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

SECTION 2 OF 2

Document Information			
Document #	DOE/RL-2000-60	Revision	1
Title	URANIUM-RICH/GENERAL PROCESS CONDENSATE & PROCESS WASTE GROUP OU RI/FS WORK PLAN & RCRA TSD UNIT SAMPLING PLAN INCLUDES 200-PW-2 & 200-PW-4 OU		
Date	07/22/2004		
Originator		Originator Co.	DOE-RL
Recipient		Recipient Co.	
References			
Keywords			
Projects			
Other Information	PAGES APPENDIX A-I THRU APPENDIX D-20		

APPENDIX A

PART A PERMIT APPLICATIONS

CONTENTS

Part A, Form 3 Permit Application for the 216-U-12 Crib A-1

Part A, Form 3 Permit Application for the 216-A-10 Crib A-11

Part A, Form 3 Permit Application for the 216-A-36B Crib A-23

Part A, Form 3 Permit Application for the 207-A South Retention Basin A-35

Part A, Form 3 Permit Application for the 216-A-37-1 Crib A-43

PART A, FORM 3 PERMIT APPLICATION

FOR THE

216-U-12 CRIB

216-U-12 Crib
Rev. 4, 07/01/2002, 1 of 9

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

FOR 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		

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*Add per request of Washington State Department of Ecology (01/2001)

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	2	600		G					
X-2	T	0	3	20		E					
1	D	8	1	50,000		U					
2											
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 216-U-12 Crib was used to dispose of UO_3 (uranium-oxide) Plant corrosive process condensate. The 216-U-12 Crib, a percolation unit, was designed to receive mixed waste from the UO_3 Plant for approximately 5 minutes every hour, 100 gallons (379 liters) per minute, and to dispose of the process condensate by percolation into the soil column.

Process condensate discharges were considered only a dangerous waste because of corrosivity caused by UO_3 Plant operations. After January 1987, process condensate administratively was controlled to prevent corrosive dangerous waste discharge to the 216-U-12 Crib. The unit continued to receive process condensate until the crib pipeline was cut and permanently capped on January 30, 1988. The 216-U-12 Crib will be closed under interim status.

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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))*
X-1	K	0	5	4	900		P		T03	D80			
X-2	D	0	0	2	400		P		T03	D80			
X-3	D	0	0	1	100		P		T03	D80			
X-4	D	0	0	2					T03	D80			Included with above

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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	2	4,454,000	P		D81				Percolation
2												
3												
4												
5												
6												
7												
8												
9												
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IV. DESCRIPTION OF DANGEROUS WASTE (continued)

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

The 216-U-12 Crib was used to dispose of corrosive (D002) UO_3 Plant process condensate until January 1987, at which time administrative controls were implemented to neutralize the condensate before discharge. Waste consisted of process condensate off-gasses from the production of UO_3 powder from uranium nitrate hexahydrate solutions. When the plant was operating, the pH of this waste ranged from 0.5 to 1.5.

When the UO_3 Plant was shut down for periods, the pH of the process condensate ranged from 2.0 to 4.0. The UO_3 Plant has been shutdown permanently and no process condensate is being discharged to the 216-U-12 Crib. Past process rates show that approximately 1,700,000 gallons (6,440,000 liters) per year of process condensate were disposed in the 216-U-12 Crib.

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).

VII. 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		7/1/02

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		

ECY 030-31 Form 3 (Rev. 7/97)

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

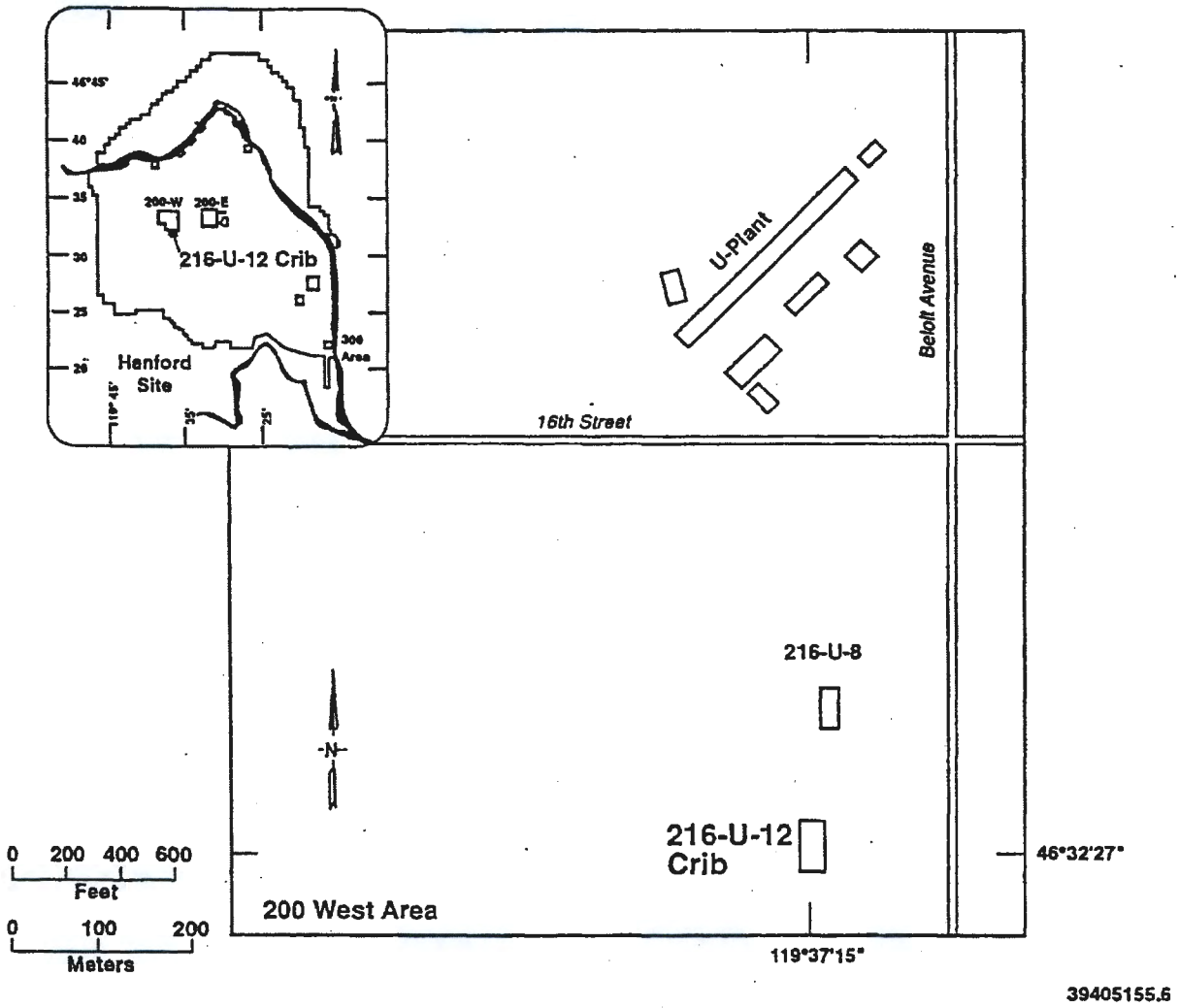
7/1/02
Date

Co-operator
E. Keith Thomson
President and Chief Executive Officer
Fluor Hanford

5-30-02
Date

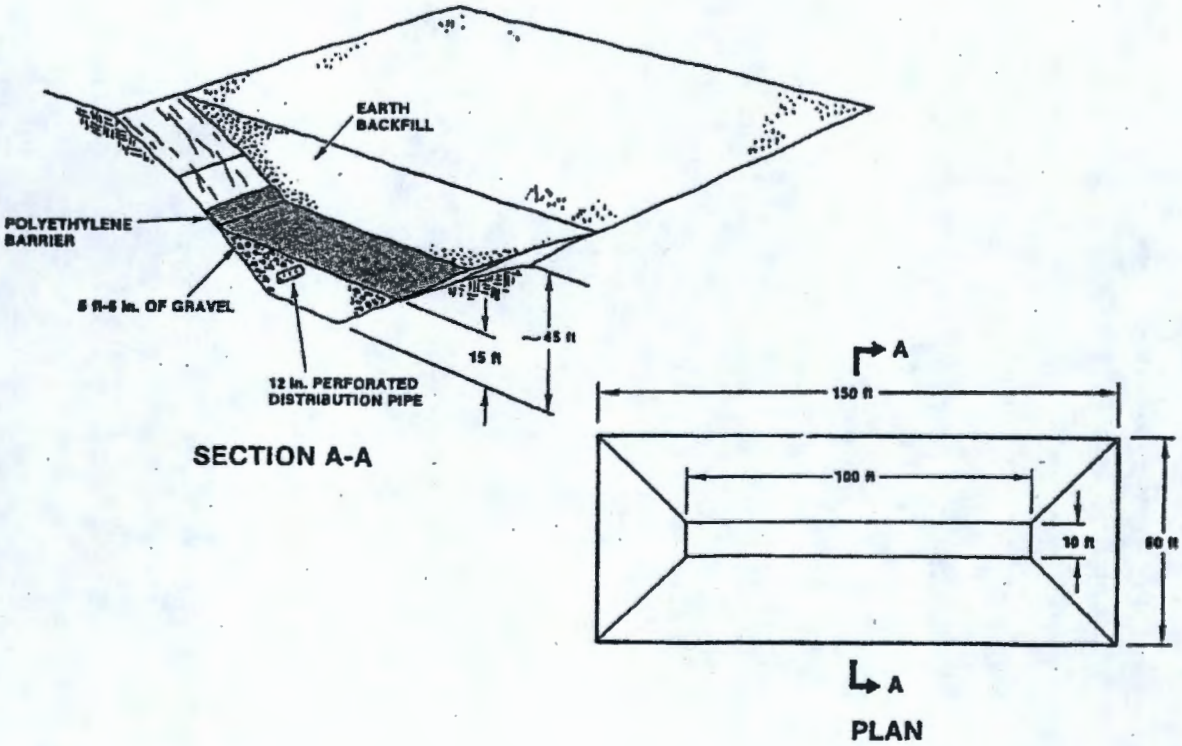
ECY 030-31 Form 3 (Rev. 7/97)

216-U-12 CRIB SITE PLAN



ECY 030-31 Form 3 (Rev. 7/97)

216-U-12 CRIB



For conversions, apply the following:

Feet to meters--multiply feet by 0.3048
Inches to centimeters--multiply inches by 2.54.

216-U-12 CRIB

46°32'27"
119°37'15"

8704509-1CN
(PHOTO TAKEN 1987)

ECY 030-31 Form 3 (Rev. 7/97)

PART A, FORM 3 PERMIT APPLICATION

FOR THE

216-A-10 CRIB

216-A-10 Crib
Rev. 4, 07/01/2002, 1 of 10

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

FOR 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		

ECY 030-31 Form 3 (Rev. 7/97)
*Add per request of Washington State Department of Ecology (01/2001)

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	2	600		G					
X-2	T	0	3	20		E					
1	D	8	1	72,000		U					
2											
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 216-A-10 Crib was used for the disposal of the process distillate discharge (PDD) from the plutonium-uranium extraction (PUREX) process. The 216-A-10 Crib received the corrosive/mixed waste PDD at an average flow rate of 60 gallons (227 liters) per minute. The 216-A-10 Crib was a percolation unit designed for the disposal of liquid wastes by way of the soil column. The process design capacity for the 216-A-10 Crib was 72,000 gallons (272,500 liters) per day. The 216-A-10 Crib has not received waste since March 1987, and will be closed under interim status.

ECY 030-31 Form 3 (Rev. 7/97)

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))*
X-1	K	0	5	4	900		P		T03	D80			
X-2	D	0	0	2	400		P		T03	D80			
X-3	D	0	0	1	100		P		T03	D80			
X-4	D	0	0	2					T03	D80			Included with above

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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	2	138,096,000	P		D81				Percolation
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
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ECY 030-31 Form 3 (Rev. 7/97)

IV. DESCRIPTION OF DANGEROUS WASTE (continued)

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

The 216-A-10 Crib received PDD, which is an acidic waste stream generated from two product concentrators in the PUREX process. The pH of this waste ranged from as low as 1.0 to 2.5 standard units. Thus, this waste was a corrosive mixed waste. Approximately 138,096,000 pounds (62,640,345 kilograms) of waste were disposed of in the 216-A-10 Crib in 1986.

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).

VII. 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		7/1/00

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		

ECY 030-31 Form 3 (Rev. 7/97)

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

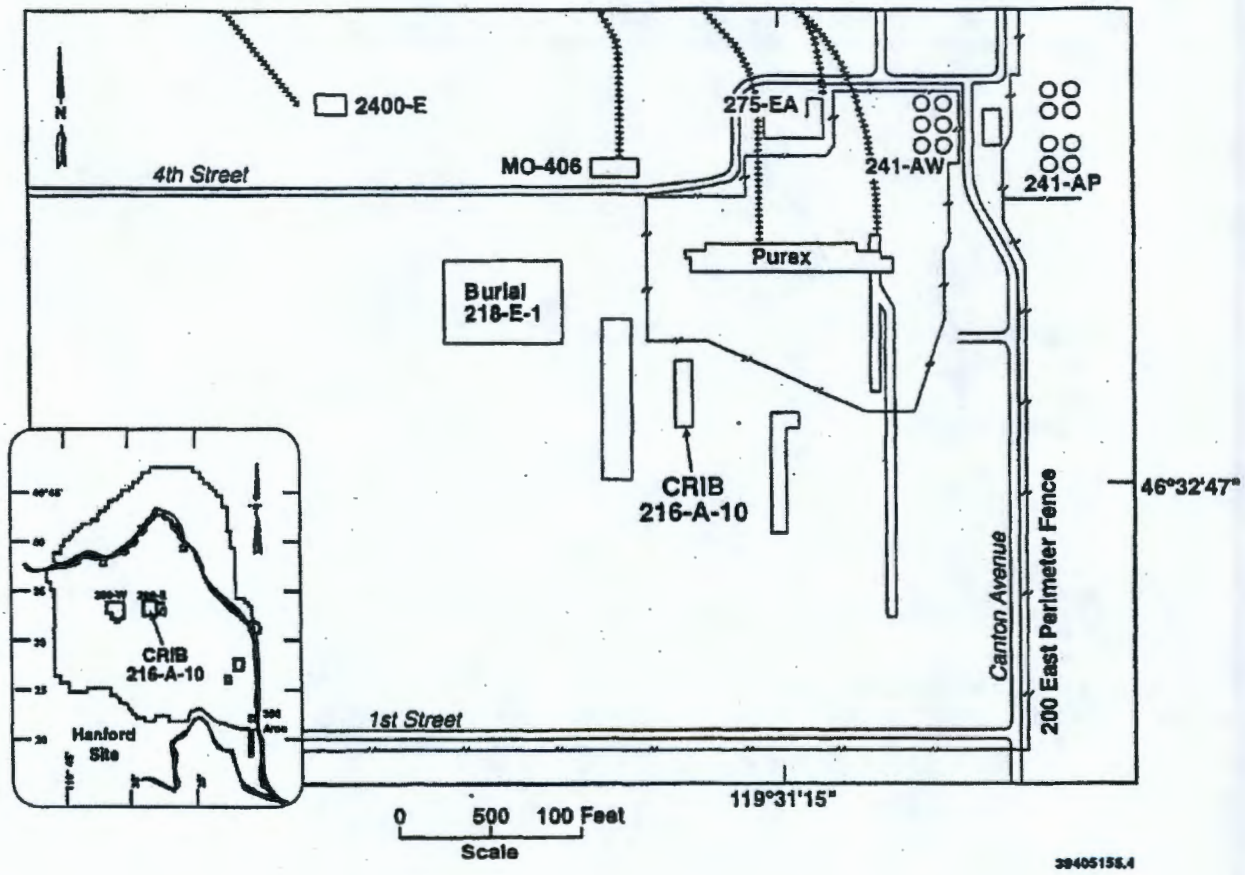
Date 7/1/02

Co-operator /FOR
E. Keith Thomson
President and Chief Executive Officer
Fluor Hanford

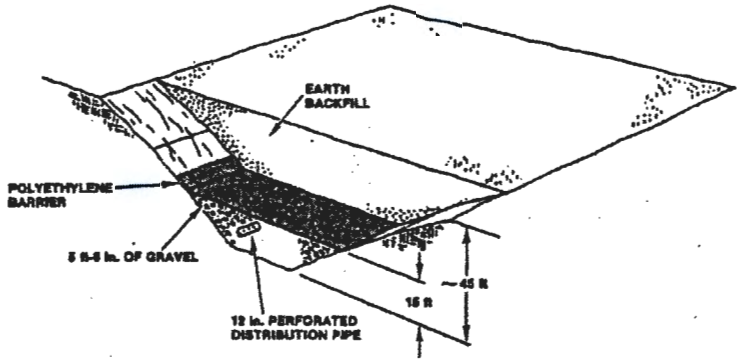
Date 5-30-02

ECY 030-31 Form 3 (Rev. 7/97)

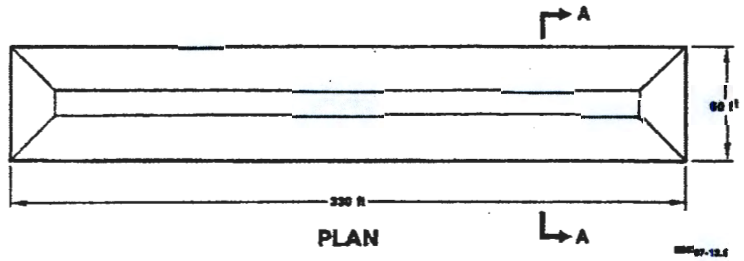
216-A-10 CRIB SITE PLAN



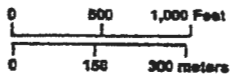
216-A-10 CRIB



SECTION A-A



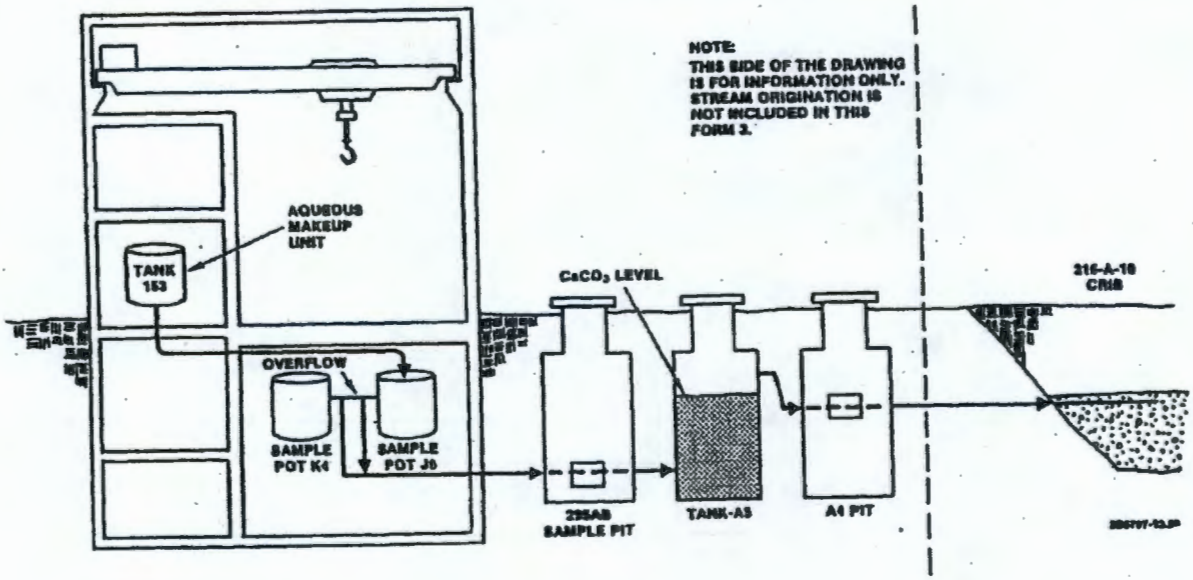
PLAN



For conversions, apply the following:

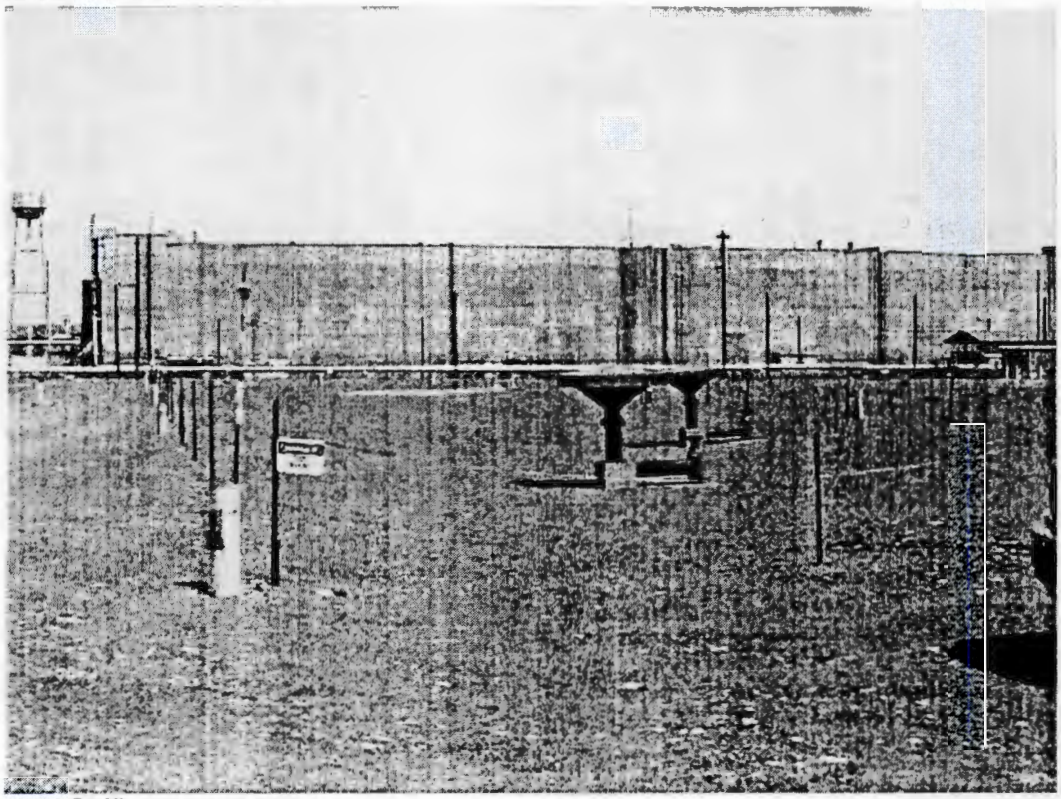
Feet to meters–multiply feet by 0.3048
Inches to centimeters–multiply inches by 2.54.

PDD WASTE STREAM ORIGINATION



ECY 030-31 Form 3 (Rev. 7/97)

216-A-10 CRIB



46°32'51.9"
119°31'16.3"

(PHOTO TAKEN 2002)

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PART A, FORM 3 PERMIT APPLICATION

FOR THE

216-A-36B CRIB

216-A-36B Crib
Rev. 2, 07/01/2002, 1 of 10

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

FOR 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		

ECY 030-31 Form 3 (Rev. 7/97)
*Add per request of Washington State Department of Ecology (01/2001)

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	2	600		G					
X-2	T	0	3	20		E					
1	D	8	1	116,000		U					
2											
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 216-A-36 Crib, placed into operation in September 1965, was divided into A and B sections. The A section is the first 100 feet (30.5 meters) on the north end of the crib and is bypassed by the process pipe. The A section was closed in 1966. The B section was operational from March 1966 to October 1972, and was reactivated in November 1982 for the Plutonium-Uranium Extraction (PUREX) Plant restart. Discharges to the B section were stopped in August 1987. The mixed waste discharged to the 216-A-36B Crib came from the PUREX ammonia scrubber distillate (ASD) stream. The process design capacity for the 216-A-36B Crib was 116,000 gallons (440,000 liters) per day. The 216-A-36B Crib will be closed under interim status.

ECY 030-31 Form 3 (Rev. 7/97)

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))*
X-1	K	0	5	4	900		P		T03	D80			
X-2	D	0	0	2	400		P		T03	D80			
X-3	D	0	0	1	100		P		T03	D80			
X-4	D	0	0	2					T03	D80			Included with above

ECY 030-31 Form 3 (Rev. 7/97)

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	W	T	0	2	265,000,000	P		D81				Percolation
2												
3												
4												
5												
6												
7												
8												
9												
10												
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ECY 030-31 Form 3 (Rev. 7/97)

IV. DESCRIPTION OF DANGEROUS WASTE (continued)

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

The ASD waste stream is a basic byproduct waste stream generated by the ammonia scrubbers during decladding operations in the PUREX process. The waste stream came from the coating dissolution stage where ammonium fluoride and ammonium nitrate were used to dissolve the zirconium alloy cladding from fuel elements. Ammonia gas was produced as a byproduct during this reaction. The gas stream from the dissolver was scrubbed with water, which absorbed and reacted with most of the ammonia to form liquid ammonium hydroxide. This waste stream was sent to the 216-A-36B Crib for disposal.

This waste was determined to be a state-only toxic waste (WT02) under the Washington State Department of Ecology's waste mixture rule because the concentrations of ammonium hydroxide were in excess of 1% by weight.

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).

VII. 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		7/1/02

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		

ECY 030-31 Form 3 (Rev. 7/97)

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

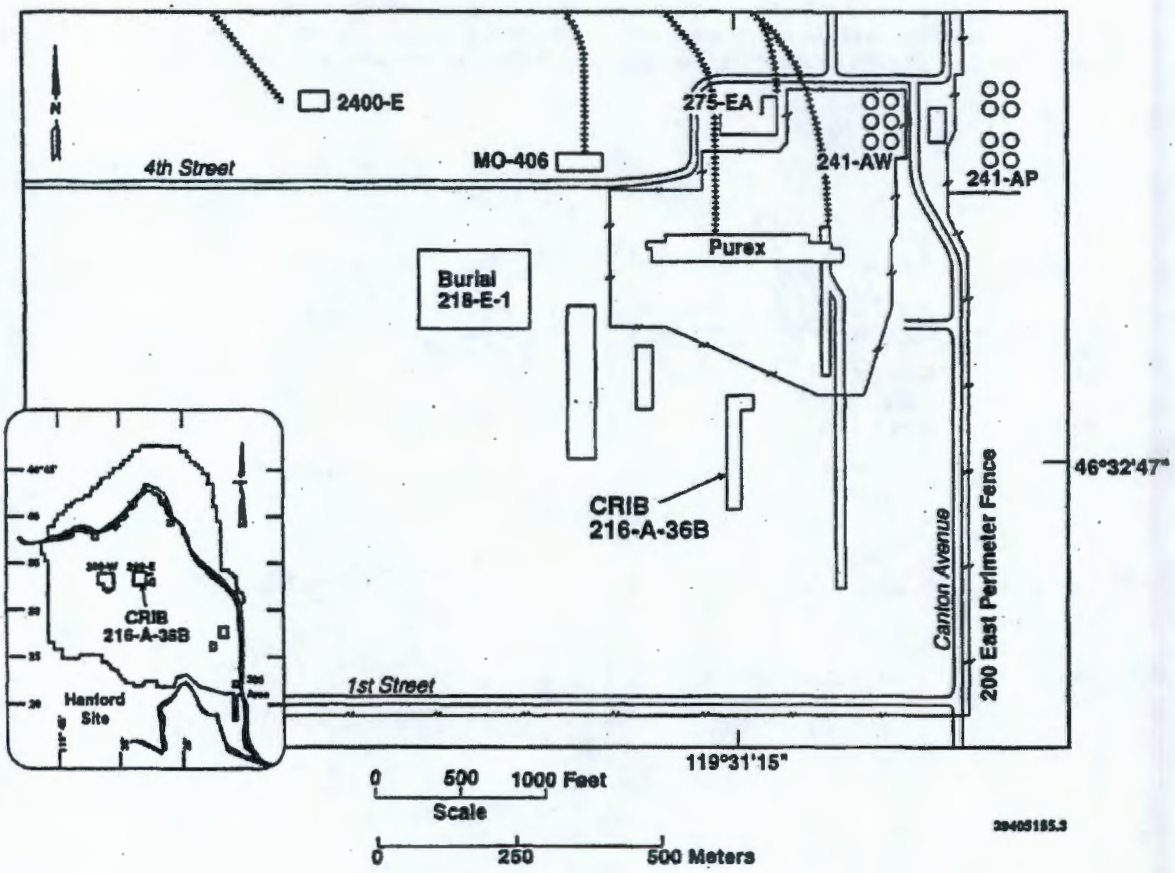
Date 7/1/02

Co-operator
E. Keith Thomson
President and Chief Executive Officer
Fluor Hanford

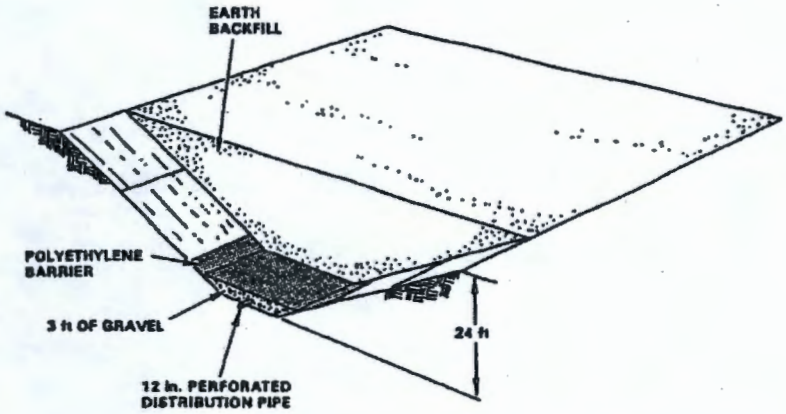
Date 5-30-02

ECY 030-31 Form 3 (Rev. 7/97)

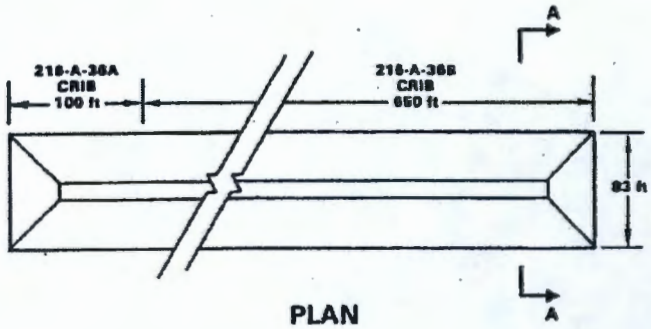
216-A-36B CRIB SITE PLAN



216-A-36 A AND B CRIBS



SECTION A-A



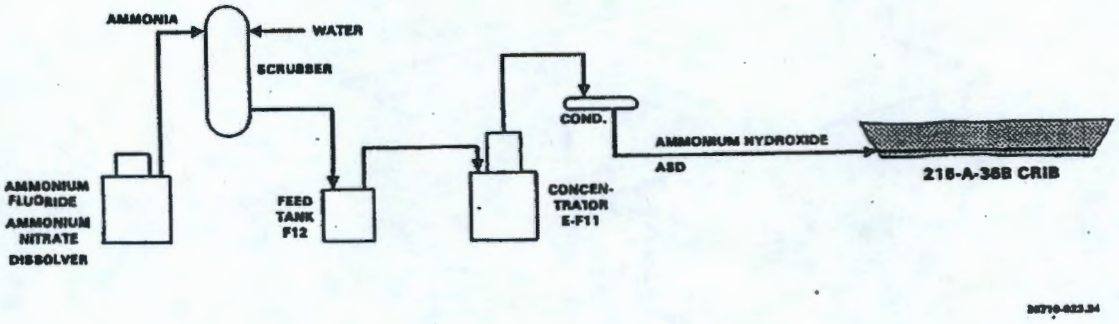
PLAN

For conversions, apply the following:

Feet to meters--multiply feet by 0.3048
Inches to centimeters--multiply inches by 2.54.

29710-023.12

216-A-36B CRIB WASTE STREAM FLOW DIAGRAM



216-A-36B CRIB

46°32'47"
119°31'15"

8706243-2CN
(PHOTO TAKEN 1987)

ECY 030-31 Form 3 (Rev. 7/97)

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PART A, FORM 3 PERMIT APPLICATION

FOR THE

207-A SOUTH RETENTION BASIN

DOE/RL-86-21
207-A South Retention Basin
Rev. 2, 10/01/96
Page 1 of 7

Please print or type in the unshaded areas only
(fill-in areas are spaced for elite type, i.e., 12 characters/inch).

FORM 3

DANGEROUS WASTE PERMIT APPLICATION

I. EPA/STATE I.D. NUMBER: W A 7 8 9 0 0 0 8 9 8 7

FOR OFFICIAL USE ONLY

APPLICATION APPROVED	DATE RECEIVED (mo., day, & yr.)	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	YR.
0 3	2 2	4 3

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	YR.

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 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 code(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
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

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
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
GALLONS	G
LITERS	L
CUBIC YARDS	Y
CUBIC METERS	C
GALLONS PER DAY	U

UNIT OF MEASURE	UNIT OF MEASURE CODE
LITERS PER DAY	V
TONS PER HOUR	D
METRIC TONS PER HOUR	W
GALLONS PER HOUR	E
LITERS PER HOUR	H

UNIT OF MEASURE	UNIT OF MEASURE CODE
ACRE-FEET	A
HECTARE-METER	F
ACRES	B
HECTARES	Q

EXAMPLE FOR COMPLETING SECTION III *(shown in the 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 NUMBER	A. PROCESS CODE (from list above)	B. PROCESS DESIGN CAPACITY 1. AMOUNT (specify)	B. PROCESS DESIGN CAPACITY 2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY	LINE NUMBER	A. PROCESS CODE (from list above)	B. PROCESS DESIGN CAPACITY 1. AMOUNT (specify)	B. PROCESS DESIGN CAPACITY 2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY
X-1	S 0 2	600	G		6				
X-2	T 0 3	20	E		8				
1	S 0 4	794,937	L		7				
2					8				
3					9				
4					10				

ECL30 - 300 - ECY 030-31 Form 3 Rev. 2/94 PAGE 1 OF 5 CONTINUE ON REVERSE

Continued from the front.

III. PROCESSES (continued)

C. SPACE FOR ADDITIONAL PROCESS CODES OR FOR DESCRIBING OTHER PROCESS (code "T04"). FOR EACH PROCESS ENTERED HERE INCLUDE DESIGN CAPACITY.

S04

The 207-A South Retention Basin (207-A Basin), which also is known as the Process Condensate (PC) Basins 1, 2, and 3 (i.e., PC-1, PC-2, and PC-3), began operation in March of 1977. The 207-A Basin consists of three concrete cells (S04), each with a 264,979-liter (70,000-gallon) design capacity for a total capacity of 794,937 liters (210,000 gallons). All three cells were coated to prevent constituents from penetrating the concrete. The 207-A Basin was used for the interim storage of the 242-A Evaporator process condensate to allow for sampling and analysis before the condensate was discharged to the 216-A-37-1 Crib for final disposition. Discharge of 242-A Evaporator process condensate to the 207-A Basin was terminated on April 12, 1989, when it was determined that the 242-A Evaporator process condensate contained mixed waste regulated under Washington Administrative Code 173-303. The 207-A Basin was emptied and is no longer used to receive or store mixed waste. The 207-A Basin will remain out of service and will be closed. Closure activities for the 207-A Basin are in the planning phase.

IV. DESCRIPTION OF DANGEROUS WASTES

A. DANGEROUS WASTE NUMBER - Enter the four 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 these 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 codes 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 800 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. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

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))
X-1	K 0 5 4	800	P	T 0 3 D 8 0	
X-2	D 0 0 2	400	P	T 0 3 D 8 0	
X-3	D 0 0 1	100	P	T 0 3 D 8 0	
X-4	D 0 0 2			T 0 3 D 8 0	Included with above

 CONTINUE ON PAGE 3

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207-A South Retention Basin
Rev. 2, 10/01/96
Page 3 of 7

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER (entered from page 1)

W	A	7	8	9	0	0	0	8	9	9	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))
1	F001	793,469	K	S04				Storage - Surface Impoundment
2	F002							
3	F003							
4	F004							
5	F005							
6	WT02							Included With Above
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8								
9								
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ECL30 - 271 - ECY 030-31 Form 3

PAGE 3 ____ OF 5

(enter "A", "B", "C", etc. behind the "3" to identify photo copied pages)

CONTINUE ON REVERSE

Continued from the front.

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

E. USE THIS SPACE TO LIST ADDITIONAL PROCESS CODES FROM SECTION D(1) ON PAGE 3.

The 207-A Basin was taken out of service on April 12, 1989, emptied, and no longer receives or stores mixed waste. A description of the mixed waste residue at the 207-A Basin follows.

The 242-A Evaporator process condensate is regulated as mixed waste because the waste is derived from a waste containing spent halogenated and nonhalogenated solvents (F001, F002, F003, F004, and F005), and for the toxicity of ammonia (WT02, state-only, toxic, dangerous waste). The estimated annual quantity of dangerous waste (Section IV.B.) of 793,469 kilograms (1,749,300 pounds) represents the maximum operating capacity of the 207-A Basin, and a specific gravity for the waste of 1.0, when the basin was operational.

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)*.

VII. FACILITY GEOGRAPHIC LOCATION This information is provided on the attached drawing(s) and photograph(s).

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 NO. *(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
John D. Wagoner, Manager U.S. Department of Energy Richland Operations Office	John D. Wagoner	9/26/96

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		

ECL30 - 271 - ECY 030-31 Form 3 PAGE 4 OF 5 CONTINUE ON PAGE 5

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.

John D. Wagoner

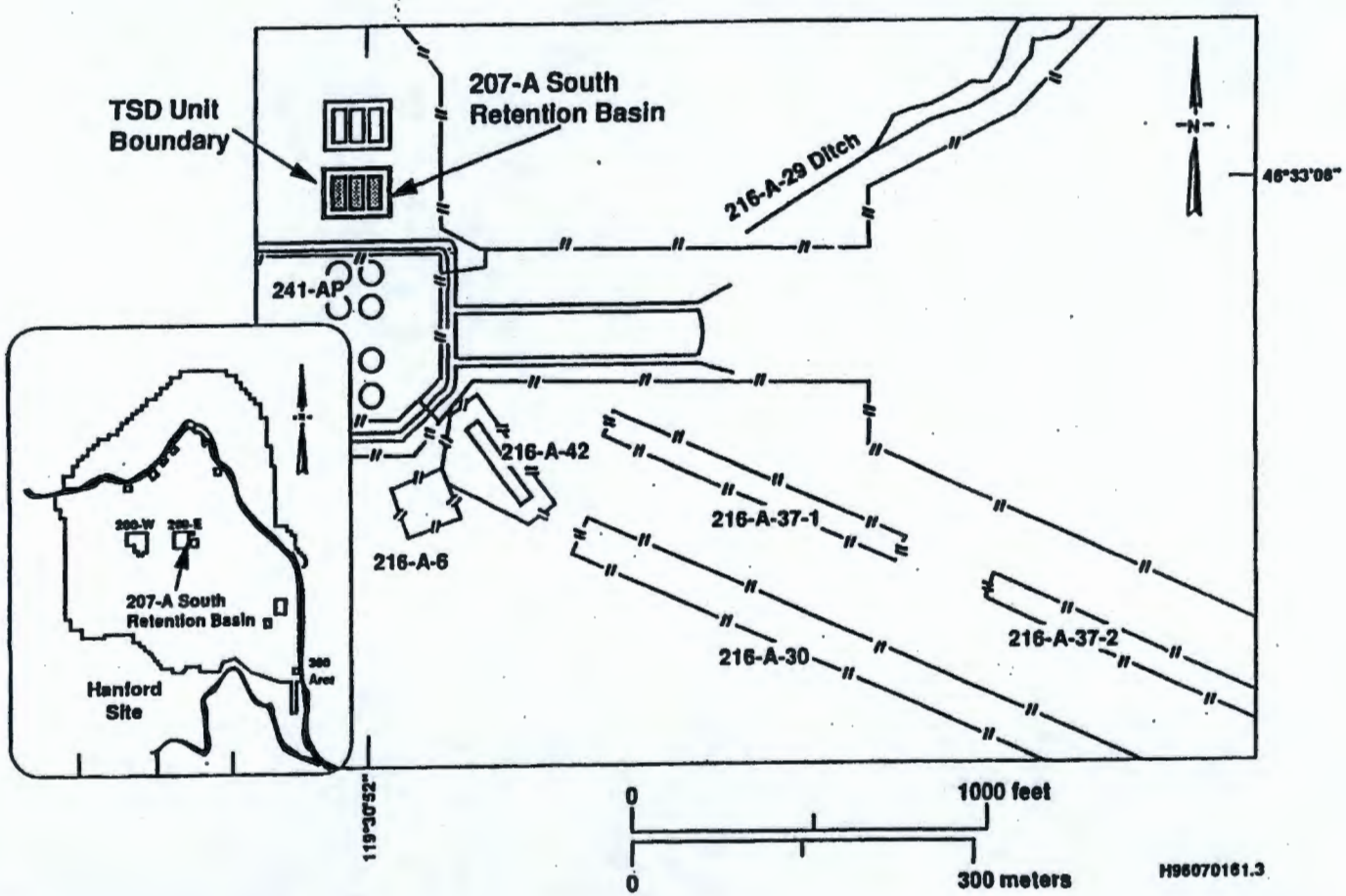
Owner/Operator
John D. Wagoner, Manager
U.S. Department of Energy
Richland Operations Office

9/26/96
Date

Co-operator
H. J. Hatch,
President and Chief Executive Officer
Fluor Daniel Hanford, Inc.

