but changes in the burial ground boundary caused this well to be downgradient of portions of the burial ground. Three additional upgradient monitoring wells (299-W10-19, 299-W10-20, and 299-W10-21) were installed in 1992 and 1993. Analytical results from these wells indicated that the elevated total organic halides came from an upgradient source. An assessment report was prepared (WHC-SD-EN-DP-086) and detection level monitoring resumed.

5.2.4 Low-Level Waste Management Area 4

The interim status monitoring network for Low-Level Waste Management Area 4 is illustrated in Figure 5-6. RCRA monitoring has shown no evidence of groundwater contamination from the burial grounds. Total organic halides in downgradient well 299-W15-16 has exceeded the upgradient/downgradient comparison value since January 1999, but the source of contamination is believed to be the regional carbon tetrachloride plume, not the burial grounds. Well 299-W15-16 was upgradient of the waste management area in the past.

5.2.5 Low-Level Waste Management Area 5

RCRA groundwater monitoring was conducted from 1988 through 1996. Monitoring was terminated at that time because no waste has been placed in this area.

5.3 AQUIFER IDENTIFICATION [D-10c]

The following sections discuss geology and hydrology for the 200 East and 200 West Areas, including site-specific information for the Low-Level Waste Management Areas. This information, combined with knowledge of waste constituents and contaminant mobility, forms a conceptual model for each of the Low-Level Waste Management Areas. This section identifies the uppermost aquifer beneath the LLBG as required under WAC 173-303-806(4)(a)(xx)(B).

The Hanford Site lies within the Pasco Basin of the Columbia Plateau. The bedrock in this region is characterized by a thick sequence of flood basalts of the Columbia River Basalt Group. The basalt has been folded and faulted, forming broad structural and topographic basins separated by asymmetric anticlines. The basalt is overlain by sediment that accumulated in the basins. The suprabasalt sediment consists primarily of (1) fluvial-lacustrine clay, sand, silt, and gravel of the Neocene-age Ringold Formation; (2) the Plio-Pleistocene unit made up of alluvial, eolian, and paleosol deposits that might be cemented; and (3) Pleistocene cataclysmic flood deposits of the Hanford formation, composed of unconsolidated gravel, sand, and silt. A thin layer of eolian and alluvial Holocene deposits of silt, sand, and gravel cover much of the Hanford Site. Figure 5-7 presents the generalized stratigraphy of the Hanford Site.

The hydrology of the Hanford Site can be divided into two major aquifer systems: the basalt-confined and the Hanford/Ringold. The basalt-confined aquifer system consists of a series of rubbly basalt flow

tops and, where present, sedimentary interbeds, separated by low-permeability basalt flow interiors. The Hanford/Ringold aquifer system includes the uppermost aquifer beneath the Hanford Site. The aquifer generally is unconfined, but there are some confined or semiconfined units within the Ringold Formation. There are also local zones of perched water in the Ringold Formation, the Plio-Pleistocene unit, and the Hanford formation.

5.3.1 Hydrogeology of the 200 East Area

The primary references for the geologic interpretation are WHC-SD-EN-TI-290 and PNNL-12261. The information in those reports is based on the data collected during the long history of drilling that has taken place in and around the 200 Areas (WHC-SD-EN-DP-044; SD-BWI-DP-039; PNL-6820; WHC-MR-0205; WHC-MR-0204; RHO-ST-23, WHC-SD-EN-DP-049, WHC-SD-EN-DP-086).

The suprabasalt sediment in the 200 East Area consists of the Hanford and Ringold Formations. Ringold Formation sediment generally is not present beneath the northern half of this area. The Elephant Mountain Member of the Saddle Mountains Basalt is the uppermost basalt unit beneath the 200 East Area.

The water table beneath most of the 200 East Area is in the Hanford formation. The base of the unconfined aquifer is the lower mud unit of the Ringold Formation, where present, or the uppermost basalt unit. In some locations, basalt is present above the water table and there is no Hanford/Ringold aquifer. The Hanford/Ringold aquifer system in the 200 East Area consists of at least two distinct aquifers (PNNL-12261): (1) an unconfined aquifer in gravels of the Hanford formation and Ringold unit 5, and (2) a confined aquifer in Ringold unit 9, below the Ringold lower mud.

Testing at the time of borehole installation for the LLBG was used to determine the hydraulic conductivity values. Most of the tests were constant-discharge pumping tests up to 8 hours in duration, followed by recovery tests. None of the tests in the 200 East Areas created sufficient drawdown to be observed in nearby observation wells. In many cases, testing was inconclusive because there was insufficient drawdown in the pumping well to evaluate the results. Hydraulic conductivity estimates for the other tests ranged from 430 to 2,040 meters per day (PNL-6820).

Groundwater flow in the 200 East Area is influenced by the past disposal of large quantities of liquid waste to the 216-B-3 Pond System (also called B Pond) to the east. A large groundwater mound that developed under B Pond essentially reversed the pre-Hanford (west to east) flow direction in the northern portion of the 200 East Area. B Pond stopped receiving effluent in 1997, and the groundwater mound in the unconfined aquifer has dissipated in recent years. Currently, the water table is flat in the 200 East Area and flow directions are difficult to determine and also are believed to be changing.

In the northern 200 East Area and farther north near Gable Mountain, geologists have mapped areas where the uppermost confining unit of basalt is not present (RHO-RE-ST-12P). The absence of this layer creates a potential pathway for contaminants to move from the unconfined aquifer into the basalt-confined aquifer. However, the hydraulic gradient in this region currently is upward, so groundwater movement would be from the basalt-confined aquifer into the unconfined aquifer (Section 2.14.1 of PNNL-13788).

5.3.1.1 Hydrogeology of Low-Level Waste Management Area 1

The suprabasalt sediment in this area consists entirely of the Hanford formation, which varies in thickness from 70 to 100 meters. The Hanford formation consists of sand or gravelly sand with layers of sandy gravel and silty sand. Ringold Formation deposits are not present beneath this waste management area, though boreholes adjacent to the BX-BY tank farms, east of Low-Level Waste Management Area 1,

encountered a thin sequence of Ringold-like deposits. Data from the boreholes that reach the top of the basalt beneath the burial ground indicate the basalt dips to the west and south.

The water table is 71 to 87 meters below the ground surface beneath Low-Level Waste Management Area 1. The saturated thickness of the unconfined aquifer ranges from 3 meters in the northeast to 14 meters in the south.

The groundwater flow direction in this portion of the 200 East Area is difficult to determine, but is believed to be toward the northwest at a rate of less than 0.5 meter per day (PNNL-13788, Table A.2). Water levels in Low-Level Waste Management Area 1 monitoring wells are all within 0.1 meter of each other and these data do not define a consistent gradient. Uncertainties caused by possible barometric effects, borehole deviation from vertical, and limits of precision restrict the use of water-level data to determine flow directions in this area. Recent flow studies included use of an in-well borescope and trend surface analysis (Section 2.9.1.1 in PNNL-13404). The borescope measures flow directions very locally (within individual wells). The study included some wells on the northern and eastern boundaries of Low-Level Waste Management Area 1, and wells in the B-BX-BY tank farms, east of this waste management area. Results indicated flow directions ranging from southwest to southeast. Trend surface analysis, which indicates flow over a larger area by fitting a plane to a set of water-level data, indicated flow toward the northwest beneath Low-Level Waste Management Area 1. Results of this analysis are included in Appendix 5F. The distribution of contaminant plumes also indicates flow to the northwest, at least in the past. Eventually flow probably will revert toward the southeast, which is believed to be the pre-Hanford direction.

5.3.1.2 Hydrogeology of Low-Level Waste Management Area 2

The Hanford formation is the sole suprabasalt unit beneath Low-Level Waste Management Area 2. The Hanford formation beneath this area is similar to that under Low-Level Waste Management Area 1 and ranges from 57 to 80 meters thick. The top of the basalt gently dips to the south beneath the waste management area. The top of the basalt represents an erosional surface, scoured by Pleistocene cataclysmic floods, and gently is undulating with enclosed depressions 3 to 4.5 meters deep. A much deeper depression in the basalt, ~12 meters deep, is inferred to exist just to the north of the site (RHO-RE-ST-12P; WHC-SD-EN-AP-015).

The water table beneath Low-Level Waste Management Area 2 is 62 to 72 meters beneath the surface. The saturated aquifer thickness ranges from 0 in the north and east to 7.5 meters in the south.

Groundwater flow beneath this waste management area is believed to be toward the west, which was the predominant direction when the B Pond system was active. The rate of flow is estimated to be ~0.05 to ~0.8 meter per day (PNNL-13788, Table A.2). The water table beneath this area is flat, and flow is influenced by the presence of basalt structures that extend above the water table. Trend surface analysis at the nearby 216-B-63 Trench (on the southwestern side of Low-Level Waste Management Area 2) indicated flow toward the southwest (Section 2.9.1.1 of PNNL-13404). This plan assumes westward flow as was previously estimated for this area. Flow directions will be re-evaluated at least annually to determine if there is sufficient evidence to revise this interpretation.

As the water table beneath the waste management area continues to drop, the area where the basalt is above the water table will expand toward the south. The current rate of decline is ~0.2 meter per year. The basalt beneath this area has a low permeability, indicating the basalt acts as a barrier to downward migration. The lack of saturated permeable sediment means that groundwater monitoring is not practicable in the northern portion of Low-Level Waste Management Area 2.

5.3.2 Hydrogeology of the 200 West Area

The primary references for the geologic interpretation are WHC-SD-EN-TI-290 and PNNL-12261. The information in these reports is based on the data collected during the long history of drilling in and around the 200 Areas (RHO-ST-23; SD-ABWI-DP-039; WHC-SD-EN-AP-015; WHC-MR-0205; WMC-MR-0204; WHC-SD-EN-DP-044, WHC-SD-EN-DP-049, WHC-SD-EN-DP-086).

The 200 West Area is underlain, from the ground surface to the top of the basalt, by the Hanford formation, the Plio-Pleistocene unit, and the Ringold Formation. The Plio-Pleistocene unit in this area consists mostly of carbonate-cemented alluvial and eolian facies.

Testing at the time of borehole installation for the LLBG was used to determine the hydraulic conductivity values. Most of the tests were constant-discharge pumping tests up to 8 hours in duration, followed by recovery tests. Only two of the tests in the 200 West Area created sufficient drawdown to be observed in nearby observation wells. Hydraulic conductivity estimates ranged from 0.02 to 61 meters per day (WHC-SD-EN-AP-015).

The water table beneath the entire 200 West Area is in the Ringold Formation. The base of the unconfined aquifer is the lower mud unit of the Ringold Formation, which confines the coarse-grained unit 9 of the Ringold Formation beneath most of the 200 West Area. Where the lower mud is not present, the basalt surface is the base of the unconfined aquifer.

Groundwater flow in the 200 West Area is influenced by past disposal practices. The pre-Hanford groundwater flow was predominantly west to east. Liquids discharged to the 216-U-10 pond (U Pond; decommissioned in 1984) and other disposal facilities created a substantial groundwater mound in the southern part of the 200 West Area, ~25 meters above the pre-Hanford water table. This mound has since decreased to ~15 meters. Figure 5-8 is a water table map for March 2001.

5.3.2.1 Hydrogeology of Low-Level Waste Management Area 3

Low-Level Waste Management Area 3 is underlain, from the ground surface to the top of the basalt, by the Hanford formation, the Plio-Pleistocene unit, and the Ringold Formation. The Ringold formation at this location is mostly sand and gravel with minor units of finer-grained sediment. The Ringold lower mud unit is present beneath the southern part of the area. The suprabasalt sediment ranges from 145 to 160 meters thick and generally dips to the south. The Plio-Pleistocene unit rises to within 6 meters of the surface along the northern boundary of this waste management area (PNL-7336).

The water table is 67 to 76 meters beneath the surface at this waste management area. The saturated thickness of the uppermost aquifer is ~60 meters in the south and 75 meters in the north where the Ringold lower mud unit is absent (PNNL-12261). There is some evidence that there may be a locally confining layer or at least a zone of lower permeability just at the water table.

Groundwater beneath Low-Level Waste Management Area 3 flows to the east-northeast, and slightly more eastward in the eastern portion of the area (218-W-3AE Burial Ground) (Figure 5-8). Estimates of groundwater flow rate range from 0.0001 to 0.12 meter per day (PNNL-13788, Table A.2). As the 200 West Area groundwater mound continues to decline, groundwater flow beneath this waste management area might change to a more eastward direction. Disposal of tritium-contaminated water at the State-Approved Land Disposal Site (SALDS) to the north slightly distorts groundwater flow paths, but does not affect significantly groundwater flow beneath Low-Level Waste Management Area 3.

5.3.2.2 Hydrogeology of Low-Level Waste Management Area 4

The stratigraphic units beneath Low-Level Waste Management Area 4 are similar to those beneath Low-Level Waste Management Area 3. The Plio-Pleistocene unit underlies the entire area and is up to 12 meters thick, is generally thickest to the north and west, and thins to the east and south. The top of the Plio-Pleistocene unit is very irregular with only a minor overall dip to the south. Perched water might be present locally on carbonate-rich layers in the unit, but because of the presence of numerous discontinuities such as pinch-outs and fractures, the lateral distribution of perched water probably is limited. The entire sedimentary sequence in this area ranges from 165 to 172 meters thick.

The water table is 65 to 74 meters beneath the surface at this waste management area. The saturated thickness of the Ringold Formation above the lower mud unit varies from 60 to 70 meters (PNNL-12261).

Groundwater currently flows from west to east beneath Low-Level Waste Management Area 4 (Figure 5-8), at a rate of 0.2 to 0.6 meter per day. Groundwater flow has been influenced by past effluent disposal and current pump-and-treat activities. The groundwater flow direction at the start of the RCRA monitoring program was east to west, with a northwest component in the northern portion of the area, because of the 200 West Area groundwater mound. The groundwater mound currently is dissipating at a rate of 0.2 to 0.4 meter per year. A pump-and-treat program initiated in August 1996 in the 200-ZP-1 Groundwater Operable Unit extracts groundwater from wells east of the waste management area and injects the treated water west of the area. This program is intended to contain the highest concentrations of the carbon tetrachloride plume beneath the 200 West Area. The injected water might contain contaminants that are not removed by the treatment system, potentially affecting groundwater chemistry beneath Low-Level Waste Management Area 4.

5.3.2.3 Hydrogeology of Low-Level Waste Management Area 5

Low-Level Waste Management Area 5 is underlain by essentially the same stratigraphic units that underlie Low-Level Waste Management Area 3 to the west. The Ringold Formation in this area has well-cemented zones that can generate locally confined conditions beneath the water table that have the potential to produce local perched water conditions in the vadose zone. The total thickness of the sedimentary units above the basalt in this area ranges from 141 to 148 meters.

Hydrologic conditions are similar to those at Low-Level Waste Management Area 3. The saturated thickness of the uppermost aquifer is ~40-55 meters (PNNL-12261). The best estimate of hydraulic conductivity is 12 meters per day. Groundwater flow beneath this waste management area is generally to the east-northeast.

5.3.3 Conceptual Model

The LLBG do not appear to have contaminated groundwater to date. This section describes a conceptual model for potential contaminant transport to guide future groundwater monitoring. The discussion includes radionuclides as well as dangerous waste components of the waste. Although radionuclides are not regulated under RCRA, radionuclides are monitored as part of the overall Hanford Site groundwater program and are discussed to provide a complete conceptual model of the LLBG.

The scenarios for contaminant release and transport are based on the following assumptions.

- Engineered barriers are not taken into account, so the model is applicable to unlined trenches but is highly conservative for the newest (lined) mixed waste trenches.

- Only the operational period is considered (i.e., closure and postclosure time periods are excluded).

- Average precipitation and net infiltration (10 centimeters per year) prevails over the time period of interest.

- Preferential pathways, if present, are assumed to have little if any influence on the average net flux of contaminants reaching groundwater.

- Leaching of mobile contaminants from buried waste in unsealed containers, or contaminated soils in direct contact with the trench, is assumed to occur at a constant rate beginning at the time of placement.

- There are no artificial sources of water (e.g., leaking potable or raw water lines based on Hanford Site drawings).

- Extreme conditions or accidental releases are recognized as factors but would be addressed under emergency response/corrective actions.

5.3.3.1 Geochemical Considerations

The leachability and subsequent mobility of waste constituents in pore fluid depend on the container, chemical nature of the waste constituents, and natural subsurface geochemical conditions.

Pore fluid in the unsaturated and saturated zones beneath the 200 Areas is slightly alkaline (pH >8) with appreciable amounts of bicarbonate (HCO_3^-) and very little natural organic material. The lack of organic matter means that conditions generally are oxidizing. Calcium carbonate also is abundant in vadose zone sediment. These general conditions favor sorption or retardation of many heavy metals and radionuclides and favor complex formation and enhanced mobility in other cases (e.g., hexavalent chromium, uranium, and neptunium). Laboratory sorption studies have documented these effects and related mobility issues in Hanford Site media (e.g., WHC-EP-0645; PNNL-11800).

Based on the general geochemical conditions noted previously, the chemistry of the waste constituents and observations made under Hanford Site conditions, waste constituent mobility is summarized in Table 5-1. The cationic constituents are not expected to be very mobile unless anionic complexes or oxyanions are formed in solution. For example, hexavalent chromium is more mobile in groundwater than trivalent chromium because of the formation of the chromate ion (CrO_4^{-2}). While the uranyl ion, UO_2^{2+} is cationic, it readily forms a carbonate complex in natural alkaline waters that is either anionic or neutrally charged and is thus mobile in pore fluid. The anionic constituents are expected to be mobile in pore fluid and are assumed, in the worst case, to travel relatively unhindered in vadose zone moisture that drains to the water table.

5.3.3.2 Soil Moisture Factors

Except for waste in sealed metal or concrete containers (e.g., retrievable TRU waste), direct precipitation is the primary driver for hypothetical leaching of waste constituents from the burial trenches and subsequent transport to groundwater. Contaminated soil in direct contact with the trench or waste in degradable containers (cardboard boxes or wooden boxes subject to collapse) is assumed to be leachable.

The amount of natural infiltration that can pass through the leachable buried waste and drain to the water table is controlled by the texture of the cover and backfill and the degree of vegetative cover. Stratigraphic features in the soil column beneath the buried waste also can influence or retard downward

migration by spreading soil moisture laterally. Direct observational evidence to assess this effect in each burial ground is lacking. Thus this conceptual model does not account for lateral spreading.

Most of the burial ground trenches are backfilled with the natural excavation materials (Hanford formation) consisting of coarse gravel, cobbles, and some interstitial sand. Sparse amounts of native vegetation appear on the established backfilled areas and on the unused portions. A coarse, unvegetated cover material allows a major fraction of the precipitation to infiltrate and potentially drain to groundwater. Gee[1] estimates that in the 200 West Area, drainage beneath a coarse cover can be as high as 10 centimeters per year. Under such conditions, the average rate of water movement through the vadose zone could be as high as 2 meters per year.

The presence of fine-grained sediment and the occurrence of vegetation over the burial grounds can significantly reduce the net drainage because of enhanced evapotranspiration. In these cases, the net drainage could be an order of magnitude less than the maximum indicated previously. However, direct observations of drainage are lacking at the LLBG. Vertical moisture profiles would be needed at key locations before any credit could be taken for enhanced evapotranspiration. Thus for purposes of this monitoring plan, the maximum infiltration and moisture migration rates are assumed.

5.3.3.3 Low-Level Waste Management Area 1

Based on the hydrogeology of the site, source characteristics and infiltration conditions as discussed previously, a conceptual model of contaminant transport is illustrated in Figure 5-9.

This burial ground began receiving waste in 1960. The northern portion is currently unused. The southern portion consists of 20 unlined trenches. The trenches are backfilled with the natural excavation materials consisting of course gravel, cobble, and some interstitial sand. Sparse amounts of native vegetation appear on the established backfilled areas and on the unused portion.

Assuming a vadose zone thickness of 80 meters and a maximum rate of infiltration of 2 meters per year, the minimum travel time to reach groundwater would be 40 years. Because the burial ground has been in operation since 1960, breakthrough of infiltrating moisture to groundwater beneath some of the earlier waste trenches could occur in the near future. The most mobile contaminants, including nitrate, chromate (if present), technetium-99, and uranium, would be expected to arrive first, if released from the waste. After reaching groundwater, the contaminants would move with regional groundwater flow, currently believed to be toward the northwest. Nitrate, chromate, and technetium-99 generally are most mobile in Hanford Site groundwater; uranium travels slightly slower (Section 2.9.1 of PNNL-13788). The presence of any of the major mobile constituents in groundwater necessarily does not indicate that contamination from this burial ground actually has reached groundwater since plumes of nitrate, technetium-99, and uranium from other sources already pass beneath Low-Level Waste Management Area 1.

5.3.3.4 Low-Level Waste Management Area 2

This burial ground began receiving waste in 1967. Most of the waste that is subject to leaching and transport through the vadose zone to groundwater is in the south-central area of the waste management area. The defueled naval reactor compartments in trench 94 are self-contained and are not considered a source of contamination.

Based on these considerations and the previously discussed hydrogeology and waste characteristics, a conceptual model of contaminant transport through the vadose zone to groundwater beneath Low-Level

[1]Gee, Glendon, PNNL, personal communication with Vernon Johnson, February 2002.

Waste Management Area 2 is illustrated in Figure 5-10. The conceptualization is based on a north-south cross section through the central part of the waste management area. Breakthrough of infiltrating moisture to groundwater would be most likely to occur first beneath the older, south-central section.

The surface of the backfilled trenches in Low-Level Waste Management Area 2 primarily consists of course gravel, cobbles, and boulders with some sand. As noted in previously, significant drainage can occur under these conditions with vadose zone transport rates of as much as 2 meters per year. Transport time to groundwater beneath these trenches could be as low as 40 years. However in some areas of this waste management area, the surface was covered with finer textured soil and vegetation is allowed to grow. Much less net infiltration and drainage is expected under these conditions (depicted with shorter downward arrows in Figure 5-10), and travel time to groundwater is much greater than 40 years. Direct measurements of the vertical moisture profile are lacking for confirmation of the conditions depicted. Contaminant release from the defueled naval reactor compartments is not considered plausible. However, the deep trench might be conducive to ponding and enhanced infiltration of precipitation during extreme conditions.

The saturated thickness of the aquifer varies from 0 in the northern part of the waste management area to approximately 7.5 meters at the southern end. The uppermost basalt in this area generally is impermeable to vertical and horizontal groundwater movement. Thus, the only expected transport in groundwater would be in the southern portion of the waste management area. Flow direction is expected to change from westward to south-southeast.

Direct measurement of flow direction and velocity were made during 2001 at C tank farm, located approximately 400 meters south of the southern fence line of Low-Level Waste Management Area 2. These measurements suggest aquifer flow rates of approximately 2 meters per day toward the south to southwest.[2] Darcy velocity estimates for Low-Level Waste Management Area 2 were 0.8 meter per day (Table A.2 of PNNL-13788). For purposes of this discussion, the higher estimates, based on the flow meter, are used.

Hypothetical breakthrough of mobile contaminants (e.g., nitrate, chromate, uranium, technetium-99) would travel to the west and spread over 500 meters per year in lateral extent based on the 2 meters per day rate. Groundwater monitoring data to date, however, do not indicate the presence of these contaminants from Low-Level Waste Management Area 2, suggesting that either contaminant migration through the vadose zone has not reached groundwater or that leaching from the waste containers has not occurred.

5.3.3.5 Low-Level Waste Management Area 3

This waste management area began receiving waste in 1970 at the 218-W-3A Burial Ground, in 1981 at the 218-W3-AE Burial Ground, and in 1986 at the 218-W-5 Burial Ground. Most of the waste in this complex is contained in the 218-W-3A Burial Ground, the central section of the waste management area. Assuming a vadose zone thickness of 70 meters, the apparent travel time for infiltrating moisture to reach groundwater would be 35 years (70 meters to water table at infiltration rate of 2 meters per year), taking no credit for lateral spreading or enhanced evapotranspiration. As the earliest waste was received in 1970, it is not likely that breakthrough of infiltrating moisture from the disturbed surface of this burial ground has occurred. If some credit is taken for evapotranspiration because of the presence of some vegetation and finer-grained cover material, the likelihood of breakthrough is even lower.

[2] McDonald, John P. (Pacific Northwest National Laboratory), personal communication with Vernon Johnson (Pacific Northwest National Laboratory), February 2002.

Based on the hydrogeology of the site, source characteristics, and infiltration conditions, as discussed previously, a conceptual model of contaminant transport is illustrated in Figure 5-11. The maximum depth of migration shown for each of the three main sections of the waste management area is based on the earliest date waste was received and a constant moisture migration rate of 2 meters per year. Only the mobile constituents are shown in Figure 5-11. Uranium and neptunium are shown with less depth of penetration than chromate, nitrate, or technetium-99. This reflects the slight tendency of these alpha emitting radionuclides to become adsorbed and thus to migrate somewhat slower than either moisture or other simple anions. Constituents identified as having a low mobility are assumed to be located immediately beneath the trenches.

The stratigraphic feature noted as the Plio-Pleistocene layer in Figure 5-11 is likely to retard downward movement of moisture and contaminants because of the finer textured sediment and cementing that characterizes this stratigraphic feature in the vadose zone. The depth of the Plio-Pleistocene increases from north to south in this waste management area. The east to west cross section shown represents a point that is about midway between the northern and southern ends of the waste management area.

Another important stratigraphic feature is the zone at or near the water table labeled as "cemented zone". This zone could become more important as the water table declines below the depth at which this cemented zone occurs. Experience during drilling of wells in this area suggests the cemented material acts as an aquitard where it is submerged below the static water level in the area. Where this feature is above the water table, it is expected to act as a barrier to vadose zone transport of contaminants down to groundwater.

If contaminants do break through to groundwater beneath this waste management area, contaminants would move toward the east-northeast. The flow direction has shifted from nearly north to northeast and is slowly changing eastward as the influence of the groundwater mound subsides. Also, because of the low permeability of the aquifer in this area, groundwater flow rate is estimated to be <40 meters per year (Section 5.3.2).

5.3.3.6 Low-Level Waste Management Area 4

This waste management area began receiving waste at the 218-W-4B Burial Ground in 1967 and at the 218-W-4C Burial Ground in 1978. The approximate depth to groundwater in this area is 70 meters. Using 2 meters per year as a maximum moisture migration rate, the travel time to groundwater is 35 years. This theoretically would allow breakthrough of infiltrating moisture in 2002 beneath the area of the burial ground that first received waste in 1967 (35 years). However, as discussed previously, the vegetation and finer textured sediments as well as stratigraphic features likely would result in much less vertical penetration than estimated.

Buried waste constituents include retrievable TRU waste (sealed in stainless steel drums) and sealed concrete containers, as well as contaminated soil from the 216-Z-9 Trench, containing TRU contaminants. The waste in this waste management area is much better contained than that in Low-Level Waste Management Area 3, and thus is less likely to be subject to leaching and transport to groundwater. The conceptual model for this burial ground is very similar to Low-Level Waste Management Area 3 (Figure 5-11).

Groundwater flow direction beneath Low-Level Waste Management Area 4 was formerly westward, but has reversed because of the declining water table mound and effects of a pump-and-treat system. This reversal in flow leaves the new downgradient side of waste management area with only two wells (formerly upgradient wells). However, in view of the much better containment of waste (e.g., retrievable TRU waste containers), this waste management area should receive lower priority than Low-Level Waste Management Area 3 for upgrading the monitoring network.

Another difficulty in monitoring Low-Level Waste Management Area 4 is that technetium-99 and nitrate concentrations might increase in monitoring wells because water from the pump-and-treat system contains these constituents and is injected into wells upgradient of the waste management area.

5.4 CONTAMINANT PLUME DESCRIPTION [D-10d]

The LLBG do not appear to have contaminated groundwater. However, past-practice waste sites such as cribs, ponds, ditches, and underground tanks have contaminated groundwater beneath the 200 Areas. Plume maps are included in Appendix 5A.

5.4.1 Groundwater Contamination in 200 East Area

Regional groundwater contamination from past-practice sources is evident in many of the wells monitoring Low-Level Waste Management Area 1. The major groundwater contaminants are iodine-129, nitrate, and tritium. Iodine-129 and tritium are not regulated under RCRA. As stated previously, it is DOE-RL's position that radionuclides are excluded from RCRA based on the *Atomic Energy Act of 1954*. These plumes originate from facilities to the south and east of the waste management area. Technetium-99 and other contaminants have affected the wells in the extreme northeastern corner of this area. Cyanide has exceeded the maximum contaminant level in the past in one well at the extreme northeastern corner of the waste management area. The sources of these contaminants are the series of liquid effluent percolation cribs located to the east of Low-Level Waste Management Area 1.

Major groundwater contamination beneath Low-Level Waste Management Area 2 is limited to elevated iodine-129 and tritium along the southern boundary. Iodine-129 concentrations exceed the 1-pCi/L drinking water standard. The drinking water standard for tritium (20,000 pCi/L) has not been exceeded in any of the groundwater monitoring wells at Low-Level Waste Management Area 2. The sources of the contamination include past-practice waste sites to the east and south.

5.4.2 Groundwater Contamination in 200 West Area

Groundwater beneath the 200 West Area LLBG shows evidence of contamination with carbon tetrachloride, nitrate and, to a lesser extent, trichloroethene from past-practices sources. Groundwater beneath a portion of Low-Level Waste Management Area 5 also is contaminated with tritium and iodine-129. Cribs associated with the Plutonium Finishing Plant in the southern portion of the 200 West Area are sources of the carbon tetrachloride contamination. The trichloroethene contamination also is believed to be related to the Plutonium Finishing Plant operations. Nitrate has multiple sources and tritium and iodine-129 have sources in the central 200 West Area. Several monitoring wells completed at the base of the uppermost aquifer have elevated levels of contaminants.

5.4.3 Vadose Zone Contamination

As discussed in Section 5.3.3, contamination could be present in the vadose zone beneath the LLBG. No analytical data are available. Field screening for radioactivity and carbon tetrachloride were made for safety purposes while drilling monitoring wells and no significant contamination was detected.

5.5 DETECTION MONITORING PROGRAM [D-10e]

This section describes the essential facets of a groundwater monitoring program, including monitoring constituents/parameters, well networks, sampling procedures, and statistical methods as required under WAC 173-303-806(4)(a)(xx) items E and F, and WAC 173-303-645(8) and (9). This information is provided for the four active Low-Level Waste Management Areas (1 through 4). Low-Level Waste Management Area 5 has not received waste and currently does not require groundwater monitoring.

Three stages of groundwater monitoring with three separate objectives are defined in WAC 173-303-645. The *detection* monitoring program [173-303-645(9)] is designed to determine whether a RCRA-regulated unit has contaminated groundwater with dangerous waste constituents in the uppermost aquifer beneath the regulated unit. This is accomplished by comparing downgradient concentrations to values indicative of background concentrations. If a statistically significant increase (or pH decrease) over background occurs in any downgradient well, a *compliance* monitoring program is initiated (Section 5.6). In compliance monitoring, downgradient concentrations of dangerous waste constituents are compared to the concentration limits set in a unit's permit. Concentration limits could be those specified in WAC 173-303-645 5(a)(ii) or alternative concentration limits established by Ecology. If concentration limits are exceeded, the regulated unit must implement a *corrective action* program (Section 5.7). The objective of corrective action is to protect human health and the environment by removing the dangerous waste constituents or treating constituents in place.

Results of interim status groundwater monitoring did not indicate that the waste management areas have impacted the quality of the underlying groundwater. Thus, detection monitoring programs are deemed appropriate for each of the active waste management areas.

Each of the following monitoring programs was designed for current groundwater flow directions and current knowledge of locations and types of waste. If flow directions change significantly, this permit might need to be revised.

5.5.1 Indicator Parameters, Waste Constituents, Reaction Products to be Monitored for [D-10e(1)]

Because the LLBG contain a wide variety of waste types, packaging, and disposal history, subsets of waste constituents will be monitored to indicate possible groundwater contamination from the waste management areas. If breakthrough is suspected based on the primary indicators, additional constituents could be analyzed selectively.

Tables 5-2 through 5-5 list constituents to be monitored for Low-Level Waste Management Areas 1 through 4. Statistical evaluations will be performed on selected indicator parameters. Increases in these parameters could indicate impacts of burial grounds waste, while the organic indicators are proposed to account for unknown organic constituents that might be present.

Additional parameters such as metals (cations) and anions will be monitored to provide supplemental data on general groundwater chemistry upgradient and downgradient of the LLBG. This information aids data interpretation and quality control but will not be used in statistical evaluations. Radionuclides such as iodine-129, technetium-99, and uranium are monitored for performance assessment monitoring (DOE/RL-2000-72) to comply with conditions for authorizing continued disposal of radioactive waste in the LLBG (DOE Order 435.1), but are not regulated under RCRA.

5.5.1.1 Dangerous Waste Characterization [D-10e(1)(a)]

Solid low-level radioactive, TRU, and mixed waste has been stored routinely or disposed in shallow unlined burial trenches. Mixed waste contains both radioactive and hazardous materials. Waste disposed in the LLBG is predominately dry.

Much of the historical information is of variable and unknown quality because past-practice procedures significantly were different than those in use today. Some of the buried waste is in boxes made of wood, metal, or cardboard; some waste is in metal drums or otherwise encapsulated; other waste is not in containers.

5.5.1.2 Behavior of Constituents [D-10e(1)(b)]

The mobility of waste constituents in the subsurface depends on the specific constituent and the various factors affecting mobility, as described in Section 5.3.3.

5.5.1.3 Detectability [D-10e(1)(c)]

Detection limits for the monitoring parameters are specified in contracts with the analytical laboratories. The desired detection limits sometimes vary from year to year; Table 5-6 lists limits for fiscal year 2002.

5.5.2 Groundwater Monitoring Program [D-10e(2)]

The following sections provide a description of wells, equipment decontamination, and representative samples. Delineations of the waste management areas and locations of monitoring wells, which make up the "point of compliance" as defined under WAC 173-303-645(6), are illustrated in Figures 5-12 through 5-15. The requirement of WAC 173-303-806(4)(a)(xx)(C) states that this information should be plotted on a topographic map. A topographic map is provided separately in Chapter 2.0, Appendix 2A.

The final status groundwater monitoring networks are based on the following criteria:

- Are the monitoring wells installed at appropriate locations and depths?
- Are data from the monitoring wells representative of the groundwater quality beneath the site?
- Do data from the monitoring wells allow for detection of contamination?
- Do the wells have sufficient water for sampling?

Groundwater staff evaluated the proposed network using the Monitoring Efficiency Model (MEMO; Appendix 5D provides a brief discussion of the program and the assumptions used for parameter inputs). For each set of well locations input to the program, MEMO estimates the adequacy of monitoring coverage, expressed as a percentage. Because input parameters are in some cases rough estimates or averages, the output values are not precise, 'hard' numbers. Instead, MEMO provides a tool to evaluate various well network designs relative to one another or to determine the effect on monitoring coverage if wells go dry.

5.5.2.1 Description of Wells [D-10e(2)(a)]

This section describes interim status and final status monitoring networks for each of the Low-Level Waste Management Areas.

Low-Level Waste Management Area 1

The interim status groundwater monitoring network at Low-Level Waste Management Area 1 consists of 17 wells completed in the uppermost portion of the unconfined aquifer (Figure 5-3). The unconfined aquifer is thin beneath Low-Level Waste Management Area 1 and many of these wells are completed at the top of basalt.

Based on the criteria presented previously and past analytical results, the final status network includes seven downgradient and five upgradient wells (Table 5-7 and Figure 5-12). Five of the wells in the interim status network will no longer be monitored under final status. Three of these do not improve monitoring coverage because these are cross-gradient, and two are within the Low-Level Waste Management Area rather than on the line of compliance. The proposed statistical method does not rely on upgradient/downgradient comparisons (Section 5.5.4), but upgradient wells are included in the final status network to help assess changing groundwater chemistry from upgradient sources before groundwater reaches the downgradient wells. As-built diagrams of the wells in the interim and final status networks are provided in Appendix 5C.

Results from the MEMO program indicate that this network will provide greater that 95% coverage, assuming groundwater flow to the northwest (Appendix 5D).

Low-Level Waste Management Area 2

Thirteen wells are currently in the groundwater monitoring network for Low-Level Waste Management Area 2 (Figure 5-4). These wells monitor the uppermost portion of the unconfined aquifer.

The final status groundwater monitoring network for Low-Level Waste Management Area 2 consists of three upgradient wells and four downgradient wells (Table 5-8 and Figure 5-13). Six wells in the interim status network will no longer be monitored under final status: downgradient well 299-E34-11 no longer contains enough water to sample, and the others do not improve monitoring coverage. The proposed statistical method does not rely on upgradient/downgradient comparisons (Section 5.5.4), but upgradient wells are included in the final status network to help assess changing groundwater chemistry from upgradient sources before groundwater reaches the downgradient wells. As-built diagrams of the wells in the interim and final status networks are provided in Appendix 5C.

Two of the wells in the proposed network have less than 1 meter of water remaining. At the current rates of water-level decline, these wells will go dry in 2 to 4 years. It would not be feasible to replace the wells because the wells are completed at the top of basalt. The wells are both upgradient wells and do not affect network efficiency.

The MEMO program was used to evaluate the proposed monitoring network, assuming a westward flow direction (Appendix 5D). The result was 58%, which is lower than desired. The low result is primarily a result of the lack of coverage along the northern edge of the burial ground, where there is no unconfined aquifer and groundwater monitoring is not feasible. The basalt has a low permeability, which would prevent movement of contaminants into the basalt-confined aquifer. In addition, an upward vertical hydraulic gradient exists in this vicinity and therefore contaminants are not likely to migrate into the basalt-confined aquifer. This portion of the waste management area contains the defueled naval reactor compartments, which are self-contained and are not considered a source of leachable contamination. The southwestern corner of Low-Level Waste Management Area 2 also is poorly monitored, but no waste has been placed in this portion of the burial ground. Therefore, the network coverage is adequate to monitor the current waste configuration.

Low-Level Waste Management Area 3

The interim status groundwater monitoring network at Low-Level Waste Management Area 3 consists of 10 wells completed in the uppermost portion of the unconfined aquifer and two deeper wells (Figure 5-5). Details on well construction are included in the as-built diagrams in Appendix 5C.

Based on the criteria presented previously and past analytical results, the proposed network includes eight existing downgradient wells and 13 new wells (Figure 5-14; Table 5-9). Four wells in the interim status network will no longer be monitored under final status: 299-W7-8 no longer contains enough water to monitor, 299-W7-4 is within the Low-Level Waste Management Area instead of at the line of compliance, and two wells are deep. The two deep wells, completed at the base of the unconfined aquifer, have been sampled under interim status to monitor potential downward migration of contaminants, but were not subject to statistical evaluations. Low-levels of contamination in the deep wells have been related to regional plumes from past-practices sources, not from the burial grounds (PNNL-13788). The 15 years of experience of monitoring the LLBG under interim status regulations indicate that the deep wells are of little use for detection monitoring purposes. The low natural recharge is insufficient to provide a driving force to move contamination from the LLBG downward to the bottom of the unconfined aquifer. The wells still can provide valuable information for the requirements of the 200-ZP-1 CERCLA operable unit and the *Atomic Energy Act*. Four of the wells in the final status network contain ~1 meter of water or less and will go dry as the water table continues to decline. The wells will be monitored as long as practicable, and will be replaced.

The final status network also will include 13 new monitoring wells (Figure 5-14). DOE-RL will negotiate with Ecology to determine final well placement and priority for well installation. Adding the new wells increases monitoring coverage from 56% to 98% (Appendix 5D). New wells will be completed with ~11 meter screens across the water table so the wells can continue to be monitored as the water table drops. New wells will be constructed to meet the standards for resource protection wells in WAC 173-160.

Low-Level Waste Management Area 4

Seven wells are currently in the groundwater monitoring network for Low-Level Waste Management Area 4. Five of these wells monitor the uppermost portion of the unconfined aquifer and two wells are completed at the base of the unconfined aquifer (Figure 5-6). Details on well construction are included in the as-built diagrams in Appendix 5C.

The proposed groundwater monitoring network for Low-Level Waste Management Area 4 consists of three upgradient wells, two existing downgradient wells, and 10 proposed downgradient wells (Figure 5-15; Table 5-10). Two wells that were in the interim status network are completed at the base of the unconfined aquifer. These wells were not used in the statistical determinations but have been sampled to monitor for potential downward migration of contaminants. Low levels of contamination in the deep wells have been related to regional plumes from past-practices sources, not from the LLBG (PNNL-13788). The 15 years of experience of monitoring the LLBG under interim status regulations indicates that the deep wells are of little use for detection monitoring purposes. The low natural recharge is insufficient to provide a driving force to move contamination from the LLBG downward to the deep wells. The wells still can provide valuable information for the requirements of the 200-ZP-1 and 200-UP-1 Operable Units and the *Atomic Energy Act*.

Both of the downgradient wells contain less than ~1 meter of water and will go dry as water levels continue to drop. The wells will be sampled as long as possible, and replacement wells are proposed (Figure 5-15). Until new wells are installed, supplemental wells farther downgradient of Low-Level Waste Management Area 4 will be monitored (Table 5-10 and Figure 5-15). These wells are not located

optimally, and one well does not meet WAC standards for current well construction, but monitoring the supplemental wells increases the estimated monitoring coverage from 19% to 72% (Appendix 5D). Because of the potential for impacts from other sources, the supplemental wells will not be subject to statistical analysis.

Flow direction changes and declining water levels have caused the groundwater monitoring network for Low-Level Waste Management Area 4 to be inadequate for RCRA detection monitoring. Ten additional monitoring wells are proposed to meet RCRA requirements (Figure 5-15). Adding the new 10 wells increases monitoring coverage from 19% to 98% (Appendix 5D). Well installations will be prioritized based on existing waste and future disposal plans. DOE-RL will determine final locations and priorities in discussions with Ecology. New wells will be completed with ~11 meter screens across the water table so the wells can continue to be monitored as the water table drops. New wells will be constructed to meet the standards for resource protection wells in WAC 173-160.

5.5.2.2 Equipment Decontamination [D-10e(2)(b)]

Drilling equipment will be decontaminated using high temperature and pressure [82°C (180°F) and greater than 70.3 kg/cm^2 (1,000 psi)] washing with an approved cleaning solution. The equipment will be rinsed with clean water. The procedure is specified in controlled manuals maintained by DOE/RL contractors.

Equipment used for soil sampling during drilling will be decontaminated according to established methods and specified in controlled manuals maintained by DOE-RL contractors. The methods call for washing equipment with phosphate-free detergent, rinsing three times with reverse osmosis/de-ionized water, rinsing once with 1M or 10% nitric acid (glass or stainless steel equipment only), rinsing three more times with reverse osmosis/de-ionized water, and a final rinse with chromatograph grade hexane. Equipment will be dried for 50 minutes at 100°C (212°F). After drying, equipment will be wrapped in unused aluminum foil and sealed with tape.

No decontamination of groundwater sampling equipment will be necessary because each well will have a dedicated pump.

5.5.2.3 Representative Samples [D-10e(2)(c)]

The degree to which samples represent the actual composition of the groundwater in the aquifer is addressed qualitatively by the specification of well construction, sampling locations, well depth, and sampling and analysis techniques.

New wells will be developed to remove any water added during drilling, to minimize other drilling effects on groundwater chemistry, and to remove fine-grained sediment from around the screen to reduce sample turbidity. All wells will be purged before sampling to remove stagnant water that might be affected by prolonged contact with well materials and loss of volatile constituents. In general, wells are purged until indicator parameters stabilize and 3 bore-volumes have been removed. Perimeters are considered stable if two consecutive conductivity readings are within 10% of each other, pH readings are within 0.2 pH units, and temperature is within 0.2 degree centigrade. A turbidity reading of less than 5 NTUs is attempted, but not always obtainable. Sampling will be performed in such a way to minimize suspension of sediment into the water as much as is practicable. Samples for metals will be filtered through 0.45 μm filters to avoid the introduction of particulates during sampling. It is recognized that small colloidal particles can pass through these filters and some such particles might not represent material mobile in the aquifer. However, the filtered samples are believed to provide a good indication of mobile concentrations. Samples for other constituents generally are not filtered. In some instances, additional sample fractions might be filtered because of excessive suspended sediments. This typically happens

with wells that are going dry because of declining water levels. The filtration allows the useful life of the well to be extended.

Analytical procedures, which are specified in contracts with the laboratories, define holding times and shipping conditions (e.g., cooling) for different constituents. Samples analyzed outside holding times are flagged in data reports. Laboratory performance with respect to holding times is assessed as part of the quarterly quality control reporting.

5.5.2.4 Locations of Background Groundwater Monitoring Wells that are Not Upgradient [D-10e(2)(d)]

The statistical evaluation method chosen for the LLBG relies on within-well comparisons rather than comparisons to upgradient groundwater quality. However, upgradient wells will be monitored to detect influences of contamination from other waste sites. Well locations are shown in Figures 5-12 through 5-15.

5.5.3 Plan for Establishing Groundwater Quality Data [D-10e(3)(b)]

Well location, sampling frequency, sampling quantity, and background values are discussed in the following sections.

5.5.3.1 Well Location [D-10e(3)(b)(i)]

Baseline groundwater quality data will be collected from the existing upgradient and downgradient wells at the LLBG. When new wells are installed, the wells also will undergo 4 years of semiannual baseline sampling. The wells were described previously and their locations are shown on Figures 5-12 through 5-15.

5.5.3.2 Sampling Frequency [D-10e(3)(B)(ii)]

The monitoring wells will be sampled at least semiannually during the compliance period. Temporal variability because of seasonal effects is not expected in groundwater at the Low-Level Waste Management Areas.

5.5.3.3 Sampling Quantity [D-10e(3)(b)(iii)]

The number and volume of samples required are determined by the constituent lists (Tables 5-2 through 5-5) and contracts with analytical laboratories.

5.5.3.4 Background Values [D-10e(3)(b)(iv)]

A baseline will consist of at least eight sample results (e.g., 4 years of semiannual data points) for each constituent or indicator, assuming the data will be 'in control' (i.e., no significant trends in the background data set). Trends often will be observed in the background database from which the mean and variance are computed. This would lead to upward biased estimates and grossly inflated control limits. Therefore, when significant trends in the background data are found, their source must be identified before application of the statistical evaluation, because the sources might be evidence of a previous impact from the LLBG or another site. If the source of the trend is not the LLBG, an alternative indicator constituent might be required for that well or all wells or additional baseline sampling might be needed until background control is established. Baseline sampling will continue until the baseline is determined to be in control before implementing statistical testing for that well and constituent. Alternatively, regression

analysis could be performed, if appropriate, to remove the effects of a significant trend (Gibbons 1994, Section 8.4.4).

Assuming data are in control, the most recently obtained data will be used for data evaluation purposes. Baseline summary statistics (e.g., number of baseline samples, mean, standard deviation, coefficient of variation, etc.) will be calculated. The statistical method to be applied is described in Section 5.5.4.10.

5.5.4 Sampling, Analysis, and Statistical Procedures [D-10e(4)]

Sample collection, sample preservation and shipment, analytical procedures, chain of custody, and additional requirements for compliance point monitoring are discussed in the following sections.

5.5.4.1 Sample Collection [D-10e4(a)]

Monitoring for the LLBG is part of the Hanford Groundwater Monitoring Project. Procedures for groundwater sampling, documentation, sample preservation, shipment, and chain-of-custody requirements are described in PNNL or subcontractor manuals[3]. Samples generally are collected after three bore volumes of water have been purged from the well or after field parameters (pH, temperature, specific conductance, and turbidity) have stabilized (Section 5.5.2.3). When required, preservatives are added to the collection bottles before their use in the field. Samples to be analyzed for metals will be filtered in the field so that results represent dissolved metals. In cases where turbidity is elevated (greater than 20 NTU), samples for other constituents also might be filtered to provide samples more representative of groundwater concentrations.

Groundwater level measurements will be made each time a well is sampled. Measurement procedures are described in PNNL-13021 and were developed in accordance with ASTM (1988), Garber and Koopman (1968), EPA (1986), and U. S. Geological Survey (1977). Currently, subcontractor procedures are used. Water levels are measured primarily with laminated steel electrical sounding tapes, although graduated steel tapes are used occasionally

5.5.4.2 Sample Preservation and Shipment [D-10e(4)(b)]

Sample preservation will be done in accordance with existing procedures. A chemical preservative label will be affixed to the sample container listing the specific preservative. The brand name, lot number, concentration, and date opened of the preservatives will be recorded. A calibrated dispenser or pipette will be used to dispense preservatives. Appropriate measures will be taken to eliminate any potential for cross contamination.

Sample packaging and shipping will be done in accordance with subcontractor procedures. Samples will be labeled and sealed with evidence tape and placed in U.S. Department of Transportation approved shipping container with coolant (if required). Hazardous and radioactive samples will have packaging parameters determined by associated hazards. A chain of custody will accompany all samples.

5.5.4.3 Analytical Procedures [D-10e(4)(c)]

Procedures for field measurements are specified in the subcontractor or manufacturer's manuals. Analytical methods are specified in contracts with laboratories, and most are standard methods from

[3] Currently *Sampling Services Procedure Manual*, DFSNW-SSPM-001, Duratek Federal Services, Richland, Washington.

SW-846, *Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods*. Alternative procedures meet the guidelines of Chapter 10 of SW-846. Analytical methods are included in Table 5-6.

5.5.4.4 Chain of Custody [D-10e(4)(d)]

The procedures used for chain-of-custody control of samples are documented in existing subcontractor procedures.

5.5.4.5 Data Storage and Retrieval

The contract laboratories report analytical results electronically. The results are loaded into the Hanford Environmental Information System (HEIS) database. Field-measured parameters are entered manually or through electronic transfer. Paper data reports and field records are considered to be the record copies and are stored in the groundwater monitoring project file.

5.5.4.6 Data Verification and Validation

Verification of analytical data provided by the subcontracted laboratory will be performed in accordance with a documented procedure[4]. This procedure includes checks for: (1) completeness of hardcopy deliverable, (2) condition of samples upon receipt by the laboratory, (3) problems that arose during the analysis of the samples, and (4) correct reporting of results. The procedure also describes the actions to be taken associated with incomplete or deficient data.

Quality control data are evaluated against criteria listed in the project QA plan[5] and data flags are assigned when the data do not meet these criteria. The data undergo a validation/verification process according to a documented procedure.[6] Under this procedure, data are screened by scientists familiar with the site hydrogeology, compared to historical trends or spatial patterns, and flagged if the data are not representative. Other checks on data may include comparison of general parameters to their specific counterparts (e.g., specific conductance to ions), calculation of charge balances, and comparisons of calculated versus measured values. If data appear anomalous, the project scientist submits a Request for Data Review[7]. If necessary, the laboratory could be requested to check calculations or re-analyze the sample, or the well could be resampled. Results of a review could be used to flag or correct data in HEIS.

