DOE/RL-2007-02-VOLII-ADD2
DRAFT A
Volume II

Site-Specific Field-Sampling Plans for 216-T-34, 216-T-8, 216-B-10A&B, and 216-Z-16 Cribs

(Addendum 2)

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

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

Attachment to 0076907

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1

VOLUME II ADDENDA

2 ***(Each addendum consists of one or more site-specific field-sampling plans)***

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ADDENDUM 2

SITE-SPECIFIC FIELD-SAMPLING PLANS FOR 216-T-34, 216-T-8, 216-B-10A&B, AND 216-Z-16 CRIBS

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CONTENTS

FIGURES

TABLES

APPROVAL PAGE

Title: Supplemental Remedial Investigation Work Plan for the 200 Areas Central Plateau Operable Units, Volume II, Addenda

Addendum 2 – Site-Specific Field Sampling Plans for 216-T-34, 216-T-8, 216-B-10A&B, and 216-Z-16 Cribs

Approval: U.S. Department of Energy, Richland Operations Office

_____ _____

Signature Date

Lead Regulatory Agency:

☐ U.S. Environmental Protection Agency

☒ Washington State Department of Ecology

_____ _____

Signature Date

The approval signatures on this page indicate that this document has been authorized for information release to the public through appropriate channels. No other forms or signatures are required to document this information release.

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TERMS

ALARA	As Low As Reasonably Achievable
bgs	below ground surface
CCU	Cold Creek unit
COPC	contaminants of potential concern
DG-S	downhole geophysics-spectral
DG-SC	downhole geophysics-scintillation
DOE	U.S. Department of Energy
DQO	data quality objectives
Ecology	Washington State Department of Ecology
ERC	electrical resistivity characterization
FH	Fluor Hanford, Inc.
GL	geologic log
H_f	Hanford formation
HRR	high resolution resistivity
MESC/MNA/IC	Maintain Existing Soil Cover, Monitored Natural Attenuation, Institutional Controls
N/A	not applicable
NPH	normal paraffin hydrocarbon
PFP	Plutonium Finishing Plant
PNNL	Pacific Northwest National Laboratory.
PVC	polyvinyl chloride
QAPjP	Quality Assurance Project Plan
RPP	RCRA past practice
R_E	Ringold Formation, Unit E
RI/FS	Remedial Investigation/Feasibility Study
RL	U.S. Department of Energy, Richland Operations Office
SAP	sample and analysis plan
SGE	surface geophysical exploration
SIM	*Hanford Soil Inventory Model, Rev. 1* (RPP-26744)
SSSP	site-specific field-sampling plan
TBP	tributyl phosphate
TD	total depth
WIDS	*Waste Information Data System*

1 # METRIC CONVERSION CHART

Into Metric Units			Out of Metric Units		
If you know	*Multiply by*	*To get*	*If you know*	*Multiply by*	*To get*
Length			**Length**		
Inches	25.40	millimeters	millimeters	0.0394	inches
Inches	2.54	centimeters	centimeters	0.394	inches
Feet	0.305	meters	meters	3.281	feet
Yards	0.914	meters	meters	1.094	yards
miles (statute)	1.609	kilometers	kilometers	0.621	miles (statute)
Area			**Area**		
sq. inches	6.452	sq. centimeters	sq. centimeters	0.155	sq. inches
sq. feet	0.0929	sq. meters	sq. meters	10.764	sq. feet
sq. yards	0.836	sq. meters	sq. meters	1.196	sq. yards
sq. miles	2.591	sq. kilometers	sq. kilometers	0.386	sq. miles
Acres	0.405	hectares	hectares	2.471	acres
Mass (weight)			**Mass (weight)**		
ounces (avoir)	28.349	grams	grams	0.0353	ounces (avoir)
Pounds	0.454	kilograms	kilograms	2.205	pounds (avoir)
tons (short)	0.907	Ton (metric)	ton (metric)	1.102	tons (short)
Volume			**Volume**		
Teaspoons	5	milliliters	milliliters	0.034	ounces (U.S., liquid)
Tablespoons	15	milliliters	liters	2.113	pints
ounces (U.S., liquid)	29.573	milliliters	liters	1.057	quarts (U.S., liquid)
Cups	0.24	liters	liters	0.264	gallons (U.S., liquid)
Pints	0.473	liters	cubic meters	35.315	cubic feet
quarts (U.S., liquid)	0.946	liters	cubic meters	1.308	cubic yards
gallons (U.S., liquid)	3.785	liters			
cubic feet	0.0283	cubic meters			
cubic yards	0.764	cubic meters			
Temperature			**Temperature**		
Fahrenheit	(°F-32)*5/9	Centigrade	Centigrade	(°C*9/5)+32	Fahrenheit
Radioactivity			**Radioactivity**		
Picocurie	37	millibecquerel	millibecquerel	0.027	picocurie

2

3

AD2-1.0 INTRODUCTION

Addendum 2 of Work Plan Volume II contains the site-specific field sampling plans (SSSP) for the 216-T-34 Crib in the 200-LW-1 Operable Unit, and the 216-T-8, 216-B-10A&B, and 216-Z-16 Cribs in the 200-LW-2 Operable Unit. The SSSPs in this addendum provide site-specific information regarding the waste sites including detailed sampling location maps, conceptual models, and the detailed sampling strategy for each site (i.e. number and location of samples, analytes, and sampling and analytical methods). These requirements have been determined by the Tri-Parties (U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology) and documented via the data quality objective (DQO) process in the data-needs priority summary tables (Volume 1, Appendix C).

Volume 1 of the supplemental work plan also includes the Overarching Supplemental Sampling and Analysis Plan (SAP) which supports the Remedial Investigation/Feasibility Study (RI/FS) process for all of the supplemental waste sites (DOE/RL-2007-02 Rev. 0, Vol. I, Appendix A). Data collected under the overarching SAP will be used to support completion of the RI/FS process for the 216-T-34, 216-T-8, 216-B-10A&B, and 216-Z-16 Cribs. The overarching SAP includes the field-sampling plan which includes investigative strategies for a range of sampling techniques, the health and safety plan, and the quality assurance project plan (QAPjP) which establishes quality requirements for the supplemental investigation activities. For radioactive samples, ALARA principles may limit the amount of sample the laboratory can process for analysis. This may result in elevated levels of detection (greater than the Required Detection Limits listed in Tables A2-1 and A2-2 of DOE/RL-200702l, Vol. I) and provide limitations on the analytical batch quality control analyses that can be completed. The overarching SAP also includes the list of contaminants of potential concern (COPC) identified for each of the supplemental waste sites (Vol. I, Appendix A, Table A2-3). The overarching SAP was approved by the Tri-Parties to support all supplemental waste site sampling activities.

Together with the elements of the overarching sampling and analysis plan (volume I, Appendix A), the SSSPs presented in Chapter 2.0 through 6.0 of this addendum complete the sampling and analysis plan for these waste sites. This addendum is part of the supplemental work plan and is considered a component of that primary document under the *Hanford Federal Facility Agreement and Consent Order*[1].

[1] Ecology, EPA, and DOE, 1989, *Hanford Federal Facility Agreement and Consent Order*, 2 vols., Washington State Department of Ecology, U.S. Environmental Protection Agency, and U.S. Department of Energy, Olympia, Washington, as amended.

Field activities associated with surface geophysical exploration (SGE) or high resolution resistivity (HRR), now referred to as electrical resistivity characterization (ERC), and geophysical logging of existing wells as identified in Volume I, Appendix C, have been completed and will not be discussed further in this SSSP. At the time of this document preparation, all ERC data collection activities are complete and final data reports have not been published. The 216-T-8 and 216-T-34 Cribs were included in the scope of studies conducted by CH2M Hill. The 216-B-10A&B and 216-Z-17 Cribs were in included in the scope of studies conducted by Pacific National Northwest Laboratory (PNNL).

AD2-2.0 216-T-34 CRIB SITE-SPECIFIC FIELD SAMPLING PLAN

The supplemental characterization planned for the 216-T-34 Crib includes drilling a shallow borehole, collecting soil samples, electrical resistivity characterization data, and borehole geophysical data. Split spoon soil samples and grab samples will be collected at the locations specified in Table AD2-1. The collected samples will be analyzed for contaminants of potential concern identified in Volume I Table A2-3.

The supplemental characterization data is intended to provide information on nature of contamination in the shallow zone to support risk assessment, address uncertainty regarding groundwater protection due to nitrate inventory, and address the difference in inventory between 216-T-34 and the representative site 216-Z-7. Data collected would also support an evaluation of 216-T-35 as an analogous site to 216-T-34. The grab samples to be analyzed will be determined by the field geologist and technical lead, utilizing characterization data such as geophysical logs, lithology (driller's logs), and split-spoon sample analyses.