9/13/96
Date

207-A South Retention Basin Site Plan



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WA7890008967

207-A SOUTH RETENTION BASIN

46°33'08"
119°30'52"

93060005-12CN
(PHOTO TAKEN 1993)

PART A, FORM 3 PERMIT APPLICATION

FOR THE

216-A-37-1 CRIB

216-A-37-1 Crib
Rev. 3, 07/01/2002, 1 of 8

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

FOR 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		

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*Add per request of Washington State Department of Ecology (01/2001)

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							
				1. Amount *(Specify)*		2. Unit of Measure *(enter code)*		For Official Use Only			
X-1	S	0	2	600		G					
X-2	T	0	3	20		E					
1	D	8	1	86,400		U					
2											
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 216-A-37-1 Crib (Crib) began operation in March 1977 and was used for the percolation of the 242-A Evaporator (Evaporator) process condensate to the soil column. The process design capacity of 86,400 gallons (327,000 liters) per day is based on the daily output of the Evaporator process condensate discharged to the Crib. Discharge of the Evaporator process condensate to the Crib was terminated on April 12, 1989, when it was determined that the Evaporator process condensate contained or could have contained mixed waste regulated under Washington Administrative Code 173-303. The Crib is out of service and will be closed under interim status.

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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))*
X-1	K	0	5	4	900		P	T03	D80			
X-2	D	0	0	2	400		P	T03	D80			
X-3	D	0	0	1	100		P	T03	D80			
X-4	D	0	0	2				T03	D80			Included with above

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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	F	0	0	1	108,290,000	P		D81				Disposal-Landfill (Percolation)
2	F	0	0	2		P		D81				Disposal-Landfill (Percolation)
3	F	0	0	3		P		D81				Disposal-Landfill (Percolation)
4	F	0	0	4		P		D81				Disposal-Landfill (Percolation)
5	F	0	0	5		P		D81				Disposal-Landfill (Percolation)
6	W	T	0	2		P		D81				Disposal-Landfill (Percolation)
7												
8												
9												
10												
11												
12												
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ECY 030-31 Form 3 (Rev. 7/97)

IV. DESCRIPTION OF DANGEROUS WASTE (continued)

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

The Crib was taken out of service on April 12, 1989, and longer receives dangerous waste. A description of the dangerous waste discharged to the Crib is as follows.

The Evaporator process condensate has since been determined to be regulated as a mixed waste due to the presence of spent halogenated and nonhalogenated solvents (F001, F002, F003, F004, and F005), and for the toxicity of ammonia (WT02, toxic state-only). The Estimated Annual Quantity of Dangerous Waste (Item III.B.1.) of 108,290,000 pounds (4,912,000 kilograms) represents the maximum annual output of Evaporator process condensate during operating campaigns.

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).

VII. 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		7/1/02

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		

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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

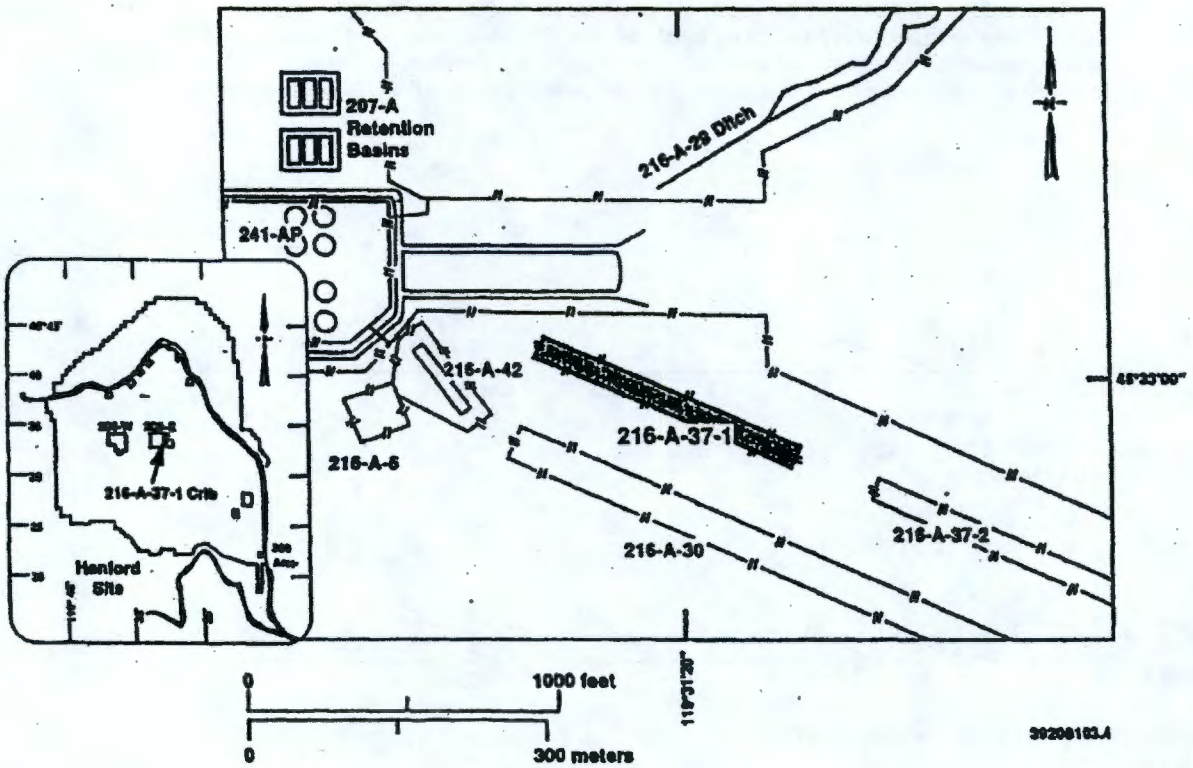
7/1/02
Date

/FOR
Co-operator
E. Keith Thomson
President and Chief Executive Officer
Fluor Hanford

5-30-02
Date

ECY 030-31 Form 3 (Rev. 7/97)

216-A-37-1 CRIB SITE PLAN



216-A-37-1 CRIB

46°33'00"
119°31'20"

8706421-25CN
(PHOTO TAKEN 1987)

ECY 030-31 Form 3 (Rev. 7/97)

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APPENDIX B

SAMPLING AND ANALYSIS PLAN

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Table B-12. 216-A-37-1 Crib Sampling Plan. B-48

Table B-13. Summary of Projected Sample Collection Requirements. B-48

Table B-14. List of Boreholes for Spectral Gamma-Ray Logging. B-49

TERMS

AEA	alpha energy analysis
aG	amber glass
ASAP	as soon as possible
ASTM	American Society for Testing and Materials
bgs	below ground surface
CFR	*Code of Federal Regulations*
COC	contaminant of concern
COPC	contaminant of potential concern
CVAA	cold vapor atomic absorption
DBBP	dibutyl butyl phosphonate
DOE	U.S. Department of Energy
DQO	data quality objective
DR	decision rule
EPA	U.S. Environmental Protection Agency
FS	feasibility study
G	glass
GC	gas chromatograph
GCMS	gas chromatograph/mass spectrometry
GEA	gamma energy analysis
GPC	gas proportional counter
GW	groundwater
HEIS	*Hanford Environmental Information System*
IC	ion chromatography
ICP	inductively coupled plasma
ICPMS	inductively coupled plasma mass spectrometer
N/A	not applicable
OU	operable unit
P	plastic
PUREX	Plutonium/Uranium Extraction (Plant)
QAPjP	quality assurance project plan
QC	quality control
RCRA	*Resource Conservation and Recovery Act of 1976*
RECUPLEX	recovery of uranium and plutonium by extraction (process)
REDOX	Reduction/Oxidation (Plant)
RESRAD	RESidual RADioactivity dose model
RI	remedial investigation
SAP	sampling and analysis plan
SVOA	semivolatile organic analyte
TBD	to be determined
TBP	tributyl phosphate
TOC	total organic carbon
TSD	treatment, storage, and disposal
VOA	volatile organic analyte
WTPH	Washington Total Petroleum Hydrocarbon

APPENDIX B

SAMPLING AND ANALYSIS PLAN

B1.0 INTRODUCTION

This sampling and analysis plan (SAP) for the remedial investigation (RI) of the 200-PW-2 and 200-PW-4 Operable Units (OU) directs sampling and analysis activities that will be performed to characterize the vadose zone at eight waste sites: the 216-A-19 Trench, the 216-B-12 Crib, the 216-U-8 Crib, the 216-U-12 Crib, the 216-A-10 Crib, the 216-A-36B Crib, the 216-A-37-1 Crib, and the 207-A South Retention Basin. These waste sites are part of the 200-PW-2 Uranium-Rich Process Waste Group OU and the 200-PW-4 General Process Waste Group OU in the 200 Areas of the Hanford Site. The sampling and analyses described in this document will provide soil data to refine the conceptual contaminant distribution models, support an assessment of risk, and evaluate a range of remedial alternatives for waste sites in these OUs. Characterization activities described in this plan are based on the implementation of the data quality objectives (DQO) process as documented in BHI-01411, *Remedial Investigation Data Quality Objectives Summary Report for the 200-PW-2 Uranium-Rich Process Waste Group Operable Units*, and CP-14176, *Remedial Investigation Data Quality Objectives Summary Report for the 200-PW-4 Operable Unit.*

The scope of activities described in this SAP involves sampling and geophysical logging of five deep boreholes to be drilled at five waste sites, sampling at up to 4 shallow borings to be drilled at one waste site (207-A South Retention Basin), and geophysical logging of existing boreholes to obtain additional information on the distribution of contamination at four of those five waste sites. In addition, geophysical logging also will be performed at two additional waste sites (216-U-8 Crib and 216-U-12 Crib) for which no further borehole drilling or soils characterization is required. Boreholes will be drilled to groundwater at the 216-A-19 Trench, the 216-B-12 Crib, the 216-A-10 Crib, the 216-A-36B Crib, and the 216-A-37-1 Crib. Soil samples will be collected and analyzed for radiological and nonradiological contaminants of concern (COC) and physical properties.

B1.1 BACKGROUND

The 37 waste sites associated with the 200-PW-2 OU primarily received mostly process drainage, process distillate discharge, and miscellaneous condensates. Most of the waste discharged to the soil column in this OU was generated at U Plant, the Reduction/Oxidation (REDOX) Plant, the Plutonium/Uranium Extraction (PUREX) Plant, B Plant (i.e., Waste Encapsulation and Storage Facility, and the Hot Semiworks Facility (C Plant) from 1952 through 1988. In general, the majority of the waste generated by operations associated with these waste sites can be described as a variety of liquid effluents, all containing relatively large amounts of uranium. The pH of the waste ranges from acidic to basic, depending on the source. The waste contains various constituents that include radionuclides, metals, inorganic chemicals, and

semivolatile and volatile organic chemicals. Contamination has penetrated the vadose zone and reached the aquifer beneath some of the waste sites.

Four of the waste sites (216-A-19 Trench, and 216-B-12, 216-A-10, and 216-A-36B Cribs) within the 200-PW-2 OU will be characterized to determine the nature and vertical extent of contamination via soil sampling and geophysical logging. Two additional sites (216-U-8 and 216-U-12 Cribs) will be characterized only by geophysical surveys of existing boreholes to obtain information to supplement existing data.

The 16 waste sites associated with the 200-PW-4 OU primarily received process condensate wastes and process wastes. Most of the waste discharged to the soil column in this OU was generated at the U and T Plants, the REDOX Plant, the PUREX Plant, the Hot Semiworks Facility (C Plant), and several other contributing tank farm-related facilities such as the 242-A Evaporator. In general, these sites have low inventories of all radionuclides and have received mostly low salt, neutral/basic liquids. Liquid volumes discharged to the cribs are significant, such as at the 216-A-37-1 Crib, which received more than 300,000,000 L of wastewater. The sites in this group received less than 20 Ci of fission products (cesium-137 or strontium-90) and low quantities of plutonium, uranium, and organics. Inorganic content is not reported, with the exception of several streams that received low levels of nitrates. The two *Resource Conservation and Recovery Act of 1976* (RCRA) treatment, storage, and disposal (TSD) units (216-A-37-1 Crib and 207-A South Retention Basin) within the 200-PW-4 OU will be characterized to determine the nature and vertical extent of contamination via soil sampling and geophysical logging.

Knowledge gained from the RI of characterizing these sites will be used to refine the conceptual contaminant distribution models and facilitate the use of the analogous site approach in reaching remedial action decisions for all the waste sites in these OUs. The analogous site approach is described in detail in DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan - Environmental Restoration Program* (Implementation Plan).

B1.2 200-PW-2 AND 200-PW-4 OPERABLE UNIT WASTE SITE LOCATIONS

The 200-PW-2 and 200-PW-4 OUs are located on the Hanford Site in southeastern Washington State, in the vicinity of the 200 East and 200 West Areas. All waste sites are located within the 200 Areas exclusive land-use boundary identified in DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*. Figures 2-10 through 2-14 in the main body of this Work Plan show the specific locations of waste sites in these two OUs.

B1.3 SITE DESCRIPTION AND HISTORY

The following sections provide brief descriptions of the eight waste sites that will be investigated. More detail is provided in Section 2.2 of the Work Plan. Section 3.3 of the Work Plan contains information on the nature and extent of contamination and previous investigations.

B1.3.1 216-A-19 Trench

The 216-A-19 Trench is one of several cribs/trenches that received startup wastes from the PUREX facility. The 216-A-19 Trench is located in the 200 East Area about 800 m (2,625 ft) northwest of the 202-A (PUREX) Building. It is approximately 7.6 by 7.6 by 4.6 m (25 by 25 by 15 ft) deep. It operated from November 1955 until January 1956. During that period it received PUREX startup wastes and possibly condenser cooling water from the 241-A-431 Building. Waste from PUREX entered the trench from above-ground piping that emptied into the trench. Condenser cooling water from the 241-A-431 Building may have reached the trench via the 216-A-34 Ditch, which lies adjacent to the 216-A-19 Trench. The trench and ditch later were covered with several feet of fill. The site was surface stabilized again in 1990.

B1.3.2 216-B-12 Crib

The 216-B-12 Crib received process condensate from the 221-U and 224-U Buildings and B Plant (221-B). The 216-B-12 Crib is located in the 200 East Area about 305 m (1,000 ft) northwest of the 221-B Building. It was constructed in 1952 and consisted of a series of three cascading 5- by 5- by 3-m (16- by 16- by 10-ft)-high wooden boxes made from 6- by 8-in. Douglas fir in a 9-m (30-ft)-deep excavation. The bottom 4 m (12 ft) contains 1.3-cm (0.5-in.) of gravel backfill, 1.2 m (4 ft) of which underlie the cribs. The crib operated from November 1952 through December 1957 and from May 1967 through November 1973. The crib was abandoned in November 1973 when the ground above the crib started to subside. The subsidence was backfilled and the fill line was blanked in 1973. In 1974, the crib was stabilized with layers of sand and gravel, with a plastic liner to deter vegetation growth. An additional 0.6 m (2 ft) of clean soil was added in 1993.

B1.3.3 216-U-8 Crib

The 216-U-8 Crib received process condensate from U Plant (221-U), the 224-U Building (UO_3) tanks, and 291-U-1 Stack drainage. The 216-U-8 Crib is located in the 200 West Area about 137 m (450 ft) west of Beloit Avenue and 229 m (750 ft) south of 16th Street. The crib consists of three timbered cascading crib structures, in a manner similar to that of the 216-B-12 Crib described in the preceding section. The crib operated from June 1952 to March 1960. In 1960, the crib was deactivated when it began to subside. Sinkholes were backfilled around the three cribs, and the risers were cut off and capped below grade. The incoming waste transfer line was blanked about 18 m (60 ft) north of the crib and waste materials were diverted to the 216-U-12 Crib. In 1994, the crib and the portion of the vitrified clay pipe from 16th Street south to the crib were stabilized with about 0.6 m (2 ft) of soil. The site was characterized in 1994 as part of the 200-UP-2 OU characterization activities. Waste in the site was considered to be acidic because of the large amounts of nitric acid disposed of at the site.

B1.3.4 216-U-12 Crib

The 216-U-12 Crib replaced the 216-U-8 Crib when it began to subside. The 216-U-12 Crib is located in the 200 West Area about 650 m (2,130 ft) south of the 221-U Building and 140 m

(460 ft) north of Beloit Avenue. The crib was constructed in 1960. It was designed to receive mixed waste from U Plant. The 46-m (150-ft)-long gravel-filled crib has no constructed internal structure and is about 5 m (15 ft) below grade. From 1960 to 1967 it received stack drainage from the 291-U-1 Stack, 244-WR Vault waste, stormdrain waste from the 224-U Building, and waste from the C-5 and C-7 tanks in the 224-B Building. In October 1965, the crib received 31.4 kg (69 lb) of thorium from contaminated water and 3.1 kg (6 lb) of thorium from the 244 WR Vault. From May 1967 to September 1972, it received occasional waste via tank C-7 in the 244-U Building. From September 1972 to November 1981, the crib was out of service. From November 1981 to June 1988, the crib received process condensate from the 224-U Building. The crib received process condensate until January 1988, when it was replaced by the 216-U-17 Crib. The site was characterized in 1994 as part of the 200-UP-2 OU characterization activities. The site is permitted as a RCRA TSD unit because of the acidic nature of the nitric acid disposed of at the site. The crib was stabilized with at least 0.6 m (2 ft) of soil.

B1.3.5 216-A-10 Crib

The 216-A-10 Crib is the second of three RCRA units in this OU. The crib is located in the 200 East Area approximately 82 m (270 ft) south of the southwest corner of the 202-A (PUREX) Building. The crib is rock filled with dimensions of 84 by 14 by 14 m (275 by 45 by 45 ft) deep. The crib was designed as a percolation unit for the disposal of liquid wastes from the PUREX facility. The 216-A-10 Crib replaced the 216-A-5 Crib in 1961, which was the year that contaminated liquid waste began being discharged into the crib. Liquid wastes included an acidic waste stream (nitric acid) from the process distillate discharge from PUREX, which resulted in the site being permitted as a RCRA TSD unit. The crib operated until 1987. Following operational use the crib was backfilled.

B1.3.6 216-A-36B Crib

The 216-A-36B Crib is the third RCRA TSD unit in this OU. The 216-A-36B Crib is located in the 200 East Area about 366 m (1,200 ft) south of the 202-A (PUREX) Building. The gravel-filled crib has bottom dimensions of 152 m (500 ft) and a width that varies from 2 to 3.4 m (7 to 11 ft). The 216-A-36B Crib is the southern portion of a longer crib, originally known as the 216-A-36 Crib. The original 216-A-36 Crib received effluent from September 1956 to March 1966. A substantial inventory of radionuclides was disposed to the crib and is assumed to have infiltrated sediments near the inlet of the crib. To continue effluent discharge to the crib, it was divided into two sections: 216-A-36A and 216-A-36B. Grout was injected into the gravel layer to form a barrier between the two sections. Replacement piping was inserted through the original discharge piping, effectively moving the discharge point further south along the length of the trench into the section that became the 216-A-36B Crib. The 216-A-36B Crib operated from 1966 to 1972 and was reactivated in 1982 for the PUREX Plant restart; it remained active until early 1988. During its operational use, it received ammonia scrubber distillate waste from the 202-A Building. The caustic nature of the waste (WT02) resulted in the site being permitted as a RCRA TSD unit. Use of the crib was discontinued later and the facility was backfilled. No stabilization actions have taken place at the waste site.

B1.3.7 207-A-South Retention Basin

The 207-A South Retention Basin, which also was known as the Process Condensate Basins 1, 2, and 3 (i.e., PC-1, PC-2, and PC-3), began operations in March of 1977. The 207-A South Retention Basin consists of three concrete cells, each with a 264,979-L (70,000 g) design capacity for a total capacity of 794,937 L (210,000 g). The bottom dimension of each cell is 16.8 m (55 ft) long, 3.0 m (10 ft) wide at the bottom, and 2.1 m (7 ft) deep. All three cells were coated to prevent constituents from penetrating the concrete. The 207-A-South Retention Basin was used for the interim storage of the 242-A Evaporator process condensate to allow for sampling and analysis before the condensate was discharged to the 216-A-37-1 Crib for final disposition. Discharge of 242-A Evaporator process condensate to the 207-A-South Retention Basin was terminated on April 12, 1989, when it was determined that the 242-A Evaporator process condensate contained mixed waste regulated under WAC 173-303. The basin was emptied and no longer is used to receive or store mixed waste.

The 242-A Evaporator process condensate was regulated as mixed waste, because the waste was derived from a waste containing spent halogenated and nonhalogenated solvents (F001, F002, F003, F004, and F005), and because of the toxicity of ammonia (WT02, state-only, toxic, dangerous waste). The estimated annual quantity of dangerous waste of 793,469 kg (1,749,300 lb) represented the maximum operating capacity of the 207-A-South Retention Basin, and a specific gravity for the waste of 1.0, when the basin was operational. The retention basin is located in the 200 East Area directly east of the 242-A Evaporator building.

B1.3.8 216-A-37-1 Crib

The 216-A-37-1 Crib began operation in March 1977 and was used for percolation of the 242-A Evaporator process condensate to the soil column. The process design capacity of 86,400 g (327,000 L) per day was based on the daily output of the 242-A Evaporator process condensate discharged to the crib. Discharge of the evaporator process condensate to the crib was terminated on April 12, 1989, when it was determined that the evaporator process condensate contained or could have contained mixed waste regulated under WAC 173-303. The crib is out of service and will be closed under interim status.

The 242-A Evaporator process condensate later was confirmed to be regulated as a mixed waste because of presence of spent halogenated and nonhalogenated solvents (F001, F002, F003, F004, and F005), and because of the toxicity of ammonia (WT02, toxic state-only). The estimated annual quantity of dangerous waste of 4,912,000 kg (108,290,000 lb) represented the maximum annual output of evaporator process condensate during operating campaigns. This TSD unit is located outside the 200 East Area perimeter fence, about 2,000 ft east of the 202-A building. The gravel-filled crib has bottom dimensions of 213 m (700 ft) long and 3 m (10 ft) wide. The site received 377,000,000 L of process condensate, thought to contain americium-241, cesium-137, tritium, iodine-129, promethium-147, plutonium-239, ruthenium-106, tin-113, and strontium-90, from the 242-A evaporator. A valve station is at the south end of the crib and a vent is located at the north end. The valve station is inside the crib perimeter fence and has surface radiation warning signs and a light chain barricade.

Wells 299-E25-19 and 299-E25-20 monitor this site and indicate an increasing and decreasing tritium activity, respectively. The NO_3 concentration remains at two to five times the drinking water standards. A surface radiation survey, performed in 1991, did not detect contamination (BHI-00033, *Surface and Near Surface Field Investigation Data Summary Report for the 200-UP-2 Operable Unit*).

B1.4 CONTAMINANTS OF CONCERN

Step 1 of the DQO process identifies the need to develop a list of contaminants of potential concern (COPC) for the 200-PW-2 and 200-PW-4 OU waste sites. Development of the COPCs is an essential step toward refining the preliminary conceptual contaminant distribution model to obtain site-specific models for the representative sites. From an investigation of historical sources including process documents, logbooks, original plant technical manuals, and interviews of plant operators, a list of potential contaminants was identified. This list was screened during the DQO to arrive at a final list of COCs for the 200-PW-2 and 200-PW-4 OUs. Development of this list is described in the 200-PW-2 and 200-PW-4 DQO summary reports (BHI-01411, CP-14176) and is summarized in Section 3.6 of the Work Plan. The COCs are identified in Tables B-1 and B-2.

B1.5 DATA QUALITY OBJECTIVES

The U.S. Environmental Protection Agency (EPA) document, EPA/600/R-96/055, *Guidance for the Data Quality Objectives Process*, EPA QA/G-4, was used to support the development of this SAP. The DQO process is a strategic planning approach that provides a systematic process for defining the criteria that a data collection design should satisfy. Using the DQO process ensures that the type, quantity, and quality of environmental data used in decision making will be appropriate for the intended application.

This section summarizes the key outputs resulting from the implementation of the seven-step DQO process for the RI of the OUs. Additional details are included in the DQO summary reports (BHI-01411, CP-14176).

B1.5.1 Statement of the Problem

The 200-PW-2 OU consists of 37 waste sites that received mostly uranium-rich process drainage, process distillate discharge, and miscellaneous condensates that were generated at U Plant, REDOX, PUREX, B Plant (i.e., Waste Encapsulation and Storage Facility), and the Hot Semiworks Facility (C Plant) from 1952 through 1988. Twenty-five of the sites in this group are RCRA past-practice waste sites and three are RCRA TSD units. Nine RCRA past-practice sites are unplanned release sites. Vadose zone soils and the aquifer have been impacted by effluent released to the 200-PW-2 OU waste sites.

The 200-PW-4 OU consists of 16 waste sites that received mostly process condensate wastes and process wastes that were generated at U and T Plants, REDOX, PUREX, the Hot Semiworks Facility (C Plant), and several other contributing tank farm-related facilities such as the 242-A Evaporator. Fourteen of the sites in this group are RCRA past-practice waste sites and

two are RCRA TSD units. Only one of the RCRA past-practice sites is an unplanned release site. Vadose zone soils and the aquifer have been impacted by effluent released to the 200-PW-4 waste sites.

The objective of the DQO process for these OUs is to determine the environmental measurements necessary to support the remedial investigation/feasibility study (RI/FS) process and remedial decision making, including refinement of the preliminary conceptual contaminant distribution model. Additionally, the DQO process supports development of this SAP.

Possible alternatives identified in the Implementation Plan (DOE/RL-98-28) include the following:

- No action alternative (no institutional controls)
- Engineered multimedia barrier
- Excavation and disposal of waste
- Excavation, ex situ treatment, and geologic disposal of transuranic soil (if present)
- In situ vitrification of soil
- In situ grouting or stabilization
- Monitored natural attenuation (with institutional controls).

B1.5.2 Decision Rules

Decision rules are developed from the combined results of DQO Steps 2, 3, and 4. These results include the principal study questions, decision statements, remedial action alternatives, data needs, COC action levels, analytical requirements, and scale of the decision(s). Decision rules are generally structured as "IF…THEN" statements that indicate the action that will be taken when a prescribed condition is met. Decision rules incorporate the parameters of interest (e.g., COCs), the scale of the decision (e.g., location), the preliminary action level (e.g., COC concentration), and the resulting action(s). The 200-PW-2 and 200-PW-4 OU decision statements are summarized in Table B-3.

B1.5.3 Error Tolerance and Decision Consequences

The consequence of selecting an inadequate nonstatistical sampling design is not considered severe. Based on Section 6.0 of the DQO summary reports (BHI-01411, CP-14176), the sampling design rigor requirements are not significant because of the combination of low severity and accessibility after remedial investigation sampling. If the sampling design is determined to be inadequate, additional sampling can be performed because the sites still will be accessible. Section 5.5 of the Work Plan summarizes the sampling activities that are planned after the evaluation of initial characterization efforts that are described in this SAP.

B1.5.4 Sample Design Summary

A nonstatistical sampling design (i.e., professional judgment) was used to select sample locations at the waste sites. This biased (or focused) sampling approach was selected based on Ecology 94-049, *Guidance on Sampling and Data Analysis Methods*. The intended use of the data and the process knowledge, expected behavior of COCs, the observed distribution of contamination,

waste site configuration, and the conceptual contaminant distribution models developed for the waste sites support the focused sampling approach. Using this approach, sample locations are selected that increase the likelihood of encountering the worst-case conditions or maximum concentrations of contaminants.

The total number of samples for the waste sites is selected based on the conceptual contaminant distribution models and the physical setting of the waste sites. The models suggest that the highest contaminant concentrations should be detected near the bottom of the crib/trench and should decrease with depth. Therefore, a greater frequency of sampling is planned in the zone immediately below the release point of the contaminants (i.e., the bottom of the cribs/trenches). Sample frequency will decrease with depth, based on the expected distribution of contamination. Additional samples will be collected at the discretion of the site geologist, based on the field screening data. All drill cuttings and soil samples will be screened as described in Section B3.2.2. Field screening will be performed to reduce the potential for overlooking zones of significant contamination and for worker safety. The optimal sample design for this RI is presented in Chapter B3.0.

Table B-1. 200-PW-2 Operable Unit Final Contaminant of Concern List. (3 Pages)

Final COCs	Rationale for Inclusion (see B6.0 for full References)
Radioactive Constituents	
Americium-241	Reactor product and is listed via tank farm integration (LA-UR-96-3860, *Hanford Tank Chemical and Radionuclide Inventories: HDW Model*; WHC-SD-WM-ER-133, *An Assessment of the Inventories of the Ferrocyanide Watchlist Tanks*).
Carbon-14	Fission/activation product and is listed via tank farm integration (LA-UR-96-3860; WHC-SD-WM-ER-133).
Cesium-137	Known fission product (HW-10475, *Hanford Engineer Works Technical Manual (T/B Plants)*, Sections A, B, and C; WHC-SD-WM-ER-133).
Cobalt-60	Known activation product (HW-10475, Sections A, B, and C; WHC-SD-WM-ER-133; WHC-MR-0270, *200-BP-5 Operable Unit Technical Baseline Report*).
Europium-152	Known fission product (HW-10475, Sections A, B, and C; HNF-1744, *Radionuclide Inventories of Liquid Waste Sites at Hanford*).
Europium-154	Known fission product (HW-10475, Sections A, B, and C; HNF-1744).
Europium-155	Known fission product (HW-10475, Sections A, B, and C; WHC-SD-WM-ER-133).
Hydrogen-3 (tritium)	Fission/activation product and is listed via tank farm integration (LA-UR-96-3860, WHC-SD-WM-ER-133).
Iodine-129	Reactor product (HW-10475, Sections A, B, and C).
Neptunium-237	Reactor product and is listed via tank farm integration (LA-UR-96-3860; WHC-SD-WM-ER-133).
Nickel-63	Activation product and is listed via tank farm integration (LA-UR-96-3860; WHC-SD-WM-ER-133).
Plutonium-238	Reactor product (HW-10475, Sections A, B, and C).
Plutonium-239/240	Reactor product (HW-10475, Sections A, B, and C).
Radium-226	Known production from fission reaction and is listed via tank farm integration (LA-UR-96-3860; WHC-SD-WM-ER-133).
Radium-228	Known production from fission reaction and is listed via tank farm integration (LA-UR-96-3860; WHC-SD-WM-ER-133).

Table B-1. 200-PW-2 Operable Unit Final Contaminant of Concern List. (3 Pages)

Final COCs	Rationale for Inclusion (see B6.0 for full References)
Strontium-90	Known fission product (HW-10475, Sections A, B, and C; WHC-SD-WM-ER-133).
Technetium-99	Known fission product (HW-10475, Sections A, B, and C; WHC-MR-0270).
Thorium-232	Reactor feed (HW-10475, Sections A, B, and C; HNF-1744).
Uranium-233/234	Reactor feed (HW-10475, Sections A, B, and C).
Uranium-235/236	Reactor feed (HW-10475, Sections A, B, and C).
Uranium-238	Reactor feed (HW-10475, Sections A, B, and C).
Chemical Constituents – Metals	
Antimony	Metal byproduct from uranium fuel rod (HW-19140, *Uranium Recovery Technical Manual*).
Arsenic	RCRA constituent.
Barium	Metal byproduct from uranium fuel rod (HW-19140).
Beryllium	Metal used in braze to seal end of fuel rod (HW-19140).
Cadmium	Metal used in lead-dipped cladding and thus cladding waste stream (1952 to 1956) (HW-10475, Section A).
Chromium	Because of sodium/potassium dichromate added during first- and second-cycle decontamination and concentration operations of bismuth phosphate process (HW-10475, Section C; WHC-MR-0132, *A History of the 200 Area Tank Farms*).
Chromium (VI)	Because of sodium/potassium dichromate added during first- and second-cycle decontamination and concentration operations of bismuth phosphate process (HW-10475, Section C; WHC-MR-0132).
Copper	Metal used in triple-dip process of cladding and thus cladding waste stream (1944 to 1952) (HW-10475, Section A).
Lead	Metal used in lead-dipped cladding and thus cladding waste stream (1952 to 1956) (HW-10475, Section A). Lead oxide was added as an oxidizing agent to the first- and second-cycle decontamination operations of bismuth phosphate process (HW-10475, Section C).
Mercury	Several uses in bismuth phosphate campaign including addition to cladding and metal waste streams to prevent gaseous generations and miscellaneous laboratory uses. Listed by the basis of knowledge gained by interviews and via tank farm integration (LA-UR-96-3860).
Nickel	Experimental additions of nickel sulfate during the bismuth phosphate process that served as a scavenging agent. Listed as a result of tank farm integration LA-UR-96-3860, WHC-SD-WM-ER-133) and extensive use (1954 to 1958) as nickel ferro/ferric cyanide during scavenging and recovery processes (WHC-SD-WM-ER-133).
Selenium	Several uses in bismuth phosphate campaign including filtering of gases generated in the 1950s and miscellaneous laboratory uses. Listed by the basis of knowledge gained by previous sampling efforts in the 200 Areas.
Silver	Several uses in bismuth phosphate campaign, including filtering of gas generated in the 1950s and miscellaneous laboratory uses. Listed by the basis of knowledge gained by interviews.
Chemical Constituents – General Inorganics	
Ammonia/ammonium	Several compounds contained ammonium. The most widely used included ammonium silica fluoride, which was used as a cleaning and decontamination compound based on its ability to dissolve metals and fission products (HW-10475, Section C; WHC-SD-WM-ER-133; OUT-1462, *History of Operations (1 January 1944 to 20 March 1945*).
Chloride	Several compounds contained chloride. The most widely used included ferrous chloride, which was used as a carrier, and potassium/sodium chloride, which was used as a salting agent during the bismuth phosphate process (HW-10475, Section C; WHC-SD-WM-ER-133; OUT-1462).
Cyanide	Extensive use (1954 to 1958) as nickel ferro/ferric cyanide during scavenging and recovery processes; listed as a result of tank farm integration (LA-UR-96-3860; WHC-SD-WM-ER-133).

Table B-1. 200-PW-2 Operable Unit Final Contaminant of Concern List. (3 Pages)

Final COCs	Rationale for Inclusion (see B6.0 for full References)
Fluoride	Several compounds contained fluoride. The most widely used included lanthanum fluoride, which was used during the concentration operations of the bismuth phosphate process, and ammonium silica fluoride, which was used as a cleaning and decontamination compound based on the ability to dissolve metals and fission products (HW-10475, Section C; WHC-SD-WM-ER-133; OUT-1462).
Nitrate/nitrite	Several compounds contained nitrates/nitrites. The most widely used included sodium nitrite, a salting agent during the cladding removal, nitric acid, which was used throughout the bismuth phosphate and uranium recovery processes, and bismuth subnitrate, which was used to create the bismuth phosphate/ plutonium solid during the first- and second-cycle decontamination process (HW-10475, Section C; WHC-SD-WM-ER-133; OUT-1462).
Phosphate	Several compounds contained phosphate. The most widely used included phosphoric acid, which was used throughout bismuth phosphate process (HW-10475, Section C; OUT-1462).
Sulfate	Several compounds contained sulfate. The most widely used included sulfuric acid, which was used in dissolving the fuel rods during the bismuth phosphate process (HW-10475, Section C; WHC-SD-WM-ER-133; OUT-1462). Many other sulfate complexes were used as carriers for various metals.
Semivolatile Organics	
AMSCO[a]	Extensive use (1953 to 1957) in solvent extraction operation as the dilutant for tributyl phosphate in the uranium recovery processes (WHC-SD-WM-ER-133).
Dodecane[a]	Used (1953 to 1957) in solvent extraction operation as the dilutant for tributyl phosphate in the uranium recovery processes (WHC-SD-WM-ER-133).
Normal paraffin hydrocarbons[a]	Extensive use (1953 to 1957) in solvent extraction operation as the dilutant for tributyl phosphate in the uranium recovery processes (WHC-SD-WM-ER-133).
Tributyl phosphate and derivatives (mono, bi)	Extensive use (1953 to 1957) in solvent extraction in the uranium recovery and PUREX processes (WHC-SD-WM-ER-133; HW-38562, *Radioactive Contaminants in Liquid Wastes Discharged to Ground at Separation Facilities Through June 1955*).
Volatile Organics	
Methyl iso butyl ketone (MIBK, hexone, or 4-methyl-2-pentanone) [b]	Used as solvent for solvent extraction of uranium and plutonium from fission products in REDOX (S Plant). Present in process drainage and possibly in process condensates (HW-19140).

[a]Analyzed as kerosene total petroleum hydrocarbons. AMSCO is a trademark of Allen Maintenance Supply Company, Inc., Allentown, Pennsylvania.

[b]Only present at 216-S-1 and 216-S-2 Cribs, 216-S-7 Crib, and 216-S-8 Trench via REDOX process condensate and process cell drainage waste streams. This constituent will only be considered at the 216-S-7 Crib as discussed in Appendix D.

COC = contaminant of concern.

RCRA = *Resource Conservation and Recovery Act of 1976.*

REDOX = Reduction-Oxidation (Plant).

Table B-2. List of Contaminants of Concern for the 200-PW-4 Operable Unit. (2 Pages)

Final Contaminants of concern [a]	Rationale for Inclusion (see B6.0 for References)
Semivolatile Organics	
Hydraulic fluids (greases)	Used for equipment in laboratory. Only an oil/grease separation analysis will be performed.
Kerosene[b]	Use (1953 to 1957) in solvent extraction operation as the dilutant for tributyl phosphate in the uranium recovery processes (WHC-SD-WM-ER-133).
Phenol	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248, *1994 Conceptual Model of the Carbon Tetrachloride Contamination in the 200 West Area at the Hanford Site*).
Polychlorinated biphenyls (PCB)	Various types of normal paraffins were used as milling, cutting, and washing solutions during the production of plutonium buttons/rods. These solutions almost always contained polychlorinated biphenyls (CCN 092730, "Discussion Notes with PFP Personnel").
Volatile Organics	
1,1-dichloroethane (DCA)	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248).
1,2-dichloroethane (DCA)	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248).
1,1,1-trichloroethane (TCA)	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248).
Acetone	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248).
Benzene	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248).
Carbon tetrachloride	Carbon tetrachloride was widely used as a dilutant for TBP and DBBP in the RECUPLEX, Plutonium Reclamation Facility, and americium-241 recovery processes. Analytical results and measurements have illustrated that this contaminant is prevalent throughout the vadose zone and has impacted groundwater (WHC-SD-EN-TI-248).
Cis/trans-1,2-dichloroethylene	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248).
Chlorobenzene	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248).
Chloroform	Chloroform is a degradation product of carbon tetrachloride. Analytical results and measurements have illustrated that this contaminant is prevalent throughout the vadose (WHC-SD-EN-TI-248).
Ethylbenzene	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248).
Ethylene glycol	Antifreeze component used as a coolant for equipment.
Methyl ethyl ketone (MEK, 2-butanone)	Analytical results and measurements have illustrated that this contaminant is prevalent throughout the vadose zone (WHC-SD-EN-TI-248).