5.5.4.7 Reporting

Groundwater chemistry and water level data are reviewed at least semiannually (i.e., after each sampling event) and are available in HEIS. DOE-RL will submit the results of the statistical evaluation to Ecology in RCRA quarterly reports and in the annual groundwater monitoring report of the Hanford Site Groundwater Monitoring Project (e.g., PNNL-13404). If an analytical result (after verification sampling) at a point-of-compliance well indicates that there is statistically significant evidence of contamination (using the method described in Section 5.5.4.10) for one or more of the statistical indicators, DOE-RL will notify Ecology within 7 days indicating which constituent(s) or indicator(s) have shown statistically significant evidence of contamination. If a source other than the regulated unit caused the contamination or the detection is an artifact caused by an error in sampling, analysis, or statistical evaluation or natural variation in the groundwater (the previous conditions are called false positives), DOE-RL will submit a report to Ecology demonstrating that fact within 90 days or within the time agreed by Ecology in writing

[4] Procedure DM-3, Verification of Analytical Data (Hardcopy). in PNL-MA-567.
[5] Hanford Ground-Water Monitoring Project Quality Assurance Project Plan, QA Plan ETD-012, Rev. 2, December 2000, or most recent revision.
[6] Procedure QC-5, Groundwater Data Validation Process in PNL-MA-567.
[7] Procedure DA-3, Data Review Procedure in PNL-MA-567.

[WAC 173-303-645(9)(g)(vi)]. If DOE-RL determines not to seek a false positive claim, DOE-RL will submit a permit modification to establish a compliance-monitoring program within 90 days or within the time agreed by Ecology in writing. A compliance-monitoring plan will be written and submitted to Ecology for approval.

5.5.4.8 Additional Requirements for Compliance Point Monitoring [D-10e(4)(e)]

The point of compliance is represented by wells at the downgradient extent of the Low-Level Waste Management Areas. This section describes sampling frequency and determination of groundwater quality for the downgradient wells.

5.5.4.8.1 Sampling Frequency [D-10e(4)(e) (i)]

The monitoring wells will be sampled at least semiannually during the compliance period.

5.5.4.8.2 Compliance Point Groundwater Quality Values [D-10e(4)(e)(ii)]

During each semiannual sampling event, one sample will be collected from each downgradient well and individually compared to the control limit (i.e., trigger value) established for that statistical indicator. If an exceedance occurs, verification sampling is needed to determine if the exceedance is an artifact of an error in sampling, analysis, or statistical evaluation, or if the exceedance represents an actual variation in groundwater chemistry. If the initial sample result exceeds the trigger value, a re-sample will be obtained and analyzed for the constituent in question. Adequate time should elapse to ensure statistical independence between the original triggering measurement and the re-sample measurement. If the verification result is less than the trigger value, detection monitoring will continue. A statistically significant result will be declared only if the re-sample result is larger than the trigger value. Split samples (duplicate samples sent to two different laboratories) will be used in the verification sampling as appropriate (e.g., if the magnitude of the exceedance is small).

5.5.4.9 Annual Determination [D-10e(4)(f)]

Water levels will continue to be measured before sampling the monitoring wells in the LLBG networks (semiannually). The groundwater project also measures water levels in most of these and nearby wells in March of each year to prepare a sitewide water-table map. The water-level data will be evaluated at least annually to estimate flow direction and rate beneath the LLBG using a form of the Darcy equation and existing estimates of hydraulic conductivity. These data also could be evaluated using the trend surface technique to refine interpretations of flow direction. Contaminant plume distribution and trends also will be evaluated to determine flow direction and rates.

5.5.4.10 Statistical Determination [D-10e(4)(g)]

This section describes the method of statistical evaluation and the statistical procedures to indicate whether dangerous waste or dangerous waste constituents from the low-level burial grounds might have entered the groundwater in the uppermost aquifer. These evaluations will be made as soon as practicable after validation of the full data set for each waste management area.

The monitoring program periodically will re-evaluate the statistical tests being used. The methods described will be reviewed during and after background (baseline) data are collected to ensure the methods are the most appropriate, considering site conditions.

The goal of a RCRA final status detection-monitoring program [WAC 173-303-645(9)] is to monitor for indicator parameters that provide a reliable indication of the presence of dangerous constituents in

groundwater in the uppermost aquifer beneath the site. This is accomplished by testing for statistically significant changes in concentrations of indicators in downgradient wells relative to baseline values. Therefore, the objectives of the proposed statistical evaluation method are as follows:

1. To have adequate statistical power to detect real contamination when it occurs

2. To keep the sitewide false-positive rate (across all constituents and wells being tested) at an acceptably low level.

The power of a statistical test depends on several factors that include the baseline sample size, the type of statistical test proposed, and the number of comparisons. It is judged that the statistical goals will be best achieved by the combined Shewhart-CUSUM control chart method for reasons as discussed in the following.

The number of tested constituents is limited to the most useful indicators to maintain a sufficiently low false-positive rate (EPA/530-R-93-003, page 62; Gibbons 1994, page 16); therefore, only the site-specific constituents or indicators will be subject to statistical evaluation. Verification sampling is an integral part of the statistical design to lower the overall false-positive rate and determine whether the change between baseline and compliance-point data is an artifact caused by an error in sampling, analysis, or statistical evaluation (Section 5.5.4.8.2).

5.5.4.10.1 Statistical Procedure [D-10e(4)(g)(i)]

In accordance with WAC 173-303-645(8)(h), acceptable statistical methodology includes analysis of variance (ANOVA), tolerance intervals, prediction intervals, control charts, test of proportions, or other statistical methods approved by Ecology. The type of monitoring, the nature of the data, the proportions of non-detects, and spatial and temporal variations are some of the important factors to be considered in the selection of appropriate statistical methods. One of the alternative statistical tests allowable under final status regulations [WAC 173-303-645(8)(h)] is the use of a combined Shewhart-CUSUM control chart approach, which was first referenced by Westgard et al (1977) and further developed by Lucas (1982). This method is also discussed in a groundwater context by Starks (1989), Gibbons (1994), and ASTM (1996) and was first adopted into EPA guidance in 1989 (PB89-151047, EPA/530-R-93-003). This method relies on in-well comparisons rather than upgradient/downgradient comparisons. The following are several advantages in applying the control chart procedure.

- This method can be implemented with a single observation at any monitoring event (i.e., this method is efficient).

- This method could be applied to monitoring each well individually and yet maintain desired sitewide false positive and false-negative error rates. The spatial variations that adversely affect the ANOVA procedure do not play a role under the control chart procedure. [Note: Because of the elimination of spatial variability, the uncertainty in measured concentrations is decreased making intra-well comparisons more sensitive to a real release (that is, false negatives) and false positive results (ASTM 1996)].

- The power of the control chart method can be enhanced by the combined Shewhart and CUSUM procedures. It is well known that the Shewhart procedure is sensitive to sudden shifts and the CUSUM procedure is sensitive to gradual changes in the mean concentrations. A combined Shewhart and CUSUM procedure, therefore, is well designed to detect both types of changes.

The combined Shewhart-CUSUM control chart method is a sequential testing procedure to test for an upward shift in the mean concentration of a constituent of interest. The Shewhart portion of the test

checks for any sudden upward shift in groundwater quality parameters based on a single observation, while the CUSUM checks for any gradually increasing trend in the groundwater quality parameters. The combined Shewhart–CUSUM method can be implemented following a baseline of eight or more independent sampling periods for a given well (ASTM 1996). The method assumes that the groundwater baseline data and future observations will be independent and normally distributed. The most important assumption is that the data are independent. The assumption of normality can usually be met by log-transforming the data or by other Box-Cox transformations.

The combined Shewhart-CUSUM procedure will be implemented as follows: Let x'_i be a series of independent baseline observations i = 1,...., b (b = 8). Let x_i be a series of future monitoring measurements i = 1, 2, 3.... Using the baseline data, the following steps are applied:

(1) First determine if the x'_i can be assumed to follow a normal distribution with mean μ and standard deviation σ. If not, transform the x'_i using the appropriate Box-Cox transformation and work with the transformed data.

(2) Next, use the baseline data to compute the estimates

$$\bar{x}' = \sum_{i=1}^{b} x'_i/b \text{ for } \mu \text{ and } s' = \sqrt{\sum_{i=1}^{b} (x'_i - \bar{x}')^2 /(b-1)} \text{ for } \sigma.$$

(3) Determine the upper Shewhart control limit (SCL) for the procedure by calculating $SCL = \bar{x}' + z_s s'$ where z_s is a percentile from the standard normal distribution used to set the false negative and false positive values of the Shewhart control limit. The value of z_s that usually is most appropriate for groundwater applications is 4.5 (Starks 1989, EPA 1989, and ASTM 1996).

(4) Determine the upper CUSUM control limit (CCL), with $CCL = \bar{x}' + z_c s'$. The value of z_c suggested by Starks (1989) and EPA (1989) is $z_c = 5$. This value also can be adjusted to reach desired false negative and false positive error rates. In practice setting $z_c = z_s = 4.5$ results in a single limit with no compromise in leak detection capabilities (ASTM 1996).

(5) Determine the amount of increased shift in the mean of the water quality parameter of interest to detect an upward trend. This value is referenced as k and usually is measured in σ units of the water quality parameter. Following Lucas (1982), Starks (1989), and EPA (1989), a value of k = 1 will be used if there are less than 12 baseline observations; and a value of k = 0.75 will be used if there are 12 or more baseline observations.

(6) Using the monitoring data after the baseline measurements have been established: compute the CUSUM statistic as $S_i = \max\{0, (x_i - ks') + S_{i-1}s'\}$ as each new monitoring measurement, x_i becomes available, where i = 1,2,3,....., max{a, b} is the maximum of a and b, and $S_0 = 0$.

(7) As each new monitoring measurement becomes available, compute the Shewhart and CUSUM tests; a verification sampling will be conducted if either $x_i \geq$ SCL or $S_i \geq$ CCL. A well is declared to be out of control only if the verification results also exceed the SCL or the CCL. If both $x_i <$ SCL and $S_i <$ CCL, then continue monitoring.

(8) As monitoring continues and the process is shown to be in control, the baseline mean and standard deviation should be updated periodically (e.g., every year or two) to incorporate these new data. This updating process will continue for the life of the monitoring program.

American Society for Testing and Materials guidance (ASTM 1996) for circumstances regarding non-detects and outliers will be used in the statistical testing.

If resampling is required during monitoring, the analytical result from the resample is substituted into these formulas for the original value, and the CUSUM statistic is updated. Note in the combined test that the Shewhart portion of the test quickly will detect extremely large deviations from the baseline period. The CUSUM portion of the combined test is sequential; thus, a small shift in the mean concentration over the baseline period slowly will aggregate in the CUSUM statistic and eventually cause the test to exceed the CUSUM control limit CCL.

A statistically significant exceedance over background (baseline) levels only indicates that the new measurement in a particular monitoring well for a particular constituent is inconsistent with chance expectations based on the available sample of background (baseline) measurements. Any statistical result must be supported by other information to determine if a waste disposal facility has impacted groundwater (ASTM 1996).

5.5.4.10.2 Results [D-10e(4)(g)(ii)]

Sampling and analysis results are reviewed at least semiannually (i.e., after each sampling event) and are available in HEIS. DOE-RL will submit results of statistical evaluations to Ecology as soon as practicable after data validation and evaluation.

5.6 COMPLIANCE MONITORING PROGRAM [D-10f]

A compliance-monitoring program that satisfies requirements set forth in WAC 173-303-645(10) will be established for the LLBG if detection-level monitoring reveals statistically significant evidence of dangerous waste contamination from sources within the regulated unit. If compliance monitoring is required, DOE-RL will submit a revised monitoring plan to Ecology, specifying dangerous constituents to be monitored, sampling and analysis protocols, statistical evaluation methods, etc. In the compliance-monitoring program, the dangerous constituents or parameters will be compared to concentration limits specified in the permit as discussed in WAC 173-303-645(5) during the compliance period.

The RCRA regulations [WAC 173-303-645(9)(g)] state that if a statistical exceedance occurs in a downgradient well, the entire network must be resampled immediately and analyzed for the constituents in Appendix IX of 40 CFR 264. This sampling would be conducted in parallel with a required permit modification (Section 5.5.4.7). The additional sampling would take place only at the affected waste management area. Appendix IX is an extensive list including a wide variety of volatile and semivolatile organic compounds and trace metals. It is prudent to narrow the analyte list to the specific exceedance event; e.g., if the exceeding contaminant is total organic halides, the project would analyze for the chlorinated hydrocarbons most likely to be present in the area. Results of the resampling will form the basis for returning to detection monitoring or designing a compliance monitoring program

5.7 CORRECTIVE ACTION PROGRAM [D-10g]

If, at a point of compliance well, the dangerous waste constituents are measured in the uppermost aquifer underlying the regulated units at concentrations that exceed the applicable groundwater concentration limits, DOE-RL will notify Ecology and apply for a permit modification to establish a corrective-action program within 90 days or within the time agreed to by Ecology. In conjunction with a corrective action program, a corrective action level groundwater monitoring program will be established. A description of

the groundwater monitoring plan that is appropriate for a corrective action program will be prepared and submitted to Ecology if the need for corrective action is identified.

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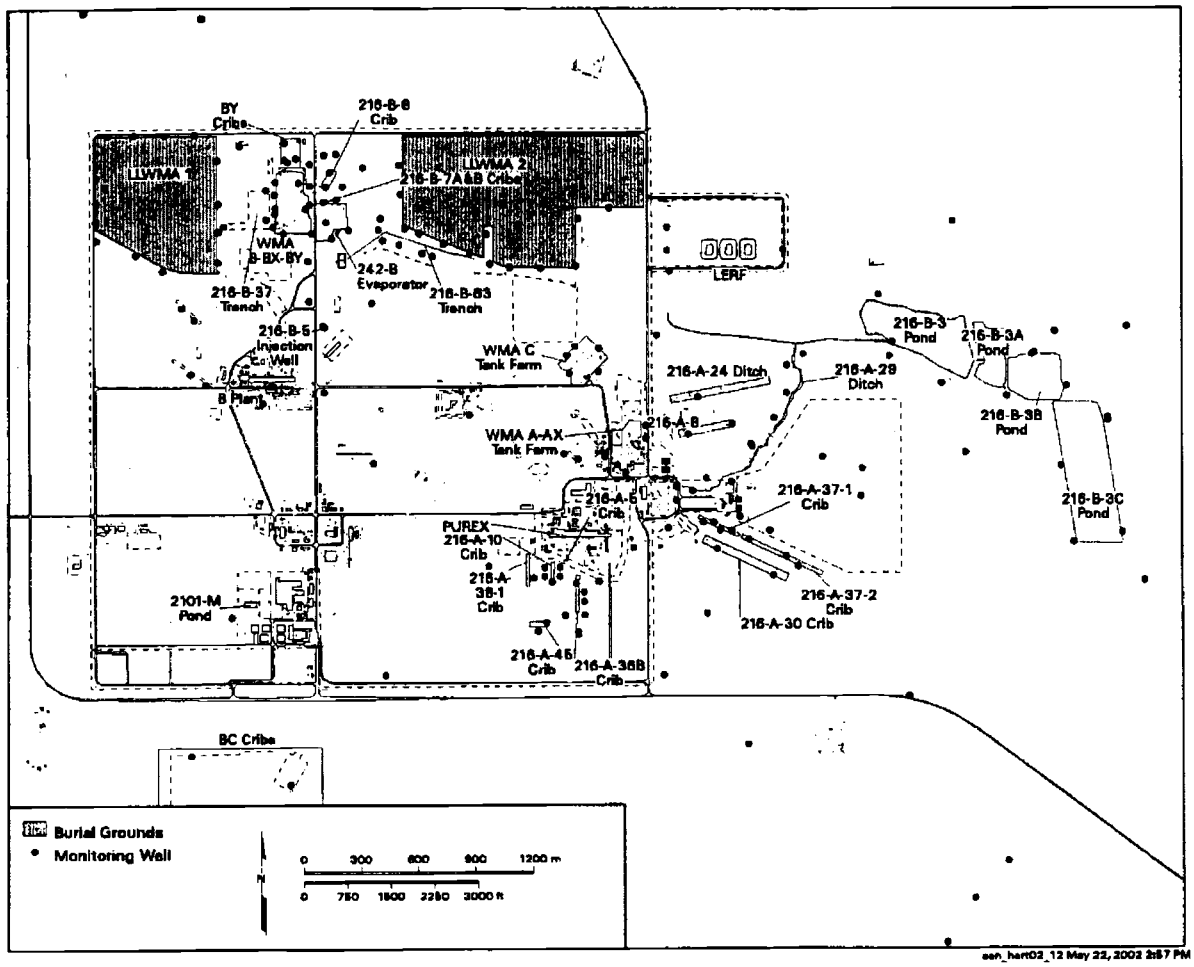

Figure 5-1. Low-Level Burial Grounds in 200 East Area.

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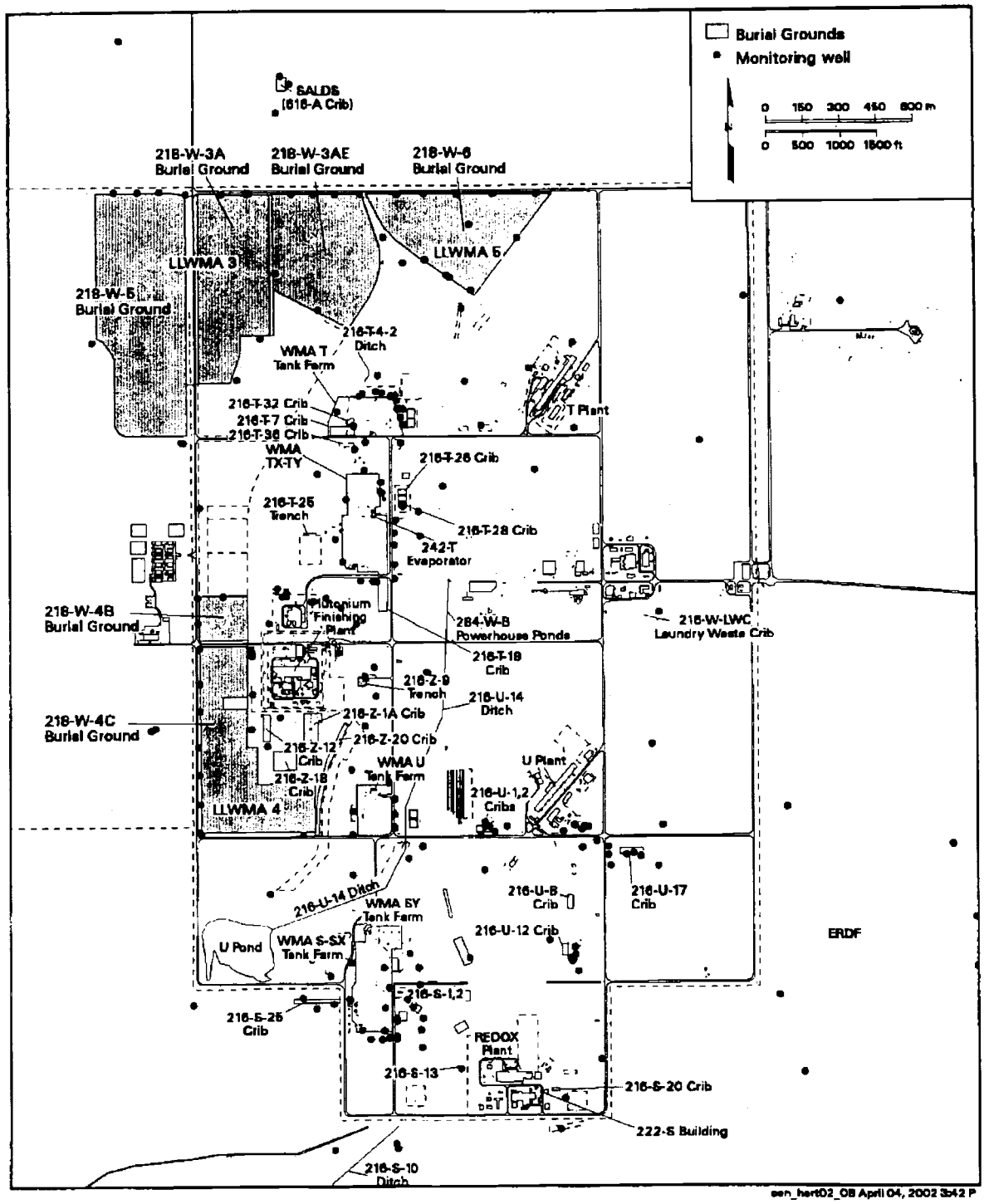

Figure 5-2. Low-Level Burial Grounds in 200 West Area.

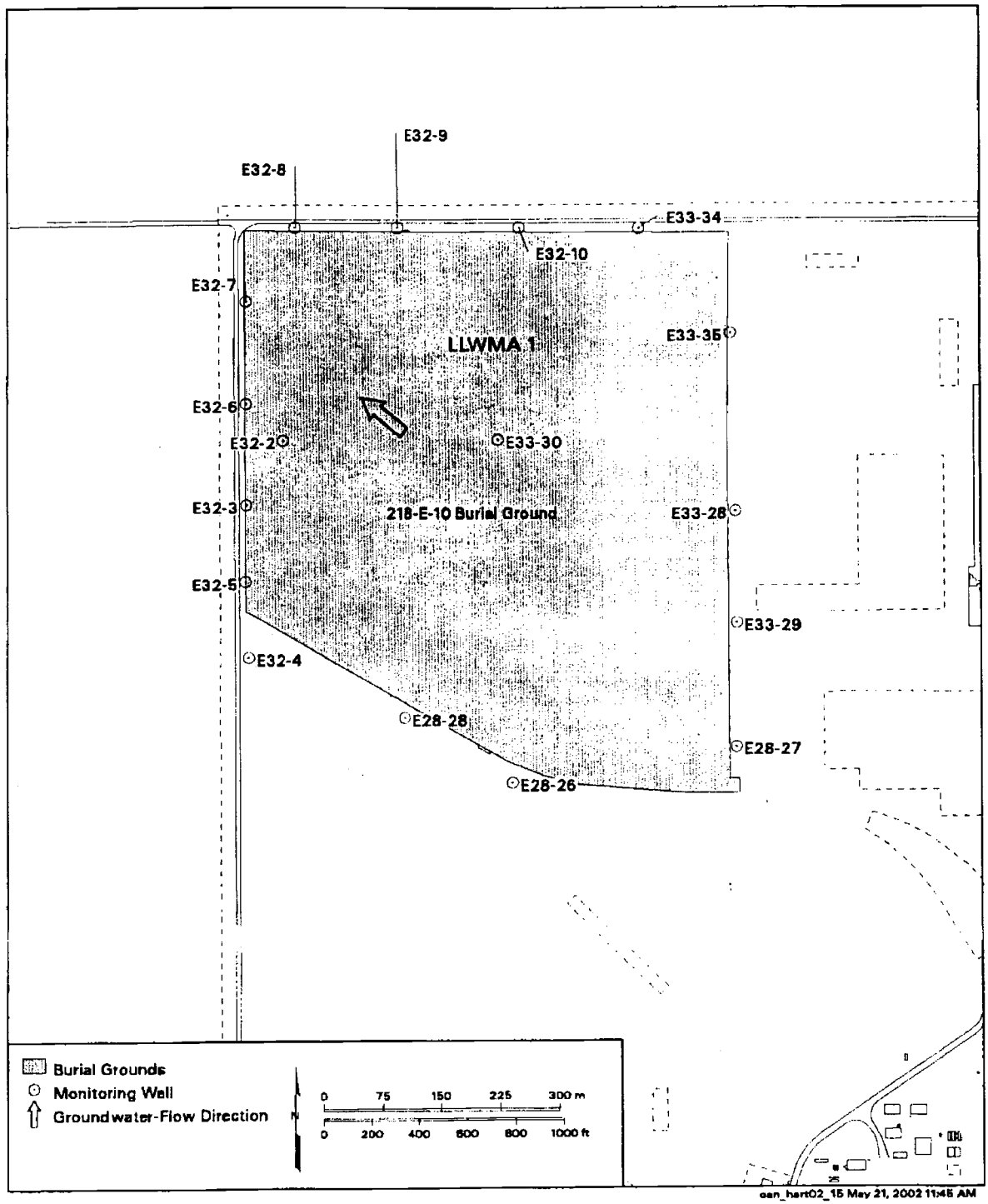

Figure 5-3. Interim Status Groundwater Monitoring Network for Low-Level Waste Management Area 1.

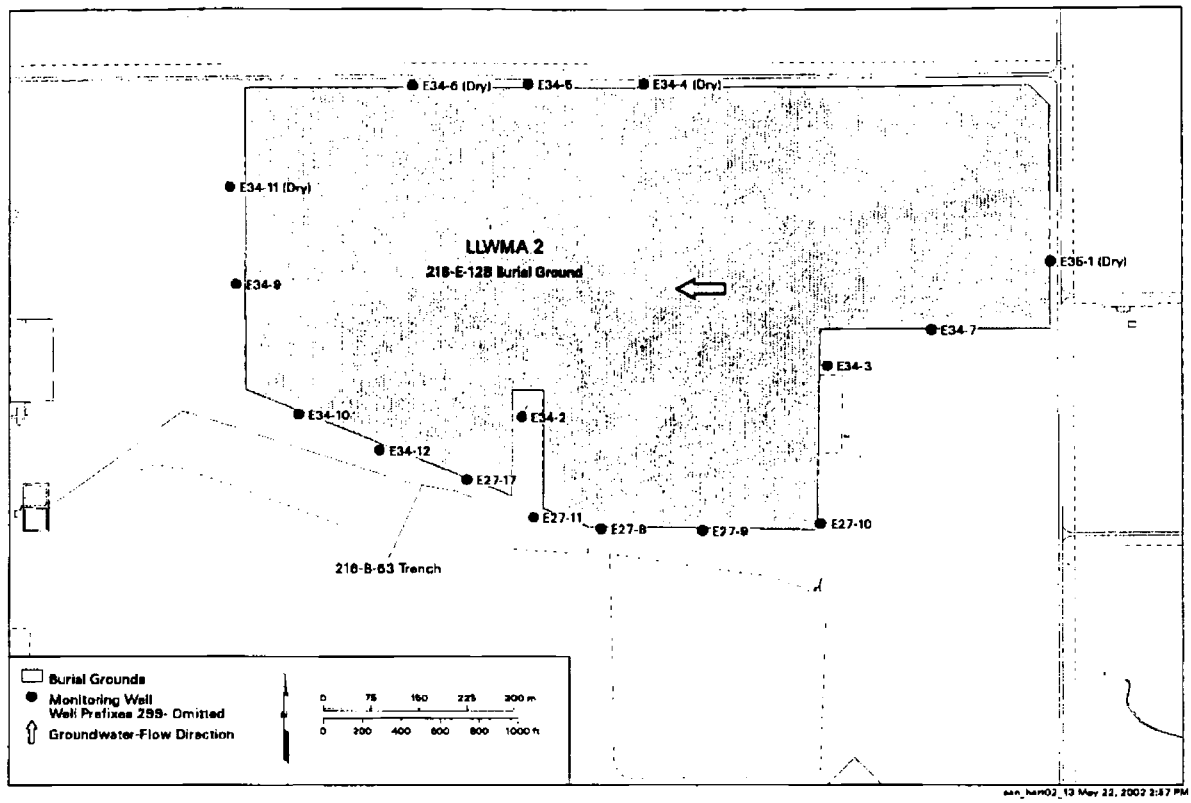

Figure 5-4. Interim Status Groundwater Monitoring Network for Low-Level Waste Management Area 2.

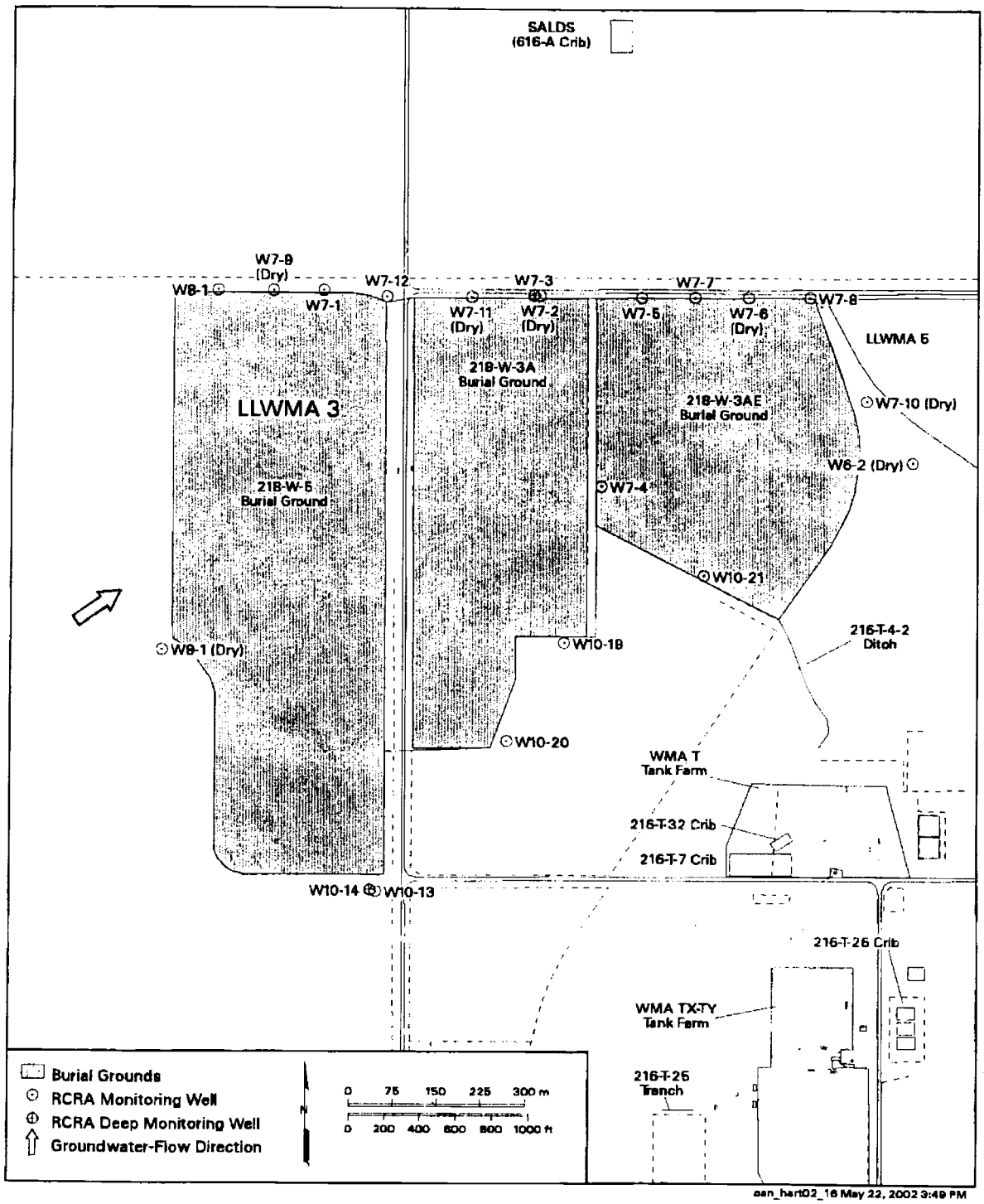

Figure 5-5. Interim Status Groundwater Monitoring Network for Low-Level Waste Management Area 3.

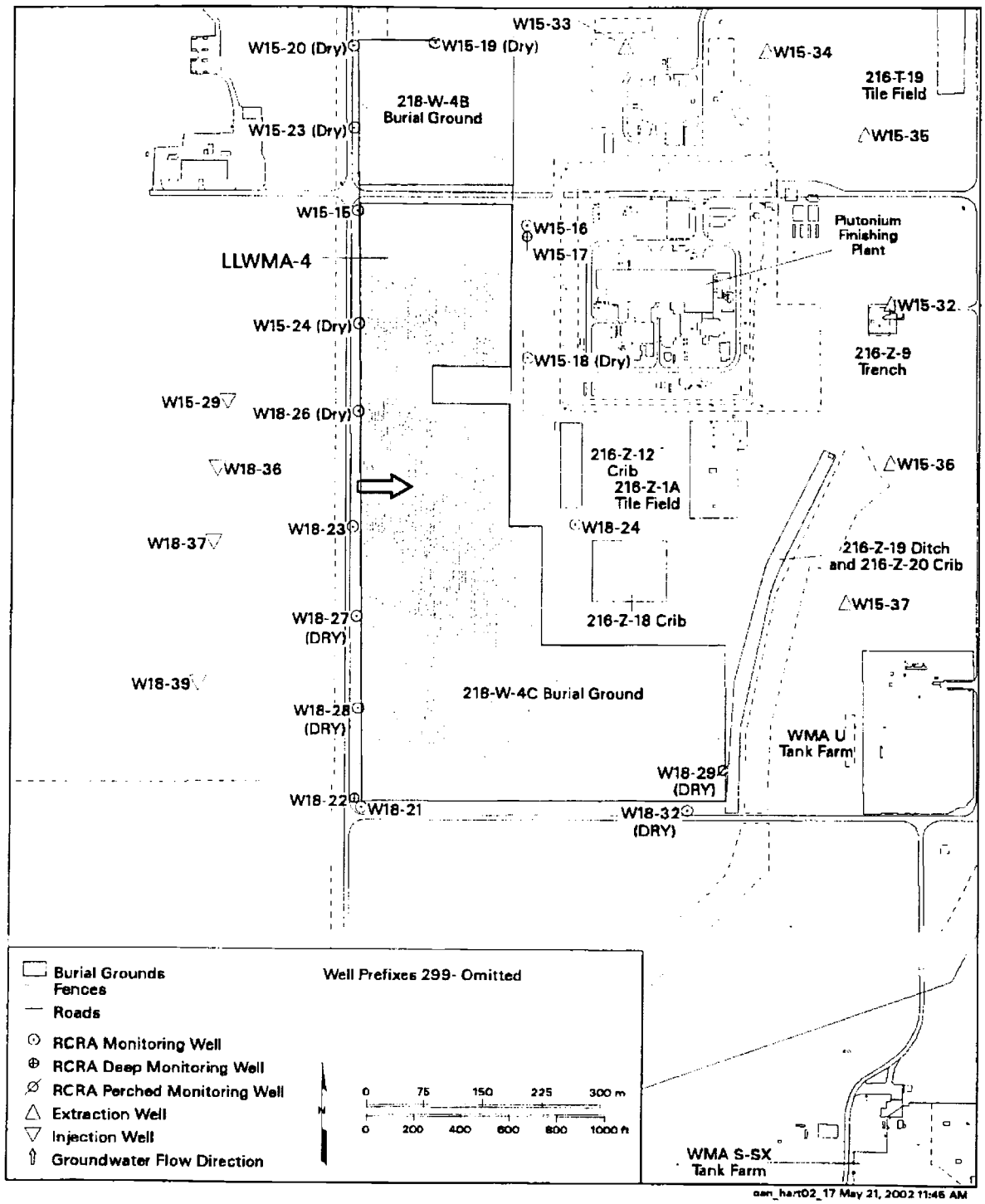

Figure 5-6. Interim Status Groundwater Monitoring Network for Low-Level Waste Management Area 4.

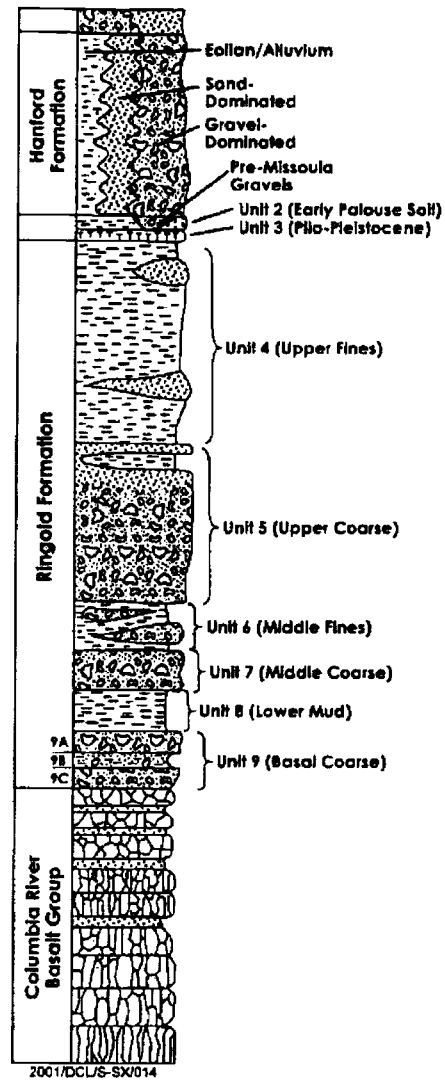

Figure 5-7. Stratigraphy of the 200 Areas.

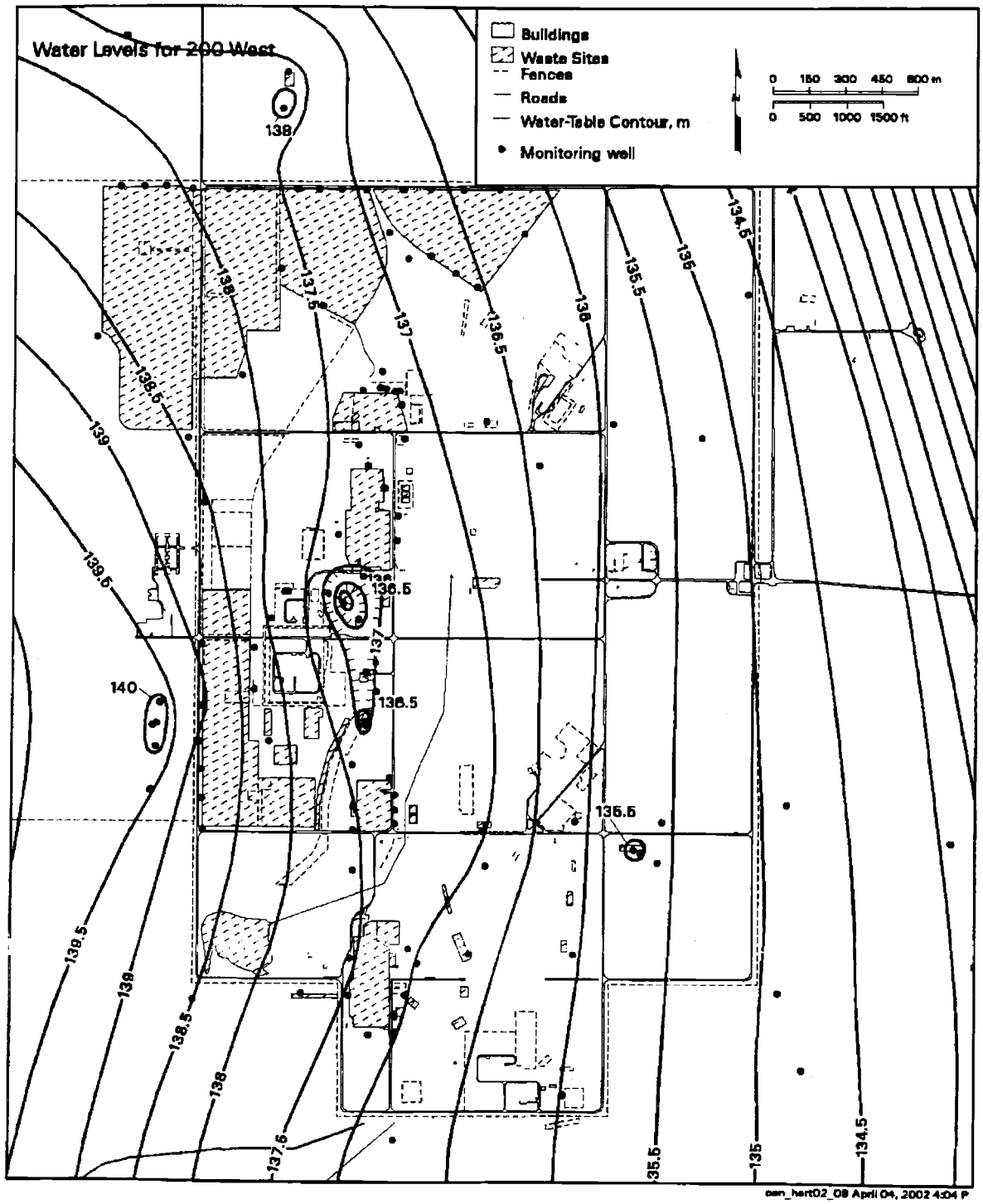

Figure 5-8. Water-Table Map for 200 West Area, March 2001 (PNNL-13788).

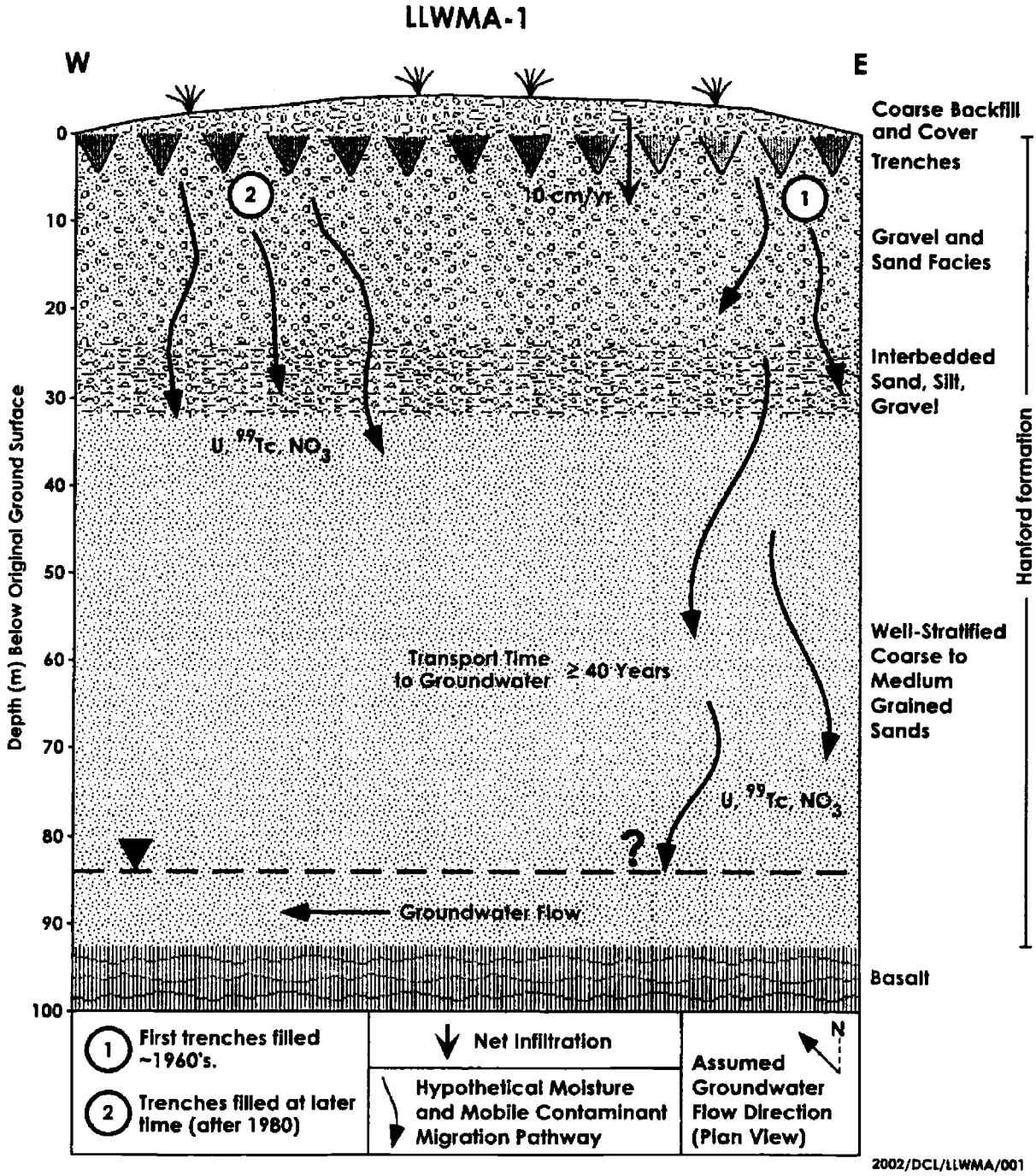

Figure 5-9. Conceptual Model for Low-Level Waste Management Area 1.

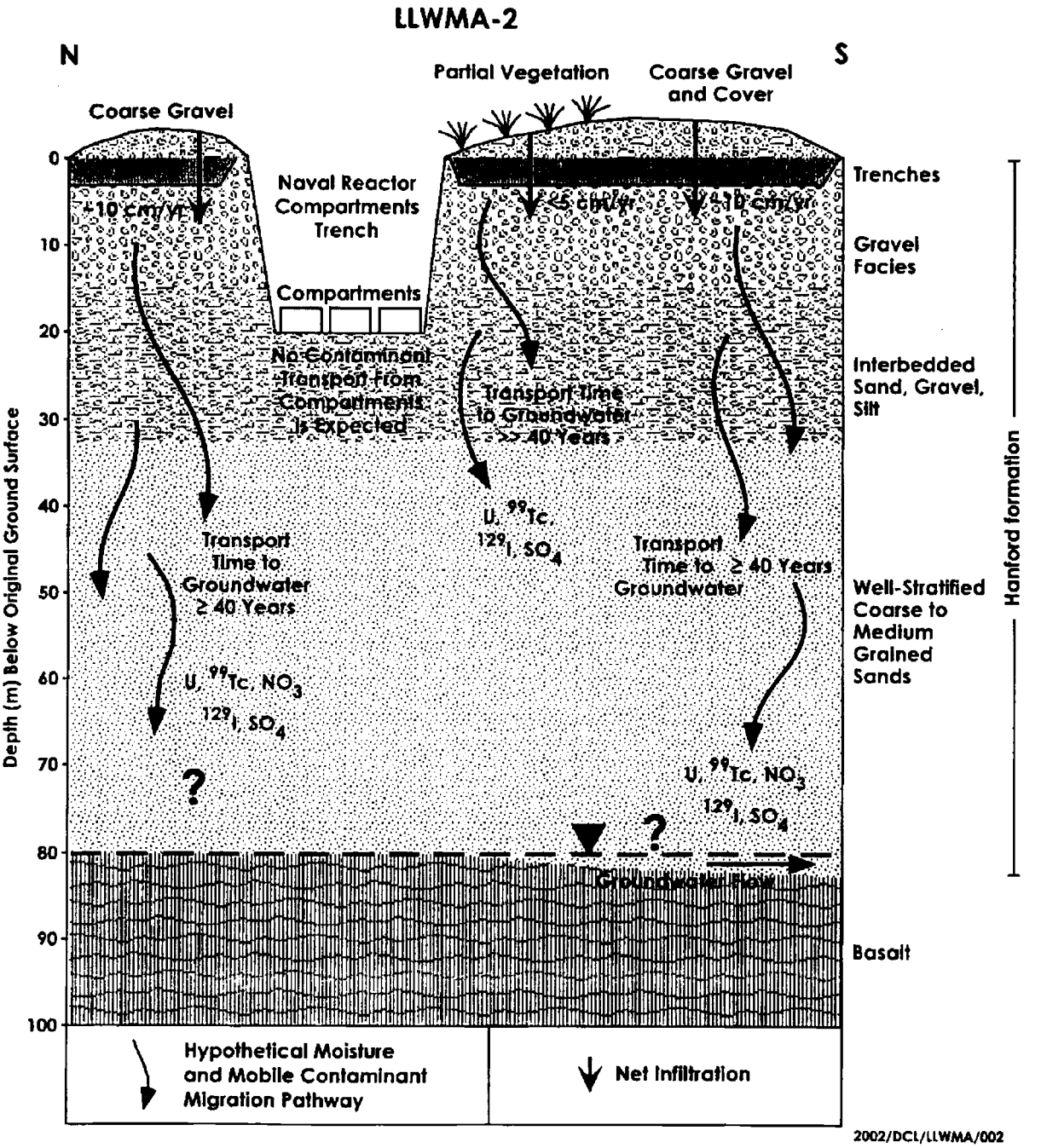

Figure 5-10. Conceptual Model for Low-Level Waste Management Area 2.

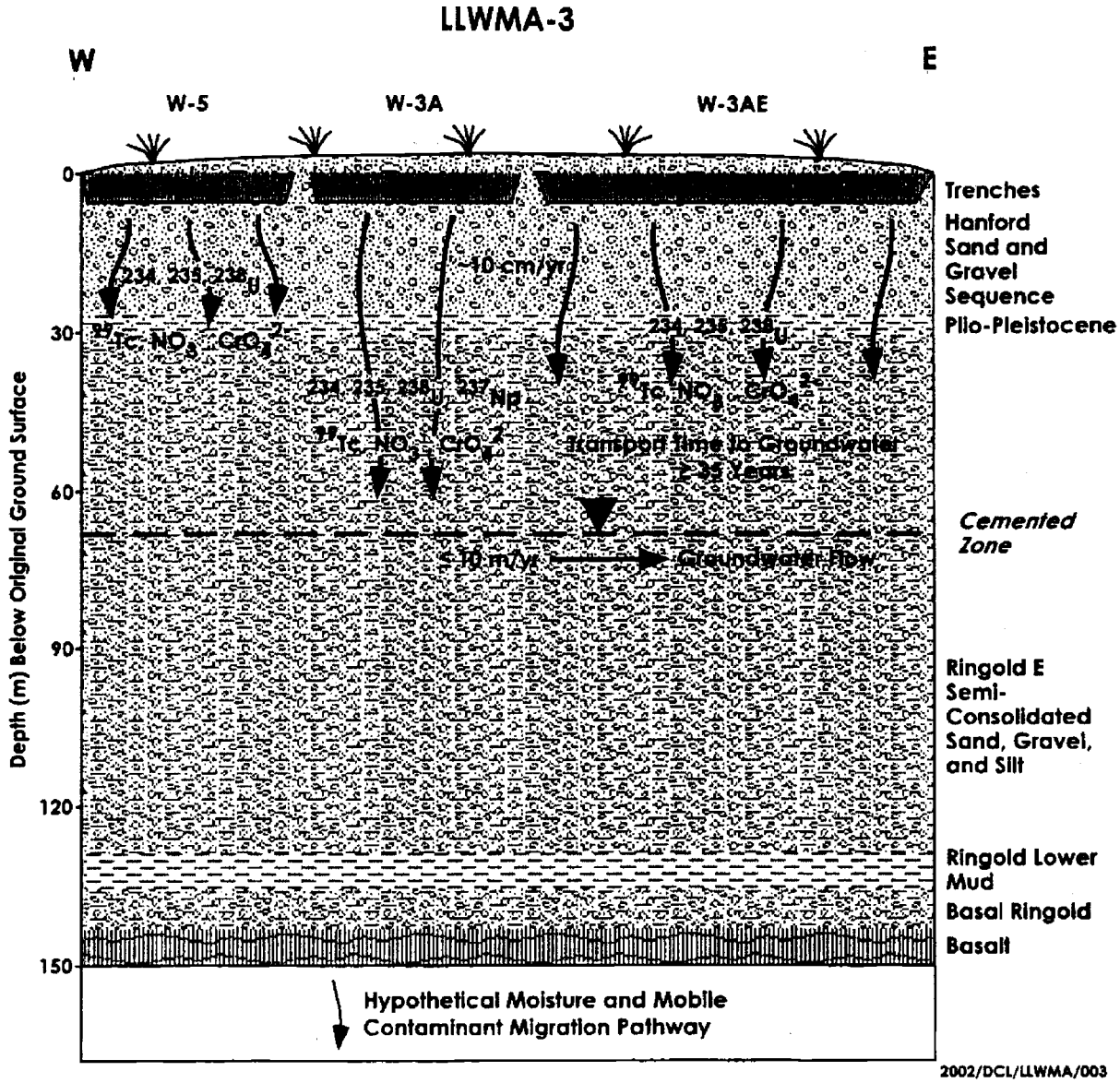

Figure 5-11. Conceptual Model for Low-Level Waste Management Area 3.