The following figures and tables provide the site-specific field sampling plan for the 216-T-34 Crib.

Figure AD2-1. 216-T-34 Crib Data-Collection Locations.

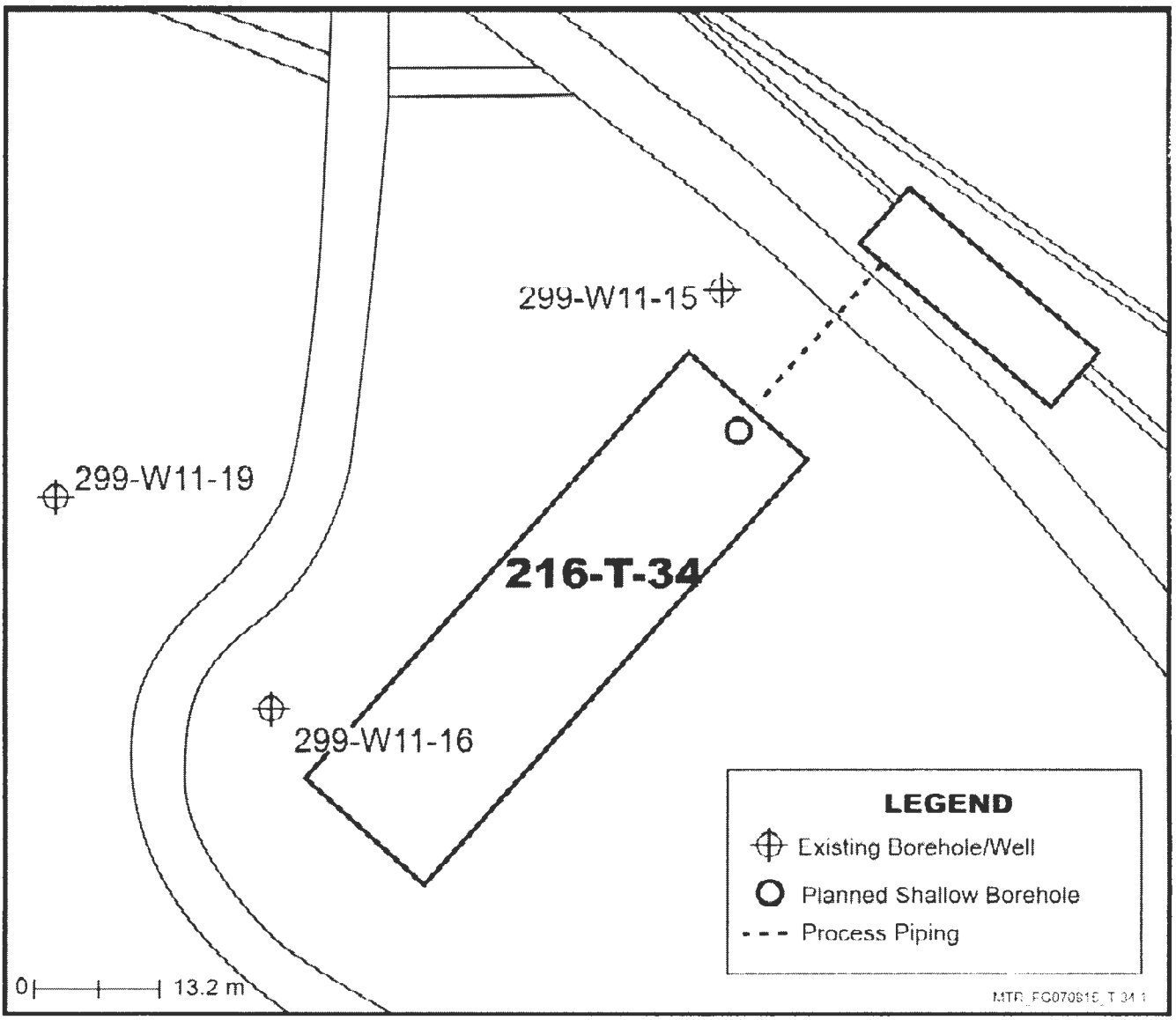


Figure AD2-2. 216-T-34 Crib Stratigraphy and Sample-Collection Intervals.

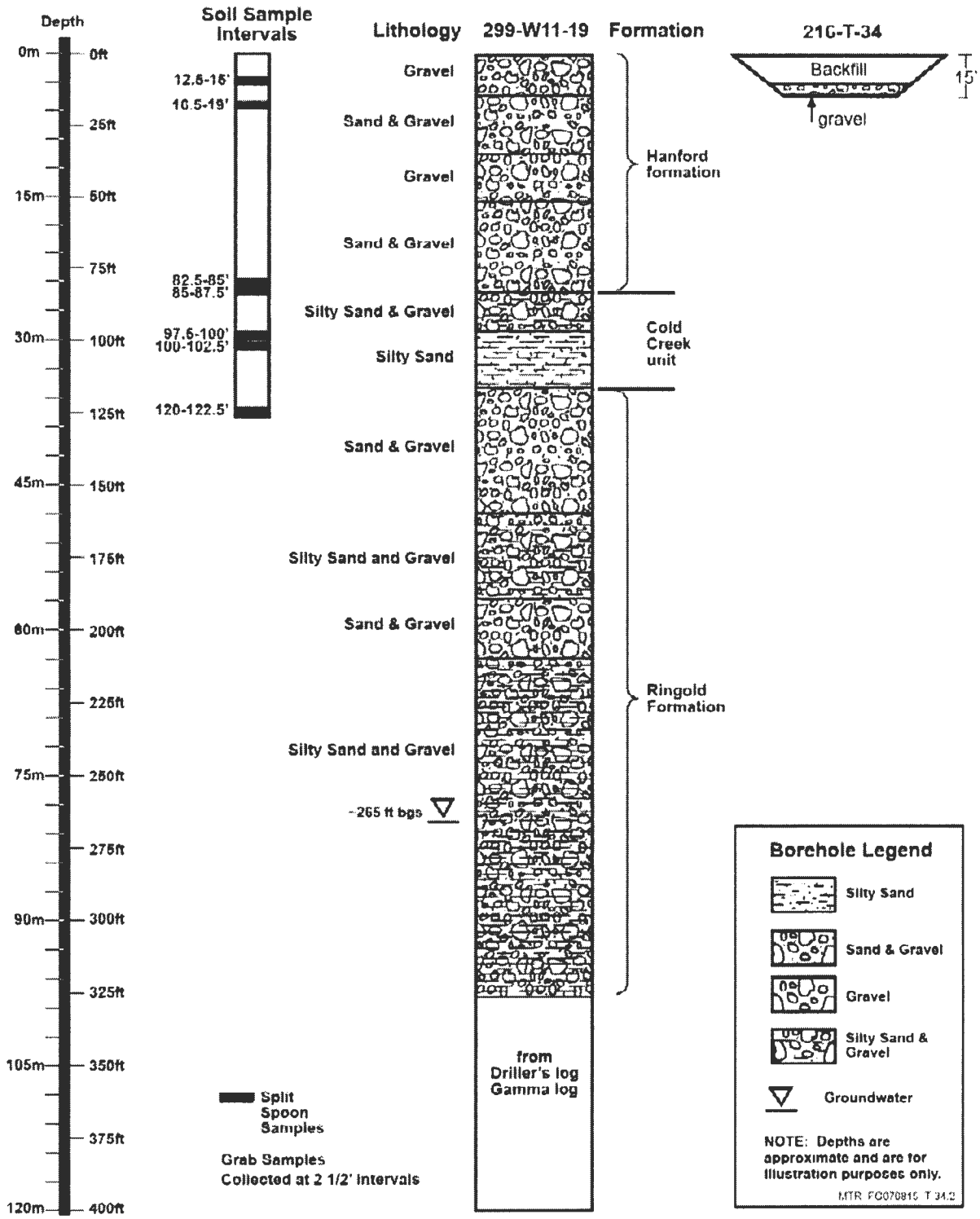


Table AD2-1. 216-T-34 Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investi-gation	Sample Interval Depth (ft bgs) [a]	Analyte List [b]	Physical Properties	
					Sample Interval	Parameters
Shallow borehole with split spoon and grab samples	One shallow borehole near inlet of crib	122.5 ft bgs	Split spoon sample at depths of: 12.5 – 15 ft bgs 16.5 – 19 ft bgs 82.5 – 85 ft bgs 85 – 87.5 ft bgs 97.5 – 100 ft bgs 100 – 102.5 ft bgs 120 – 122.5 ft bgs Also, grab samples at 2.5-ft intervals throughout borehole	Analytes are presented in Volume I, Table A2-3 for 200-LW-1/ 200-LW-2 columns.	One sample at each change in lithology. Other samples taken at fine-grained intervals.	pH, specific conductance, bulk density, moisture, particle size distribution, calcium carbonate content

Number of split-spoon samples	7
Approximate number of field quality-control samples [c]	2
Approximate number of physical-property samples	6
Approximate total number of soil samples collected	60
Approximate total number of soil samples analyzed[d]	24

Non-Sample Data Collection	Maximum Depth of Investigation
Downhole spectral gamma log, neutron moisture log	Surface to TD
ERC	Not defined

[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 Volume 1, Appendix A, Tables A2-1, A2-2, A2-3, A2-4, A2-5, and A3-2 for detection limits and other analytical parameters.
[c] One duplicate and one equipment blank. Field blanks also will be collected for volatile organic analysis, but are not included here.
[d] The number of samples analyzed includes: 7 split-spoon samples, 2 quality control samples, 6 physical-property samples, and 9 grab samples.

bgs = below ground surface.
ERC = electrical resistivity characterization.