Table B-2. List of Contaminants of Concern for the 200-PW-4 Operable Unit. (2 Pages)

Final Contaminants of concern [a]	Rationale for Inclusion (see B6.0 for References)
Methyl iso butyl ketone (MIBK, hexone)	Analytical results and measurements have illustrated that this contaminant is prevalent throughout the vadose zone (WHC-SD-EN-TI-248). Used as a solvent for solvent extraction of uranium and plutonium from fission products. Present in process drainage and possibly in process condensate. (HW-19140).
Methylene chloride	Analytical results and measurements have illustrated that this contaminant is prevalent throughout the vadose zone (WHC-SD-EN-TI-248).
n-butyl benzene	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248).
Tetrachloroethylene (PCE)	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248).
Trichloroethylene (TCE)	A degradation product of carbon tetrachloride. Analytical results and measurements have illustrated that this contaminant is prevalent throughout the vadose zone and has impacted groundwater (WHC-SD-EN-TI-248).
Toluene	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248).
Xylene	Analytical results and measurements have illustrated that this contaminant is found throughout the vadose zone (WHC-SD-EN-TI-248).

[a]The 200-PW-4 OU final contaminant of concern list consists of the analytes listed for the 200-PW-2 Operable Unit (Table B-1) and the additional constituents listed here.

[b]Analyzed as kerosene total petroleum hydrocarbons.

COC = contaminant of concern. RECUPLEX = recovery of uranium and plutonium by extraction (process).
DBBP = dibutyl butyl phosphonate. TBP = tributyl phosphate.

Table B-3. Decision Rules.

DR #	Decision Rule
1 & 2	If the analytical results of the vadose zone soil samples within the geographic boundaries of the individual 200-PW-2 and 200-PW-4 Operable Unit representative and treatment, storage, and disposal unit waste sites over the next 5 years meet all of the following conditions: • The RESRAD[b] analysis of maximum detected soil sampling results for the radiological contaminants of concern in the 200-PW-2 and 200-PW-4 Operable Unit representative and treatment, storage, and disposal unit waste site vadose zone soils do not exceed the annual exposure limits for human health protection. • The fate and transport analysis (to be determined) of the maximum detected soil sampling results for the radiological contaminants of concern in the 200-PW-2 and 200-PW-4 Operable Unit representative and treatment, storage, and disposal unit waste site vadose zone soils do not exceed the annual exposure limits for protection of groundwater. • The analytical results of the 200-PW-2 and 200-PW-4 Operable Unit representative and treatment, storage, and disposal unit waste site vadose zone soils indicate that maximum detected values do not exceed the respective nonradiological contaminant of concern preliminary action levels for direct exposure. • The analytical results of the 200-PW-2 and 200-PW-4 Operable Unit representative and treatment, storage, and disposal unit waste site vadose zone soils indicate that the maximum detected values do not exceed the respective nonradiological contaminant of concern preliminary action levels for protection of groundwater. Then evaluate for site closure with no remedial action.[a] If any of these conditions are not met, then evaluate the need for conventional remedial action alternatives within a feasibility study/closure plan, or evaluate a streamlined approach to site closure to be applied administratively via an existing record of decision.
3	If the maximum detected values indicate that the contamination distribution and physical characteristics in the 200-PW-2 and 200-PW-4 Operable Unit waste sites do not differ significantly from the preliminary conceptual contaminant distribution model, then the preliminary conceptual contaminant distribution model will not be revised prior to use for remedial decision making or remedial action planning. If the maximum detected values indicate that the contamination distribution and physical properties in the 200-PW-2 and 200-PW-4 Operable Unit waste sites differ significantly from the preliminary conceptual contaminant distribution model, then the preliminary conceptual contaminant distribution model will be revised prior to use for remedial decision making or remedial action planning.

[a]The term "remedial action" is used collectively to refer to one of the alternatives described in the project objectives discussion. The selection of the appropriate alternative action is beyond the scope of this document.
[b]ANL 2002, *RESRAD for Windows*, Version 6.21.

DR = decision rule.
RESRAD = RESidual RADioactivity dose model.

B2.0 QUALITY ASSURANCE PROJECT PLAN

The quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. The overall QAPjP for environmental restoration waste sites in the 200 Areas is included in Appendix A of the Implementation Plan (DOE/RL-98-28). The QAPjP complies with the requirements of the following:

- U.S. Department of Energy (DOE) Order 414.1A, *Quality Assurance*
- *Code of Federal Regulations* (CFR), 10 CFR 830.122, "Quality Assurance Criteria"
- EPA/240/B-01/003, *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations*, EPA QA/R-5
- DOE/RL-96-68, *Hanford Analytical Services Quality Assurance Requirements Documents*.

The Implementation Plan provides the general framework of technical and administrative requirements that apply to OUs in the 200 Areas.

To meet the site-specific needs for the 200-PW-2 and 200-PW-4 OUs, this QAPjP identifies supplemental requirements developed during the DQO process and described in the group-specific SAP. These requirements are listed below:

- **Analytical Performance.** Requirements for detection limits, precision, and accuracy are presented in Tables B-4a and B-4b. The analytical methods also are shown in this table.
- **Field Quality Control.** The frequency and type of quality control (QC) samples to be collected are addressed in Section B2.1.
- **Sample Preservation, Containers, and Holding Time.** The requirements for the specific test/laboratory methods are addressed in Section B2.3 and in Table B-5.
- **Onsite Measurements Quality Control.** The specific types of QC samples for onsite measurements and the frequency of collection are addressed in Section B2.4.
- **Data Validation and Usability.** Specific validation requirements, including the frequency and level of validation, are addressed in Section B2.6.

The following sections describe the supplemental waste group quality requirements and the procedural controls applicable to this investigation. The 200 Areas QAPjP (Appendix A of the Implementation Plan [DOE/RL-98-28]) and this section of the SAP will serve as the QAPjP for the 200-PW-2 and 200-PW-4 OU RIs. Correlation between EPA/240/B-01/003 (QA/R-5) requirements and information provided in the 200 Areas QAPjP and/or this chapter is provided below.

EPA QA/R-5 Criteria	EPA QA/R-5 Title	Reference Section
Project Management	Project/Task Organization	A2.1 (DOE/RL-98-28), Figure 1 (HNF-20635)[1]
	Problem Definition and Background	B1.5.1, B1.1
	Project Task Description	B1.0, B2.0
	Quality Objectives and Criteria	B1.5, B2.2
	Special Training/Certification	B2.7
	Documents and Records	B2.7
Data Generation and Acquisition	Sample Process Design	B3.0
	Sampling Methods	B2.7
	Sample Handling and Custody	B2.7.4, B2.7.5, B2.7.6
	Analytical Methods	B2.2, Tables B-4a and B-4b
	Quality Control	B2.1, B2.2
	Instrument/Equipment Testing, Inspection and Maintenance	B2.7
	Instrument/Equipment Calibration and Frequency	B2.7
	Inspection and Acceptance of supplies and consumables	B2.7
	Non Direct Measurement	B1.1
	Data Management	B2.5
Assessment and Oversight	Assessment and Response Actions	B2.7
	Reports to Management	B2.7
Data Validation and Usability	Data Review, Verification and Validation	B2.6
	Verification and Validation Methods	B2.6
	Reconciliation with User Requirements	B2.5, A6.0 (DOE/RL-98-28)

[1]HNF-20635, *Groundwater Remediation Project Quality Assurance Project Plan.*

B2.1 FIELD QUALITY CONTROL

Field QC samples shall be collected to evaluate the potential sources for error including cross-contamination and laboratory performance that could bias the results. A data quality assessment will be performed to assess the quality of the data collected to support the RI/FS activities for the 200-PW-2 and 200-PW-4 OUs. Field QC for sampling in the 200-PW-2 and 200-PW-4 OUs

will require the collection of co-located duplicate, field split, and equipment rinsate blank samples. The QC samples are described in this section with the required frequency of collection.

B2.1.1 Co-Located Duplicates

Co-located duplicates are independent samples collected as close as possible to the same point in space and time, taken from the same source, stored in separate containers, and analyzed independently. These samples provide a relative measure of the degree of local heterogeneity in the sample medium, unlike laboratory duplicates that are used to evaluate precision and the analytical process. It is important that these samples not be homogenized together.

A minimum of 5 percent of the total collected soil samples will be duplicated (i.e., 1 field duplicate will be collected for every 20 soil samples). At least one co-located duplicate will be collected from each borehole. The duplicates generally should be collected from an interval that is expected to have some contamination, so that valid comparisons between the samples can be made (i.e., at least some of the COCs will be above detection limit). When sampling is done with a split spoon, the duplicate sample probably will be from a separate split spoon either above or below the main sample because of sample volume requirements.

B2.1.2 Equipment Rinsate Blanks

Equipment rinsate blanks shall be collected at the same frequency as are the co-located duplicate samples, where applicable, and are used to assess the possibility of cross-contamination caused by sampling equipment, sample containers, or laboratory procedures; the blanks verify the adequacy of sampling equipment decontamination procedures. The field geologist may request that additional equipment blanks be taken. Equipment blanks shall consist of pure deionized water washed over decontaminated sampling equipment and placed in containers identical to those used for actual soil samples.

Equipment rinsate blanks shall be analyzed for the following:

- Gross alpha
- Gross beta
- Metals (excluding hexavalent chromium and mercury)
- Anions (except cyanide).

These analytes are considered to be the best indicators of decontamination effectiveness.

B2.1.3 Prevention of Cross-Contamination

Special care should be taken to prevent cross-contamination of soil samples. Particular care will be exercised to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers

- Contaminating the equipment or sample bottles by setting them on or near potential contamination sources, such as uncovered ground
- Handling bottles or equipment with dirty hands
- Improperly decontaminating equipment before sampling or between sampling events.

B2.2 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Quality objectives and criteria for soil measurement data are presented in Tables B-4a and B-4b for chemical and radiological analytes and physical properties of interest. Analysis of soil physical properties will be performed according to American Society for Testing and Materials (ASTM) procedures, if applicable (ASTM, *1993 Annual Book of ASTM Standards*).

B2.3 SAMPLE PRESERVATION, CONTAINERS, AND HOLDING TIMES

Soil sample preservation, containers, and holding times for chemical and radiological analytes of interest and physical property tests are presented in Table B-5. Final sample collection requirements will be identified on the Sampling Authorization Form per procedure CP-GPP-EE-01-2.0, *Sample Event Coordination*.

B2.4 ONSITE MEASUREMENTS QUALITY CONTROL

The collection of QC samples for onsite measurements is not applicable to field-screening techniques described in this plan. Field-screening instrumentation will be calibrated and controlled according to the procedures identified in Section B2.7.

B2.5 DATA MANAGEMENT

Data resulting from the implementation of this QAPjP will be managed and stored by the Fluor Hanford (FH) organization responsible for sampling and characterization, in accordance with procedure CP-GPP-EE-01-2.2, *Data Package Receipt and Control*. At the direction of the task lead, all analytical data packages will be subject to final technical review by qualified personnel before their submittal to regulatory agencies or inclusion in reports. Electronic data access, when appropriate, will be via a database (e.g., *Hanford Environmental Information System* [HEIS] or a project-specific database). Where electronic data are not available, hard copies will be provided in accordance with Section 9.6 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989).

B2.6 VALIDATION AND VERIFICATION REQUIREMENT

Validation will be performed on completed data packages by qualified FH Sample Management personnel or by a qualified independent contractor following CP-GPP-EE-01-2.5, *Data Package Validation Process*. Validation will consist of verifying required deliverables, requested versus reported analyses, and transcription errors. Validation also will include the evaluation and qualification of results based on holding time, method blanks, matrix spikes, laboratory control samples, laboratory duplicates, and chemical and tracer recoveries, as appropriate to the methods used. No other validation or calculation checks will be performed. At least 5 percent of all data will be validated.

Assuming that about 80 samples will be collected during the 200-PW-2 and 200-PW-4 OU representative site and TSD unit investigations (including full QC sets, but exclusive of discretionary samples; see Tables B-7 through B-13 in Chapter B3.0), approximately 10 to 20 sample delivery groups will be submitted to the laboratory containing between 4 and 8 samples in each sample delivery group. At least one data validation package will be generated for each waste site. Validation requirements identified in this section are consistent with Level C validation, as defined in BHI-01433, *Data Validation Procedure for Radiochemistry Analysis*, and BHI-01435, *Data Validation Procedure for Chemical Analysis*. No validation for physical property data will be performed.

B2.7 TECHNICAL PROCEDURES AND SPECIFICATIONS

Soil sampling and onsite environmental measurements will be (or were) performed according to approved procedures. Sampling and field measurements will be (or were) conducted according to the approved procedures listed below, but are not limited to those shown. Procedures used for work already completed are shown in parentheses where the procedure number has since been changed.

- Training/certifications
  - HNF-PRO-459, *Environmental Training*
  - HNF-RD-11061, *Training Requirements*
- Documents and records
  - HNF-PRO-10863, *Notebooks and Logbooks*
  - HNF-RD-210, *Records Management Program*
- General sampling and sample management
  - CP-GPP-EE-01-2.0, *Sample Event Coordination*
  - CP-GPP-EE-01-2.1, *Sampling Documentation Processing*

- GRP-EE-01-3.0 (CP-GPP-EE-01-3.0), *Chain of Custody*
- GRP-EE-01-3.1 (CP-GPP-EE-01-3.1), *Sample Packaging and Shipping*
- GRP-EE-01-3.2 (CP-GPP-EE-01-3.2) , *Field Decontamination of Sampling Equipment*
- GRP-EE-05-1.0 (CP-GPP-EE-05-1.0) , *Routine Field Screening*
- CP-GPP-EE-01-1.6, *Survey Requirements and Techniques*
- GRP-EE-01-6.2 (CP-GPP-EE-01-6.2), *Field Cleaning and/or Decontamination of GeoProbe and Drilling Equipment*
- GRP-EE-01-7.0 (CP-GPP-EE-01-7.0), *Geologic Logging*
- GRP-EE-02-14.1, *Drilling, Remediating, and Decommissioning Resource Protection Wells, and Geotechnical Soil Borings*
- (CP-GPP-EE-02-14.0), *Drilling, Maintaining, Remediation, and Decommissioning Resource Protection Wells, GeoProbe, and Geotechnical Soil Borings*

- Soil and groundwater sampling
  - GRP-EE-01-4.0 (CP-GPP-EE-01-4.0), *Soil and Sediment Sampling*
  - GRP-EE-01-4.1 (CP-GPP-EE-01-4.1), *Groundwater Sampling*
  - GRP-EE-01-4.2 (CP-GPP-EE-01-4.2), *Sample Storage and Shipping Facility*
  - GRP-EE-01-4.5 (CP-GPP-EE-01-4.5), *Sample Compositing*
- Instrument/equipment calibration and testing
  - HNF-PRO-490, *Calibration Management Program*
  - GRP-PRO-8377, *Instrument Accuracy and Reliability (Calibration)*
- Supplies and consumables
  - HNF-PRO-268, *Control of Purchased/Acquired Items and Services*
  - HNF-PRO-123, *Requesting Materials and Services*
- Radiological surveys, protection, and control
  - HNF-13536, *PHMC Radiological Control Procedures*
  - HNF-5173, *PHMC Radiological Control Manual*

- HNF-12494, *Environmental Radiological Measurement Plan for the Central Plateau Remediation Project*
- HNF-IP-1277, *D&D Radiological Protection Procedures*
- HNF-PRO-1623, *Radiological Work Planning Process*
- Waste Disposal/Groundwater Remediation Project (WD/GRP) Radiological Control Procedure (RCP) 4.5.1, *Portable Environmental Survey Instrument Operation*
- WD/GRP RCP 4.5.2, *Performance of Environmental Radiological Measurements*
- WD/GRP RCP 4.5.3, *MDA and Scan Speed Determination for Environmental Radiological Surveys*
- WD/GRP RCP 4.5.7, *Preparation of Environmental Radiological Survey Task Instructions (ERSTIs)*
- WD/GRP RCP 4.5.8, *Background Measurements for Environmental Radiological Surveys*
- WD/GRP RCP 4.5.9, *Documenting Environmental Radiological Measurements*
- WD/GRP RCP 5.6.15, *Operation of Mobile Surface Contamination Monitor II*
- HNF-13536 Procedure 3.1.2, "Evaluation of Outdoor Contamination Areas"

• Waste management

- (CP-A-EE-010-14), *Waste Identification*
- (CP-A-EE-010-16), *Waste Storage and Handling.*
- HNF-PRO-462, *Pollution Prevention*
- HNF-PRO-15333, *Environmental Protection Processes*
- HNF-PRO-15334, *Effluent and Environmental Monitoring*
- HNF-PRO-15335, *Environmental Permitting and Documentation Preparation*
- HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria*
- CP-13934, *Waste Control Plan for the 200-PW-4 Operable Unit.*
- CP-13935, Rev. 1, *Waste Control Plan for the 200-PW-2 Operable Unit.*

Work also shall be performed in accordance with the following:

- Quality assurance
  - HNF-20635, *Groundwater Remediation Project Quality Assurance Project Plan*
  - (HNF-12494), *Environmental Radiological Measurement Plan for the Central Plateau Remediation Project*
  - (CP-MP-002), *Central Plateau Remediation Project Quality Assurance Program Plan*
    - (CP-A-QA-03-5.1), *Field Sampling Quality Assurance Program Plan*
    - (CP-A-QA-03-5.2), *Onsite Measurements Quality Assurance Program Plan*
  - HNF-RD-14988, *Project Management Requirements*
- Quality improvement
  - HNF-PRO-052, *Corrective Action Management*
  - HNF-PRO-298, *Noncomforming Items*
- Management assessment
  - HNF-PRO-246, *Management Assessment*
- Data management
  - CP-GPP-EE-01-2.4, *Environmental Information Systems – Data Package Technical Verification*
  - CP-GPP-EE-01-2.5, *Environmental Information Systems – Data Package Validation Process*
- Health and safety
  - HNF-PRO-121, *Heat Stress Control*
  - HNF-PRO-175, *Training Program Descriptions*
  - HNF-RD-10743, *Safety Communications*
  - HNF-RD-11812, *Occupational Noise Exposure and Hearing Conservation*

- Site-specific plans, as applicable:
  - Health and safety plans
  - Radiological evaluation and/or radiation work permits
  - Specification for environmental drilling services specific to the 200-PW-2 OU
  - Activity hazard analysis and/or job safety analysis.

B2.7.1 Sample Location

Sample locations (e.g., geophysical surveys, boreholes) will be staked and labeled before starting the activity. Locations will be staked by the technical lead or field team leader assigned by the project manager. After the locations have been staked, minor adjustments to the location may be made to mitigate unsafe conditions, avoid structural interferences, or bypass utilities. Locations will be identified during or after sampling following CP-GPP-EE-01-1.6. Changes in sample locations that do not impact the DQOs will require approval of the project manager. However, changes to sample locations that result in impacts to the DQOs will require lead regulator concurrence.

B2.7.2 Sample Identification

The FH Sample and Data Tracking database will be used to track the samples through the collection and laboratory analysis process. The HEIS database is the repository for the laboratory analytical results. The HEIS sample numbers will be issued to the sampling organization for this project in accordance with CP-GPP-EE-01-2.0. Each chemical/radiological and physical properties sample will be identified and labeled with a unique HEIS sample number. The sample location, depth, and corresponding HEIS numbers will be documented in the sampler's field logbook.

Each sample container will be labeled with the following information using a waterproof marker on firmly affixed, water-resistant labels:

- HEIS number
- Sample collection date/time
- Name/initials of the person collecting the sample
- Analysis required
- Preservation method, if applicable.

B2.7.3 Field Sampling Log

All information pertinent to field sampling and analysis will be recorded in bound logbooks in accordance with HNF-PRO-10863. The sampling team will be responsible for recording all relevant sampling information including, but not limited to, the information listed in Appendix A of Procedure 1.5. Entries made in the logbook will be dated and signed by the individual who made the entry.

B2.7.4 Sample Custody

A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples (cooler) shipped to any laboratory, in accordance with GRP-EE-01-3.0 (CP-GPP-EE-01-3.0). The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. Each time responsibility for custody of the sample changes, the new and previous custodians will sign the record and note the date and time. The sampler will make a copy of the signed record before sample shipment and will transmit it to FH Sample Management within 24 hours of shipping, as detailed in CP-GPP-EE-01-2.1.

A custody seal (i.e., evidence tape) shall be affixed to the lid of each sample jar. The container seal will be inscribed with the sampler's initials and the date and then will be sealed. Although not anticipated at these sites, if sample jars are collected inside a glovebag or glovebox because of contamination levels and are "bagged out," the evidence tape may be affixed to the seal of the bag or box to demonstrate that tampering has not occurred. This will eliminate problems associated with contaminated soils adhering to the custody tape while inside the glovebox.

B2.7.5 Sample Containers and Preservative

Level I EPA precleaned sample containers will be used for soil samples collected for chemical and radiological analysis. Container sizes may vary, depending on laboratory-specific volumes needed to meet analytical detection limits. If, however, the dose rate on the outside of a sample jar or the curie content exceeds levels acceptable by an offsite laboratory, the sampling lead and task lead can send smaller volumes to the laboratory after consultation with FH Sample Management to determine acceptable volumes. Smaller sample volumes may not be able to meet quality assurance/QC requirements as discussed in Tables B-4a and B-4b. Preliminary container types and volumes are identified in Table B-5. Final types and volumes will be provided on the Sample Authorization Form.

B2.7.6 Sample Shipping

The outside of each sample jar will be surveyed by the radiological control technician to verify that the container is free of smearable surface contamination. The radiological control technician also will measure the radiological activity on the outside of the sample container (through the container) and will mark the container with the highest contact radiological reading in either disintegrations per minute or millirems per hour, as applicable. Unless prequalified, all samples will have total activity analysis performed by the Radiological Counting Facility, 222-S Laboratory, or other suitable onsite laboratory, before shipment. This information, along with other data that may prequalify the samples, will be used to select proper packaging, marking, labeling, and shipping paperwork in accordance with U.S. Department of Transportation regulations (49 CFR, "Transportation") and International Air Transport Association requirements, and to verify that the sample can be received by the offsite analytical laboratory in accordance with the laboratory's acceptance criteria. The sampler will send copies of the shipping documentation to FH Sample Management within 24 hours of shipping, as detailed in CP-GPP-EE-01-2.1.

As a general rule, samples with activities <1 mR/h will be shipped to an offsite laboratory. Samples with activities between 1 mR/h and 10 mR/h may be shipped to an offsite laboratory; samples with activities in this range will be evaluated on a case-by-case basis by FH Sample Management. Samples with activities >10 mR/h will be sent to an onsite laboratory, as arranged by Sample Management. Potential impacts of onsite laboratory measurements are discussed in footnote a of Table B-4b.

Table B-4a. Analytical Performance Requirements for Radionuclides – Shallow and Deep Zone Soils. (2 Pages)

Contaminants of Concern	Chemical Abstracts Service #	Preliminary Action Level[a]			Name/Analytical Technology[1]	Required Target Quantitation Limits[c]				Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		15 mrem/yr[b] (pCi/g)	500 mrem/yr[b] (pCi/g)	GW Protection[b] (pCi/g)		Water Low Activity (pCi/L)	Water High Activity (pCi/L)	Soil-Other Low Activity (pCi/g)	Soil-Other High Activity (pCi/g)				
Americium-241	14596-10-2	335	112,000	N/A	Americium isotopic – AEA	1	400	1	4,000	±20%	80-120%	±35%	65-135%
Carbon-14	14762-75-5	33,100	1,100,000	291	Carbon-14 – liquid scintillation	200	N/A	50	N/A	±20%	80-120%	±35%	65-135%
Cesium-137	10045-97-3	23.4	780	N/A	GEA	15	200	0.1	2,000	±20%	80-120%	±35%	65-135%
Cobalt-60	10198-40-0	4.90	164	N/A	GEA	25	200	0.05	2,000	±20%	80-120%	±35%	65-135%
Europium-152	14683-23-9	11.4	388	N/A	GEA	50	200	0.1	2,000	±20%	80-120%	±35%	65-135%
Europium-154	15585-10-1	10.3	345	N/A	GEA	50	200	0.1	2,000	±20%	80-120%	±35%	65-135%
Europium-155	14391-16-3	426	14,200	N/A	GEA	50	200	0.1	2,000	±20%	80-120%	±35%	65-135%
Iodine-129	15046-84-1	3,080	103,000	N/A	Iodine-129 – Low Energy Photon Spectroscopy	5	N/A	2	N/A	±20%	80-120%	±35%	65-135%
Neptunium-237	13994-20-2	59.2	1,980	N/A	Neptunium-237 – AEA	1	N/A	1	8,000	±20%	80-120%	±35%	65-135%
Nickel-63	13981-37-8	4,026	3,008,000	N/A	Nickel-63 – liquid scintillation	15	N/A	30	N/A	±20%	80-120%	±35%	65-135%
Plutonium-238	13981-16-3	470	15,700	N/A	Plutonium isotopic – AEA	1	130	1	1,300	±20%	80-120%	±35%	65-135%
Plutonium-239/240	Pu-239/240	425	14,200	N/A	Plutonium isotopic – AEA	1	130	1	1,300	±20%	80-120%	±35%	65-135%
Radium-226	13982-63-3	7.03	234	N/A	GEA	N/A	N/A	0.1	2,000	±20%	80-120%	±35%	65-135%
Radium-228	15262-20-1	8.15	272	N/A	GEA	N/A	N/A	0.2	2,000	±20%	80-120%	±35%	65-135%
Strontium-90	Rad-Sr	2,410	80,300	N/A	Total radioactive strontium – GPC	2	80	1	800	±20%	80-120%	±35%	65-135%
Technetium-99	14133-76-7	412,000	13,700,000	171	Technetium-99 – liquid scintillation	15	400	15	4,000	±20%	80-120%	±35%	65-135%
Thorium-232	TH-232	4.8	160	N/A	Thorium isotopic – AEA (pCi) ICPMS (mg)	1	0.002 mg/L	1	0.02 mg/kg	±20%	80-120%	±35%	65-135%

Table B-4a. Analytical Performance Requirements for Radionuclides – Shallow and Deep Zone Soils. (2 Pages)

Contaminants of Concern	Chemical Abstracts Service #	Preliminary Action Level[a]			Name/Analytical Technology[i]	Required Target Quantitation Limits[c]				Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		15 mrem/yr[b] (pCi/g)	500 mrem/yr[b] (pCi/g)	GW Protection[b] (pCi/g)		Water Low Activity (pCi/L)	Water High Activity (pCi/L)	Soil-Other Low Activity (pCi/g)	Soil-Other High Activity (pCi/g)				
Tritium (H-3)	10028-17-8	66,900	2,230,000	4,100	Tritium – liquid scintillation	400	400	400	400	±20%	80-120%	±35%	65-135%
Uranium-233/234	13966-29-5	2,660	88,800	39.5	Uranium isotopic – AEA (pCi) ICPMS (mg)	1	0.002 mg/L	1	0.02 mg/kg	±20%	80-120%	±35%	65-135%
Uranium-235/236	15117-96-1	101	3,370	3.92	Uranium isotopic – AEA (pCi) ICPMS (mg)	1	0.002 mg/L	1	0.02 mg/kg	±20%	80-120%	±35%	65-135%
Uranium-238	U-238	504	16,800	38.1	Uranium isotopic – AEA (pCi) ICPMS (mg)	1	0.002 mg/L	1	0.02 mg/kg	±20%	80-120%	±35%	65-135%

Footnotes, acronyms, and references are provided following Table B-4b.

Table B-4b. Analytical Performance Requirements for Nonradionuclides – Shallow and Deep Zone Soils. (5 Pages)

COCs	CAS #	Preliminary Action Level[a]			Name/Analytical Technology[j]	Required Target Quantitation Limits[c]				Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340 Method C[d] (mg/kg)	GW Protection[e] (mg/kg)	Terrestrial Biota Protection[f] (mg/kg)		Water Low Conc. (mg/L)	Water High Conc. (mg/L)	Soil-Other Low Conc. (mg/kg)	Soil-Other High Conc. (mg/kg)				
Metals													
Antimony	7440-36-0	1,400	N/A	5	Metals – 6010 – ICP	0.06	0.2	6	20	g	g	g	g
Arsenic	7440-38-2	87.5	20[h]	20[h]	Metals – 6010 – ICP	0.1	0.2	10	20	g	g	g	g
					Metals – 6010 – ICP (trace)	0.01	N/A	1	N/A	g	g	g	g
Barium	7440-39-3	245,000	282	132[h]	Metals – 6010 – ICP	0.2	0.2	20	40	g	g	g	g
Beryllium	7440-41-7	104[j]	N/A	10	Metals – 6010 – ICP	0.005	0.01	0.5	1	g	g	g	g
Cadmium	7440-43-9	139[j]	0.81[h]	4	Metals – 6010 – ICP	0.005	0.01	0.5	1	g	g	g	g
					Metals – 6010 – ICP (trace)	0.005	N/A	0.5	N/A	g	g	g	g

Table B-4b. Analytical Performance Requirements for Nonradionuclides – Shallow and Deep Zone Soils. (5 Pages)

COCs	CAS #	Preliminary Action Level[a]			Name/Analytical Technology[d]	Required Target Quantitation Limits[e]				Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340 Method C[a] (mg/kg)	GW Protection[a] (mg/kg)	Terrestrial Biota Protection[f] (mg/kg)		Water Low Conc. (mg/L)	Water High Conc. (mg/L)	Soil-Other Low Conc. (mg/kg)	Soil-Other High Conc. (mg/kg)				
Chromium (total)	7440-47-3	Unlimited	2,000	42	Metals – 6010 – ICP	0.01	0.01	1	2	g	g	g	g
					Metals – 6010 – ICP (trace)	0.01	N/A	1	N/A	g	g	g	g
Chromium VI	18540-29-9	21[j]	7.7[k]	42	Chromium (hex) – 7196 – colorimetric	0.01	4	0.5	200	g	g	g	g
Copper	7440-50-8	130,000	22[h]	50	Metals – 6010 – ICP	0.025	0.025	2.5	2.5	g	g	g	g
Lead	7439-92-1	1,000[l]	840[k]	50	Metals – 6010 – ICP	0.1	0.2	10	20	g	g	g	g
					Metals – 6010 – ICP(trace)	0.01	N/A	1	N/A	g	g	g	g
Mercury	7439-97-6	1,050	0.33[h]	0.33[h]	Mercury – 7470 – CVAA	0.0005	0.005	N/A	N/A	g	g	g	g
					Mercury – 7471 – CVAA	N/A	N/A	0.2	0.2	g	g	g	g
Nickel	7440-02-0	70,000[m]	130.4	30	Metals – 6010 – ICP	0.04	0.04	4	4	g	g	g	g
Selenium	7782-49-2	17,500	1[k]	0.78[h]	Metals – 6010 – ICP	0.1	0.2	10	20	g	g	g	g
Silver	7440-22-4	17,500	9.4[k]	2	Metals – 6010 – ICP	0.02	0.02	2	2	g	g	g	g
					Metals – 6010 – ICP (trace)	0.005	N/A	0.5	N/A	g	g	g	g
Uranium (total)	7440-61-1	10,500[m]	115	5	Uranium total – kinetic phosphorescence analysis	0.0001	0.02	1	0.2	±20%	80-120%	±35%	65-135%
Inorganics													
Ammonia/ ammonium	7664-41-7	Unlimited	Unlimited	N/A	Ammonia – 350.N[n]	0.05	800	0.5	8,000	g	g	g	g
Chloride	16887-00-6	N/A	N/A	N/A	Anions – 300.0[n] – IC	0.2	5	2	5	g	g	g	g
Cyanide	57-12-5	70,000	0.80	N/A	Total cyanide – 9010 – colorimetric	0.005	0.005	0.5	0.5	g	g	g	g
Fluoride	16984-48-8	210,000	16	N/A	Anions – 300.0 – IC	0.5	5	5	5	g	g	g	g
Nitrate	14797-55-8	Unlimited	40	N/A	Anions – 300.0 – IC	0.25	10	2.5	40	g	g	g	g
Nitrite	14797-65-0	350,000	4	N/A	Anions – 300.0 – IC	0.25	15	2.5	20	g	g	g	g
Phosphate	14265-44-2	N/A	N/A	N/A	Anions – 300.0 – IC	0.5	15	5	40	g	g	g	g
Sulfate	14808-79-8	N/A	1,000	N/A	Anions – 300.0 – IC	0.5	15	5	40	g	g	g	g
Organics													
Acetone (2-propanone)	67-64-1	350,000	3.21	N/A	Volatile organics – 8260 – GCMS	0.02	0.02	0.02	0.02	g	g	g	g
Benzene	71-43-2	2,390	2.42	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	0.005	0.005	g	g	g	g

Table B-4b. Analytical Performance Requirements for Nonradionuclides – Shallow and Deep Zone Soils. (5 Pages)

COCs	CAS #	Preliminary Action Level[a]			Name/Analytical Technology[i]	Required Target Quantitation Limits[e]				Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340 Method C[d] (mg/kg)	GW Protection[g] (mg/kg)	Terrestrial Biota Protection[f] (mg/kg)		Water Low Conc. (mg/L)	Water High Conc. (mg/L)	Soil-Other Low Conc. (mg/kg)	Soil-Other High Conc. (mg/kg)				
Butanol; n-	71-36-3	350,000	6.62	N/A	GC organic – 8015	5	5	5	5	[g]	[g]	[g]	[g]
Butyl benzene; n	104-51-8	N/A	N/A	N/A	Volatile organics – 8260 – GCMS	0.005	N/A	0.005	N/A	N/A	N/A	N/A	N/A
Carbon tetrachloride	56-23-5	1,010	0.0031	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	0.005	0.005	[g]	[g]	[g]	[g]
Chlorobenzene	108-90-7	70,000	1.4	40	Volatile organics – 8260 – GCMS	0.005	0.005	0.005	0.005	[g]	[g]	[g]	[g]
Chloroform	67-66-3	21,500	0.0382	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	0.005	0.005	[g]	[g]	[g]	[g]
Dichloroethane; 1,1	75-34-3	350,000	4.37	N/A	Volatile organics – 8260 – GCMS	0.01	0.01	0.01	0.01	[g]	[g]	[g]	[g]
Dichloroethane; 1,2	107-06-2	1,440	0.00232	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	0.005	0.005	[g]	[g]	[g]	[g]
Dichloroethylene; 1,2- (mixed isomers)	540-59-0	31,500	0.4	N/A	Volatile organics – 8260 – GCMS	0.01	0.01	0.01	0.01	[g]	[g]	[g]	[g]
Ethylene glycol	107-21-1	Unlimited	N/A	N/A	GC organic 8015	5	5	5	5	[g]	[g]	[g]	[g]
Ethylbenzene	100-41-4	350,000	6.91	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	0.005	0.005	[g]	[g]	[g]	[g]
Methyl ethyl ketone (MEK; 2-butanone)	78-93-3	Unlimited	N/A	N/A	Volatile organics – 8260 – GCMS	0.01	0.01	0.01	0.01	[g]	[g]	[g]	[g]
Methyl isobutyl ketone (MIBK hexone)	108-10-1	280,000	N/A	N/A	Volatile organics – 8260 – GCMS	0.01	0.01	0.01	0.01	[g]	[g]	[g]	[g]
Methylene chloride (dichloromethane)	75-09-2	17,500	0.0254	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	0.005	0.005	[g]	[g]	[g]	[g]
Phenol	108-95-2	Unlimited	43.9	30	Semivolatiles – 8270 – GCMS	0.01	0.1	0.33	3.3	[g]	[g]	[g]	[g]
Polychlorinated biphenyls	1336-36-3	10[1]	0.21	0.65	PCBs – 8082 – GC	0.0005	0.005	0.0165	0.1	[g]	[g]	[g]	[g]
Tetrachloroethylene	127-18-4	2,570	0.0091	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	0.005	0.005	[g]	[g]	[g]	[g]
Toluene	108-88-3	70,000	11.6	200	Volatile organics – 8260 – GCMS	0.005	0.005	0.005	0.005	[g]	[g]	[g]	[g]
Tributyl phosphate	126-73-8	N/A	N/A	N/A	Semivolatiles – 8270 – GCMS	0.1	0.5	3.3	5	[g]	[g]	[g]	[g]

Table B-4b. Analytical Performance Requirements for Nonradionuclides – Shallow and Deep Zone Soils. (5 Pages)

COCs	CAS #	Preliminary Action Level[a]			Name/Analytical Technology[i]	Required Target Quantitation Limits[c]				Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340 Method C[d] (mg/kg)	GW Protection[e] (mg/kg)	Terrestrial Biota Protection[f] (mg/kg)		Water Low Conc. (mg/L)	Water High Conc. (mg/L)	Soil-Other Low Conc. (mg/kg)	Soil-Other High Conc. (mg/kg)				
Trichlorethane; 1,1,1	71-55-6	Unlimited	57	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	0.005	0.005	[g]	[g]	[g]	[g]
Trichloroethylene	79-01-6	11,900	0.0263	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	0.005	0.005	[g]	[g]	[g]	[g]
Xylene (total)	1330-20-7	Unlimited	135	N/A	Volatile organics – 8260 – GCMS	0.005	0.005	0.005	0.005	[g]	[g]	[g]	[g]
Total petroleum hydrocarbons – diesel to oil range (kerosene and normal paraffin hydrocarbons)	68334-30-5 and 8008-20-6	2,000[l]	2,000[l]	200	WTPH-D	0.5	0.5	5	5	[g]	[g]	[g]	[g]
Total petroleum hydrocarbons – gasoline range	8006-61-9	30[l]	30[l]	100	WTPH-G	0.5	0.5	5	5	[g]	[g]	[g]	[g]
Hydraulic fluids (grease; heavy oils)	8008-20-6	2,000[l]	2,000[l]	N/A	Oil and grease (total recoverable) – 413.N[n]	2	N/A	200	N/A	[g]	[g]	[g]	[g]
Field Screening Measurements													
pH	N/A	N/A	N/A	N/A	TBD	TBD		TBD		TBD	TBD	TBD	TBD
Soil Physical Properties													
Bulk density	N/A	N/A	N/A	N/A	ASTM D2937, or CP-GPP-EE-05-3.9	N/A		wt%		N/A	N/A	N/A	N/A
Lithology	N/A	N/A	N/A	N/A	CP-GPP-EE-01-7.0	N/A		Descriptive		N/A	N/A	N/A	N/A
Moisture content	N/A	N/A	N/A	N/A	ASTM D2216	N/A		wt%		N/A	N/A	N/A	N/A
Particle size distribution	N/A	N/A	N/A	N/A	ASTM D422	N/A		wt%		N/A	N/A	N/A	N/A

Table B-4b. Analytical Performance Requirements for Nonradionuclides – Shallow and Deep Zone Soils. (5 Pages)

COCs	CAS #	Preliminary Action Level[a]			Name/Analytical Technology[i]	Required Target Quantitation Limits[c]				Precision Water	Accuracy Water	Precision Soil	Accuracy Soil
		WAC 173-340 Method C[d] (mg/kg)	GW Protection[e] (mg/kg)	Terrestrial Biota Protection[f] (mg/kg)		Water Low Conc. (mg/L)	Water High Conc. (mg/L)	Soil-Other Low Conc. (mg/kg)	Soil-Other High Conc. (mg/kg)				

[a] The preliminary action level is the regulatory or risk-based value used to determine appropriate analytical requirements (e.g., detection limits). Remedial action levels will be proposed in the feasibility study, will be finalized in the record of decision, and will drive remediation of the sites.