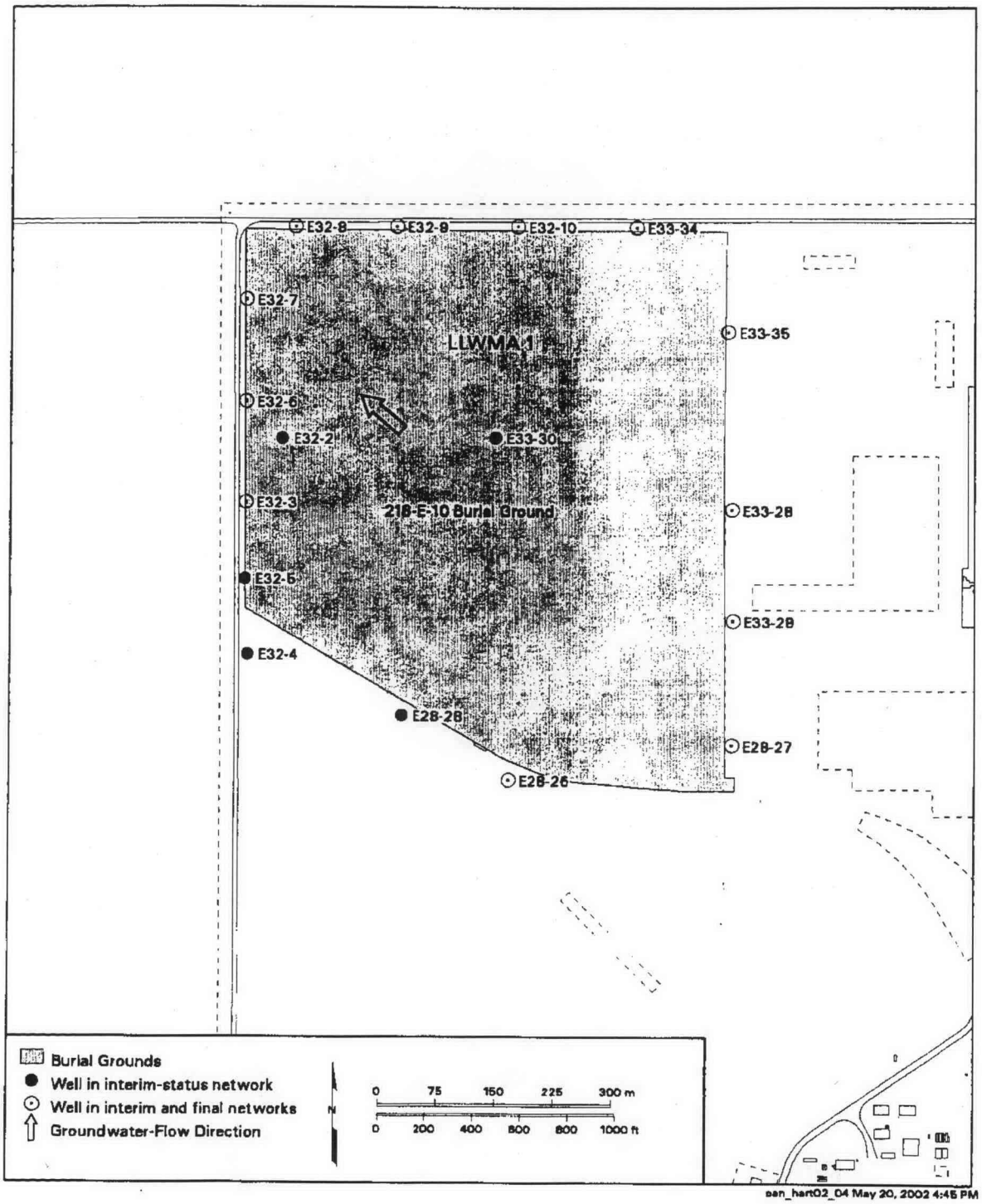

Figure 5-12. Final Status Groundwater Monitoring Network for Low-Level Waste Management Area 1.

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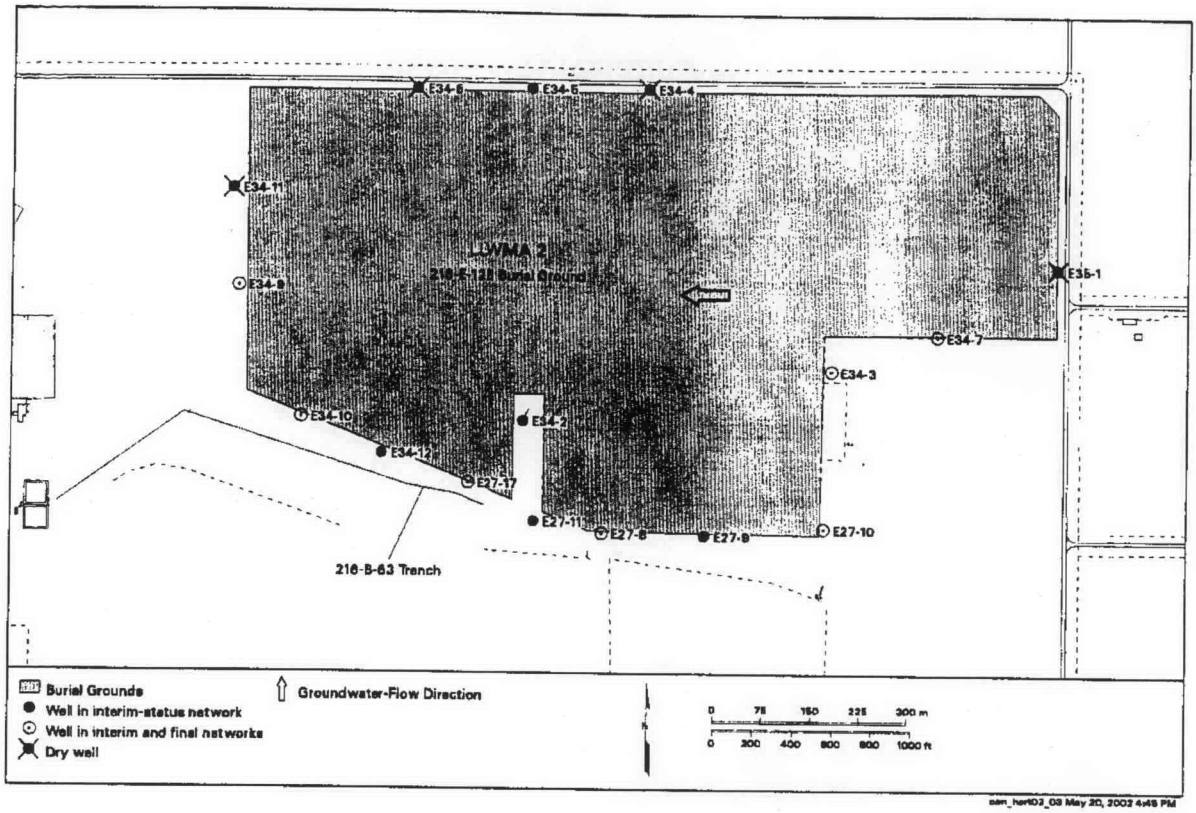

Figure 5-13. Final Status Groundwater Monitoring Network for Low-Level Waste Management Area 2.

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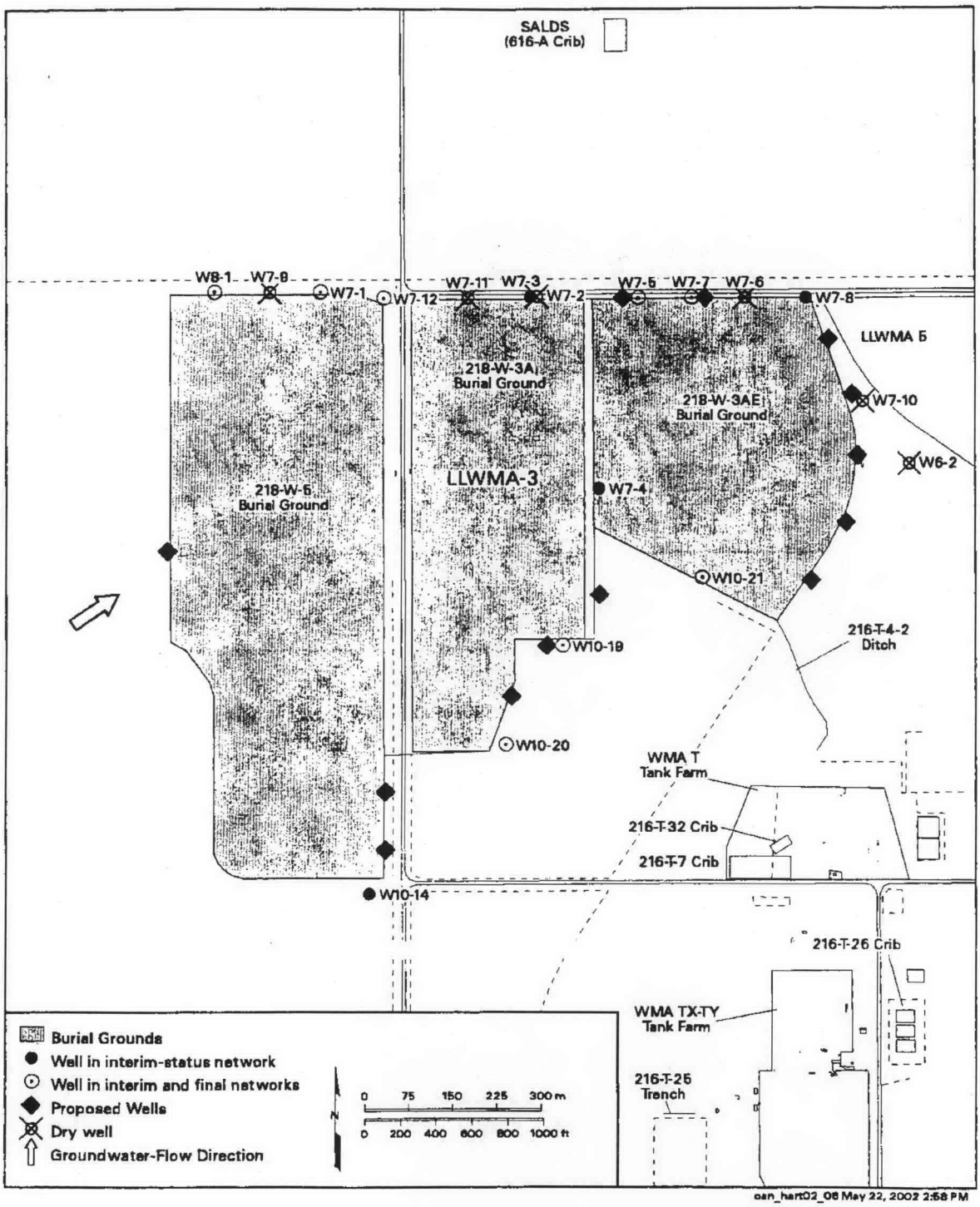

Figure 5-14. Final Status Groundwater Monitoring Network for Low-Level Waste Management Area 3.

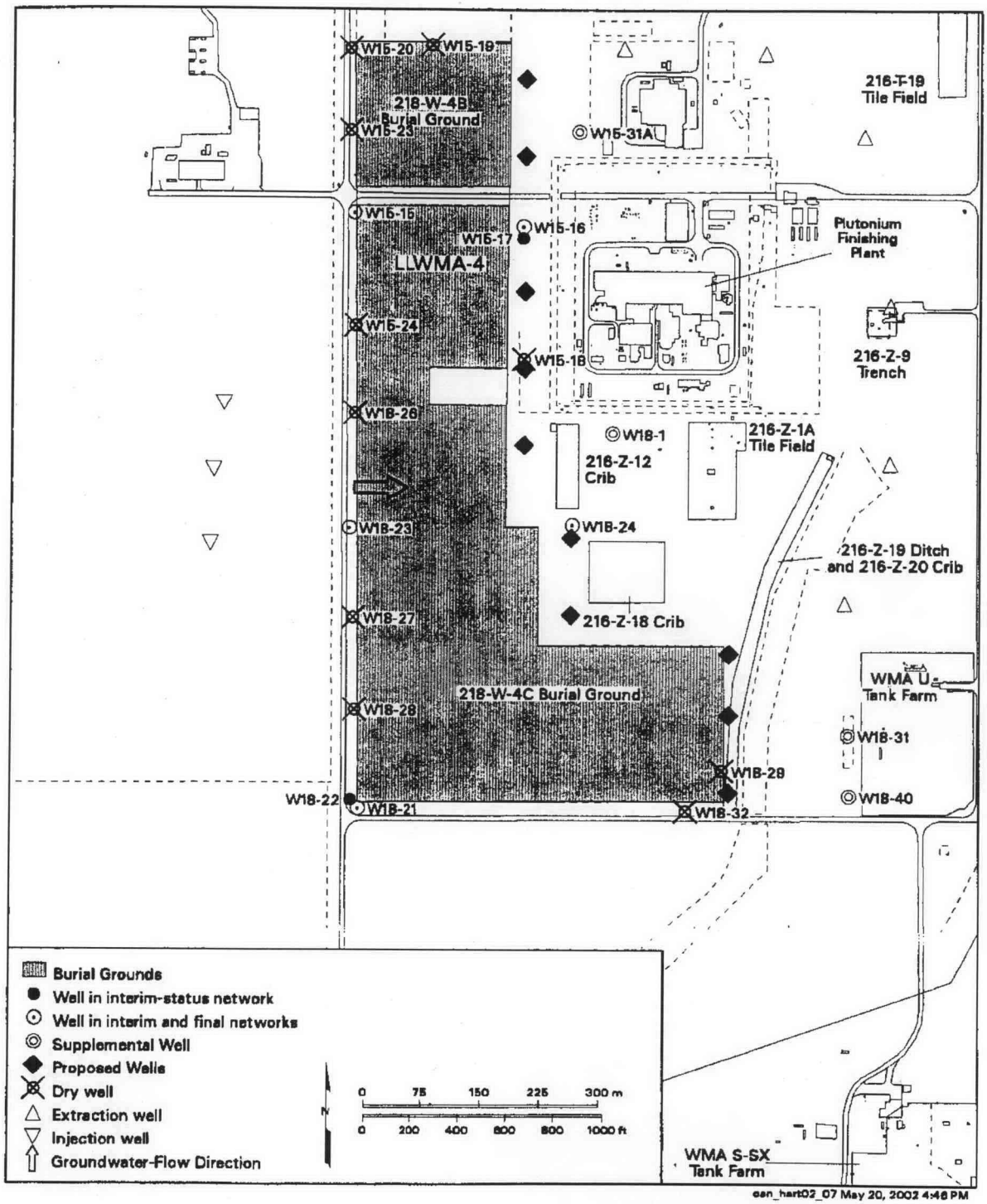

Figure 5-15. Final Status Groundwater Monitoring Network for Low-Level Waste Management Area 4.

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Table 5-1. Waste Constituent Mobility (Qualitative) in the Subsurface.

Constituent	Expected form	Mobility	Comments
Hazardous Constituents			
Asbestos	Solid mineral	low	
Lead	cation (Pb^{2+})	low	Lead shielding and batteries
PCBs	non-charged	low	Low solubility and readily adsorbed on mineral surfaces
Chromium	Anionic when in the hexavalent oxidation state (CrO_4^{-2}); cationic when trivalent	high for hexavalent	
Nitrate	Anionic (NO_3-)	high	
Radioactive Constituents			
Carbon-14	anion (HCO_3^-)	intermediate	Reacts with soil CO_3^{-2}
Cesium-137	cation (Cs^+)	low	
Europium	cation	low	
Iodine-129	anion (IO_3^-, I^-)	high	
Plutonium	oxide ((PuO_2) and hydrolysis products $Pu(OH)^{3+}$))	low	
Stronium-90	cation (Sr^{2+})	low	
Cesium-137	cation (Cs^+)	low	
Technetium-99	anion (TcO_4^-)	high	
Uranium	$UO_2(CO_3)_2^{2-}$	high to intermediate	Uranyl carbonate complex

Table 5-2. Monitoring Constituents for Low-Level Waste Management Area 1.

Statistical indicators	Supplemental constituents
Chromium (filtered) Specific conductance (field) Total organic carbon Total organic halides	Alkalinity Anions ICP metals (filtered) pH (field) Turbidity (field)
Constituents analyzed semiannually.	

Table 5-3. Monitoring Constituents for Low-Level Waste Management Area 2.

Statistical indicators	Supplemental constituents
Chromium (filtered) Specific conductance (field) Total organic carbon Total organic halides	Alkalinity Anions ICP metals (filtered) pH (field) Turbidity (field)
Constituents analyzed semiannually.	

Table 5-4. Monitoring Constituents for Low-Level Waste Management Area 3.

Statistical indicators	Supplemental constituents
Chromium (filtered) Specific conductance (field) Total organic carbon Total organic halides	Alkalinity Anions ICP metals (filtered) pH (field) Turbidity (field) Volatile organic compounds[a]
[a]Analyzed annually; other constituents analyzed semiannually.	

Table 5-5. Monitoring Constituents for Low-Level Waste Management Area 4.

Statistical indicators	Supplemental constituents
Chromium (filtered) Specific conductance (field) Total organic carbon	Alkalinity Anions ICP metals (filtered) pH (field) Turbidity (field) Volatile organic compounds[a]
[a]Analyzed annually; other constituents analyzed semiannually.	

Table 5-6. Analytical Methods and Detection Limits for Constituents Monitored for Low-Level Burial Grounds.

Constituent	Analytical method	Reference[a]	Required detection limit, fiscal year 2002[b]
Alkalinity	Electrochemical titration	310.1 (EPA-600/4-79-020)	5,000 µg/L
Anions	Ion chromatography	300.0 (EPA-600/R-93-100)	Chloride: 200 µg/L Fluoride: 500 µg/L Nitrate: 250 µg/L Nitrite: 250 µg/L Sulfate: 500 µg/L
Metals	Inductively coupled plasma, atomic emission spectrometry	6010 (SW-846)	Aluminum: 200 µg/L Antimony: 60 µg/L Arsenic: 100 µg/L Calcium: 5,000 µg/L Chromium: 10 µg/L Copper: 25 µg/L Iron: 100 µg/L Lead: 100 µg/L Magnesium: 5,000 µg/L Nickel: 40 µg/L Potassium: 5,000 µg/L Selenium: 100 µg/L Sodium: 5,000 µg/L Strontium: 50 µg/L Zinc:20 µg/L
Total organic carbon	Carbon analyzer	9060 (SW-846)	1,000 µg/L
Total organic halides	Electrolytic titration	9020 (SW-846)	20 µg/L

[a] EPA-600/4-79-020, EPA-600/R-93-100, SW-846.
[b] Detection limit required of laboratory in contract for fiscal year 2002. Required limits might vary from year to year. Actual detection limits might be lower.

Table 5-7. Groundwater Monitoring Network for Low-Level Waste Management Area 1.

Well number	Screened interval (m) NAVD88	Water level (m) NAVD88 (Mar 2002)	Water remaining, (m) (Mar 2002)	Monitoring objective
299-E28-26	118.8 - 124.9	122.40	3.6	Upgradient chemistry
299-E28-27	119.5 - 125.6	122.37	2.9	Upgradient chemistry
299-E28-28	119.5 - 125.6	122.36	2.9	Not in proposed network; does not improve coverage
299-E32-2	120.0 - 126.1	122.33	2.3	Not in proposed network; within burial ground
299-E32-3	119.7 - 125.8	122.36	2.7	Downgradient chemistry
299-E32-4	118.9 - 125.0	122.33	3.4	Not in proposed network; does not improve coverage
299-E32-5	119.2 - 125.6	122.36	3.2	Not in proposed network; does not improve coverage
299-E32-6	119.4 - 125.8	122.35	3.0	Downgradient chemistry
299-E32-7	119.4 - 125.8	122.35	3.0	Downgradient chemistry
299-E32-8	118.9 - 125.2	122.33	3.4	Downgradient chemistry
299-E32-9	119.4 - 125.7	122.35	3.0	Downgradient chemistry
299-E32-10	119.8 - 125.9	122.36	2.6	Downgradient chemistry
299-E33-28	119.0 - 125.1	122.38	3.4	Upgradient chemistry
299-E33-29	117.5 - 123.6	122.36	4.9	Upgradient chemistry
299-E33-30	119.0 - 125.1	122.35	3.4	Not in proposed network; within burial ground
299-E33-34	120.3 - 126.3	122.38	2.1	Downgradient chemistry
299-E33-35	120.2 - 126.6	122.35	2.2	Upgradient chemistry

All wells constructed to standards of WAC 173-160 resource protection wells. Stainless-steel casing and screen; sand pack around screen or 'channel pack' screen; annular seal around casing. Appendix C provides more information.

Shaded rows indicate wells in proposed, final status network.

Bold italics indicate upgradient wells.

NAVD88 = North American Vertical Datum of 1988.

Table 5-8. Groundwater Monitoring Network for Low-Level Waste Management Area 2.

Well number	Screened interval (m) NAVD88	Water level (m) NAVD88 (Mar 2002)	Water remaining (m) (Mar 2002)	Monitoring objective
299-E27-8	120.7 - 126.8	122.39	2.8	Downgradient chemistry south side of LLWMA
299-E27-9	119.4 - 125.3	122.40	3.8	Not in proposed network; does not improve coverage
299-E27-10	120.0 - 126.2	122.41	2.5	Upgradient chemistry
299-E27-11	119.6 - 126.0	122.35	2.8	Not in proposed network; does not improve coverage
299-E27-17	119.0 - 125.4	122.39	3.4	Downgradient chemistry south side of LLWMA
299-E34-2	119.7 - 125.8	122.39	2.8	Not in proposed network; does not improve coverage
299-E34-3	121.9 - 128.0	122.50 (Nov. 2001)	0.57 (Nov. 2001)	Upgradient chemistry
299-E34-5	122.6 - 128.6	123.05	0.58	Not in proposed network; not in hydrologic contact with other wells in network
299-E34-7	121.9 - 125.2	122.34	0.5	Upgradient chemistry
299-E34-9	120.6 - 127.0	122.36	1.9	Downgradient chemistry west side of LLWMA
299-E34-10	120.1 - 126.5	122.38	2.4	Downgradient chemistry southwest side of LLWMA
299-E34-11	122.0 - 125.1	122.38	0.4	Not in proposed network (not enough water to sample)
299-E34-12	120.3 - 126.6	122.31	2.1	Not in proposed network; does not improve coverage

All wells constructed to standards of WAC 173-160 resource protection wells. Stainless-steel casing and screen; sand pack around screen or 'channel pack' screen; annular seal around casing. Appendix C provides more information.

Shaded rows indicate wells in proposed, final status network.

Bold italics indicates upgradient wells.

Three additional wells, 299-E34-4, 299-E34-6, and 299-35-1, were installed to monitor Low-Level Waste Management Area 2 but because of the basalt subcrop and the declining water table, these wells are now dry.

NAVD88 = North American Vertical Datum of 1988; LLWMA = low-level waste management area.

Table 5-9. Groundwater Monitoring Network for Low-Level Waste Management Area 3.

Well Number	Screened interval, m NAVD88	Water level, m NAVD88 (Mar 2002)	Water remaining, m (Mar 2002)	Monitoring objective
299-W7-1	136.3 - 142.7	137.80	1.5	Downgradient chemistry, north.
299-W7-3	63.2 - 69.6	137.14	73.9	Not in proposed network; deep well
299-W7-4	134.0 - 143.1	137.41	3.4	Not in proposed network; does not improve coverage.
299-W7-5	136.0 - 142.3	137.51	1.2	Downgradient chemistry, north.
299-W7-7	136.7 - 142.8	137.11	0.4	Downgradient chemistry, north.
299-W7-8	136.4 - 142.7	136.68 (9/01)	0.3 (9/01)	Not in proposed network; insufficient water
299-W7-12	136.6 - 142.9	137.72	1.1	Downgradient chemistry, north.
299-W8-1	136.1 - 142.3	138.03	1.9	Downgradient chemistry, north.
299-W10-14	77.3 - 83.4	138.01	60.7	Not in proposed network; deep well
299-W10-19	136.9 - 143.0	137.68	0.8	Downgradient chemistry, southeast
299-W10-20	136.1 - 142.2	137.86	1.8	Downgradient chemistry, southeast
299-W10-21	136.0 - 142.1	137.53	1.5	Downgradient chemistry, southeast
Proposed New Wells (temporary well numbers refer to MEMO numbers in Appendix 5D)				
LLWMA-3-9	--	--	--	Downgradient chemistry
LLWMA-3-10	--	--	--	Downgradient chemistry
LLWMA-3-11	--	--	--	Upgradient chemistry
LLWMA-3-12	--	--	--	Downgradient chemistry
LLWMA-3-13	--	--	--	Downgradient chemistry
LLWMA-3-14	--	--	--	Downgradient chemistry
LLWMA-3-15	--	--	--	Downgradient chemistry
LLWMA-3-16	--	--	--	Downgradient chemistry
LLWMA-3-17	--	--	--	Downgradient chemistry
LLWMA-3-18	--	--	--	Downgradient chemistry
LLWMA-3-19	--	--	--	Replaces well 299-W10-19
LLWMA-3-20	--	--	--	Replaces well 299-W7-5
LLWMA-3-21	--	--	--	Replaces well 299-W7-7

All wells constructed to standards of WAC 173-160 resource protection wells. Existing wells have stainless-steel casing and screen; sand pack around screen or 'channel pack' screen; annular seal around casing. Appendix 5C provides more information.

Shaded rows indicate wells in proposed, final status network.

Bold italics indicates upgradient well.

NAVD88 = North American Vertical Datum of 1988.

Table 5-10. Groundwater Monitoring Network for Low-Level Waste Management Area 4.

Well number	Screened interval, m NAVD88	Water level, m NAVD88 (Mar 2002)	Water remaining, m (Mar 2002)	Monitoring objective
299-W15-15	136.0 - 145.2	138.32	2.3	Upgradient chemistry
299-W15-16	136.6 - 145.8	137.70	1.1	Downgradient chemistry, east boundary
299-W15-17	77.4 - 80.5	137.72	60.3	Not in proposed network; deep well
299-W18-21	135.5 - 144.7	138.44	2.9	Upgradient chemistry
299-W18-22	67.9 - 77.4	138.27	70.4	Not in proposed network; deep well
299-W18-23	136.3 - 145.7	138.49	2.2	Upgradient chemistry
299-W18-24	137.2 - 146.4	137.78	0.6	Downgradient chemistry, east boundary
Supplemental wells to be monitored until new wells installed. Not used for statistical evaluations.				
299-W15-31A	130.7 - 142.9	137.45	6.8	Supplemental downgradient chemistry
299-W18-1*	96.4 - 148.8*	137.80 (1/02)	41.4 (1/02)	Supplemental downgradient chemistry
299-W18-31	134.7 - 145.3	137.21	2.5	Supplemental downgradient chemistry. Also monitored for single-shell tanks
299-W18-40	125.6 - 136.3	136.87	11.3	Supplemental downgradient chemistry. Also monitored for single-shell tanks
Proposed New Wells (temporary well numbers refer to MEMO numbers in Appendix 5D)				
LLWMA-4-6	--	--	--	Downgradient chemistry, northeast
LLWMA-4-7	--	--	--	Downgradient chemistry, northeast
LLWMA-4-8	--	--	--	Downgradient chemistry, east-central
LLWMA-4-9	--	--	--	Downgradient chemistry, east-central
LLWMA-4-10	--	--	--	Replacement for W18-24
LLWMA-4-11	--	--	--	Downgradient chemistry, southeast
LLWMA-4-12	--	--	--	Downgradient chemistry, southeast
LLWMA-4-13	--	--	--	Downgradient chemistry, east-central
LLWMA-4-14	--	--	--	Downgradient chemistry, southeast
LLWMA-4-15	--	--	--	Downgradient chemistry, southeast

All wells except 299-W18-1 constructed to standards of WAC 173-160 resource protection wells. Existing wells have stainless-steel casing and screen; sand pack around screen or 'channel pack' screen; annular seal around casing. Appendix 5C provides more information.

* Perforated carbon steel casing. Partial annular seal.

Shaded rows indicate wells in proposed, final status network.

Bold italics indicate upgradient wells.

NAVD88 = North American Vertical Datum of 1988.

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6.0 PROCEDURES TO PREVENT HAZARDS [F]

This chapter discusses security, inspection schedules, preparedness and prevention requirements, preventive procedures, structures, equipment, and prevention of reaction of ignitable, reactive and incompatible waste disposed and stored in the LLBG.

The LLBG is designed and operated to minimize exposure of the general public and operating personnel to mixed waste. Shielding, contamination control, control of toxic or dangerous material, and safety and security procedures are used to keep exposure ALARA.

6.1 SECURITY [F-1]

The following sections describe the security measures, equipment, and warning signs used to control entry to the LLBG. A discussion of Hanford Facility security is provided in the General Information Portion (DOE/RL-91-28).

6.1.1 Security Procedures and Equipment [F-1a]

The following sections describe the 24-hour surveillance system, barrier, and warning signs used to provide security and control access to the LLBG.

6.1.1.1 24-Hour Surveillance System [F-1a(a)]

The entire Hanford Facility is a controlled access area [refer to General Information Portion (DOE/RL-91-28)].

6.1.1.2 Barrier and Means to Control Entry [F-1a(b)]

Within the LLBG, access to the mixed waste is minimized by administrative procedures and engineering controls used to control access. Wherever waste is placed or exposure hazards are identified, barriers (e.g., chains, flagging, etc.) and warning signs are erected that surround the waste. In addition, the access ramps to trenches 31, 34, and 94 are provided with gates to control vehicle entry.

6.1.1.3 Warning Signs [F-1a(2)]

The active portions of the LLBG are within chained radiation zones. Each active area used for mixed waste disposal is posted with a sign, in English, reading, "DANGER-UNAUTHORIZED PERSONNEL KEEP OUT". The signs are visible from all angles of approach, and are legible from a distance of at least 7.6 meters. In addition to these signs, the fences around the 200 East Area and 200 West Area burial grounds are posted with signs warning against unauthorized entry. The signs are visible from all angles of approach.

6.1.2 Waiver [F-1b]

Waiver of the security procedures and equipment requirements for the LLBG are not requested. Therefore, WAC 173-303-310(1)(a) and (b) are not applicable.

6.2 INSPECTION PLAN [F-2]

This section describes the method and schedule for inspection of the LLBG. These inspections help to ensure that situations do not exist that might cause or lead to the release of mixed waste to the environment or that might pose a threat to human health. In addition, containers in storage are inspected to identify leaking containers, improperly stored containers, and degradation of safety equipment and/or systems. Abnormal conditions identified by inspections are corrected in accordance with WAC 173-303-320(3).

6.2.1 General Inspection Requirements [F-2a, F-2b]

The content and frequency of inspections are described in this section. The inspections are documented on inspection checklists and log sheets. The schedule and inspection records are kept in the inspection logbooks and retained by the LLBG operations personnel. Inspection records are retained for a minimum of 5 years, and contain the following information:

- Date and time of inspection
- Printed name and the hand written signature of the inspector
- Notation of the observations made
- An account of spills or discharges in accordance with WAC 173-303-145
- Date and nature of any repairs or remedial actions taken.

The inspection checklists consist of a listing of items that are to be assessed during each inspection. A yes/no response is made for each listed item. A 'yes' response means that the item is in compliance with the conditions stated on the checklist. Any problems identified during the inspection, as indicated by a 'no' response on the checklist, are reported immediately to the LLBG operations supervisor.

6.2.1.1 Types of Problems [F-2a(1), (2), (4), and (5)]

Refer to Tables 6-1 through 6-3 for the types or problems looked for during an inspection.

Each day waste is handled within the LLBG, an operator performs a daily inspection of areas subject to spills (e.g., loading and unloading areas and waste handling areas). Truck unloading areas are inspected for signs of deterioration that would impact a chemical spill cleanup should a spill occur. The LLBG weekly inspections are performed for trench 34 when waste is stored to ensure operation and management is in accordance with WAC 173-303-630(6).

Backfilled mixed waste trenches are inspected for signs of erosion of the trench cover. Evidence of settling or unevenness at a backfilled trench that would indicate subsidence is recorded to initiate corrective action.

Truck unloading areas at trenches 31 and 34 are inspected for signs of deterioration that would impact the ease of a chemical spill cleanup should a spill occur. Any spills will be managed as identified in the building emergency plan/contingency plan (Chapter 7.0). Cracks and wear are recorded to initiate corrective action.

6.2.1.2 Frequency of Inspections [F-2a(3)]

Tables 6-1, 6-2, and 6-3 provide inspection frequency.

6.2.2 Schedule for Remedial Action for Problems Revealed [F-2c]

The operating organization remedies any problems revealed by the inspection in accordance with WAC 173-303-320(3). Where a hazard is imminent or has already occurred, immediate remedial action is taken. Immediate remedial actions are implemented based on ALARA considerations, availability of supplies, equipment, and personnel.

6.2.3 Specific Process or Waste Type Inspection Requirements [F-2d]

The following sections detail the inspections to be performed at the LLBG.

6.2.3.1 Container Inspection [F-2d(1)

On receipt, each container is inspected by operations personnel to confirm appropriate documentation and compliance with the waste acceptance criteria (Chapter 3.0, Appendix 3A) before the container is placed in the LLBG.

When containers are in storage, specific items and/or problems noted during weekly container inspection include the following:

- Condition trench floor and sides
- Container structural integrity
- Containers closed
- At a minimum, 76.2 centimeters aisle spacing
- Corrosion of containers
- Evidence of spills or leaks
- Container labels and markings in place, legible, and unobscured
- Areas in and around waste stored in trench 34 (and trench 31, if needed to support waste management needs) are free of combustibles (e.g., tumbleweeds)
- Access ramp is intact (e.g., free of erosion)
- Chain barricades and postings are intact.

Records of inspection are maintained as detailed in Section 6.2.1.

6.2.3.2 Landfill Inspection [F-2d(8)]

All regulated trenches subject to WAC 173-303-665 requirements are inspected weekly and after a significant run-off event.

6.2.3.2.1 Run-On and Run-Off Control System [F-2d(8)(a)]

A run-on control system is installed around the perimeter of each lined trench (Chapter 4.0, Section 4.5.8.1). The system consists of a berm along the outer margin of each lined trench and prevents run-on from entering the trench. All run-on control system berms will be inspected weekly and after significant run-off for signs of deterioration, malfunction, or improper operation. Any precipitation that falls between the run-on control berm and the edge of the trench excavation eventually might flow into the primary leachate control and removal system sump and will be treated as leachate.

6.2.3.2.2 Leak Detection System [F-2d(8)(b)]

Leak detection for the lined trenches is accomplished by the following:

- Monitoring liquid level above the secondary liner
- High- and low-level alarms tested periodically
- Monitoring liquid levels above primary liner
- Inspections for the presence of liquids after significant precipitation events
- Verification of certain gauges and instruments to ensure these are in current calibration; calibration is performed annually (refer to Chapter 4.0, Section 4.5.7.4)
- Recording the amount of liquid removed from each leak detection system sump at least once each week during the active life and closure period.
- Test leak detection system to ensure system is functioning properly:
  - Testing includes checking the indicator levels in the sumps
  - Levels are recorded on a daily action leakage rate calculation sheet (Figure 6-1).

If the action leakage rate (Chapter 4.0, Appendix 4C) has not been exceeded, the liner system is assumed to be functioning properly.

6.2.3.2.3 Wind Dispersal Control System [F-2d(8)(c)]

Waste packages placed in the LLBG that are containerized or have the characteristics of a container are in a form that eliminates the concern of wind dispersal. Waste packages are inspected upon receipt for evidence of damage, corrosion, or deterioration that might lead to dispersal of the contents. This inspection is repeated daily if waste management operations are being conducted and weekly to ensure that dispersal of contained material is not a concern.

Trench 94 is inspected weekly to verify the integrity of the defueled reactor compartments and to perform corrective action if needed.

Unpackaged or bulk waste with any potential for wind dispersal is covered or sprayed with fixative after being placed in a trench.

In addition, waste handling operations are suspended in winds exceeding 24 kilometers per hour. To operate in winds over 24 kilometers per hour, it must be determined that completion of the waste handling activity is more protective of human health and the environment than suspension of the

incomplete activity. Measures to prevent wind dispersion are implemented. This condition does not apply to containerized or stabilized waste that has no potential for wind dispersal.

6.2.3.2.4 Leachate Collection and Removal System [F-2d(8)(d)]

The leachate collection and removal system is inspected weekly to ensure proper functioning and the trench general area is inspected for evidence of deterioration, malfunctions, or improper operation of run-on and run-off control systems.

In addition, verification is performed when pumping occurs to check if the amount of actual leachate pumped from the leachate collection and removal system corresponds to the amount that is accumulated in the leachate collection tank. This periodic check verified the proper function of the leachate collection and removal sump pumps. At a minimum, monthly evaluations (October through March) on the leachate transfer lines for freeze protection also is conducted.

6.3 PREPAREDNESS AND PREVENTION REQUIREMENTS [F-3, F-3a]

The following sections describe the preparedness and prevention measures taken at the LLBG and the internal and external communications and emergency equipment required. Further discussions on the possibility of a fire, explosion, or any unplanned sudden or nonsudden release of dangerous or dangerous waste constituents to air, soil, or surface water that could threaten human health or the environment are contained in the building emergency plan (Chapter 7.0).

6.3.1 Internal Communication [F-3a(1)]

There is always a building equipped to support communications. Immediate emergency instruction to personnel working at the LLBG is provided by two-way radios and cellular telephones.

6.3.2 External Communications [F-3a(2)]

Personnel at the LLBG have voice communication or equivalent (e.g., hand signals) during work assignments to maintain external communications with shift supervisors. Supervision contacts the Hanford Facility emergency telephone number (911) (811 for cellular telephones) if assistance is needed in the field.

6.3.3 Emergency Equipment [F-3a(3)]

Emergency equipment is available for use at the LLBG. The Hanford Facility maintains a sufficient inventory of heavy equipment (Attachment 4 of the Hanford Facility RCRA Permit). The Hanford Facility relies primarily on the Hanford Fire Department to control fires. Emergency equipment is not located at burial ground trenches. Portable fire extinguishers are carried on LLBG operations vehicles. Fire Station #2 (Attachment 4 of the HF RCRA Permit) is equipped with trained firefighting and emergency medical personnel and equipment, and is located within 5 minutes of any location within the LLBG. Spill cleanup materials are readily available from the Central Waste Complex, and other locations (overpack containers, protective clothing, handling and cleanup equipment). The contingency plan (Chapter 7.0) references the emergency equipment.

6.3.4 Water for Fire Control [F-3a(4)]

Water for fire control at the LLBG is supplied by Hanford Fire Department trucks for fires requiring high water volume and pressure. Water is supplied by the following equipment:

- Each fire station normally has a truck equipped with a hydraulically operated aerial ladder, and one pumper (backup fire engine, without a boom, that is used if the aerial ladder is inoperable). Fire engines have a pumping capacity of at least 5,700 liters of water per minute.

- Other fire protection equipment uses chemicals rather than water as an extinguishing media.

6.3.5 Aisle Space Requirement [F-3b]

Aisle spacing during container storage operations is sufficient to allow the movement of personnel and fire protection equipment in and around the containers. This aisle spacing meets the requirements of WAC 173-303-340(3). Inspection aisle space must be at least 76.2 centimeters.

During container storage operations, rows of containers are placed no more than two containers wide in accordance with WAC 173-303-630(5)(c). The containers are loaded and unloaded via the access ramp on the south side of each trench.

6.4 PREVENTIVE PROCEDURES, STRUCTURES, AND EQUIPMENT [F-4]

The following sections describe preventive procedures, structures, and equipment.

6.4.1 Unloading Operations [F-4a]

Methods used to prevent releases during unloading operations depend on waste form (e.g., containerized or bulk). The methods employed are as follows.

- Containers are inspected for damage before being unloaded from the transport vehicle.

- Containerized waste is handled by appropriate equipment (e.g., forklift or crane) during unloading.

- Path from loading area to storage area is clear of obstructions.

- Bulk waste is not unloaded with winds in excess of 24 kilometers per hour.

- Bulk waste is handled in a manner to ensure that dispersal does not occur (e.g., use of fixatives while placing bulk waste in trenches and air monitoring).

Any spills are managed as identified in the contingency plan (Chapter 7.0). Cracks and wear are recorded to initiate corrective action. In the LLBG, container pallets, burial containers, and other approved waste packages are placed individually in the trenches for burial.

Waste is staged at the waste unloading area no longer than necessary for placement into the trench; however, waste might be left in place overnight (e.g., should the daily operational shift end or weather conditions preclude movement) before waste is placed into the trench.

6.4.2 Run-Off [F-4b]

The waste in the LLBG is buried below the land surface; thus, the LLBG are designed to prevent run-off of precipitation that might have come in contact with waste. The average precipitation is 16 centimeters per year, so minimal run-off occurs. The land surface is relatively level, so trenches have only internal drainage. The minimal amounts of precipitation that accumulate are contained within the trenches.

The lined mixed waste trenches are designed to channel run-on liquid away from the burial trench. Run-off liquid is captured within the trench. Surface liquid evaporates. The liquid that leaches through the waste is captured in the leachate collection system and is managed as mixed waste.

6.4.3 Water Supplies [F-4c]

The design and operation of the LLBG are intended to minimize the generation of potentially contaminated leachate and to prevent its migration into groundwater resources in the local area. Operations (Chapter 4.0) are designed to protect local water supplies while site conditions (Chapter 5.0) also mitigate contaminant migration through surface water and groundwater.

A description of activities that prevent contamination of water supplies or groundwater include the following:

- Placement of mixed waste in lined trenches
  - Waste is containerized or stabilized to control migration of mixed waste
  - Run-on and run-off are controlled
  - Leak detection systems are used
  - Leachate is collected and managed as mixed waste
  - Inspections are performed.
- Placement of backfill on completed portions of trenches
- Revegetation to control erosion of protective cover (Chapter 11.0).

6.4.4 Equipment and Power Failure [F-4d]

Electrical power for MO223 is provided. Loss of electricity at MO223 does not impair functions or constitute an emergency. Backup equipment is available for failed mechanized equipment.

Electrical power is required for trenches 31 and 34 of the 218-W-5 Burial Ground; however, loss of electricity does not constitute an emergency, but should be restored as soon as possible. Electricity supplies power to the sump pumps used to remove accumulated leachate from the primary and secondary liners.

6.4.5 Personal Protection Equipment [F-4e]

Personnel are trained in the use of applicable personal protection equipment. Examples of personal protection equipment frequently used include clothing (i.e., cloth coveralls, cloth and rubber shoe cover, cloth and rubber gloves and cloth caps); hard hats; safety shoes; safety glasses; and respiratory protection devices. The protective clothing required in the LLBG varies depending on the form and content of the waste.

Available respiratory protection equipment includes the following:

- Airpacks
- Filter masks with a graphite filter. This type of mask is for removing particulates from the respiratory stream
- Face masks with cartridges that react with various chemical fumes. These masks are used in special circumstances
- Full-face masks, with hoses attached to an air compressor some distance away, also are available when needed.

Personnel are required to be trained in using the various respiratory devices and must be checked routinely for mask fit (Chapter 8.0).

6.5 PREVENTION OF REACTION OF IGNITABLE, REACTIVE, AND INCOMPATIBLE WASTE [F-5]

The following sections describe prevention of reaction of ignitable, reactive, and incompatible waste.

6.5.1 Precautions to Prevent Ignition or Reaction of Ignitable or Reactive Waste [F-5a]

Waste acceptance criteria prohibit the disposal of ignitable or reactive waste in the LLBG. Reactive and ignitable waste must be treated and/or neutralized before receipt and disposal (Appendix 3A). No ignitable or reactive is be stored in mixed waste trenches.

6.5.2 Precautions for Handling Ignitable or Reactive Waste and Mixing of Incompatible Waste [F-5b]

The waste analysis plan (Appendix 3A) requires that ignitable or reactive waste be treated in accordance with RCRA-specified treatment standards. In addition, measures are taken to ensure that the commingling of incompatible waste does not occur. Waste acceptance criteria ensure that the required treatment has been performed before the waste is disposed or stored in the LLBG.

AVERAGE DAILY ACTION LEAKAGE RATE CALCULATION

Operating Day __/__/__ _____ Gallons

Operating Day __/__/__ _____ Gallons

Operating Day __/__/__ _____ Gallons

Operating Day __/__/__ _____ Gallons

Operating Day __/__/__ _____ Gallons

Operating Day __/__/__ _____ Gallons

Operating Day __/__/__ _____ Gallons

Secondary Sump Total Volume **TOTAL** _____ Gallons
(DIVIDE TOTAL VOLUME BY 7)

AVERAGE DAILY ACTION LEAKAGE RATE: _____ Gallons

NOTIFY LLBG Operations Supervisor if Average Daily Action Leakage Rate is GREATER than 670 Gallons

Repairs or remedial action taken:

Operator's Printed Name: _____ Date __/__/__
Operator's Signature: _____ Time ____ hrs

Operations Supervisor Printed Name: _____ Date __/__/__

Operations Supervisor Signature: _____ Time ____ hrs

Figure 6-1. Example of a Typical Average Daily Action Leakage Rate Calculation.

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Table 6-1. Container Storage Inspections.

Requirement Description	Inspection Frequency	Types of Problems
-630(6) Containers	Weekly	Leaking containers Deteriorating containers.
-630(6) Containment system	Weekly	Deteriorating containment system.
-395(1)(d) Ignitable or reactive waste	Not applicable	Not applicable.

Table 6-2. Landfill Inspections.

Requirement Description	Inspection Frequency	Types of Problems
-665(4)(b)(i) Run-on and run-off control	Weekly after storms	Deterioration, malfunction, or improper operation.
-665(4)(b)(ii) Wind dispersal control systems	Weekly and after storms*	Proper functioning.
665(4)(b)(iii) Leachate collection and removal systems	Weekly and after storms*	Presence of leachate; proper functioning.
-665(4)(c)(i) Leak detection system sump	Weekly	Amount of liquids removed.

* A storm is any atmospheric disturbance with either wind gusts of 35 miles per hour or greater or precipitation of 0.5 inch or greater with a 24-hour period.

Table 6-3. WAC 173-303-320(2) Inspection Schedule.

Requirement Description	Inspection Frequency	Types of Problems
Security devices: "Danger unauthorized personnel keep out" signs	Weekly	Signs are posted and legible.
Areas subject to spills	Daily when waste management activities having a potential for a spill to occur.	Evidence of spills.
-395(1)(d) Ignitable or reactive waste	Not applicable	Not applicable.

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CONTENTS

7.0 CONTINGENCY PLAN [G] 7-1

APPENDIX

7A BUILDING EMERGENCY PLAN FOR LOW-LEVEL BURIAL GROUNDS ..... APP 7A-i

TABLE

Table 7-1. Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3) T7-1

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7.0 CONTINGENCY PLAN [G]

The WAC 173-303 requirements for contingency plans are satisfied in the following documents: Portions of the *Hanford Facility Emergency Management Plan* [Attachment 4 of the Hanford Facility RCRA Permit (DW Portions)] and portions of the *Building Emergency Plan for Low-Level Burial Grounds* (Appendix 7A).

The unit-specific contingency plan document also serves to satisfy a broad range of other requirements [e.g., Occupational Safety and Health Administration standards (29 CFR 1910), *Toxic Substances Control Act* of 1976 (40 CRR 761) and U.S. Department of Energy Orders]. Therefore, revisions made to portions of this contingency plan that are not governed by the requirements of WAC 173-303 will not be considered as a modification subject to WAC 173-303-830 or Hanford Facility RCRA Permit (DW Portions) Condition I.C.3.

Table 7-1 identifies which portions of the building emergency plan are written to meet WAC 173-303 contingency plan requirements. In addition to the building emergency plan portions identified in Table 7-1, Section 12.0 of the building emergency plan is written to meet WAC 173-303 requirements identifying where copies of the *Hanford Emergency Management Plan* and the building emergency plan are maintained on the Hanford Facility. Therefore, revision to Section 12.0 of the B*uilding Emergency Plan* and the portions identified in Table 7-1 are considered a modification subject to WAC 173-303-830 or Hanford Facility RCRA Permit (DW Portion) Condition I.C.3.