Figure AD2-3. 216-T-34 Crib Conceptual Model and Data Summary.

200-LW-1 Operable Unit
Waste Type: Process Effluent

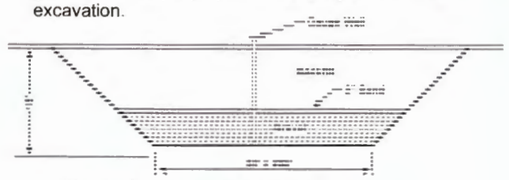
216-T-34 Crib

T Plant Zone
Model Group 6

History

The site provided subsurface liquid disposal for waste from the 340 Building in the 300 Area. The waste was transported to the 200 West Area in railroad tank cars and 18,927 L (5,000 gal) tank trucks. The crib received 17,300,000 L (4,570,000 gal) of mixed waste. The pipelines northwest of the unit were capped when the unit reached its prescribed radionuclide disposal capacity after only 5 months of use. The waste was rerouted to the 216-T-35 Crib in February 1967. Residual contamination remained near the ground surface at the unloading station. This crib was interim stabilized in July 1990. It is surrounded by a light chain barricade and posted with underground contamination warning signs. Two gauge well risers and one filter riser are visible at the surface.

CONSTRUCTION: The crib is located in a excavation 61 m (200 ft) long, 9 m (30 ft) wide, and 4.6 m (15 ft) deep. The dispersal system consists of 128 m (420 ft) of perforated 20.3 cm (8-in.) line in a rectangular loop and a 15.2 cm (6 in.) perforated line extending 15.2 m (50 ft) into the center of the unit. All piping is 3.7 m (12.2 ft) below grade. A 1.5 m (5 ft) layer of washed gravel is in the excavation.



WASTE VOLUME: 17,300,000 L (WIDS)
DURATION: 1966 to 1967 (WIDS)

ESTIMATED DISCHARGED INVENTORY:

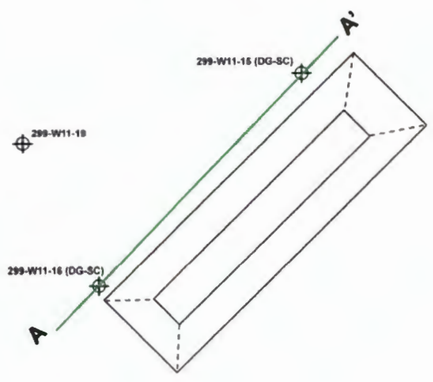
	HNF-1744/DOE/RL-91-61	SIMS
Sr-90	1.44E+02Ci	1.74E-01Ci
Cs-137	1.28E+02Ci	3.08E-01Ci
Pu-239	--	5.18E+00Ci
U Total	1.37E-03Ci	6.36E+01Ci
Cr	--	5.83E+03kg
NO3	1.00E+03kg	1.36E+06 kg

REFERENCES:
- DOE/RL-91-61
- DOE/RL-2001-66
- HNF-1744
- RHO-CD-673
- RPP-26744
- WIDS

Basis of Knowledge (Data Types)

- Downhole Geophysics – Spectral (DG-S)
- Downhole Geophysics-Scintillation (DG-SC)

Site Plan View
(not to scale)

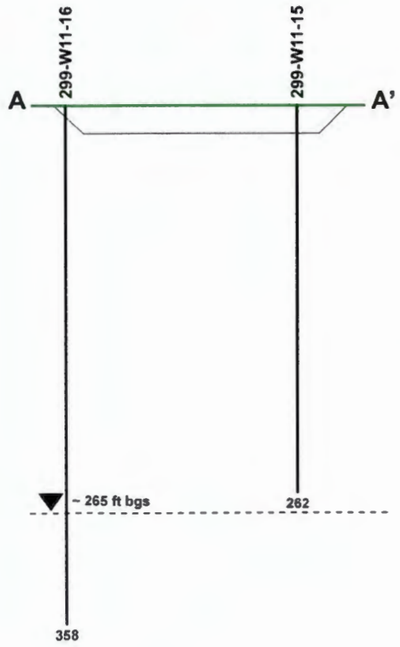


Legend
- ⊕ = Existing Borehole
- ▼ = Groundwater Surface
- bgs = Below ground surface
- SIM = Soil Inventory Model
- WIDS = Waste Information Data System

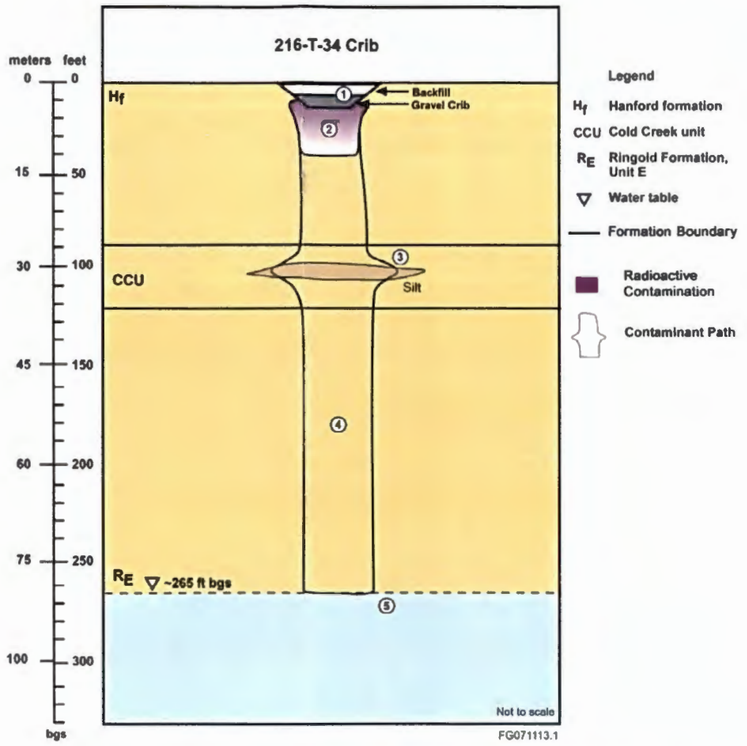
Characterization Summary

Investigation of the 216-T-34 Crib was performed under DOE/RL-2001-66. This is an analogous site assigned to the 216-Z-7 Crib. Near-background levels of radiation were detected in the wells in 1976.

Site Section View
(not to scale)



Conceptual Contaminant Distribution Model



1. A total of 17,300,000 L (4,570,000 gal) of liquid waste were discharged to the 216-T-34 Crib from 1966-1967.
2. Liquid waste was released at the crib bottom, where immobile contaminants (e.g., plutonium) sorbed to soils. A zone of higher contamination likely extends from 4.5 m (15 ft) bgs to 9 m (30 ft) bgs, based on data from similar sites. Concentrations are expected to decrease quickly with depth.
3. Fine-grained zones in the vadose zone slowed water movement and allowed contaminants to concentrate and move laterally along the interfaces between fine- grained and coarser-grained sediments, such as the interface between the Hanford formation and the Cold Creek unit.
4. As the moisture front moved downward, more mobile contaminants (e.g., nitrate) were carried along toward groundwater. The effluent volume and nitrate inventory likely are sufficient to have impacted groundwater during operations.
5. The effluent volume and nitrate inventory for the 216-T-34 Crib likely are sufficient to have impacted groundwater. Future groundwater impacts from this crib may be possible, particularly associated with nitrate. However, because the waste inventory is relatively low, significant future impacts are not expected.