[b] 15 mrem/yr = nonradiological worker industrial exposure scenario; 2,000 h/yr onsite, 60 percent indoors, 40 percent outdoors. 500 mrem/yr = radiological worker industrial scenario; 2,000 h/yr onsite, 60 percent indoors, 40 percent outdoors. GW = groundwater protection radionuclide values based on RESRAD (ANL 2002, , *RESRAD for Windows*, Version 6.21) modeling of drinking water exposure with the entire vadose zone presumed to be contaminated.

[c] Water values for sampling quality control (e.g., equipment blanks/rinses) or drainable liquid (if recovered). For both water and soil mediums, matrix effects may impact on specific sample basis.

[d] WAC 173-340, "Model Toxics Control Act - Cleanup," Method C industrial soil values for direct exposure from the CLARC Version 3.1 tables, updated November 2001 (Ecology Publication No. 94-145, *Model Toxics Control Act Cleanup Levels & Risk Calculations (CLARC) Version 3.1*).

[e] Calculated using WAC 173-340 Method B drinking water standards as inputs to the WAC 173-340 three-phase model for protection of drinking water (WAC 173-340-747[4], "Deriving Soil Concentrations for Ground Water Protection," "Overview of Methods," "Fixed Parameter Three-Phase Partitioning Model," amended February 12, 2001), except as noted.

[f] Value is the lowest concentration for each analyte (adjusted for background) from Tables 749-2 and 749-3 of WAC 173-340-900, "Tables," amended February 12, 2001.

[g] Precision and accuracy requirements as identified and defined in the referenced U.S. Environmental Protection Agency procedures implemented by laboratory analysis and quality assurance procedures.

[h] Cleanup value is less than Hanford Site soil background. Therefore, the soil background concentration is used as the preliminary action level.

[i] All four-digit numbers refer to SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*. Laboratories may propose alternate methodology if specified performance requirements can be met/exceeded with acceptance from the project prior to analysis.

[j] Calculated using air cleanup standards from WAC 173-340-750(3)(a)(ii)(B) ("Cleanup Standards to Protect Air Quality,"), page 210, equation 750-2, with Washington State Department of Health mass loading of particulates in air of 10^{-4} g/m^3.

[k] Calculated using standards for surface water protection (40 CFR 131, "Water Quality Standards," and WAC 173-201A-040, "Water Quality Standards for Surface Waters of the State of Washington," "Toxic Substances") as inputs to the three-phase model for protection of drinking water (WAC 173-340-747[4], February 12, 2001).

[l] Based on Method A values from Tables 740-1 and 745-1 of WAC 173-340-900, amended February 12, 2001.

[m] Value based upon nickel or uranium soluble salts value.

[n] From EPA/600/4-79/020, *Methods of Analysis of Water and Waste*.

ASTM D422, *Standard Test Method for Particle-Size Analysis of Soils.*

ASTM D2216, *Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.*

ASTM D2937, *Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.*

GRP-EE-01-7.0 (CP-GPP-EE-01-7.0), *Geologic Logging*

GRP-EE-05-3.9 (CP-GPP-EE-05-3.9), *Determination of Soil Bulk Density Using a Split-Spoon Sampler.*

AEA = alpha energy analysis.
CVAA = cold vapor atomic absorption..
GC = gas chromatograph.
GCMS = gas chromatograph/mass spectrometry.
GEA = gamma energy analysis.
GPC = gas proportional counter.
GW = groundwater.
IC = ion chromatography.
ICPMS = inductively coupled plasma mass spectrometer.
N/A = not applicable.
RESRAD = RESidual RADioactivity dose model.
TBD = to be determined.
TOC = total organic carbon.
WTPH-D = Washington Total Petroleum Hydrocarbon-Diesel.
WTPH-G = Washington Total Petroleum Hydrocarbon-Kerosene.

Table B-5. Sample Preservation, Container, and Holding Time Guidelines. (2 Pages)

Analytes/ References	Analytical Priority	Matrix	Bottle		Amount[a,b,c] (g)	Preservation	Packing Requirements	Holding Time
			Number	Type				
Radionuclides								
Americium-241	10	Soil	1	G/P	10-1000	None	None	6 months
Carbon-14	7	Soil	1	G/P	10-1000	None	None	6 months
Cesium-137	1	Soil	1	G/P	100-1500	None	None	6 months
Cobalt-60	1	Soil						
Europium-152	1	Soil						
Europium-154	1	Soil						
Europium-155	1	Soil						
Radium-226	1	Soil						
Radium-228	1	Soil						
Iodine-129		Soil	1	G/P	10-1000	None	None	6 months
Tritium – H3	15	Soil	1	G	100-500	None	None	6 months
Neptunium-237	6	Soil	1	G/P	10-1000	None	None	6 months
Nickel-63	6	Soil	1	G/P	10-1000	None	None	6 months
Plutonium-238	1	Soil	1	G/P	10-1000	None	None	6 months
Plutonium-239/240	1	Soil						
Strontium-90	1	Soil	1	G/P	10-1000	None	None	6 months
Technetium-99	6	Soil	1	G/P	10-1000	None	None	6 months
Thorium-232	5	Soil	1	G/P	10-1000	None	None	6 months
Uranium-233/234	1	Soil	1	G/P	10-1000	None	None	6 months
Uranium-235/236	1	Soil						
Uranium-238	1	Soil						
Uranium (total) kinetic phosphorescence analysis	1	Soil	1	G/P	6	None	None	6 months
Chemicals								
Ammonia/ ammonium – 350.N	11	Soil	1	G/P	50-500	None	Cool 4°C	28 days
IC anions – 300.0	3	Soil	1	G/P	50-500	None	None	28 days/ 48 hours
Anions – 353.1 for nitrate/nitrite	3	Soil	1	G/P	-250	None	None	28 days
ICP metals – 6010A	2	Soil	1	G/P	10-500	None	None	6 months
Chromium hex – 7196	4	Soil	1	G/P	5-500	None	Cool 4°C	30 days
Mercury – 7471 – (CVAA)	2	Soil	1	G	5-125	None	None	28 days
Total cyanide – 9010	13	Soil	1	G	10-1000	None	Cool 4°C	14 days
pH (soil) – 9045	14	Soil	1	G/P	10-250	None	None	ASAP
pH (soil) – field measurement	14	Soil	N/A	N/A	N/A	N/A	N/A	N/A
SVOA – 8270A	8	Soil	1	aG	125-1000	None	Cool 4°C	14/40 days

Table B-5. Sample Preservation, Container, and Holding Time Guidelines. (2 Pages)

Analytes/ References	Analytical Priority	Matrix	Bottle		Amount[a,b,c] (g)	Preservation	Packing Requirements	Holding Time
			Number	Type				
Total organic carbon - 9060	9	Soil	1	G	125-250	None	Cool 4°C	14 days
VOA - 8260	19	Soil	1	G	10-50	None	Cool 4°C	14 days
Nonhalogenated VOA – 8015M	8	Soil	1	G	10-50	None	Cool 4°C	14 days
Nonhalogenated VOA – 8015M-GC modified for hydrocarbon (normal paraffin hydrocarbon)	8	Soil	1	G	125-250	None	Cool 4°C	14 days
WTPH - Diesel	9	Soil	1	G	50-150	None	Cool 4°C	14 days
WTPH - Gasoline	9	Soil	1	G	50-150	None	Cool 4°C	14 days
Oil and grease	9	Soil	1	G	200	None	Cool 4°C	28 days
Polychlorinated biphenyls – 8082	13	Soil	1	G	10-50	None	Cool 4°C	14 days
Physical Properties								
Bulk density – ASTM D2937	16	Soil	1	Liner	Liner	None	None	None established for analysis
Moisture content – ASTM D2216	17	Soil	1	Moisture tin[d]	250	None	None	None established for analysis
Particle size distribution – ASTM D422	18	Soil	1	G/P	100-4000	None	None	None established for analysis

[a]Optimal volumes, which may be adjusted downward to accommodate the possibility of retrieval of small amount of sample. Minimum sample size will be defined in the Sampling Authorization Form.

[b]Should samples be liquid rather than soils, the following volumes need to be collected:

Radionuclides – 4 L for all radionuclides (except carbon-14, tritium, and technetium-99; they require approximately 500 mL each sample).
Chemicals – All liquid samples require the amount as listed for soil samples. Preservation, holding times, specific bottle types, and specific method references also may be affected if liquid samples are collected. Consult Fluor Hanford Sample Management staff for details.

[c]Mixed soil samples may be obtained and submitted to the analytical laboratory for analyses for specific analytes, including the following:

Radionuclides – 100 g of soil for all radionuclides (except carbon-14, tritium, and technetium-99; they require approximately 10 g each sample).
Chemicals – A 10-g soil sample is required for all ICP analysis, 10-g soil sample is required for IC anion analysis, 5-g soil sample for hexavalent chromium analysis, 10-g soil sample for CA analysis, 10-g soil sample for 8015 analysis, and 125-g soil samples for each 8270 and total organic carbon analysis.

[d]Note: Vessel must be sealed.

ASTM D422, *Standard Test Method for Particle-Size Analysis of Soils.*

ASTM D2216, *Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass.*

ASTM D2937, *Standard Test Method for Density of Soil in Place by the Drive-Cylinder Method.*

All four-digit method numbers refer to SW-846, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.* For EPA Methods 300.0, 350.N, and 353.1, see EPA/600/4-79/020, *Methods of Analysis of Water and Waste.*

aG = amber glass.
ASAP = as soon as possible.
CVAA = cold vapor atomic absorption.
G = glass.
GC = gas chromatograph.
IC = ion chromatography.
ICP = inductively coupled plasma.
N/A = not applicable
P = plastic.
SVOA = semivolatile organic analyte.
TBD = to be determined.
TOC = total organic carbon.
VOA = volatile organic analyte.
WTPH = Washington Total Petroleum Hydrocarbon.

B3.0 FIELD SAMPLING PLAN

B3.1 SAMPLING OBJECTIVES

The primary objective of the field sampling plan is to identify and describe sampling and analysis activities that will be conducted to resolve decision rules identified in Step 5 of the DQO process (see Section B1.2.2). Decision rule statements indicate that remedial action may be necessary if preliminary action levels and annual exposure protection limits are exceeded. The field sampling plan uses the sampling design proposed in Step 7 of the DQO process and describes pertinent elements of the sampling program. Sample methods, procedures, locations, frequencies, parameters of interest, and bottle requirements are identified in this section.

A borehole will be drilled through each of the representative sites identified in the DQO as needing additional data to support the RI/FS or TSD closure processes: the 216-A-19 Trench, the 216-B-12 Crib, the 216-A-10 Crib, the 216-A-36B Crib, and the 216-A-37-1 Crib. The boreholes will be drilled to the top of groundwater, and soil samples will be collected through the vadose zone for laboratory analysis. Physical property samples will be collected at major lithologic changes and as determined by the site geologist. The boreholes will be geophysically logged for gamma-emitting radionuclides and neutron moisture content. A spilt-spoon sampler will be the primary sampling device used to collect the samples from the boreholes. At the 207-A South Retention Basin, up to four shallow borings will be drilled to a depth of 6 m (20 ft) below ground surface (bgs) to collect soil samples for laboratory analysis. The locations of planned and existing boreholes are shown in Figures B-1 through B-4.

B3.2 FIELD MEASUREMENTS

B3.2.1 Surface Radiation Survey

A surface radiation survey will be performed at each waste site to be investigated, to document existing surface contamination and to support preparation of supporting health and safety documentation. Surface radiation surveys will be conducted by qualified radiological control technicians in accordance with applicable health and safety procedures. A survey report will be prepared for each site. Surveys will be performed according to HNF-IP-1277, Procedure RCP 5.6.15. A postsampling survey also will be performed at each sampling site to ensure that sampling activities have not contributed to surface contamination.

B3.2.2 Soil Screening

All samples and cuttings from boreholes will be field screened by the radiological control technician or other qualified personnel for evidence of radioactive contamination. Surveys of these materials will be conducted visually and with field instruments. Potential screening instruments are listed in Table B-6 with their respective detection limits. The radiological

control technician will record all field measurements, noting the depth of the sample and the instrument reading.

Before drilling begins, a local area background reading will be taken with the field screening instruments at a background site to be selected in the field. Field screening will be used to identify the bottom of the waste site (i.e., crib/trench) and adjust sampling points, assist in determining sample shipping requirements, and support worker health and safety monitoring. The site geologists will use professional judgment, screening data, and the information provided in Tables B-7 through B-12 to finalize sampling decisions.

The field action level for radionuclide screening is twice background. Intervals above this field action level will be assessed for sampling by the field geologist. Samples exceeding 0.5 mrem/h will be stored at a temporary radioactive material storage area, separated from other samples, until shipment to the laboratory.

Additional field screening for volatile organics will be performed by the health and safety technician using a photoionization detector or other methods, if required by the site-specific health and safety plan. At the 207-A South Retention Basin and the 216-A-37-1 Crib, monitoring for volatile organics will be conducted during drilling to support possible soil gas vapor sampling. Field screening instruments will be used, maintained, and calibrated in accordance with the manufacturer's specifications and approved procedures such as those found in GRP-EE-05-1.0 (CP-GPP-EE-05-1.0). The field geologist will record field screening results on the borehole log.

B3.3 SOIL SAMPLING AND ANALYSIS

The following sections discuss the details of sampling soil from boreholes.

B3.3.1 Borehole Sampling and Analysis

Nonradiological and radiological samples will be collected from four deep boreholes. Borehole C3245 will be drilled in the 216-A-19 Trench. Borehole C3246 will be drilled in the 216-B-12 Crib. Borehole C3247 will be drilled in the 216-A-10 Crib after the six drive casings (C4107 through C4112) are installed. Borehole C3248 will be drilled in the 216-A-36B Crib. Borehole C4106 will be drilled in the 216-A-37-1 Crib. Up to four borings (C4113 through C4116) will be installed at the 207-A South Retention Basin. Borehole sample collection will be guided by the sampling approaches outlined in Tables B-7 through B-12. Actual sampling intervals may vary from these approaches, depending on the thickness of clean soil cover or stabilization fill placed over the cribs and trench, field screening results, and varying subsurface conditions. The intent of the sampling design is to begin sample collection at approximately 4.6 m (15 ft) bgs. This is followed by samples beginning at the base of the crib or trench where the highest levels of contamination are expected. Samples from 4.6 m (15 ft) are critical for evaluation of direct exposure scenarios, whereas a sample from 7.6 m (25 ft) is considered desirable for remedial alternative evaluation. Samples from depths greater than the base of the waste site will be used to verify the conceptual contaminant distribution model and to evaluate remedial action alternatives and groundwater impacts.

From the base of the crib or trench, samples will be collected with greater frequency while contamination is at the highest concentrations. As depth increases, the level of contamination is expected to decrease and the frequency of sampling also will decrease. Samples will be taken at the transitions from high to medium to low contamination zones as guided by the site's conceptual contamination distribution model, results of nearby borehole logging events, and professional judgment of the field geologist. Samples also will be taken at major changes in lithology as noted by the field geologist. Drilling and sampling will stop when the water table is encountered. Figures B-5 through B-10 illustrate the anticipated sampling intervals in each of the boreholes to be drilled.

Sampling will be performed in accordance with GRP-EE-01-4.0 (CP-GPP-EE-01-4.0), using a split-spoon sampler. The split-spoon samplers will be equipped with four separate stainless steel (for chemical analyses) or LEXAN® liners (for physical property analyses). Site personnel will use caution not to overdrive the sampling device. With the exception of the co-located duplicate samples, soil will be transferred to a precleaned, stainless steel mixing bowl, homogenized, and then containerized in accordance with the sampling procedure. Radiological and nonradiological analytes of interest are presented in Tables B-4a and B-4b. If sample volume requirements cannot be met, samples will be collected according to the priority listed in Table B-5. Radiological and nonradiological samples always will take precedence over physical property samples.

Physical property samples will be collected from the boreholes to provide site-specific values to support the RESidual RADioactivity (RESRAD) dose model or other modeling efforts. Soil properties of interest are moisture content, grain-size distribution, and soil density. Samples for soil density generally shall be collected with a split-spoon sampler equipped with four separate LEXAN liners. Samples will be analyzed in accordance with the ASTM methods listed in Table B-5 (ASTM 1993) or in accordance with approved field procedures. The physical property samples will be collected from lithologies that represent the major facies in the vadose zone as identified in Tables B-7 through B-12. The samples will be collected coincident with nonradiological and radiological split-spoon sample intervals, where possible. Investigation-derived waste generated during this activity will be handled according to procedures in Section B2.7 and the waste control plans (CP-13934, CP-13935).

B3.3.2 Preshipment Sample Screening

A representative portion of each sample to be shipped to an offsite laboratory will be submitted to the Radiological Counting Facility, 222-S Laboratory, or other suitable onsite laboratory for total activity analysis before it is shipped. Total activities will be used for sample preshipment characterization. Samples that slightly exceed the offsite laboratory criterion discussed in Section B2.7.6 may be reduced in volume to allow offsite shipment. Onsite and offsite

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laboratories will be identified before field activities are initiated and will be mutually acceptable to the FH Sample and Data Management group and to the task lead.

B3.3.3 Summary of Sampling Activities

A summary of the number and types of samples to be collected at all six waste sites is presented in Table B-13.

B3.4 GEOPHYSICAL LOGGING

Planned boreholes and selected existing boreholes will be geophysically logged with a high-resolution spectral gamma-ray logging system to assess the vertical distribution and concentration of gamma-emitting radionuclides. Soil moisture also will be assessed using a neutron logging tool for all new boreholes only. These methods are described in Section 4.3 of the Work Plan. The new boreholes will be logged before the casing is telescoped and before decommissioning activities begin. The starting point for logging will be recorded; this is usually ground surface or top of casing. The site geologist will witness logging runs and will verify before and after field calibrations and repeat log intervals. The list of boreholes and wells that will be logged with the spectral gamma logging system is presented in Table B-14. These wells represent data collection points in the vicinity of the individual waste sites. Logging of these wells will provide additional updated, site-specific information on gamma contaminant distribution, both laterally and vertically, in the area of the waste sites.

The location of the area of highest potential contamination within the 216-A-10 Crib is uncertain because of the manner in which effluent was discharged to the crib. Therefore, locating the borehole for this site requires some preliminary geophysical logging activities to target the area of highest contamination. A series of up to six direct push (e.g., GeoProbe® or cone penetrometer) holes or drill casings will be installed and logged with a gamma detector. The location of the borehole will be identified based on the results of this logging. The depth of direct-push holes may be limited based on subsurface conditions (e.g., cobbles, gravel). The holes will be pushed to a maximum depth of approximately 27 m (90 ft) bgs (or approximately 14 m [45 ft] below crib bottom). 14 m (45 ft) below the crib is considered sufficient to locate the zone of highest contamination, which is expected to be above 27 m (90 ft) bgs as shown in the conceptual contaminant distribution model for this site (see Figure 3-15 of the Work Plan).

B3.5 SURVEYING

The location of all new boreholes will be surveyed after the sampling and decommissioning activities are completed. Surveys will be performed according to CP-GPP-EE-01-1.6. Data will

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be recorded in NAVD88, *North American Vertical Datum of 1988*, and in the Washington State Plane (South Zone) NAD83, *North American Datum of 1983*, with the 1991 adjustment for horizontal coordinates. All survey data will be recorded in meters and feet.

Figure B-1. Location of Planned and Existing Boreholes and Wells at the 216-A-19 Trench in the 200-PW-2 Operable Unit.

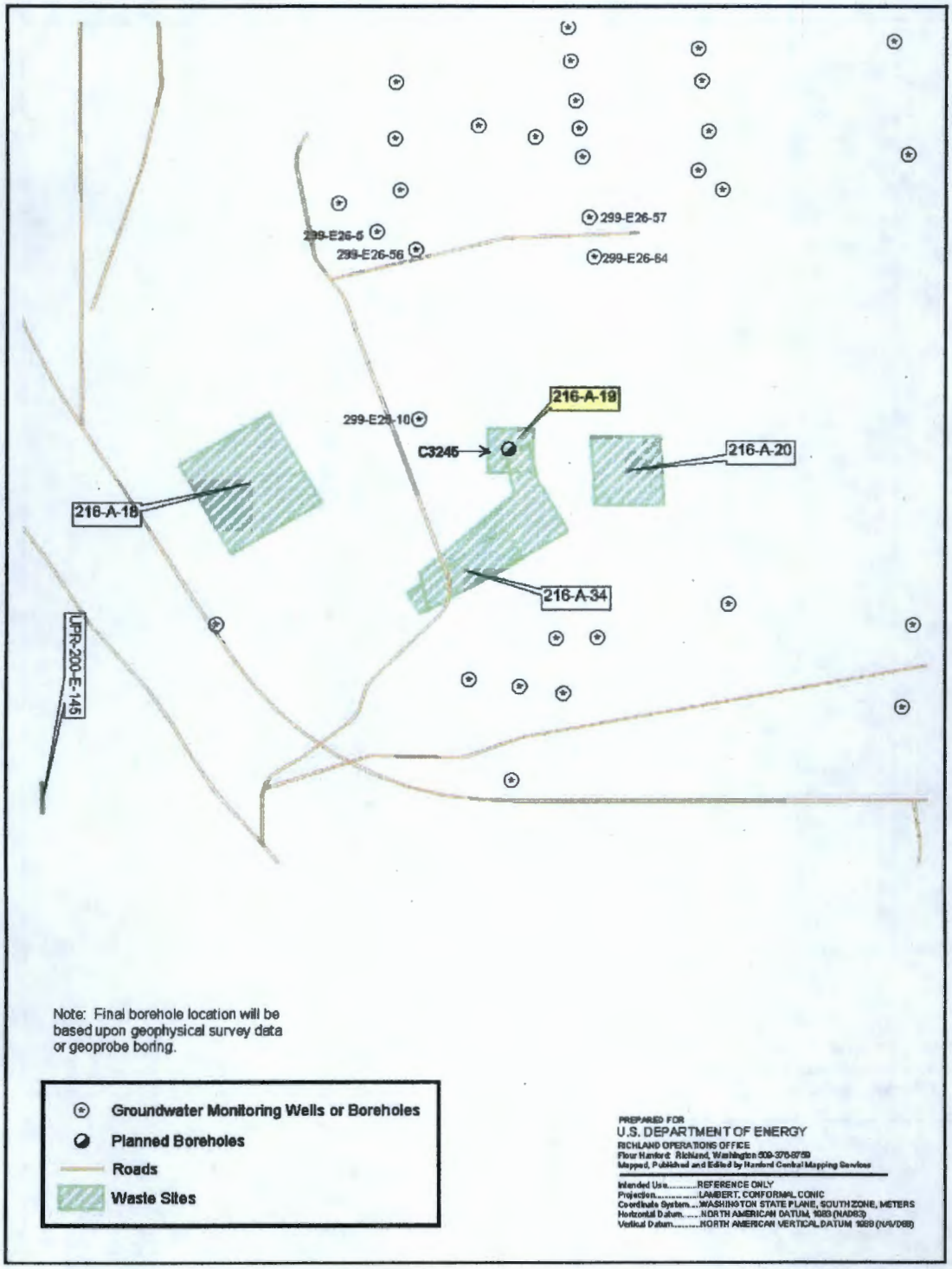

Figure B-2. Location of Planned and Existing Boreholes and Wells at the 216-B-12 Crib in the 200-PW-2 Operable Unit.

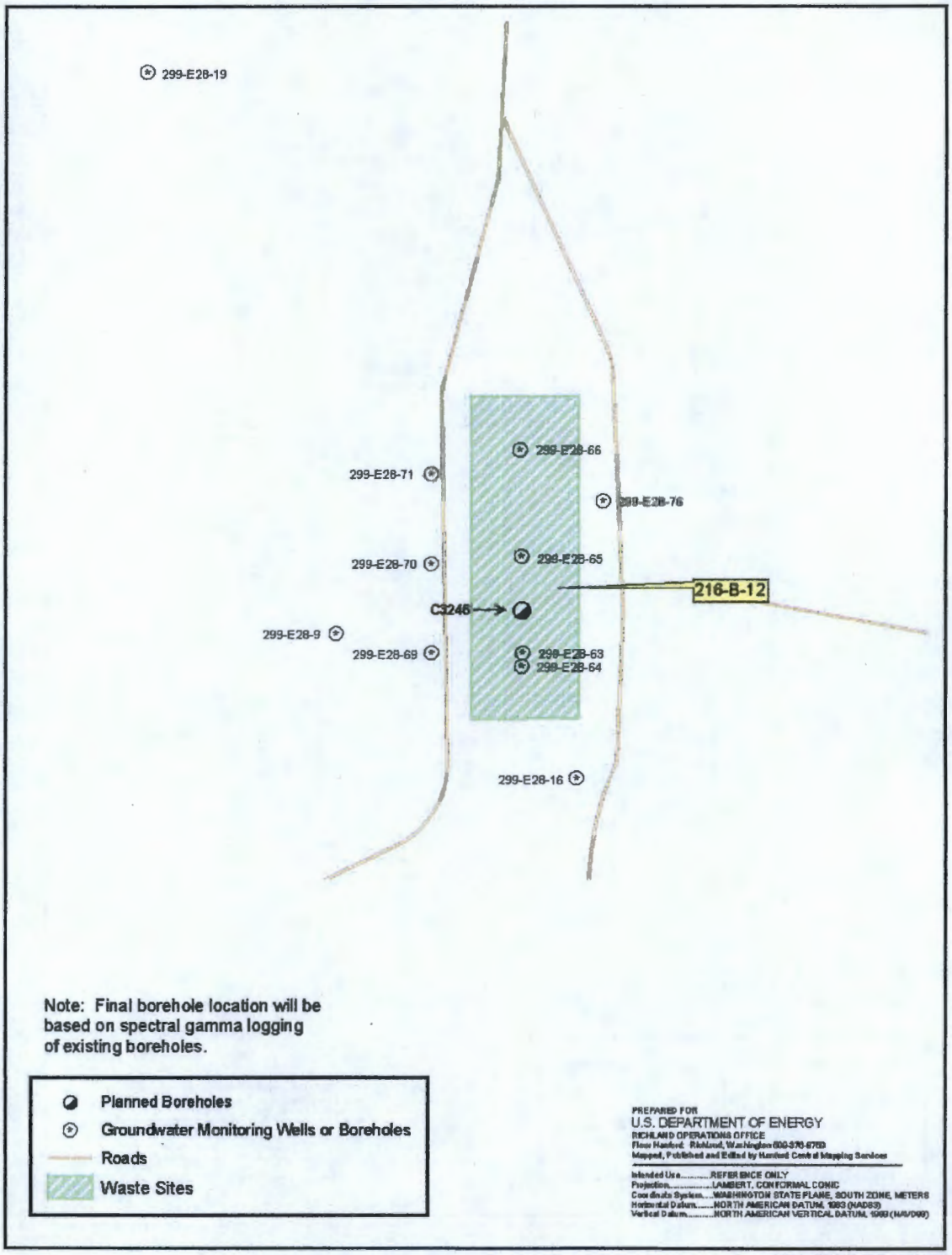

Figure B-3. Location of Planned and Existing Boreholes and Wells at the 216-A-10 Crib and 216-A-36B Crib in the 200-PW-2 Operable Unit.

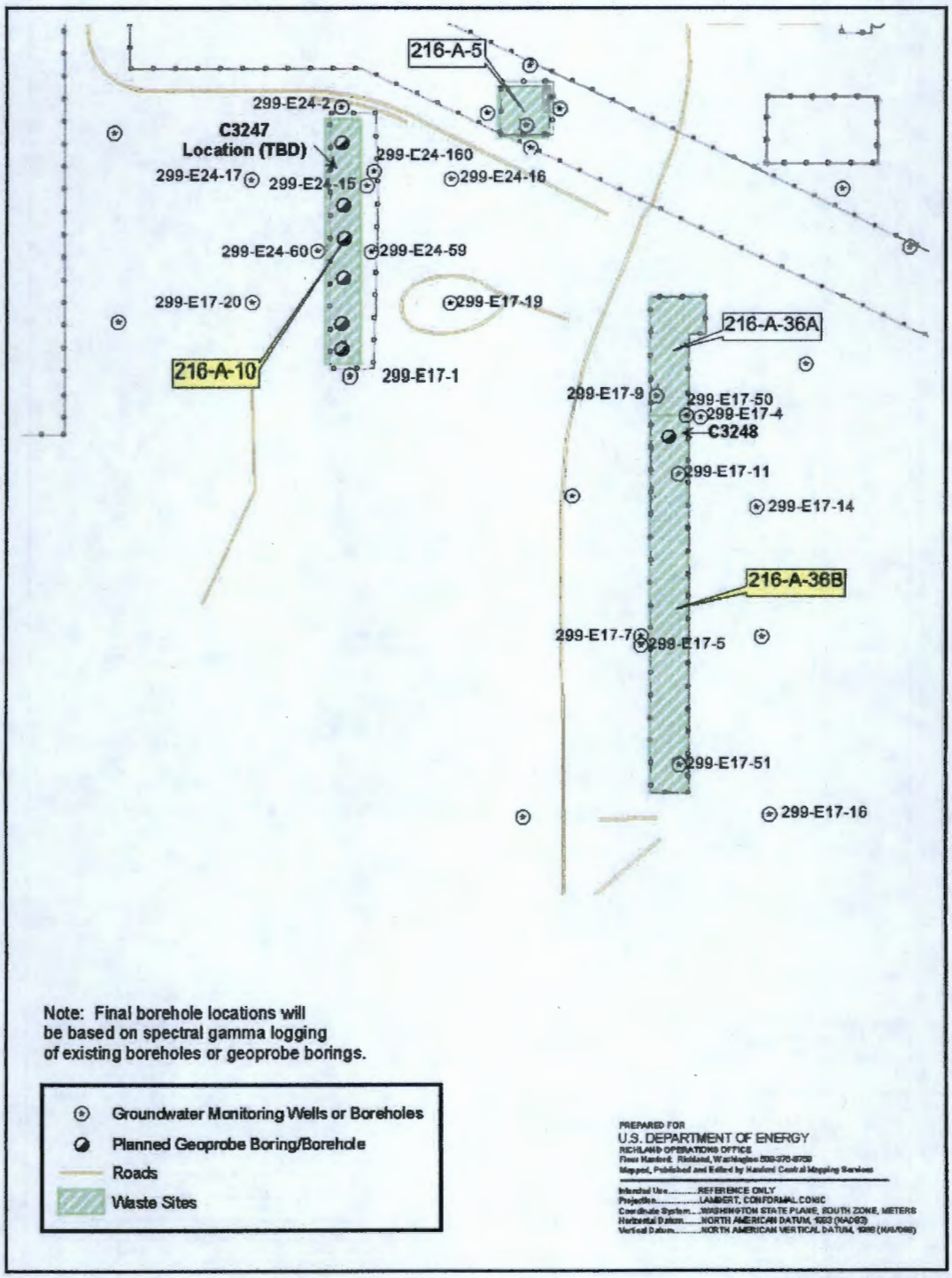

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Figure B-4. Location of Planned and Existing Boreholes and Wells at the 207-A South Retention Basin and 216-A-37-1 Crib in the 200-PW-4 Operable Unit.

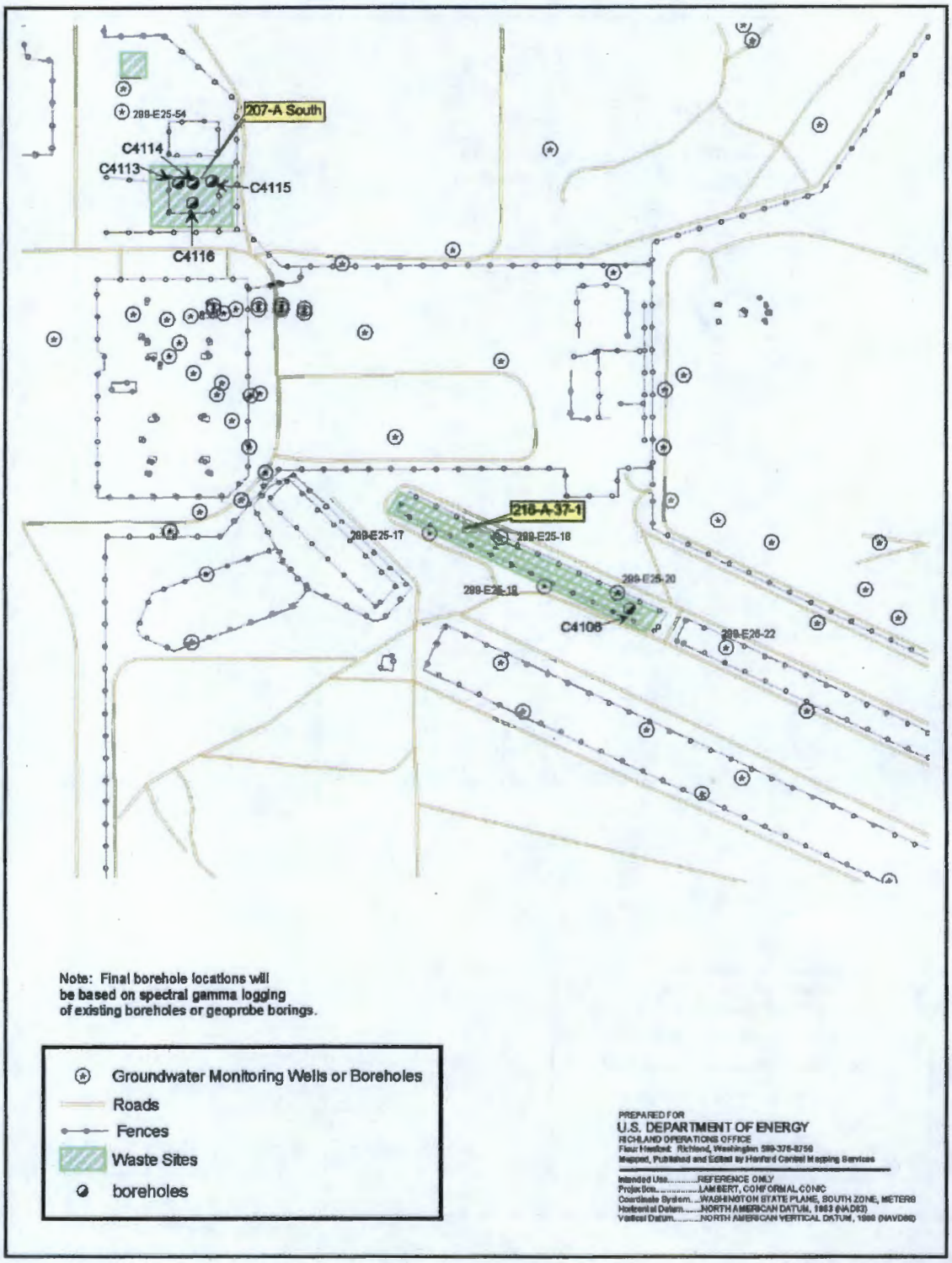

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Figure B-5. Approximate Sampling Intervals in the 216-A-19 Borehole.

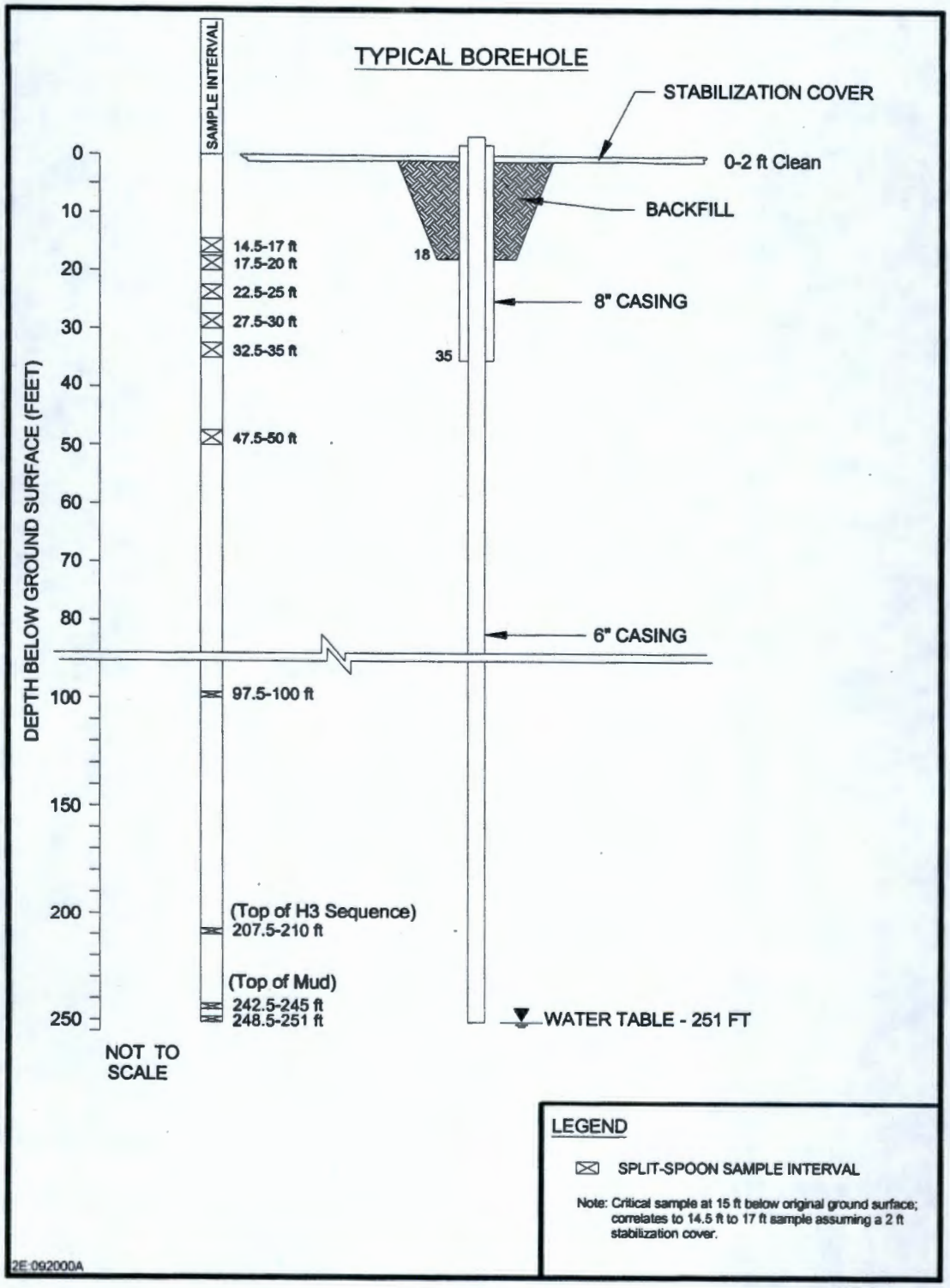

Figure B-6. Approximate Sampling Intervals in the 216-B-12 Borehole.