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Table 7-1. Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3)

Requirement	Hanford Emergency Management Plan DOE/RL-94-02; Attachment 4 of the HF RCRA Permit (DW Portion)	Building Emergency Plan[1]
-350(3)(a) - A description of the actions which facility personnel must take to comply with this section and WAC 173-303-360.	X[2] Section 1.3.4	X[2] Sections 7.1, 7.2 through 7.2.5, and 7.3[3] Sections 4.0 (first paragraph), 8.2, 8.3, 8.4, 11.0
-350(3)(b) - A description of the actions which shall be taken in the event that a dangerous waste shipment, which is damaged or otherwise presents a hazard to the public health and the environment, arrives at the facility, and is not acceptable to the owner or operator, but cannot be transported pursuant to the requirements of WAC 173-303-370(5), Manifest system, reasons for not accepting dangerous waste shipments.	X[2] Section 1.3.4	X[2,4] Section 7.2.5.1
-350(3)(c) - A description of the arrangements agreed to by local police departments, fire departments, hospitals, contractors, and state and local emergency response teams to coordinate emergency services as required in WAC 173-303-340(4).	X Sections 3.2.3, 3.3.1, 3.3.2, 3.4, 3.4.1.1, 3.4.1.2, 3.4.1.3, 3.7, and Table 3-1	
-350(3)(d) - A current list of names, addresses, and phone numbers (office and home) of all persons qualified to act as the emergency coordinator required under WAC 173-303-360(1). Where more than one person is listed, one must be named as primary emergency coordinator, and others must be listed in the order in which they will assume responsibility as alternates. For new facilities only, this list may be provided to the department at the time of facility certification (as required by WAC 173-303-810 (14)(a)(I)), rather than as part of the permit application.		X[5] Section 3.1, 13.0
-350(3)(e) - A list of all emergency equipment at the facility (such as fire extinguishing systems, spill control equipment, communications and alarm systems, and decontamination equipment), where this equipment is required. This list must be kept up to date. In addition, the plan must include the location and a physical description of each item on the list, and a brief outline of its capabilities.	X Hanford Fire Department: Appendix C	X Section 9.0

Table 7-1. Hanford Facility Documents Containing Contingency Plan Requirements of WAC 173-303-350(3)

Requirement	Hanford Emergency Management Plan DOE/RL-94-02; Attachment 4 of the HF RCRA Permit (DW Portion)	Building Emergency Plan[1]
-350(3)(f) - An evacuation plan for facility personnel where there is a possibility that evacuation could be necessary. This plan must describe the signal(s) to be used to begin evacuation, evacuation routes, and alternate evacuation routes.	X[6] Figure 7-3 and Table 5-1	X[7] Section 1.5

An 'X' indicates requirement applies.

[1] Portions of the *Hanford Emergency Management Plan* not enforceable through Appendix A of that document are not made enforceable by reference in the building emergency plan.

[2] The *Hanford Emergency Management Plan* contains descriptions of actions relating to the Hanford Site Emergency Preparedness System. No additional description of actions are required at the site level. If other credible scenarios exist or if emergency procedures at the unit are different, the description of actions contained in the building emergency plan will be used during an event by a building emergency director.

[3] Sections 7.1, 7.2 through 7.2.5, and 7.3 of the building emergency plan are those sections subject to the Class 2 "Changes in emergency procedures (i.e., spill or release response procedures)" described in WAC 173-303-830, Appendix I Section B.6.a.

[4] This requirement only applies to TSD units that receive shipment of dangerous or mixed waste defined as offsite shipments in accordance with WAC 173-303.

[5] Emergency Coordinator names and home telephone numbers are maintained separate from any contingency plan document, on file in accordance with Hanford Facility RCRA Permit (DW Portion) General Condition II.A.4. and is updated, at a minimum, monthly.

[6] The Hanford Facility (sitewide) signals are provided in this document. No unit/building signal information is required unless unique devices are used at the unit/building.

[7] An evacuation route for the TSD unit must be provided. Evacuation routes for occupied buildings surrounding the TSD unit are provided through information boards posted within buildings.

CONTENTS

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TABLE

Table 8-1. LLBG Training Matrix. T8-1

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8.0 PERSONNEL TRAINING [H]

This chapter discusses personnel training requirements based on WAC 173-303 and the HF RCRA Permit (DW Portion). In accordance with WAC 173-303-806(4)(a)(xii), the Hanford Facility Dangerous Waste Part B Permit Application must contain two items: (1) "an outline of both the introductory and continuing training programs by owners or operators to prepare persons to operate or maintain the TSD facility in a safe manner as required to demonstrate compliance with WAC 173-303-330" and (2) "a brief description of how training will be designed to meet actual job tasks in accordance with the requirements in WAC 173-303-330(1)(d)." The HF RCRA Permit (DW Portion), Condition II.C (Personnel Training), contains training requirements applicable to Hanford Facility personnel and non-Facility personnel.

Compliance with these requirements at the LLBG is demonstrated by information contained both in Chapter 8.0 of DOE/RL-91-28, Attachment 33 of the HF RCRA Permit, and this chapter. This chapter supplements Chapter 8.0 of DOE/RL-91-28.

8.1 OUTLINE OF INTRODUCTORY AND CONTINUING TRAINING PROGRAMS

The introductory and continuing training programs are designed to prepare personnel to manage and maintain the TSD unit in a safe, effective, and environmentally sound manner. In addition to preparing personnel to manage and maintain TSD units under normal conditions, the training programs ensure that personnel are prepared to respond in a prompt and effective manner should abnormal or emergency conditions occur. Emergency response training is consistent with the description of actions contained in Chapter 7.0, Contingency Plan. The introductory and continuing training programs contain the following objectives:

- Teach Hanford Facility personnel to perform their duties in a way that ensures the Hanford Facility's compliance with WAC 173-303
- Teach Hanford Facility personnel dangerous waste management procedures (including implementation of the contingency plan) relevant to the job titles/positions in which they are employed, and
- Ensure Hanford Facility personnel can respond effectively to emergencies.

8.1.1 Introductory Training

Introductory training includes general Hanford Facility training and TSD unit-specific training. General Hanford Facility training is described in DOE/RL-91-28, Section 8.1, and is provided in accordance with the HF RCRA Permit (DW Portion), Condition II.C.2. TSD unit-specific training is provided to Hanford Facility personnel allowing those personnel to work unescorted, and in some cases is required for escorted access. Hanford Facility personnel cannot perform a task for which they are not properly trained, except to gain required experience while under the direct supervision of a supervisor or coworker who is properly trained. Hanford Facility personnel must be trained within 6 months after their employment at or assignment to the Hanford Facility, or to a new job title/position at the Hanford Facility, whichever is later.

General Hanford Facility training: Refer to description in DOE/RL-91-28, Section 8.1.

Contingency Plan training: Hanford Facility personnel receive training on applicable portions of the Hanford Emergency Management Plan [Attachment 4 of the HF RCRA Permit (DW Portion)] in general Hanford Facility training. In addition, Hanford Facility personnel receive training on content of the description of actions contained in contingency plan documentation in Chapter 7.0 and Appendix 7A to be able to effectively respond to emergencies.

Emergency Coordinator training: Hanford Facility personnel who perform emergency coordinator duties in WAC 173-303-360 (e.g., Building Emergency Director) in the Hanford Incident Command System receive training on implementation of the contingency plan and fulfilling the position within the Hanford Incident Command System. These Hanford Facility personnel also must become thoroughly familiar with applicable contingency plan documentation, operations, activities, location, and properties of all waste handled, location of all records, and the unit/building layout.

Operations training: Dangerous waste management operations training (e.g., waste designation training, shippers training) is determined on a unit-by-unit basis and considers the type of waste management unit (e.g., container management unit) and the type of activities performed at the waste management unit (e.g., sampling). For example, training provided for management of dangerous waste in containers is different than the training provided for management of dangerous waste in a tank system. Common training required for compliance within similar waste management units can be provided in general training and supplemented at the TSD unit. Training provided for TSD unit-specific operations is identified in the training plan documentation based on: (1) whether a general training course exists, (2) the training needs to ensure waste management unit compliance with WAC 173-303, and (3) training commitments agreed to with Ecology.

8.1.2 Continuing Training

Continuing training meets the requirements for WAC 173-303-330(1)(b) and includes general Hanford Facility training and TSD unit-specific training.

General Hanford Facility training: Annual refresher training is provided for general Hanford Facility training. Refer to description in DOE/RL-91-28, Section 8.1.

Contingency plan training: Annual refresher training is provided for contingency plan training. Refer to description in Section 8.1.1.

Emergency coordinator training: Annual refresher training is provided for emergency coordinator training. Refer to description in Section 8.1.1.

Operations training: Refresher training occurs on many frequencies (i.e., annual, every other year, every 3 years) for operations training. When justified, some training will not contain a refresher course and will be identified as a one-time only training course. The TSD unit-specific training plan documentation specifies the frequency for each training course. Refer to description in Section 8.1.1.

8.2 DESCRIPTION OF TRAINING DESIGN

Proper design of a training program ensures personnel who perform duties on the Hanford Facility related to WAC 173-303-330(1)(d) are trained to perform their duties in compliance with WAC 173-303. Actual job tasks, referred to as duties, are used to determine training requirements. The first step taken to ensure

Hanford Facility personnel have received the proper training is to determine and document the waste management duties by job title/position. The second step compares waste management duties to general waste management unit training curriculum. If general waste management unit training curriculum does not address the waste management duties, the training curriculum is supplemented and/or on-the-job training is provided. The third step summarizes the content of a training course necessary to ensure that the training provided to each job title/position addresses associated waste management duties. The last step is to assign training curriculum to Hanford Facility personnel based on the previous evaluation. The training plan documentation contains this process.

Waste management duties include those specified in Section 8.1 as well as those contained in WAC 173-303-330(1)(d). Training elements of WAC 173-303-330(1)(d) applicable to the LLBG operations include the following:

- Procedures for using, inspecting, repairing, and replacing emergency and monitoring equipment
- Communications or alarm systems
- Response to fires or explosions
- Response to groundwater contamination incidents

Hanford Facility personnel who perform these duties receive training pertaining to their duties. The training plan documentation described in Section 8.3 contains specific information regarding the types of training Hanford Facility personnel receive based on the outline in Section 8.1.

8.3 DESCRIPTION OF TRAINING PLAN

In accordance with HF RCRA Permit (DW Portion), Condition II.C.3, the unit-specific portion of the Hanford Facility Dangerous Waste Permit Application must contain a description of the training plan. Training plan documentation is maintained outside of the Hanford Facility Dangerous Waste Part B Permit Application and the HF RCRA Permit. Therefore, changes made to the training plan documentation are not subject to the HF RCRA Permit modification process. However, the training plan documentation is prepared to comply with WAC 173-303-330(2).

Documentation prepared to meet the training plan consists of hard copy and/or electronic media as provided by HF RCRA Permit (DW Portion), Condition II.C.1. The training plan documentation consists of one or more documents and/or a training database with all the components identified in the core document.

A description of how training plan documentation meets the three items in WAC 173-303-330(2) is as follows:

1. -330(2)(a): "The job title, job description, and name of the employee filling each job. The job description must include requisite skills, education, other qualifications, and duties for each position."

   Description: The specific Hanford Facility personnel job title/position is correlated to the waste management duties. Waste management duties relating to WAC 173-303 are correlated to training courses to ensure training properly is assigned.

   Only names of Hanford Facility personnel who carry out job duties relating to TSD unit waste management operations at the LLBG are maintained. Names are maintained within the training plan documentation. A list of Hanford Facility personnel assigned to the LLBG is available upon request.

Information on requisite skills, education, and other qualifications for job titles/positions is addressed by providing a reference where this information is maintained (e.g., human resources). Specific information concerning job title, requisite skills, education, and other qualifications for personnel can be provided upon request.

2. -330(2)(b): "A written description of the type and amount of both introductory and continuing training required for each position."

   Description: In addition to the outline provided in Section 8.1, training courses developed to comply with the introductory and continuing training programs are identified and described in the training plan documentation. The type and amount of training is specified in the training plan documentation as shown in Table 8-1.

3. -330(2)(c): "Records documenting that personnel have received and completed the training required by this section. The Department may require, on a case-by-case basis, that training records include employee initials or signature to verify that training was received."

   Description: Training records are maintained consistent with DOE/RL-91-28, Section 8.4.

Table 8-1. LLBG Training Matrix.

	Training Category*					
DOE/RL-91-28 Chapter 8.0 Training Category	General Hanford Facility Training	Contingency Plan Training	Emergency Coordinator Training	Operations Training		
LLBG DWTP implementing category	Orientation Program	Emergency Response (contingency plan)	Emergency Coordinator Training	General Waste Management	Container Management	Landfill Management
Job title/position						
Nuclear Chemical Operator (NCO)	X	X		X	X	X
Operations Team Lead	X	X	X	X		
Operations Manager	X	X	X	X	X	
Environmental Compliance Officer (ECO)	X			X	X	
Non-Resident Waste Service Provider	X			X	X	

* Refer to the LLBG Dangerous Waste Training Plan for a complete description of coursework in each training category.

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9.0 EXPOSURE INFORMATION REPORT

Exposure information for the LLBG is discussed in the General Information Portion (DOE/RL-91-28).

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CONTENTS

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10.0 WASTE MINIMIZATION [D-9]

To fulfill the requirements of 40 CFR 264.73(b)(9), a certification form that the LLBG have a waste minimization/pollution prevention program in place is entered annually into the LLBG operating record.

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Table 11-1. Potential Interferences/Integration Opportunities With Closure Cap. T11-1

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11.0 CLOSURE AND FINANCIAL ASSURANCE [I]

This chapter discusses closure and postclosure activities for the regulated portions of the LLBG; regulated portions of the LLBG are areas of mixed waste disposal. Mixed waste is defined as waste containing both a radioactive component and post-August 19, 1987 RCRA/WAC 173-303 regulated waste. Mixed waste disposal areas include trenches 31 and 34 in the 218-W-5 Burial Ground, trench 94 in 218-E-12B Burial Ground, specific areas within trenches in other burial grounds (as identified in Chapter 1.0 and Chapter 2.0) and additional areas of future mixed waste disposal activity. The current status of each burial ground is provided in Chapter 2.0, Section 2.1. This closure plan complies with WAC 173-303-610 and represents the baseline for closure of the LLBG.

The closure process will be the same for partial closure or closure of the entire LLBG. The remainder of this chapter describes the performance standards that will be met and the closure/postclosure activities that will be conducted.

Federal facilities are not required to comply with WAC 173-303-620 as is stated in the regulations and as described in Condition II.H.3. of the *Dangerous Waste Portion of the Hanford Facility RCRA Permit* (Ecology 2001).

11.1 CLOSURE PLAN [I-1]

Mixed waste that meets LDR is, and will be, disposed in lined trenches that comply fully with RCRA Subtitle C standards (Chapter 4.0). Also, the use of unlined trenches for the disposal of mixed waste is, and will be, performed in accordance with applicable dangerous and hazardous waste regulations (defueled reactor compartments placed in trench 94 meet LDR in their as-built condition). Future mixed waste trenches will be located in the currently unused portions of the LLBG.

The LLBG RCRA-regulated areas will be closed according to the applicable dangerous waste regulations, DOE requirements, and the best management practices available at the time of closure.

The disposal trench cover(s) will be designed and located to comply with WAC 173-303-665(6) and WAC 173-303-610. The specification and/or variation for other cover designs will be provided at the time of closure once a hazard(s) has been defined. Although a final detailed cover design cannot be provided for all applications at this time, at closure, all covers will be designed to adequately protect human health and the environment.

11.2 CLOSURE PERFORMANCE STANDARDS [I-1a]

The General Information Portion (DOE/RL-91-28, Chapter 11.0) provides a discussion regarding landfill closures.

11.3 PRE-CLOSURE ACTIVITIES

It is assumed that pre-closure activities could include, at a minimum, placing interim or final covers over the lined mixed waste trenches once these trenches are no longer receiving waste. Placement of covers over individual trenches might be deferred until closure of the entire LLBG. Once a decision is made to construct final covers over the various burial grounds, a cover will be designed based on the hazard to be

isolated. A closure cover design that satisfies the dangerous waste disposal requirements as defined in WAC 173-303 will be placed over the lined mixed waste trenches at the time of closure.

As stated previously, the majority of the LLBG are used only for low-level waste disposal (SWMU) and this disposal is outside the regulatory scope of RCRA and WAC 173-303. However, the low-level portions do impact the ability to perform final closure of the RCRA portions of the LLBG. Another significant impact affecting closure of the LLBG is integration with nearby CERCLA operable units, operating TSD units (e.g., Double-Shell Tank System and active burial grounds), roads, rails, and utility lines. These considerations could impact closure schedules. A combined approach to address all waste sites (dangerous waste and nondangerous waste) might be necessary (Table 11-1).

A maintenance and inspection program is implemented during the pre-closure period to control erosion (e.g., the planting of shallow-rooted plants; an ongoing visual monitoring program to remove any deep rooted plants, filling in areas of subsidence, correcting any wind or water erosion if observed, and burrowing animals and insect intrusion) and other natural deterioration that could compromise human health or the environment. On filling an entire burial ground, a detailed analysis might be necessary to determine the best method for final closure.

The LLBG are located in an arid climate. To date, no known releases (radioactive and/or mixed waste) have been detected from the LLBG (Chapter 5.0). As stated previously, as a trench is filled, soil is added to make the trench match the surrounding topography and a program of erosion prevention is initiated. An exception is trench 94 of the 218-E-12B Burial Ground. To maximize the disposal capacity of this trench, the best operating method is to delay backfilling until the trench is filled with defueled reactor compartments. Other exceptions for delay would depend on best waste management practices.

The selection of a cover design has not been identified. The specification and/or variation for other designs will be provided at the time of closure once the hazard(s) has been defined. Although a final detailed cover design cannot be provided for all applications at this time, at closure, all covers will be designed to adequately protect human health and the environment. Design(s) will include features to satisfy the minimum requirements found in WAC 173-303-665(6).

11.4 MAXIMUM EXTENT OF OPERATION [I-1b(1)]

The design capacity of the LLBG for mixed waste conservatively is calculated to be 1,740,000 cubic meters (Chapter 1.0).

11.5 DECONTAMINATING STRUCTURES, EQUIPMENT, AND SOIL [I-1b(3)]

All equipment used during closure will be decontaminated as required to ensure the safety of personnel. If, after decontamination activities, waste retrieval equipment or structures are shown to have contamination above the established decontamination standards, the use of such items will be restricted or discontinued. Equipment and structures that cannot be decontaminated to operational standards and contaminated soils, pavements, and waste residuals will be disposed in accordance with WAC 173-303-610(5).

11.6 CLOSURE OF LANDFILL UNITS [I-1e and I-1e(2)]

Closure of the LLBG will be consistent with the closure requirements specified in WAC 173-303-610 where appropriate. The cover design(s) will satisfy the requirements for dangerous waste disposal as defined by WAC 173-303-665(6).

11.6.1 Cover Design [I-1e(2), I-1e(4), I-1e(5), I-1e(6), I-1e(7), and I-1e(8)]

To be effective, an engineered cover must address environmental conditions to ensure proper functioning and reliability. Over the past several decades, technologies have been developed and advanced to enable the effective capping of landfills in accordance with environmental goals. Several cover designs are being considered for use at the LLBG. Designs currently being considered include (1) an evapotranspiration soil cover, (2) a capillary barrier cover, and (3) a modified RCRA Subtitle C cover (DOE/EM-0558 and USAEC 1998).

The evapotranspiration soil cover design (Figure 11-1) limits the downward migration of water by capturing and diverting that water for use by the surface vegetation as well direct water evaporation back into the atmosphere. The evapotranspiration soil cover design consists of a layer of soil covered by native vegetation. The cover uses two natural processes to control infiltration: (1) the soil provides a water reservoir for natural evaporation from the soil plus, (2) plant transpiration empties the remaining soil water reservoir that has not been lost via evaporation. The evaporation to precipitation ratio is naturally most favorable in arid and semi-arid areas. The evapotranspiration cover consists of an optimum mix of soil texture, soil thickness, and vegetative cover species that maximize use of any incident precipitation throughout the year. Under arid and semi-arid environmental conditions, vegetation can provide an effective means of controlling or minimizing the subsurface infiltration of water. During the winter months when plant transpiration is minimal or non-existent and evaporation is minimal, the evapotranspiration cover should be thick enough and fine enough textured to be able to store precipitation (rain or snow melt) until the spring when the process of evaporation significantly increases and plant transpiration becomes active once again.

The capillary barrier cover design (Figure 11-2) uses the difference in pore-size distributions and the corresponding differences in capillary (suction) forces, under unsaturated conditions, to retain water in the upper soil layer. This condition will persist as long as the contrast in the unsaturated soil properties, as indicated by soil moisture characteristic curves and unsaturated hydraulic conductivities, is sufficiently large. To be effective, the upper soil layer must have significantly larger suction than the underlying soil layer at the same water content. Consequently, a capillary barrier is created when a relatively fine-grained soil overlies a relatively coarse-grained soil. For any appreciable flow to occur into the lower soil layer (i.e., drainage layer), capillary forces in the fine-grained upper soil layer must approach zero, which occurs only under saturated or near saturated conditions. When a vertical-moving wetting front comes in contact with a contrasting soil textural layer, water tends to move in the horizontal direction. Therefore, with a convex-shaped cap, infiltrating water is diverted to the outside of the landfill cap where water can be diverted to a suitable disposal area. In addition, roots tend to follow moisture therefore, the capillary barrier concurrently can function as a bio-intrusion barrier for plants. Another added benefit with the capillary barrier is that most burrowing animals tend to follow the roots.

The RCRA Subtitle C (Figure 11-3) cover was designed to meet the requirements for closure of hazardous and mixed waste landfills, as promulgated in 40 CFR 264 and 265, Subpart N. The RCRA cover employs barrier technology and typically includes five layers above the waste. The top layer consists of cover soil that supports a grass cover that provides wind- and water-erosion control. The second layer is a drainage layer designed to quickly remove any water that percolates through the cover

soil and is stopped by the underlying barrier layer. The third layer, a barrier or impermeable layer, consists of a low-permeability layer(s) (e.g., compacted clays). A gas-control layer could be needed under the barrier layer to remove landfill gases before gases can accumulate to harmful amounts. The bottom layer is a foundation layer of variable thickness and material that separates the waste from the cover and establishes sufficient gradient to promotes rapid and complete surface drainage from the finished cover. All covers could be armored on the surface and sideslopes with some type of coarse fragments (e.g., pebbles for the surface of the barrier and cobbles or stones for the sideslopes).

The EPA accepts alternative cover designs that consider site-specific conditions, climate, nature of the waste, and covers that meet the intent of the regulations (e.g., covers that are protective of human health and the environment). RCRA closure cover requirements include the following conditions:

- Minimize liquid migration
- Minimize maintenance
- Minimize cover erosion
- Minimize subsidence
- Permeability of the cover must be less that or equal to that of the base.

Both evapotranspiration and capillary barriers have been evaluated extensively by Sandia National Laboratory, more recently at DOE's Nevada Test Site, as well as several commercial hazardous waste landfills in the arid/semi-arid west. Deployment and subsequent testing of alternative RCRA C covers have been conducted under EPA's Alternative Cover Assessment Program (ACAP). The goal of ACAP is to evaluate the adequacy of various proposed alternative cover systems. ACAP currently is focusing on evapotranspiration covers and results are very promising for deploying evapotranspiration caps in arid and semi-arid climatic regimes. Currently, there are 13 sites throughout the U.S. participating in the ACAP study. There are several landfills in California's arid and semi-arid areas that are using evapotranspiration covers after receiving regulatory approval (Gunter 2001). The evapotranspiration closure cover is discussed extensively in a draft Region 9 EPA guidance document on closure covers entitled "Technical Guidance for RCRA/CERCLA Final Covers-Draft"-Office of Emergency and Remedial Response-Region 9 EPA (EPA 2002), as well as another EPA draft document entitled "Alternative Earthen Final Cover Design Guidance" (Dwyer 2002).

Dwyer (Dwyer 1998) has demonstrated that there is a construction cost savings of over 50% when comparing the evapotranspiration cover and the compacted clay cover. Another advantage that the evapotranspiration cover has over the conventional RCRA C covers, as well as the capillary barrier cover, is that the covers are very low in maintenance costs and are somewhat self-healing during periods of differential settling, as the soil tends slough into the low-lying, subsided areas. In contrast, with a typical RCRA Subtitle C cover or the 8 layer Modified RCRA C Cover, differential settlement can lead to tearing of the geomembrane and cracking of the underlying clay or asphalt barrier. Therefore, the effectiveness of the drainage layer could be compromised and even could act as a funnel for water to flow into the underlying waste. Another advantage the evapotranspiration cover has over the RCRA Subtitle C cover is that the geomembrane could create a slip plane, thereby decreasing sideslope stability of the cover (Dwyer 2002))

11.6.1.1 Vegetative Cover

The vegetative cover would perform three functions. First, the plants would return water stored in the surface soil back to the atmosphere, significantly decreasing net infiltration and reducing the amount of moisture available to penetrate the cover. Second, the vegetation would stabilize the surface soil component of the cover against wind and water erosion. Finally, the vegetative cover would restore the appearance of the land to a more natural condition and appearance.

A mixture of seeds would be used to establish vegetation. The seed types would be selected based on resistance to drought, rooting density, and ability to extract water.

11.6.1.2 Wind Erosion

The principal hazard associated with wind erosion is the thinning of the cover surface soil layer. This in turn potentially could lead to breaching of the moisture barriers, gradually allowing larger quantities of water to reach the waste. The engineering approaches to mitigating wind erosion of the cover would be (1) designing the surface soil layer with an appropriate total thickness to compensate for future soil loss that might result from wind erosion, (2) establishing a vegetative cover on the surface to reduce wind erosion, and (3) including an appropriate coarse material (admix) in the upper layer of the surface soil to form an armor layer.

11.6.1.3 Water Erosion

The potential hazard associated with water erosion is the same as that for wind erosion, namely the loss of soil from the top or surface layer. Several of the following engineering approaches could be adopted to minimize the potential for water erosion:

- Limiting the surface slopes
- Providing run-on control with the sideslope drainage ditches
- Compacting the surface soil in a way that promotes significant infiltration rather than excessive run-off
- Properly designing the sideslopes to prevent gullying
- Establishing a vegetative cover to slow surface run-off
- Incorporating coarse material (pea gravel admix) in the upper portion of the surface soil layer to help form an erosion-resistant armor
- Limiting flow path lengths through the use of vegetation and admix.

The cover design would be evaluated for potential erosion damage from overall soil erodibility, sheet flow, and gullying.).

11.6.1.4 Deep-Rooted Plants

Design features could minimize the potential for problems with deep-rooted plants. The surface soil (top two layers) would retain most of the precipitation, because the underlying drainage layer would have significantly higher permeability and much less water retention capacity. Therefore, it is expected that vegetation preferentially would occupy the surface soil layer and not have an affinity for growing into the drier underlying layers.

The thickness of the surface soils would be sized to promote the development of semiarid deep-rooted perennial grasses and to discourage the development of deep-rooting intrusive species.

11.7 SCHEDULE FOR CLOSURE [I-1f]

Closure of the various LLBG is not expected to occur within the next 30 or more years. At the time of closure, this closure plan will be updated to reflect the current closure plan schedule per WAC 173-303-830, Appendix I. In addition, when a closure date is established, a revised closure plan and closure schedule will be submitted to Ecology that contains detailed information regarding specific activities and implementation timeframes.

11.8 EXTENSION FOR CLOSURE [I-1(g)]

An extension for closure request is anticipated to complete the closure/postclosure process of the LLBG.

11.9 POSTCLOSURE PLAN [I-3]

Because of the long active life of the LLBG, a comprehensive postclosure plan will be developed when closure becomes imminent.

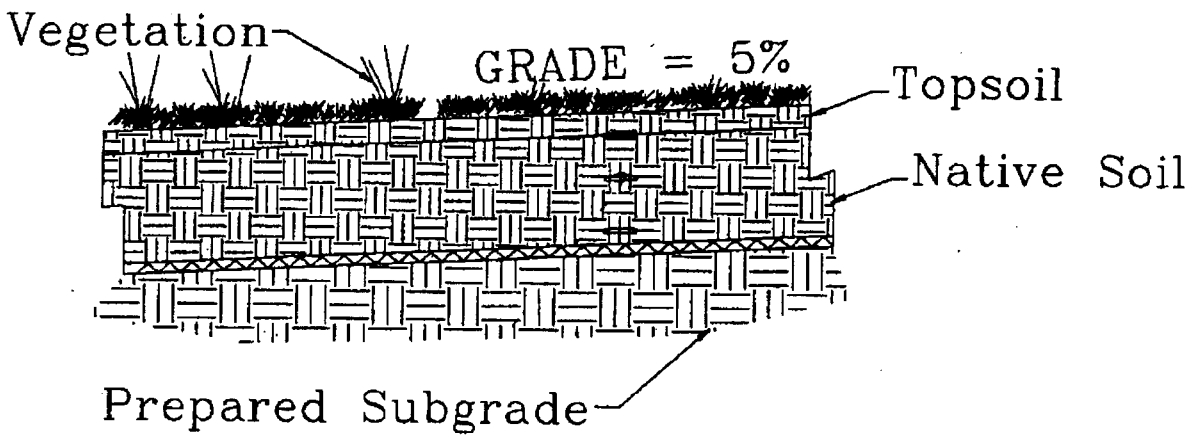

Figure 1. Example Evapotranspiration Cover Design.

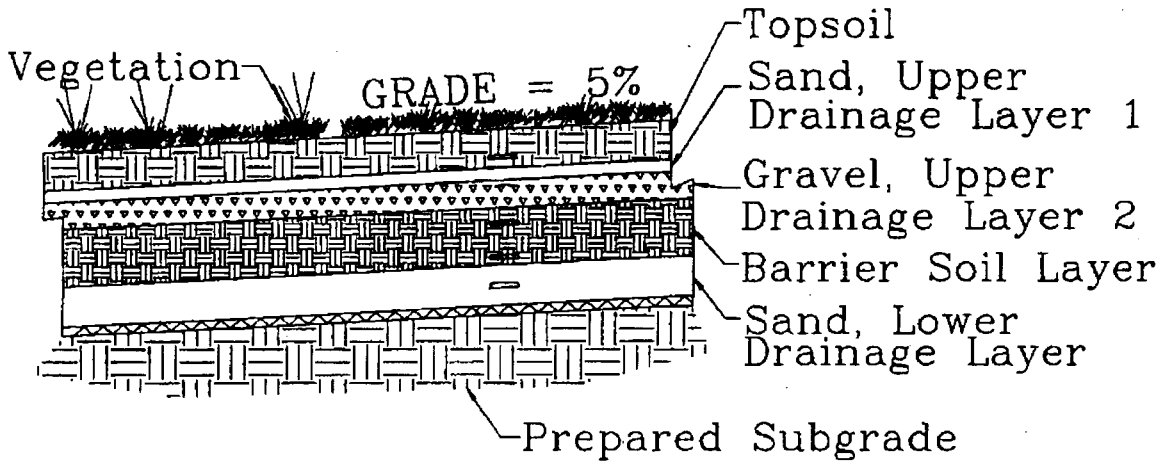

Figure 2. Example Capillary Barrier Cover Design (number of layers could vary).

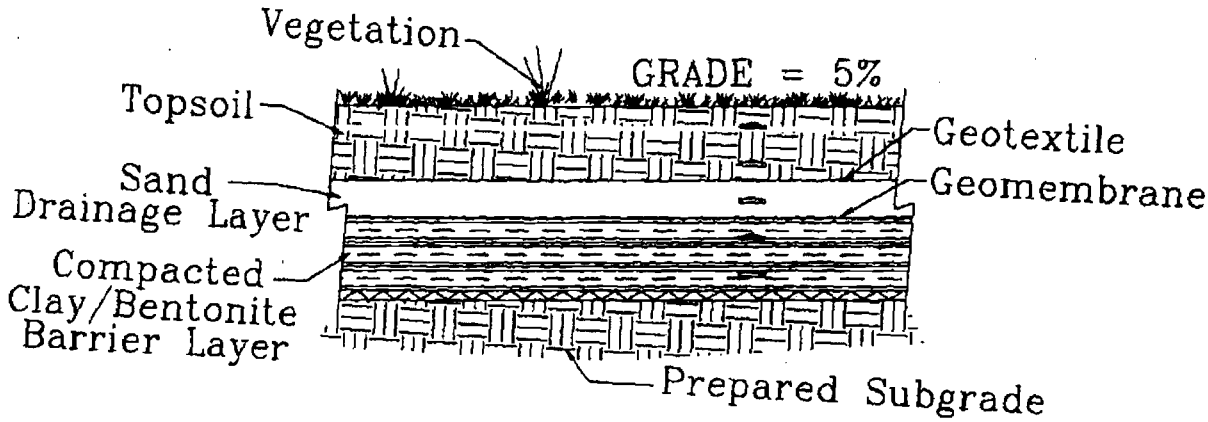

Figure 3. Typical RCRA Subtitle C Landfill Cover Design.

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Table 11-1. Potential Interferences/Integration Opportunities With Closure Cap.

Burial Ground	Predominant waste received	Active TSD units in vicinity	Operable unit	Roads	Railroads	Utilities
218-E-10	Low-level	No	200-BP-10	Akron Avenue, 12th Street	Yes	Electrical
218-E-12B	Low-level, defueled reactor compartments (mixed waste)	No	200-PO-6	Canton Avenue, 12th Street	No	Electrical, telephone
218-W-3A	Low-level	218-W-3AE, 218-W-5	200-ZP-3	Dayton Avenue, 27th Street	No	No
218-W-3AE	Low-level	218-W-3A, 218-W-6	200-ZP-3, 200-TP-3	27th Street	Yes	No
218-W-4B	Low-level	218-W-4C	200-ZP-3	Dayton Avenue, 19th Street	Yes	Electrical
218-W-4C	Low-level	218-W-4B	200-ZP-3, 200-ZP-1, 200-UP-1	Dayton Avenue, 16th Street, 19th Street	Yes	Pump and treat; electrical
218-W-5	Low-level, mixed waste	218-W-3A, WRAP Facility	200-ZP-3	Dayton Avenue, 23rd Street	No	Electrical, telephone
218-W-6	Future mixed waste	218-W-3AE	200-ZP-3	27th Street	Yes	Electrical

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CONTENTS

12.0 REPORTING AND RECORDKEEPING 12-1

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12.0 REPORTING AND RECORDKEEPING

Reporting and recordkeeping requirements that could be applicable to the Hanford Facility are described in Chapter 12.0 of the General Information Portion (DOE/RL-91-28). Not all of these requirements and associated reports and records identified in Chapter 12.0 of the General Information Portion are applicable to the LLBG. Those reporting and recordkeeping requirements determined to be applicable to the LLBG are summarized as follows:

- Contingency Plan and incident records:
  - Immediate reporting
  - Written reporting
  - Manifesting and/or waste transfer discrepancy reports.
- Unit-specific Part B permit application documentation and associated plans
- Personnel training records
- Groundwater monitoring records
- Inspection records (unit)
- Onsite transportation documentation
- Land disposal restriction records
- Waste minimization and pollution prevention.

In addition, the following reports prepared for the Hanford Facility will contain input, when appropriate, from the LLBG:

- Quarterly Hanford Facility RCRA Permit modification report
- Anticipated noncompliance
- Required annual reports.

Annual reports updating projections of anticipated costs for closure and postclosure are described in the General Information Portion (DOE/RL-91-28).

The LLBG Operating Record 'records contact' is kept on file in the General Information file of the Hanford Facility Operating Record (refer to DOE/RL-91-28, Chapter 12.0).

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CONTENTS

13.0 OTHER FEDERAL AND STATE LAWS [J] 13-1

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13.0 OTHER FEDERAL AND STATE LAWS [J]

Federal, state, and local laws applicable to the LLBG are discussed in Chapter 13.0 of the General Information Portion (DOE/RL-91-28). Generally, the laws applicable to the LLBG include, but might not be limited to, the following:

- *Atomic Energy Act of 1954*
- *Federal Facility Compliance Act of 1992*
- *Clean Air Act of 1977*
- *Safe Drinking Water Act of 1974*
- *Emergency Planning and Community Right-to-Know Act of 1986*
- *Toxic Substances Control Act of 1976*
- *National Historic Preservation Act of 1966*
- *Endangered Species Act of 1973*
- *Fish and Wildlife Coordination Act of 1934*
- *Federal Insecticide, Fungicide, and Rodenticide Act of 1975*
- *Hazardous Materials Transportation Act of 1975*
- *National Environmental Policy Act of 1969*
- *Washington Clean Air Act of 1967*
- *Washington Water Pollution Control Act of 1945*
- *Washington Pesticide Control Act of 1971*
- *Benton Clean Air Authority Regulation 1*
- *State Environmental Policy Act of 1971.*

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CONTENTS

14.0 PART B CERTIFICATION [K] 14-1

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14.0 PART B CERTIFICATION [K]

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

_____ _____

Owner/Operator Date
Keith A. Klein, Manager
U.S. Department of Energy,
Richland Operations Office

_____ _____

Co-operator* Date
E. Keith Thomson,
President and Chief Executive Officer
Fluor Hanford

* Fluor Hanford is responsible for information presented in Chapters 1.0 through 4.0 and 6.0 through 15.0, including the associated appendices.

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14.0 PART B CERTIFICATION [K]

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

_____ _____

Owner/Operator Date
Keith A. Klein, Manager
U.S. Department of Energy,
Richland Operations Office

_____ _____

Co-operator* Date
Lura J. Powell, Director
Pacific Northwest National Laboratory

* Pacific Northwest National Laboratory is responsible for information presented in Chapter 5.0, including any associated appendices.

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CONTENTS

15.0 REFERENCES 15-1

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15.0 REFERENCES

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APPENDICES

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3A	WASTE ANALYSIS PLAN FOR LOW-LEVEL BURIAL GROUNDS
4A	CONSTRUCTION QUALITY ASSURANCE REPORT
4B	DEFINITIVE DESIGN
4C	RESPONSE ACTION PLAN
4D	REQUEST FOR EXEMPTION FROM LINED TRENCH REQUIREMENTS AT 218-E-12B BURIAL GROUND TRENCH 94
4E	SITE INVESTIGATION REPORT
4F	9090A TEST RESULTS
4G	SOIL LINER PERFORMANCE CALCULATIONS
5A	SELECTED GROUNDWATER CONTAMINANT PLUME MAPS IN THE 200 AREAS
5B	SUMMARIZED RESULTS OF GROUNDWATER MONITORING (1988-2001)
5C	WELL CONSTRUCTION DATA (AS-BUILT DIAGRAMS)
5D	MONITORING EFFICIENCY MODEL OUTPUT
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5F	DETAILED GROUNDWATER FLOW CHARACTERIZATION WITHIN LOW-GRADIENT AREAS: INITIAL RESULTS FOR LOW-LEVEL WASTE MANAGEMENT AREA 1
7A	BUILDING EMERGENCY PLAN FOR LOW-LEVEL BURIAL GROUNDS

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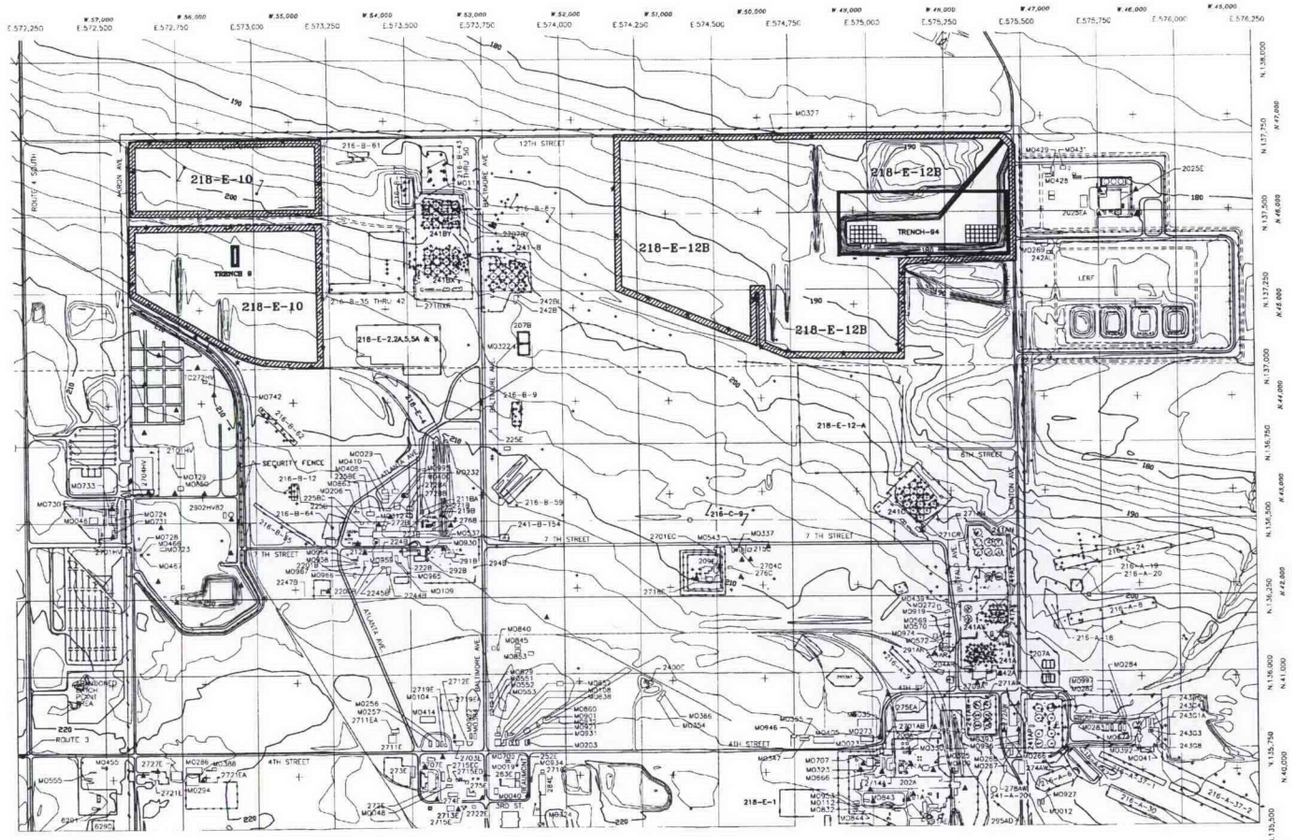
APPENDIX 2A

TOPOGRAPHIC MAPS

TOPOGRAPHIC MAPS

H-13-000259, Rev. 2	200 East Area Low-Level Burial Grounds.
H-13-000260, Rev. 2	200 West Area Low-Level Burial Grounds.



SITE PLAN

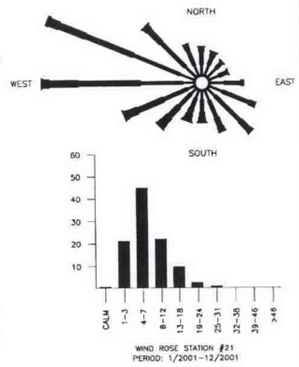
SCALE: 1:6000

0 60 120 240 360 480

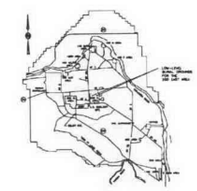
1 cm = 60 meters

LEGEND

- W +7,000 / X 43,000 — HANFORD PLANT COORDINATES (FEET)
- E 576,250 / N 136,000 — WASHINGTON STATE COORDINATES (METERS)
- MAJOR CONTOUR (METERS)
- MINOR CONTOUR (METERS)
- IMPROVED ROAD
- UNIMPROVED ROAD
- DIRT ROAD
- SIDEWALKS\PARKING LOTS
- RAILROADS
- RETAINING WALL
- BUILDINGS/STRUCTURES & TOWERS
- 242A — BUILDING NUMBER
- MOBILE OFFICES
- SECURITY,WARNING,MISC FENCES
- POST & CHAIN (CRIB,BURIAL GROUND FENCES)
- PERIMETER FENCES
- WELL
- TANKS
- PROCESS SEWER
- SANITARY SEWER
- 216-A-42 — CRIB
- 218-E-10 — BURIAL GROUND
- ACTIVE TSD UNIT BOUNDRY (HAS RECEIVED OR WILL RECEIVE MIXED WASTE POST-AUGUST 19, 1987)
- TREATMENT, STORAGE, AND/OR DISPOSAL (TSD) UNIT BOUNDRY
- WITHDRAWAL WELL
- INJECTION WELL
- RCRA MONITORING WELLS FOR LLBG
- FIRE HYDRANTS



WIND ROSE STATION #21
PERIOD: 1/2001-12/2001



KEY PLAN

SCALE: NONE

GENERAL NOTES

1. THIS MAP IS BASED ON AERIAL PHOTOGRAPHY FLOWN ON 6-24-89. THE ORIGINAL TOPOGRAPHIC MAP WAS PREPARED BY MERRICK & COMPANY AND CERTIFIED TO MEET NATIONAL MAP ACCURACY STANDARDS. OFFICIAL COPIES OF THE MERRICK MAPS THAT SHOW THE CERTIFICATE ARE LOCATED IN THE LOCKHEED MARTIN ENGINEERING FILES AS DRAWING NUMBERS H-2-79476 SHEET 1 AND H-2-79477 SHEET 1 THRU 37. NAMES OF ADDITIONAL FEATURES AND THE TITLE BLOCK WERE ADDED BY WESTINGHOUSE HANFORD COMPANY.

2. WASHINGTON STATE PLANE COORDINATE SYSTEM: THE OFFICIAL COORDINATE SYSTEM AS DEFINED BY THE REVISED CODE OF WASHINGTON (RCW). THE HANFORD SITE LIES WITHIN THE WASHINGTON COORDINATE SYSTEM, SOUTH ZONE. THIS GRID COVERS THE ENTIRE SITE AND USES X (EASTINGS) AND Y (NORTHINGS) COORDINATES.

   HORIZONTAL DATUM: NAD-83 LAMBERT PROJECTION. WASHINGTON STATE PLANE COORDINATES ARE SHOWN IN METERS.

   CONTOUR INTERVAL: 2.5 METERS.

3. HANFORD PLANT GRID: A LOCAL GRID SYSTEM WITH ITS INITIAL POINT NORTHEAST OF THE 400 AREA. IT COVERS 200 EAST AND 200 WEST AREA AS WELL AS GENERAL SITE WORK SUCH AS WELLS AND BURIAL GROUNDS. HANFORD COORDINATES ARE SHOWN IN FEET.

4. TH ELOW LEVEL BURIAL GROUNDS ARE NOT WITHIN THE 100 YEAR FLOOD PLAIN AREA.

DRAFT

THIS MAP IS TO BE USED FOR REFERENCE PURPOSES ONLY. DO NOT USE THIS MAP FOR CONSTRUCTION PURPOSES.

DWG NO	TITLE
H-13-000205 THRU H-13-000207	200 AREA TOPOGRAPHIC MAP
H-13-000213 THRU H-13-000218	200 AREA TOPOGRAPHIC MAP
H-13-000221 THRU H-13-000224	200 AREA TOPOGRAPHIC MAP
H-13-000228 THRU H-13-000231	200 AREA TOPOGRAPHIC MAP

DRAWING TRACEABILITY LIST — REFERENCES — NEXT USED ON H-13-000200

REV NO	DESCRIPTION	REV BY/DATE	CHK BY/DATE	DATA APVD/DATE	COG ENGR	OTHER	OTHER
2	DRAWING UPDATE FOR PART B PERMIT/ LLBC. HAF-FMP-02-10546	JAS 04/02					
1	INCORPORATED ECN 637453	PAM 05/98					

REVISIONS — CADFILE N000259A — CADCODE WN95/ACD2:14.0:SS

Drawn RAFAEL TORRES 4-30-87
CHECKED
DTG APVD
COG ENGR
APVD
APVD
APVD
APVD
APVD
APVD

SEE REVISION 0

U.S. DEPARTMENT OF ENERGY
Richland Operations Office
Fluor Daniel North West

200 EAST AREA LOW-LEVEL BURIAL GROUNDS TOPOGRAPHIC MAP

SIZE	BLDG NO	INDEX NO	DWG NO	REV
F	200E	0103	H-13-000259	2

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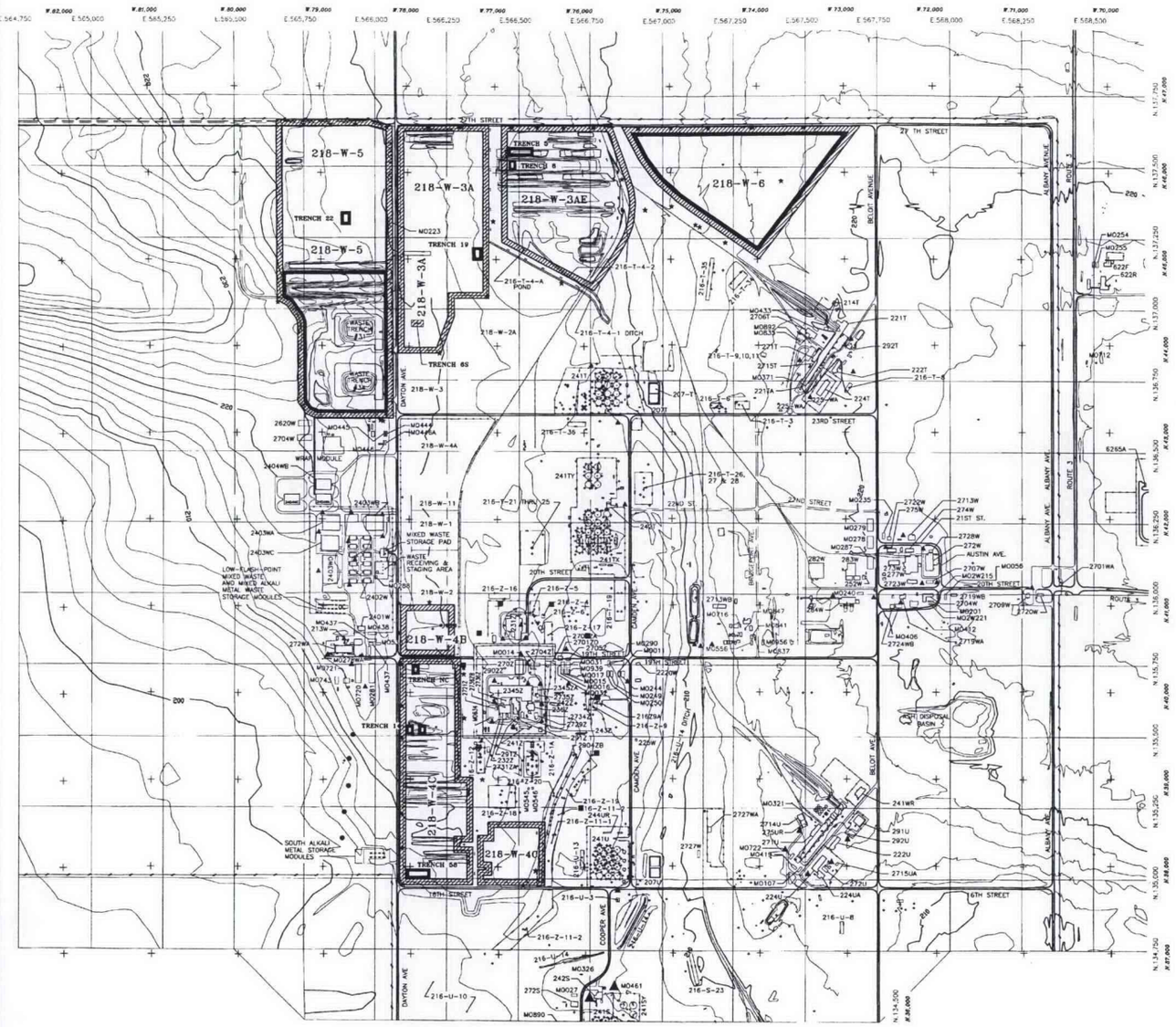
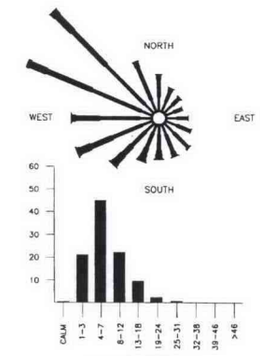
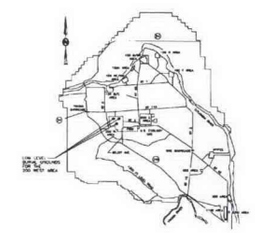


LEGEND

- HANFORD PLANT COORDINATES (FEET)
- WASHINGTON STATE COORDINATES (METERS)
- INDEX CONTOUR (METERS)
- INDEX CONTOUR (METERS)
- IMPROVED ROAD
- UNIMPROVED ROAD
- DIRT ROAD
- SIDEWALKS\PARKING LOTS
- RAILROADS
- RETAINING WALL
- BUILDINGS/STRUCTURES & TOWERS
- 224-T BUILDING NUMBER
- MOBILE OFFICES
- SECURITY,WARNING,MISC FENCES
- POST & CHAIN (CRIB,BURIAL GROUND FENCES)
- PERIMETER FENCES
- WELL
- TANKS
- 216-A-42 CRIB
- 218-W-5 BURIAL GROUND
- ACTIVE WASTE MANAGEMENT AREA (HAS RECEIVED OR WILL RECEIVE MIXED WASTE POST-AUGUST 19, 1987)
- TREATMENT, STORAGE, AND/OR DISPOSAL (TSD) UNIT BOUNDARY
- WITHDRAWAL WELL
- INJECTION WELL
- RCRA MONITORING WELLS FOR LLBG
- FIRE HYDRANTS



WIND ROSE STATION #21
PERIOD: 1/2001-12/2001



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2. WASHINGTON STATE PLANE COORDINATE SYSTEM: THE OFFICIAL COORDINATE SYSTEM AS DEFINED BY THE REVISED CODE OF WASHINGTON (RCW). THE HANFORD SITE LIES WITHIN THE WASHINGTON COORDINATE SYSTEM, SOUTH ZONE. THIS GRID COVERS THE ENTIRE SITE AND USES X (EASTINGS) AND Y (NORTHINGS) COORDINATES. HORIZONTAL DATUM: NAD-83 LAMBERT PROJECTION. WASHINGTON STATE PLANE COORDINATES ARE SHOWN IN METERS. CONTOUR INTERVAL: 2.5 METERS.
3. HANFORD PLANT GRID: A LOCAL GRID SYSTEM WITH ITS INITIAL POINT NORTHEAST OF THE 400 AREA. IT COVERS 200 EAST AND 200 WEST AREA AS WELL AS GENERAL SITE WORK SUCH AS WELLS AND BURIAL GROUNDS. HANFORD COORDINATES ARE SHOWN IN FEET.