Table AD2-2. Data Needs Priority Summary –
Model Group 6 – 216-T-34 Crib
(200-LW-1/2) (RL/FH) (RPP) (Ecology). (2 Pages)

Background	
Site Identification	216-T-34 Crib
Site Location	200 West Area, T Plant Zone, northwest of the 221-T Building and north of 23rd Street
Type of Site	Crib
Operating History	The crib is located in an excavation 61 m (200 ft) long, 9 m (30 ft) wide, and 4.6 m (15 ft) deep. The dispersal system consists of 128 m (420 ft) of perforated 20.3 cm (8-in.) line in a rectangular loop and a 15.2 cm (6-in.) perforated line extending 15.2 m (50 ft) into the center of the crib. All piping is 3.7 m (12.2 ft) below grade. A 1.5 m (5-ft) layer of washed gravel is in the excavation. The site provided subsurface liquid disposal for waste from the 340 Building in the 300 Area and operated from May 1966 to March 1967. The waste was transported to the 200 West Area in railroad tank cars and 18,927 L (5,000 gal) tank trucks. The crib received 17,300,000 L (4,570,000 gal) of mixed waste. The pipelines northwest of the unit were capped when the unit reached its prescribed radionuclide disposal capacity after only 5 months of use. The waste was rerouted to the 216-T-35 Crib in February 1967. Residual contamination remained near the ground surface at the unloading station. This crib was interim stabilized in July 1990. It is surrounded by a light chain barricade and posted with underground contamination warning signs. Two gage well risers and one filter riser are visible at the surface. Groundwater wells 299-W11-15 and 299-W11-16 monitor this site.

Soil Inventory Model 216-T-34 (RPP-26744)

Na (kg)	Al (kg)	Fe (kg)	Cr (kg)	Bi (kg)	La (kg)	Hg (kg)	Zr (kg)	Pb (kg)
6.290E+04	0.000E+00	1.466E+03	5.833E+03	0.000E+00	0.000E+00	7.276E-02	0.000E+00	1.732E+00
Ni (kg)	Ag (kg)	Mn (kg)	Ca (kg)	K (kg)	NO3 (kg)	NO2 (kg)	CO3 (kg)	PO4 (kg)
1.509E+03	3.170E-01	1.819E-02	5.127E+03	3.807E+02	1.362E+05	1.547E+04	1.680E+03	0.000E+00
SO4 (kg)	Si (kg)	F (kg)	Cl (kg)	CCl4 (kg)	Butanol (kg)	TBP (kg)	NPH (kg)	NH3 (kg)
5.424E+03	7.692E+00	4.366E-01	1.581E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe(CN)6 (kg)	H-3 (Ci)	C-14 (Ci)	Ni-59 (Ci)	Ni-63 (Ci)	Co-60 (Ci)	Se-79 (Ci)	Sr-90 (Ci)	Y-90 (Ci)
0.000E+00	3.676E-04	8.664E-02	3.167E-05	3.075E-03	3.789E-02	1.872E-07	1.736E-01	1.745E-01
Zr-93 (Ci)	Nb-93m (Ci)	Tc-99 (Ci)	Ru-106 (Ci)	Cd-113m (Ci)	Sb-125 (Ci)	Sn-126 (Ci)	I-129 (Ci)	Cs-134 (Ci)
1.111E-05	8.473E-06	7.371E-05	3.805E-05	1.527E-05	1.507E-05	7.950E-07	8.208E-03	6.407E-06
Cs-137 (Ci)	Ba-137m (Ci)	Sm-151 (Ci)	Eu-152 (Ci)	Eu-154 (Ci)	Eu-155 (Ci)	Ra-226 (Ci)	Ra-228 (Ci)	Ac-227 (Ci)
3.079E-01	2.915E-01	6.394E-03	3.619E-06	2.602E-04	9.844E-05	3.763E-07	1.464E-08	1.853E-06
Pa-231 (Ci)	Th-229 (Ci)	Th-232 (Ci)	U-232 (Ci)	U-233 (Ci)	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)
3.022E-06	9.209E-09	9.513E-09	5.410E-03	3.200E-01	3.083E-02	1.226E-03	1.395E-03	2.127E-02
U-Total (kg)	Np-237 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Pu-241 (Ci)	Pu-242 (Ci)	Am-241 (Ci)	Am-243 (Ci)
6.366E+01	1.210E-03	5.925E-01	5.182E+00	1.805E+00	3.403E+01	3.081E-04	1.811E+00	1.727E-03
Cm-242 (Ci)	Cm-243 (Ci)	Cm-244 (Ci)						
2.893E-03	3.129E-04	7.618E-03						

Radionuclide Inventories of Liquid Waste Disposal Sites on the Hanford Site (HNF-1744) (Curie Content Based on 12/31/98)

Co-60 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	Cs-137 (Ci)	Th-232 (Ci)	U (Gross) (Ci)
9.58E-02	1.44E+02	9.03E-02	1.28E+02	5.15E-16	1.37E-03

T Plant Source Aggregate Area Management Study Report (DOE/RL-91-61)

NO3 (kg)
1.00E+03

Table AD2-2. Data Needs Priority Summary –
Model Group 6 – 216-T-34 Crib
(200-LW-1/2) (RL/FH) (RPP) (Ecology). (2 Pages)

Vicinity Waste Sites	216-T-35, 218-W-1A, 200-W-21, 218-W-6						
Current Status	Analogous site; preliminarily assigned to 216-Z-7 in draft 200-LW-1/2 feasibility study (in progress); capping preliminarily identified as preferred alternative in draft feasibility study.						
Potential Remedial Alternatives							
X for viable alternatives	**No Action**	**MESC/MNA/IC**	**Removal/Disposal**	**Barrier**	**Partial Removal/Barrier**	**In Situ Treatment**	**Other**
			X	X	X		

Data Evaluation and Gaps Analysis

Data	**Knowns**	**Data Uncertainties**	**Are supplemental data required to support decision making?**
Scintillation logs: 299-W11-15 299-W11-16 Both are scintillation logs dated 1968, 1970, and 1976 299-W11-43 (438 ft) spectral, 2005	Located on the northwest edge of the crib. Located on the southwest edge of the crib. Near-background levels of radiation were detected. 299-W11-43 A decrease in gamma activity occurred at each casing joint, where the increase in wall thickness results in greater attention of gamma activity. No anomalous gamma activity was observed. This observation suggests no significant concentrations of manmade radionuclides.	Nature of 340 Building waste Plutonium concentration	Yes. Existing data and inventory support decision making; however, the representative site (216-Z-7) for the 216-T-34 Crib has greater Cs-137, plutonium, and uranium inventory. ERC would provide information to address uncertainty on groundwater protection due to nitrate inventory. A shallow borehole would provide information on the nature of contamination, including plutonium, in the shallow zone to support risk assessment. Data also would support evaluation at 216-T-35 Crib as an analogous site to 216-T-34 Crib.

Additional Notes: Near-background levels of radiation are detected (from surface to groundwater) at wells 299-W11-15 and 299-W11-16. (ARH-ST-156).

References/Bibliography:

- ARH-ST-156, *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells*
- DOE/RL-2001-66, Rev. 0, *Chemical Laboratory Waste Group Operable Units RI/FS Work Plan, Includes: 200-LW-1 and 200-LW-2 Operable Units*
- DOE/RL-91-61, Rev. 0, *T Plant Source Aggregate Area Management Study Report*
- DOE/RL-96-81, Rev. 0, *Waste Site Grouping for 200 Areas Soil Investigations*
- HNF-1744, Rev. 0, *Radionuclide Inventories of Liquid Waste Disposal Sites on the Hanford Site*
- RPP-26744, *Hanford Soil Inventory Model, Rev. 1*
- *Waste Information Data System* database.

Proposed Activities and Path Forward:

- Electrical resistivity characterization to evaluate potential for elevated conductivity that may be associated with nitrate inventory and that would support evaluation of protection of groundwater
- Shallow borehole through crib to determine nature of shallow contamination
- Data would support evaluation of 216-T-35 Crib.

Ecology = Washington State Department of Ecology.
FH = Fluor Hanford, Inc.
MESC/MNA/IC = Maintain Existing Soil Cover, Monitored Natural Attenuation, Institutional Controls.
NPH = normal paraffin hydrocarbon.
RL = U.S. Department of Energy, Richland Operations Office.
RPP = RCRA past practice.
TBP = tributyl phosphate.

AD2-3.0 216-T-8 CRIB SITE-SPECIFIC FIELD SAMPLING PLAN

The supplemental characterization planned for the 216-T-8 Crib includes pushing two shallow boreholes, collecting soil samples and borehole geophysical data. Split spoon soil samples will be collected at the locations specified in Table AD2-3. The samples will be analyzed for contaminants of potential concern identified in Volume I Table A2-3.

Supplemental data collection at 216-T-8 is intended to permit a stronger analysis of possible remedial action alternatives. The following figures and tables provide the site-specific field-sampling plan for the 216-T-8 Crib.

Figure AD2-4. 216-T-8 Crib Data-Collection Locations.