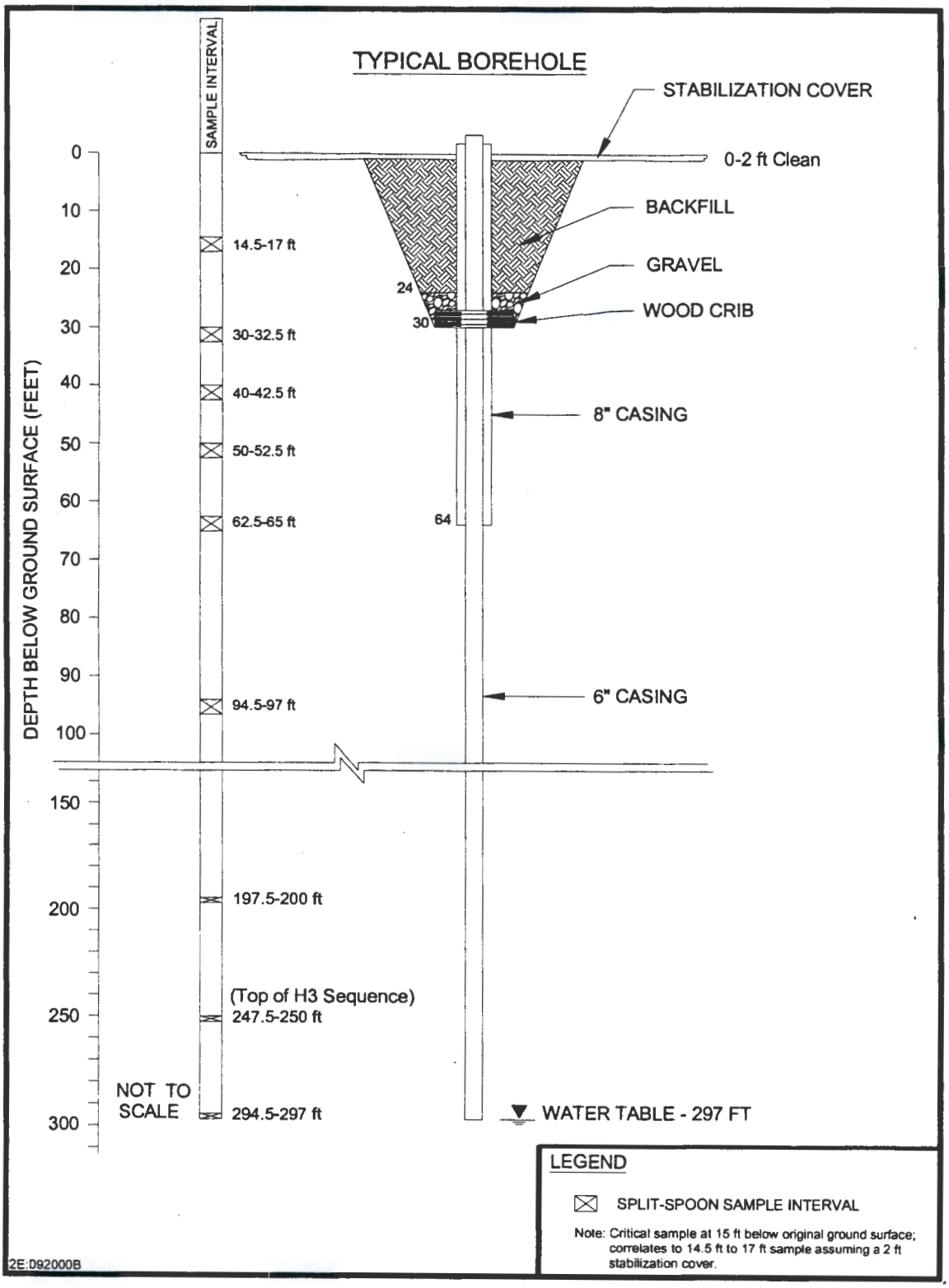

Figure B-7. Approximate Sampling Intervals for the 216-A-10 Borehole.

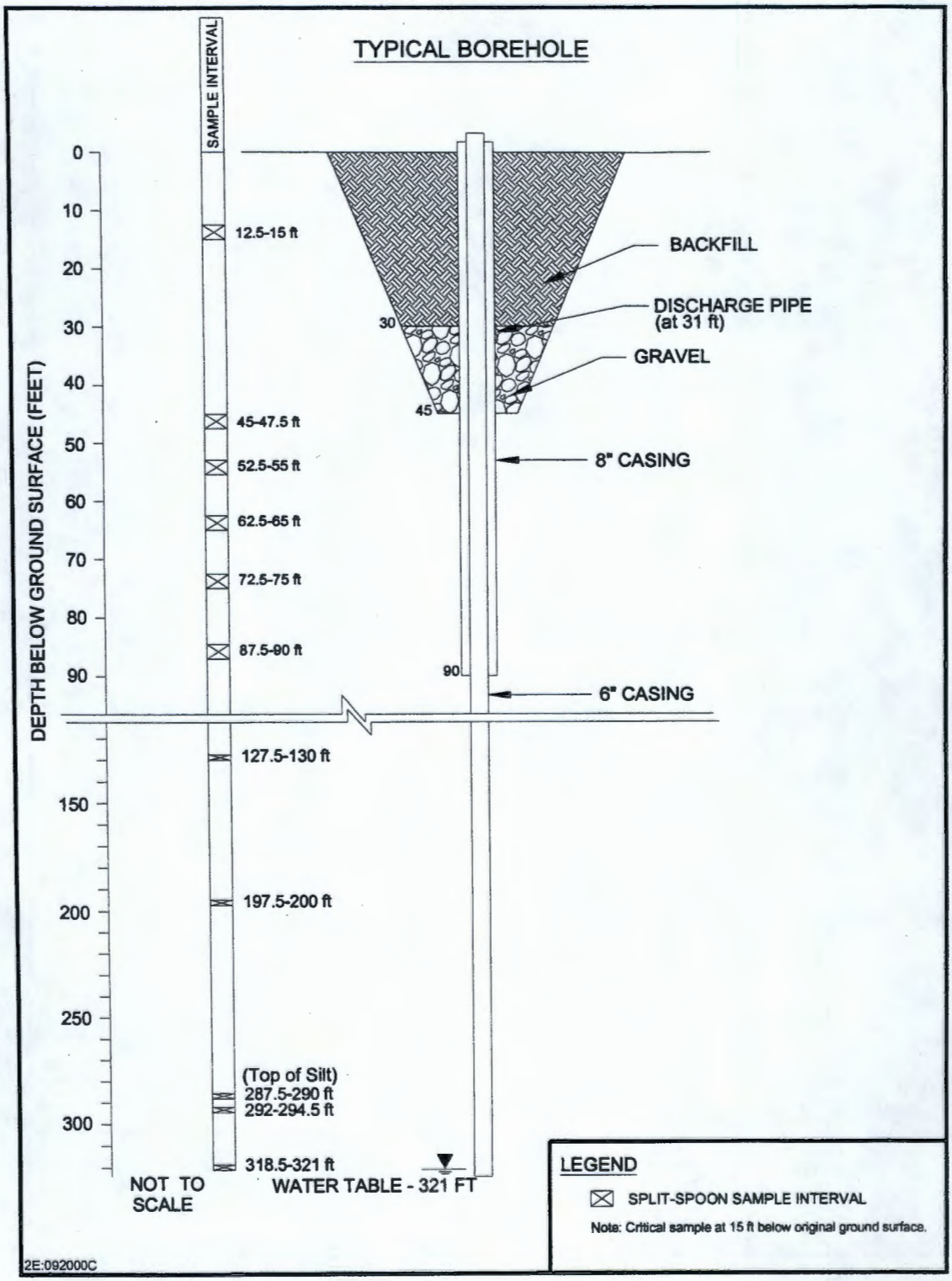

Figure B-8. Approximate Sampling Intervals for the 216-A-36B Borehole.

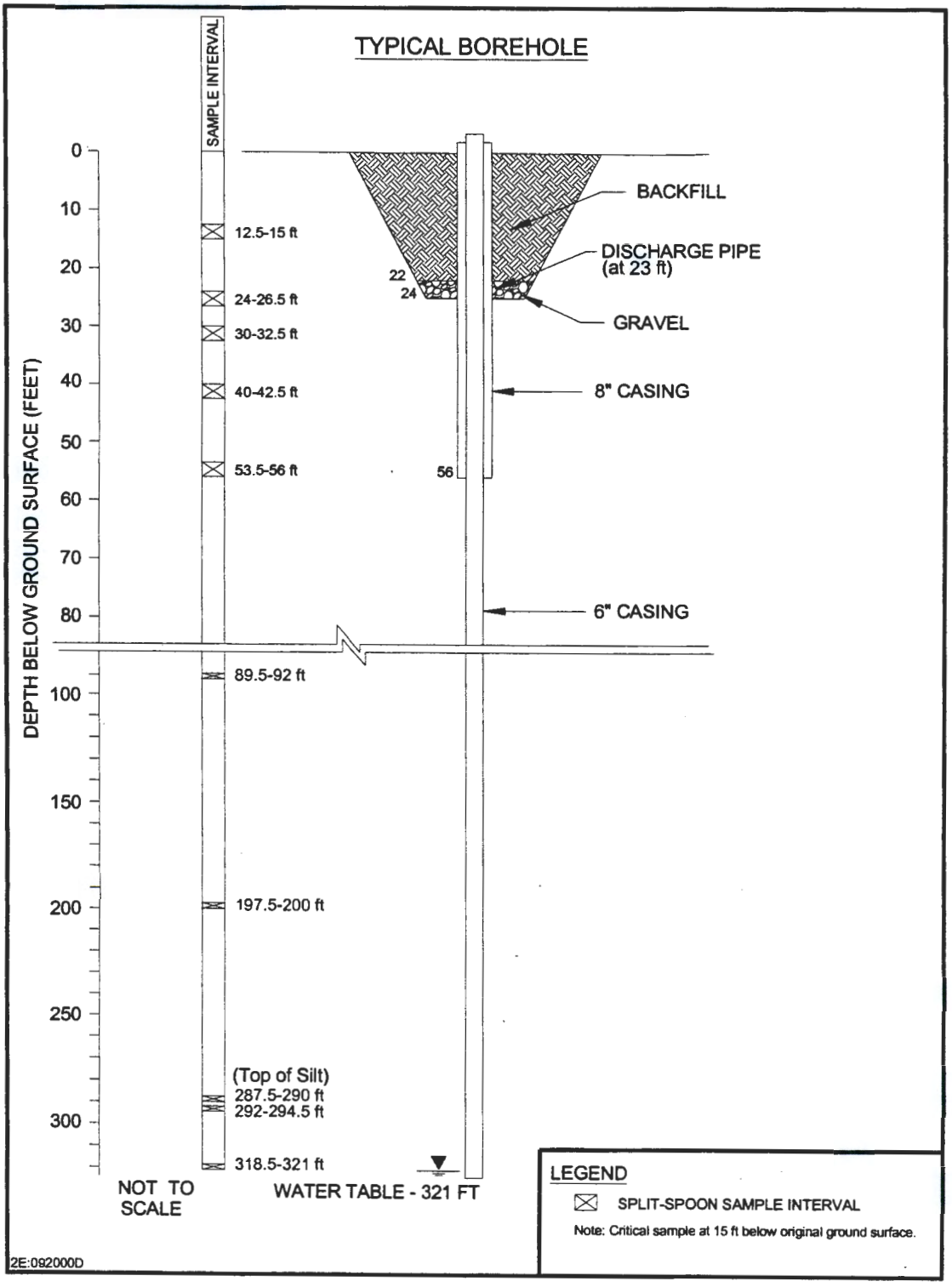

Figure B-9. Approximate Sampling Intervals for a Typical Borehole at the 207-A South Retention Basin.

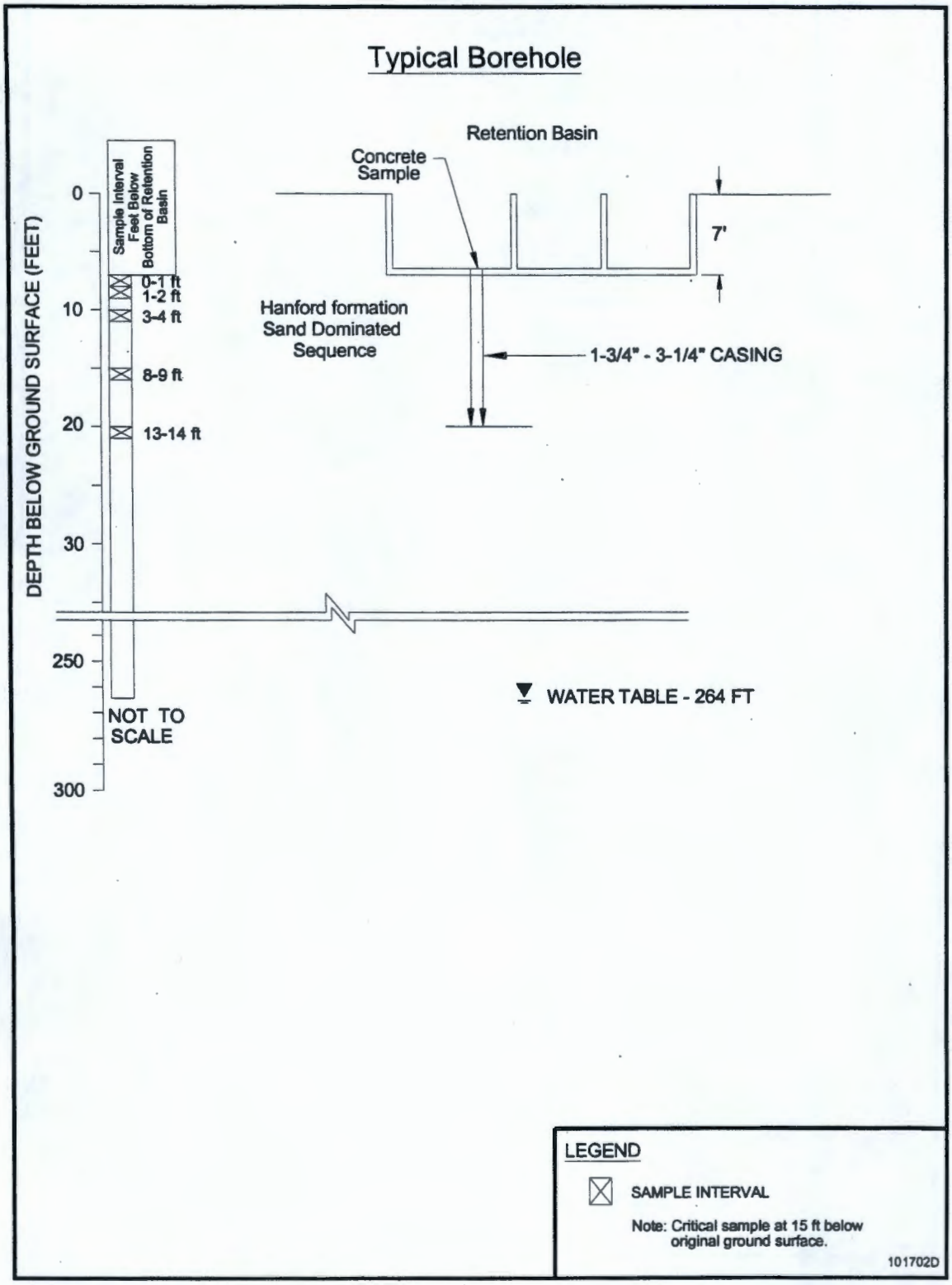

Figure B-10. Approximate Sampling Intervals for the 216-A-37-1 Borehole.

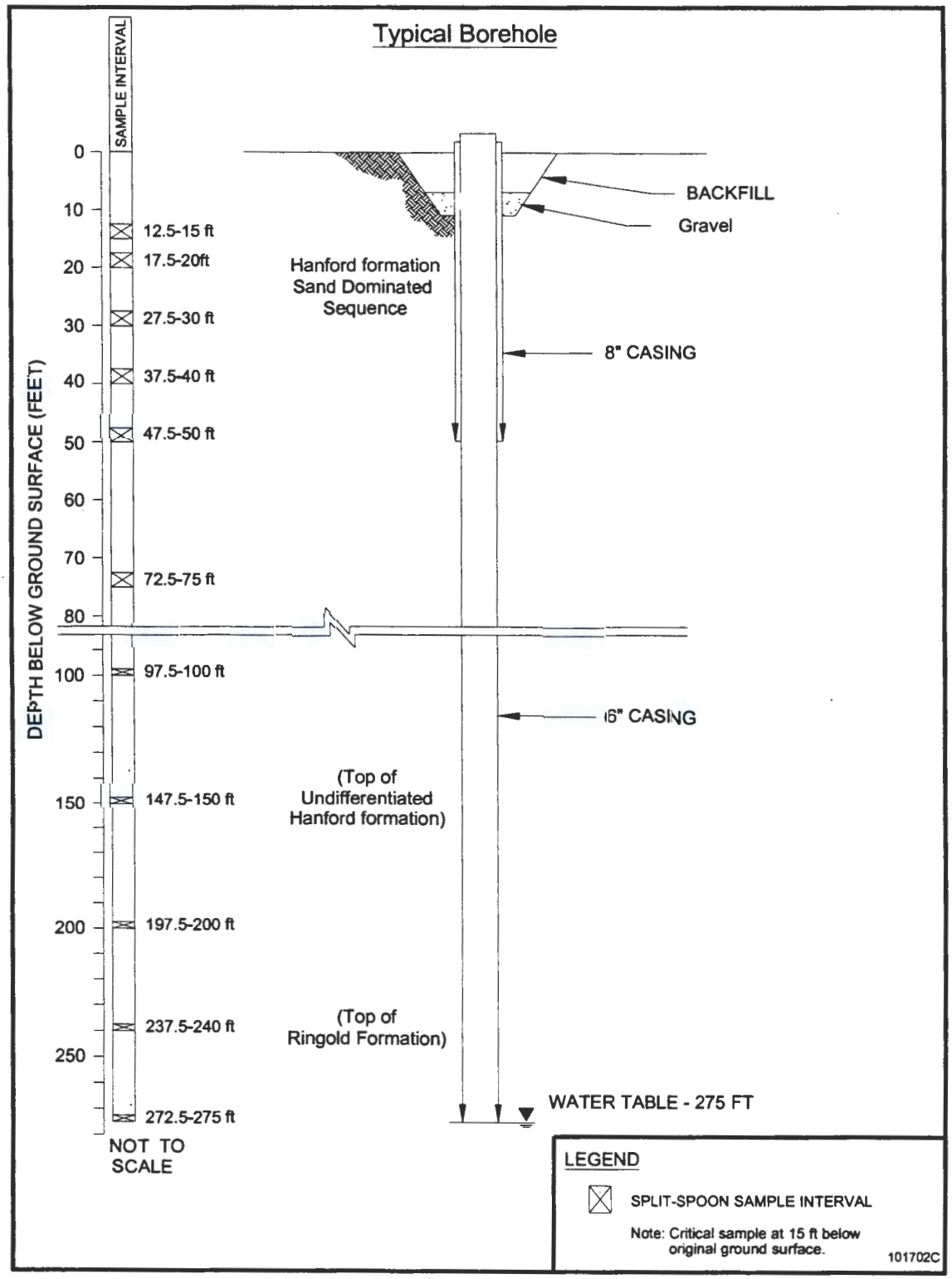

Table B-6. Field Screening Methods.

Measurement Type	Emission Type	Method/Instrument	Detection Limit
Exposure/dose rate	Beta/gamma	RO-20/RO-03 portable ionization chamber*	0.5 mrem/h
Contamination level	Alpha/beta-gamma	E-600 ratemeter with a SHP380-A/B scintillation probe*	100 d/min α 1,921 d/min β–γ

*RO-20/RO-03, Eberline E-600, and SHP380-A/B are trademarks of Eberline Instruments, a subsidiary of Thermo Electron Corporation, Waltham, Massachusetts

Table B-7. 216-A-19 Trench Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft) bgs[a]	Analyte List[b]	Physical Properties	
					Sample Interval	Parameters
Borehole C3245	C3245	251 ft bgs	14.5-17, 17.5-20, 22.5-25, 27.5-30, 32.5-35, 47.5-50, 97.5-100, 207.5-210, 242.5-245, 248.5-251	Table B-5	One sample from each of the following: • H_1 • H_2 • H_3 • Mud sequence	Bulk density, moisture content, particle size distribution
Maximum Number of Samples		10				
Approximate Number of Field Quality Control Samples		2[c]				
Approximate Total Number of Samples		12				

[a]Actual sampling depths may vary depending on the amount of backfill/overburden used in interim stabilization activities at the waste site, field screening results, and varying subsurface conditions.

[b]See Table B-4 for detection limits and other analytical parameters.

[c]See Table B-13 for details of quality control samples.

bgs= below ground surface.

H_1 = Hanford formation upper gravel sequence.

H_2 = Hanford formation sandy sequence.

H_3 = Hanford formation gravel sequence.

Table B-8. 216-B-12 Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft) bgs[a]	Analyte List[b]	Physical Properties	
					Sample Interval	Parameters
Borehole C3246	C3246	297 ft	14.5-17, 30-32.5, 40-42.5, 50-52.5, 62.5-65, 94.5-97, 197.5-200, 247.5-250, 294.5-297	Table B-5	One sample from each of the following: • H_2 • H_3	Bulk density, moisture content, particle size distribution
Maximum Number of Samples		9				
Approximate Number of Field Quality Control Samples		2[c]				
Approximate Total Number of Samples		11				

[a]Actual sampling depths may vary depending on the amount of backfill/overburden used in interim stabilization activities at the waste site, field screening results, and varying subsurface conditions.

[b]See Table B-4 for detection limits and other analytical parameters.

[c]See Table B-13 for details of quality control samples.

bgs= below ground surface.

H_2 = Hanford formation sandy sequence.

H_3 = Hanford formation gravel sequence.

Table B-9. 216-A-10 Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft) bgs[a]	Analyte List[b]	Physical Properties	
					Sample Interval	Parameters
Borehole C3247	C3247	321 ft	12.5-15, 45-47.5, 52.5-55, 62.5-65, 72.5-75, 87.5-90, 127.5-130, 197.5-200, 287.5-290, 292-294.5, 318.5-321	Table B-5	1 sample from each of the following: • H_2 • Silt Sequence • Ringold Unit A	Bulk density, moisture content, particle size distribution
Maximum Number of Samples		11				
Approximate Number of Field Quality Control Samples		2[c]				
Approximate Total Number of Samples		13				

[a]Actual sampling depths may vary depending on the amount of backfill/overburden used in interim stabilization activities at the waste site, field screening results, and varying subsurface conditions.

[b]See Table B-4 for detection limits and other analytical parameters.

[c]See Table B-13 for details of quality control samples.

bgs = below ground surface.

H_2 = Hanford formation sandy sequence.

Table B-10. 216-A-36B Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft) bgs[a]	Analyte List[b]	Physical Properties	
					Sample Interval	Parameters
Borehole C3248	C3248	321 ft	12.5-15, 24-26.5, 30-32.5, 40-42.5, 53.5-56, 89.5-92, 197.5-200, 287.5-290, 292-294.5, 318.5-321	Table B-5	One sample from each of the following: • H_2 • Silt Sequence • Ringold Unit A	Bulk density, moisture content, particle size distribution
Maximum Number of Samples		10				
Approximate Number of Field Quality Control Samples		2[c]				
Approximate Total Number of Samples		12				

[a]Actual sampling depths may vary depending on the amount of backfill/overburden used in interim stabilization activities at the waste site, field screening results, and varying subsurface conditions.

[b]See Table B-4 for detection limits and other analytical parameters.

[c]See Table B-13 for details of quality control samples.

bgs = below ground surface.

H_2 = Hanford formation sandy sequence.

Table B-11. 207-A South Retention Basin Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft) bgs[a]	Analyte List[b]	Physical Properties	
					Sample Interval	Parameters
Boreholes C4113 – C4116	C4113 – C4116	20 ft	6-7, 7-8, 9-10, 14-15, 19-20	Table B-5	One sample from the following: • H_2	Bulk density, moisture content, particle size distribution
Maximum Number of Samples		20				
Approximate Number of Field Quality Control Samples		2[c]				
Approximate Total Number of Samples		22				

[a]Actual sampling depths may vary depending on the amount of backfill/overburden used in interim stabilization activities at the waste site, field screening results, and varying subsurface conditions. Sample at 6-7 ft is of the concrete comprising the basin.

[b]See Table B-4 for detection limits and other analytical parameters.

[c]See Table B-13 for details of quality control samples.

bgs = below ground surface.

H_2 = Hanford formation sandy sequence.

Table B-12. 216-A-37-1 Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft) bgs[a]	Analyte List[b]	Physical Properties	
					Sample Interval	Parameters
Borehole C4106	C4106	275 ft	12.5-15, 17.5-20, 27.5-30, 37.5-40, 47.5-50, 72.5-75, 97.5-100, 147.5-150, 197.5-200, 237.5-240, 272.5-275	Table B-5	One sample from each of the following: • H_2 • Undifferentiated Hanford • Ringold	Bulk density, moisture content, particle size distribution
Maximum Number of Samples		11				
Approximate Number of Field Quality Control Samples		2[c]				
Approximate Total Number of Samples		13				

[a]Actual sampling depths may vary depending on the amount of backfill/overburden used in interim stabilization activities at the waste site, field screening results, and varying subsurface conditions.

[b]See Table B-4 for detection limits and other analytical parameters.

[c]See Table B-13 for details of quality control samples.

bgs = below ground surface.

H_2 = Hanford formation sandy sequence.

Table B-13. Summary of Projected Sample Collection Requirements.

Data	216-A-19 Trench	216-B-12 Crib	216-A-10 Crib	216-A-36B Crib	207-A South Retention Basin[a]	216-A-37-1 Crib	Project Total
Chemical Parameters							
Projected maximum number of characterization samples	10	9	11	10	20	11	71
Detail of quality control samples							
Co-located duplicates	1	1	1	1	1	1	6
Equipment blanks	1	1	1	1	1	1	6
Approximate number of field quality control samples	2	2	2	2	2	2	12
Approximate total number of samples	12	11	13	12	22	13	83
Physical Properties							
Bulk density, moisture content, particle size distribution	4	2	3	3	4	3	19

[a]Based on the presumption of sampling from 4 shallow boreholes, including one concrete sample at each borehole.

Table B-14. List of Boreholes for Spectral Gamma-Ray Logging.

Borehole Number	Approximate Location	Coordinates (Wash. State Plane, NAD83[91])	
		Northing	Easting
C3245[a]	Within the boundaries of the 216-A-19 Trench	575663	136256
C3246[a]	Within the boundaries of the 216-B-12 Crib	136594	573127
C3247[a]	Within the boundaries of the 216-A-10 Crib; also will log direct push holes to help define borehole location	TBD	TBD
C3248[a]	Within the boundaries of the 216-A-36B Crib	135360	575104
C4106[a]	Within the boundaries of the 216-A-37-1 Crib	135641	575914
C4107[a]	Direct Push within the boundaries of the 216-A-10 Crib	TBD	TBD
C4108[a]	Direct Push within the boundaries of the 216-A-10 Crib	TBD	TBD
C4109[a]	Direct Push within the boundaries of the 216-A-10 Crib	TBD	TBD
C4110[a]	Direct Push within the boundaries of the 216-A-10 Crib	TBD	TBD
C4111[a]	Direct Push within the boundaries of the 216-A-10 Crib	TBD	TBD
C4112[a]	Direct Push within the boundaries of the 216-A-10 Crib	TBD	TBD
C4113[a]	Within the boundaries of the 207-A South Retention Basin	135984	575557
C4114[a]	Within the boundaries of the 207-A South Retention Basin	135984	575568.5
C4115[a]	Within the boundaries of the 207-A South Retention Basin	135984	575582
C4116[a]	Within the boundaries of the 207-A South Retention Basin	135979	575569.6
299-E28-64	Within the boundaries of the 216-B-12 Crib	136584.01	573127.762
299-E28-65	Within the boundaries of the 216-B-12 Crib	136600.469	573127.558
299-E28-66	Within the boundaries of the 216-B-12 Crib	136618.537	573127.34
299-E28-71	West of the 216-B-12 Crib	136614.438	573112.438
299-E28-76	Eastern edge of the 216-B-12 Crib	136609.872	573141.211
299-E28-16	South of the 216-B-12 Crib	136562.635	573136.748
299-W19-70	Within the boundaries of the 216-U-8 Crib	134697.757	567615.853
299-W19-71	Within the boundaries of the 216-U-8 Crib	134679.761	567616.007
299-W22-75	Within the boundaries of the 216-U-12 Crib	134490.421	567594.191
299-E17-1	Southern edge of the 216-A-10 Crib	135386.153	574977.079
299-E24-2	Northern edge of the 216-A-10 Crib	135493.023	574973.639
299-E24-59	Eastern edge of the 216-A-10 Crib	135435.478	574985.793
299-E24-60	Western edge of the 216-A-10 Crib	135435.779	574964.093
299-E17-5	Western edge of the 216-A-36B Crib	135278.548	575093.967
299-E17-11	Within the boundaries of the 216-A-36B Crib	135347.191	575109.138
299-E17-51	Within the boundaries of the 216-A-36B Crib	135230.501	575109.364
299-E25-17	South of the 216-A-37-1 Crib	135702.51	575760.245
299-E25-18	North of the 216-A-37-1 Crib	135699.304	575817.379
299-E25-19	South of the 216-A-37-1 Crib	135659.027	575852.333
299-E25-20	North of the 216-A-37-1 Crib	135654	575910.942

NOTE: Initial selection of existing wells was based on a review of well construction as-built diagrams. A single casing in contact with the formation is the preferred configuration for logging. A field inspection of the well configuration will be performed for final selection of boreholes. No logging of existing boreholes at 216-A-19 Trench is planned because the closest borehole in this area was recently logged.

[a] Planned boreholes.

TBD = to be determined.

B4.0 HEALTH AND SAFETY

All field operations will be performed in accordance with FH health and safety requirements, and the requirements of HNF-5173. In addition, a work control package will be prepared in accordance with HNF-PRO-079, *Job Hazard Analysis*, which will further control site operations. This package will include an activity hazard analysis, site-specific health and safety plan, and applicable radiological work permits.

The sampling procedures and associated activities will take into consideration exposure reduction and contamination control techniques that will minimize the radiation exposure to the sampling team as required by HNF-5173.

B5.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Investigation-derived waste generated by characterization activities will be managed in accordance with HNF-PRO-15333, *Environmental Protection Processes*, Sections 5.57, "*Generating Waste*", and 5.58 "*Identifying and Designating Waste*", HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria,* CP-A-EE-010-14.0, "Waste Identification"; and CP-A-EE-010-16.0, "Waste Storage and Handling", which identifies the requirements and responsibilities for containment, labeling, and tracking of investigation-derived waste. These procedures were developed to comply with "Strategy for Management of Investigation-Derived Waste" (Ecology et al. 1999), or as amended. An overview of the waste management strategy for the 200 Areas waste sites is presented in Appendix E of DOE/RL-98-28. Management of investigation-derived waste, minimization practices, and waste types applicable to 200-PW-2 and 200-PW-4 waste control are described in the respective OU waste control plans (CP-13935, *Waste Control Plan for the 200-PW-2 Operable Unit*; CP-13934, *Waste Control Plan for the 200-PW-4 Operable Unit*).

Unused samples and associated laboratory waste for the analysis will be dispositioned in accordance with the offsite laboratory contract, which in most cases will require the laboratory to dispose of this material. Similar materials from onsite laboratories will be either disposed of by the laboratory or returned to the project. The approval of the remedial project manager is required before unused samples or waste from offsite laboratories may be returned.

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APPENDIX C

200-PW-2 AND 200-PW-4 OPERABLE UNIT CONSOLIDATION REVIEW

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TERMS

COC	contaminant of concern
DOE	U.S. Department of Energy
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FS	feasibility study
HSW	high-salt waste
IS-1 RI/FS Work Plan	DOE/RL-2002-14
LFI	limited field investigation
NPH	normal paraffin hydrocarbon
OU	operable unit
PUREX	Plutonium-Uranium Extraction (Plant)
RCRA	*Resource Conservation and Recovery Act of 1976*
REDOX	Reduction-Oxidation (Plant)
RI/FS	remedial investigation/feasibility study
TBP	tributyl phosphate
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
TSD	treatment, storage, and disposal (unit)
UNH	uranyl nitrate hexahydrate
UNKN	unknown
UPR	unplanned release
VCP	vitrified clay pipeline
WESF	Waste Encapsulation and Storage Facility
WIDS	*Waste Information Data System* report, Hanford Site database

APPENDIX C

200-PW-2 AND 200-PW-4 OPERABLE UNIT CONSOLIDATION REVIEW

The U.S. Department of Energy (DOE), Richland Operations Office; the U.S. Environmental Protection Agency (EPA); and Washington State Department of Ecology (Ecology) conducted a thorough review of the cleanup approach that was being applied to waste sites through the Implementation Plan (DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*) and identified improvements to accelerate cleanup of these waste sites. A part of this risk-based approach to prioritizing work associated with waste site cleanup is the proposal to consolidate the 22 process-based operable units (OU) into 12 distinct groupings (because of similarities between contaminant sources) for the remedial investigation/feasibility study process.

This consolidation effort was accomplished by revising the 200 Areas work plans to incorporate designated analogous operable units in accordance with agreements reached among the decision-makers. In an initial review of two of the consolidated OU work plans, comments were received from EPA and Ecology indicating that there was a need for additional documentation to support the alignment of the consolidated waste sites with the representative sites in the work plans. DOE subsequently committed to a formal evaluation of the consolidated OU waste sites against the conceptual models in the work plans and to the development of a series of tables that would document the evaluation process. The series of tables presented in this appendix represents the consolidated OU waste site evaluation logic for the 200-PW-2 and the 200-PW-4 OUs.

The goal of this evaluation was to align the consolidated OU waste sites with the appropriate representative waste sites and treatment, storage, and disposal (TSD) units based on the potential nature and vertical extent of contamination, so that remedial alternative(s) chosen for the sites would be an effective and reasonable choice. Several characteristics of the waste sites were reviewed and compared to the same characteristics of representative sites and TSD units to ensure that these sites were indeed similar and/or that they bounded the analogous waste sites.

The characteristics considered in the assignment of grouping analogous waste sites with contaminant distribution models included the following:

- Waste site dimensions as indicated by the *Waste Information Data System* (WIDS), and physical configuration, indicated by type of waste site (e.g., cribs were used to percolate wastes, while ditches typically channeled waste to other wastes sites)

- Vertical extent of contaminants were qualitatively compared for the calculated pore volume and the estimated effluent volume discharged, as documented in DOE/RL-96-81, *Waste Site Grouping for 200 Areas Soil Investigations*, Appendix A

- Process information including historical discharge operations, contaminants of concern, and physical properties such as retardation factors that would influence k_d values, illustrated by the known inventories of important radionuclides, key inorganic chemicals,

and known organic chemicals released to the ground as documented by DOE/RL-96-81, Appendix A.

A comparison of the physical setting, geology, and characterization data of the analogous waste sites (if available and applicable) to those of the representative or TSD units also was performed in this evaluation. A more detailed look at previous characterization data will be performed during the feasibility study (FS).

A series of tables is provided in this appendix that document the assessment of consolidated waste sites against the work plan representative waste sites and TSD units. The contents of the tables include the following.

- Table C-1 - Provides an overall listing of the waste sites, their status (accepted versus rejected), and an indication of where these sites were placed in subsequent tables.

- Table C-2 - Indicates which waste sites have been rejected or reclassified by the WIDS classification procedures found in *Tri-Party Agreement Handbook Management Procedures*, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)" (DOE-RL 1998).

- Table C-3 - Contains waste sites that aligned well with the representative waste site or TSD unit conceptual contaminant distribution models in the original OU work plans.

- Table C-4 - Identifies waste sites that do not align well with the representative waste site or TSD unit conceptual contaminant distribution models in the original work plans, but that are better represented or bounded by the conceptual contaminant distribution models of representative waste sites and TSD units from other OUs. For these waste sites, the conceptual contaminant distribution models from other OUs are provided in this appendix as Figures C-1 through C-4.

- Table C-5 - Lists the waste sites in which no conceptual contaminant distribution model has been previously developed. Thus, waste sites listed in Table C-5 will require the development of new conceptual contaminant distribution models and additional characterization before the nature and vertical extent of contamination can be known and a reasonable remedial action alternative(s) can be selected.

The streamlined analogous OU and waste site approach for the 200 Areas waste sites is viable and will be implemented as the next phase of this project. Characterization data, physical and chemical properties, nature of the mobility of constituents, knowledge of the 200 Areas chemical separation and waste recovery processes, and the physical setting of the waste sites within the 200 Areas has been collected for over 10 years. Collectively reviewing this project data and applying it to analogous OUs and waste sites during individual FS efforts will allow effective and reasonable remedial alternative(s) to be chosen and will successfully expedite the cleanup of the Hanford Site Central Plateau.

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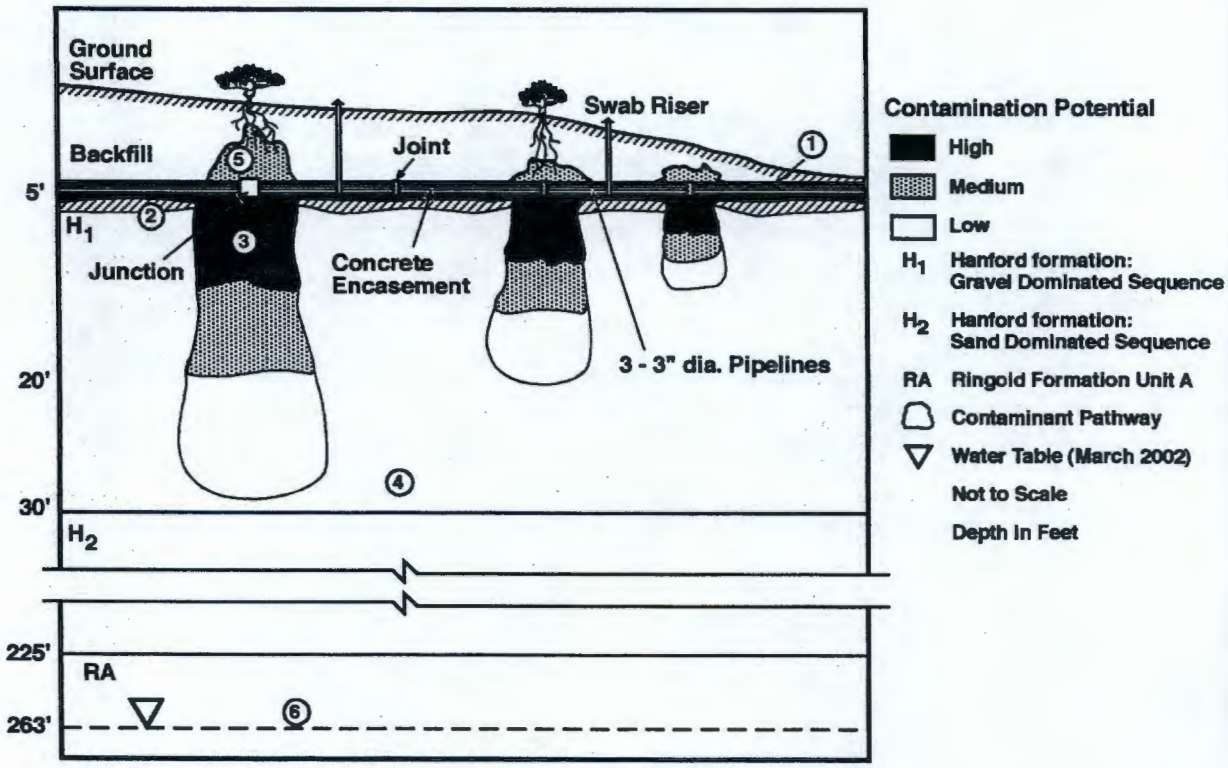
Figure C-1. 200-E-111 Pipeline Contaminant Distribution Model.



1. The 200-E-111 Tank Farm Process Piping is an encasement that contains three 3-inch diameter stainless steel waste transfer pipelines. The pipelines were used to transport bismuth phosphate and uranium recovery waste (uranium and fission rich process wastes) from 1946 to 1957, waste fractionation fission product waste from 1961 to 1978, and interim stabilization and isolation waste from 1975 to 2001. The pipelines transferred waste to the C Tank Farm and the 244-AR Vault from the 241-ER-151 Diversion Box.
2. Effluent and contaminants were released to the subsurface from the encasement approximately 5 to 8 feet below the ground surface within H1. The releases are characterized as low volume leaks and are most likely attributed to faulty or degraded seals, joints, or fittings.
3. The effluent and contaminants move vertically down beneath the encasement at various points of release. Low mobility contaminants such as cesium and plutonium sorb near points of release, and concentrations decrease with depth.
4. Mobile contaminants such as nitrate and tritium migrate with the moisture front to a maximum depth of 20 to 30 ft.
5. Contamination extends above the pipeline in some places because of transport by vegetation (i.e., tumbleweed).
6. Waste water and contaminants do not impact groundwater, because the suspected volume of releases is small.

Figure C-2. 216-B-2-2 Ditch (West End) Contaminant Distribution Model.