KEY PLAN

SCALE: NONE

DRAFT

THIS MAP IS TO BE USED FOR REFERENCE PURPOSES ONLY. DO NOT USE THIS MAP FOR CONSTRUCTION PURPOSES.

SITE PLAN

SCALE: 1:6000

0 60 120 240 360 480

1 cm = 60 meters

DWG NO	TITLE
H-13-000201 THRU	200 AREA TOPOGRAPHIC MAP
H-13-000203	200 AREA TOPOGRAPHIC MAP
H-13-000206 THRU	200 AREA TOPOGRAPHIC MAP
H-13-000211	200 AREA TOPOGRAPHIC MAP
H-13-000217 THRU	200 AREA TOPOGRAPHIC MAP
H-13-000218	200 AREA TOPOGRAPHIC MAP
H-13-000225 THRU	200 AREA TOPOGRAPHIC MAP
H-13-000227	200 AREA TOPOGRAPHIC MAP
H-13-000233	200 AREA TOPOGRAPHIC MAP
H-13-000234	200 AREA TOPOGRAPHIC MAP
REF NUMBER	TITLE

DRAWING TRACEABILITY LIST

REFERENCES

NEXT USED ON H-13-000200

REV NO	DESCRIPTION	REV BY DATE	CHK BY DATE	DFTG DATE	COG ENGR	OTHER	OTHER
2	DRAWING UPDATE FOR PART B PERMIT/ LLBG, HNF-FMP-02-10546	JAS 04/02					
1	INCORPORATED ECN 637453	PMM 05/98					

REVISIONS

APPROVALS BY/DATE

CADFILE N000260A CADCODE WN95:ACD2:12.0:SS

DRAWN RAFAEL TORRES 4-30-87

CHECKED

DFTG APVD

COG ENGR

APVD

APVD

APVD

APVD

APVD

SEE REVISION 0

U.S. DEPARTMENT OF ENERGY
Richland Operations Office
FLUOR FEDERAL SERVICES

200 WEST AREA
LOW-LEVEL BURIAL GROUND
TOPOGRAPHICAL MAP

SIZE	BLDG NO	WBS NO	DWG NO	REV
F	200W	0103	H-13-000260	2

SCALE SHOWN EST HNF-FMP-02-6489 SHEET 1 OF 1

DWG PRINT DATE

COMMENT PRINT DATE

H-13-000260 1 of 1 REV 2

34-6000-027(5/89)

APPENDIX 3A

WASTE ANALYSIS PLAN FOR LOW-LEVEL BURIAL GROUNDS

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GLOSSARY

CAP	corrective action plan
CFR	Code of Federal Regulations
COLIWASA	composite liquid waste sampler
CWC	Central Waste Complex
DOE-RL	U.S. Department of Energy, Richland Operations Office
DST	double-shell tank
Ecology	Washington State Department of Ecology
LDR	land disposal restriction
LLBG	Low-Level Burial Grounds
NDE	nondestructive examination
PES	Performance Evaluation System
PPE	personal protective equipment
QA	quality assurance
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RCW	Revised Code of Washington
SWITS	Solid Waste Information Tracking System
T Plant	T Plant Complex
TRU	transuranic
TSCA	*Toxic Substances Control Act of 1976*
TSD	treatment, storage, and/or disposal
WAC	Washington Administrative Code
WAP	waste analysis plan
WRAP	Waste Receiving and Processing Facility
°C	degree Celsius

METRIC CONVERSION CHART

Into metric units			Out of metric units		
If you know	Multiply by	To get	If you know	Multiply by	To get
Length			**Length**		
inches	25.40	millimeters	millimeters	0.03937	inches
inches	2.54	centimeters	centimeters	0.393701	inches
feet	0.3048	meters	meters	3.28084	feet
yards	0.9144	meters	meters	1.0936	yards
miles (statute)	1.60934	kilometers	kilometers	0.62137	miles (statute)
Area			**Area**		
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.09290304	square meters	square meters	10.7639	square feet
square yards	0.8361274	square meters	square meters	1.19599	square yards
square miles	2.59	square kilometers	square kilometers	0.386102	square miles
acres	0.404687	hectares	hectares	2.47104	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.34952	grams	grams	0.035274	ounces (avoir)
pounds	0.45359237	kilograms	kilograms	2.204623	pounds (avoir)
tons (short)	0.9071847	tons (metric)	tons (metric)	1.1023	tons (short)
Volume			**Volume**		
ounces (U.S., liquid)	29.57353	milliliters	milliliters	0.033814	ounces (U.S., liquid)
quarts (U.S., liquid)	0.9463529	liters	liters	1.0567	quarts (U.S., liquid)
gallons (U.S., liquid)	3.7854	liters	liters	0.26417	gallons (U.S., liquid)
cubic feet	0.02831685	cubic meters	cubic meters	35.3147	cubic feet
cubic yards	0.7645549	cubic meters	cubic meters	1.308	cubic yards
Temperature			**Temperature**		
Fahrenheit	subtract 32 then multiply by 5/9ths	Celsius	Celsius	multiply by 9/5ths, then add 32	Fahrenheit
Energy			**Energy**		
kilowatt hour	3,412	British thermal unit	British thermal unit	0.000293	kilowatt hour
kilowatt	0.94782	British thermal unit per second	British thermal unit per second	1.055	kilowatt
Force/Pressure			**Force/Pressure**		
pounds (force) per square inch	6.894757	kilopascals	kilopascals	0.14504	pounds per square inch

06/2001

Source: *Engineering Unit Conversions*, M. R. Lindeburg, PE., Third Ed., 1990, Professional Publications, Inc., Belmont, California.

LOW-LEVEL BURIAL GROUNDS WASTE ANALYSIS PLAN

1.0 INTRODUCTION

The purpose of this waste analysis plan (WAP) is to document the waste acceptance process, sampling methodologies, analytical techniques, and overall processes that are undertaken for mixed waste accepted for storage and/or disposal at the Low-Level Burial Grounds (LLBG), which are located in the 200 East and 200 West Areas of the Hanford Facility, Richland, Washington. Because dangerous waste does not include the source, special nuclear, and by-product material components of mixed waste, radionuclides are not within the scope of this documentation. The information on radionuclides is provided only for general knowledge. The LLBG also receive low-level radioactive waste for disposal. The requirements of this WAP are applicable to mixed waste, and are not applicable to the low-level radioactive waste. The term 'treatment, storage, and/or disposal (TSD) unit' is used throughout this WAP to refer to the LLBG. Activities could be performed by the LLBG operating organization or its delegated representative.

1.1 DESCRIPTION OF PROCESSES AND ACTIVITIES

The LLBG consist of eight burial grounds located in the 200 East Area and 200 West Area (Figures 1-1 and 1-2). The 218-E-10 and 218-E-12B Burial Grounds are located in the 200 East Area. The 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6 Burial Grounds are located in the 200 West Area (Figures 1-3 through 1-10).

The 218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4C, and 218-W-6 Burial Grounds are landfills, and the 218-W-5 Burial Ground is a landfill and container storage waste management unit. The regulated portions of this TSD unit cover a total area of approximately 49 hectares. Currently, disposal of mixed waste is authorized only in trench 94 of the 218-E-12B Burial Ground and trenches 31 and 34 of the 218-W-5 Burial Ground.

This TSD unit consists of various sizes and depths of lined and unlined disposal trenches. All mixed waste received for disposal meets land disposal restriction (LDR) requirements [Washington Administrative Code (WAC) 173-303-140, "Dangerous Waste Regulations", and 40 Code of Federal Regulations (CFR) 268, "Land Disposal Restrictions"] or other regulatory alternatives (Sections 2.1.3.2 and 7.4). Disposal of mixed waste in unlined trenches (e.g., trench 94) requires an exemption from the liner/leachate collection system and LDR requirements. The lined trenches have leachate collection and removal systems. The leachate collection tanks are operated in accordance with the generator provisions of WAC 173-303-200 and are not subject to this WAP.

Future mixed waste trench development and configuration within a burial ground are subject to change as disposal techniques improve or as waste management needs dictate and will be subject to an approved permit modification in accordance with WA7890008967, "Dangerous Waste Portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste" (Hanford Facility RCRA Permit).

Mixed waste is disposed in lined or in unlined trenches. An electronic database is maintained that documents each waste receipt, type of waste, and disposal location. Table 1-1 provides a brief description and identifies examples of the types of waste disposed in this TSD unit.

1.2 IDENTIFICATION AND CLASSIFICATION OF WASTE

Mixed waste is accepted for disposal in this TSD unit except for the following waste.

- Waste is not accepted for disposal when the waste contains free-standing liquid unless all free-standing liquid:
  - Has been removed by decanting or other methods
  - Has been mixed with sorbent or stabilized (solidified) so that free-standing liquid is no longer observed
  - Has been otherwise eliminated
  - Container is very small, such as an ampoule
  - Container is a labpack and is disposed in accordance with WAC 173-303-161 or 40 CFR 264.316
  - Container is designed to hold free liquids for use other than storage, such as a battery or capacitor.

  There could be cases in which small amounts of residual liquids are present in mixed waste containers because condensate has formed following packaging or free liquids remain in debris items (e.g., pumps, tubing) even after draining. When it is not practical to remove this residual liquid, the free liquid must be eliminated to the extent possible by adding a quantity of sorbent sufficient to sorb all residual liquids.

  Free liquid is determined by SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Method*, Method 9095 (Paint Filter Liquids Test) [WAC 173-303-140(4)(b) and 40 CFR 264.314(d)] only for waste that has the potential for free liquid formation.

- Gaseous waste is not accepted for disposal if the waste is packaged at a pressure in excess of 1.5 atmospheres at 20°C.

- Pyrophoric waste is not accepted for disposal. Waste containing less than 1 weight percent pyrophoric material partially or completely dispersed in each package is not considered pyrophoric for the purposes of this requirement.

- Solid acid waste is not accepted for disposal [WAC 173-303-140(4)(c)].

- Untreated extremely hazardous waste is not accepted for disposal. Extremely hazardous waste that has been treated could be disposed in accordance with Revised Code of Washington (RCW) 70.105.050(2), "Hazardous Waste Management".

- Untreated organic/carbonaceous waste is not accepted for disposal [WAC 173-303-140(4)(d)] except as allowed by WAC 173-303-140(4)(d)(iii).

- Waste not meeting the applicable treatment standards is not accepted for disposal [40 CFR 268 and WAC 173-303-140(4)].

- Mixed waste that is incompatible with the liner system is not accepted in this TSD unit. Table 1-2 provides a list of chemicals that have been shown to be incompatible with the liner material in

concentrated form. In general, mixed waste that meets federal and state treatment standards is compatible with the TSD unit liner system. Waste streams are evaluated during pre- shipment review to ensure that the waste streams do not contain constituents incompatible with the liner system in concentration sufficient to degrade the liner.

The Part A, Form 3, permit application for this TSD unit identifies dangerous waste numbers, quantities, and design capacity (DOE/RL-88-21, *Hanford Facility Dangerous Waste Part A Permit Application*).

1.3 MANAGEMENT OF WASTE

Mixed waste is accepted at this TSD unit for storage and/or disposal. Additionally, mixed waste is generated during normal operation. The onsite generating units, offsite generators, and onsite TSD units transferring/shipping waste to this TSD unit hereafter are referred to as the 'generator' unless otherwise denoted in this WAP. This TSD unit accepts mixed waste from other onsite solid waste project TSD units [i.e., Central Waste Complex (CWC), Waste Receiving and Processing (WRAP) Facility, and T Plant Complex], onsite generator units, and offsite waste generators. The differences in the waste acceptance process for transfers from onsite solid waste project TSD units (Figure 1-11) and onsite generating units and offsite generators (Figure 1-12) are discussed in detail in Section 2.0, "Confirmation Process".

Written waste tracking procedure(s) are implemented to ensure waste received at the TSD unit matches the manifest or transfer papers, to ensure that the waste is tracked though the TSD unit to final disposition, and to maintain the information required in WAC 173-303-380. Waste is tracked through processing such as segregation, repackaging, and/or intra-TSD transfers. The waste tracking process (Figure 1-13) provides a mechanism to track waste through a uniquely identified container. The unique identifier is a barcode (or equivalent) that is recorded in a solid waste information tracking system. This mechanism encompasses the waste acceptance process, the movement of waste, the processing of waste, and management of the waste. The container identification number allows the TSD unit to link to hard copy records that are maintained as part of the operating record to maintain information on the location, quantity, and physical and chemical characteristics of the waste.

The following sections describe the process for waste acceptance and the different types of information and knowledge reviewed/required during the acceptance process. The process for management of waste is described in Chapter 4.0 of this TSD unit dangerous waste permit application documentation (DOE/RL-88-20).

1.3.1 Waste Generated Within the LLBG

This TSD unit generates mixed waste as a result of operational (e.g., chemical, radiological) activities. These activities include storage and transfer functions along with inspection, decontamination, cleanup, and maintenance tasks. This waste material consists of such items as personal protective equipment (PPE), rags, and spent equipment contaminated with cleaning agents, lubricants, paints, or other dangerous materials. Process knowledge, field screening, or sampling and analysis (conducted elsewhere) are used as appropriate to characterize these waste materials. Field screening and sampling are performed in accordance with this WAP and occur at the point of waste generation or at the location where the waste materials are stored.

1.3.2 Waste Acceptance Process for Newly Generated Waste

The LLBG waste acceptance process consists of the following activities.

- **Waste Stream Approval.** The generator provides information concerning each waste stream on a waste profile sheet. The waste stream information is reviewed against the TSD unit waste acceptance criteria. If the waste stream information is sufficient and meets the applicable waste acceptance criteria, the waste stream is approved. In addition, the initial verification frequency for the waste is determined in accordance with the requirements found in the Performance Evaluation System (PES) (Section 2.4). For a more complete description of the waste stream approval process, refer to Section 2.1.1.

- **Waste Shipment Approval.** The generator provides specific data for each waste. The container data are reviewed against the waste profile sheet data and the TSD unit waste acceptance criteria before being approved for shipment. In addition, the TSD unit determines if any of the containers require verification based on the verification frequency as determined by PES. For a more complete description of the waste shipment approval process, refer to Section 2.1.2.

- **Verification.** All waste shipments are subject to receipt inspection during the waste shipment acceptance process. The percentage of the waste shipment selected for physical and/or chemical screening is determined in accordance with the requirements found in PES (Section 2.4). Containers are opened and verified visually or by nondestructive examination (NDE). Of those containers subjected to physical screening, a percentage is subject to chemical screening via field or laboratory analysis. All information and data are evaluated to confirm that the waste matches the waste profile and container data/information supplied by the generator. For a more complete description of the verification process, refer to Section 2.2.

1.3.3 Waste Acceptance Process for Transfers Among Solid Waste Project TSD Units

Waste transfers among onsite solid waste project TSD units could be necessary to support Hanford Site goals. In these instances, a waste stream profile that already has been developed and approved for another solid waste project TSD unit could be used. A technical review for container transfers is performed to confirm that the waste meets this TSD unit's waste acceptance criteria. All waste transfers are subject to receipt inspection. Physical and chemical screening is required for waste previously not accepted at a solid waste project TSD unit. All information and data are evaluated to confirm that the waste matches the container data information. For a more complete description of the transfer process, refer to Section 2.3.

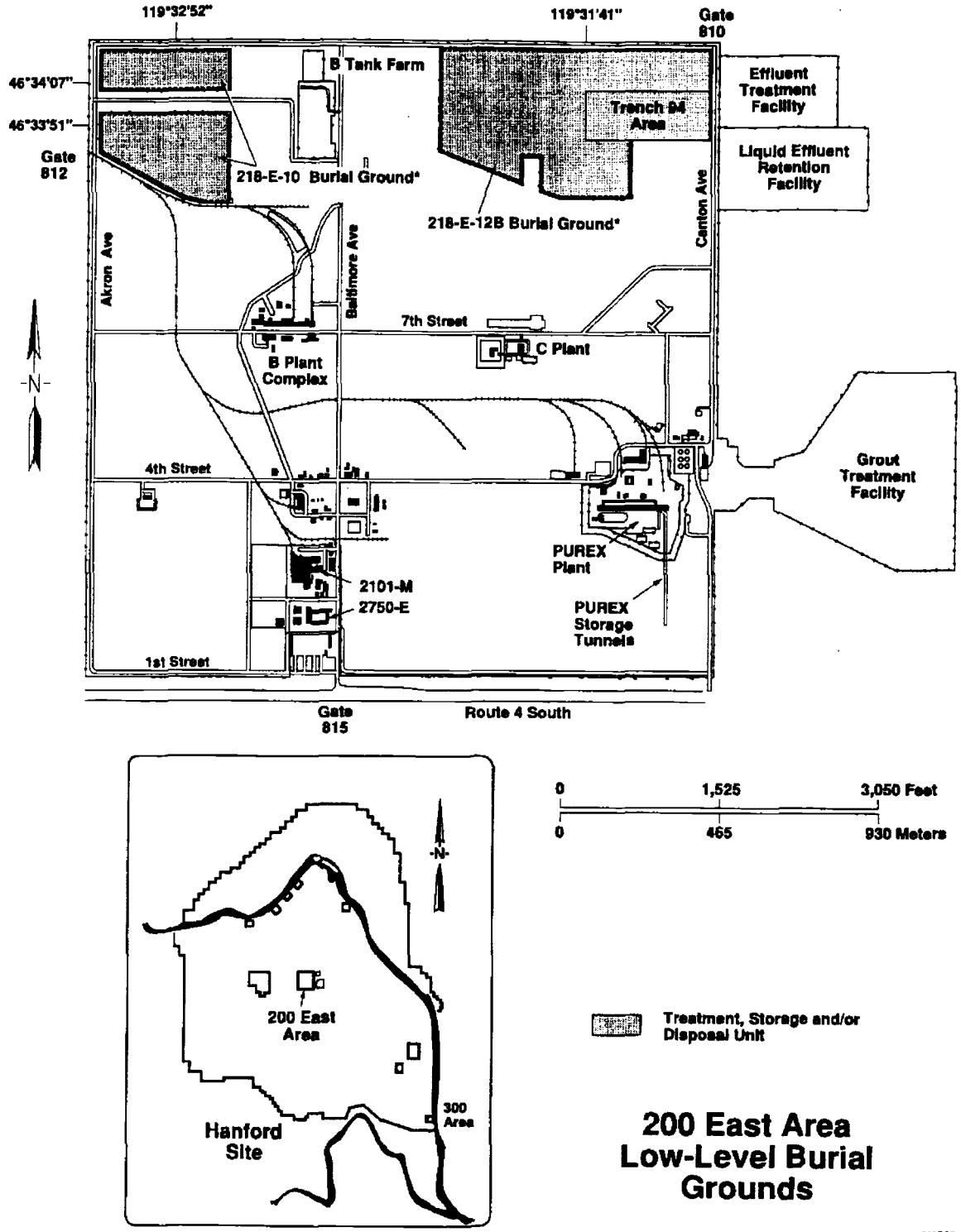

Figure 1-1. Locations of Low-Level Burial Grounds in the 200 East Area.

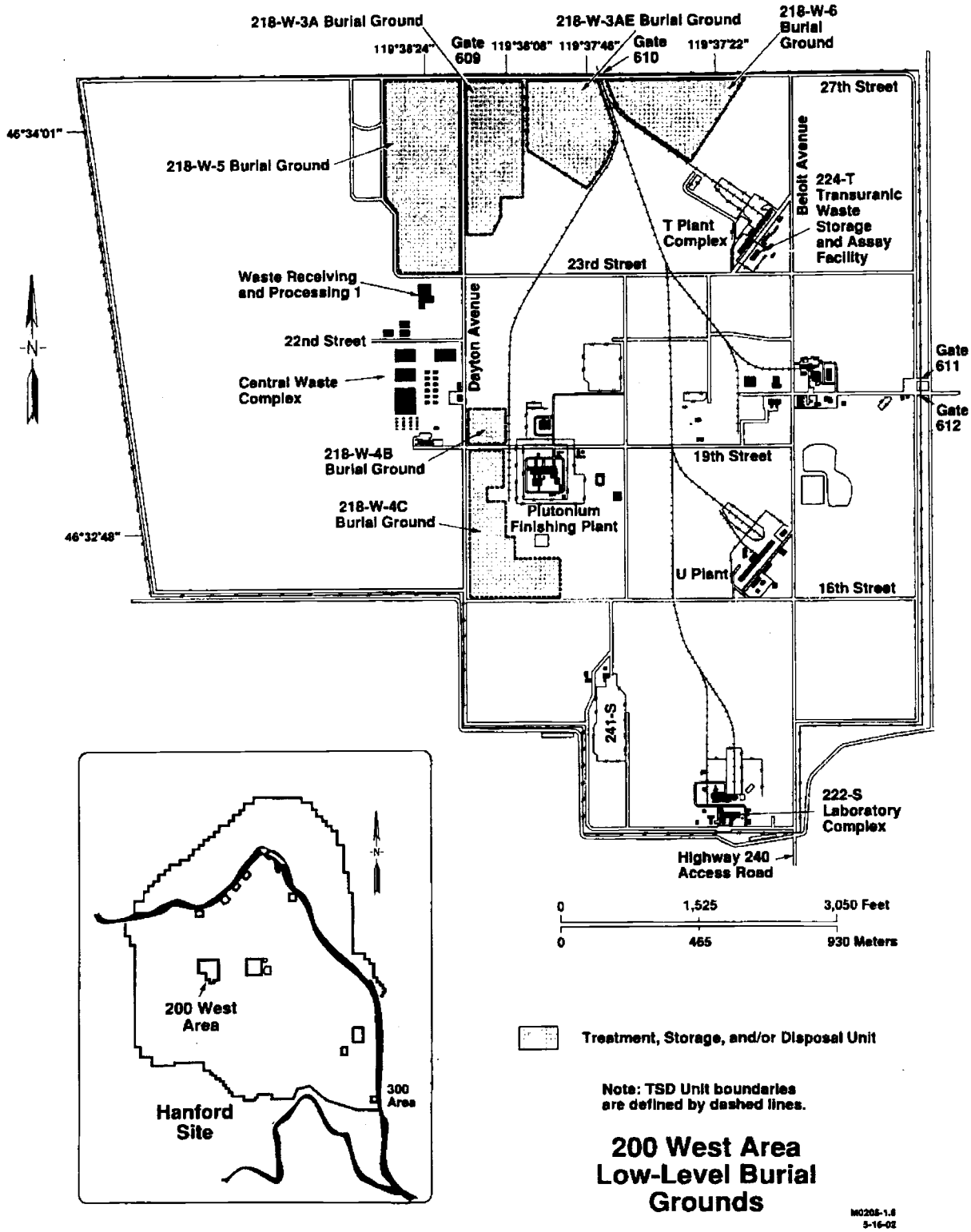

Figure 1-2. Locations of Low-Level Burial Grounds in the 200 West Area.

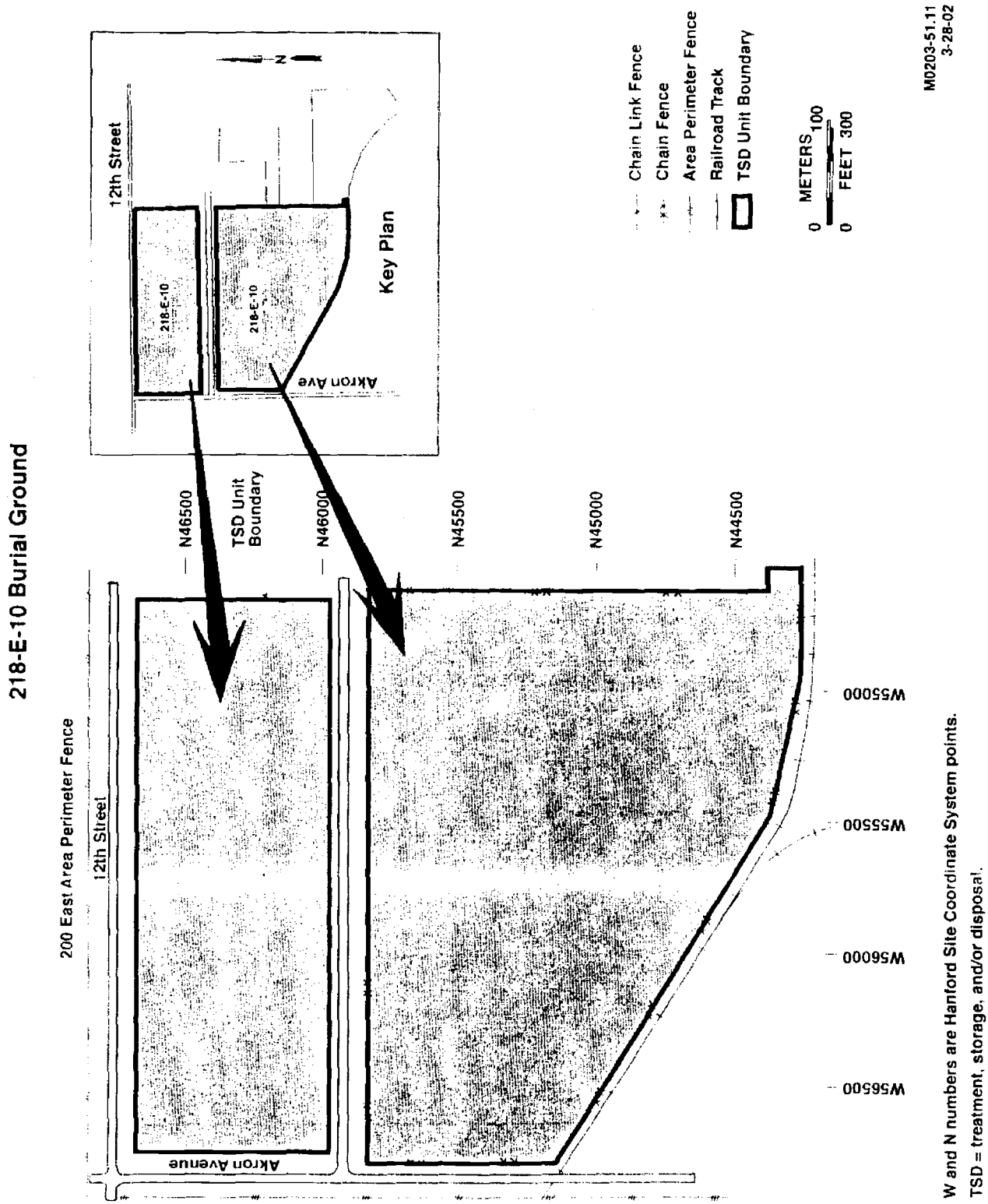

Figure 1-3. 218-E-10 Burial Ground.

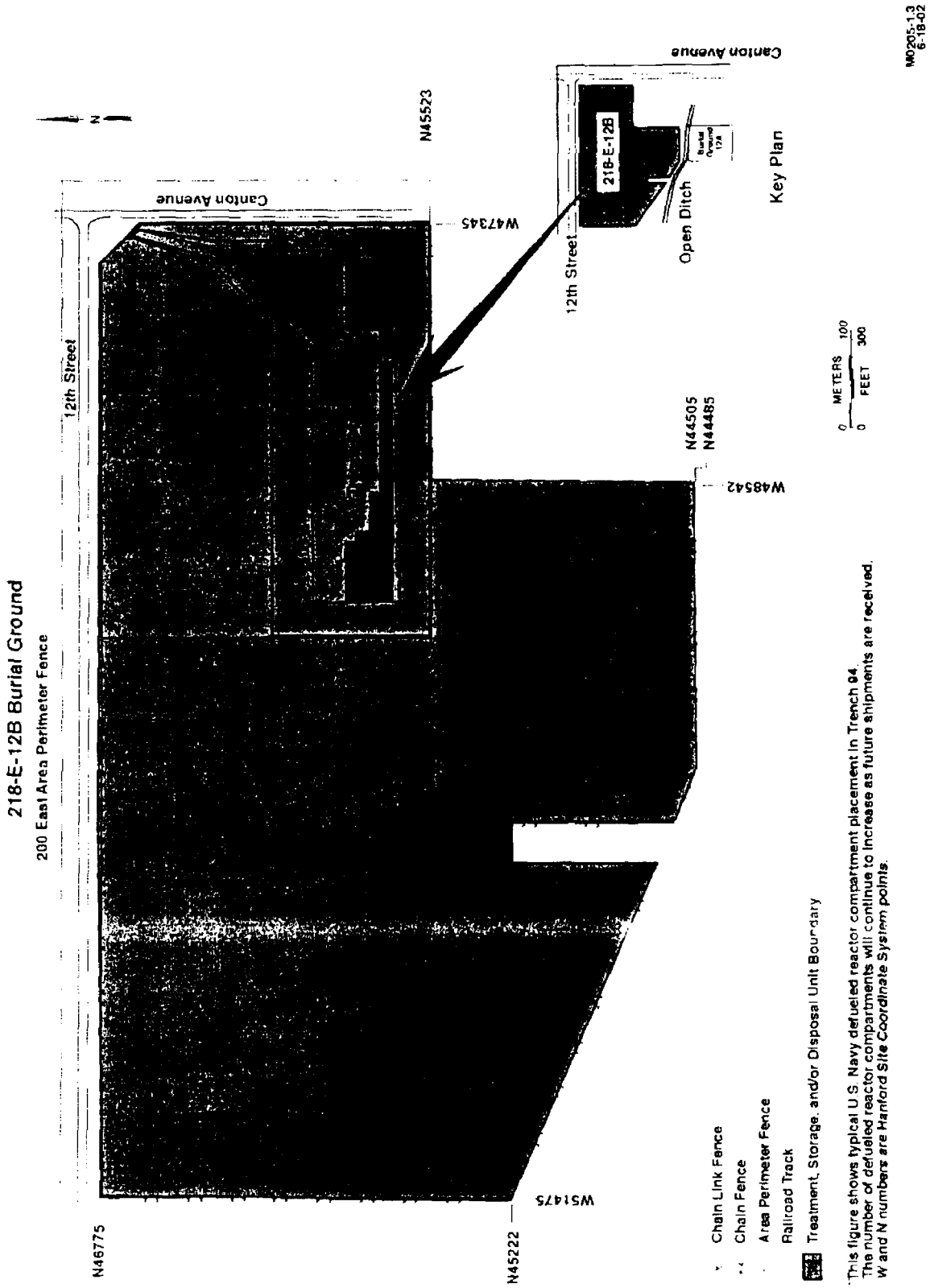

Figure 1-4. 218-E-12B Burial Ground.

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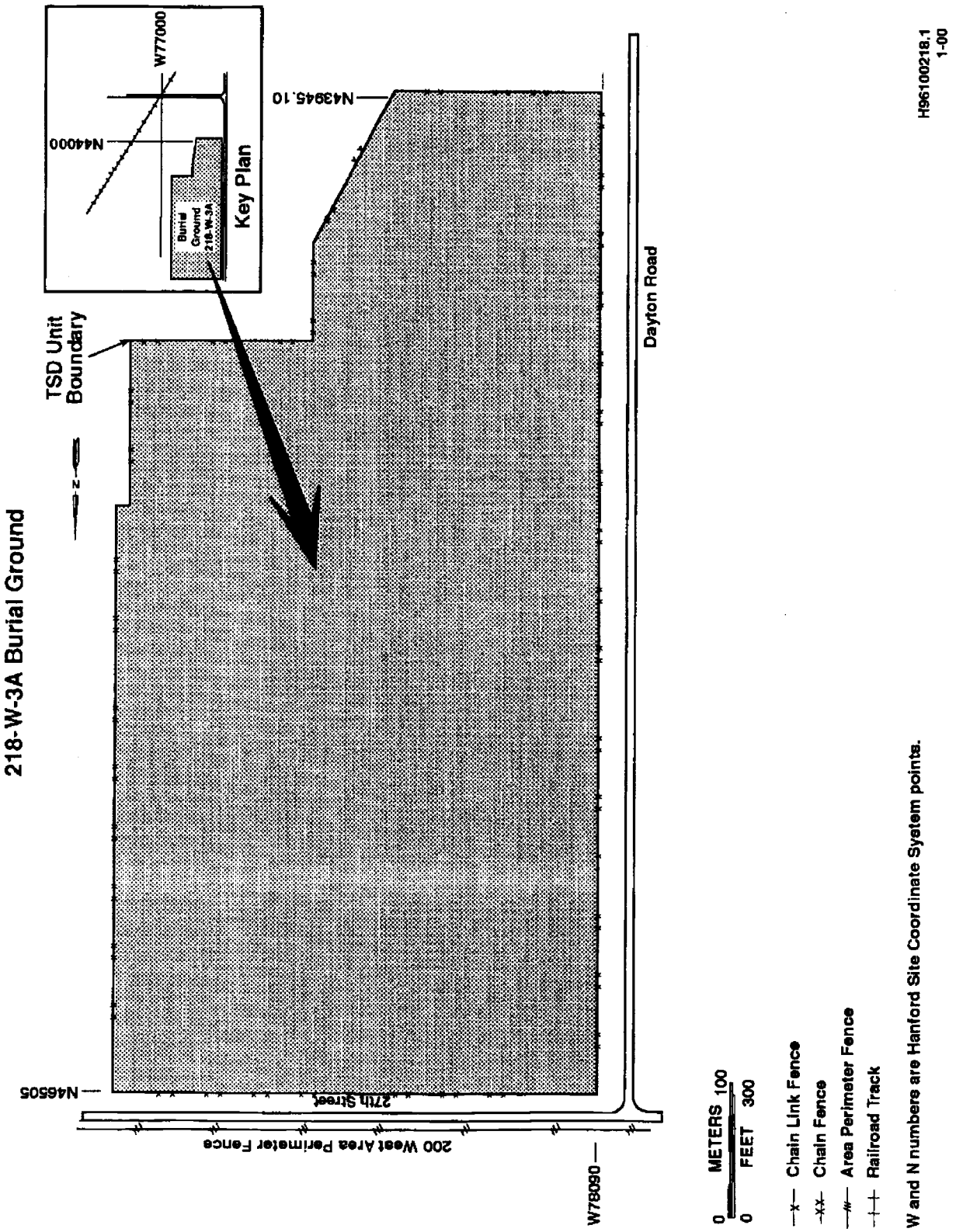

Figure 1-5. 218-W-3A Burial Ground.

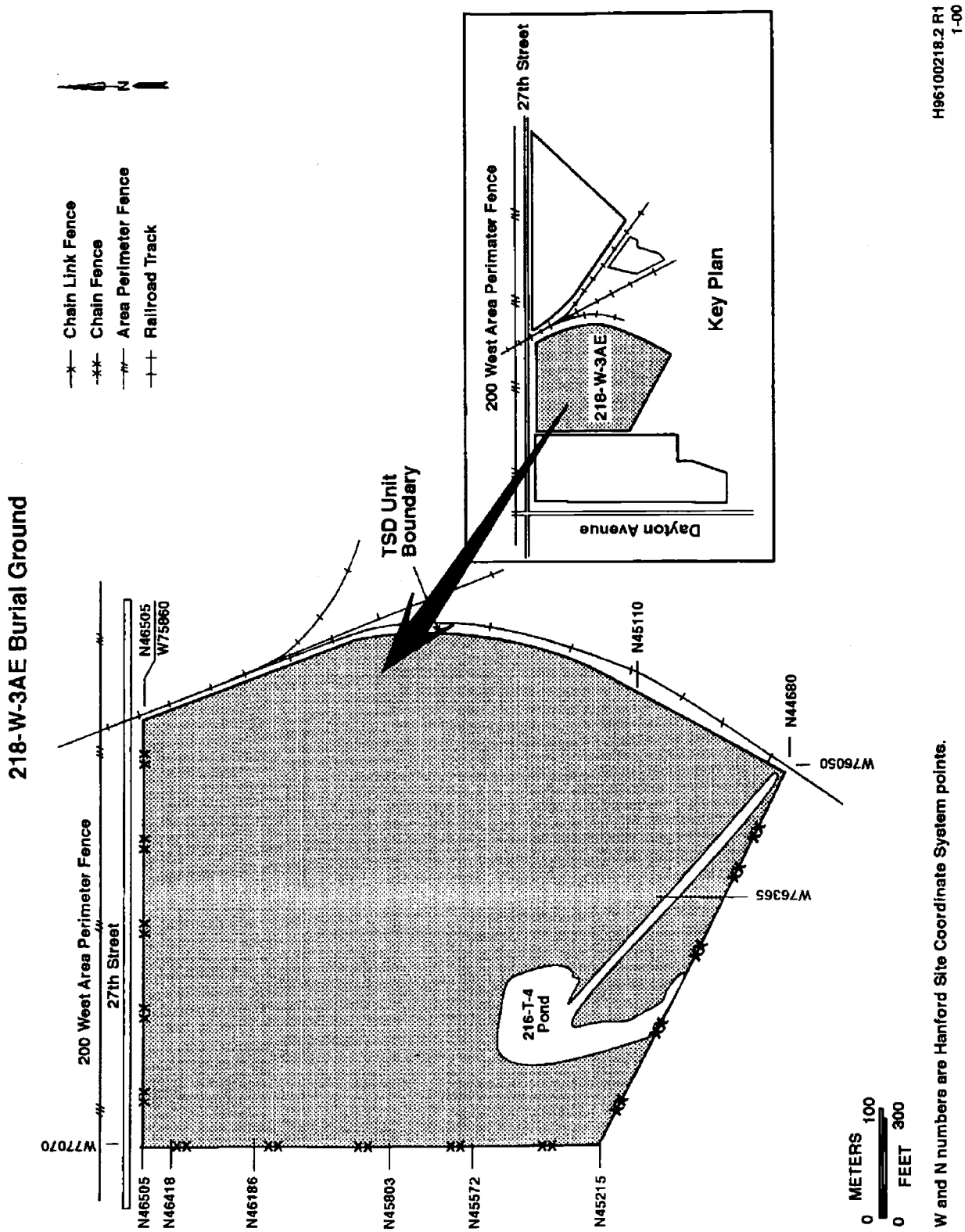

Figure 1-6. 218-W-3AE Burial Ground.

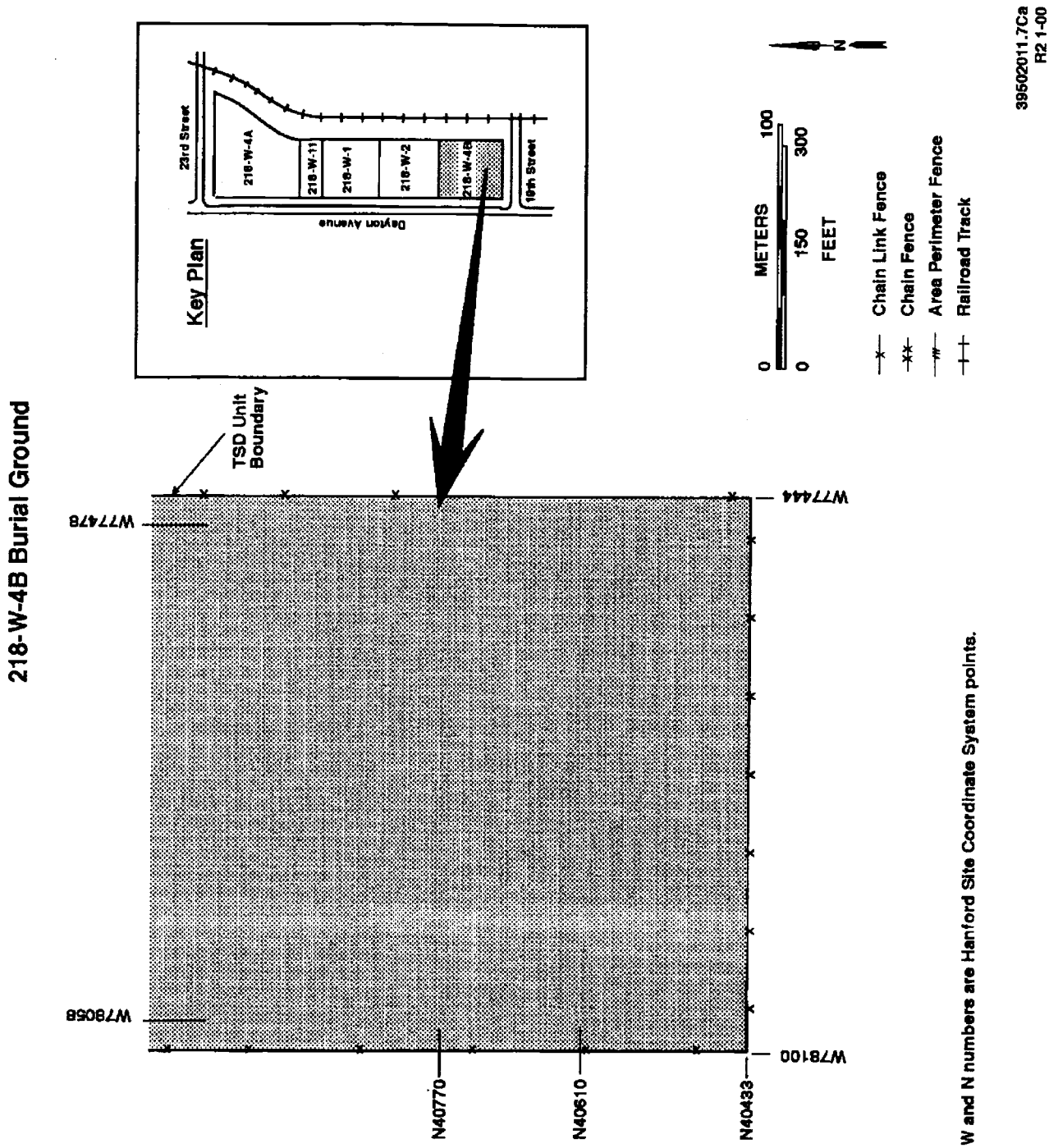

Figure 1-7. 218-W-4B Burial Ground.

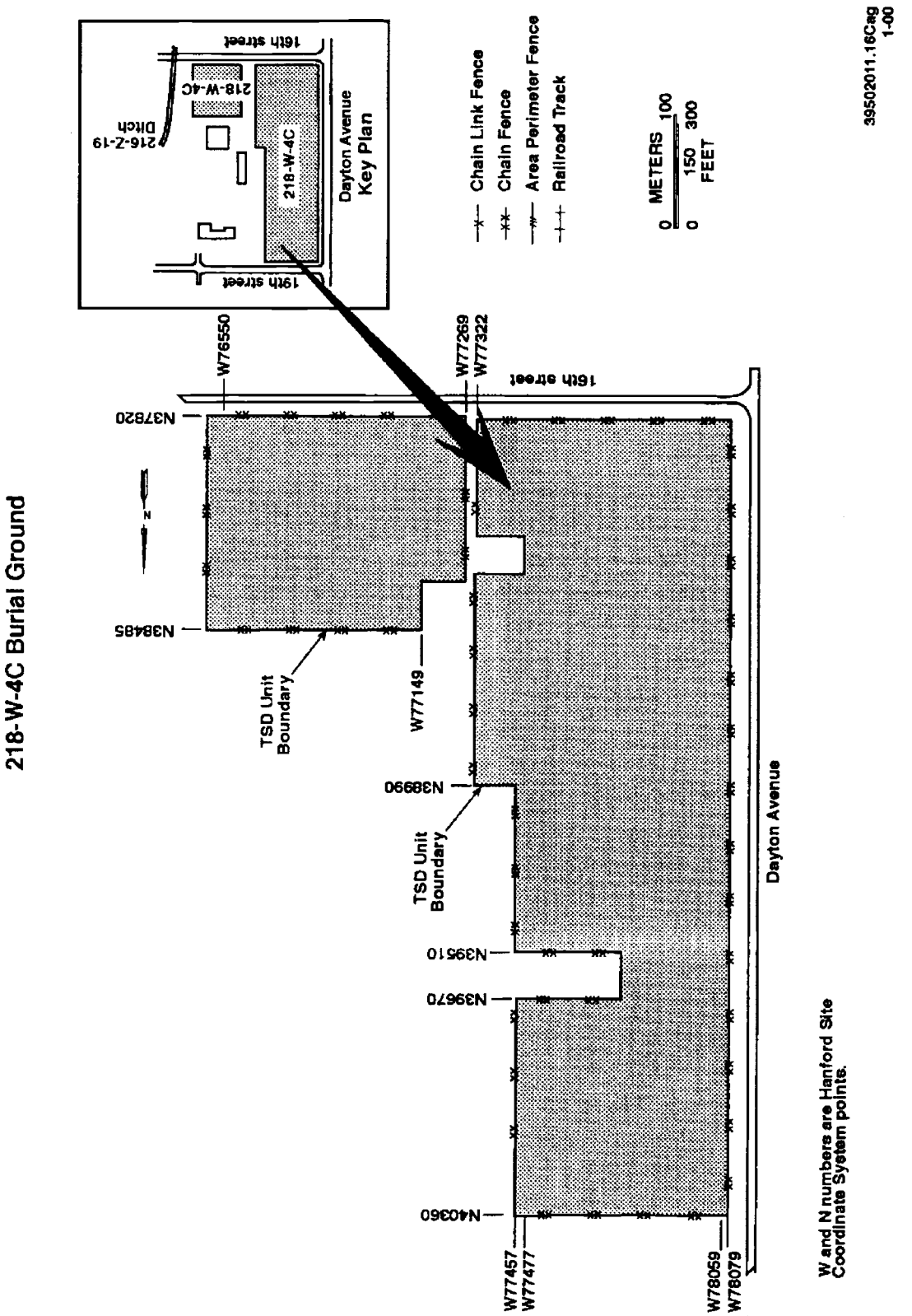

Figure 1-8. 218-W-4C Burial Ground.

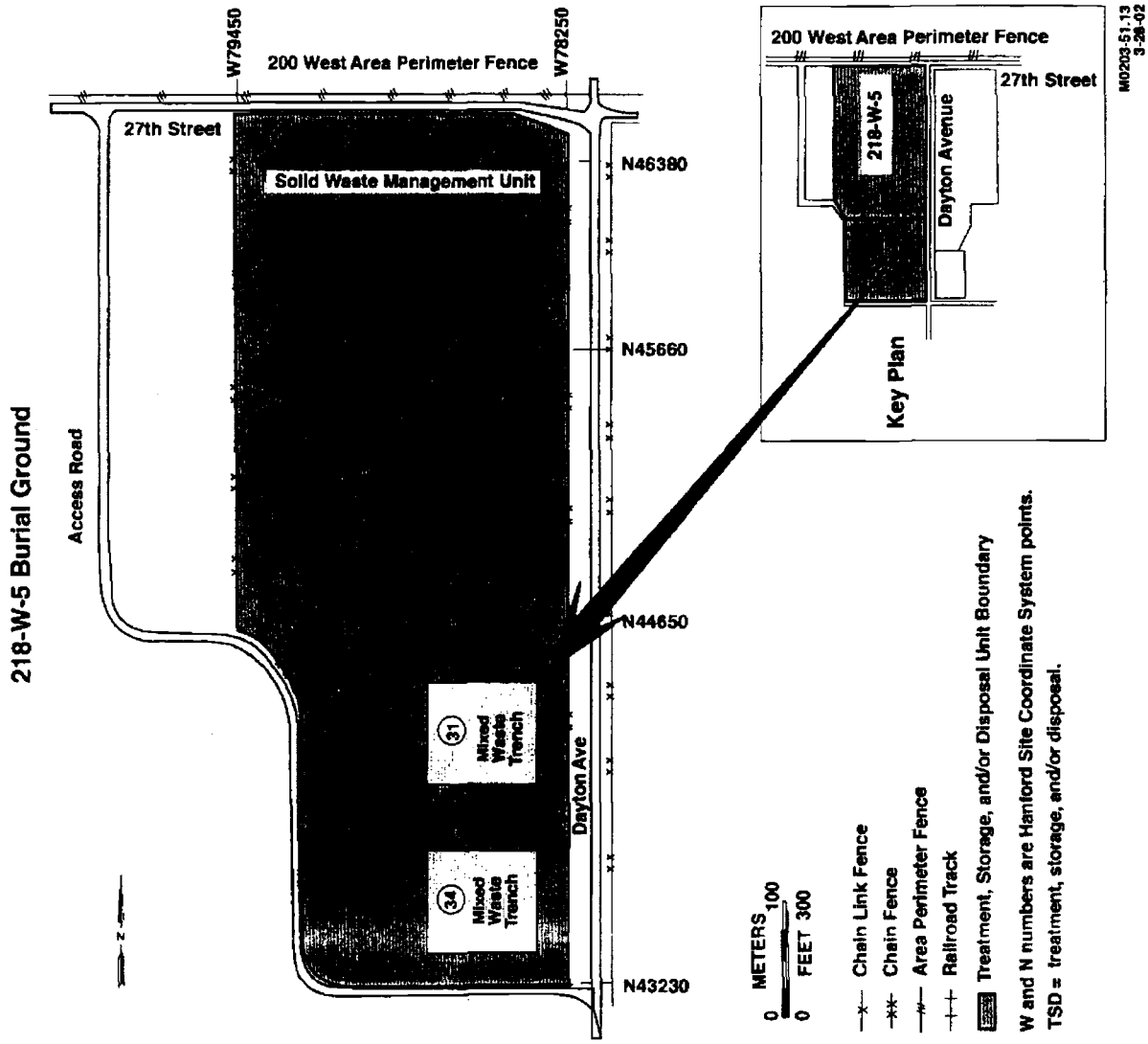

Figure 1-9. 218-W-5 Burial Ground.