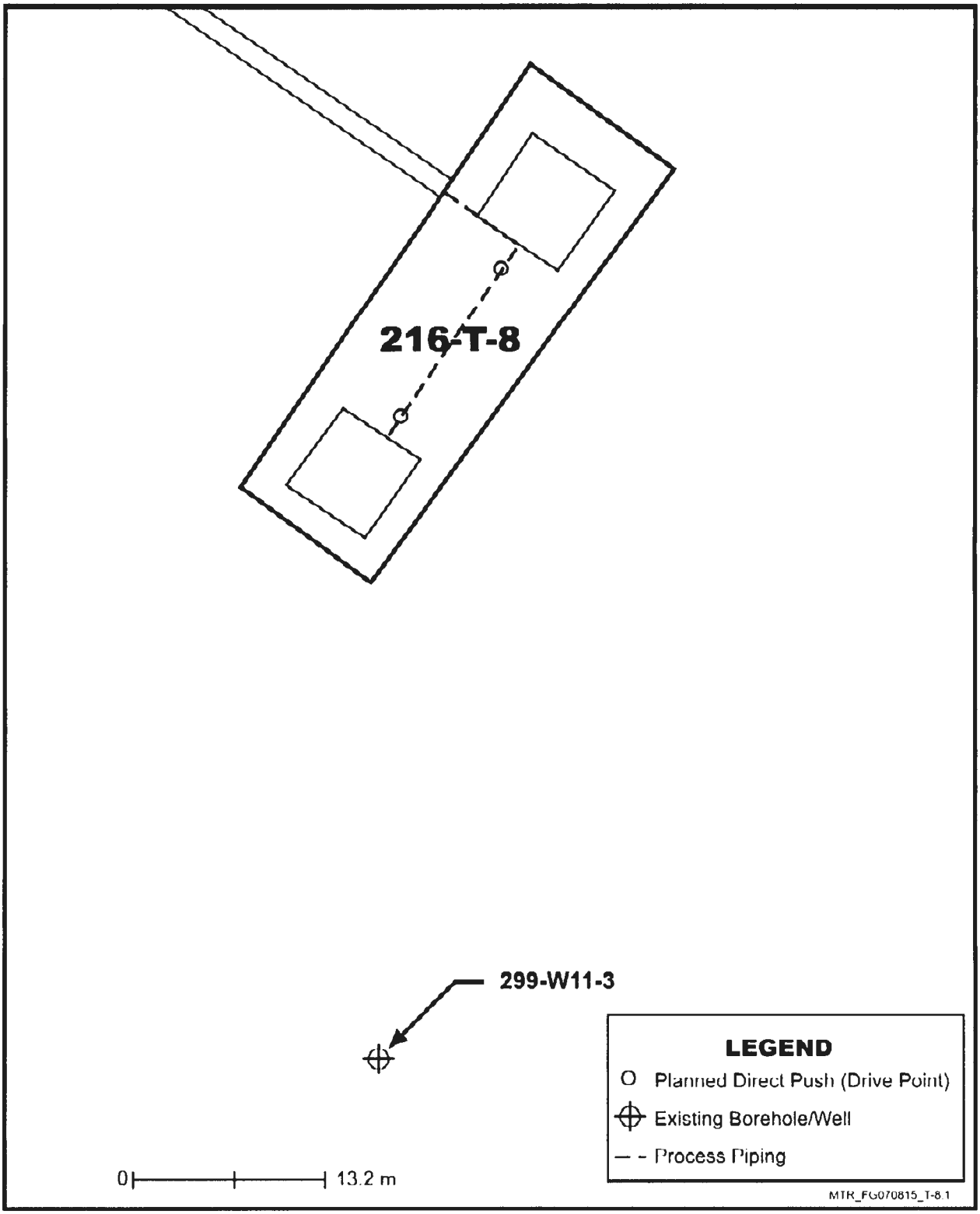
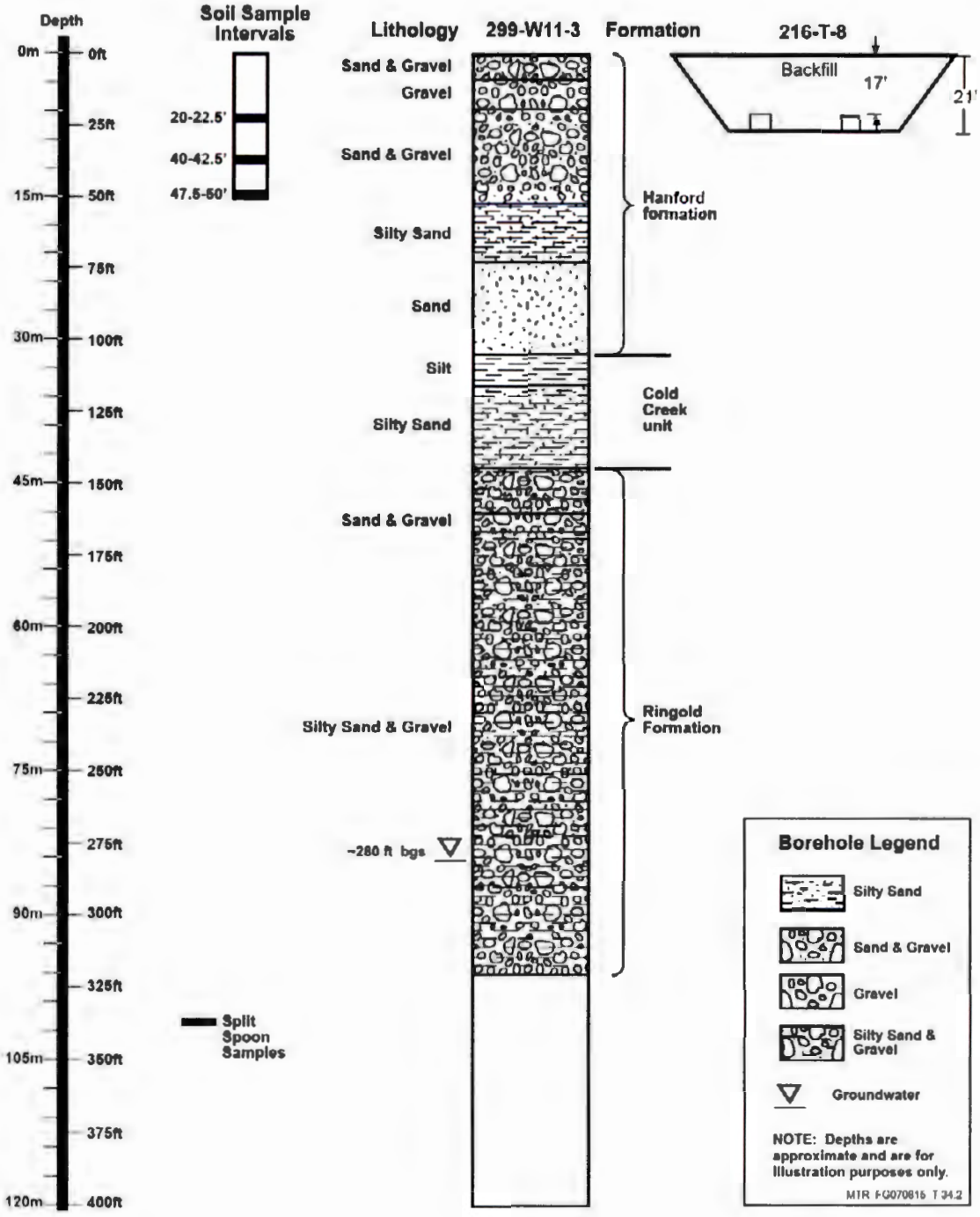


Figure AD2-5. 216-T-8 Crib Stratigraphy and Sample-Collection Intervals.



1

Table AD2-3. 216-T-8 Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investi-gation	Sample Interval Depth (ft bgs) [a]	Analyte List [b]	Physical Properties	
					Sample Interval	Parameters
Push-type split spoon	2 locations between the two boxes within 216-T-8 Crib	50.0 ft bgs	Sample at depths of: 20 – 22.5 ft bgs 40 – 42.5 ft bgs 47.5 – 50.0 ft bgs	Analytes are presented in Volume I, Tables for 200-LW-1/ 200-LW-2	N/A	N/A

Total number of split-spoon samples	6
Approximate number of field quality-control samples [c]	4
Approximate number of physical-property samples	0
Approximate total number of soil samples collected	10
Approximate total number of soil samples analyzed[d]	10

Non-Sample Data Collection	Maximum Depth of Investigation
Downhole spectral gamma log, neutron moisture log	Surface to TD

[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 Volume 1, Appendix A, Tables A2-1, A2-2, A2-3, A2-5, and A3-2 for detection limits and other analytical parameters.
[c] One duplicate and one equipment blank. Field blanks also will be collected for volatile organic analysis, but are not included here.
[d] Number of samples analyzed includes; 6 split-spoon samples and 4 QC samples.

bgs = below ground surface.
N/A = not applicable.