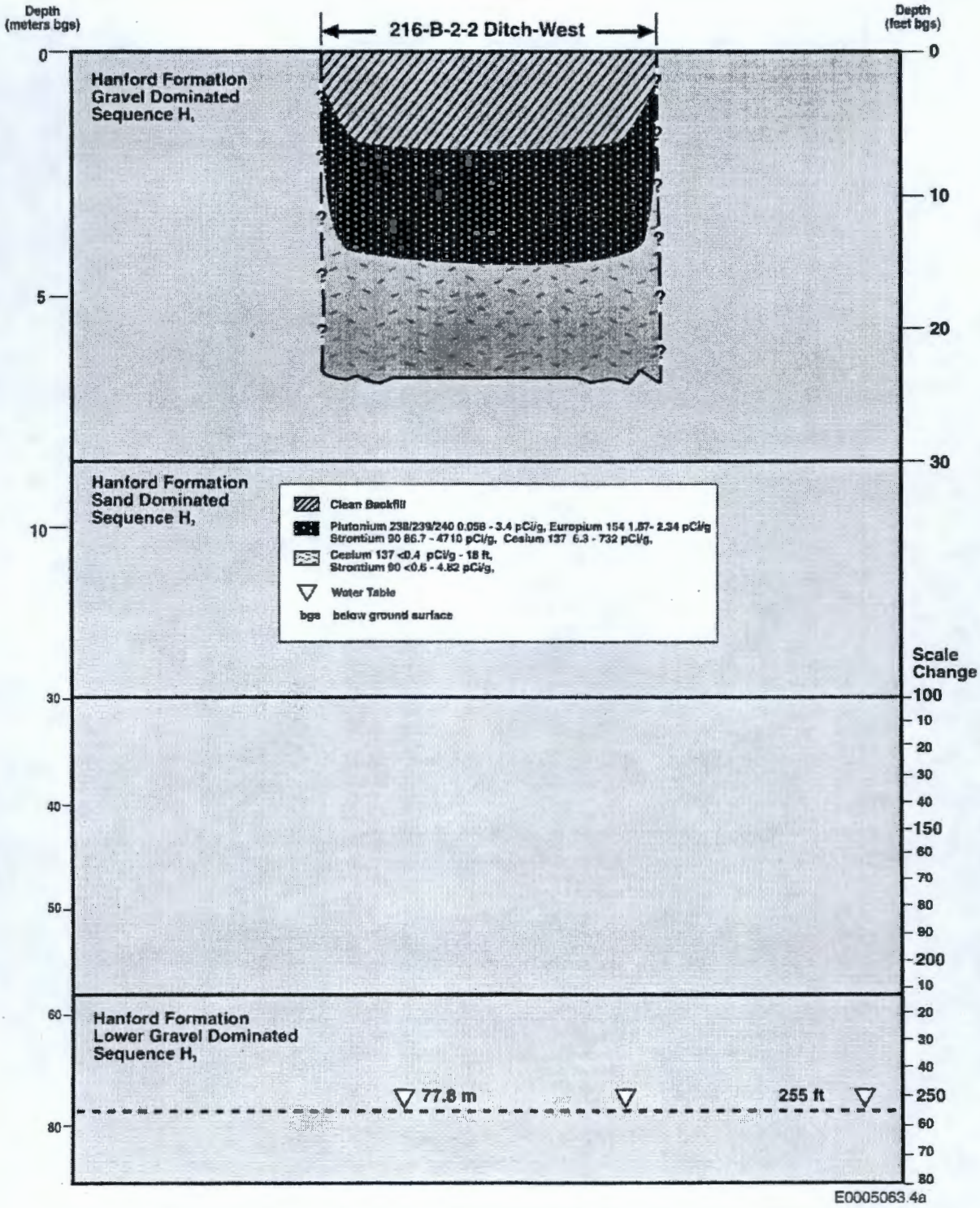
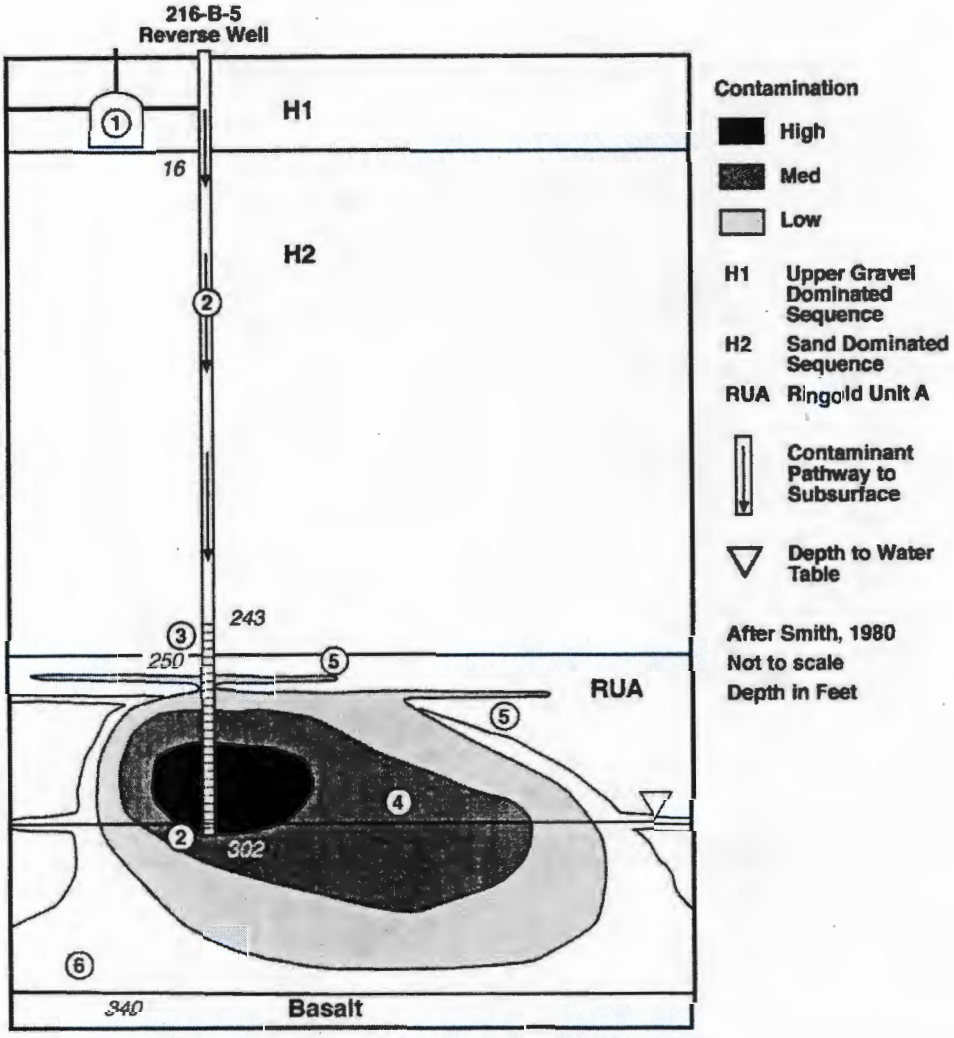


Figure C-3. 216-B-5 Reverse Well Contaminant Distribution Model.



1. High salt, neutral/basic/low organic liquid waste with high quantities of plutonium 239/240. Cesium-137, and strontium-90 were discharged to the 216-B-361 settling tank. Contaminants precipitated/settled out in the tank.
2. Wastewater overflowed from the 216-B-361 settling tank and into the 216-B-5 reverse well through a 5 cm (2-inch) diameter stainless steel inlet pipe about 3.6 m (12 ft) bgs. The reverse well received approximately 30,600,000 L (8.1 million gal) of liquid waste. In addition, studies indicate that the well receive 4.3 kg of Pu.
3. Waste was released to the vadose zone and the water table through a perforated section of the reverse well extending 74 m - 92 m (242 ft - 302 ft) bgs. When the well was actively receiving waste, it penetrated 3 m (10 ft) into the aquifer.
4. Contaminant detected in the subsurface include: cesium-137, strontium-90, plutonium-239/240, and americium-241. The highest activities were detected near the well perforations. Activities generally decrease away from the well.
5. Cesium-137 preferentially sorbs into silt lenses intersected by perforated casing.
6. Plutonium-239/240 may occur in phosphate based mineral phase.
7. The vadose zone and groundwater has been impacted by operation of the 216-B-5 reverse well.

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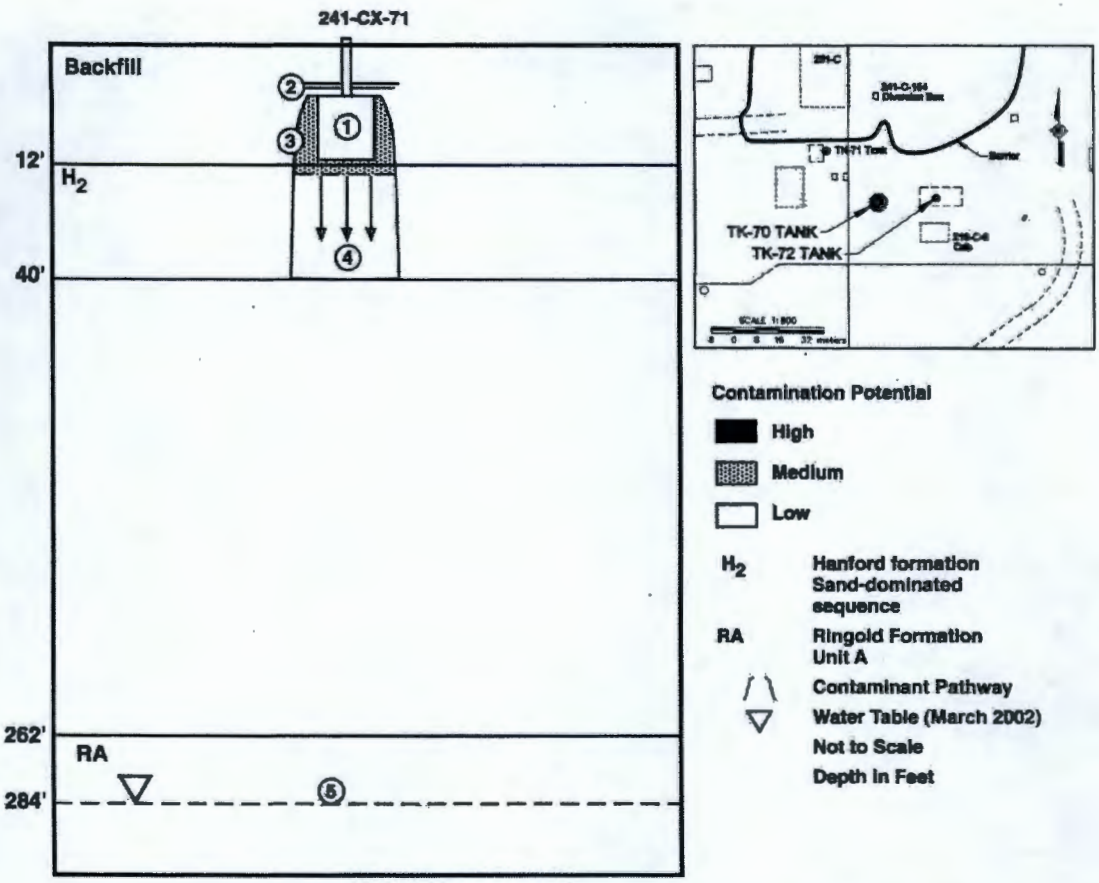
Figure C-4. 241-CX-71 Tank Contaminant Distribution Model.



1. Process condensate waste containing plutonium-239/240, uranium, cesium-137, strontium-90, tributyl phosphate, caustic-tartrate, oxalic acid, hydrogen peroxide, sodium nitrate, sodium nitrite, sodium fluoride, aluminum sulfate, and sodium chromate were discharged to the tank from late 1952 until mid 1957. The tank's capacity was 3,807 liters (1,000 gallons). The tank transferred a total volume of 33,308,000 liters (8.8 million gallons) of liquid waste to C-1 and C-5 cribs. In 1974, visual inspection indicated that the tank contained very little liquid and limestone. Very little data are available to evaluate contaminant distribution at this site.
2. Potential leaks from this tank are likely because of the volume of liquid waste received and similar leaks reported in other equipment in the Hot Semiworks building. For the purposes of this conceptual contaminant distribution model, a leak of 0.1 gallon per hour is assumed over the time the tank was in service. Based on this assumption, a potential release of 8,300 liters (2,200 gallons) may have been released to the soil column. Based on this assumption and the nature of the soils near the waste site, little lateral spreading is expected to have occurred. Assuming that the spilled liquid was released within the soil adjacent to and beneath the tank, the entire assumed released amount would be retained by the soil within a 15 m (50-ft) radius of the tank.
3. Immobile contaminants, such as plutonium, normally sorb near the point of release. Contaminant concentrations decrease with depth.
4. Mobile contaminants, like nitrate, migrate with the moisture front to depth.
5. Waste water and mobile contaminants are not likely to have impacted groundwater because the potential leak volume is less than the soil column pore volume. While groundwater concentrations of iodine-129 exceed groundwater protection standards beneath the tank, the contaminant is not attributed to this site.

Table C-1. 200-PW-2 and 200-PW-4 Operable Units Consolidation Logic, Waste Site Summary. (3 Pages)

Site Code	Site Names	Site Type	Site Status	Class Status	Reclass Status	Table Assignment[a]
200-PW-2 OU Waste Sites						
200-E-58	200-E-58, 216-A-5 Neutralization Tank, Tank A5, IMUST, Inactive Miscellaneous Underground Storage Tank	Neutralization Tank	Inactive	Accepted		Table C-4
200-W-22	200-W-22, 203-S/204-S/205-S Stabilized Area	Unplanned Release	Inactive	Accepted		Table C-5
200-W-23	200-W-23, 203-S, 205-S, Underground Contaminated Zone	Unplanned Release	Inactive	Rejected		Table C-2
200-W-42[d]	200-W-42, U Plant Radioactive Process Sewer from 221-U to 216-U-8 & 216-U-12 Cribs	Radioactive Process Sewer	Inactive	Accepted		Table C-4
203-S & 205-S[b]	203-S & 205-S, 203-S/204-S/205-S Stabilized Area, 203-S Uranyl Nitrate Hexahydrate Tank Farm, 204-S Tank Farm & Pumphouse, 205-S Process Vault & Chemical Makeup Building, 205-S Uranyl Nitrate Hexahydrate Processing Facility	Process Unit/Plant	Inactive	Accepted		Table C-4
216-A-1	216-A-1, 216-A-1 Cavern, 216-A-1 Trench	Crib	Inactive	Accepted		Table C-3
216-A-3	216-A-3, 216-A-3 Cavern, 216-A-3 Crib	Crib	Inactive	Accepted		Table C-3
216-A-5	216-A-5, 216-A-5 Cavern	Crib	Inactive	Accepted		Table C-3
216-A-10	216-A-10, 216-A-10 Crib	Crib	Active	Accepted		Table C-3
216-A-18	216-A-18, 216-A-18 Excavation, 216-A-18 Grave, 216-A-18 Sump, 216-A-18 Crib	Trench	Inactive	Accepted		Table C-3
216-A-19	216-A-19, 216-A-19 Test Hole, 216-A-19 Grave, 216-A-19 Sump, 216-A-19 Crib	Trench	Inactive	Accepted		Table C-3
216-A-20	216-A-20, 216-A-20 Test Hole, 216-A-20 Grave, 216-A-20 Sump, 216-A-20 Crib	Trench	Inactive	Accepted		Table C-3
216-A-22[c]	216-A-22, 216-A-22 French Drain, 216-A-22 Crib	Crib	Inactive	Accepted		Table C-3
216-A-28	216-A-28, 216-A-28 French Drain, 216-A-28 Crib	Crib	Inactive	Accepted		Table C-3
216-A-36A	216-A-36A, 216-A-36 Crib	Crib	Inactive	Accepted		Table C-3
216-A-36B	216-A-36B, 216-A-36 Crib, Purex Ammonia Scrubber Distillate (ASD)	Crib	Active	Accepted		Table C-3
216-B-12	216-B-12, 216-ER Crib, 216-ER-1,2,3 Cribs	Crib	Inactive	Accepted		Table C-3
216-B-60	216-B-60, 216-B-60 Crib	Crib	Inactive	Accepted		Table C-3

Table C-1. 200-PW-2 and 200-PW-4 Operable Units Consolidation Logic, Waste Site Summary. (3 Pages)

Site Code	Site Names	Site Type	Site Status	Class Status	Reclass Status	Table Assignment[a]
216-C-1	216-C-1, 216-C-1 Crib, 216-C Crib	Crib	Inactive	Accepted		Table C-3
216-S-1&2	216-S-1&2, 216-S-5 Crib, 216-S-1 & 2	Crib	Inactive	Accepted		Table C-3
216-S-7	216-S-7, 216-S-7 Crib, 216-S-15	Crib	Inactive	Accepted		Table C-3
216-S-8	216-S-8, Cold Aqueous Trench, Cold Aqueous Crib, 216-S-3, Unirradiated Uranium Waste Trench, Cold Aqueous Grave	Trench	Inactive	Accepted		Table C-3
216-U-1&2[d]	216-U-1&2, 361-WR (Crib 2), 216-U-3, 216-UR #1&2 Cribs, 216-U-1 & 2	Crib	Inactive	Accepted		Table C-3
216-U-5[d]	216-U-5, 216-U-4, 221-U Cold U Trench #2	Trench	Inactive	Accepted		Table C-3
216-U-6[d]	216-U-6, U Facility Unirradiated Uranium Waste Trench, 221-U Cold U Trench, 216-U Cold U Trench #1, 216-U-5, 221-U Cold U Grave #1	Trench	Inactive	Accepted		Table C-3
216-U-8[d]	216-U-8, 216-WR-1,2,3 Cribs, 216-U-9	Crib	Inactive	Accepted		Table C-3
216-U-12[d]	216-U-12, 216-U-12 Crib	Crib	Active	Accepted		Table C-3
241-U-361[d]	241-U-361, 241-U-361 Settling Tank, 361-U-TANK, IMUST, Inactive Miscellaneous Underground Storage Tank	Settling Tank	Inactive	Accepted		Table C-4
270-E-1	270-E-1, 270-E CNT, 270-E Condensate Neutralization Tank, 216-ER-1, IMUST, Inactive Miscellaneous Underground Storage Tank	Neutralization Tank	Inactive	Accepted		Table C-4
270-W[d]	270-W, 270-W Tank, 270-W Neutralization Tank, IMUST, Inactive Miscellaneous Underground Storage Tank	Neutralization Tank	Inactive	Accepted		Table C-4
UPR-200-E-17[c]	UPR-200-E-17, Overflow at 216-A-22, UN-200-E-17	Unplanned Release	Inactive	Accepted		Table C-3
UPR-200-E-39	UPR-200-E-39, Release from 216-A-36B Crib Sampler (295-A), UN-200-E-39	Unplanned Release	Inactive	Accepted		Table C-4
UPR-200-E-40	UPR-200-E-40, Release from the 216-A-36B Crib Sampler, UN-200-E-40	Unplanned Release	Inactive	Accepted	Rejected	Table C-2
UPR-200-E-64	UPR-200-E-64, Radioactive Soil and Ant Hills, UN-200-E-64, UN-216-E-36	Unplanned Release	Inactive	Accepted		Table C-4
UPR-200-W-163[d]	UPR-200-W-163, Contaminated Vegetation at the 216-U-8 Pipeline, UN-216-W-33	Unplanned Release	Inactive	Accepted		Table C-3
UPR-200-W-19[d]	UPR-200-W-19, 241-U-361 Overflow, UN-200-W-19	Unplanned Release	Inactive	Accepted		Table C-4

Table C-1. 200-PW-2 and 200-PW-4 Operable Units Consolidation Logic, Waste Site Summary. (3 Pages)

Site Code	Site Names	Site Type	Site Status	Class Status	Reclass Status	Table Assignment[a]
UPR-200-W-36	UPR-200-W-36, Groundwater Contamination at 216-S-1 and 216-S-2	Unplanned Release	Inactive	Accepted		Table C-4
200-PW-4 OU Waste Sites						
207-A-SOUTH	207-A-SOUTH, 207-A, 207-A Retention Basin, 207-A-SOUTH Retention Basin, 207-A South	Retention Basin	Active	Accepted		Table C-5
209-E-WS-3	209-E-WS-3, Critical Mass Laboratory Valve Pit and Hold Up Tank (209-E-TK-111), IMUST, Inactive Miscellaneous Underground Storage Tank	Valve Pit	Inactive	Accepted		Table C-4
216-A-34	216-A-34, 216-A-34 Ditch, 216-A-34 Crib	Ditch	Inactive	Accepted		Table C-4
216-A-37-1	216-A-37-1, 216-A-37 Crib	Crib	Active	Accepted		Table C-5
216-A-45	216-A-45, 216-A-45 Crib	Crib	Inactive	Accepted		Table C-3
216-C-3	216-C-3, 201-C Leaching Pit, 216-C-3 Crib	Crib	Inactive	Accepted		Table C-3
216-C-5	216-C-5, 216-C-5 Crib	Crib	Inactive	Accepted		Table C-3
216-C-7	216-C-7, 216-C-7 Crib	Crib	Inactive	Accepted		Table C-3
216-C-10	216-C-10, 216-C-10 Crib	Crib	Inactive	Accepted		Table C-3
216-S-4	216-S-4, 216-S-7, 216-S-4 Sump or Crib, UN-216-W-1	French Drain	Inactive	Accepted		Table C-3
216-S-22	216-S-22, 216-S-22 Crib	Crib	Inactive	Accepted		Table C-3
216-S-23	216-S-23, 216-S-23 Crib	Crib	Inactive	Accepted		Table C-3
216-T-20	216-T-20, 216-TX-2, 216-T-20 Crib, 241-TX-155 Contaminated Acid Grave	Trench	Inactive	Accepted		Table C-3
216-U-16[d]	216-U-16, UO3 Crib	Crib	Inactive	Accepted		Table C-3
216-U-17[d]	216-U-17, 216-U-17 Crib	Crib	Inactive	Accepted		Table C-3
UPR-200-E-145	UPR-200-E-145, W049H Green Soil, VCP Pipeline Leak	Unplanned Release	Inactive	Accepted		Table C-4

[a] Specific table assignments for each waste site are based on the most applicable contaminant distribution model.

[b] This site presently is assigned to the 200-RO-2 OU, which is one of the old geographic-based OUs. Contaminated soils that remained after the building demolition are associated with 200-W-22. Therefore, this site will be assigned to the 200-PW-2 OU as well.

[c] For each of these waste sites, final approval is required of Appendix C of the *Hanford Federal Facility Agreement and Consent Order* before WIDS will change the sites from the 200-MW-1 OU to the 200-PW-2 OU.

[d] This site is included in the U Plant Regional Closure Area (see Section 1.2 for more details).

Table C-2. 200-PW-2 and 200-PW-4 Operable Units Consolidation Logic, Rejected Waste Sites.

Operable Unit	Site Code	Site Names	Site Type	Site Status	Class Status	Reclass Status
200-PW-2	200-W-23	200-W-23, 203-S, 205-S, Underground Contaminated Zone	Unplanned Release	Inactive	Rejected	
200-PW-2	UPR-200-E-40	UPR-200-E-40, Release from the 216-A-36B Crib Sampler, UN-200-E-40	Unplanned Release	Inactive	Accepted	Rejected

Notes:
The 200-W-23 operable unit is a duplicate of the 200-W-22 operable unit.
The UPR-200-E-40 operable unit has been consolidated within the larger 200-E-103 (200-UR-1) operable unit in which it is located.

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Table C-3. 200-PW-2 and 200-PW-4 Operable Unit Consolidation Logic – Waste Sites Conforming to the Work Plan Contaminant Distribution Models. (6 Pages)

Representative Site or TSD	Accepted Waste Site Name	Waste Site Type	Rationale	Site Size	Area	Plant Process	Contaminant Inventory																		
							Case (Effluent Volume)	Soil Pore Volume Exceeded	Characterized or Data Evaluated	Case (Inventory)	Effluent Volume (m^3)	Pore Volume (m^3)	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	CCl_4 (kg)	Ferrocyanide (kg)	Hexone (kg)	Nitrate (kg)	NPH (kg)	$Na_2Cr_2O_7$ (kg)	TBP (kg)
216-A-10		Crib	**Site is a RCRA TSD unit that requires characterization as part of closure activities. The contaminant distribution model is developed in the Work Plan.**	**83.8 m x 13.7 m (275 ft x 45 ft)**	**200 East**	**PUREX: 1956-1987 RCRA TSD; The crib with VCP distribution pipe was a replacement for 216-A-5 Crib that received cooling water; acidic waste stream from process distillate discharge, and corrosive/mixed waste process distillates and condensates from 202-A.**	**Worst Case**	**Yes/114**	**Yes**	**Typical**	**3,210,096**	**28,072**	**2.41 E+02**	**3.50 E+02**	**7.73 E-01**	**8.05 E+01**	**8.25 E+01**	**—**	**—**	**—**	**—**	**—**	**—**	**—**
200-PW-2 Operable Unit Analogous Waste Sites																									
	216-A-5	Crib	Inventory and effluent volume similar in nature to the 216-A-10 Crib.	10.7 m x 10.7 m x 8.8 m (35 ft x 35 ft x 29 ft)	200 East	PUREX: 1955-1966; Site received acidic process condensate from PUREX from December and later was a backup for the 216-A-10 Crib.	Worst Case	**Yes/557**	Yes	Typical	1,630,049	2,925	2.61 E+02	6.50 E+01	—	1.21 E+01	4.16 E+01	—	—	—	1,000,000	—	—	—
	216-C-1	Crib	219-C-1 Crib received experimental PUREX operations wastes where cold/unirradiated uranium was used. 216-A-10 Crib also received the same type of waste. However, 216-A-10 Crib received more plutonium which is likely to be bound in the upper surface of 216-A-10 Crib. Thus, the two contaminant distribution models would be similar.	8.2 m x 3.7 m x 4 m (27 ft x 12 ft x 13 ft)	200 East	Hot Semiworks: 1953-1957 Site received PUREX high salt waste, cold-run waste, and process condensate from 201-C.	Typical	**Yes/30**	No	Typical	23,400	785	3.00 E+02	8.00 E+00	—	4.55 E-02	8.55 E+01	—	—	—	—	—	—	—
200-PW-4 Operable Unit Analogous Waste Sites																									
	216-A-45	Crib	Inventory and effluent volume similar to the 216-A-10 Crib. 216-A-45 Crib replaced the 216-A-10 Crib.	94.5 m x 18.3 m (310 ft x 60 ft)	200 East	PUREX: 1987-1991 Site received process condensate from 202-A.	Typical	**Yes/2**	No	Typical	103,003	58,074	6.69 E+00	—	1.10 E-01	9.70 E-03	8.34 E-03	—	—	—	—	—	—	—
	216-S-22	Crib	216-A-10 Crib is a bounding condition for this waste site. The inventory and effluent volumes are similar due to comparable waste stream chemistry based on process knowledge (Both are process condensate waste cribs, however, the 216-A-10 Crib utilized TBP in NPH while the 216-S-22 Crib used Hexone as a solvent. Same radionuclides and metal waste constituents are present.) Also, less effluent was discharged and ground water would not be impacted such as it is at the 216-A-10 Crib.	30.5 m x 1 m x 3 m (100 ft x 3.5 ft x 9.8 ft)	200 West	REDOX: 1957-1967 Site received liquid waste from the acid recovery facility in the 293-S Building	Typical	No	No	Typical	98	585	5.00 E-02	1.01 E-01	—	4.78 E-01	4.55 E-01	—	—	—	7,000	—	—	—

Table C-3. 200-PW-2 and 200-PW-4 Operable Unit Consolidation Logic – Waste Sites Conforming to the Work Plan Contaminant Distribution Models. (6 Pages)

Representative Site or TSD	Accepted Waste Site Name	Waste Site Type	Rationale	Site Size	Area	Plant Process	Contaminant Inventory																	
							Case (Effluent Volume)	Soil Pore Volume Exceeded	Characterized or Data Evaluated	Case (Inventory)	Effluent Volume (m^3)	Pore Volume (m^3)	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	CCl_4 (kg)	Ferrocyanide (kg)	Hexone (kg)	Nitrate (kg)	NPH (kg)	$Na_2Cr_2O_7$ (kg)	TBP (kg)
216-A-19		Trench	**The contaminant distribution model for this representative site is developed in the Work Plan. The site received approximately 0.9 times the calculated pore volume, potentially impacting groundwater.**	**7.6 m x 7.6 m x 4.5 m (25 ft x 25 ft x 15 ft)**	**200 East**	**PUREX: 1955-1956; Single trench that received cold startup wastes from PUREX; high volume of uranium; others include nitrate, cobalt, strontium, cesium, plutonium; condenser water via 216-A-34 Ditch**	**Typical**	**No**	**No**	**Worst Case**	**1,100**	**1,232**	**3.87 E+04**	**1.00 E-01**	**—**	**4.44 E-02**	**4.20 E-02**	**—**	**—**	**—**	**20,000**	**—**	**—**	**—**
200-PW-2 Operable Unit Analogous Waste Sites																								
	216-A-1	Crib	Inventory and effluent volume similar to the 216-A-19 Crib.	9 m x 9 m x 4.6 m (30 ft x 30 ft x 15 ft)	200 East	PUREX: 1955-1955; Site received depleted uranium waste from the cold startup tests at PUREX	Typical	No	Yes	Typical	98	1,980	1.53 E+02	1.00 E-01	—	4.44 E-02	4.22 E-02	—	—	—	80	—	—	—
	216-A-3	Crib	Inventory and effluent volume similar to the 216-A-19 Crib.	6.1 m x 6.1 m x 4.9 m (20 ft x 20 ft x 16 ft)	200 East	PUREX: 1956-1967 Site received silica gel regeneration waste and pump house drainage from 203-A and drainage from the UNH storage pit. 1967-1981 received UNH storage pit drainage, liquid drainage, liquid waste from 203-A enclosure sumps, and heating coil condensate from UNH tanks. waste included uranium, cesium, strontium, and ruthenium. see 216-A-28 and 216-A-22 Cribs.	Typical	Yes/3	No	Typical	3,050	952	1.66 E+03	2.00 E-01	—	4.55 E-02	4.31 E-02	—	—	—	—	—	—	—
	216-A-18	Trench	Inventory and effluent volume similar to the 216-A-19 Crib.	24.4 m x 24.4 m (80 ft x 80 ft)	200 East	PUREX: 1955-1955; Site received depleted uranium waste from the cold startup tests at PUREX	Typical	No	Yes	Typical	488	13,050	1.39 E+03	1.00 E-01	—	4.44 E-02	4.20 E-02	—	—	—	730	—	—	—
	216-A-20	Trench	Inventory and effluent volume similar to the 216-A-19 Crib. The site received approximately 0.75 times the calculated pore volume, potentially impacting groundwater.	7.6 m x 7.6 m x 4.6 m (25 ft x 25 ft x 15 ft)	200 East	PUREX and A Tank Farm processes: 1955-1955; Site received depleted uranium waste from the cold startup tests at PUREX; also received contact condenser cooling water from 241-A-431 Ventilation Building via the 216-A-34 Ditch	Typical	No	Yes	Typical	961	1,274	4.01 E+02	1.00 E-01	—	4.44 E-02	4.20 E-02	—	—	—	210	—	—	—
	216-A-22	Crib	Inventory and effluent volume similar to the 216-A-19 Crib. A proposal to move this site from the 200-MW-1 OU was approved in the 200-MW-1 RI/FS work plan (DOE/RL-2001-65) by EPA. However, it is still pending approval of Appendix C of the Tri-Party Agreement.	3 m deep x 4.8 m dia. (10 ft deep x 16 ft dia.)	200 East	PUREX: 1955-1958 The drainage from the 203-A Building to the site was directed to the 216-A-22 Crib. The tanks in the 203-A Acid Pump House building were used for storage and shipping of UNH product and concentration of UNH waste. Discharge to the crib was rerouted to 216-A-28 Crib.	Typical	No	No	UNKN	10	68	—	—	—	—	—	—	—	—	—	—	—	—
	216-A-28	Crib	Inventory and effluent volume similar to the 216-A-19 Crib. Discharge to the crib was rerouted to 216-A-3 Crib.	3.4 m deep x 6 m dia. (11 ft deep x 20 ft dia.)	200 East	PUREX: 1958-1976; liquid waste from 203-A sumps and heating coil condensate from the UNH tanks; truncated cone shape; initial discharge went to 216-A-22 Crib; after ceasing use of the 216-A-28 Crib, waste was routed to the 216-A-3 Crib; may contain uranium. (See MW-1, Table B-6, for 216-A-22 Crib)	Typical	No	No	Typical	30	191	6.27 E+02	—	—	—	—	—	—	—	300	—	—	—
	216-S-8	Trench	Inventory and effluent volume similar to the 216-A-19 Crib.	30.5 m x 18.3 m x 7.6 m (100 ft x 60 ft x 25 ft)	200 West	REDOX: 1951-1952; Site received unirradiated uranium startup waste from 202-S.	Typical	Yes/1	Yes	Typical	10,000	10,033	1.93 E+02	2.00 E+00	—	4.92 E+00	3.86 E-01	—	—	—	100	—	—	—
	216-U-5[a]	Trench	Inventory and effluent volume similar to the 216-A-19 Crib.	12.9 m x 3 m x 3 m (40 ft x 10 ft x 10f t)	200 West	Uranium Recovery process: 1952; Site received unirradiated uranium startup waste from 221-U; contained nitrate.	Typical	No	Yes	Typical	4,500	3,300	3.63 E+02	—	—	—	—	—	—	—	200	—	—	—

Table C-3. 200-PW-2 and 200-PW-4 Operable Unit Consolidation Logic – Waste Sites Conforming to the Work Plan Contaminant Distribution Models. (6 Pages)

Representative Site or TSD	Accepted Waste Site Name	Waste Site Type	Rationale	Site Size	Area	Plant Process	Contaminant Inventory																	
							Case (Effluent Volume)	Soil Pore Volume Exceeded	Characterized or Data Evaluated	Case (Inventory)	Effluent Volume (m^3)	Pore Volume (m^3)	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	CCl_4 (kg)	Ferrocyanide (kg)	Hexone (kg)	Nitrate (kg)	NPH (kg)	$Na_2Cr_2O_7$ (kg)	TBP (kg)
	216-U-6[a]	Trench	Inventory and effluent volume similar to the 216-A-19 Crib.	22.9 m x 3 m x 3 m (75 ft x 10 ft x 10 ft)	200 West	Uranium recovery process: 1952; Site received unirradiated uranium startup waste from 221-U; contained nitrate.	Typical	No	Yes	Typical	4500	3300	3.63 E+02	—	—	—	—	—	—	—	200	—	—	—
	UPR-200-E-17	UPR	Inventory and effluent volume similar to the 216-A-19 Crib. A proposal to move this site from the 200-MW-1 OU was approved in the 200-MW-1 RI/FS work plan (DOE/RL-2001-65) by EPA. However, it is still pending approval of Appendix C of the Tri-Party Agreement.	UNKN	200 East	Sufficient splashing occurred when the 216-A-22 Crib inlet failed, causing the ground on top of the crib to become yellow with uranium. No specific occurrence date is mentioned. HW-60807 was issued in July 1959, so it occurred before that date. The 216-A-22 Crib was active from 1955 through 1958.	Typical	UNKN	No	UNKN	-	-	—	—	—	—	—	—	—	—	—	—	—	—
216-A-36B		Crib	**Site is a RCRA TSD unit that requires characterization as part of closure activities. The contaminant distribution model is developed in the Work Plan.**	**152.4 m x 3.4 m (500 ft x 11 ft)**	**200 East**	**PUREX: 1966-1988 RCRA TSD; single crib with VCP distribution pipe; part of original 216-A-36 Crib; reconfigured into 216-A-36A and 36B; received PUREX operations for ammonia scrubber wastes.**	**Typical**	**Yes/19**	**Yes**	**Typical**	**318,080**	**16,327**	**2.62 E+02**	**2.58 E+02**	**2.17 E-01**	**1.20 E+03**	**1.31 E+03**	—	—	—	—	**350**	**178**	**0.0569**
200-PW-2 Operable Unit Analogous Waste Sites																								
	216-A-36A	Crib	Inventory and effluent volume included with the 216-A-36B Crib estimate.	30.5 m x 3.4 m (100 ft x 11 ft)	200 East	PUREX: 1965-1966; Site received ammonia scrubber wastes from 202-A; a large discharge of fission products resulted in termination of discharge and creation of 216-A-36B portion of the crib.	Typical	See Rationale	Yes	UNKN	See Rationale		—	—	—	—	—	—	—	—	—	—	—	—
216-B-12		Crib	**The contaminant distribution model for this representative site is developed in the Work Plan.**	**48.8 m x 15.2 m (160 ft x 50 ft)**	**200 East**	**Uranium Recovery and B Plant processes:1952-1973 3 cascading wood box design; process condensate from 221-U, 224-U, and 221-B process condensates low salt, neutral to basic; ammonium nitrate, uranium from the URP process condensate, and other rads.**	**Typical**	**Yes/28**	**No**	**Worst Case**	**520,000**	**18,300**	**2.10 E+04**	**3.74 E+02**	—	**7.16 E+02**	**7.93 E+01**	—	—	—	—	—	—	—
200-PW-2 Operable Unit Analogous Waste Sites																								
	216-B-60	Crib	Composite samples of the solid waste (sample numbers B-814, B-815, and B-816) indicated the solids contained 715.5 kg of uranium, 0.08 g of plutonium, 777 Ci of Ce-144, 8 Ci of Cs-137, and 5 Ci of Eu-154. 216-B-12 Crib received the same waste stream, however, 216-B-60 Crib did not receive enough effluent to impact groundwater.	2.4 m diam. x 5 m long (8 ft diam. x 16 ft long) caisson bottoms at 12 m (40 ft) depth and are covered by 46 cm (18 in.) thick concrete tops	200 East	B Plant: 1967-1967; The crib was specifically built for solid and liquid wastes generated from the cleanout of the 221-B Building cell drain header. Waste containing 700 kg of uranium was put into two steel caissons now located under a portion of 225-B (WESF).	Typical	No	No	Typical	18.9	438	7.20 E+02	8.00 E-02	—	8.00 E+00	—	—	—	—	—	—	—	—

Table C-3. 200-PW-2 and 200-PW-4 Operable Unit Consolidation Logic – Waste Sites Conforming to the Work Plan Contaminant Distribution Models. (6 Pages)