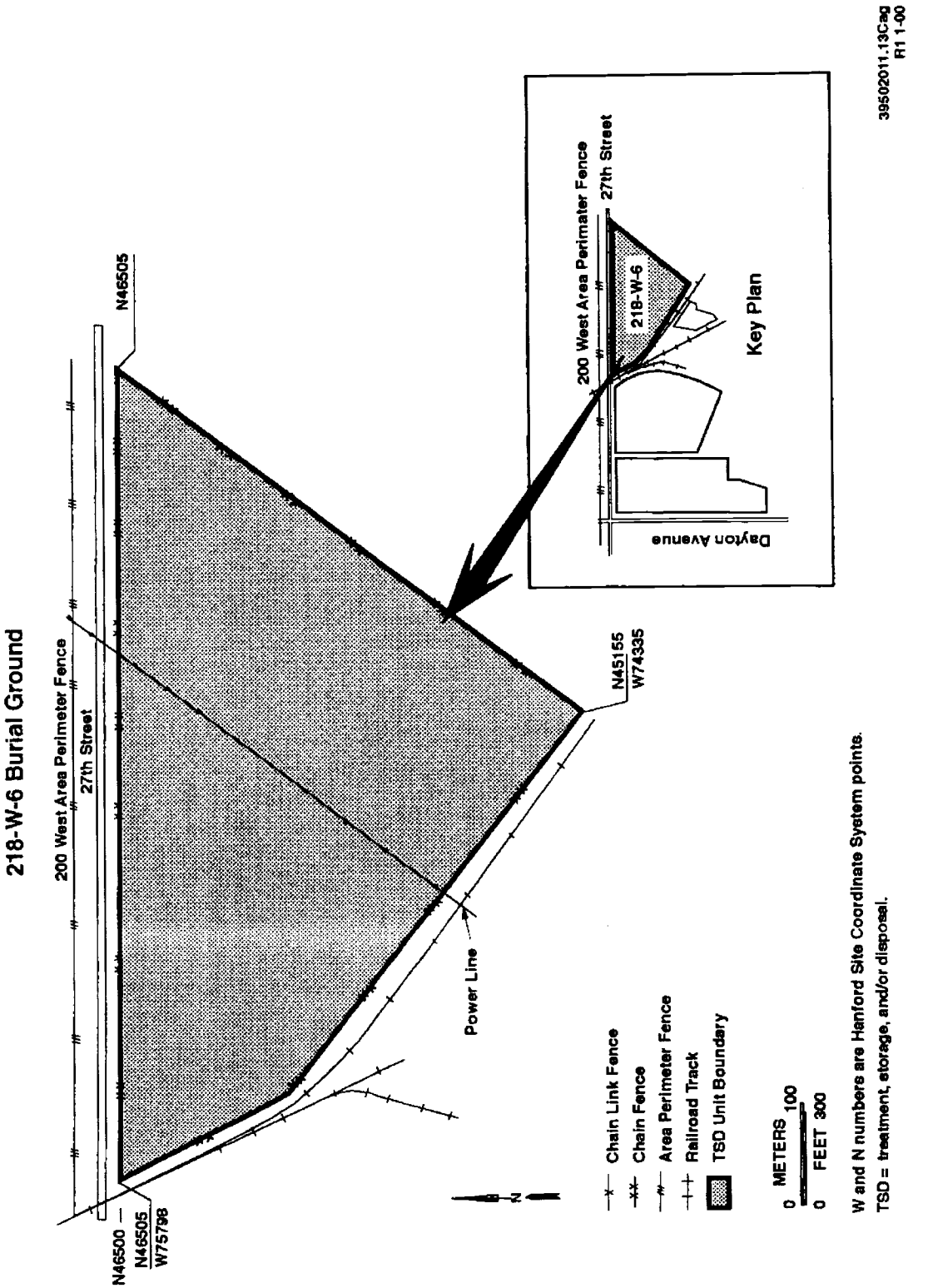

Figure 1-10. 218-W-6 Burial Ground.

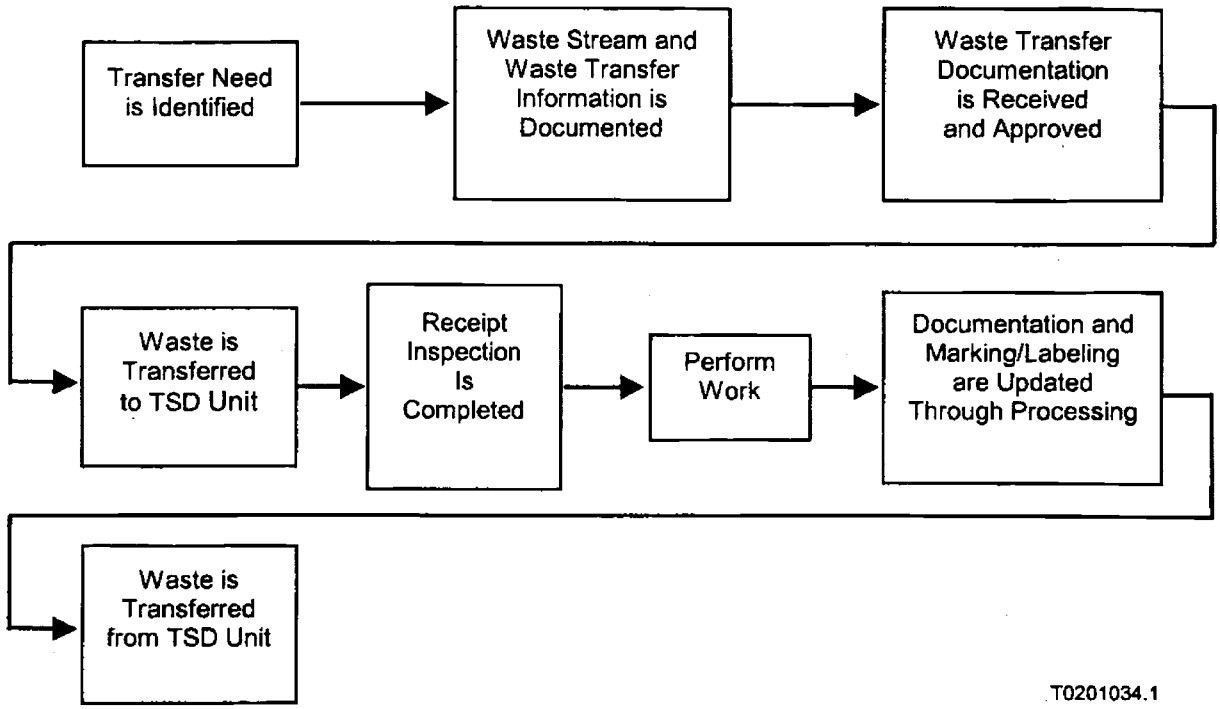

Figure 1-11. Waste Transfers Among Solid Waste Project TSD Units.

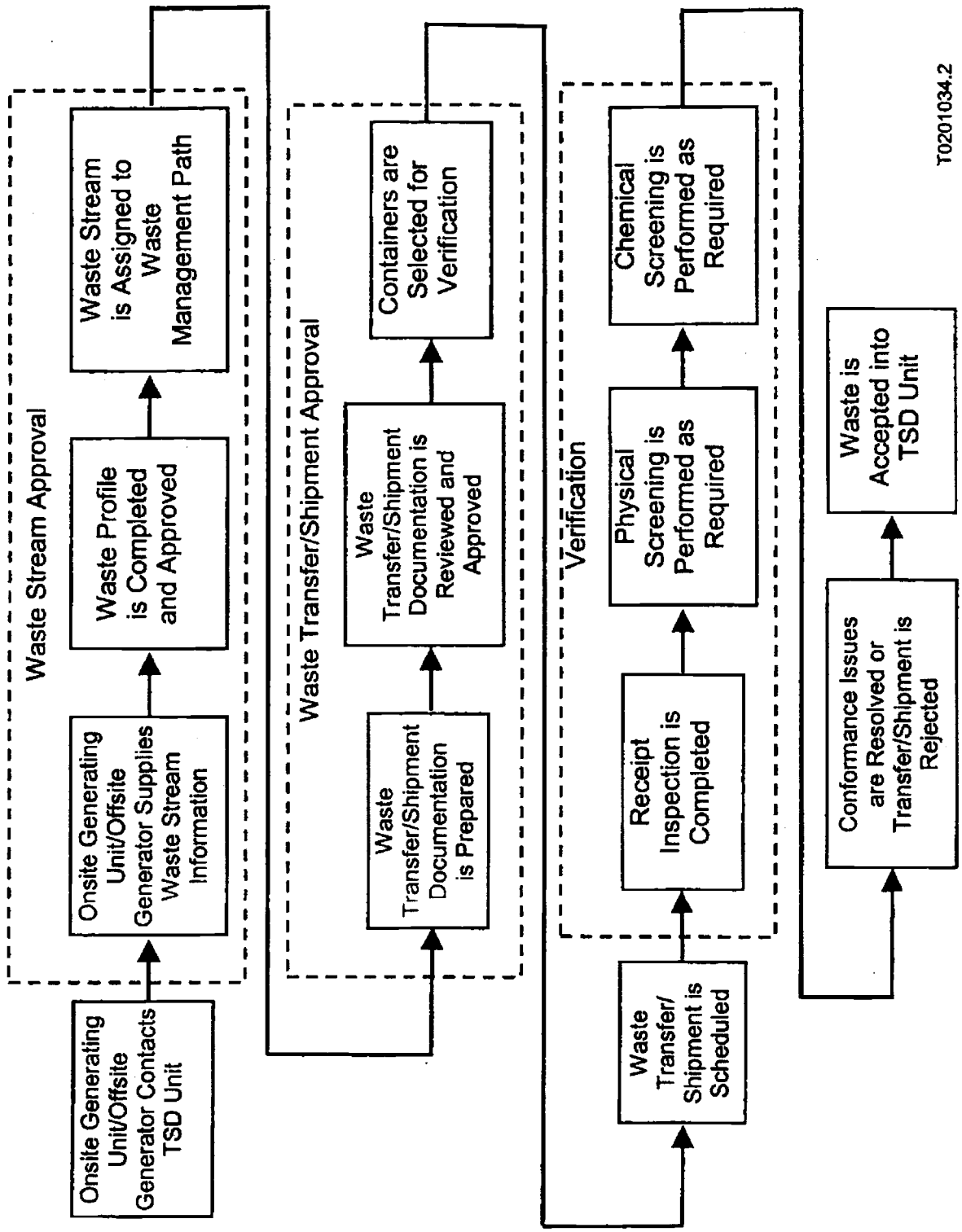

Figure 1-12. Waste Confirmation and Acceptance Process for Newly Generated Waste.

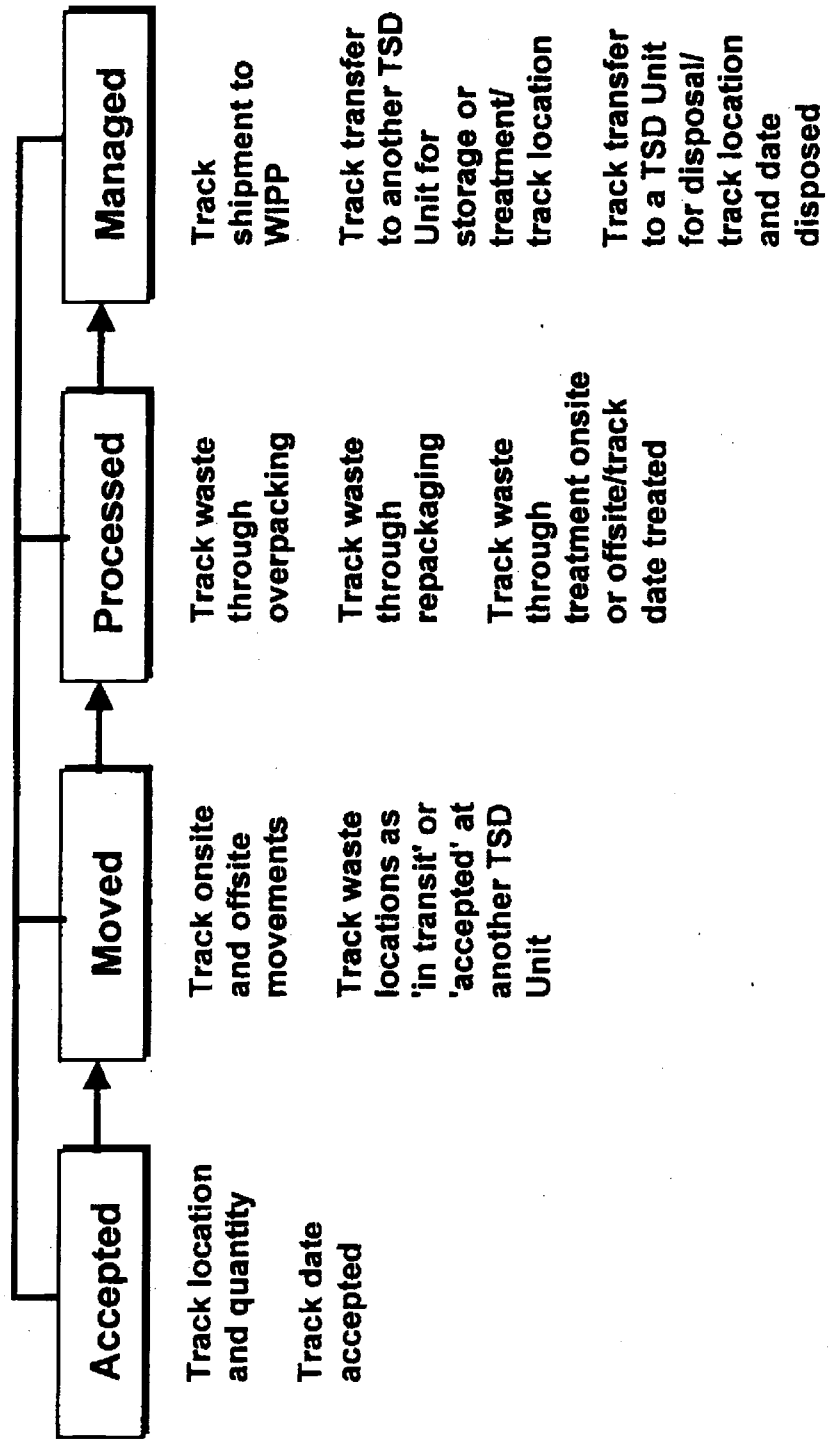

Figure 1-13. Solid Waste Project Waste Tracking.

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Table 1-1. Low-Level Burial Grounds Disposal Sites.

Burial ground	Size (hectares)	Year placed in service	Authorized to receive mixed waste	Examples of waste
218-E-10	36.1	1960	No[1]	Failed equipment, rags, paper, rubber gloves, disposable supplies, broken tools.
218-E-12B	68.0	1967	Yes (trench 94 only)	Defueled reactor compartments (trench 94), low-level waste, and retrievable transuranic (TRU) waste
218-W-3A	20.4	1970	No[1]	Ion exchange resins, failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, accessories, retrievable TRU waste.
218-W-3AE	20.0	1981	No[1]	Rags, paper, rubber gloves, disposable supplies, broken tools.
218-W-4B	3.5	1968	No	Rags, paper, rubber gloves, disposable supplies, broken tools, alpha caissons, and retrievable TRU waste
218-W-4C	20.0	1978	No[1]	Contaminated soil, decommissioned pumps, and pressure vessels.
218-W-5	37.2	1986	Yes[1] (mixed waste is authorized for trenches 31 and 34)[2]	Rags, paper, rubber gloves, disposable supplies, and broken tools. Trench 31 and 34—Mixed waste that has been treated to meet LDR requirements (including bulk waste), macroencapsulated long-length contaminated equipment, etc.
218-W-6	16.0	Not yet placed in service	Reserved	Has not received any waste and is reserved for future mixed waste disposal.

[1] Discrete locations within the 218-E-10, 218-W-3A, 218-W-3AE, 218-W-4C, and 218-W-5 burial grounds contain mixed waste received during or after 1987 that is known as "Post-August 19, 1987, RCRA/state-only designated mixed wastes". These locations are identified in the Part A, Form 3, Permit Application (DOE/RL-88-21).
[2] Double-lined mixed waste trenches.

LDR = land disposal restriction.
RCRA = *Resource Conservation and Recovery Act of 1976*, 42 USC 6901 et seq.
TRU = transuranic.

Table 1-2. Chemicals Incompatible With the High-Density Polyethylene Liner (in concentrated form).

Chemical	CAS Number
Amyl chloride	543-59-9
Aqua regia	8007-56-5
Bromic acid	15541-45-4
Bromobenzene	108-86-1
Bromoform	75-25-2
Calcium bisulfite	13780-03-5
Calcium sulfide	20548-54-3
Diethyl benzene	25340-17-4
Diethyl ether	60-29-7
Bromine	7726-95-6
Chlorine	7782-50-5
Fluorine	7782-41-4
Ethyl chloride	75-00-3
Ethylene trichloride	79-01-6
Nitrobenzene	98-95-3
Perchlorobenzene	78-87-5
Sulfur trioxide	7446-11-9
Sulfuric acid (fuming)	8014-95-7
Thionyl chloride	7719-09-7
Vinylidene chloride.	75-35-4

CAS = Chemical Abstract Service.

2.0 CONFIRMATION PROCESS

WAC 173-303-300(1) requires confirmation on mixed waste before acceptance of waste into a waste management unit. Confirmation is not required for transfer of waste within this TSD unit's waste management units. The confirmation process consists of two parts, pre-shipment review and verification. Confirmation activities are performed in accordance with TSD unit-specific governing documentation. Differences in the confirmation process for onsite generating units, transfers from onsite solid waste project TSD units, and offsite generators are addressed in the following text. The confirmation process is detailed in Figure 2-1.

2.1 PRE-SHIPMENT REVIEW

Pre-shipment review takes place before waste can be scheduled for transfer or shipment to this TSD unit. The review focuses on whether the waste stream is defined accurately and meets the TSD unit waste acceptance criteria and whether the LDR status is determined correctly. Only waste determined to be acceptable for storage and/or disposal is scheduled. This determination is based on the information provided by the generator. Except for waste transfers among solid waste project TSD units, the pre-shipment review consists of waste stream approval and the waste shipment approval process. Waste being transferred from one solid waste project TSD unit to another is discussed in Section 2.3. The following sections discuss the pre-shipment review process. The information obtained during the pre-shipment review, at a minimum, includes all information necessary to safely store and/or dispose the waste. The pre-shipment review ensures the waste is characterized and the data provided qualify as 'acceptable knowledge' (Section 2.1.3).

2.1.1 Waste Stream Approval Process

The waste stream approval process consists of reviewing stream information supplied on a waste stream profile and supporting documentation. The waste stream profile normally requires the following supporting documentation:

- Generator information (e.g., name, address, point-of-contact, telephone number)
- Waste stream name
- Waste generating process description
- Radiological knowledge (e.g., classification, reportable radionuclides, characterization method)
- Chemical characterization information [e.g., characterization method(s), chemicals present, concentration ranges]
- Designation information
- LDR information including identification of underlying hazardous constituents if applicable
- Waste type information (e.g., physical state, adsorbents used, inert materials, stabilizing agents used)
- Packaging information (e.g., container type, maximum weight, size)

Attachments could consist of container drawings, process flow information, analytical data, etc.

In some cases, such as variable waste streams, the waste stream profile information could be general in nature. In these cases, more detailed information is gathered during the waste shipment approval process. This information is reviewed against the TSD unit waste acceptance criteria to ensure the waste is acceptable for receipt. If conformance issues are found during this review, additional information is requested that could include analytical data or a sample to be analyzed. If the waste cannot be received, the TSD unit pursues acceptance of the waste at an alternate TSD unit or requests the generator to pursue acceptance at an offsite facility.

Once the waste is determined to be acceptable, the TSD unit assigns the profile to a waste management path (waste specification record) and establishes a waste verification frequency based on the requirements found in Section 2.4. Profile information is re-evaluated as discussed in Section 6.0.

2.1.2 Waste Shipment Approval Process

For each waste transfer or shipment that is a candidate for disposal in this TSD unit, the generator provides the following information:

- Container identification number
- Profile number (except for waste transfers of previously accepted waste)
- Waste description
- Generating unit/generator information (e.g., name, address, point-of-contact, telephone number)
- Container information (e.g., type, size, weight)
- Waste numbers
- Extremely hazardous waste or dangerous waste
- Waste composition
- Packaging materials and quantities.

The pertinent information is entered into a solid waste information tracking system.

Where potential conformance issues exist in the information provided (i.e., waste characteristics do not match the waste profile information, TSD unit waste acceptance criteria, or additional constituents are expected to be present that do not appear on the documentation), the generator is contacted by the TSD unit for resolution.

For each container, a technical review, physical screening determination, and chemical screening determination are performed. Individual container data are compared to the waste profile data to ensure the waste to be shipped is as described on the waste profile. Screening provides a means to minimize the potential for acceptance of incorrectly identified waste.

- **Technical review.** Every shipment is reviewed to ensure the waste meets the TSD unit waste acceptance criteria. Based on waste identification information provided, the waste designation is reviewed to ensure consistency with waste designations per WAC 173-303-070, as well as for technical accuracy to ensure the waste meets the waste acceptance criteria.

  If the shipment information is found to be acceptable, the TSD unit determines if any of the waste containers are required to be physically or chemically screened.

- **Physical and chemical screening determination.** Written procedures are maintained describing the process for selecting containers for physical and chemical screening. Authoritative/directive means of selecting containers for physical/chemical screening are used based on the pre-shipment review process. The selection is based on the contents listed in the associated shipment documentation, the variation within the shipment, and experience with the specific waste.

  Two criterion are used in making the selection. The first criterion is based on whether pre-shipment review activities (document and characterization review) identify areas of potential concern. The second criterion is reviewing the current physical screening percentage (calculated using the following method) of containers received from said stream from said generator that have been received over the past 12 months or the date of the last physical screening adjustment, whichever occurs first. The rate is applied as compared to those that physically have been screened. This criterion ensures that the minimum physical screening confirmation rates required by this WAP are met.

  The number of containers selected for physical screening in shipments is determined by multiplying the total number of containers received during the previous 12 months for that stream, including the containers identified in the shipment, by the applicable verification percentage, rounded up to the next integer. This selected group of containers constitutes a sample set.

2.1.3 Acceptable Knowledge Requirements

The TSD unit ensures that all information used to make waste management decisions is based on adequate characterization data as described in the following sections. The TSD unit evaluates the data to ensure that the data are adequate acceptable knowledge for management of the waste.

2.1.3.1 General Acceptable Knowledge Requirements

One or more of the following types of information could be considered acceptable knowledge:

- Mass balance from a controlled process that has a specified output for a specified input
- Material safety data sheet on chemical products
- Test data from a surrogate sample
- Analytical data on the waste or a waste from a similar process.

In addition, acceptable knowledge requirements can be met using a combination of analytical data or screening results and one or more of the following:

- Interview information
- Logbooks
- Procurement records
- Qualified analytical data
- Radiation work package
- Procedures and/or methods
- Process flow charts
- Inventory sheets
- Vendor information
- Mass balance from an uncontrolled process (e.g., spill cleanup)
- Mass balance from a process with variable inputs and outputs (e.g., washing/cleaning methods).

If the information is sufficient to quantify the constituents of regulatory concern and to determine waste characteristics as required by the regulations and TSD unit waste acceptance criteria, the information is considered acceptable knowledge. Adequate acceptable knowledge includes (1) general waste knowledge requirements and/or (2) LDR waste knowledge requirements.

(1) **General waste knowledge requirements.** At a minimum, the generator supplies enough information for the waste to be managed at this TSD unit. The minimum level of acceptable knowledge consists of designation data where the constituents causing a waste number to be assigned are quantified and that data address any TSD unit operational parameters necessary for proper management of the waste.

When process knowledge indicates that constituents, which if present in the waste might cause the waste to be regulated, are input to a process, but not expected to be in the waste, sampling and analysis must be performed to ensure the constituents do not appear in the waste above applicable regulatory levels. This requirement can be met through chemical screening. This sampling and analysis are required only for initial characterization of the waste stream.

When the available information does not qualify as acceptable knowledge or is not sufficient to characterize a waste for management, the sampling and testing methods outlined in WAC 173-303-110 are used to determine whether a waste designates as ignitable, corrosive, reactive, and/or toxic and whether the waste contains free liquids as applicable. If the analysis is performed to complete characterization after acceptance of the waste by the TSD unit, this WAP governs the sampling and testing requirements.

(2) **LDR waste knowledge.** Waste might be stored in this TSD unit while awaiting analytical results for LDR requirements. The TSD unit operating record contains all information required to document that the appropriate treatment standards have been met or will be met after the waste is treated unless otherwise excepted in this section.

For the purposes of this WAP, a representative sample is required to demonstrate compliance with a concentration-based treatment standard (refer to Section 4.5). Corroborative testing for the sample could be accomplished in the following manner.

- Onsite generating units/offsite generators could use onsite laboratories or other laboratories to certify that the waste meets LDR requirements. For waste that does not meet LDR requirements, information must be supplied on the treatment methods necessary to meet LDR requirements in accordance with WAC 173-303-380(1) (j), (k), (n), and (o).

- This TSD unit uses these analytical data to ensure that the applicable requirements found in 40 CFR 268.7 and WAC 173-303-140(4) are met.

2.1.3.2 Methodology to Ensure Compliance with LDR Requirements

All onsite generating units/offsite generators are subject to LDR requirements and are required to submit all information notifications and certifications described in WAC 173-303-380(1) (j), (k), (n), and (o). Mixed waste not meeting the treatment standards, but meeting the TSD unit waste acceptance criteria, can be stored at the TSD unit. The following are general requirements for certification or information notification.

- The waste is subject to LDR and the waste has been treated. The generator supplies the appropriate LDR certification information (40 CFR 268).

- The waste is subject to LDR and the generator has determined that the waste meets the LDR as generated. The generator develops the certification based on process knowledge and/or analytical data and supplies the appropriate LDR certification information necessary to demonstrate compliance with the LDR treatment standards of 40 CFR 268 and WAC 173-303-140. State-only LDRs do not require this type of certification.

- The waste is subject to LDR and requires further treatment to meet applicable treatment standards.

  - The generator supplies additional information concerning the waste and details any treatment necessary to meet applicable treatment standards.

  - If waste is treated to meet state-only or federal LDRs, the TSD unit prepares information necessary to meet WAC 173-303-380(1)(k) (refer to Section 7.4).

When demonstrating that a concentration-based LDR treatment standard has been met, a representative sample of the waste must be submitted for analysis. This sample could be taken by the treatment facility or the generator and is required to comply with the LDR treatment standards contained in 40 CFR 268.40 and 268.48 for underlining hazardous constituents.

2.2 VERIFICATION

Verification is an assessment performed by this TSD unit to substantiate that the waste received is the same as represented by the analysis supplied by the generator for the pre-shipment review. Verification includes container receipt inspection, physical screening, and chemical screening. Waste is not accepted by the TSD unit for storage/disposal until the required elements of verification have been completed, including evaluation of any data obtained from verification activities. All conformance issues identified during the verification process are resolved in accordance with Section 2.4.3.

2.2.1 Container Receipt Inspection

Container receipt inspection is a mandatory element of the confirmation process. Therefore, 100 percent of each shipment is inspected at the TSD unit for possible damage or leaks, complete labeling, and intact tamper seals as required per Sections 2.2.2 and 2.2.3. This is to ensure that the shipment (1) is received at the TSD unit in good condition, (2) has the waste indicated on the transfer or shipping papers, (3) has not been opened after physical and/or chemical screening was performed, and (4) is complete. When a conformance issue exists, a case-by-case determination is performed, and the appropriate action is taken based on the severity of the issue. One of the following actions occurs:

- Implementation of the contingency plan in accordance with the Hanford Facility RCRA Permit, LLBG, Chapter 7.0

- Resolution of conformance issues where additional information is needed to safely manage the waste before verification continues

- Continuation of verification for waste with conformance issues not meeting these criteria.

2.2.2 Physical Screening Process

Physical screening is a verification element. This section describes the requirement pertaining to methods, frequency, and exceptions concerning the use of physical screening as a verification activity. Physical screening could be performed before the waste is transferred/shipped to this TSD unit. When screening is performed at a location not within the solid waste project TSD units, tamper-resistant seals are applied to each container examined and, on receipt at this TSD unit, verified as acceptable to ensure that no changes could have occurred to the waste content. Written procedures are maintained by the TSD unit detailing the requirements for adding and/or removing tamper-resistant seals. Documentation is maintained in the TSD operating record.

2.2.2.1 Physical Screening Methods

Each of the following physical screening methods, listed in order of preference, complies with the requirement to verify a waste:

1. Visual inspection (opening the container)
2. NDE.

Section 2.2.5.1 discusses quality control (QC) pertaining to physical screening. Section 3.1 provides for the rationale for choosing a physical screening method.

2.2.2.2 Physical Screening Frequency

The minimum physical screening frequency is 5 percent for onsite generating units, applied per waste stream per subcontractor per year. For offsite generators, the minimum physical screening frequency is 10 percent per waste stream per generator per year. The TSD unit adjusts the physical screening frequency for onsite generating units/offsite generators based on objective performance criteria (refer to Section 2.4.1).

In the event that one of the containers in the original sample set fails, a second sample set of equal size, or a minimum of three additional containers, is selected from the shipment. First and second sample sets are selected using the rationale described in the pre-shipment review section (Section 2.1). A second failure in either the first or the second sample set constitutes failure of the shipment. If the second sample set passes the inspection, the single failed container is considered an anomaly, and the remainder of the shipment passes verification. All failed containers and shipments are dispositioned via PES as described in Section 2.4.

2.2.2.3 Physical Screening Exceptions

The following are exceptions to the physical screening process outlined previously.

- Shielded, classified, TRU retrieved waste and remote-handled mixed waste are not required to be screened physically; however, the LLBG operating organization performs a more rigorous documentation review and obtains the raw data used to characterize the waste (less than 1 percent of current waste receipts). For classified waste, it is necessary to have an appropriate U.S. Department of Energy security clearance and a need to know the information as defined by the classifying organization or agency.

- Waste that cannot be screened physically at the TSD unit or at an associated screening facility must be screened physically at the generator location (e.g., large components, containers that cannot be opened,

are greater than 20 mrem per hour, contain greater than 10 nanocuries per gram of TRU radionuclides, or do not fit into the NDE unit). If no location can be found to perform the physical screening, no screening is required.

- Waste that is packaged by the TSD unit is considered to have met the physical screening requirements denoted in this WAP (e.g., TSD unit packaged waste that is transferred to solid waste managed TSD units). On closure of the container, tamper-resistant seals are applied to ensure content integrity.

2.2.3 Chemical Screening Process

Chemical screening is a verification element. This section describes methods, frequency, and exceptions for chemical screening. Chemical screening could be performed by this TSD unit before the waste is transferred to this TSD unit. When screening is performed at a location not within the solid waste project TSD units, tamper-resistant seals are applied to each container examined and, upon receipt at this TSD unit, verified as acceptable to ensure that no changes could have occurred to the waste content. Written procedures are maintained by this TSD unit detailing the requirements for adding and/or removing tamper-resistant seals. Documentation is maintained in the TSD operating record.

Selection and interpretation of the appropriate chemical screening method(s) are conducted and performed by qualified personnel. Unless otherwise noted, tests are qualitative, not quantitative. The objective of chemical screening is to obtain reasonable assurance that the waste received by the TSD unit generally is consistent with the description of the waste on the waste profile and to provide information that is used to safely manage the waste at the TSD unit. The following tests are selected depending on the waste matrix and the applicability of the method. A minimum of three listed screening tests, including pH screening, are conducted on each sample.

- pH
- Peroxide
- Oxidizer
- Water reactivity.
- Halogenated organic carbons (chlor-n-oil/water/soil)
- Ignitability/headspace screening for volatile compounds
- Sulfide
- Cyanide
- Paint filter test.

Section 2.2.5.2 provides QC pertaining to chemical screening.

2.2.3.1 Chemical Screening Frequency

At a minimum, 10 percent of the mixed waste containers verified by physical screening (Section 2.2.2.2) must be screened chemically. The TSD unit obtains a representative sample, which could be a grab sample.

Small containers of waste (labpacks), not otherwise identified in the exceptions, packaged in accordance with 40 CFR 264.316, 40 CFR 265.316, and WAC 173-303-161, are screened chemically in accordance with the chemical screening frequency of the waste stream as determined by PES (Section 2.4). Inner containers are segregated by physical appearance (e.g., color, physical state). At least one container from each group (or three containers if all are similar) are screened chemically.

2.2.3.2 Chemical Screening Exceptions

The following are cases in which chemical screening is not required:

- Small containers of waste in overpacked containers (labpacks) packaged in accordance with WAC 173-303-161 and not prohibited under LDR specified in WAC 173-303-140
- Waste exempted from the physical screening requirements (Section 2.2.2.3)
- Commercial chemical products in the original product container(s) (e.g., off-specification, outdated, or unused products)
- Chemical-containing equipment removed from service (e.g., ballasts, batteries)
- Waste containing asbestos
- Waste, environmental media, and/or debris from the cleanup of spills or release of single substance or commercial product or otherwise known material (e.g., material for which a material safety data sheet can be provided)
- Confirmed noninfectious waste (e.g., xylene, acetone, ethyl alcohol, isopropyl alcohol) generated from laboratory tissue preparation, slide staining, or fixing processes
- Hazardous debris as defined in WAC 173-303-040
- Other special cases on a case-by-case basis with prior approval by the Washington State Department of Ecology (Ecology).

2.2.4 Sampling for Confirmation Screening

Sampling is performed in accordance with WAC 173-303-110(2). A representative sample is obtained for chemical screening. The chemical screening methods described in Section 3.0 do not require any sample preservation methods because the screening tests are performed at the time and location of sampling or as soon as possible thereafter. When a delay is required, the samples are stored in a manner that maintains chain of custody and protects the sample composition. The equipment requirements in Table 4-1 apply to sampling for chemical screening.

2.2.5 Quality Assurance and Quality Control for Confirmation Process

The following QA and QC elements are used by the TSD unit to ensure confirmation activities provide sufficient data to provide an indication that waste received is as described in the shipping documentation.

Screening methods have sufficient performance levels to yield valid decisions when considering method variability (precision and accuracy).

2.2.5.1 Physical Screening Quality Control

This section describes the QC used by this TSD unit to ensure that quality data are obtained when performing physical screening methods identified in Section 2.2.2, except visual inspection. Physical

screening QC is used only to ensure that quality data are obtained when performing NDE. Visual inspection does not consist of the use of instrumentation or chemical tests. QC objectives for visual inspection are obtained through the appropriate training.

The following QC elements apply to NDE used for physical screening.

- A penetration test is performed when image data generating components are changed to document system capability has not changed.
- A resolution test is performed at the beginning of a shift. A shift ends when shutdown activities are performed. A shift can be up to 24 hours.
- A radiographer is qualified per SNI-TC-1A, *Personnel Qualification and Certification in Nondestructive Testing*, Level II certification of American Society for Nondestructive Testing training.
- Examination of the waste must cover 100 percent of the waste in the container.
- Five percent per year of the containers that have been nondestructively examined are opened to ensure the method is providing accurate data. Containers opened for other reasons, such as chemical screening or to investigate inconsistencies, could be used to meet this requirement. This requirement is based on the total number of containers reviewed, not on a shipment or general waste stream basis. This TSD unit is required, at a minimum, to meet this requirement over a running 3-month average with a minimum of one container being opened for every month NDE is operated.
- At least annually, a capability demonstration is performed on a training drum.

2.2.5.2 Chemical Screening Quality Control

The following QC elements are used when performing chemical screening.

- Appropriate sample containers and equipment are used.
  - Containers and equipment of the appropriate size that are chemically compatible with the waste and testing reagents shall be used.
- Reagent checks are used.
  - Water that is reagent grade and from a documented source shall be used.
  - Chemicals and test kits must be labeled so that these are traceable and documented in the TSD unit operating record.
  - QC checks shall be performed on each test kit and associated replacements and documented in the TSD unit operating record unless a more frequent period is specified in the test kit instructions.

2.3 WASTE TRANSFERS AMONG SOLID WASTE PROJECT TSD UNITS

Waste transfers among the CWC, WRAP, or T Plant Complex TSD units to this TSD unit might be necessary to perform verification, to obtain additional knowledge to support treatment/disposal, or to make

the waste amenable for long-term storage. A technical review is required to ensure compliance with the LLBG, Part A, Form 3, and waste acceptance criteria. For waste that is being transferred from CWC, WRAP, or T Plant Complex TSD units to the LLBG, the following requirements apply.

2.3.1 Waste Stream Approval Process

The waste stream already must have been approved using the process described in Section 2.1.1. Waste knowledge exceptions could apply as described in Section 2.1.3.1.

2.3.2 Waste Transfer Approval Process

A technical review of documentation associated with each waste container in the transfer is performed to ensure the waste meets the TSD unit waste acceptance criteria. The individual container data, inclusive of all knowledge obtained on the container, are compared to TSD unit waste acceptance requirements. If necessary, the waste management path (waste specification record) previously assigned to the waste stream is updated, and relabeling/remarking is completed before the transfer. Waste is tracked through processing at the TSD unit in accordance with Section 1.3. As new information is obtained on the waste, the container is managed to any new requirements. Updates to container data during transfer and subsequent processing activities are reflected in SWITS, documented, and maintained in accordance with Section 8.0.

2.3.3 Verification

For container receipt inspection, 100 percent of each transfer is inspected for damage and to ensure the waste containers are those indicated on the documentation. This activity is a mechanism for identifying any document discrepancies or damaged containers before receipt/acceptance. Conformance issues identified during receipt are managed as described in Section 2.2.1.

For physical and chemical screening, waste that has not been accepted at WRAP, CWC, T Plant Complex, or LLBG TSD units, physical and/or chemical screening is completed as described in Sections 2.2.2 and 2.2.3.

2.3.4 Performance Evaluation System

Performance of the generator is evaluated and documented in accordance with the PES as described in Section 2.4. The PES is used to determine physical screening frequency and to review and determine corrective actions for conformance issues. The performance evaluation considers all newly generated waste accepted at CWC, WRAP, LLBG, and T Plant TSD units.

2.4 DESCRIPTION OF PERFORMANCE EVALUATION SYSTEM

The PES is used to determine the initial physical screening frequency of each waste stream. The PES provides a periodic status of performance of the generator for waste received. Also, the PES provides a mechanism for addressing corrective actions, resolving waste acceptance issues, and adjusting physical screening frequency.

2.4.1 Initial Physical Screening Frequency Determination

The initial physical screening frequency is determined based on the following process.

- The TSD unit reviews the waste profile information to determine the relative potential for misdesignation or inappropriate segregation based on all relevant information, including any previous experience with the generator. Based on this review, the TSD unit identifies any concerns associated with the following criteria:

  - Documented waste management program
  - Waste stream characterization information
  - Potential for inappropriate segregation.

- Based on the identification of concerns during the review, the TSD unit establishes the initial physical screening frequency for the new waste stream based on the following criteria:

  - Initial physical screening frequency of, at a minimum, 20 percent: No concerns identified; e.g., cleanup of contaminated soil where the soil has been well characterized and no other waste generation processes are occurring at that location

  - Initial physical screening frequency of, at a minimum, 50 percent: Concern(s) identified in one criterion

  - Initial physical screening frequency of 100 percent: Concerns identified in two or more criteria.

2.4.2 Performance Evaluation

A performance evaluation is used to trend the waste acceptance performance of the generator and is used to adjust the overall physical screening frequency. This evaluation, identified as an integral part of the QA program, is objective and considers the conformance issues documented during the pre-shipment review and verification functions. The TSD unit must maintain written procedures to (1) perform evaluations based on deficiencies and conformance issues identified, (2) evaluate unsatisfactory performance for corrective actions, and (3) adjust physical screening rates accordingly.

The performance evaluation is conducted and subsequently accepted by the PES team and is documented and maintained in accordance with Section 8.0. Performance evaluation frequency is based on frequency of shipments and generator performance.

2.4.3 Conformance Issue Resolution

Conformance issues could result in a waste container that does not meet this TSD unit's waste acceptance criteria of the TSD unit. A conformance issue is any discrepancy identified during the confirmation process with waste package documentation, a waste package, or a shipment. Discrepancies can be identified during pre-shipment reviews of waste streams or during the verification process. If a possible conformance issue is identified, the following actions are taken to resolve the issue.

- This TSD unit compiles all information concerning the possible conformance issue(s).

- The generator is notified and requested to supply additional knowledge that could assist in the resolution of the concern(s). If the generator supplies information that resolves the concern(s) identified, no further action is required.

- On determination that a conformance issue has been identified during verification, the TSD unit personnel and the generator discuss the conformance issue and identify the appropriate course of action to resolve the container/shipment in question; i.e., pick another sample set, return the container/shipment, divert the container/shipment to another TSD unit that can accept the container/shipment and resolve the issue, or the generator resolves the issue at the TSD unit. If the conformance issue(s) results in the failure of a shipment, the physical screening frequency for the stream is adjusted to 100 percent. Other streams from the same generator with the potential to exhibit the same failure also are adjusted to 100 percent until the issue(s) can be addressed adequately.

- For shipment failures, the TSD unit requests the generator to provide a corrective action plan (CAP) that clearly states the reason for the failure and describes the actions to be completed to prevent recurrence. The generator could request a reduction in verification of unaffected streams. This request must be accompanied by a justification that identifies why this stream(s) would not exhibit the same conformance issue. The TSD unit reviews the stream justification for adequacy and reduces the physical screening frequency to the previous percentage accordingly.

2.4.4 Process for Reducing the Physical Screening Frequency

Screening rate frequencies and changes to those frequencies could be applied to a specific waste stream or to a specific generator based on the circumstances surrounding the conformance issue. After the initial screening frequency for a given waste stream has been established or increased, the physical screening frequency can be reduced in accordance with the following process.

The physical screening frequency is reduced in three steps. Reduction for all steps is based on the ability to demonstrate that five containers from the waste stream in question pass verification. In addition, reduction to the minimum frequency requires that the TSD unit documents an acceptable evaluation of the CAP. At no time will the physical screening frequency be reduced below 5 percent for waste generated onsite or below 10 percent for offsite generators.

- Step 1. Reduce frequency by up to 66 percent after five containers from the waste stream in question pass verification.

- Step 2. Reduce frequency established in Step 1 by up to 50 percent or to the minimum allowable, whichever results in a greater frequency after five containers from the waste stream in question pass verification.

- Step 3. Reduce frequency established in Step 2 to the minimum allowable after five containers from the waste stream in question pass verification. The TSD unit documents an acceptable evaluation of the CAP.

The physical screening rate reduction is established during periodic PES team evaluation and the documentation is maintained according to Section 8.0 of this WAP. The percentage of the reduction is based on the evaluation of the relative severity of the original conformance issue, the status of the CAP,

any interim actions taken by the generator, the performance of the generator for this waste stream before this reduction, and/or other factors deemed relevant.

2.5 WASTE ACCEPTANCE

Initial acceptance of waste occurs only after the confirmation process described in Section 2.0 is complete. Conformance issues identified during the confirmation process are documented and managed in accordance with Section 2.4. Conformance issues that must be corrected before waste acceptance include the following:

- Waste does not match approved profile documentation
- Designation, physical, and/or chemical characterization discrepancy
- Incorrect LDR paperwork
- Packaging discrepancy
- Manifest discrepancies as described in WAC 173-303-370(4).

For waste shipments with unresolved conformance issue(s) that exceed 90 days, this TSD unit contacts Ecology at least once per calendar quarter.

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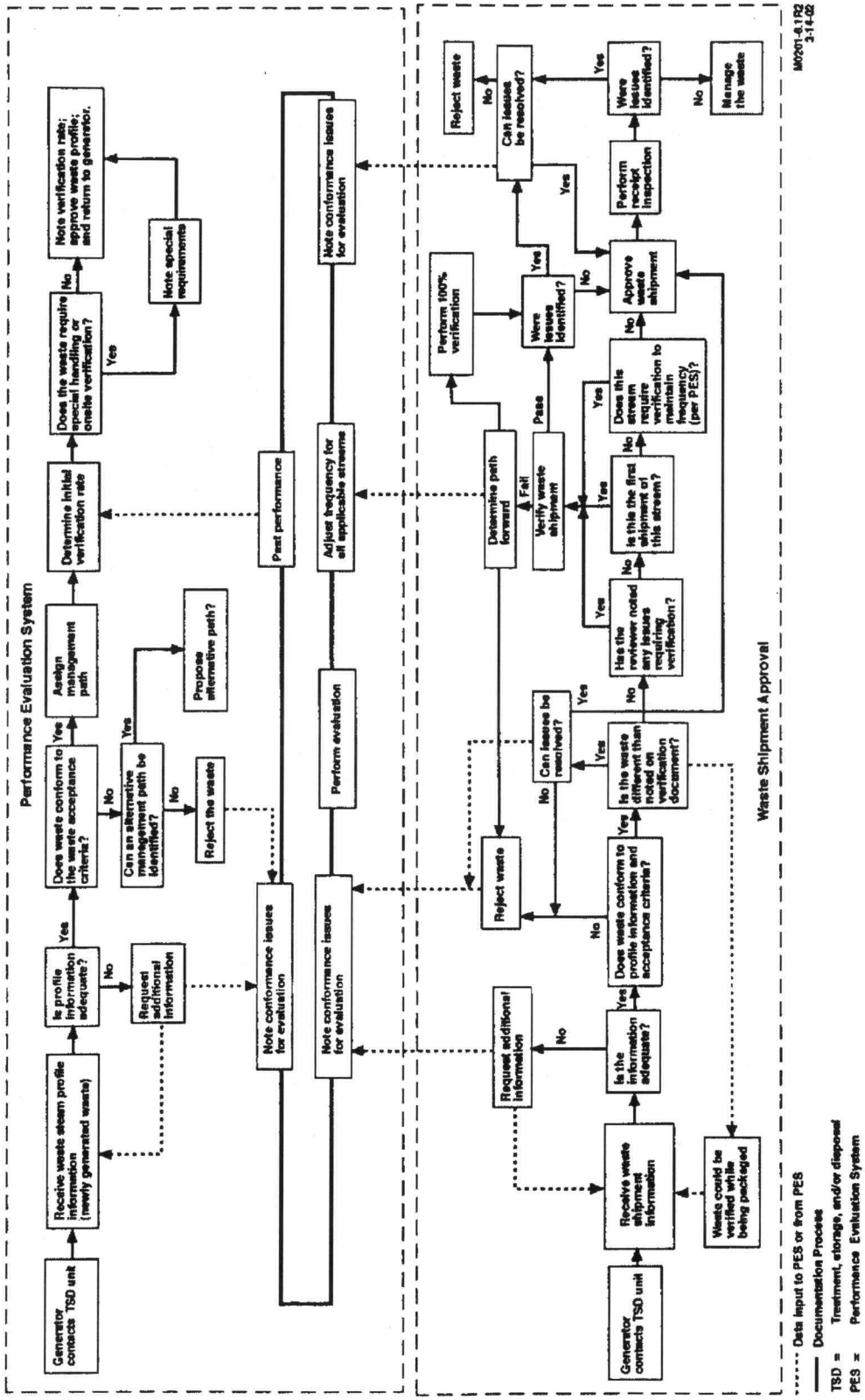

Figure 2-1. Confirmation and Waste Acceptance Process.

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3.0 SELECTING WASTE ANALYSIS PARAMETERS

Physical and chemical screening parameters for verification must be chosen from those in Sections 3.1 and 3.2. Parameters for waste designation and to met LDR requirements are addressed in Section 3.3. Waste analysis screening parameters are selected to demonstrate that the waste matches the shipping documentation. Parameters, methods, and rationale for physical and chemical screening parameters are provided in Table 3-1.

Table 3-1. Parameters and Rationale for Physical and Chemical Screening.

Parameter	Method*	Rationale for selection
Physical screening		
Visual inspection	Field method – observe phases, presence of solids in waste	Confirm consistency between waste and shipping documentation.
Nondestructive examination	Field method	Confirm consistency between waste and shipping documentation.
Chemical screening		
Ignitability and/or headspace volatile organic compound screening	Organic vapor monitor, colorimetric gas sampling tubes, or a lower explosive level meter	Confirm consistency between waste and shipping documentation; ensure compliance with WAC 173-303-395(1)(b).
Peroxide	Field peroxide test paper	Confirm consistency between waste and shipping documentation; ensure compliance with WAC 173-303-395(1)(b).
Liquids	SW-846, Method 9095, Paint Filter Test	Confirm consistency between waste and shipping documentation.
pH	Field pH screen (pH paper method)	Confirm consistency between waste and shipping documentation; ensure compliance with WAC 173-303-395(1)(b).
Oxidizer	Field potassium iodide test paper	Confirm consistency between waste and shipping documentation; ensure compliance with WAC 173-303-395(1)(b).
Water reactivity	Field water mix screen	Confirm consistency between waste and shipping documentation; ensure compliance with WAC 173-303-395(1)(b).
Cyanides	Field cyanide screen	Confirm consistency between waste and shipping documentation; ensure compliance with WAC 173-303-395(1)(b).
Sulfides	Field sulfide screen	Confirm consistency between waste and shipping documentation; ensure compliance with WAC 173-303-395(1)(b).
Halogenated organic carbons	Screening method for PCBs in transformer oil (SW-846, Method 9079)	Confirm consistency between waste and shipping documentation.