2

3

Figure AD2-6. 216-T-8 Crib Conceptual Model and Data Summary.

200-LW-2 Operable Unit
Waste Type: Process Effluent

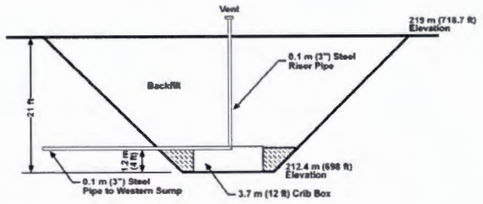
216-T-8 Crib

T Plant Zone
Model Group 6

History

The 216-T-8 Crib is an inactive double-crib waste site located approximately 15 m (49 ft) south of the 222-T Building. BHI-00177 states these "cribs have cave-in potential signs." This site provided subsurface liquid disposal for the 222-T Decontamination Sink Waste and Sample Slurper waste. The associated structure is the 222-T Facility. It was deactivated because laboratory operations in 222-T were shut down. The pipeline to the crib was blanked in 222-T and the pits were backfilled. The site was interim stabilized in 1991. The site is posted Underground Radioactive Material (WIDS).

CONSTRUCTION: The site consists of two wood crib boxes, 1.2 m (4 ft) in height (H-2-353 Calc. Sht), each set into a pit with sloped sides. Each crib pit has a 4.3 m (14 ft) by 4.3 m (14 ft) bottom dimension. The depth to bottom is 7.6 m (25 ft) with an overburden depth of 5.2 m (17 ft). The pits are 23 m (75 ft) apart. The boxes have risers and are connected in series by a pipe. One box overflows into the other (WIDS).



WASTE VOLUME: 500,000 L of effluent (WIDS)
DURATION: 1950 to 1951 (WIDS)

ESTIMATED DISCHARGED INVENTORY:

	HNF-1744/DOE/RL-91-61	SIMS
Sr-90	3.04E-01Ci	1.52E+01Ci
Cs-137	3.25E-01Ci	4.41E-01Ci
U Total	1.50E-03Ci	4.75E+01Ci

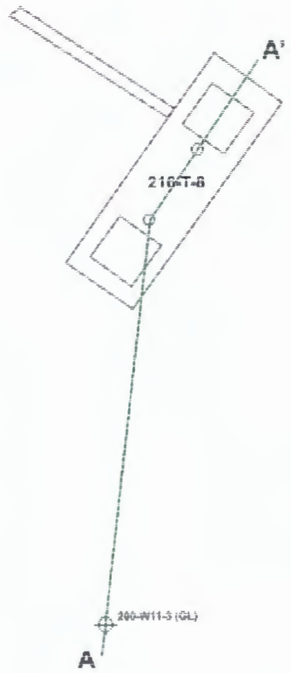
REFERENCES:

- BHI-00177
- DOE/RL-91-61
- DOE/RL-2001-66
- DOE/RL-2005-61
- DOE/RL-2006-56
- H-2-353
- HNF-1744
- RPP-26744
- WIDS general summary reports

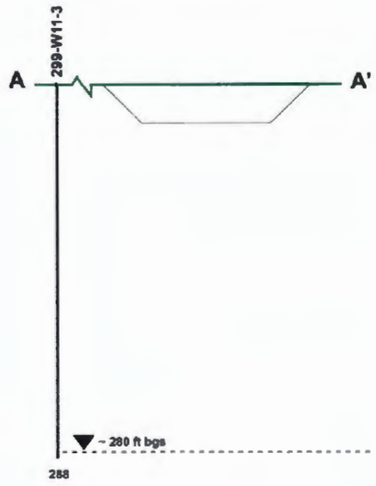
Basis of Knowledge (Data Types)

- Process History (PH)
- Geologic Log (GL)

Site Plan View
(not to scale)



Site Section View
(not to scale)



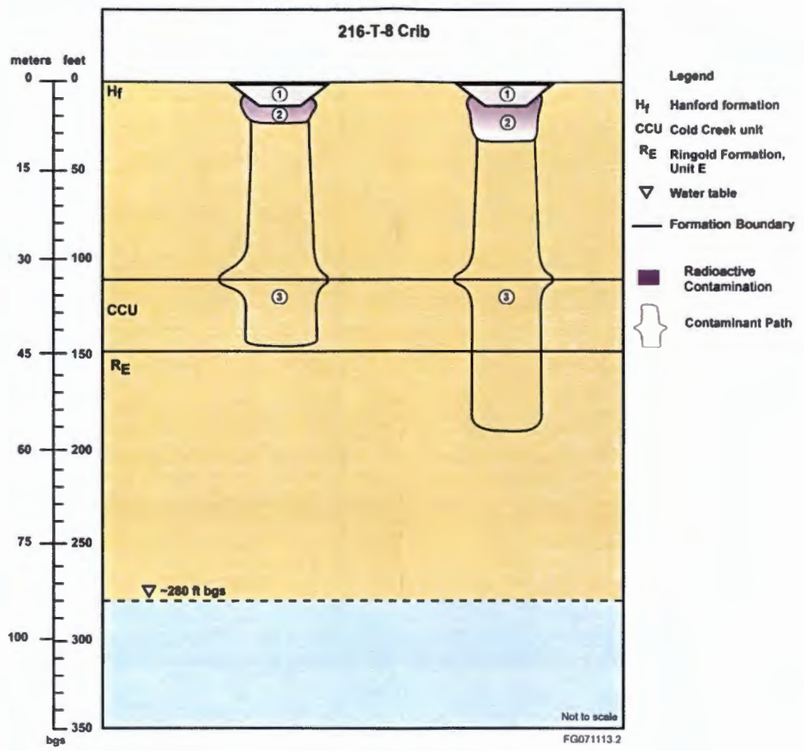
Legend

- ⊕ = Existing Borehole
- ▼ = Groundwater Surface
- bgs = Below ground surface
- SIM = Soil Inventory Model
- WIDS = Waste Information Data System

Characterization Summary

Characterization of the 216-T-8 Crib was performed under DOE/RL-2001-66.

Conceptual Contaminant Distribution Model



1. The 216-T-8 Crib received 500,000 L (132,000 gal) of effluent from the 222-T Decontamination Sink Waste and Sample Slurper waste from 1950 to 1951.
2. The more immobile radioactive contaminants (e.g., Cs-137, Sr-90) sorbed to soils at the bottom of the crib and concentrations decrease with depth.
3. The effluent and mobile contaminants traveled downward through coarser-grained material but tended to slow and spread at the intersection with finer-grained material. As the effluent traveled downward after discharge, contaminants may have been deposited along the top of these zones. Migration of contaminants may have been exacerbated by the 1,000 kg (2,200 lb) nitric acid and 1,000 kg (2,200 lb) sulfuric acid received by the crib.

Table AD2-4. Data Needs Priority Summary –
Model Group 6 – 216-T-8 Crib
(200-LW-1/2) (RL/FH) (RPP) (Ecology). (2 Pages)

Background	
Site Identification	216-T-8 Crib
Site Location	200 West Area, T Plant Zone, east side of 224-T Building
Type of Site	Crib
Operating History	The 216-T-8 Crib is an inactive double-crib waste site located approximately 15 m (49 ft) south of the 222-T Building. BHI-00177 states these "cribs have cave-in potential signs." The site consists of two wood crib boxes, 1.2 m (4 ft) in height (see H-2-353 Calculation Sheet), each set into a pit with sloped sides. Each crib pit has a 4.3 m (14-ft) by 4.3 m (14-ft) bottom dimension. The depth to bottom is 7.6 m (25 ft) with an overburden depth of 5.2 m (17 ft). The pits are 23 m (75 ft) apart. The boxes have risers and are connected in series by a pipe. One box overflows into the other. This site provided subsurface liquid disposal for the 222-T Decontamination Sink Waste and Sample Slurper waste. The associated structure is the 222-T Facility. The site operated from May 1950 to September 1951 and received 500,000 L (132,000 gal) of mixed waste. The site also received 1,000 kg (2,200 lb) sulfuric acid and 1,000 kg (2,200 lb) of nitric acid. The site was deactivated because laboratory operations in the 222-T Building were shut down. The pipeline to the crib was blanked in the 222-T Building and the pits were backfilled. The site was interim stabilized in 1991. The site is posted Underground Radioactive Material. Soil Inventory Model 216-T-8 Crib