Representative Site or TSD	Accepted Waste Site Name	Waste Site Type	Rationale	Site Size	Area	Plant Process	Contaminant Inventory																	
							Case (Effluent Volume)	Soil Pore Volume Exceeded	Characterized or Data Evaluated	Case (Inventory)	Effluent Volume (m^3)	Pore Volume (m^3)	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	CCl_4 (kg)	Ferrocyanide (kg)	Hexone (kg)	Nitrate (kg)	NPH (kg)	$Na_2Cr_2O_7$ (kg)	TBP (kg)
200-PW-4 Operable Unit Analogous Waste Sites																								
	216-C-3	Crib	216-B-12 Crib is a bounding condition for this waste site. The inventory and effluent volumes are similar because they have comparable waste stream chemistry based on process knowledge. However less effluent was discharged and ground water would not be impacted such as it is at 216-B-12 Crib.	15.2 m x 3 m x 3 m (50 ft x 10 ft x 10 ft)	200 East	Hot Semiworks: 1953-1954 Site received waste from the 201-C, 215-C Gas Preparation Building, and 271-C Aqueous Makeup and Control Building	Typical	Yes/4	No	Typical	5,000	1,211	4.50 E+01	1.00 E+00	—	4.24 E-02	8.04 E+00	—	—	—	—	—	—	—
	216-C-5	Crib	216-B-12 Crib is a bounding condition for this waste site. The inventory and effluent volumes are similar because they have comparable waste stream chemistry based on process knowledge. However less effluent was discharged and ground water would not be impacted such as it is at 216-B-12 Crib.	6.1 m x 3 m x 4.9 m (20 ft x 10 ft x 16 ft)	200 East	Hot Semiworks: 1955 Site received the high salt waste (HSW) cold run waste from the 201-C and some waste that had passed through the 241-CX-71 Neutralization Tank.	Typical	No	No	Typical	38	484	5.40 E+01	1.00 E+00	—	4.44 E-02	4.20 E+00	—	—	—	—	—	—	—
	216-C-7	Crib	216-B-12 is a bounding condition for this waste site. The inventory and effluent volumes are similar because they have comparable waste stream chemistry based on process knowledge. However less effluent was discharged and ground water would not be impacted such as it is at 216-B-12 Crib.	6.1 m x 6.1 m x 3.7 m (20 ft x 20 ft x 12 ft)	200 East	Critical Mass Lab: 1961-1983 received radioactive liquid waste from the 209-E Critical Mass Laboratory	Typical	No	No	Typical	60	967	1.00 E-02	1.10 E+00	—	5.34 E-02	5.12 E-02	—	—	—	—	—	—	—
	216-C-10	Crib	216-B-12 Crib is a bounding condition for this waste site. The inventory and effluent volumes are similar because they have comparable waste stream chemistry based on process knowledge. However less effluent was discharged and ground water would not be impacted such as it is at 216-B-12 Crib. Scintillation Probe data are available for this waste site	9.8 m x 1.5 m x 2.1 m (32 ft x 5 ft x 7 ft)	200 East	Hot Semiworks: 1964-1969 Site received process condensate and liquid waste from the 201-C Building.	Typical	Yes/2	No	Typical	897	387	5.00 E-02	1.50 E-01	—	8.55 E-02	3.45 E+00	—	—	—	—	—	—	—
216-U-8[a]		Crib	**Site was characterized as part of the 200-UP-2 OU (DOE/RL-95-13). The contaminant distribution model for this representative site is developed in the Work Plan.**	**48.8 m x 15.2 m (160 ft x 50 ft)**	**200 West**	**Uranium Recovery: 1952-1960 3 cascading wood box design; process condensate from 221-U and 224-U Tanks, and 291-U-1 Stack drainage.**	**Typical**	**Yes/34**	**Yes**	**Worst Case**	**379,000**	**11,100**	**2.39 E+04**	**3.70 E+02**	**—**	**4.55 E-02**	**4.31 E-02**	**—**	**—**	**—**	**—**	**—**	**—**	**—**
200-PW-2 Operable Unit Analogous Waste Sites																								
	216-S-1&2	Crib	Inventory and effluent volume is bounded by the 216-U-8 Crib. Characterization performed for the 216-S-1 and 216-S-2 Cribs. (RHO-ST-39)	27.4 m x 12.2 m x 10.7 m (90 ft x 40 ft x 35 ft)	200 West	REDOX: 1952-1956; 2 cascading timbered cribs; received acidic cell drainage and process condensate from REDOX (202-S); contained cesium and strontium; rerouted to 216-S-7 Crib after UPR-200-W-36 release to groundwater.	Typical	Yes/27	Yes	Typical	160,000	6,020	2.25 E+03	1.20 E+03	—	1.10 E+03	1.25 E+03	—	—	—	60,000	—	—	—
	216-S-7	Crib	Inventory and effluent volume similar to the 216-U-8 Crib. Two nearby wells drilled in 1966 showed cesium and strontium within 21 ft of surface.	30.5 m x 15.2 m x 6.6 m (100 ft x 50 ft x 21.8 ft)	200 West	REDOX: 1956-1965; 2 cascading timbered cribs; replaced 216-S-1 and 216-S-2 Cribs; received REDOX acidic cell drainage and process condensate; D-2 receiver tank waste was rerouted to 216-S-9 Crib.	Typical	Yes/47	No	Typical	390,000	8,361	2.56 E+03	4.40 E+02	—	7.03 E+02	1.39 E+03	—	—	—	110,000	—	—	—

Table C-3. 200-PW-2 and 200-PW-4 Operable Unit Consolidation Logic – Waste Sites Conforming to the Work Plan Contaminant Distribution Models. (6 Pages)

Representative Site or TSD	Accepted Waste Site Name	Waste Site Type	Rationale	Site Size	Area	Plant Process	Contaminant Inventory																	
							Case (Effluent Volume)	Soil Pore Volume Exceeded	Characterized or Data Evaluated	Case (Inventory)	Effluent Volume (m^3)	Pore Volume (m^3)	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	CCl_4 (kg)	Ferrocyanide (kg)	Hexone (kg)	Nitrate (kg)	NPH (kg)	$Na_2Cr_2O_7$ (kg)	TBP (kg)
	216-U-1&2[a]	Crib	Site was characterized as part of the 200-UP-2 OU LFI (DOE/RL-95-13). The site is similar to the 216-U-8 Crib.	23.8 m x 8.5 m (78 ft x 28 ft)	200 West	Uranium recovery process: 1952-1957 Site received cell drainage from Tank 5-6 (221-U Building) and waste from the 224-U Building via the overflow from the 241-U-361 Settling Tank. From 6/57-7/57, the site received waste from the 224-U Building via the overflow from the 241-U-361 Settling Tank and contaminated solvent from the settling tanks in the 276-U Solvent Recovery area. From 7/57-5/67, the site received waste from the 224-U Building and equipment decontamination and reclamation wastes from Chemical Processing Division Services Operations in the 221-U Building canyon. Crib 2 was deactivated in May 1967. The waste is low in salt and is neutral to basic.	Typical	Yes/116	Yes	Typical	46,200	400	4.00 E+03	4.26 E+01	—	4.36 E+00	2.11 E+00	—	—	—	1,200,000	—	—	—
	UPR-200-W-163[a]	UPR	The UPR was caused by contaminated vegetation growing on the pipeline to the 216-U-8 Crib. Thus 216-U-8 Crib bounds this site for waste stream constituents and volume effluent. This site has been previously characterized as part of the 200-UP-2 OU LFI (DOE/RL-95-13).	4,000 sq. m (3.5 acres)	200 West	Uranium Recovery: Associated with contaminated vegetation growing on the pipeline to the 216-U-8 Crib (200-W-42 UPR).	Typical	UNKN	Yes	UNKN	-	-	—	—	—	-	-	—	—	—	—	—	—	—
216-U-8[a]		**Crib**	**Site was characterized as part of the 200-UP-2 OU LFI (DOE/RL-95-13). The contaminant distribution model for this representative site is developed in the Work Plan.**	**48.8 m x 15.2 m (160 ft x 50 ft)**	**200 West**	**Uranium Recovery: 1952-1960 3 cascading wood box design; process condensate from 221-U and 224-U Tanks, and 291-U-1 stack drainage.**	**Typical**	**Yes/34**	**Yes**	**Worst Case**	**379,000**	**11,100**	**2.39 E+04**	**3.70 E+02**	**—**	**4.55 E-02**	**4.31 E-02**	**—**	**—**	**—**	**—**	**—**	**—**	**—**
200-PW-4 Operable Unit Analogous Waste Sites																								
	216-S-4	French Drain	216-U-8 Crib is a bounding condition for this waste site. The inventory and effluent volumes are similar because they have comparable waste stream chemistry based on process knowledge (Both are process condensate waste cribs, however, 216-U-8 Crib used TBP in NPH, while 216-S-4 French Drain used hexone as a solvent. Same radionuclides and metal waste constituents are present.) Also, less effluent was discharged and ground water would not be impacted such as it is at 216-U-8 Crib.	0.76 m (2.5 ft) dia., 6.1 m (20 ft) long	200 West	Tank Farm: 1953-1956 Site received liquid from the 241-S-101 and 241-S-104 Tank condensers via an aboveground pipe.	Typical	Yes/7	No	UNKN	1,000	150	—	—	—	—	—	—	—	—	1	—	—	—
	216-S-23	Crib	216-U-8 Crib is a bounding condition for this waste site. The inventory and effluent volumes are similar because they have comparable waste stream chemistry based on process knowledge. (Both are process condensate waste cribs, however, 216-U-8 Crib used TBP in NPH, while 216-S-23 Crib used hexone as a solvent. Same radionuclides and metal waste constituents are present.)	109.7 m x 3 m x 8.5 m (360 ft x 10 ft x 28 ft)	200 West	REDOX: 1969-1972 Site received REDOX process condensate from D-2 Receiver Tank	Typical	Yes/6	No	Typical	34,100	6,020	2.90 E-01	9.94 E-01	—	3.47 E+00	1.14 E+00	—	—	—	0	—	—	—
	216-T-20	Trench	216-U-8 Crib is a bounding condition for this waste site. The inventory and effluent volumes are similar because they have comparable waste stream chemistry based on process knowledge Also, less effluent was discharged and ground water would not be impacted such as it is at 216-U-8 Crib.	3 m x 3 m x 1.2 m (10 ft x 10 ft x 4 ft)	200 West	Tank Farm: 1952 Site received contaminated nitric acid from 241-TX-155 Diversion Box Catch Tank.	Typical	No	No	Typical	18.9	66	5.00 E+00	—	—	4.40 E-01	3.88 E-01	—	—	—	15,000	—	—	—

Table C-3. 200-PW-2 and 200-PW-4 Operable Unit Consolidation Logic – Waste Sites Conforming to the Work Plan Contaminant Distribution Models. (6 Pages)

Representative Site or TSD	Accepted Waste Site Name	Waste Site Type	Rationale	Site Size	Area	Plant Process	Contaminant Inventory																	
							Case (Effluent Volume)	Soil Pore Volume Exceeded	Characterized or Data Evaluated	Case (Inventory)	Effluent Volume (m^3)	Pore Volume (m^3)	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	CCl_4 (kg)	Ferrocyanide (kg)	Hexone (kg)	Nitrate (kg)	NPH (kg)	$Na_2Cr_2O_7$ (kg)	TBP (kg)
	216-U-17[a]	Crib	Site replaced the 216-U-16 Crib, which was characterized as part of the 200-UP-2 OU LFI (DOE/RL-95-13). 216-U-8 Crib also was characterized as part of the 200-UP-2 OU because of its similar waste stream constituents and effluent volume	45.7 m x 3 m x 5.5 m (150 ft x 10 ft x 18 ft)	200 West	224-U Process: 1988-1994 Site received 224-U steam condensate, 224-U chemical sewer waste, 271-U compressor cooling water, 221-U chemical sewer waste, and 224-U process condensate.	Typical	Yes/1	No	Typical	2,110	2,100	1.42 E+00	—	5.30 E-05	—	—	—	—	—	—	—	—	—
216-U-12[a]		Crib	Site was characterized as part of the 200-UP-2 OU LFI (DOE/RL-95-13). Site is also a RCRA TSD unit that was characterized as part of closure activities. The contaminant distribution model for this representative site is developed in the Work Plan.	30.5 m x 3 m x 4.6 m (100 ft x 10 ft x 15 ft)	200 West	224-U Process: 1960-1965 RCRA TSD; Replacement for 216-U-8 Crib; single trench with VCP distribution pipe received stack drainage from 291-U-1 Stack, 244-WR vault, storm drainage from 224-U, and waste from C-5 and C-7 tanks in 224-U. In October, 1965 it received thorium waste from 244-WR vault; additional drainage from 224-U until it was replaced by 216-U-17 Crib.	Worst Case	Yes/107	Yes	Typical	150,000	1,400	2.01 E+03	1.00 E+00	6.45 E-03	5.66 E-02	5.59 E+01	—	—	—	—	—	—	—
200-PW-4 Operable Unit Analogous Waste Sites																								
	216-U-16[a]	Crib	Site was discussed as part of the 200-UP-2 OU LFI (DOE/RL-95-13) relative to the 216-U-1 and -2 Cribs and is similar to 216-U-12 Crib because they have comparable waste stream chemistry and effluent volumes. 216-U-12 Crib is a bounding condition for this waste site.	80 m x 58 m (262 ft x 191 ft)	200 West	224-U Process: 1984-1987 Site received 224-U steam condensate, 224-U chemical sewer waste, 271-U compressor cooling water, 221-U chemical sewer waste, and 224-U process condensate.	Worse Case	Yes/25	Yes	Typical	409,000	16,500	1.76 E+01	—	—	1.65 E-02	9.20 E-03	—	—	—	—	—	—	—

DOE/RL-95-13, *Limited Field Investigation for the 200-UP-2 Operable Unit.*

DOE/RL-2001-65, *200-MW-1 Miscellaneous Waste Group Operable Unit RI/FS Work Plan*, Rev. 0.

Hanford Federal Facility Agreement and Consent Order, 1989, as amended.

HW-60807, *Unconfined Underground Radioactive Waste and Contamination in the 200 Area—1959.*

RHO-ST-39, *216-S-1 and S-2 Mixed Fission Product Crib Characterization Study*, Rev. 0.

EPA = U.S. Environmental Protection Agency.
HSW = high-salt waste.
LFI = limited field investigation.
NPH = normal paraffin hydrocarbon.
OU = operable unit.
PUREX = Plutonium-Uranium Extraction (Plant).
RCRA = *Resource Conservation and Recovery Act of 1976.*
REDOX = Reduction-Oxidation (Plant).
RI/FS = remedial investigation/feasibility study.
TBP = tributyl phosphate.
Tri-Party Agreement = *Hanford Federal Facility Agreement and Consent Order*
TSD = treatment, storage, and disposal.
UNH = uranyl nitrate hexahydrate.
UNKN = unknown.
UPR = unplanned release.
VCP = vitrified clay pipe.
WESF = Waste Encapsulation and Storage Facility

[a] This site is included in the U Plant Regional Closure Area (see Section 1.2 for more details).

Table C-4. 200-PW-2 and 200-PW-4 Operable Units Consolidation Logic – Waste Sites Aligned With Other Operable Unit Contaminant Distribution Models. (5 Pages)

Representative Site or TSD/OU	Accepted Waste Site Name	Waste Site Type	Rationale	Site Size	Area	Plant Process	Contaminant Inventory															
							Case (Effluent Volume)	Soil Pore Volume Exceeded	Characterized or Data Evaluated	Case (Inventory)	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	CCl_4 (kg)	Ferrocyanide (kg)	Hexone (kg)	Nitrate (kg)	NPH (kg)	$Na_2Cr_2O_7$ (kg)	TBP (kg)
200-E-111/ 200-IS-1		**Process Piping**	**The 200-E-111 Pipeline conceptual contaminant distribution model was developed in the 200-IS-1 DQO (CP-13196) and Draft RI/FS Work Plan (DOE/RL-2002-14). The conceptual model illustrates a shallow vertical extent of contaminants that potentially occurred during process operations. Leaks are the primary source of potential contamination.**	**3 m long (9 ft long)**	**200 East**	**The underground, encased pipeline was used to transfer waste from 241-ER-151 to the C Tank Farm and the 244-AR Vault. The pipeline transported liquid effluent from the 241-ER-151 Diversion Box to the tank farms. Some adjacent soil has been contaminated from pipeline leaks.**	**Typical**	**UNKN**	**No**	**UNKN**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**	**—**
200-PW-2 Operable Unit Analogous Waste Sites																						
	200-W-42 [a]	Radioactive Process Sewer	Site was characterized as part of the 200-UP-2 OU (DOE/RL-95-13). Wastes, discharged via leaks would be shallow and of similar COCs to the 216-U-8 and 216-U-12 Cribs. However, a pipeline leak is best represented by a shallow contaminant distribution model or the 200-E-111 Pipeline conceptual contaminant distribution model generated during the 200-IS-1 OU DQO process.	646 m long (2120 ft long)	200 West	Uranium Recovery: 1952-1988; underground pipeline from the 221-U Building to the 216-U-8 and 216-U-12 Cribs.	Typical	UNKN	Yes	UNKN	---	---	---	---	---	---	---	---	---	---	---	---
	UPR-200-E-64 [b]	UPR	The speck contamination is best represented chemically by 216-B-12 Crib, because they are both from the same waste stream. However, the speck contamination represents a very shallow vertical extent of contamination. Because the 200-UR-1 OU does not yet have a conceptual contaminant distribution model for unplanned releases, the best representation is that of a pipeline.	Irregular	200 East	Site is associated with speck contamination from the 270-E-1 Neutralization Tank or a pipe just west of the 216-B-64 Basin. The tank was used to neutralize acidic process condensate from the 221-B and the 224-B facilities, via the 241-ER-151 Diversion Box to the tank and then to 216-B-12 Crib.	Typical	No	Yes	UNKN	—	—	—	—	—	—	—	—	—	—	—	—
200-PW-4 Operable Unit Consolidated Analogous Waste Sites																						
	UPR-200-E-145 [b]	UPR	Contaminated soil reading 300,000 d/min of beta/gamma was found in an excavation, above a buried vitrified clay pipeline. The pipeline carried waste from the 216-A-8 Crib Proportional Sample Pit #2 to the 216-A-34 Ditch. The contaminated soil read 300,000 d/min with a Geiger-Mueller/ Probe-11 instrument. Sample results indicate that the contamination was primarily caused by uranium oxide from past practices on the Hanford site. The 200-E-111 Pipeline is analogous based on similarity of the structures.	12.2 m x 1.8 m (40 ft x 6 ft)	200 East	PUREX: 1993 pipeline between 216-A-8 Crib and 216-A-34 Ditch leaked. Nonrelated excavation found contamination around the VCP.	UNKN	UNKN	No	UNKN	—	—	—	—	—	—	—	—	—	—	—	—

Table C-4. 200-PW-2 and 200-PW-4 Operable Units Consolidation Logic – Waste Sites Aligned With Other Operable Unit Contaminant Distribution Models. (5 Pages)

Representative Site or TSD/OU	Accepted Waste Site Name	Waste Site Type	Rationale	Site Size	Area	Plant Process	Contaminant Inventory															
							Case (Effluent Volume)	Soil Pore Volume Exceeded	Characterized or Data Evaluated	Case (Inventory)	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	CCl_4 (kg)	Ferrocyanide (kg)	Hexone (kg)	Nitrate (kg)	NPH (kg)	$Na_2Cr_2O_7$ (kg)	TBP (kg)
216-B-2-2/ 200-CW-1		Ditch	The site received approximately 0.7 times the calculated pore volume, however, the ditch was used to route wastewater to B Pond. The effluent did not percolate into the vadose zone more than 25 ft as reported in the borehole summary report, which was based on characterization of a borehole at the head end of the ditch. Samples were collected and analyzed for chemical, radiological and physical properties. A total account of the drilling and sampling can be found in BHI-01177, "Borehole Summary Report for the 216-B-2-2 Ditch."	1,097 m x 4.6 m (3,600 ft x 15 ft)	200 East	Power house and WESF operations: 1963-1970 The site received chemical process sewer effluent from B Plant and its support facilities. The site also transported and percolated the 284-E Powerhouse waste, 241-CR Vault cooling water, 221-B cooling water and steam condensate (replacing 216-B-2-1), and chemical sewer toward 216-B-3 Pond. In addition, BY Tank Farm In Tank Solidification Unit 1 cooling water was transported and percolated by the ditch.	Typical	No	Yes	Typical	—	4.20 E-02	—	3.14 E-01	1.47 E+02	—	—	—	—	—	—	—
200-PW-4 Operable Unit Consolidated Analogous Waste Sites																						
	216-A-34	Ditch	The 216-A-34 Ditch is configured similarly to the 200-CW-1 OUs 216-B-2-2 Ditch. Thus, the contaminant distribution model is expected to be similar for vertical migration. However, 216-A-19 Trench would better represent the COCs expected at the waste site.	85.3 m x 9.1 m (280 ft x 30 ft)	200 East	A Tank Farm: 1955-1957 received the cooling water from the contact condenser in the 241-A-431 Building in route to the 216-A-19 and 216-A-20 Trenches.	UNKN	UNKN	No	UNKN	—	—	—	—	—	—	—	—	—	—	—	—
216-B-5/ 200-TW-2		Injection/ Reverse Well	The 216-B-5 reverse well received waste discharge that went directly to the water table. A water sample collected from well 299-E33-18 in September 1947 revealed alpha contamination in the groundwater (<20 x 10-7 µCi/L). The reverse well was characterized again in 1980.	0.2 m diam by 92 m long (0.7 ft diam by 302 ft long)	200 East	B Plant (Bismuth Phosphate): 1945-1947 The site received supernatant overflow from 241-B-361 Settling Tank waste via Tank 5-6 in 221-B Building and liquid waste from 224-B Building. The site also received the cell drainage and other liquid waste via Tank 5-6 in 221-B.	Worst Case	Yes	Yes	Worst Case	—	4.27 E+03	—	2.92 E+01	2.55 E+01	—	—	—	400,000	—	—	—
200-PW-2 Operable Unit Consolidated Analogous Waste Sites																						
	UPR-200-W-36	UPR	Waste contaminants are analogous to the 216-S-1 and 216-S-2 Cribs and were investigated in RHO-ST-39. The faulty well-casing served as a preferential pathway for the contaminants to travel through the vadose zone and impact groundwater, causing this UPR. UPR is monitored by nearby wells (HW-60807). Based on this information, the 216-B-5 Reverse Well provides the best contaminant distribution model.	30 m x 15 m (98 ft x 49 ft)	200 West	REDOX: 1955; Contaminants from the 216-S-1 and 216-S-2 Cribs were inadvertently released to the groundwater via an adjacent failed groundwater well casing.	UNKN	Yes	No	UNKN	—	—	—	—	—	—	—	—	—	—	—	—

Table C-4. 200-PW-2 and 200-PW-4 Operable Units Consolidation Logic – Waste Sites Aligned With Other Operable Unit Contaminant Distribution Models. (5 Pages)

Representative Site or TSD/OU	Accepted Waste Site Name	Waste Site Type	Rationale	Site Size	Area	Plant Process	Contaminant Inventory																
							Case (Effluent Volume)	Soil Pore Volume Exceeded	Characterized or Data Evaluated	Case (Inventory)	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	CCl_4 (kg)	Ferrocyanide (kg)	Hexone (kg)	Nitrate (kg)	NPH (kg)	$Na_2Cr_2O_7$ (kg)	TBP (kg)
241-CX-71/ 200-IS-1		Neutralization Tank	**Releases from the tank, if present, would have been due to leaks. It is anticipated, that if the tank did leak, it would be caused by an overflow through a vent riser or connecting valve or through pin hole leaks. Thus, a minimal amount of waste would reach the vadose zone, resulting in a shallow vertical extent.**	**1.5 m dia. by 2 m long (5 ft dia. by 6.5 ft long)**	**200 East**	**REDOX, PUREX, and Hot Semiworks operations: 1952-1957 The tank was used for neutralizing the 201-C process condensate and the coil and condenser cooling water via a limestone layer. It also received process condensates from the REDOX and PUREX pilot plant processes, which would include hexone and kerosene solvents. The unit also received flush wastes during decontamination. This tank currently contains a bottom layer of sludge and the limestone layer.**	**UNKN**	**UNKN**	**Yes**	**Typical**	**—**	**—**	**—**	**4.92 E-02**	**9.30 E+01**	**—**	**—**	**—**	**—**	**—**	**—**	**—**
200-PW-2 Operable Unit Consolidated Analogous Waste Sites																							
	200-E-58[b]	Neutralization Tank	Wastes, if any, that may have been discharged via leaks would be shallow and of similar COCs to the 216-A-5 and 216-A-10 Cribs. However, a tank leak is best represented by the contaminant distribution model of 241-CX-71 Neutralization Tank generated during the 200-IS-1 OU DQO process.	4.9 m deep x 3.4 m dia. (16 ft deep x 11 ft dia.)	200 East	PUREX: 1955-1987 Limestone waste neutralization tank for PUREX acid waste.	Typical	No	No	UNKN	—	—	—	—	—	—	—	—	—	—	—	—
	241-U-361[a]	Settling Tank	Waste contaminants are analogous to 216-U-1 and 216-U-2 Cribs, which previously have been characterized as part of the 200-UP-2 OU (DOE/RL-95-13). However, a tank leak is best represented by the contaminant distribution model of 241-CX-71 Neutralization Tank generated during the 200-IS-1 OU DQO process.	7.6 m deep x 6.1m dia. (25 ft deep x 20 ft dia.)	200 West	Uranium Recovery and 224-U processes: 1951-1967 The tank received cell drainage from the 5-6 tank in 221-U and waste from the 224-U building. The tank also routed 224-U facility and equipment decontamination waste and reclamation waste from the 221-U canyon to the 216-U-1 and 216-U-2 Cribs.	Typical	UNKN	Yes	Typical	4.00 E+03	—	—	—	—	—	—	—	—	—	—	—
	270-E-1[b]	Neutralization Tank	Waste contaminants are analogous to 216-B-12 which has been previously characterized as part of the 200-UP-2 OU (DOE/RL-95-13). However, a tank leak is best represented by the contaminant distribution model of 241-CX-71 Neutralization Tank generated during the 200-IS-1 OU DQO process.	2.7 m deep x 2.7 m dia. (9 ft deep x 9 ft dia.)	200 East	B Plant: 1952-1957; The tank was used to neutralize acidic process condensate from the 221-B and the 224-B facilities, via the 241-ER-151 Diversion Box. Condensate entered the tank at the bottom and flowed upward through the limestone to an outlet pipe located 2.4 m (8 ft) above the tank bottom. The tank contained a limestone bed through which the condensate percolated, reacted, and then overflowed to the 216-B-12 Crib.	Typical	UNKN	Yes	UNKN	—	—	—	—	—	—	—	—	—	—	—	—
	270-W[a]	Neutralization Tank	Waste contaminants are analogous to 216-U-12 Crib, which has been previously characterized as part of the 200-UP-2 OU (DOE/RL-95-13). However, a tank leak is best represented by the contaminant distribution model of 241-CX-71 Neutralization Tank generated during the 200-IS-1 OU DQO process.	2.7 m deep x 2.7 m dia. (9 ft deep x 9 ft dia.)	200 West	Uranium Recovery: 1952-1960; The tank was filled with limestone and used to neutralize acidic process condensate generated from the 224-U building. Following the pH adjustment, the waste was released to the 216-U-8 Crib via a 15 cm (6 in.) VCP line. The 216-U-8 Crib was taken out of service in 1960 and replaced with the 216-U-12 Crib.	Typical	UNKN	Yes	UNKN	—	—	—	—	—	—	—	—	—	—	—	—
	UPR-200-E-39[b]	UPR	Release occurred during operation of the 216-A-36B Crib and because it was caused by similar process chemistry in the waste stream, 216-A-36B Crib best represents the waste stream constituents. However, the release was caused by an overflow of effluent to the sample shack. Thus, the release is modeled by an overfilled tank. Thus, 241-CX-71 best describes the contaminant distribution of the waste.	7.9 m x 7.9 m (26 ft x 26 ft)	200 East	PUREX: 1968; Associated with the 216-A-36B Crib. Pressurized PUREX ammonia scrubber waste containing fission products was found to be spewing from the vent filter at the 216-A-36B Crib Sampling Shack (295-A). Waste was released to the ground and asphalt pad near the sampling shack.	Typical	No	Yes	UNKN	—	—	—	—	—	—	—	—	—	—	—	—

Table C-4. 200-PW-2 and 200-PW-4 Operable Units Consolidation Logic – Waste Sites Aligned With Other Operable Unit Contaminant Distribution Models. (5 Pages)

Representative Site or TSD/OU	Accepted Waste Site Name	Waste Site Type	Rationale	Site Size	Area	Plant Process	Contaminant Inventory															
							Case (Effluent Volume)	Soil Pore Volume Exceeded	Characterized or Data Evaluated	Case (Inventory)	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	CCl_4 (kg)	Ferrocyanide (kg)	Hexone (kg)	Nitrate (kg)	NPH (kg)	$Na_2Cr_2O_7$ (kg)	TBP (kg)
	UPR-200-W-19[a]	Unplanned Release	Waste is analogous to 216-U-1 and 216-U-2 Cribs, which previously have been characterized as part of the 200-UP-2 OU. However, the shallow extent of contamination is best represented by a conceptual contaminant distribution model that represents a tank overflow.	>4.7 sq m (>50 sq ft)	200 West	Uranium Recovery: 1953; Associated with a surface release from the 241-U-361 Settling Tank and 216-U-1 and 216-U-2 Cribs vent structure overflow.	Typical	No	Yes	UNKN	—	—	—	—	—	—	—	—	—	—	—	—
200-PW-4 Operable Unit Consolidated Analogous Waste Sites																						
	209-E-WS-3[b]	Valve Pit and Tank	Releases occurring from the tank and valve pit during operations have the same waste stream process chemistry. 216-C-7 Crib best represents the waste stream constituents. However, a potential release is caused by an overflow or minor leaking of effluent. The release is best modeled by an overfilled tank. Thus, 241-CX-71 Neutralization Tank describes the expected contaminant distribution of the waste.	2.1 m x 1.5 m x 2.1 m (7 ft x 5 ft x 7 ft)	200 East	Critical Mass Lab: 1960 to 1989- The tank held the condensate before it was released to the cribs. The tank was routinely sampled for plutonium content to determine that the contents were below crib discharge levels. Present contents of the tank are estimated to consist of residual water from condensate collection, containing only low levels of plutonium. After sampling, the contents were discharged to the 216-C-7 Crib.	UNKN	UNKN	No	UNKN	—	—	—	—	—	—	—	—	—	—	—	—
207-A-SOUTH	See Table C-5																					
200-PW-2 Operable Unit Analogous Waste Sites																						
	200-W-22	UPR	This site is the area presently designated as an underground radioactive materials area. This includes radioactive structures that were covered in place such as the 203-S Basin, the 204-S Basin, the 205-S Vault, the 205-S Building base pad, various isolated utility lines, the concrete encased pipeline from the REDOX facility to the tank farm, and the REDOX chemical sewer. Structures were removed to a level equal to 0.6 m (2 ft) below the railroad grade level. The area was graded and leveled with clean backfill material. The final closure activities included placing signs and concrete monuments. Thus, the best contaminant distribution model for this general area is that of 207-A South Retention Basin. Please note that this site will not be characterized, but information gained through the characterization of 207-A South Retention Basin will be applied to the site before a remedial alternative is chosen.	84 m x 68 m (276 ft x 223 ft)	200 West	REDOX UNH Recovery: The site is associated with the 203-S and 205-S UNH Processing Facilities and the REDOX UNH Unloading Facility. This WIDS site is the stabilized area remaining after the process facility was decommissioned. Decommissioning activities (1983) included removing aboveground equipment and structures, isolating utilities, removal of process equipment and tanks, and surface stabilizing the remainder of the site. The bulk of the radioactive structures and equipment were removed and buried. No attempt was made to remove deep concrete structures or buried piping.	UNKN	Typical	No	No	---	---	---	---	---	---	---	---	---	---	---	---
	203-S & 205-S	Process Unit/Plant	This site is essentially the same as 200-W-22 UPR with the exception that designations 203-S and 205-S originally represented the facilities that have now been removed. Because this area has been included with the 200-W-22 UPR, it is presumed that the 207-A South Retention Basin will be the analogous contaminant distribution model for this site.	Contained within the previously described area	200 West	See the description provided above.	UNKN	Typical	No	No	---	---	---	---	---	---	---	---	---	---	---	---

Table C-4. 200-PW-2 and 200-PW-4 Operable Units Consolidation Logic – Waste Sites Aligned With Other Operable Unit Contaminant Distribution Models. (5 Pages)

Representative Site or TSD/OU	Accepted Waste Site Name	Waste Site Type	Rationale	Site Size	Area	Plant Process	Contaminant Inventory															
							Case (Effluent Volume)	Soil Pore Volume Exceeded	Characterized or Data Evaluated	Case (Inventory)	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	CCl_4 (kg)	Ferrocyanide (kg)	Hexone (kg)	Nitrate (kg)	NPH (kg)	$Na_2Cr_2O_7$ (kg)	TBP (kg)

BHI-01177, *Borehole Summary Report for the 216-B-2-2 Ditch.*

CP-13196, *Remedial Investigation Data Quality Objectives Summary Report – 200-IS-1 and 200-ST-1 Operable Units*, Draft A.

DOE/RL-95-13, *Limited Field Investigation for the 200-UP-2 Operable Unit*, Rev. 0.

DOE/RL-2002-14, *Tanks/Lines/Pits/Boxes/Septic Tank and Drain Fields Waste Group Operable Unit RI/FS/Work Plan and RCRA TSD Unit Sampling Plan.*

HW-60807, *Unconfined Underground Radioactive Waste and Contamination in the 200 Area—1959.*

RHO-ST-39, *216-S-1 and S-2 Mixed Fission Product Crib Characterization Study*, Rev. 0.

COC = contaminant of concern.
DQO = data quality objective.
IS-1 RI/FS Work Plan = DOE/RL-2002-14.
NPH = normal paraffin hydrocarbon.
OU = operable unit.
PUREX = Plutonium-Uranium Extraction (Plant).
REDOX = Reduction-Oxidation (Plant).
RI/FS = remedial investigation/feasibility study.
TBP = tributyl phosphate.
TSD = treatment, storage, and disposal (unit).
UNH = uranyl nitrate hexahydrate.
UNKN = unknown.
UPR = unplanned release.
VCP = vitrified clay pipeline.
WESF = Waste Encapsulation and Storage Facility.
WIDS = Waste Information Data System.

[a] This site is included in the U Plant Regional Closure Area (see Section 1.2 for more details).

[b] This site will be evaluated for potential reassignment to another operable unit during the feasibility study.

Table C-5. 200-PW-2 and 200-PW-4 Operable Unit Consolidation Logic – Waste Sites Not Aligned With the 200-PW-2 and 200 PW-4 Operable Units or Other Operable Unit Contaminant Distribution Models.

Representative Site or TSD	Accepted Waste Site Name	Waste Site Type	Rationale	Site Size	Area	Plant Process	Contaminant Inventory															
							Case (Effluent Volume)	Soil Pore Volume Exceeded	Character-ized or Data Evaluated	Case (Inventory)	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	CCl_4 (kg)	Ferrocyanide (kg)	Hexone (kg)	Nitrate (kg)	NPH (kg)	$Na_2Cr_2O_7$ (kg)	TBP (kg)
200-PW-4 Operable Unit Consolidated Waste Sites and Treatment, Storage, and Disposal Unitss																						
207-A-SOUTH		Retention Basin	Site is a RCRA TSD unit that requires characterization as part of closure activities. Effluent passed through this site to the 216-A-37-1 Ditch. Contaminants would be the same.	40.5 m x 29 m x 2 m (133 ft x 95 ft x 7 ft)	200 East	Tank Farm: RCRA TSD; 1977 to 1989; interim storage of the 242-A Evaporator process condensate before discharge to the 216-A-37-1 Crib.	UNKN	UNKN	No	UNKN	---	---	---	---	---	---	---	---	---	---	---	---
216-A-37-1		Crib	Site is a RCRA TSD unit that requires characterization as part of closure activities. Site Groundwater has been monitored by nearby RCRA groundwater wells. (PNNL-13788).	213.4 m x 3 m (700 ft x 10 ft)	200 East	Tank Farm: RCRA TSD; 1977 to 1989 for the percolation of the 242-A Evaporator process condensate; regulated as mixed waste; low rad inventory; low salt, neutral/basic liquids; originated from some waste volume reduction process.	Typical	Yes/24	No	Typical	3.24 E+01	2.83 E-02	3.69 E-04	9.47 E-02	5.42 E-02	---	---	---	600	---	---	---

PNNL-13788, *Hanford Site Groundwater Monitoring for Fiscal Year 2001.*

NPH = normal paraffin hydrocarbon.

RCRA = *Resource Conservation and Recovery Act of 1976.*

TBP = tributyl phosphate.

TSD = treatment, storage, and disposal (unit).

APPENDIX D

SAMPLING AND ANALYSIS PLAN

FOR THE 216-S-7 CRIB

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TERMS

AMSCO	Allen Maintenance Supply Company, Inc.
amsl	above mean sea level
bgs	below ground surface
COC	contaminant of concern
DQO	data quality objective
Ecology	Washington State Department of Ecology
FH	Fluor Hanford, Inc.
FS	feasibility study
hexone	methyl isobutyl ketone
MIBK	methyl isobutyl ketone
OU	operable unit
PPU	Plio-Pleistocene unit
QAPjP	quality assurance project plan
REDOX	Reduction/Oxidation (Plant)
RI	remedial investigation
RL	U.S. Department of Energy, Richland Operations Office
SAP	sampling and analysis plan
Tri-Party Agreement	*Hanford Federal Facility Agreement and Consent Order*
WIDS	*Waste Information Data System*

APPENDIX D

SAMPLING AND ANALYSIS PLAN

D1.0 INTRODUCTION

This sampling and analysis plan (SAP) for the remedial investigation (RI) of the 200-PW-2 and 200-PW-4 Operable Units (OU) directs sampling and analysis activities that will be performed to characterize the vadose zone at the 216-S-7 Crib which is a part of the 200-PW-2 Uranium-Rich Process Waste Group OU in the 200 Areas of the Hanford Site. The sampling and analyses described in this document will provide soil data to define a conceptual contaminant distribution model, support an assessment of risk, and evaluate a range of remedial alternatives for waste sites in the 200-PW-2 and 200-PW-4 OUs.

In January 2004, the Washington State Department of Ecology (Ecology) sent a letter (Ecology 2004, "Requested Revision of the 200-PW-2/200-PW-4 Operable Units (OU) Remedial Investigation/Feasibility Study (RI/FS) Work Plan") to the U.S. Department of Energy, Richland Operations Office (RL), requesting additional revisions to the work plan beyond those that initially had been discussed when the 200-PW-4 OU was consolidated into the 200-PW-2 OU. More specifically, Ecology requested that the 216-S-7 Crib be characterized as an additional representative waste site for the 200-PW-2 OU. In a response letter (DOE/RL 2004, "Response to Request for Revision of the 200-PW-2/200-PW-4 Operable Units (OU) Remedial Investigation/Feasibility Study (RI/FS) Work Plan") RL agreed to prepare a separate SAP to execute the additional sampling; this new SAP would become an additional appendix in the revision to the work plan. Data collected from the characterization borehole to be drilled at the 216-S-7 Crib will be included in the feasibility study (FS) that will be written to meet *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1989) Milestone M-15-43C. In this manner, the schedule for submittal of the RI report, due in June 2004 as part of Tri-Party Agreement Milestone M-15-43B, still can be achieved.

The scope of activities described in this SAP involves sampling and geophysical logging of a borehole to be drilled to groundwater at the 216-S-7 Crib, and geophysical logging of existing boreholes within the immediate vicinity of the 216-S-7 Crib, to obtain additional information on the distribution of contamination at this waste site. Soil samples will be collected and analyzed for radiological and nonradiological contaminants of concern (COC) and physical properties.

D1.1 BACKGROUND

Background information on the remaining waste sites associated with the 200-PW-2 and 200-PW-4 OUs can be found in the remainder of the work plan or the SAP found in Appendix B.

D1.2 200-PW-2 AND 200-PW-4 OPERABLE UNIT WASTE SITE LOCATIONS

The 200-PW-2 and 200-PW-4 OUs are located on the Hanford Site in southeastern Washington State, in the vicinity of the 200 East and 200 West Areas. All waste sites are located within the 200 Areas exclusive land-use boundary identified in DOE/EIS-0222-F, *Final Hanford Comprehensive Land-Use Plan Environmental Impact Statement*. Figures 2-10 through 2-14 in the main body of this work plan show the specific locations of waste sites in these two OUs. The 216-S-7 Crib is shown in Figure 2-11.

D1.3 SITE DESCRIPTION AND HISTORY

The following section provides a description of the 216-S-7 Crib that will be investigated. More general details are provided in Section 2.2 of the work plan.

D1.3.1 216-S-7 Crib

The 216-S-7 Crib is located in the 200 West Area, about 230 m (750 ft) northwest of the 202-S Canyon Building and 290 m (95 ft) east of the SX Tank Farm (Figure 2-11 in the work plan). It was constructed in 1955 to receive the waste treatment stream from the Reduction-Oxidation (REDOX) process and was active between January 1956 and July 1965. Before disposal at this crib, the waste stream had been sent to the 216-S-1/216-S-2 Cribs. The 216-S-1/216-S-2 Cribs were shut down when it was discovered that acidic wastes had corroded the monitoring well casing and penetrated to sediments near the groundwater. A release of hexone-rich concentrator wastes to the 216-S-1/216-S-2 Cribs was documented as an unplanned release (UPR-200-W-36) in August 1955, and construction of the 216-S-7 Crib began shortly thereafter. After operations ceased in 1965, this waste stream was routed to the 216-S-9 Crib until January 1969 and then to the 216-S-23 Crib until July 1972.