*Procedures based on manufacturer's recommended methodology unless otherwise noted. When regulations require a specific method, the method is followed.

SW-846, *Test Methods for Evaluating Solid Waste*, latest edition, U.S. Environmental Protection Agency, Washington, D.C.

WAC 173-303, "Dangerous Waste Regulations".

3.1 PHYSICAL SCREENING PARAMETERS

The following methods are approved for use in performing physical screening. These methods are listed in order of preference.

(1) Visual inspection

Rationale: This method meets the requirement to ensure consistency among waste containers and the accompanying shipment documentation.

Method: The container is opened and the contents are removed, as needed, for visual examination. Homogenous loose solids are probed to determine the presence of material not documented on the shipment documentation or for improperly absorbed liquids. Visual observations are compared with the applicable profile information and the container specific information on the shipment documentation.

Failure Criteria: A container fails inspection for any of the following reasons: (a) undocumented or improperly packaged waste; (b) discovery of prohibited articles or materials listed in Section 1.2; (c) discovery of material not consistent with the applicable waste stream profile; and (d) variability greater than 25 percent by volume in listed constituents (e.g., paper, plastic, cloth, metal).

(2) NDE

Rationale: This method meets the requirement to ensure consistency among waste containers and the accompanying shipment documentation. This method is subject to the QC requirements in Section 2.2.5.1. Containers that easily are not amenable to visual inspection because of physical or radiological content or facility availability can be examined safely and economically.

Method: The container is scanned with a NDE system. Data are observed on a video monitor and captured on video tape. Personnel experienced with the interpretation of NDE imagery record their observations. These observations are compared to the contents listed on the accompanying shipment documentation.

Failure Criteria: A container does not meet inspection criteria for any of the following reasons: (a) undocumented or improperly packaged waste; (b) discovery of prohibited articles as listed in Section 1.2; (c) image data not consistent with the applicable waste stream profile; and (d) variability greater than 25 percent by volume in listed constituents (e.g., paper, plastic, cloth, metal).

3.2 CHEMICAL SCREENING PARAMETERS

The following methods are approved for use in performing chemical screening.

(1) Ignitability and/or headspace volatile organic compound screening

Rationale: To determine the potential ignitability and the presence or absence of volatile organic compounds in waste and to ensure personnel are protected adequately. This method is used when containers are opened for inspection. This method can be applied to any matrix.

Method: A sample of the headspace gases in a container is analyzed by one or more of the following types of portable instrumentation: organic vapor monitor, colorimetric gas sampling tubes, or a lower explosive level meter.

Failure criteria: High organic vapor readings in matrices not documented as having volatile organic content constitute failure.

(2) Peroxide screening

Rationale: To determine the presence of organic peroxides in solvent waste, to alert personnel to potential hazards, to ensure safe segregation and storage of incompatible waste, and to confirm consistency with the shipment documentation. The test is sensitive to low parts-per-million ranges.

Method: A peroxide test strip is dampened with a pipette sample of liquid waste. Solids are tested by first wetting the test strip with water and contacting a small sample of the waste. A blue color change indicates a positive reaction. The color change can be compared with a chart on the packaging to determine an approximate organic peroxide concentration.

Failure criteria: Peroxide concentrations greater than 20 parts per million in liquid waste constituents that are known organic peroxide formers not documented as having been stabilized constitute failure.

(3) Paint Filter Test

Rationale: To verify the presence or absence of free liquid in solid or semisolid material.

Method: To a standard paint filter, 100 cubic centimeters or 100 grams of waste are added and allowed to settle for 5 minutes. Any liquid passing through the filter signifies failure of the test. The required method for the paint filter test is Method 9095 in the U.S. Environmental Protection Agency SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods* (the most recently promulgated version).

Failure criteria: Failure of the test in waste matrices not documented as having free liquids constitutes failure of the container. Small quantities of condensate trapped in inner plastic liner folds are acceptable.

(4) pH screen

Rationale: To identify the pH and corrosive nature of an aqueous or solid waste, to ensure safe segregation and storage of incompatible waste, and to confirm consistency with the shipment documentation.

Method: pH is measurement performed in accordance with written procedures maintained by this TSD unit or manufacturer's suggested methodology that conforms with the requirements of Section 2.2.5.

Failure criteria: If the pH of a matrix exceeds regulatory limits (less than or equal to 2.0 or greater than or equal to 12.5) in waste not documented as being regulated for this property, the container fails verification.

(5) Oxidizer screen

Rationale: To determine if a waste exhibits oxidizing properties, to ensure safe segregation and storage of incompatible waste, and to confirm consistency with the shipment documentation. This test can be applied to waste liquids, solids, and semisolids.

Method: Acidified potassium iodide (KI) test paper is used to measure the oxidizing properties of solid or liquid waste in accordance with written procedures maintained by this TSD unit or manufacturer's suggested methodology that conforms with the requirements of Section 2.2.5.

Failure criteria: A positive indication in a waste that is not consistent with documented constituents fails verification.

(6) Water reactivity screen

Rationale: To determine if the waste has the potential to vigorously react with water or to form gases or other reaction products. This information is used to ensure safe segregation and storage of incompatible waste and to confirm consistency with the shipment documentation.

Method: Water reactivity screen is performed in accordance with written procedures maintained by this TSD unit or manufacturer's suggested methodology that conforms with the requirements of Section 2.2.5.

Failure criteria: A positive indication in a waste that is not consistent with documented constituents fails verification.

(7) Cyanide screen

Rationale: To indicate if waste could release hydrogen cyanide upon acidification near pH 2. This information is used to ensure safe segregation and storage of incompatible waste and to confirm consistency with the shipment documentation.

Method: A cyanide screen is performed in accordance with written procedures maintained by this TSD unit or manufacturer's suggested methodology that conform with the requirements of Section 2.2.5.

Failure criteria: A positive indication in a waste that is not consistent with documented constituents fails verification.

(8) Sulfide screen

Rationale: To indicate if the waste could release hydrogen sulfide upon acidification near pH 2. This information is used to ensure safe segregation and storage of incompatible waste and to confirm consistency with the shipment documentation.

Method: A sulfide screen is performed in accordance with written procedures maintained by this TSD unit or manufacturer's suggested methodology that conform with the requirements of Section 2.2.5.

Failure criteria: A positive indication in a waste that is not consistent with documented constituents fails verification.

(9) Halogenated organic carbon screen

Rationale: To indicate whether polychlorinated biphenyls or other chlorinated solvents are present in the waste. This information is used to confirm consistency with the shipment documentation and to determine if additional information/data are needed to properly store and dispose the waste.

Methods: Field organic chlorine tests appropriate to the matrix, such as those offered by the Dexsil Corporation (e.g., chlor-n-oil, chlor-n-soil), are used. These screening tests are available with several detection limits that enable the verification to be performed in the concentration range applicable to the proposed management path of the waste.

Failure criteria: A positive indication of chlorinated organics in a waste that is not documented as having chlorinated organic content constitutes failure.

3.3 OTHER ANALYSIS PARAMETERS

Parameters need to meet designation, characterization, and LDR requirements for waste stored and/or treated at this TSD unit are identified in Table 3-2.

In determining the characteristic of ignitability (flashpoint), either the Pensky-Martens (method 1010) or the Setaflash (method 1020), must be employed when testing. The characteristic of corrosivity also requires a specific test method. When testing the pH of a given waste stream, method 9040 or method 9045 must be used in accordance with WAC 173-303-090(6).

Compliance with LDR for wastes that have a treatment standard expressed as constituent concentrations in wastes (CCW) (40 CFR 268.40) can be shown using any appropriate method. If the waste treatment standard is expressed as constituent concentrations in waste extracts (CCWE) (40 CFR 268.40), then the Toxicity Characteristic Leaching Procedure (TCLP), which is specifically referenced in 40 CFR 268.41(a), must be performed. Following that, however, any appropriate method may be used to determine concentrations of hazardous constituents in the extract and to show compliance with LDR. Both Cyanides (Total) and Cyanides (Amenable) for nonwastewaters are to be analyzed using Method 9010 or 9012, as incorporated by reference in 40 CFR 260.11.

For other parameters or methods not otherwise specified, the following are acceptable sources of testing methods (standard methods):

- Analytical methods cited in WAC 173-303
- The most recently promulgated version of *Test Method for Evaluating Solid Waste: Physical/Chemical Methods*, SW-846
- Other current U.S. EPA methods, as applicable to the matrix under evaluation

- *Standard Methods for the Examination of Water and Wastewater, American Public Health Association* (APHA), American Water Works Association, Water Environment Federation

- *Annual Book of ASTM Standards, American Society for Testing and Materials*

- *AOAC Official Methods of Analysis*, AOAC (Association of Official Analytical Chemists), International.

Appropriate QA/QC documentation is required to be maintained per Section 5.0, regardless of the method used.

Table 3-2. Analytical Parameters, Methods, and Rationale for Waste Received at Low-Level Burial Grounds. (4 sheets total)

Parameter		Analytical method[a]	Media type	Rationale for selection of waste acceptance parameters	Rationale for analysis
General chemistry					
Flashpoint (ignitability)		1010/1020	Liquid	To provide documentation for safe storage conditions.	To determine regulatory status as D001 waste and to provide proper waste designation and applicability of LDR requirements.
pH	Liquid	9040	Liquid, sludge	To indicate the degree of corrosivity for safe handling, to provide for proper waste designation, and to identify waste that might compromise container integrity.	To determine regulatory status as D002 waste and to provide proper waste designation and applicability of LDR requirements and state-only requirements.
	Solid	9045c	Solid		
Hydroxide		9040	Liquid	To provide documentation for safe treatment and storage conditions and to comply with DST System waste acceptance criteria.	To provide proper waste designation and applicability of LDR requirements.
Water reactivity		Field method	Liquid, sludge	To determine whether the waste has a potential to violently react with water to form gases or generate heat, to provide documentation for safe treatment and/or storage conditions for waste designation, and to comply with TSD unit waste acceptance criteria.	To provide proper waste designation for safe storage and management.
Free liquids		9095A	Liquid, sludge, solid	To determine applicability of LDRs and for characterization of appropriate treatment.	To determine appropriate state-only LDR status of the waste.
Cyanide		9010B/9012A	Liquid, sludge, solid	For safe storage, for proper waste designation, applicability of LDR, and characterization of appropriate treatment.	To provide proper waste designation and applicability of LDR requirements.
Sulfide		9030B	Liquid, sludge, solid	For safe storage, for proper waste designation, applicability of LDR, and characterization of appropriate treatment.	To provide proper waste designation and applicability of LDR requirements.

Table 3-2. Analytical Parameters, Methods, and Rationale for Waste Received at Low-Level Burial Grounds. (4 sheets total)

Parameter	Analytical method[a]	Media type	Rationale for selection of waste acceptance parameters	Rationale for analysis
Organic analyses				
Polychlorinated biphenyls	8081A/8082	Liquid, sludge, solid	To determine proper waste designation for management of waste in accordance with the *Toxic Substances Control Act* (TSCA) *of 1976* and WAC 173-303.	To provide proper waste designation and to meet TSCA and LDR requirements.
Total organic carbon	9060	Liquid, sludge, solid	To determine applicability of LDR and applicability to state-only requirements.	To provide proper waste designation and applicability to state-only requirements, to meet LDR requirements, and to meet DST System waste acceptance criteria.
Total organic halides	9020B/9021/9022	Liquid, sludge	To determine proper waste designation and applicability to state-only requirements.	To provide proper waste designation and applicability to state-only requirements.
Persistent constituents	9075/9076/9077/ 9211/9212/9214/ 9250/9251/9253			
Total suspended solids	160.2[b]	Liquid, sludge	To determine applicability of LDR and status as a wastewater.	To provide applicability of LDR and status as a wastewater.
Volatile organic compounds	1311/8260B	Liquid, sludge, solid	To determine proper waste designation, applicability of LDRs, and characterization of appropriate treatment.	To provide proper waste designation, regulatory status, and applicability of LDR requirements.
Semi-volatile organic compounds	1311/8270A	Liquid, sludge, solid	To determine proper waste designation, applicability of LDRs, and characterization of appropriate treatment.	To provide proper waste designation, regulatory status, and applicability of LDR requirements.
Chlorinated herbicides	8151A	Liquid	Not applicable	To provide proper waste designation and applicability to state-only requirements.

Table 3-2. Analytical Parameters, Methods, and Rationale for Waste Received at Low-Level Burial Grounds. (4 sheets total)

Parameter	Analytical method[a]	Media type	Rationale for selection of waste acceptance parameters	Rationale for analysis
Inorganic analyses				
Arsenic	1311/6010B	Liquid, sludge, solid	To provide for proper waste designation, applicability of LDRs, and for characterization of appropriate treatment.	To determine proper waste designation, regulatory status as a toxic characteristic waste, and applicability of LDR requirements.
Barium	1311/6010B	Liquid, sludge, solid	To provide for proper waste designation, applicability of LDRs, and for characterization of appropriate treatment.	To determine proper waste designation, regulatory status as a toxic characteristic waste, and applicability of LDR requirements.
Cadmium	1311/6010B	Liquid, sludge, solid	To provide for proper waste designation, applicability of LDRs, and for characterization of appropriate treatment.	To determine proper waste designation, regulatory status as a toxic characteristic waste, and applicability of LDR requirements.
Chromium	1311/6010B	Liquid, sludge, solid	To provide for proper waste designation, applicability of LDRs, and for characterization of appropriate treatment.	To determine proper waste designation, regulatory status as a toxic characteristic waste, and applicability of LDR requirements.
Lead	1311/6010	Liquid, sludge, solid	To provide for proper waste designation, applicability of LDRs, and for characterization of appropriate treatment.	To determine proper waste designation, regulatory status as a toxic characteristic waste, and applicability of LDR requirements.
Mercury	1311/7470	Liquid, sludge, solid	To provide for proper waste designation, applicability of LDRs, and for characterization of appropriate treatment.	To determine proper waste designation, regulatory status as a toxic characteristic waste, and applicability of LDR requirements.
Silver	1311/6010	Liquid, sludge, solid	To provide for proper waste designation, applicability of LDRs, and for characterization of appropriate treatment.	To determine proper waste designation, regulatory status as a toxic characteristic waste, and applicability of LDR requirements.

Table 3-2. Analytical Parameters, Methods, and Rationale for Waste Received at Low-Level Burial Grounds. (4 sheets total)

Parameter	Analytical method[a]	Media type	Rationale for selection of waste acceptance parameters	Rationale for analysis
Selenium	1311/6010	Liquid, sludge, solid	To provide for proper waste designation, applicability of LDRs, and for characterization of appropriate treatment.	To determine proper waste designation, regulatory status as a toxic characteristic waste, and applicability of LDR requirements.
Nickel	6010	Liquid, sludge, solid	To determine applicability of LDRs and for characterization of appropriate treatment.	To meet LDR requirements.

[a]SW-846 unless otherwise noted.
[b]EPA-600/4-7-020 unless otherwise noted.
DST = Double-Shell Tank (System).
LDR = land disposal restriction.

EPA-600/4-79-020, *Methods for Chemical Analysis of Water and Wastes*, U.S. Environmental Protection Agency, Cincinnati, Ohio.

SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Method*, latest edition, Office of Solid Waste, U.S. Environmental Protection Agency, Washington, D.C.

WAC 173-303, "Dangerous Waste Regulations".

4.0 SELECTING SAMPLING PROCEDURES

Specific sampling procedures and techniques depend on both the nature of the material and the type of packaging. Waste samples are treated and preserved as necessary to protect the sample. Recommended treatment, preservation techniques and holding times are used as stated in SW-846. This section describes the sampling methodology used to obtain representative samples.

4.1 SAMPLING STRATEGIES

Table 4-1 contains waste forms and sample equipment used to sample referenced waste. Sampling of these waste forms is performed in accordance with Table 4-1.

4.2 SAMPLING METHODS

The appropriate personnel are responsible for arranging all sampling and laboratory support for sample analysis. Samples are processed at one of several laboratories qualified to perform analysis of waste samples (refer to Section 5.0). Sampling methods are those described in WAC 173-303-110(2).

Sampling typically includes the following:

- Obtain a unique sample number and complete the sample tag before sampling
- Obtain a precleaned sampler and sample bottles
- Attach sample label to sample bottles
- For sampling liquid waste, a sampler or pipette is used to sample for two phase liquids. Homogeneous liquids in small containers are poured into a sample bottle
- For sampling solid waste, use a scoop, trier, or hand auger to obtain a sample of the waste. For large containers of waste, composite several augers or scoops to ensure samples are representative
- Fill sample containers in the following sequence: volatile organics, semivolatile organics, metals, ignitability, pH (corrosivity)
- For solid waste, wipe the exterior surfaces of the sample bottles with a dry rag
- Place samples in an appropriate receptacle for transfer to the laboratory
- Complete the chain-of-custody forms
- Seal and mark the receptacle in accordance with WAC 173-303-071(3)(1)
- Transfer receptacle to the analytical laboratory as appropriate to meet sample holding times
- Properly clean and decontaminate nondisposable sampling equipment or package for return to central sampling equipment decontamination area according to onsite requirements.

4.3 SELECTING SAMPLING EQUIPMENT

Sampling equipment selection is detailed in Table 4-1. Sample preservation follows SW-846 protocol except as amended by the Hanford Facility RCRA Permit.

4.4 SAMPLE PRESERVATION

Sample preservation follows SW-846 protocol except as provided by the Hanford Facility RCRA Permit.

4.5 ESTABLISHING QUALITY ASSURANCE AND QUALITY CONTROL PROCEDURES FOR SAMPLING

Sample collectors prepare a permanent log of sampling activities. A log of sampling activities is kept in accordance with SW-846, Chapter 9.0. Log entries include, as appropriate: date of collection, time of collection, location, batch number, sample number, tank number, copy of the chain-of-custody form, sampling methodology, container description, waste matrix (liquid), description of generating process (e.g., decontamination activities), number and volume of samples, field observations, field measurements (e.g., pH, percent lower explosive limit), laboratory destination and laboratory number, and signature. These log entries are made while sampling is performed. The logs or copies of logs are maintained by appropriate personnel after completion of sampling activities.

A chain-of-custody record accompanies samples at all times. The TSD unit maintains written chain-of-custody procedures to ensure accountability of waste sample handling and to ensure sample integrity. All samples are labeled with a unique identifier.

During all sampling activities, strict compliance with applicable industrial hygiene and safety standards is mandatory. If samplers accidentally contact waste material, decontamination of sampling personnel is performed immediately. Transportation of samples is performed in accordance with all applicable Hanford Site and U.S. Department of Transportation requirements.

The following QA/QC elements are used to ensure sampling activities for designation purposes result in acceptable laboratory data:

- Representative sampling methods as defined by WAC 173-303-110(2), 40 CFR 261, Appendix I, and/or SW-846, Chapter 9.0
- Appropriate sample containers and equipment
- Samples numbered
- Traceable labeling system
- Field QA/QC samples (applicable sampling and analysis plan)
- Equipment calibration (current as applicable)
- Chain of custody.

Table 4-1. Low-Level Burial Ground Chemical Screening Sampling Equipment.

Waste form	Reference in SW-846, Chapter 9.0	
	Waste	Equipment*
Liquids	Free-flowing liquids and slurries	COLIWASA, glass thief or pipette
Solidified liquids	Sludges	Trier, scoops, and shovels
Sludges	Sludges	Trier, scoops, and shovels
Soils	Sand or packed powders and granules	Auger, scoops, and shovels
Absorbents	Large-grained solids	Large trier, scoops, and shovels
Wet absorbents	Moist powders or granules	Trier, scoops, and shovels
Process solids and salts	Moist powders or granules	Trier, scoops, and shovels
	Dry powders or granules	Thief, scoops, and shovels
	Sand or packed powders and granules	Auger, scoops, and shovels
	Large-grained solids	Large trier, scoops, and shovels
Ion exchange resins	Moist powders or granules	Trier, scoops, and shovels
	Dry powders or granules	Thief, scoops, and shovels
	Sand or packed powders and granules	Auger, scoops, and shovels

COLIWASA = composite liquid waste sampler.

*Other American Society for Testing and Materials-approved equipment could be used to collect samples. The equipment requirements of Table 4-1, as amended by any Hanford Facility RCRA Permit conditions, apply to sampling for chemical screening. In addition, the following sampling equipment could be used in sampling for chemical screening: (1) for liquids and slurries-dip, tank, bomb, and bailer samplers as well as tube-type samplers (e.g., thin-walled Shelby tubes, split spoons, probes); and (2) for sludges and solids-tube-type samplers (as stated) and augers; for small containers, a spoon could be used in place of a scoop.

SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, U.S. Environmental Protection Agency, Washington, D.C.

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5.0 SELECTING A LABORATORY AND QUALITY ASSURANCE/QUALITY CONTROL

The QA and QC requirements outlined in this section are applicable to laboratory activities governed by this WAP. The selection of any laboratory is based on the ability of the laboratory to demonstrate compliance to this section with experience and capability in the following major categories:

- Comprehensive written QA/QC program
- Technical analytical expertise
- Effective information management systems.

5.1 EVALUATION OF LABORATORIES

All laboratories providing analytical support to the TSD unit are required to have a laboratory QA plan. The laboratory QA plan is submitted to the TSD unit for review before the commencement of analytical work. The QA plan, at a minimum, addresses the following elements:

- Sample custody and management practices (also refer to Section 4.0)
- Sample preservation protocols
- Sample preparation and analytical procedure requirements
- Instrument maintenance and calibration requirements
- Internal QC measures, e.g. method blanks, spikes.

Each laboratory is audited periodically to evaluate the effective implementation of the QA/QC program. QA personnel and a technical expert evaluate the laboratory through onsite observations and/or reviews of the following documentation: copies of the QA/QC documents, records of surveillances/inspections, audits, nonconformances, and corrective actions.

5.2 QUALITY ASSURANCE/QUALITY CONTROL OBJECTIVES

The overriding goal of the analytical program is to support the accurate designation of waste and/or to demonstrate compliance to LDR standards. Laboratory QA/QC programs are designed to meet the following objectives.

- Minimize errors. Errors could be introduced during preparative, analytical, and/or reporting phases of work. QC programs enable the source(s) of error to be identified and enable appropriate precautions to be taken to minimize the errors.

- Provide information. The designation of waste relies on a combination of knowledge and data. The use of analytical laboratories with QA/QC programs ensures accurate, reliable analytical data are available to support proper waste management.

QC program elements include analysis of samples to written and approved procedures and certification of the laboratory. Key QA program elements are designed to provide objective evidence that waste testing meets the performance specifications of the TSD unit. QA activities and implementation responsibilities are as follows.

- Activity based laboratory inspections. Inspections are performed by the TSD unit. Inspections verify that specific guidelines, specifications, or procedures for the activities are completed successfully.

- Laboratory analysis. Analyses are performed by onsite or offsite laboratories on samples of waste using written and approved procedures.

- Development of inspection checklists. Checklists are required for laboratory inspections and are designed to ensure that the inspected activity consistently is addressed. Checklists are completed during the inspection to document results.

- Instrument calibration and calibration verification. These activities are performed by the laboratory, and are required for ensuring data of known accuracy and precision. Calibration data are maintained and stored to ensure tractability to reported results.

5.3 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

All analytical work is defined and controlled by a statement of work, work order, or other work authorizing documentation. Samples are handled according to approved laboratory procedures. The accuracy, precision, and limitations of analytical data are determined by QC performance.

As needed, the TSD unit conducts analyses to determine completeness of information and whether waste meets the waste acceptance criteria for TSD at one of the Hanford Facility TSD units or those of a chosen offsite TSD facility. Testing and analytical methods depend on the type of analysis sought and the reason for needing the information. For parameters or methods, refer to Section 3.0.

5.4 DATA ASSESSMENT

The acquired data need to be scientifically sound, of known quality, and thoroughly documented. Data validation is not required; however, the TSD unit is responsible to ensure that data assessment or evaluation is completed. Data are assessed to determine compliance with quality standards established by Ecology and this WAP, which are as follows.

Precision – The overall precision is the agreement between the collected samples (duplicates) for the same parameters, at the same location, subjected to the same preparative and analytical techniques. Analytical precision is the agreement between individual test portions taken from the same sample, for the same parameters, subjected to the same preparative and analytical techniques.

Accuracy – Accuracy of the measurement system is evaluated by use of various kinds of QA samples, including, but not limited to, certified standards, in-house standards, and performance evaluation samples.

Representativeness – Representativeness addresses the degree to which the data accurately and precisely represent a real characterization of the waste stream, parameter variation at a sampling point, sampling conditions, and the environmental condition at the time of sampling. The issue of representativeness is addressed for the following points.

- Based on the generating process, the waste stream, and its volume, an adequate number of sampling locations are selected.

- The representativeness of selected media has been defined accurately.

- The sampling and analytical methodologies are appropriate.

- The environmental conditions at the time of sampling are documented.

Completeness – Completeness is the amount of usable data obtained from a measurement system compared to the total amount of data requested.

Comparability – Comparability is the confidence with which one data set can be compared to another. This usually is accomplished by using standard methods.

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6.0 RE-EVALUATION OF WASTE PROFILES

The frequency to re-evaluate the waste profile and supporting data and documentation is each 12 months at a minimum or more often if the generator has informed the TSD unit of a change in the waste generation process, or if the TSD unit has identified that the waste received at the TSD unit or the description on the transfer or manifest papers does not match the waste profile. If the generator has informed the TSD unit of a change in the waste generation process, the waste re-enters the waste stream approval process described in Section 2.1.1. The TSD unit evaluates verification data against the waste profile to identify any waste streams for which a change in waste generation process is suspect. If a waste stream is suspect, that waste stream also re-enters the approval process described in Section 2.1.1.

When a waste profile is re-evaluated, the TSD unit could request the organization generating the waste to do one of the following:

- Verify the current waste profile is accurate
- Supply a new waste profile
- Submit a sample for parameter analysis.

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7.0 SPECIAL WASTE ANALYSIS PROCEDURAL REQUIREMENTS

This section discusses any special process requirements for receiving mixed waste at this TSD unit.

7.1 PROCEDURES FOR RECEIVING WASTE GENERATED ONSITE

In general, mixed waste received from onsite generating units is managed the same as waste received from offsite generators. Differences include, but are not limited to, the following: (1) physical and chemical screening frequencies for verification (minimum percentages of 5 percent for waste from onsite generating units and 10 percent for waste from offsite generators (note that chemical screening frequency depends on the physical screening frequency); (2) shipping documentation (Uniform Hazardous Waste Manifests are used for waste from offsite generators, and waste tracking forms are used for waste from onsite generating units); and (3) LDR documentation requirements (notification for waste from offsite generators and the information contained in the notice for waste from onsite generating units).

7.2 PROCEDURES FOR RECEIVING WASTE GENERATED OFFSITE

Waste received from offsite is handled in the same manner as mixed waste received from onsite except for those items described in Section 7.1 and defueled reactor compartments disposed in trench 94 of the 218-E-12B Burial Ground, which are transported directly from the offsite generator to trench 94.

7.3 PROCEDURES FOR IGNITABLE, REACTIVE, AND INCOMPATIBLE WASTE

This TSD unit does not accept ignitable, reactive, or incompatible waste (refer to Section 1.2). The TSD unit ensures that ignitable, reactive, or incompatible waste is not accepted at this TSD unit in the following manner.

- Pre-shipment review and chemical screening ensure ignitable and reactive waste is not accepted.
- Pre-shipment review ensures waste incompatible with the liner is not accepted in the lined trenches.

The types of prohibited waste not accepted at this TSD unit are listed in Section 1.2.

7.4 PROVISIONS FOR COMPLYING WITH FEDERAL AND STATE LAND DISPOSAL RESTRICTION REQUIREMENTS

State-only and federal LDR requirements restrict the land disposal of certain types of waste subject to RCRA and RCW 70.105, "Hazardous Waste Management", as amended. Waste managed on the Hanford Facility falls within the purview of these LDRs per 40 CFR 268 and WAC 173-303-140. Waste constituents that are subject to LDRs are identified in 40 CFR 268.40 and referenced by WAC 173-303-140. Waste must meet certain treatment standards, as specified in 40 CFR 268.40 and WAC 173-303-140, if the waste is to be land disposed.

Generators (as defined in the regulation) determine if LDRs apply to the waste based on knowledge or testing [40 CFR 268.7(a)]. Each waste is analyzed for those LDR constituents contained in the listed and characteristic waste numbers identified by the generator, if the knowledge of the generator is not sufficient to make a determination. If the LDR waste does not meet the applicable treatment standards, the generator

provides with each shipment of waste information stating so in accordance with WAC 173-303-380(1)(j),-(k),-(l),-(m),-(n) or -(o). If the waste meets the standards, the generator must send a certification that the waste meets the treatment standards.

8.0 RECORDKEEPING

Recordkeeping requirements that are applicable to this WAP are described in Hanford Facility RCRA Permit, Attachment 33, General Information Portion, Table 12-1, and within this WAP.

The TSD unit maintains the waste stream profile, supporting documentation, and any associated QA/QC data described in Section 2.0 of the WAP in accordance with the requirements in Hanford Facility RCRA Permit, Attachment 33, General Information Portion, Table 12-1.

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9.0 REFERENCES

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APHA, 1998, *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, American Public Health Association, American Water Works Association, and Water Environment Federation, Washington, D.C.

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WA7890008967, latest revision, *Hanford Facility Dangerous Waste portion of the Resource Conservation and Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste*, Washington State Department of Ecology, Olympia, Washington.

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APPENDIX 4A

CONSTRUCTION QUALITY ASSURANCE REPORT

Transmitted from DOE-RL to Ecology.

Reference: Transmittal of the Hanford Facility Low-Level Burial Grounds Construction Quality Assurance Report and W-025 As-Built Drawings

Document Number: WHC-SD-W025-RPT-002, Revision 0.

Correspondence Number: 95-PCA-238, March 28, 1995.

Document Number: WHC-SD-W025-RPT-001, Revision 0.

Correspondence Number: 95-SWT-568, September 19, 1995.

APPENDIX 4B

DEFINITIVE DESIGN

Transmitted from DOE-RL to Ecology.

Reference: Low-Level Burial Grounds Dangerous Waste Permit Application Supplement 2: Design Documentation for Mixed Waste Nondragoff Land Disposal Facility (DOE/RL-88-20, Supplement 2, Revision 0).

Definitive Design Report, WHC-SD-W025-FDR-001, Revision 0.

Correspondence Number: 90-PPB-186, September 20, 1990.

APPENDIX 4C

RESPONSE ACTION PLAN

Transmitted from DOE-RL to Ecology.

Reference:	Revision to Response Action Plan.
Document Number:	WHC-SD-W025-AP-001, Revision 1.
Correspondence Number:	95-SWT-427, July 19, 1995.

APPENDIX 4D

REQUEST FOR EXEMPTION FROM LINED TRENCH REQUIREMENTS AT 218-E-12B BURIAL GROUND TRENCH 94

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2 LETTER 02/01/91 FROM M. GEARHEARD (U.S. ENVIRONMENTAL PROTECTION AGENCY) TO K.W. BRACKEN (U.S. DEPARTMENT OF ENERGY, RICHLAND OPERATIONS OFFICE) REGARDING "REGULATION OF SUBMARINE REACTOR COMPARTMENT DISPOSAL PACKAGES" ..... ATT 2-i

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6 LETTER FROM D.R. HELGESON (CORROSION CONTROL SPECIALISTS) TO C.L. REAUME (PUGET SOUND NAVAL SHIPYARD) REGARDING SOIL RESISTIVITY TESTING, HANFORD, WASHINGTON ..... ATT 6-i

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1.0 INTRODUCTION

This request for exemption applies only to the decommissioned, defueled reactor compartments disposed in trench 94 of the 218-E-12B Burial Ground (Figure 1-1). This exemption request does not apply to any other waste at the 218-E-12B Burial Ground or to any other burial ground on the Hanford Facility, and is limited to regulatory requirements addressing liner/leachate collection systems.

Decommissioned, defueled reactor compartments contain radioactivity caused by exposure of structural components to neutrons during normal operation of the ships and submarines. In addition to radioactivity, the reactor compartments disposed in trench 94 contain lead used as shielding and polychlorinated biphenyls (PCBs). The lead used as shielding is regulated as a state-only dangerous waste in accordance with WAC 173-303. The PCBs are regulated in accordance with the TSCA as PCB/radioactive waste under 40 CFR 761.50(b)(7), which allows for PCB disposal without taking into account the PCBs in the waste if the PCB waste meets certain criteria for PCB Bulk Product Waste under 40 CFR 761.62(b)(1).

In May of 1984, the Navy issued an environmental impact statement (EIS) that evaluated alternatives for disposal of reactor compartments from submarines preceding the LOS ANGELES (SSN 688) class (USN 1984). Land disposal was the alternative selected. Shipment of reactor compartments from pre-LOS ANGELES submarines to trench 94 of the 218-E-12B Burial Ground began in April of 1986.

In 1996, the Navy issued an EIS that considered the disposal of reactor plants from cruisers, and from LOS ANGELES and OHIO Class submarines (USN 1996). The record of decision for this EIS selected disposal by land burial of the entire reactor compartment at the LLBG. Land disposal of these reactor compartments could require additional capacity beyond the existing size of trench 94. It might be necessary to expand trench 94 to accommodate the additional reactor compartments.

The DOE-RL's objectives in preparing and submitting this exemption request is to request an exemption from dangerous waste landfill liner and leachate collection and removal system (hereinafter referred to as liner/leachate collection system) requirements for trench 94 of the 218-E-12B Burial Ground.

Revision 0 of the LLBG Part B dangerous waste permit application was submitted in December 1989 to Ecology and the U.S. Environmental Protection Agency (EPA), Region 10. The Part B dangerous waste permit application indicated that a request for exemption from liner/leachate collection system requirements for disposal of the reactor compartments would be submitted to Ecology and the EPA. The *Low-Level Burial Grounds Dangerous Waste Permit Application Request for Exemption from Lined Trench Requirements for Submarine Reactor Compartments* (Revision 0) was submitted in July 1990 (DOE/RL-90-12).

1.1 SCOPE

This exemption request applies only to the decommissioned, defueled reactor compartments that are being disposed in trench 94 of the 218-E-12B Burial Ground. This exemption request does not apply to any other waste at the 218-E-12B Burial Ground or to any other burial ground on the Hanford Facility, and is limited to regulatory requirements addressing liner/leachate collection systems.

1.2 BACKGROUND

The 218-E-12B Burial Ground began receiving waste in 1967. Waste contained in the 218-E-12B Burial Ground includes mixed waste, low-level waste, and transuranic waste. Trench 94 is used for the final disposal of decommissioned, defueled reactor compartments.

The first defueled reactor compartment was placed in trench 94 in April 1986. The reactor compartments are prepared for disposal by the Puget Sound Naval Shipyard (PSNS) in Bremerton, Washington, and are transported by barge to the Port of Benton adjacent to the Hanford Facility and then over land to the 218-E-12B Burial Ground.

Final disposal of the decommissioned, defueled reactor compartments has been addressed in the Navy's EISs (USN 1984, USN 1996). The EISs discuss the presence of potentially hazardous materials. Because of the large amount of lead shielding in the reactor compartments, the EISs specifically discussed the long-term potential hazard of the lead shielding.

Extraction procedure testing of elemental solid lead has determined that the leachate contains lead in concentrations that would require regulation of elemental lead as a RCRA hazardous waste. However, the EPA, in a June 1987 letter, stated that "lead whose primary use is shielding in low-level waste disposal operations is not subject to Federal hazardous waste regulations when placed on the land as part of its normal commercial use." This was reiterated by the EPA in a February 1991 letter (Attachment 2), which stated that "the lead shielding contained in the SRC disposal packages is not considered to be solid waste as defined by 40 CFR 261.2," and the EPA believes that the reactor compartment disposal packages are not subject to regulation under RCRA. Regardless, the thick metal encapsulation of the shielding lead within the reactor compartments, as built, already meets the RCRA treatment standards of 40 CFR 268.42, Treatment Code MACRO, for disposal of radioactive lead solids.

The presence of the lead shielding within the reactor compartments has caused the reactor compartments to be regulated as 'state-only' dangerous waste for disposal under WAC 173-303. The PSNS has studied the feasibility of removing this lead from the reactor compartments (e.g., PSNS 1990a, USN 1996). These studies found that removal of the lead would be very difficult and would result in radiation exposure to shipyard workers ranging from about 184 to 1,065 roentgen equivalent man (rem) per reactor compartment depending on the ship class. This exposure is orders of magnitude higher than the exposure that results from preparing reactor compartments for disposal. Additionally, lead removal would cost about $14 to $108 million dollars per reactor compartment depending on the ship class. Thus, both the additional exposure and expense would be substantial. The studies concluded that the removal of lead from the reactor compartments is not a reasonable method to mitigate the hazards associated with the lead contained within the reactor compartments. As discussed in Section 4.2.2, lead is not expected to migrate from the reactor compartments to groundwater for over 2 million years (240,000 years at the minimum) (USN 1995).

The PCB impregnated wool felt sound damping material is removed from reactor compartments when present. The reactor compartments might contain several kilograms of PCBs (typically less than 5 kilograms) tightly bound in the composition of solid materials such as thermal insulation, electric cable coverings, and rubber items manufactured before PCBs were banned. The PCB-containing materials are distributed widely throughout the reactor compartment, and their removal would be difficult and would result in significant exposure of personnel to radiation. These PCBs would be contained totally within the fully sealed, all-welded reactor compartment structures. The PCBs would be present in materials in concentration over the regulatory limit of 50 parts per million. In 1999, EPA agreed (Attachment 1) that the PCBs found in the defueled reactor compartments meet the requirements for PCB bulk product waste under 40 CFR 761.62(b)(1) and that the disposal of the defueled reactor compartments in trench 94 of the

218-E-12B Burial Ground is now in compliance with the current TSCA regulations under 40 CFR Part 761.

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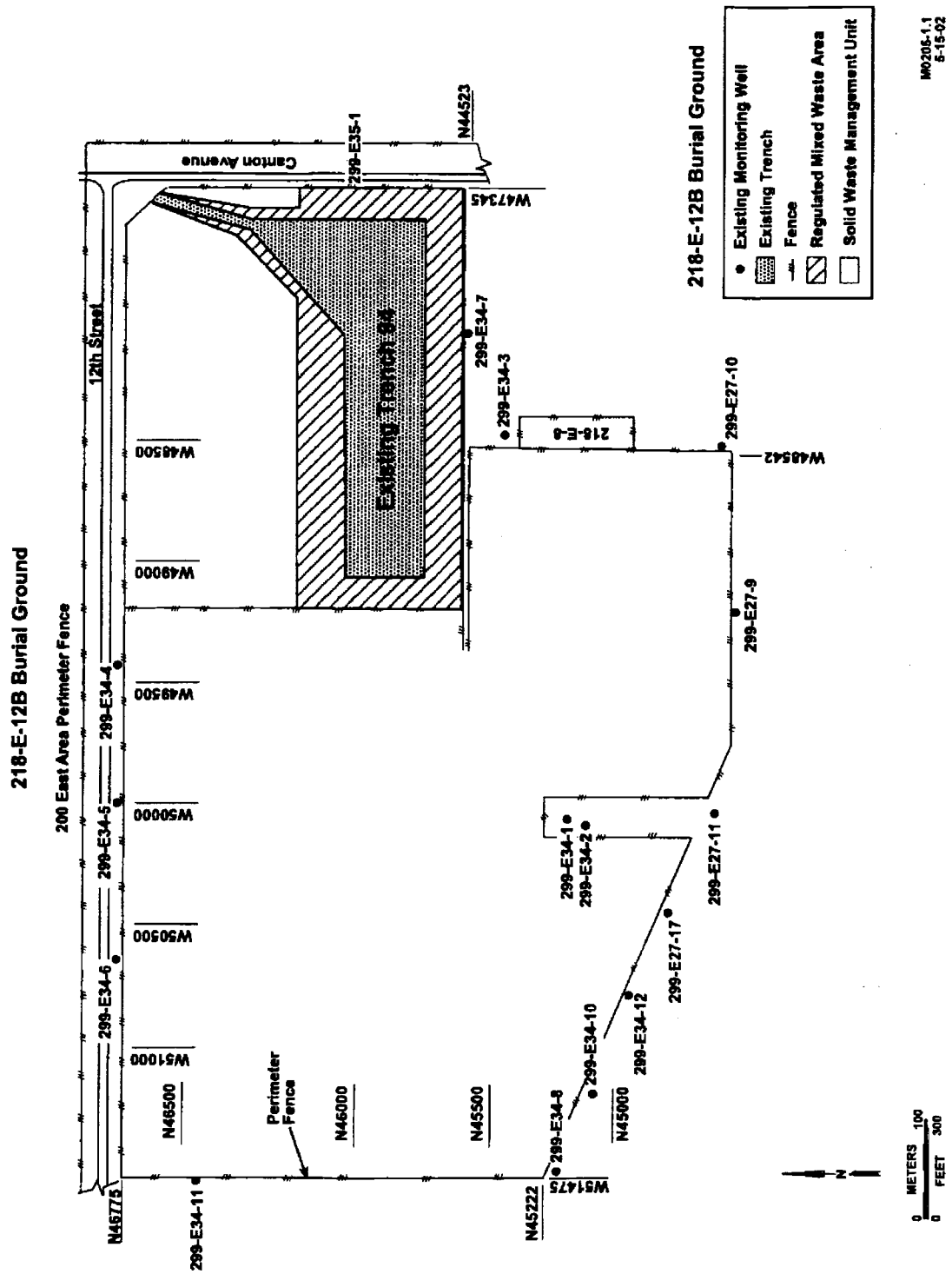

Figure 1-1. Location of Trench 94 within the 218-E-12B Burial Ground.

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2.0 BASIS FOR LINER/LEACHATE COLLECTION SYSTEM EXEMPTION REQUEST

Landfills used for the disposal of dangerous and mixed waste must meet a number of regulatory requirements. For some of these requirements, the regulations allow exemptions provided that certain conditions are met (Table 2-1). One of the requirements for which an exemption may be granted is the requirement for liner/leachate collection systems. This section describes the specific regulatory requirements for mixed waste landfill liner/leachate collection systems applicable to reactor compartments in trench 94 and describes the conditions that must be met to obtain an exemption. The approach to be applied to satisfy these requirements also is described, including specific performance objectives and a criterion to be used to determine whether requirements have been met.

2.1 REGULATORY REQUIREMENTS

Requirements for mixed waste and dangerous waste landfill liner/leachate collection systems are given in WAC 173-303-665(2). Under WAC 173-303-665(2)(a)(i), dangerous waste landfills are required to have a liner "that is designed, constructed, and installed to prevent any migration of wastes out of the landfill to the adjacent subsurface soil or groundwater or surface water at anytime during the active life (including the closure period) of the landfill. The liner must be constructed of materials that prevent wastes from passing into the liner during the active life of the facility". Under WAC 173-303-665(2)(a)(ii), dangerous waste landfills are required to have "a leachate collection and removal system immediately above the liner that is designed, constructed, maintained, and operated to collect and remove leachate from the landfill". Under WAC 173-303-665(2)(h), a landfill unit that commences construction on a lateral expansion after July 29, 1992 must install two or more liners and a leachate collection and removal system above and between such liners.

Provisions for exemptions from liner/leachate collection system requirements are given in WAC 173-303-665(2)(b). Exemptions could be given if Ecology finds, based on a demonstration by the owner or operator, that alternative design and operating practices, together with location characteristics, would prevent migration of any dangerous constituents into the groundwater or surface water at any future time. Specific requirements for exemption requests in permit applications are given in WAC 173-303-806(4)(h)(ii)(A). These requirements include detailed plans and engineering and hydrogeologic reports, as appropriate, describing alternate design and operating practices that will, in conjunction with location aspects, prevent the migration of any dangerous constituent into the groundwater or surface water at any future time.

Conditions for the minimum technological design requirements are contained in WAC 173-303-665(2)(j). Exemptions may be granted if the owner/operator demonstrates that alternative design and operating practices, together with location characteristics: "Will prevent the migration of any dangerous constituent into the groundwater or surface water at least as effectively as the liners and leachate collection and removal systems" and "will allow detection of leaks of dangerous constituents through the top liner as least at effectively".

2.2 APPROACH TO LINER/LEACHATE COLLECTION SYSTEM EXEMPTION REQUEST

Washington State requirements for landfills are contained in WAC 173-303-665(2). The basic design to which the alternate design (i.e., reactor compartment burial in an unlined trench) will be compared is the

Ecology minimum technological design specified in WAC 173-303-665(2)(h), which requires liners and leachate collection systems.

The results of a detailed site-specific lead migration study show that the trench 94 location characteristics will prevent migration of lead from reactor compartments to the unconfined aquifer or to the Columbia River for very long periods of time [hundreds of thousands of years or greater (PNL-8356)]. Available data on the geology, geochemistry, and geohydrology of the disposal site were used to develop a conceptual model for release and transport of lead from the reactor compartments. Laboratory studies were performed to provide information needed for the model that was not available from existing databases.

The condition for exemption of minimum technological design requirements under WAC 173-303-665(2)(j) for each new landfill unit on which construction commences after January 29, 1992, and each lateral expansion of a landfill unit on which construction commences after July 29, 1992, is that alternative design and operating practices, together with location characteristics: (i) "Will prevent the migration of any dangerous constituent into the ground water or surface water at least as effectively as the liners and leachate collection and removal systems" and (ii) "Will allow detection of leaks of dangerous constituents through the top liner at least as effectively." The minimum technological design relies on the use of engineered features (i.e., liner/leachate collection system) to prevent the release of dangerous constituents to the environment. These features have a finite lifetime after which a release can occur and a finite lifetime during which the features can be operated to prevent release of contaminants. The effective lifetime of these features, therefore, is the reasonable time for which the minimum technological design should be expected to prevent the release of dangerous constituents to the environment.

It will be demonstrated that the design and operating practice of the reactor compartment package buried in an unlined trench will contain the dangerous constituents within the reactor compartments for a much longer period than the expected design life of the geosynthetic liner components.

2.3 PERFORMANCE OBJECTIVES AND CRITERION

In the preceding section, conditions were established that, if met, will allow exemption from liner/leachate collection system requirements. In this section, specific, measurable performance objectives and criterion of the alternate landfill design are defined to determine whether these conditions have been met.

Performance is evaluated for both the active life of the unit and the period after the active life. The active life is defined as the period from initial receipt of dangerous waste until certification of final closure, which is effectively the period preceding installation of a cover. The period after the active life will include a postclosure care period for the 218-E-12B Burial Ground. For the purpose of the performance evaluations, the postclosure care period is defined as the period 30 years after final closure of the 218-E-12B Burial Ground*. This definition is consistent with postclosure care requirements given in WAC 173-303-610(7).

The following sections establish the specific performance objectives and criterion.

*The period 30 years after final closure of the 218-E-12B Burial Ground extends more than 30 years beyond final closure of trench 94 because the burial ground could be closed in phases (Chapter 11.0).

2.3.1 Performance Objectives and Criterion to Demonstrate Better Performance than the Minimum Technological Design Requirements for Liner/Leachate Collection Systems

The preamble to the final minimum technological requirement rules states that "The goal of liners and leachate collection systems is to prevent migration by collecting and removing leachate before it can migrate during the unit's active life and post-closure care period" (51 FR 60, p. 10708). This was reiterated in the preamble to the rules as amended in response to the requirements of the 1984 HSWA to RCRA (57 FR 3462). This objective recognizes that at many landfills leachate will be generated during the active life and will continue to be generated during the postclosure care period. An impermeable cover is installed at closure to promote drainage and to provide long-term minimization of liquid migration through the landfill. Thus, the minimum technological performance objective will be the basis for comparison. The minimum technological design performance objective is to prevent leachate migration from the landfill unit by collecting and removing leachate before the leachate can migrate during the active life of the unit and the postclosure care period.

Trench 94 has been in operation since 1986 without burial of the reactor compartments placed there. This mode of operation allows flexibility in the disposal of this unique waste and this practice could continue until installation of the final RCRA cover. The following operating practices are employed to monitor the condition of the reactor compartments until they are buried. Each week a nuclear operator performs an inspection of trench 94. The reactor compartments are visually inspected to verify their integrity. In addition, trench 94 is inspected for run-on, run-off, and erosion problems after a significant precipitation or windstorm event. Further corrective actions are discussed in the building emergency plan (Chapter 7.0).

The performance of the alternate design must be at least as effective as the liners and leachate collection and removal system of the minimum technological design and must allow detection of leaks of hazardous constituents through the top liner at least as effectively. It can be concluded that the performance of the minimum technological design will be exceeded if generation of contaminated leachate is prevented beyond the expected lifetime of the minimum technological design. Therefore, the performance criterion selected for evaluating the alternate design is as follows:

Demonstrate that the alternate design and operating practice, together with location characteristics, prevent generation of any contaminated leachate beyond the expected design lifetime of the minimum technological liner/leachate collection system design.

Section 4.0 demonstrates that the containment provided by the reactor compartment package outlasts the expected design life of a liner/leachate collection system, and that no contaminated leachate will be generated during the active life and postclosure period of the unit.

2.3.2 Performance of Designs After Expected Lifetime of a Liner/Leachate Collection System

This section addresses performance of the disposal system design after the expected lifetime of a liner/leachate collection system.

As discussed in Sections 2.3.1 and 2.3.2, the liner/leachate collection systems are intended to prevent migration of contaminants during the active life and postclosure care period of the unit. Liner/leachate collection systems are not designed specifically to provide long-term control over migration of contaminants; the cover provides that function by preventing the infiltration of water. In the preamble to the final minimum technological requirement rules, the EPA (51 FR 60, p. 10711) stated the following:

"Based on presently available information, the Agency does not view liner systems as the primary means of controlling the migration of hazardous constituents in the long term. The Agency continues to believe that liners are best used to facilitate the collection and removal of leachate (47 FR 32284, July 26, 1982). Because the function of liner systems then, is relatively short-term in nature, as opposed to providing protection for many decades or even hundreds of years, the effectiveness of liners is overshadowed by other factors that include: (1) the nature of the location of the unit with respect to climate, hydrogeology, and population, (2) the nature of the waste in the unit, and (3) the long-term performance of the final cover that is placed over the unit at closure."

For many hundreds of years, the reactor compartment package will prevent migration of contaminants. Over the very long periods of interest with respect to preventing contaminant migration, however, neither the liner/leachate collection system nor the reactor compartment (which will outlast the liner/leachate collection system) will prevent contaminant migration. Over the very long timeframes under consideration, even the cover cannot be expected to withstand the elements and remain fully functional. Thus, the factors that most influence the potential for long-term contaminant migration are the hydrogeologic and geochemical characteristics of the disposal site. Therefore, Section 4.0 also addresses the performance of the disposal system over these very long timeframes.