Na (kg)	Al (kg)	Fe (kg)	Cr (kg)	Bi (kg)	La (kg)	Hg (kg)	Zr (kg)	Pb (kg)
2.268E+02	0.000E+00	5.282E+00	2.101E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni (kg)	Ag (kg)	Mn (kg)	Ca (kg)	K (kg)	NO3 (kg)	NO2 (kg)	CO3 (kg)	PO4 (kg)
9.314E+00	0.000E+00	0.000E+00	2.421E+01	1.362E+00	4.906E+02	5.575E+01	1.498E+01	0.000E+00
SO4 (kg)	Si (kg)	F (kg)	Cl (kg)	CCl4 (kg)	Butanol (kg)	TBP (kg)	NPH (kg)	NH3 (kg)
1.985E+01	0.000E+00	0.000E+00	5.679E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe(CN)6 (kg)	H-3 (Ci)	C-14 (Ci)	Ni-59 (Ci)	Ni-63 (Ci)	Co-60 (Ci)	Se-79 (Ci)	Sr-90 (Ci)	Y-90 (Ci)
0.000E+00	4.383E-04	7.868E-05	2.344E-06	2.096E-04	8.395E-06	4.037E-07	1.522E+01	1.525E+01
Zr-93 (Ci)	Nb-93m (Ci)	Tc-99 (Ci)	Ru-106 (Ci)	Cd-113m (Ci)	Sb-125 (Ci)	Sn-126 (Ci)	I-129 (Ci)	Cs-134 (Ci)
2.803E-06	2.482E-06	1.937E-04	2.226E-15	1.326E-05	4.572E-07	1.554E-06	2.171E-07	5.090E-09
Cs-137 (Ci)	Ba-137m (Ci)	Sm-151 (Ci)	Eu-152 (Ci)	Eu-154 (Ci)	Eu-155 (Ci)	Ra-226 (Ci)	Ra-228 (Ci)	Ac-227 (Ci)
4.412E-01	4.160E-01	1.524E-02	7.027E-07	5.170E-05	2.864E-05	1.906E-08	1.122E-13	5.211E-08
Pa-231 (Ci)	Th-229 (Ci)	Th-232 (Ci)	U-232 (Ci)	U-233 (Ci)	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)
2.437E-09	5.269E-13	4.474E-15	2.365E-07	1.858E-08	1.558E-02	6.879E-04	2.113E-04	1.588E-02
U-Total (kg)	Np-237 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Pu-241 (Ci)	Pu-242 (Ci)	Am-241 (Ci)	Am-243 (Ci)
4.754E+01	1.123E-06	9.546E-06	1.085E-03	1.366E-04	2.989E-04	2.176E-09	7.643E-05	1.170E-08
Cm-242 (Ci)	Cm-243 (Ci)	Cm-244 (Ci)						
2.021E-08	2.442E-10	5.686E-09						

Radionuclide Inventories of Liquid Waste Disposal Sites on the Hanford Site (HNF-1744) (Curie Content Based on 12/31/98)

Sr-90 (Ci)	Tc-99 (Ci)	Cs-137 (Ci)	Th-232 (Ci)	U (gross) (Ci)
3.04E-01	3.13E-04	3.25E-01	5.62E-16	1.50E-03

T Plant Source Aggregate Area Management Study Report (DOE/RL-91-61)

HNO3 (kg)	Na2Cr2O7 (kg)	H2SO4 (kg)
9.84E+02	3.97E+00	9.79E+02

Table AD2-4. Data Needs Priority Summary –
Model Group 6 – 216-T-8 Crib
(200-LW-1/2) (RL/FH) (RPP) (Ecology). (2 Pages)

Vicinity Waste Sites	218-W-8, 241-TX-302C, 241-TX-154, UPR-200-W-2
Current Status	Analogous site; preliminarily assigned to 216-T-28 in the draft 200-LW-1/2 feasibility study; MESC/MNA/IC preliminarily identified as preferred alternative in draft feasibility study.

Potential Remedial Alternatives

X for viable alternatives	No Action	MESC/MNA/IC	Removal/Disposal	Barrier	Partial Removal / Barrier	In Situ Treatment	Other
		X	X	X	X		

Data Evaluation and Gaps Analysis

Data	Knowns	Data Uncertainties	Are supplemental data required to support decision making?
No site-specific sampling or logging	Existing information indicates only minor contamination would be expected.	Nature and extent of contamination	Yes. This crib is preliminarily assigned to 216-T-28, which has a larger inventory of several constituents. While the analogous relationship with 216-T-28 would bound the decision process, supplemental data at 216-T-8 may permit a stronger analysis of no action and MESC/MNA/IC alternatives and may permit lesser alternative than the analogous evaluation.

Additional Notes: None

References/Bibliography:

- DOE/RL-2001-66, Rev. 0, *Chemical Laboratory Waste Group Operable Units RI/FS Work Plan, Includes: 200-LW-1 and 200-LW-2 Operable Units*
- BHI-00177, *T Plant Aggregate Area Management Study Technical Baseline Report*
- H-2-353, *Waste Disposal Cribs, 216-T-6, 216-T-8 Cribs & Reverse Wells 216-T-3 & T-2*
- RPP-26744, *Hanford Soil Inventory Model, Rev. 1*
- *Waste Information Data System* database General Summary Report 216-T-8.

Proposed Activities and Path Forward:

- Two shallow direct pushes, one at each crib to support stronger evaluation of MESC/MNA/IC alternative.

FH = Fluor Hanford, Inc.
MESC/MNA/IC = Maintain Existing Soil Cover, Monitored Natural Attenuation, Institutional Controls.
NPH = normal paraffin hydrocarbon.
RL = U.S. Department of Energy, Richland Operations Office.
RPP = RCRA past practice.
TBP = tributyl phosphate.

AD2-4.0 216-Z-16 CRIB SITE-SPECIFIC FIELD SAMPLING PLAN

The supplemental characterization planned for the 216-Z-16 Crib includes drilling a deep borehole, collecting soil samples, electrical resistivity characterization data, and borehole geophysical data. Split spoon samples and grab samples will be collected at the locations specified in Table AD2-5. The collected samples will be analyzed for contaminants of potential concern presented in Volume I Table A2-3.

The SIM inventory indicates a large volume of fluoride went to this crib. The supplemental characterization is intended to reduce uncertainty regarding the vertical extent of vadose zone contamination and potential impacts to groundwater.

The following figures and tables provide the site-specific field-sampling plan for the 216-Z-16 Crib.

Figure AD2-7. 216-Z-16 Crib Data-Collection Locations.