D1.3.1.1 Construction

The waste site consists of two roofed wooden boxes, or cribs, each of which is 4.9 x 4.9 m (16 x 16 ft) square by 1.6 m (5.2 ft) tall (Figure D-1). The wooden cribs are centered 15.2 m (50 ft) apart in an excavation with bottom dimensions of 15.2 x 30.4 m (50 x 100 ft). The cribs received liquid waste from the 202-S REDOX Plant building through an 8.9 cm (3.5 in.) OD, 304 L stainless steel pipeline buried approximately 4.6 m (15 ft) below ground surface (bgs). Within the waste site, the pipeline slopes at a 0.85 percent grade to maintain flow. The pipeline split at the center of the crib and fed the two boxes in parallel. Two risers extended from the roof of the cribs to above grade. Each riser was a Schedule 40, 10 cm (4 in.) diameter pipe. One riser was equipped with filters to ventilate the cribs and the other probably was used to measure water levels in the cribs.

The excavation is 6.7 m (22 ft) deep. Surface elevation at the original ground surface is 205.5 m (674.2 ft) above mean sea level (amsl). The wood cribs rest on a 0.61 m (2 ft) thickness of 3+ in. washed gravel, which also filled the excavation around the cribs to a depth of at least 1.5 m (5 ft). This gravel is capped by a 10 cm (4 in.) thickness of 0.75 to 1.5 in. gravel which, in turn,

is covered with a 5 cm (2 in.) thickness of 0.25 to 0.75 in. pea gravel. Covering this is a vapor barrier, composed of two layers of heavy Sisalkraft[1] construction paper. The paper extended over the entirety of the gravel bed and lapped up the side of the excavation 0.61 m (2 ft). The 15 cm (6 in.) of finer gravels was carried over the tops of the cribs and required mounding of the coarser gravels around the sides of the cribs. The excavated soil probably was used as backfill over the gravel and Sisalkraft barrier. Surface dimensions of the excavation are 28.7 x 43.9 m (94 x 144 ft), based on a 45 degree slope into the excavation.

At least one 0.61 m (2 ft) thickness of clean soil was placed over the waste site in 1992. At least one, and possibly more, episodes of collapse at the wooden boxes are known and were stabilized with available fill. This may have raised the local stabilized soil thickness to greater than 0.61 m. There are no indications of the Schedule 40 risers at ground level, and the *Waste Information Data System* (WIDS) report suggests that the above-ground risers were removed before August 1975.

D1.3.1.2 Waste Stream Characteristics

The 216-S-7 Crib received 390,000,000 L (103,000,000 gal) of process wastes. The primary sources for the wastes were the D-1 and D-2 cell tanks in the 202-S (REDOX) Plant. The discharged waste was acidic (as low as pH=2), at least at the start of 216-S-7 Crib operations. An estimated 3 percent by volume of the waste from this tank was settleable solids. Temperatures of the waste sent to the crib ranged up to 60°C (140°F).

The waste received by the crib was stored in the D-1 and D-2 tanks inside 202-S Plant. The 202-S Plant was designed around a reduction-oxidation, solvent extraction separations process using methyl isobutyl ketone (hexone) to separate plutonium and uranium from decladded, dissolved fuel rod solutions. The process used a multicolumn solvent extraction system to (1) extract most of the uranium and plutonium from the fission products-rich dissolved fuel rod solution, (2) separate plutonium from uranium, and (3) refine resultant uranium and plutonium solutions in two- or three-step decontamination processes. Solvent (hexone) extraction, treatment, and recycling also was important to overall plant operations. The residual fuel rod solution was concentrated and sent to the S/SX Tank Farms for storage.

The D-2 tank discharged an estimated 63,200 L/day (16,700 gal) of waste from a series of concentrators and evaporators associated with each hexone-based solvent extraction decontamination column. These columns were first used to strip fission products from the dissolved fuel rods containing plutonium and uranium. This high-activity waste stream was sent to the tanks in theS Tank Farm after it had been treated in the D-12 waste concentrator. The D-12 vessel reduced and concentrated the liquid volume for disposal to the S Tank Farms; hexone and other volatiles were driven off in the heated vapor phase. This and other process condensate waste streams ultimately were sent to the D-5 condensate stripper, where the hexone was driven off for recovery and reuse. Residual liquid from this vessel was routed to the

[1] Sisalkraft (paper) is a trademark of Fortifiber Corporation, Los Angeles, California.

D-4 evaporator for concentration. The residual liquids from this step were sent to the D-2 holding tank and discharged to the crib in batches.

Cell drainage waste from the D-1 holding tank was collected from a variety of sources, cell floor drainage, and decontamination room drainage. The latter included caustics, acids solvents, grease, hexone, and miscellaneous materials from washing cask railcars.

D1.3.1.3 Waste Site Contaminants

As shown in Table 3-1 of the work plan, the wastes discharged to the soil column at the 216-S-7 Crib included 2,560 kg of uranium, 440 g of plutonium, 703 Ci of Cs-137, and 1,390 Ci of Sr-90 (decayed through 1989). RHO-CD-673, *Handbook, 200 Area Waste Sites*, Vol 2, also indicated that the initial inventory included 25 Ci of Co-60 and 1,500 Ci of Ru-106. Chemical inventory data included 110,000 kg of nitrate, 40,000 kg of aluminum nitrate, 250,000 kg of nitric acid, and 7,000 kg of sodium.

D1.3.1.4 Geology/Hydrogeology

This discussion is summarized from RPP-6149, *Vadose Zone Geology of Boreholes 299-W22-50 and 299-W23-19 S-SX Waste Management Area Hanford Site, South-Central Washington*, which was written based on observations and logging from wells 299-W22-50 and 299-W23-19 around the SX Tank Farms. That geologic interpretation has been used to evaluate the driller's logs from the five boreholes (299-W22-12, 299-W22-13, 299-W22-14, 299-W22-32, and 299-W22-33) drilled in and around the 216-S-7 Crib. Also, recent (2001) borehole logs from wells 299-W22-82 and 299-W22-83, located 125 m (400 ft) west of the crib, were examined to check on correlations with the older wells. The stratigraphy is presented in Figure D-2, and the locations of the existing and planned boreholes are shown in Figure D-3.

The site geology is dominated by a series of unconsolidated fine-grained sands interbedded with river gravels ranging in age from Recent to Pliocene (up to 5.8 million years old) and derived from depositional environments associated with rivers and floodplains. At the surface, a thin surface veneer of wind-blown sand dunes overlies an estimated 39 m (128 ft) thickness of Hanford formation sands and gravels. The Hanford formation is an informally defined unit used on and around the Site and includes all deposits associated with Holocene glacial flooding, whether flood channel gravels or overbank silty sands. It is broken down into silty, sandy, and gravelly subunits. The lower unit has been noted to vary laterally from sandy silts to gravels. This unit varies widely in characteristics and thickness, up to 107 m (350 ft), across the site and is thickest in the 200 East Area.

Below this lies the Cold Creek unit, formerly known as the Plio-Pleistocene unit, a 0 to 12 m (40 ft) thick combination of silty sand and sandy silt, consisting of the Palouse soil and calcium carbonate-rich caliche sediments. This unit is locally discontinuous across the Hanford Site, but is present over most of the 200 West Area. The Ringold Formation comprises a number of Pliocene-age silty sands interbedded with thick river gravels. The Ringold Formation is up to 180 m (600 ft) thick and overlies Columbia River basalt flows, which form the base of the unconfined aquifer.

The uppermost sand dune layer frequently is cleared from site construction areas and may have been incorporated as part of the backfill at the crib. The Hanford 1 unit silty sand underlies the 216-S-7 Crib to a depth of 16.8 m (55 ft) bgs. Gravels are found in the lower part of this unit. The Hanford 2 unit is another combination of silty sands interbedded with occasional sandy gravels. This unit is about 29 m (95 ft) thick. The Hanford 3 and Hanford 4 units, gravelly and silty sediments, respectively, are present elsewhere on site but are absent here.

The Cold Creek unit (Palouse soil/caliche) is estimated to be less than 3 m (10 ft) thick and is found at a depth of about 44-47 m (145-155 ft) bgs. The thickness of both components is difficult to gauge from borehole logs, because the lithologies vary considerably among the five boreholes at the crib.

Directly below the Cold Creek unit, the Ringold Formation varies from fine-grained silty sands to coarse gravels and cobbles. The sands appear to coarsen with depth, also gaining in gravel content. Where present, the sands range between 7.6 and18.3 m (25 to 60 ft) in thickness before giving way to coarser gravels, cobbles, and rock below the water table. Where present, the gravel/cobble/rock layer may extend for the entire thickness from the Cold Creek Unit to below the current groundwater layer.

In the 200-West Area at the Hanford Site, the unconfined aquifer is found primarily within the Ringold Formation. Before Hanford Site operations began, groundwater flow was from west to east, including at the site of the 216-S-7 Crib. With the disposal of large quantities of waste water to ponds and cribs, the regional flow regime was radically altered. The 216-U-10 Pond, active between 1944 and 1985, received 165 billion liters (43.6 billion gallons) of water. The pond was located ~700 m (2,300 ft) northwest of the 216-S-7 Crib. Groundwater mounding under the pond produced radial flow which, beneath the 216-S-7 Crib, likely flowed to the east-southeast. In the process, groundwater elevations were raised significantly during the pond's operation, to within 60.4 m (198.2 ft) of the ground surface in June 1978. Water levels have declined at the crib since then and are declining at a rate of about 0.3 m/yr (1 ft/yr). At present, the groundwater is about ~69.2 m (227 ft) bgs, and the groundwater flow is approaching a more west-to-east flow. Regionally, groundwater flow in the 200 West Area is typically to the northeast, toward the gap between Gable Butte and Gable Mountain. In the southern-most part of the 200 West Area, the flow may be more to the east and southeast.

Groundwater in the unconfined aquifer occurs in the Ringold Formation and extends down to the top of basalt. The Ringold Formation is a series of interbedded stream gravels and fine grained, overbank deposits, composed primarily of silty sands. The top of the aquifer is currently in the Ringold E gravels, the uppermost of the stream gravel units, and is overlain in places by a fine-grained silty sand.

The interbedding of the stratigraphic units varies both vertically and laterally. Available borehole logs at the 216-S-7 Crib, although old and of limited detail, indicate that there is considerable variability in the depth to contact between the subunits, both in the Ringold aquifer and in the overlying Hanford formation. Significant elevation differences and unit thicknesses may exist between boreholes.

D1.3.1.5 Vadose Zone Waste Behavior

Early crib operations were governed by limits on the breakthrough of Sr-90 and Cs-137 to groundwater. Three boreholes (299-W22-12, 299-W22-13 and 299-W22-14) were installed to below groundwater (total depth = 97.9 to 105.2 m, or 321 to 345 ft) at the beginning of crib operations, to monitor radionuclide movement through the soil column. Two other boreholes were installed in 1966 (299-W22-32 and 299-W22-33) to evaluate the distribution of radionuclides in the soil column and were extended to below groundwater to a depth of 64.6 m (212 ft). All wells were reconfigured in 1979 to prevent preferential migration of liquids along the outside of the casing.

At well 299-W23-33, analyses of core samples indicated that Cs-137 concentrations reached 13 μCi/g at 6.4 m (21 ft) bgs (RHO-CD-673). At a depth of 10.7 m (35 ft), Cs-137 concentrations had dropped to 3×10^{-4} μCi/g and remained at that concentration to 39.6 m (130 ft) bgs. Below that depth, Cs-137 concentrations declined to 2×10^{-6} μCi/g. Strontium-90 concentrations also peaked at 2.70 μCi/g at 6.4 m (21 ft) and decreased to below detection levels 2×10^{-5} μCi/g below 42.7 m (140 ft).

For well 299-W23-32, similar depth intervals were reported for contamination peaks but at lesser concentrations. Cesium-137 peaked at 1.5 x 10-2 μCi/g at 6.4 m but dropped to below detection levels at 13.7 m (45 ft.) Two Sr-90 peaks were encountered: 5.8×10^{-2} μCi/g at 7.6 m (25 ft) and 6.1 μCi/g at 15.2 m (50 ft). Groundwater samples taken at the completion of drilling indicated a concentration of Sr-90 just above detection, at 7.8×10^{-7} μCi/cm^3.

Geophysical logging using a scintillation probe (RHO-LD-29, *Scintillation Probe Profiles 200-West Area Crib Monitoring Wells*) was conducted to examine the migration of gamma-emitting radionuclides through the vadose zone to groundwater during and after crib operations. The target radionuclides for this logging tool were Ru-106 and Cs-137. The first three boreholes (299-W22-12, 299-W22-13, and 299-W22-14) were drilled outside of the crib excavation and indicate a degree of lateral spreading along with downward movement of contaminants. The latter two boreholes (299-W22-32 and 299-W22-33) were drilled through the crib adjacent to the wooden boxes and represent a more accurate picture of contaminant stratification and post-operation downward migration of radionuclides. Each hole has been logged multiple times.

The logging at the outer wells shows a slow downward movement of gross gamma contamination with time, along with a general decline in radioactivity. RHO-LD-29 presents logs from the five boreholes covering the years 1958, 1959, 1968, and 1976. Typically the logs are off scale (at > 2×10^6 c/min) for the first 10 m below the crib for all logging events at the three wells, and for the 1958 and 1959 logging runs the upper 30 m are typically off scale. Also, a peak at ~55 to 58 m (180 to 190 ft) is seen in the 1968 and 1976 data, which may be associated with a change in lithology. Radioactivity levels detected in the 1968 surveys are typically over an order of magnitude higher than those recorded in 1976.

Geophysical logs at wells 299-W22-32 and 299-W22-33 show behavior patterns similar to those of the three wells farther removed from the cribs. The 1968 logs were off scale for much of the first 30 to 35 m below the crib excavation. A short break in the off scale trend is present at about 10 to 12 m below the crib in each well, a depth that may correlate with a change from gravel

(Hanford A) to silty sand units (Hanford B). This break becomes a departure point for 1968 versus 1976 logging data. Below this depth, the 1976 logs range up to two orders of magnitude lower in count per minute rates than the 1968 data. Local peaks around the 55 to 58 m depth are less pronounced than those noted above.

The effluent volume discharged (390,000,000 L) at this site is 47 times greater than the soil pore volume (8,361,000 L). These data indicate that there has been impact to the groundwater at this site. Groundwater contamination in the area of this site is described in PNNL-13788, *Hanford Site Groundwater Monitoring for Fiscal Year 2001*. Major groundwater plumes in the vicinity of the 200 West Area and the 216-S-7 Crib are shown in Figures 3-7 and 3-8 in the work plan.

Figure D-1. 216-S-7 Crib Construction Diagram.

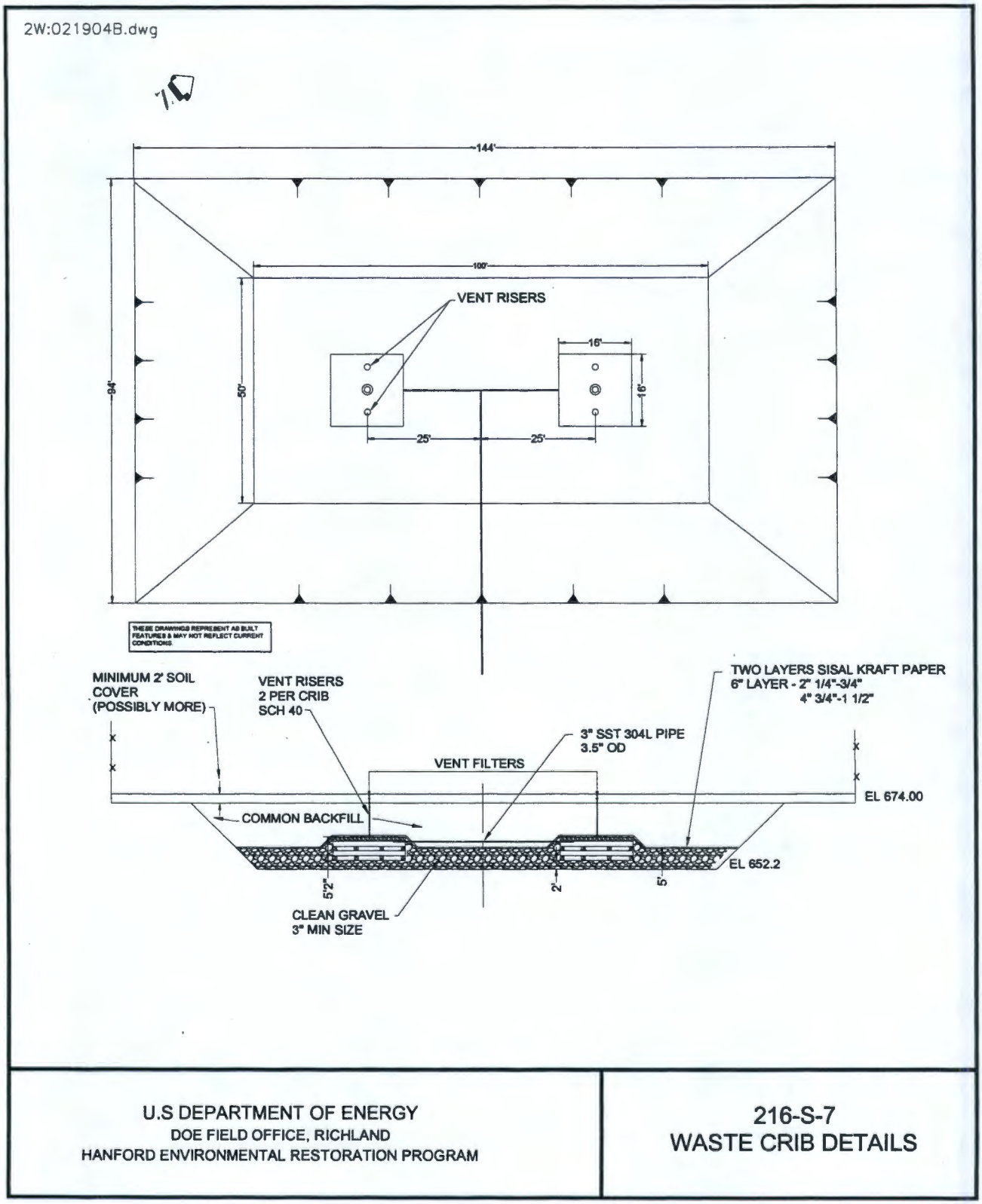


Figure D-2. Stratigraphy in the Vicinity of the 216-S-7 Crib.

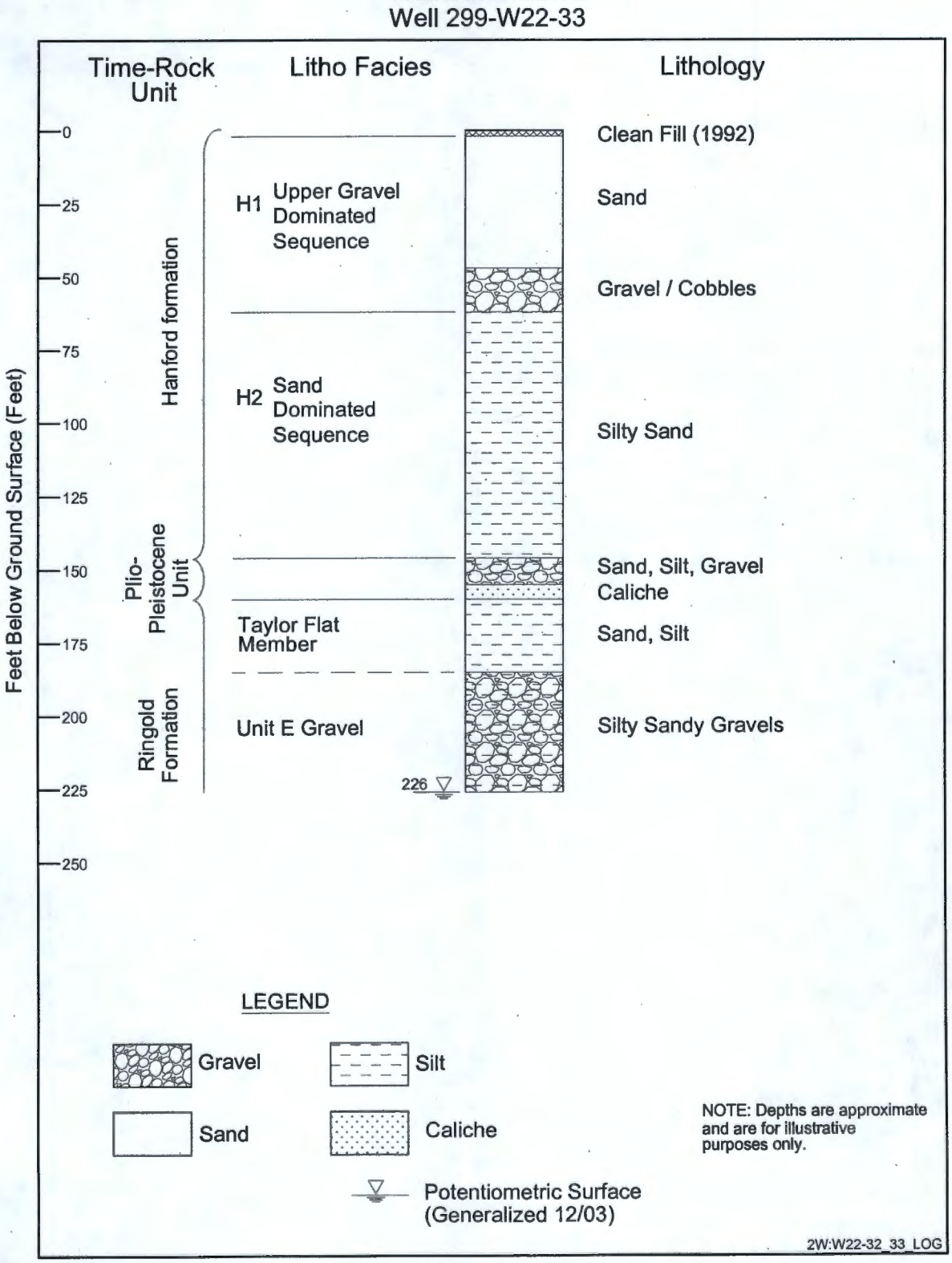
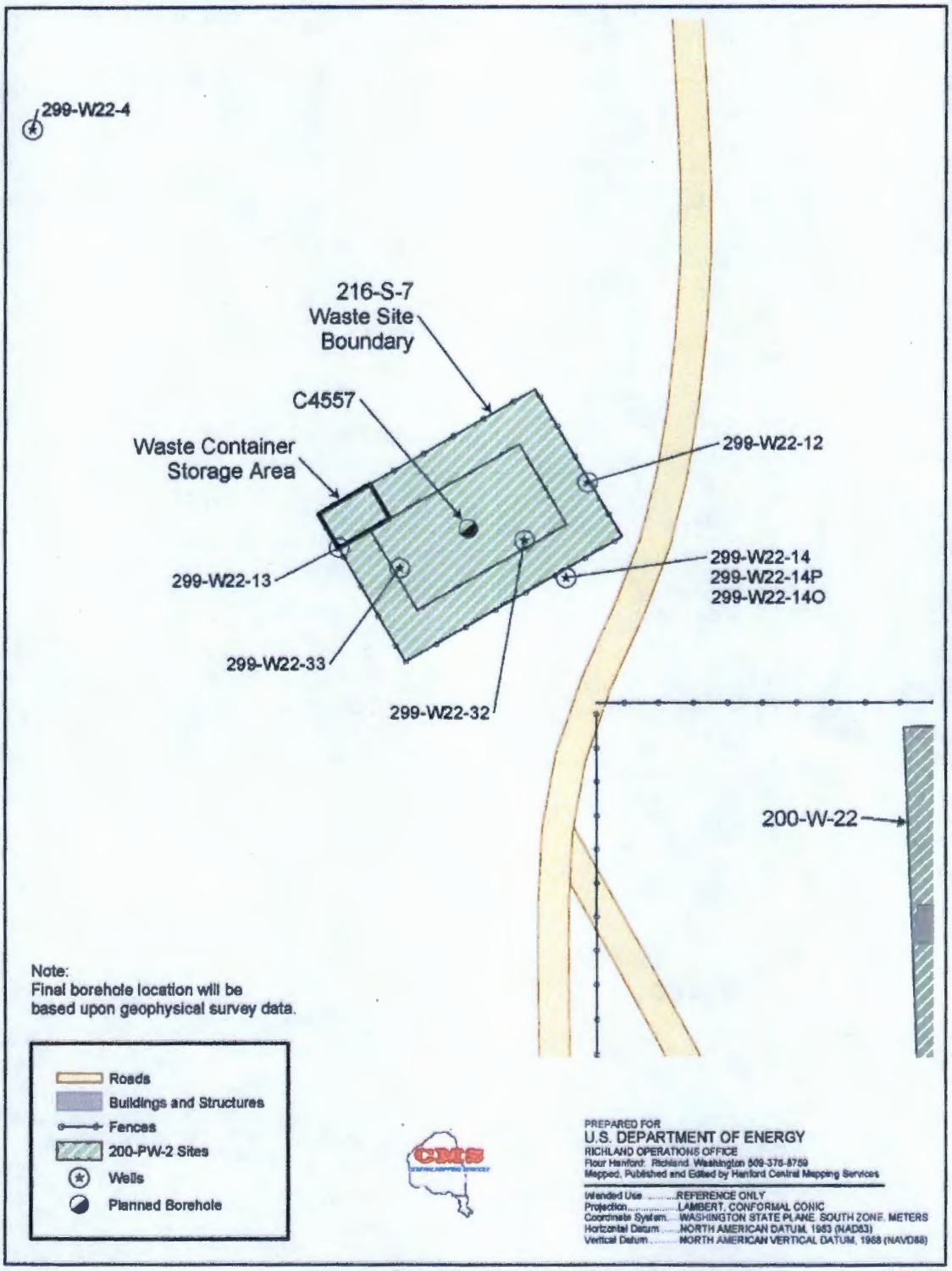


Figure D-3. Location of Planned and Existing Boreholes and Wells at the 216-S-7 Crib in the 200-PW-2 Operable Unit.



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D1.4 CONTAMINANTS OF CONCERN

Contaminants of concern for the 200-PW-2 OU were developed following the data quality objective (DQO) process that is documented in BHI-01411, *Remedial Investigation Data Quality Objectives Summary Report for the 200-PW-2 Uranium-Rich Process Waste Group Operable Unit*, summarized in Section 3.6 of the work plan. The COCs are identified in Table D-1.

Table D-1. List of Contaminants of Concern at the 200-PW-2 Operable Unit.

Radioactive Constituents		
Americium-241	Iodine-129	Strontium-90
Carbon-14	Neptunium-237	Technetium-99
Cesium-137	Nickel-63	Tritium
Cobalt-60	Plutonium-238	Thorium-232
Europium-152	Plutonium-239/240	Uranium-233/234
Europium-154	Radium-226	Uranium-235/236
Europium-155	Radium-228	Uranium-238
Chemical Constituents – Metals		
Antimony	Copper	
Arsenic	Lead	
Barium	Mercury	
Beryllium	Nickel	
Cadmium	Selenium	
Chromium	Silver	
Hexavalent Chromium		
Chemical Constituents - Other Inorganics		
Ammonia/Ammonium	Nitrate/Nitrite	
Chloride	Phosphate	
Cyanide	Sulfate	
Fluoride		
Volatile Organics[a]		
Methyl isobutyl ketone (MIBK, hexone, or [4-methyl-2-pentanone])		
Semivolatile Organics		
AMSCO[b, c] tributyl phosphate dilutant	Normal paraffin hydrocarbon[b]	
Dodecane[b]	Tributyl phosphate	

[a]Only present at waste sites 216-S-1, 216-S-2, and 216-S-7 Cribs and the 216-S-8 Trench via REDOX process condensate and process cell drainage waste streams only.

[b]Analyzed as kerosene or total petroleum hydrocarbons.

[c]Product of Allen Maintenance Supply Company, Inc.

REDOX = Reduction Oxidation (Plant).

D1.5 DATA QUALITY OBJECTIVES

The DQO process for this waste site is generally the same as that followed for the remaining 200-PW-2 and 200-PW-4 OU waste sites. Information describing this process is found in Appendix B and is not repeated here.

D2.0 QUALITY ASSURANCE PROJECT PLAN

The quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. The overall QAPjP for environmental restoration waste sites in the 200 Areas is included in Appendix A of the Implementation Plan (DOE/RL-98-28, *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program*). The QAPjP for the sampling at the 216-S-7 Crib is the same as that contained in Appendix B and is therefore not repeated here.

D3.0 FIELD SAMPLING PLAN

D3.1 SAMPLING OBJECTIVES

The primary objective of the field sampling plan is to identify and describe sampling and analysis activities that will be conducted. Sample methods, procedures, locations, frequencies, parameters of interest, and bottle requirements are essentially the same as those identified in this section of Appendix B of the work plan.

A borehole (C4557) will be drilled through the 216-S-7 Crib to provide additional data to support the RI/ FS process. The borehole will be drilled to the top of groundwater, and soil samples will be collected through the vadose zone for laboratory analysis. Physical property samples will be collected at major lithologic changes and as determined by the site geologist. The borehole will be geophysically logged for gamma-emitting radionuclides and neutron moisture content. A spilt-spoon sampler will be the primary sampling device used to collect the samples from the borehole. The locations of planned and existing boreholes is shown in Figure D-3.

Field measurements such as a surface radiation survey and other soil screening activities are conducted in the same manner as that previously described in Appendix B of the work plan and are not repeated here.

D3.2 SOIL SAMPLING AND ANALYSIS

The following sections discuss the details of sampling soil from the borehole.

D3.2.1 Borehole Sampling and Analysis

Nonradiological and radiological samples will be collected from borehole C4557 to be drilled in the 216-S-7 Crib. Borehole sample collection will be guided by the sampling approach outlined in Table D-2. Actual sampling intervals may vary from these approaches, depending on the thickness of clean soil cover or stabilization fill placed over the crib, field screening results, and varying subsurface conditions. The intent of the sampling design is to begin sample collection at approximately 4.6 m (15 ft) bgs. The remaining samples (both chemical and physical) are taken following the same logic and procedures as that used for the other 200-PW-2/200-PW-4 OU boreholes as described in Appendix B of the work plan. Drilling and sampling will stop when the water table is encountered. Figure D-4 illustrates the anticipated sampling interval in the borehole to be drilled.

D3.2.2 Preshipment Sample Screening

A representative portion of each sample to be shipped to an offsite laboratory will be submitted to the Radiological Counting Facility, 222-S Laboratory, or other suitable onsite laboratory for total activity analysis before it is shipped. Total activities will be used for sample preshipment characterization. Samples that slightly exceed the offsite laboratory criterion discussed in Section B2.7.6 in Appendix B may be reduced in volume to allow offsite shipment. Onsite and offsite laboratories will be identified before field activities are initiated and will be mutually acceptable to the Fluor Hanford, Inc. (FH), Sample and Data Management group and to the task lead.

D3.3 GEOPHYSICAL LOGGING

The planned borehole and selected existing boreholes will be geophysically logged with a high-resolution spectral gamma-ray logging system to assess the vertical distribution and concentration of gamma-emitting radionuclides. Soil moisture also will be assessed using a neutron logging tool for the new borehole only. These methods are described in Section 4.3 of the work plan. The new borehole will be logged before the casing is telescoped and before decommissioning activities begin. The starting point for logging will be recorded; this is usually ground surface or top of casing. The site geologist will witness logging runs and will verify before and after field calibrations and repeat log intervals. The borehole and wells that will be logged with the spectral gamma logging system are presented in Table D-3. These wells represent data collection points in the vicinity of the waste site. Logging of these wells will provide additional updated, site-specific information on gamma contaminant distribution, both laterally and vertically, in the area of the waste site.

D3.4 SURVEYING

The location of the new borehole will be surveyed after the sampling and decommissioning activities are completed. The survey will be performed according to CP-GPP-EE-01-1.6, *Survey Requirements and Techniques*. Data will be recorded in NAVD88, *North American Vertical Datum of 1988*, and in the Washington State Plane (South Zone) NAD83, *North American*

Datum of 1983, with the 1991 adjustment for horizontal coordinates. All survey data will be recorded in meters and feet.

Figure D-4. Approximate Sampling Intervals in the 216-S-7 Borehole.

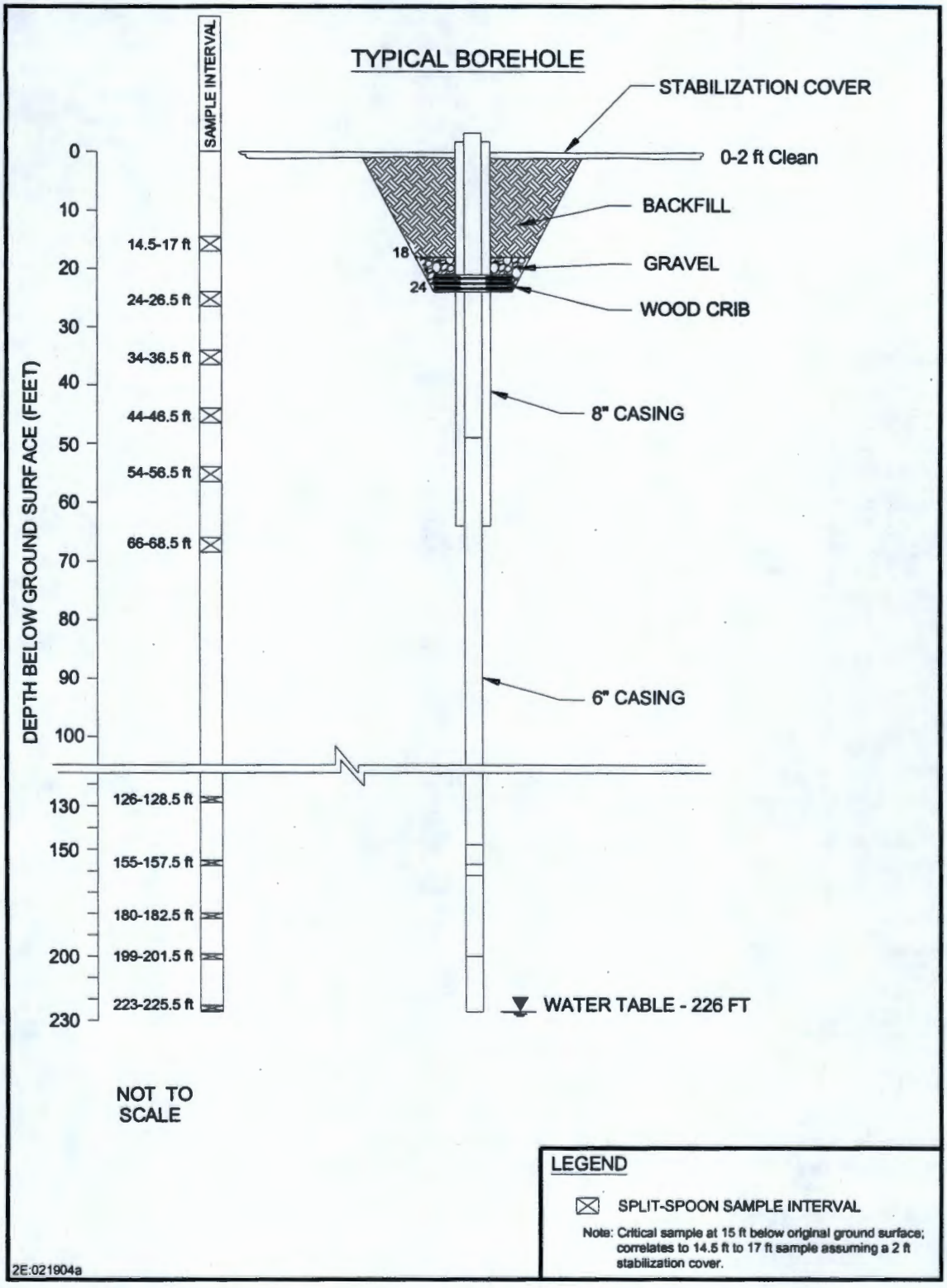

Table D-2. 216-S-7 Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft) bgs[a]	Analyte List[b]	Physical Properties	
					Sample Interval	Parameters
Borehole C4557	C4557	226 ft	14.5-17, 24-26.5, 34-36.5, 44-46.5, 54-56.5, 66-68.5, 126-128.5, 155-157.5, 180-182.5, 199-201.5, 223-225.5	Table D-1	One sample from each of the following: • H_1 • H_2 • PPU • Ringold Unit E	Bulk density, moisture content, particle size distribution
Maximum Number of Samples		11				
Approximate Number of Field Quality Control Samples		2[c]				
Approximate Total Number of Samples		13				

[a]Actual sampling depths may vary depending on the amount of backfill/overburden used in interim stabilization activities at the waste site, field screening results, and varying subsurface conditions.

[b]See Tables B-4 and B-5 of Appendix B for detection limits and other analytical parameters.

[c]One duplicate and one equipment blank.

bgs = below ground surface.
H_1 = Hanford formation upper gravel sequence.
H_2 = Hanford formation sandy sequence.
PPU = Plio-Pleistocene unit.

Table D-3. List of Boreholes for Spectral Gamma-Ray Logging.

Borehole Number	Approximate Location	Coordinates (Wash. State Plane, NAD83[91])	
		Northing	Easting
C4557[a]	Within the boundaries of the 216-S-7 Crib	134174	567164
299-W22-12	Eastern edge of the 216-S-7 Crib	134185	567191
299-W22-13	Western edge of the 216-S-7 Crib	134172	567143
299-W22-14	Southern edge of the 216-S-7 Crib	134166	567187
299-W22-32	Within the boundaries of the 216-S-7 Crib	134174	567179
299-W22-33	Within the boundaries of the 216-S-7 Crib	134168	567155

NOTE: Initial selection of existing wells was based on a review of well construction as-built diagrams. A single casing in contact with the formation is the preferred configuration for logging. A field inspection of the well configuration will be performed for final selection of boreholes.

NAD83, *North American Datum of 1983*.

[a] Planned boreholes.

D4.0 HEALTH AND SAFETY

All field operations will be performed in accordance with FH health and safety requirements, and the requirements of DOE/RL-96-109, *Hanford Site Radiological Control Manual*. In addition, a work control package will be prepared in accordance with HNF-PRO-079, *Job Hazard Analysis*, which will further control site operations. This package will include an activity hazard analysis, site-specific health and safety plan, and applicable radiological work permits.

The sampling procedures and associated activities will take into consideration exposure reduction and contamination control techniques that will minimize the radiation exposure to the sampling team as required by HNF-MP-599, *Quality Assurance Program Description*.

D5.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Investigation-derived waste generated by characterization activities will be managed in accordance with HNF-PRO-15333, *Environmental Protection Processes*, Sections 5.57, "*Generating Waste*", and 5.58 "*Identifying and Designating Waste*", HNF-EP-0063, *Hanford Site Solid Waste Acceptance Criteria,* CP-A-EE-010-14.0, *Waste Identification*; and CP-A-EE-010-16.0, *Waste Storage and Handling*, which identifies the requirements and responsibilities for containment, labeling, and tracking of investigation-derived waste. These procedures were developed to comply with "Strategy for Management of Investigation-Derived Waste" (Ecology et al. 1999), or as amended. An overview of the waste management strategy for the 200 Areas waste sites is presented in Appendix E of DOE/RL-98-28. Management of investigation-derived waste, minimization practices, and waste types applicable to 200-PW-2 waste control are described in CP-13935, *Waste Control Plan for the 200-PW-2 Operable Unit*.

Unused samples and associated laboratory waste for the analysis will be dispositioned in accordance with the offsite laboratory contract, which in most cases will require the laboratory to dispose of this material. Similar materials from onsite laboratories will be either disposed of by the laboratory or returned to the project. The approval of the remedial project manager is required before unused samples or waste from offsite laboratories may be returned.

D6.0 REFERENCES

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