Table 2-1. Regulatory Requirements for Liners, Leachate Collection, and Exemptions.

Requirement	Dangerous waste regulations
Liner(s)	WAC 173-303-665(2) requires liners that will prevent migration out of the landfill during the active life.
Leachate collection	WAC 173-303-665(2) requires a leachate collection and removal system above and between liners. WAC 173-303-665(2)(h) requires a leachate collection and removal system above and between the liners (refer to note).
Exemption conditions	WAC 173-303-665(2)(b) allows for exemptions from liner and leachate collection requirements upon demonstrating no migration of dangerous constituents to surface water or groundwater at any future time. WAC 173-303-665(2)(j) allows for approval of alternative design or operating practices upon demonstration that design will prevent migration of dangerous constituents into the groundwater and will allow detection of leaks of dangerous constituents through the top liner.

WAC = Washington Administrative Code.
cm/sec = centimeter per second.

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3.0 NATURE AND QUANTITY OF WASTE

This section describes the reactor compartment waste that will be disposed in trench 94.

3.1 WASTE CHARACTERISTICS

Each reactor compartment package is that section of the ship containing the nuclear reactor plant. The nuclear reactor plant consists of the reactor vessel, steam generators, pumps, valves, and piping. Figure 3-1 provides typical dimensions and weights of reactor compartment packages. The reactor compartments are completely sealed by welding to prevent release of the radioactive and dangerous materials contained within the reactor compartments. All nuclear fuel has been removed from the reactor compartments; therefore, the radioactive materials remaining in the reactor compartments consist only of activation products from operation of the nuclear reactors. Figures 3-2 and 3-3 provide general cross-sections of typical submarine and cruiser reactor compartment packages. Before shipment to the Hanford Facility, the reactor compartment is removed from the decommissioned/defueled ship. Removal of the reactor compartment from the ship includes the following:

- Removing spent nuclear fuel from the reactor
- Removing liquids that can be pumped or drained
- Removing wool felt sound damping material that contains PCB (when present)
- Cutting and sealing radioactive system piping at the reactor compartment boundary
- Cutting the reactor compartment from the rest of the ship
- Sealing the reactor compartment with welded steel plates
- Testing the reactor compartment package to verify that all penetrations and openings have been closed and sealed to meet U.S. Department of Transportation and Nuclear Regulatory Commission standards.

Once prepared for shipment, the reactor compartment is a completely sealed unit.

The reactor compartments each contain more than 90.7 metric tons of permanently installed lead shielding in the form of panels or poured-in-place lead contained within thick metal sheathing plates. The thick metal encapsulation of this lead, as originally constructed, meets the treatment standards of 40 CFR 268.42, Treatment Code MACRO, for disposal of radioactive lead solids, including lead shielding. Work during the reactor compartment preparation process maintains this encapsulation with no treatment of the lead shielding occurring. The PSNS has studied the feasibility of removing this lead from the reactor compartments (Section 1.0).

The presence of the large quantity of lead as a dangerous waste constituent within the reactor compartments causes the reactor compartments to be regulated as 'state-only' dangerous waste for disposal under WAC 173-303.

A variety of other hazardous materials could be present in small amounts in reactor compartments, including silver plating on electrical contacts; silver brazing alloys; cadmium plating or fasteners and components; chromates; amines, and ethylene glycol in small pockets of residual liquid; arsenic trioxide in

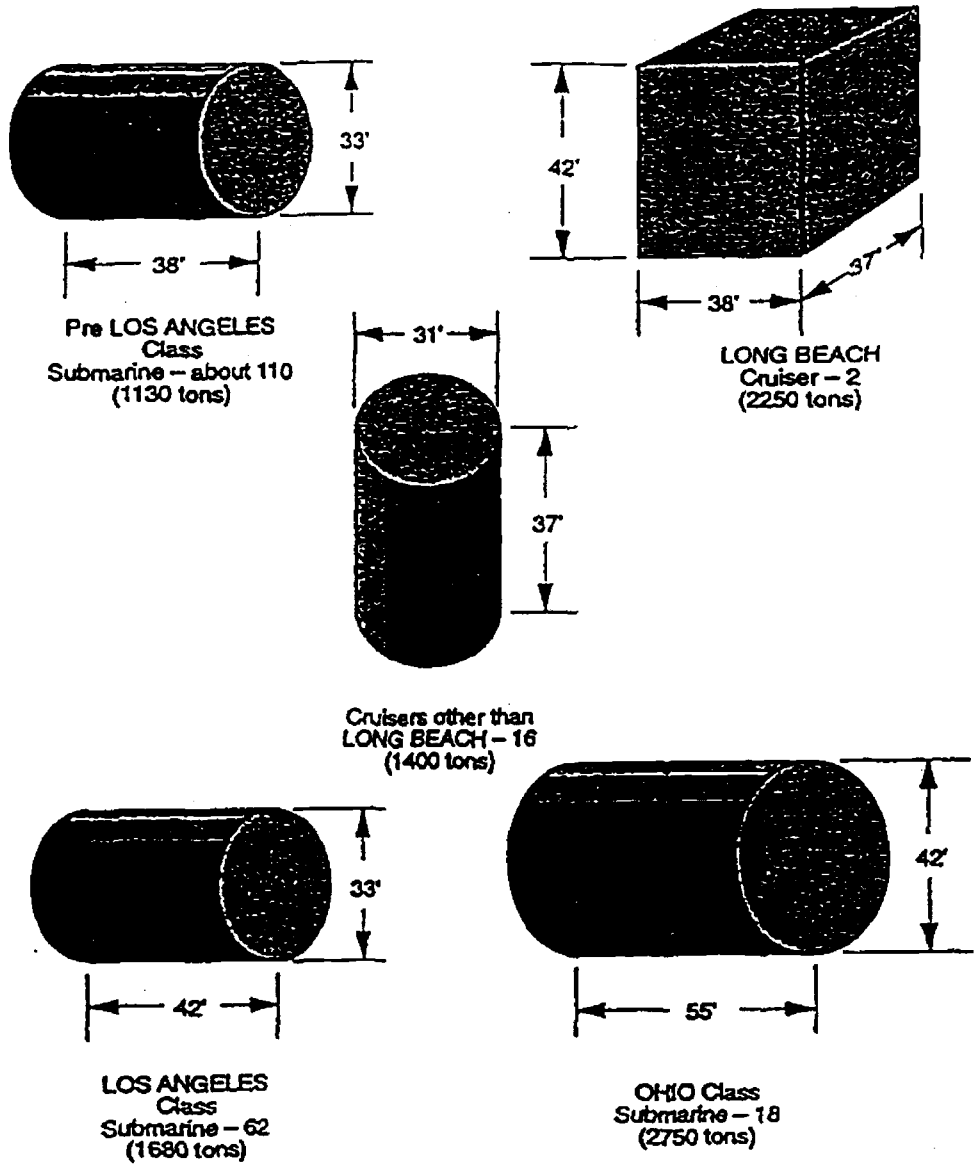
glass; cyanoacrylate adhesive; and paints containing cyanide, red lead, lead napthenate, coal tar, and chromium trioxide. Preliminary investigations indicate these materials at below regulated levels for the reactor compartments considered for disposal under the 1996 EIS. This is consistent with the conclusions of earlier work conducted in support of the current reactor compartment disposal program (PSNS 1990b). Reactor compartments constructed before the mid-1970s also contain thousands of kilograms of asbestos in the insulation on pipes and other components. The asbestos would be fully contained within the reactor compartment package, complying with 40 CFR 61. The reactor compartments are a unique, integrated waste form that is both containment and waste. Thus, the entire reactor compartment disposal package is the waste under evaluation. For cruiser reactor compartments, the reactor compartment forms part of the containment that would be supplemented by exterior structure built around the reactor compartment, enclosing the reactor compartment to form the disposal package. For these packages, the supplemental structure would not be considered part of the waste when evaluated.

Residual liquid is removed from the reactor compartments to the maximum extent practical, while keeping radiation exposure to workers ALARA. Federal radiation exposure guidelines require that nuclear work be accomplished in a manner that keeps radiation exposure to workers and the public ALARA (10 CFR 20). Proven liquid removal methodologies used for the current reactor compartment disposal program will be adapted for the reactor compartments considered for disposal under the 1996 EIS. Residual liquid in reactor compartments is trapped in pockets within valves, pumps, tanks, vessels, and other inaccessible piping system components of the reactor plant and associated ship support systems (widely distributed in over 300 discrete locations for current reactor compartments). The piping and components of the reactor plant and associated ship support systems are designed and intended to hold water for a use other than storage (e.g., the transfer of heat energy from the reactor to produce steam for propulsion). The reactor plant and associated ship support systems are a part of the reactor compartment disposal package, a unique integrated waste form that also contains a number of other structures designed to perform other functions not related to liquid containment. However, the reactor compartment package provides multiple barriers to liquids within the structures. Absorbent also is added to a shield tank and the reactor vessel, when component configuration allows, in quantities calculated to absorb two times the maximum residual liquid volume that could be present. Ecology has determined that the reactor compartment packages are protective of the environment and in compliance with WAC 173-303 (Attachment 3).

3.2 WASTE PACKAGE STRUCTURAL DESCRIPTION

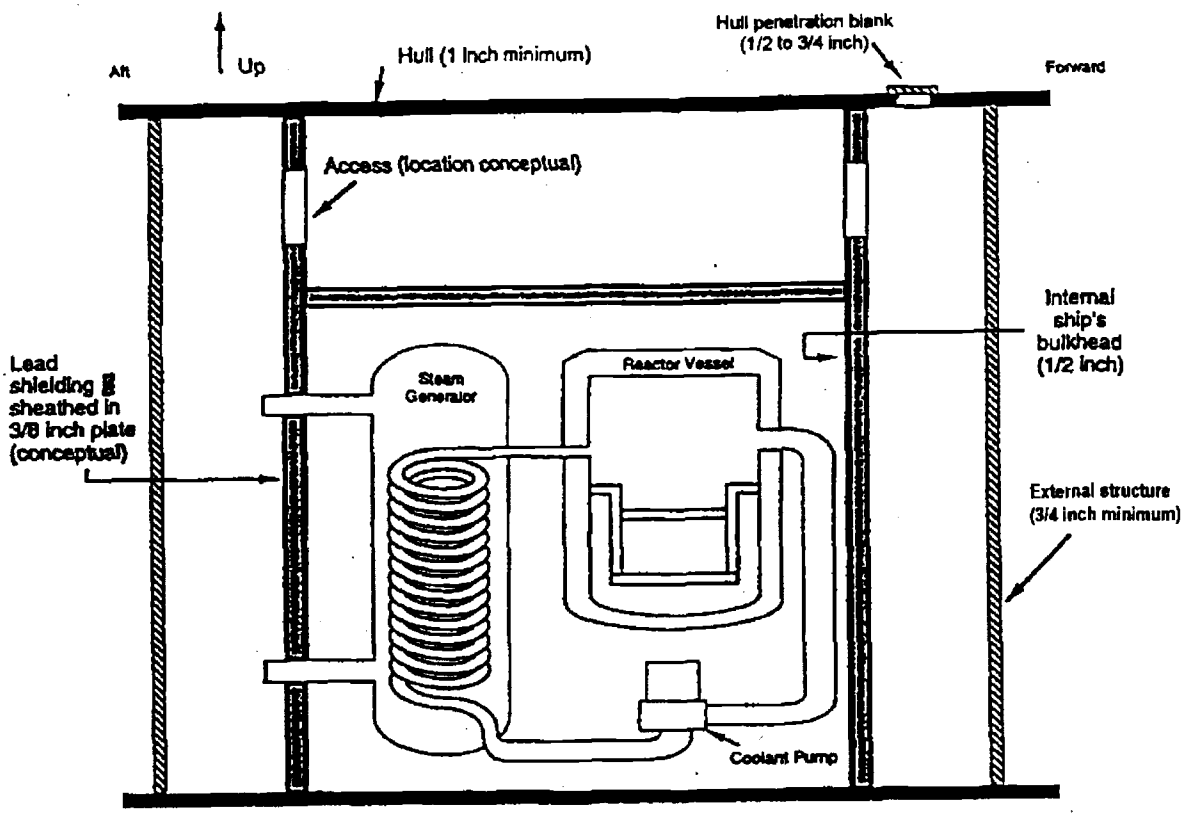
Figures 3-2 and 3-3 provide cross-sections of typical reactor compartment packages. Major structural components are shown. The ship's hull and inner bulkheads provide barriers for containment of materials within the reactor compartment packages and provide strength to the packages. External structures installed by PSNS provide additional strength and containment to seal the packages.

The containment lifetime of the reactor compartment package is discussed in Section 4.0 and is based on these figures.



Note: Dimensions and weights are approximate. Quantities are current projections.

Figure 3-1. Comparison of Reactor Compartment Packages.



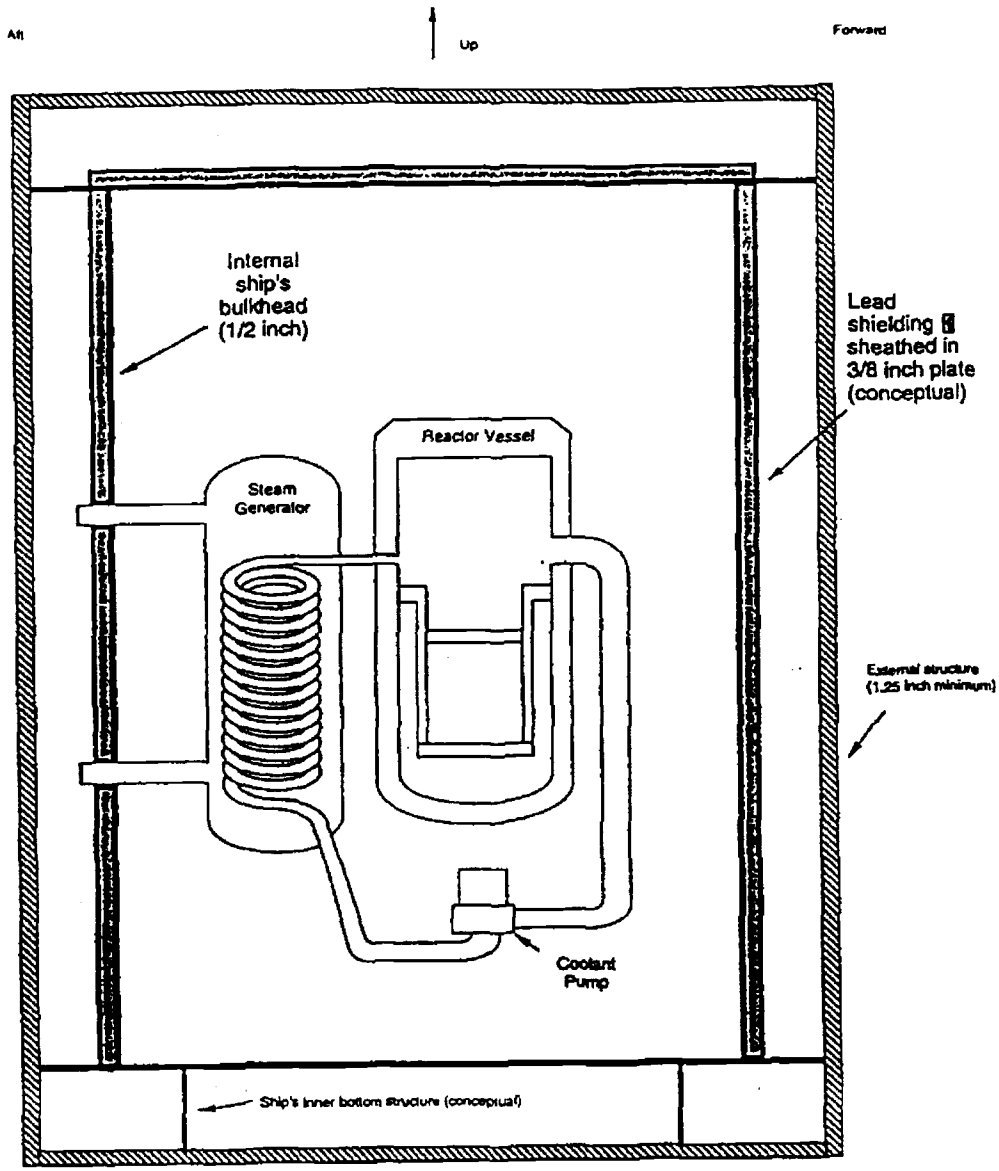
General Notes:

(1) PSNS installed structure is cross hatched:

(2) There are a limited number of small diameter penetrations through the hull (e.g., about 10 with maximum 6 inch diameter is typical for pre-LOS ANGELES Class ships). These are sealed with 1/2 to 3/4 inch blanks (typical location shown).

(3) On some submarines, the aft end of the hull tapers inwards with an external shelf (at least 3/8-inch thick) forming a ballast tank external to the hull.

Figure 3-2. General Cross-Section of Typical Submarine Reactor Compartment Package.



General Note:
PSNS installed structure is cross hatched:

Figure 3-3. General Cross-Section of Typical Cruiser Reactor Compartment Package.

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4.0 PERFORMANCE EVALUATION

The purpose of this section is to demonstrate that the following performance criterion is satisfied. The criterion was established in Section 2.3.1, as meeting the regulatory requirements for obtaining an exemption from the lined trench and leachate collection system requirements for dangerous waste landfills. The performance criterion is as follows:

Demonstrate that the alternate design (i.e., burial without a liner/leachate collection system) and operating practices, together with location characteristics, prevent generation of any contaminated leachate beyond the expected lifetime of the minimum technological liner/leachate collection system design.

Sections 2.1.1 and 2.2.1 discuss the minimum technological requirements that hazardous waste landfills have two or more liners and a leachate collection system above and between the liners. The liner/leachate collection design life is discussed in Chapter 4.0. Studies on estimated lifetimes of geosynthetics have been performed (WHC-SD-W025-PD-001, WHC-MR-0376). It has been noted that "buried HDPE is expected to have a lifetime of about 50 years, while more optimistic studies cite evidence that indicates polypropylene geotextiles could survive as long as 200 years" (WHC-MR-0376).

The performance of the cover (Chapter 11.0) will affect the overall performance of the 218-E-12B Burial Ground. The cover will limit further the amount of moisture available to corrode the reactor compartments. The amount of lead that could be reached from the waste in trench 94, after ultimate breach of the reactor compartment containment, will be controlled by the amount of moisture that can migrate through the cover to contact the waste and the chemistry of this moisture.

This section demonstrates that the criterion is met and that no benefit would result from using liner/leachate collection systems.

4.1 INTEGRITY OF THE REACTOR COMPARTMENT PACKAGE

For the following reactor compartment integrity corrosion studies, credit was not taken for the presence of the cover.

The thick structure of reactor compartment packages inherently provides a very high-integrity waste package. The packages have substantial ability to contain waste for a long time.

Waste containers are required to be at least 90 percent full when placed in a landfill to minimize subsidence. Although this rule is not directly applicable to the reactor compartments, which are a unique, integrated waste form that is both containment and waste, the capacity of the reactor compartment package structure to withstand soil loading at trench 94 was evaluated. For submarine reactor compartments (Figure 3-2), the hull and external structure on each end make up the outer containment boundary. These structures easily can withstand the soil pressure of burial. Cruiser reactor compartments (Figure 3-3) would perform comparably given their thick external structure. All of the radioactivity and lead, in the reactor compartments are contained within these boundaries. Burial of the reactor compartment packages will not compromise their containment integrity. There will not be subsidence in the landfill cover due to package containment failure over the cover's engineered design life as a moisture barrier.

The integrity of the reactor compartment is its ability to provide a containment barrier to prevent the lead shielding from contacting the environment. The time required for corrosion of the reactor compartment to allow exposure of lead to the environment depends on the corrosion rate of steel in trench 94, the thickness

of the steel barriers, and the ability of the reactor compartment to withstand soil pressure after its structure is weakened by corrosion.

4.1.1 Reactor Compartment Corrosion Studies

The Naval Civil Engineering Laboratory (NCEL) study (Attachment 4) quantified corrosion of reactor compartments in trench 94 using two approaches. First, corrosion information from the National Institute of Standards and Technology (NIST) (formerly National Bureau of Standards) test sites was researched to obtain data from test sites with soil conditions similar to the Hanford Facility (Attachment 5). Second, the NCEL reviewed the *Underground Fuel Storage Tank Corrosion Study* (WHC-EP-0507), which reported the results of the inspection of recently unearthed fuel storage tanks on the Hanford Facility to determine their rate of corrosion. The following discussion is derived from these studies.

Steel buried in soil experiences both general and pitting* corrosion. General corrosion is the type of corrosion that is uniformly distributed over a metal surface. Conversely, pitting corrosion is a localized corrosion that results in small pits or cavities randomly distributed over a surface. The pits result from variations in the environment in contact with the surface of the steel that cause local variations in the corrosion rate. It is important to note that for carbon steel, the pitting rate decreases with time because of corrosion products that accumulate on the surface of the metal and that retard the pitting process. Thus, in the early years of burial, steel will exhibit a higher pitting rate. As the corrosion products accumulate on the steel surface, the pitting process slows down. The pit will continue to get deeper, but at a progressively decreasing rate.

Factors that affect the rate of corrosion of steel in soil include soil resistivity, soil chloride content, soil sulfate content, and soil acidity (pH). Site-specific data were collected at trench 94 to determine the corrosion potential of the soils in which the reactor compartments will be buried.

The soil resistivity was measured at depths of 3, 6, 9, 12, and 15 meters at each of six locations around the perimeter of and adjacent to trench 94 using the Wenner Four Electrode Method [Standard Method G-57-78 (ASTM 1989)], identified in Attachment 6. The results of this investigation indicate that the soils at and near trench 94 are generally of high resistivity and present a low corrosion potential. Soil resistivity values ranged from 10,140 ohm-centimeter to 166,305 ohm-centimeters, with an average of 31,000 ohm-centimeter. For comparison, values above 10,000 ohm-centimeters are considered by the National Association of Corrosion Engineers (NACE) to indicate low relative corrosion rates. Although resistivity is a good indicator of soil corrosivity, the resistivity data used alone do not allow calculation of site-specific corrosion rates for the reactor compartments in trench 94.

Soil samples were taken from representative locations in trench 94 and tested for moisture content and soil chemistry, including pH, and chloride and sulfate concentrations.

Information from NIST corrosion test sites with soil characteristics comparable to those at trench 94 was evaluated. These sites (Springfield, Ohio; Los Angeles, California; and Salt Lake City, Utah) provided a good indication of expected corrosion rates for trench 94. Corrosion data from these NIST test sites showed a pitting corrosion rate that ranged between 0.0058 and 0.0091 centimeter per year for bare uncoated steel. These comparisons are shown in Attachment 4, Table 1. The NCEL predicts the pitting

*The term 'pitting' used in this report refers to the type of local corrosion that forms pits when carbon steels corrode in soil and where the rate of pit propagation decreases with time. This is not the same as pitting corrosion associated with passive metals such as stainless steels when these steels are exposed to solutions containing halide ions, where the rate of pit propagation increases with time.

corrosion rate for trench 94 actually to be lower than the values from the comparison sites because the soil resistivity at the 218-E-12B Burial Ground is significantly higher than at the comparison sites.

Based on these comparisons, the maximum pitting rate is predicted to be no more than 0.0089 centimeter per year. A linear projection predicts a maximum pit depth of 0.89 centimeters in 100 years. However, a pit depth of 0.254 centimeter in 100 years is more likely (averages to an expected pitting rate of 0.0025 centimeter per year) because of the benign conditions that are established in the controlled burial of reactor compartments in trench 94, and the fact that the pitting rate for steel buried in soil will not follow a linear rate, but actually will decrease with time.

These predicted values were supported by the data obtained from inspection of fuel storage tanks unearthed at the Hanford Facility (WHC-EP-0507). Sixteen underground fuel storage tanks were exhumed from soil between 1989 and 1990. These tanks were constructed of carbon steel somewhat similar to the steel of the reactor compartments. The tanks had been buried for as long as 46 years and provided good evidence of the expected performance of steel buried at the Hanford Facility over long periods (WHC-EP-0507).

An independent review of the NCEL study was performed by NIST, who combined the NCEL data from comparison sites and performed a linear regression analysis to evaluate the validity of the linear model used by NCEL to predict pitting at 100 years (Attachment 5). Based on analysis of these data, the expected maximum pit depth in samples buried at the NIST sites for 100 years is 0.553 ± 0.262 centimeter) with a 99 percent confidence interval (dashed lines Figure 1, Attachment 5). This averages to a pitting rate of 0.005 ± 0.0014 centimeter) per year (solid line of Figure 1, Attachment 5). Considering that trench 94 has higher resistivity than the NIST sites used for comparison, and considering that a linear projection to estimate maximum pit penetration provides a conservative estimate, the NIST review indicated that the estimated maximum pit depth in steel buried in the trench 94 environment will be less than 0.89 centimeter after 100 years with an expected pit depth of 0.25 centimeter in 100 years being reasonable. These 100-year pit depths, when converted to linear pitting rates, result in a maximum pitting rate of 0.0089 centimeter per year and an expected pitting rate of 0.0025 centimeter per year.

4.1.2 Reactor Compartment Package Expected Lifetime

Based on the containment thicknesses presented in Section 3.2, and the predicted corrosion rates, the containment lifetime of the reactor compartments can be calculated. For submarine reactor compartments, the earliest time to penetration of the 1.27-centimeter-thick plates (covering small diameter hull penetrations on older reactor compartments at trench 94) is 143 years, using the maximum pitting corrosion rate of 0.0089 centimeter per year. Using the expected pitting corrosion rate of 0.0025 centimeter per year, the covers would not be penetrated for 500 years. It would take 1.5 times as long to penetrate the 1.9-centimeter-thick hull penetration covers currently installed on submarine reactor compartments and the minimum 1.9-centimeter-thick plate forming the ends of submarine reactor compartment packages. It would take even longer to penetrate the minimum 3.18-centimeter-thick exterior structure of cruiser reactor compartment packages.

Pitting corrosion of the 1.27-centimeter-thick cover plates is, however, unlikely to be the controlling factor in exposing contaminants to the soil. Pitting corrosion initially would result in only very small pits (0.159 centimeter diameter) randomly distributed over the surface of the reactor compartment. Because of the arid climate, and dry nature of in situ soil at trench 94, the soil above the reactor compartments (when buried) is not expected to become saturated with water, and thus moisture should not separate from the soil and enter pits at the reactor compartment surface. In addition, these pits will not allow soil to enter the reactor compartment in any significant quantity. Because of the geometry of the reactor compartment,

small amounts of soil entering through pits in the 1.27-centimeter covers will not contact contaminants. Oxygen depletion will inhibit corrosion in the sealed reactor compartments until the time the containment is penetrated by external corrosion. An analysis of corrosion failure of the reactor compartments indicates that the first significant contact of soil with lead probably will occur when general corrosion weakens external containment structures to the degree where soil loading causes the structures to rupture.

Pitting corrosion rates are based essentially on the depth of the deepest pit measured on a test surface. Figure 4-1 depicts a typical corrosion profile on a corroded steel surface. Pit depth and volume, shown by the solid line, vary across the surface. This variation can be normalized across the corroded surface to a uniform reduction in metal thickness (shown by the dashed line). This is accomplished by measuring the weight loss of the corrosion specimen, converting to a metal volume loss by use of a material density, and applying this volume loss across the entire surface. Dividing this uniform thickness reduction over a time period produces a general (uniform) corrosion rate. General corrosion rates in soils are significantly lower than pitting rates. Table 4-1 is a list of 'maximum penetrations' (pitting rates) and 'average penetrations' (general corrosion rates) derived from NIST corrosion test sites. The ratio of pitting rate to general corrosion rate is called the pitting factor. To estimate the general corrosion rate from a predicted pitting rate, the pitting rate is divided by the pitting factor. As shown, the general corrosion rates in soils considered to be similar to those in trench 94 are approximately 10 times less than the pitting rates (pitting factor of 10). To be conservative, general corrosion rates for trench 94 were estimated using a pitting factor of 6, thus set at 1/6th the pitting rates predicted by NCEL vice 1/10th as the data would suggest. Using this ratio, the maximum long-term general corrosion rate for trench 94 would be 0.0015 centimeter per year based on the maximum 0.0089 centimeter per year pitting rate predicted by NCEL. Similarly, an expected long-term general corrosion rate of 0.0005 centimeter per year would be calculated from the expected pitting rate of 0.0025 centimeter per year.

General corrosion eventually will cause reactor compartment package containment structures to be unable to resist the pressure exerted by the soil, causing the structures to rupture. The capacity of these structures to withstand soil loading is evaluated. The minimum 1.9-centimeter-thick containment structure forming the ends of submarine reactor compartment packages (spanning most of the hull diameter) is expected to be the limiting case in this regard, rupturing before the small cover plates. The earliest time at which rupture occurs is approximately 600 years, using the maximum general corrosion rate of 0.0015 centimeter per year. Using the expected general corrosion rate of 0.0005 centimeter per year, rupture would not occur for approximately 2,100 years. Even then, only a small amount of lead would be exposed because there is typically 0.95-centimeter-thick steel plate covering the lead shielding panels inside the reactor compartment packages. Cruiser reactor compartments are expected to be as durable as submarine reactor compartments due in part to the minimum 3.18-centimeter-thick external structure of these reactor compartment packages.

It is important to note that the structures being discussed are separated from the internal shielded bulkheads of the reactor compartment. Even after the external containment structures begin to fail, structural support would be provided by the internal shielded bulkheads and, for submarines, also internal hull stiffeners, which have not been exposed to soil.

It is concluded that pitting corrosion will not penetrate the thinnest containment plating (the small 1.27-centimeter-thick hull penetration covers on submarine reactor compartments) for at least 143 years and more likely about 500 years; however, this penetration would not result in generation of contaminated leachate. Using a conservative approach, the first potential generation of contaminated leachate would not occur for about 600 years at the minimum and more likely about 2,000 years, as a result of general corrosion and soil pressure causing the rupture of external containment structures allowing soil to enter areas containing lead shielding.

4.2 LEAD MIGRATION

Leachate can be generated when waste is contacted by moisture that infiltrates down through the soil. The characteristics of the leachate, combined with the geochemical and geohydraulic properties of the soil, determine how quickly and at what concentration contaminants will reach groundwater. This section discusses the potential of the lead shielding in the reactor compartments to dissolve and migrate to groundwater (the unconfined aquifer) and to surface water (the Columbia River).

Lead is relatively stable and insoluble in the environment and does not readily form leachate through dissolution or by soil chemical reactions. Additionally, soil has a strong tendency to adsorb lead and lead compounds. Thus lead will not migrate readily from the reactor compartments to groundwater. However, the detrimental health effects of lead cause lead to be of concern in drinking water, even at very low concentrations. Therefore, the DOE-RL considers that there would be an inherent responsibility to evaluate the potential for the lead in the reactor compartment to migrate to groundwater and to potential future downstream users, even if this were not required to support a request for exemption from lined trench requirements.

4.2.1 Lead Migration Analysis

A lead migration analysis was conducted by PNL using the site-specific information of trench 94 (PNL-8356). The following discussion summarizes the results of the report.

Over the future millennia, the reactor compartments will be subject to degradation by the natural environment, primarily through corrosion caused by chemical weathering, and dissolution by vertically infiltrating water. The resulting leachate (infiltrating water containing solute) will drain downward through the unsaturated vadose zone under the influence of gravity until the leachate enters the unconfined aquifer, where the leachate would disperse and would be transported to the Columbia River. Some materials are transported at the same velocity as the water in which the materials are dissolved. Others are retarded by soil adsorption mechanisms. These mechanisms are represented by a retardation factor (R), which is the ratio of the velocity of the water to the velocity of the solute. These transport processes occur very slowly in the dry, slightly alkaline Hanford Facility soils.

The potential for lead within the reactor compartments to enter groundwater under the 218-E-12B Burial Ground was investigated by examining available data on the geology, geochemistry, and geohydrology of the 218-E-12B Burial Ground. The data were used to develop a conceptual model for release and transport of lead from the reactor compartments. This model assumes that the geology of the site will remain constant over the future millennia. The characteristics of the Hanford formation beneath the burial ground were investigated using existing data and by sampling soil from the excavated faces of trench 94. Strata in the faces of trench 94 were mapped, and drilling logs from boreholes and wells adjacent to the 218-E-12B Burial Ground were used to map sediment in the strata between the floor of trench 94 and the basalt formation. Sediment samples collected at trench 94 and a limited number of samples from borehole cuttings were tested to determine their physical and hydraulic properties, including grain size distribution, moisture content, porosity, permeability, and bulk density.

The solubility of lead in Hanford Facility soils and groundwater was predicted using the MINTEQ computer code (PNL-6106) along with groundwater chemistry data from laboratory analysis of samples from an onsite monitoring well. Laboratory batch adsorption studies and flow through soil column studies were conducted to determine the distribution coefficient (Rd) for lead adsorbed on Hanford formation sediments. These studies also included experiments to determine the effect of other major materials in the

reactor compartments, such as nickel, to compete with lead for adsorption by the soil. The retardation factor (R) was calculated using the distribution coefficient (Rd), soil bulk density, and soil porosity.

Computer modeling was employed to quantify the rate of groundwater movement through the vadose zone and the unconfined aquifer, and to predict the rate of lead migration from trench 94 to downgradient locations. The CFEST code was used to produce a two-dimensional model of the regional aquifer to obtain parameters necessary for the lead transport analysis. The TRANSS code (PNL-6029) was employed to simulate mass flow and transport through the vadose zone and the unconfined aquifer using a one-dimensional stream tube approach. This approach is similar to that used in previously published documents for the Hanford Site (DOE/EIS-0113; DOE/EIS-0119D). The TRANSS code used for the modeling is a less sophisticated code than the VAM3D or PORFLO-3 codes. The TRANSS code was selected because it had been used in previous onsite studies (e.g., DOE/EIS-0113; DOE/EIS-0119D). The TRANSS code provided a relatively uncomplicated approach to generate a conservative model of lead migration. A conservative code uses weighted input parameters to generate the shortest likely migration times and the largest likely groundwater concentrations. Extensive conservatism was built into the one-dimensional TRANSS code analysis.

Results were obtained for a single reactor compartment and for 120 reactor compartments in trench 94, using both current climactic conditions and a potential future wetter condition. The 'recharge' volume of water moving down through the soil was established as 0.5 centimeter per year for the current climate case and 6.0 centimeters per year for the wetter condition, which generally is consistent with values used in other Hanford Site environmental impact studies (DOE/EIS-0113; DOE/EIS-0119D). Neither scenario takes credit for the cover. The models were used to calculate the travel times and potential lead concentrations in the aquifer 100 meters from the reactor compartment burial site, and at a well location 5 kilometers downstream. The travel times and potential concentration of lead in the Columbia River also were calculated.

The results from the PNL lead migration study (PNL-8356) were extrapolated (USN 1995) to consider the cumulative effects of the disposal at trench 94 of all of the reactor compartment types shown in Figure 3-1. A total of 220 reactor compartments were considered in the extrapolation for a conservative estimate of impact. The extrapolation incorporated refinements in the migration modeling developed by PNL after the original lead migration study, namely a more accurate estimate of the amount of recharge water contacting reactor compartments and a more accurate aquifer streamtube dimension. These refinements tended to reduce predicted lead concentrations in the aquifer. The very long times predicted by PNL for lead to migrate to groundwaters were unchanged.

4.2.2 Lead Migration Results

The results of the lead migration studies indicate the following (as extrapolated for 220 reactor compartments at trench 94) (USN 1995; PNL-8356).

- For an arid climate similar to present conditions at a recharge rate of 0.5 centimeter per year:
  - Lead would not reach the unconfined aquifer for 2.2 million years
  - The maximum predicted concentration of lead after 2.2 million years is 4 parts per billion at 100 meters and at 5 kilometers from the reactor compartment burial site
  - Lead would not reach the Columbia River for 2.8 million years

- The quantity of lead entering the Columbia River would not exceed 94 grams per year (not presented in USN 1995).

- For the wetter condition at a recharge rate of 6 centimeters per year:
  - Lead would not reach the unconfined aquifer for 240,000 years
  - The maximum predicted concentration of lead after 240,000 years is 26 parts per billion at 100 meters and at 5 kilometers from the reactor compartment burial site
  - Lead would not reach the Columbia River for 740,000 years
  - The quantity of lead entering the Columbia River would not exceed 1,110 grams per year (not presented in USN 1995).

It is important to note that these studies are very conservative.

- The modeling does not account for the presence of a (moisture barrier) cover.

- The studies conservatively assume that all moisture contacting lead dissolves lead to the maximum concentration of lead that the moisture can hold (i.e., the lead solubility limit). Conservative lead solubilities are assumed at about twice the value obtained through laboratory testing.

- The adsorption of lead in soil is characterized with a Rd that effectively shows the ratio of lead adsorbed in soil to that remaining in solution. Conservative values for this coefficient are assumed at about one-half the values obtained through laboratory testing.

- The one-dimensional TRANSS code simulation of lead mass transport modeling assessed the magnitude of potential problems resulting from contaminant migration. The code was used as a conservative screening tool. In general, this less sophisticated code would be expected to overestimate groundwater concentrations when compared with the results of two- and three-dimensional groundwater flow and transport codes (PNL PNL-8356). The calculations indicate that any lead migration will be tens to hundreds of thousands of years into the future, and the resulting groundwater concentrations will be low.

4.3 DEMONSTRATION THAT PERFORMANCE EVALUATIONS SATISFY PERFORMANCE CRITERION

This section demonstrates that the results of the previous performance evaluations satisfy the performance criterion of Section 2.3, which was established to determine if the regulatory requirements of WAC 173-303 for exemption from liner/leachate collection system requirements are met.

4.3.1 Demonstration of Better Performance than Minimum Technological Design Requirements for Liner/Leachate Collection Systems

Section 4.1.2 contains an estimate of the containment lifetime of reactor compartment packages buried in trench 94 using site-specific corrosion studies. Without credit for the cover, and using the 'maximum' pitting corrosion rate of 0.0089 centimeter per year, the first pit would not penetrate the containment for at least 143 years. Using the more probable 'expected' pitting corrosion rate of 0.0025 centimeter per year,

the first pit would not penetrate the containment for 500 years. These first small penetrations would occur in the minimum 1.27-centimeter-thick cover plates and would not result in the generation of contaminated leachate. It is estimated that the first potential for generation of contaminated leachate would not occur until general corrosion caused structural failure that allowed the surrounding soil to contact lead. This event would not occur for about 600 years at a minimum, and more likely for about 2,000 years after burial.

It is clear that the optimistic estimate of liner design life falls far short (by an estimated 500 years) of the conservative estimate of reactor compartment containment lifetime (i.e., based on 'maximum' corrosion rates). Thus, the performance criterion is satisfied.

Trench 94 has been in operation since 1986 without burial of the reactor compartments placed there. This mode of operation allows flexibility in the disposal of this unique waste and this practice could continue until installation of the final RCRA cover. The following operating practices are employed to monitor the condition of the reactor compartments until these are buried. Each week a nuclear operator performs an inspection of trench 94. The reactor compartments are visually inspected to verify their integrity. In addition, trench 94 is inspected for run-on, run-off, and erosion problems after a significant precipitation or windstorm event. Further corrective actions are discussed in the building emergency plan (Chapter 7.0).

4.3.2 Demonstration of Long-Term Performance of the Disposal System

Section 4.2.2 summarized the results of the site-specific lead migration studies. The PNL study (PNL PNL-8356) showed that lead is strongly retained by soil adsorption. This result was not affected by the addition of reactor compartments to trench 94 (USN 1995). For the current arid climate condition, using conservative assumptions and the immediate availability of soluble lead, with conservative modeling, lead would not migrate to the aquifer at 100 meters from trench 94 for at least 2.2 million years or to the Columbia River for at least 2.8 million years.

For a potential future wetter condition, using the same conservative assumptions and modeling, lead would not migrate to the aquifer at 100 meters from trench 94 for at least 240,000 years or to the Columbia River for at least 740,000 years.

These timeframes are well beyond the time the Hanford Site geological and hydrological features could be transformed by glacial flooding and scouring (DOE/EIS-0113, p. 3.58). The predicted timeframe for return of an ice age is 40,000 to 50,000 years (DOE/EIS-0113, p. 5.25). Studies based on previous ice age events postulate that breakthrough of ice dams on upper tributaries of the Columbia River will produce glacial flooding in the Hanford Basin, which reasonably could be expected to scour out the waste sites to a depth of several meters. Then, as flood waters back up at Wallula Gap, the water velocity markedly would decrease and most of the sediments and waste probably would be reworked and redeposited within the Pasco Basin (PNL-5684). Waste in burial ground trenches could be scoured out and either would be carried to the ocean or redeposited along with other sediments in the Pasco Basin. The Hanford Site defense waste EIS indicated that "In any event, such floods would obliterate most evidence of civilization along the Columbia River" (DOE/EIS-0113, p. 5.25). Thus, it is generally accepted that events that reasonably cannot be expected to occur within a 100,000-year timeframe should not be considered in environmental evaluations. In fact, most studies are limited to 10,000 years, with a period of interest occasionally extending up to 100,000 years.

It is clear that even the most conservative estimate of the time for lead to reach groundwater or surface water significantly exceeds the timeframes of concern.

4.4 SUMMARY

The information presented in this section has demonstrated that the reactor compartments will outlast, by a considerable margin, the estimated design life of a liner/leachate collection system. This section also has demonstrated that the lead in the reactor compartments will not migrate to groundwater before a timeframe that is beyond the geologist's ability to predict future geologic conditions. These demonstrations satisfy the regulatory requirements for exempting trench 94 from liner/leachate collection system regulatory requirements.

The strong structure of the reactor compartments and the low corrosion rates identified for buried steel at trench 94 provide an excellent barrier to the generation of leachate from the waste. The dry climate and native soil together will further limit any potential movement of lead from the waste. Even when considering future wetter conditions, lead would not reach the groundwater aquifer for about 240,000 years. Over this time, impacts from human activities and geologic events (e.g., next ice age) would be far greater than any impacts from the lead.

Trench 94 has been in operation since 1986. The reactor compartments placed there have not been covered. This mode of operation allows flexibility in the disposal of this unique waste and this practice could continue until installation of the final RCRA cover. Weekly inspections of the waste and trench are conducted and will continue until the reactor compartments are buried.

The beneficial site and waste characteristics combined with the operating practices for trench 94 ensure that human health and the environment are protected adequately by the proposed alternative of land disposal of the reactor compartments in an unlined trench with a cover.

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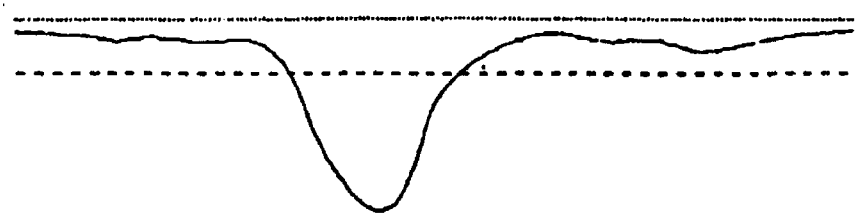

Average Penetration

Actual Profile

Original Surface

Figure 4-1. Typical Corrosion Profile.

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Table 4-1. National Institute of Standards and Technology Corrosion Test Site Data.

Test site	Maximum penetration rate (inches per year)	Average penetration rate (inches per year)	Pitting factor*
Springfield, Ohio	0.00355	0.00037	9.59
Los Angeles, California	0.00338	0.00028	12.07
Salt Lake City, Utah	0.00229	0.00023	9.96

*Pitting factor = maximum penetration/average penetration.
For conversion to centimeters, multiply inches by 2.54.

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5.0 REQUEST FOR EXEMPTION FROM LINED TRENCH REQUIREMENTS

Section 4.0 provides the following:

- Performance of the proposed alternate design in preventing migration of the only WAC 173-303 regulated dangerous waste constituent, the shielding lead; and performance results from the ability of the site characteristics to strongly attenuate migration of this constituent

- Demonstrates that this performance satisfies the previously stated conditions for waiving liner/leachate collection system requirements (i.e., there is no technical advantage to installing a liner/leachate collection system at trench 94)

- Concludes that not only are the regulatory criteria for waiving liner/leachate collection system requirements satisfied, but in addition, operating practices are employed that are protective of the environment.

Thus, the DOE-RL hereby applies for an exemption from the dangerous waste landfill liner/leachate collection system requirements specified in WAC 173-303-665(2)(a) and WAC 173-303-665(2)(h), under the provisions of WAC 173-303-665(2)(b) and WAC 173-303-665(2)(j), for disposal of reactor compartments in trench 94 of the 218-E-12B Burial Ground on the Hanford Facility.

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ATTACHMENT 1

LETTER 11/01/99 FROM M. A. BUSSELL (U.S. ENVIRONMENTAL PROTECTION AGENCY) TO J. A. RASSMUSSEN (U.S. DEPERATMENT OF ENERGY, RICHLAND OPERATIONS OFFICE) REGARDING "TERMINATION OF THE COMPLIANCE AGREEMENT BETWEEN THE UNITED STATES DEPARTMENT OF ENERGY, RICHLAND OPERATIONS OFFICE AND THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, REGION 10, SEATTLE, WASHINGTON (MARCH 1990). WITHDRAWAL OF THE TOXIC SUBSTANCES CONTROL ACT (TSCA) INTERIM APPROVAL, DOE/RL-90-12 REVISION 2, JUNE 1994"

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

November 1, 1999

Reply To
Attn Of: WCM-128

Mr. James A. Rassmussen, Director
Environmental Assurance, Permits
and Policy Division
Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

Dear Mr. Rassmussen:

Re: Termination of the Compliance Agreement between the United States Department of Energy, Richland Operations Office and the United States Environmental Protection Agency, Region 10 , Seattle, Washington (March 1990). Withdrawal of the Toxic Substances Control Act (TSCA) Interim Approval, DOE/RL-90-12 Revision 2, June 1994 .

This letter is in response to your August 9, 1999, letter regarding the Compliance Agreement between the United States Department of Energy, Richland Operations Office, and the United States Environmental Protection Agency, Region 10, Seattle, Washington. We have completed our review of your August 9, 1999, letter and concur that the Compliance Agreement regarding the disposal of polychlorinated biphenyls (PCBs) in Navy reactor compartments at Hanford Trench 94 is no longer necessary given the June 29, 1998 PCB Disposal Amendments, and the June 24, 1999 PCB Disposal Technical Amendments. We are therefore terminating our March 1990 Compliance Agreement and we withdraw our June 1994 Toxic Substances Control Act (TSCA) Interim Approval of your application.

It is our understanding that the Navy reactor compartments are PCB/radioactive waste under 40 CFR § 761.50(b)(7) which allows for PCB disposal without taking into account the PCBs in the waste if the PCB waste meets certain criteria such as being a PCB bulk product waste under 40 CFR § 761.62(b)(1). We agree that the small amounts of PCB waste within the Navy reactor compartment meets the requirements for PCB bulk product waste under 40 CFR § 761.62(b)(1). The disposal of the Navy reactor compartments at Hanford Trench 94 is now in compliance with the current TSCA regulations under 40 CFR Part 761. We also understand that the Navy will continue to remove PCB impregnated sound damping felt found in older submarines.

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We further understand that a dangerous waste permit is being obtained for Hanford Trench 94 from the Washington State Department of Ecology. Our concurrence and resulting termination of the PCB Compliance Agreement and withdrawal of approval of your TSCA Interim Approval application does not effect the Washington State permit status.

If any additional information is required, please contact Daniel Duncan, Regional PCB Program Manager, Solid Waste and Toxics Units, Office of Waste and Chemicals Management, on (206) 553-6693.

Sincerely,

Michael A. Bussell, Director
Office of Waste and Chemicals Management

ATTACHMENT 2

LETTER 02/01/91 FROM M. GEARHEARD (U.S. ENVIRONMENTAL PROTECTION AGENCY) TO K.W. BRACKEN (U.S. DEPARTMENT OF ENERGY, RICHLAND OPERATIONS OFFICE) REGARDING "REGULATION OF SUBMARINE REACTOR COMPARTMENT DISPOSAL PACKAGES"

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United States
Environmental Protection
Agency

Region 10
1200 Sixth Avenue
Seattle WA 98101

Alaska
Idaho
Oregon
Washington

EPA

February 1, 1991

Reply To
Attn Of: HW-074

Kenneth W. Bracken, Acting Director
Waste Management Division
Department of Energy
Richland Operations Office
P.O. Box 550 (A5-21)
Richland, Washington 99352

Re: Regulation of Submarine Reactor Compartment Disposal Packages

Dear Mr. Bracken:

The U.S. Environmental Protection Agency (EPA) Region 10 has recently reviewed the regulation of the Submarine Reactor Compartment (SRC) disposal packages under the Resource Conservation and Recovery Act (RCRA). The lead shielding in the SRC disposal packages is considered by EPA Region 10 to be an integral part of the container and still serving its intended primary purpose. Therefore, the lead shielding contained in the SRC disposal packages is not considered to be solid waste as defined by 40 CFR § 261.2. This position is consistent with the enclosed EPA-Headquarters policy and guidance regarding lead used as shielding. In addition, since the lead shielding is not a RCRA hazardous waste, it is not subject to the treatment requirements under RCRA for a D008 radioactive lead solid as defined in 40 CFR § 268.42, Table 3. The SRC lead shielding is, however, regulated as a "state only dangerous waste" by the Washington State Department of Ecology.

EPA Region 10, based on a review of the Puget Sound Naval Shipyard, March 12, 1990 "Reactor Compartment Disposal Package Hazardous Material Investigation" and December 12, 1990 "Engineering Report of Liquid Removal from Submarine Reactor Compartment Disposal Packages", believes that the SRC disposal packages are not subject to regulation by EPA Region 10 under RCRA. The EPA Region 10 will, however, continue to regulate the polychlorinated biphenyls (PCBs) contained in the SRC disposal packages in accordance with the Toxic Substances Control Act (TSCA). Until such time as the TSCA chemical waste landfill approval is granted, the Department of Energy (DOE) must continue to operate under the terms of the March 27, 1990 TSCA Compliance Agreement regarding PCB disposal for the SRC disposal packages. If any additional information pertinent to the regulation of the SRC disposal packages becomes available, the DOE must inform EPA Region 10 of any changes.

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If any additional information is required, please contact Daniel Duncan at (206) 553-6693/FTS 399-6693.

Sincerely,

Michael Gearheard, Chief
Waste Management Branch

cc:

Paul Day, EPA
Tom Eaton, Ecology
Toby Michelena, Ecology
Timothy Nord, Ecology
Roger Stanley, Ecology
Captain Arthur Clark, PSNS