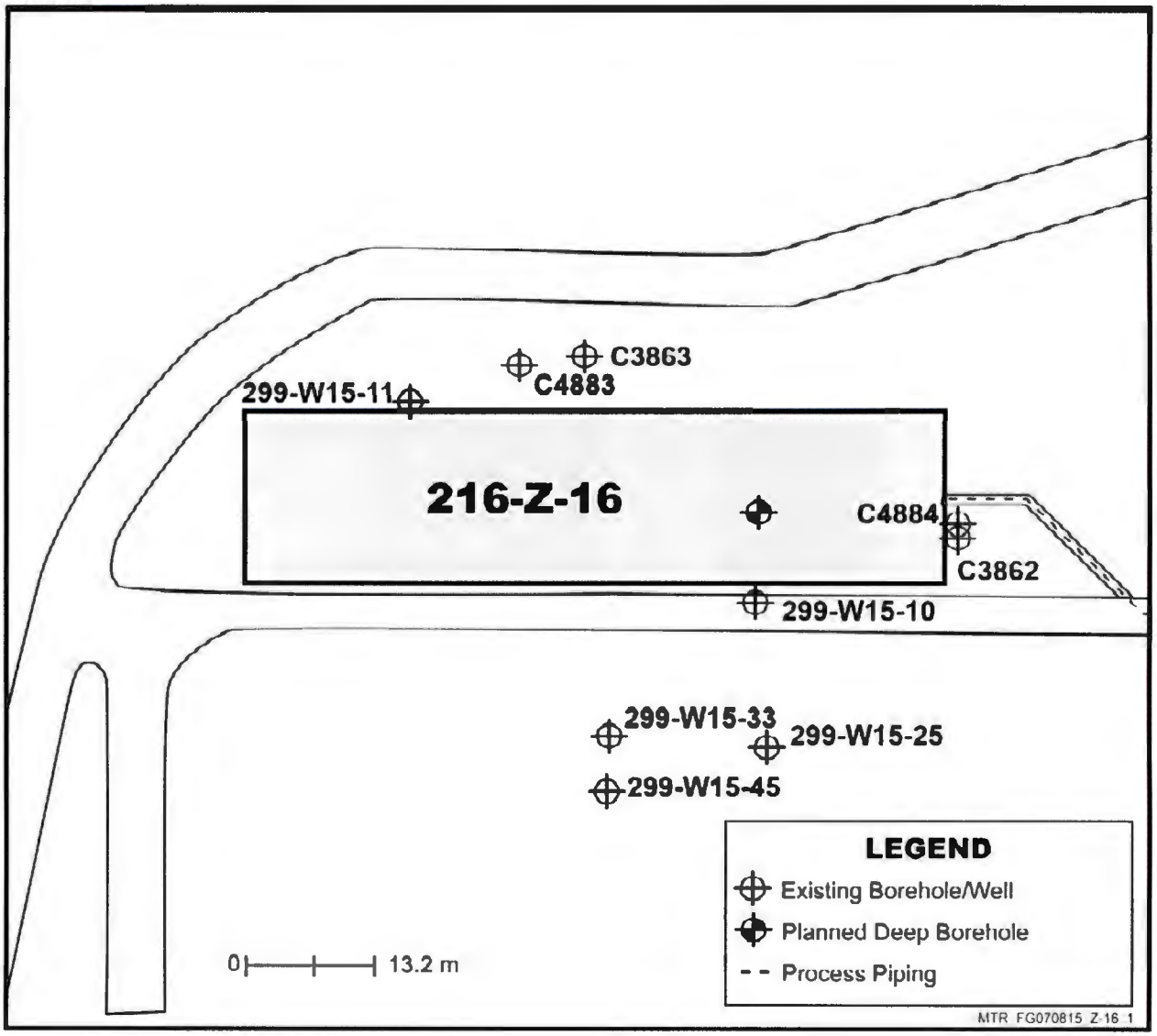


Figure AD2-8. 216-Z-16 Crib Stratigraphy and Sample-Collection Intervals.

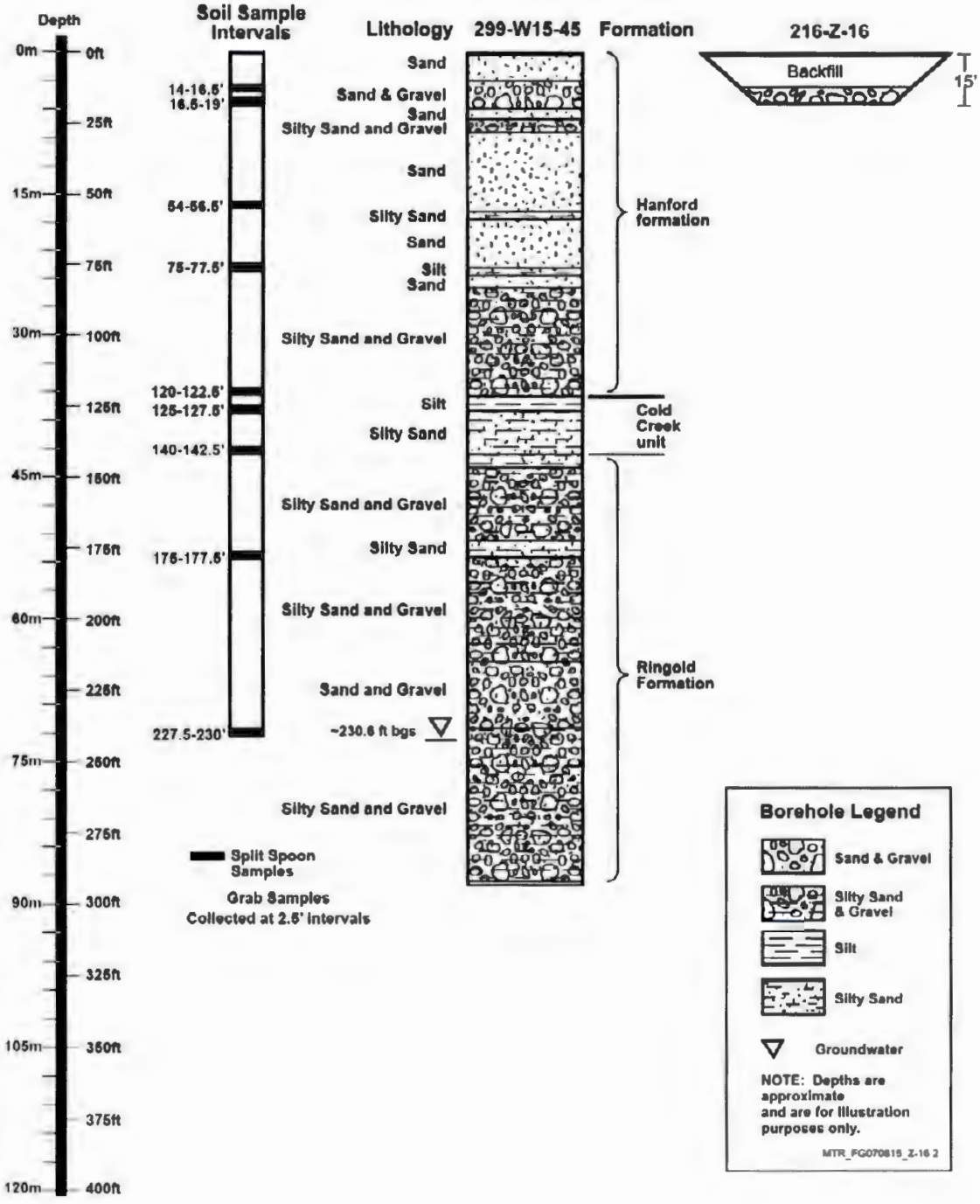


Table AD2-5. 216-Z-16 Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investi-gation	Sample Interval Depth (ft bgs) [a]	Analyte List [b]	Physical Properties	
					Sample Interval	Parameters
One deep borehole and sampling	One deep borehole near the inlet to crib	230 ft bgs	Sample at depths of: 14 – 16.5 ft bgs 16.5 – 19.0 ft bgs 54 – 56.5 ft bgs 75 – 77.5 ft bgs 100 – 122.5 ft bgs 125 – 127.5 ft bgs 140 – 142.5 ft bgs 175 – 177.5 ft bgs 227.5 – 230 ft bgs	Analytes are presented in Volume I, tables for 200-LW-1/ 200-LW-2 column	One sample at each change in stratigraphy. Sample interval at Hanford formation, sand dominated. Other samples taken at fine-grained intervals.	pH, specific conductance, bulk density, moisture, particle size distribution

Number of split-spoon samples	9
Approximate number of field quality-control samples [c]	2
Approximate number of physical-property samples	17
Approximate total number of soil samples collected	100
Approximate total number of soil samples analyzed[d]	28

Non-Sample Data Collection	Maximum Depth of Investigation
ERC	Not defined
Downhole spectral gamma log, neutron moisture log	Surface to TD

[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 Volume 1, Appendix A, Tables A2-1, A2-2, A2-3, A2-5, and A3-2 for detection limits and other analytical parameters.
[c] One duplicate and one equipment blank. Field blanks also will be collected for volatile organic analysis, but are not included here.
[d] Number of samples analyzed includes; 9 split-spoon samples, 2 QC samples, and 17 physical properties samples.

bgs = below ground surface.
ERC = electrical resistivity characterization.

Figure AD2-9. 216-Z-16 Crib Conceptual Model and Data Summary.

200-LW-2 Operable Unit
Waste Type: Process Effluent

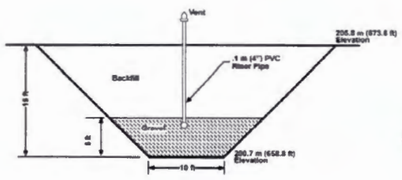
216-Z-16 Crib

PFP Zone
Model Group 6

History

The site is a rectangular excavation with gravel filling the bottom third. A perforated pipe runs the length of the excavation. The gravel is covered with a polyethylene barrier. The excavation is backfilled to grade. The crib was used to dispose of 231-Z Laboratory waste to the soil column. One gauge well, two monitoring wells adjacent to the crib, a vent riser, and the waste transfer line from the 231-Z Building comprise structures associated with this trench (WIDS).

CONSTRUCTION: The crib is 55 m (180 ft) long, and 3 m (10 ft) wide at the bottom, and is 4.9 m (16 ft) deep with 2.7 m (9 ft) of overburden. The waste site received 102,000,000 L ((27,000,000 gal.) of liquid effluent containing 72 g (2.5 oz) of total plutonium. The SIM inventory includes 5,800,000 kg (12,800,000 lb) of fluoride (WIDS).



WASTE VOLUME: 102,000,000 L of effluent (WIDS)
DURATION: 1968 to 1977 (WIDS)

ESTIMATED DISCHARGED INVENTORY:

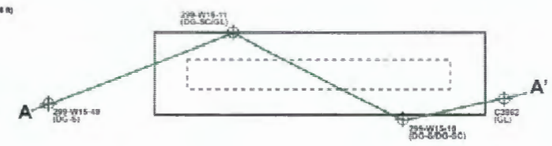
	SIM	WIDS
F	5.81E+06kg	--
Cr	1.70E+01kg	--
Na	2.35E+06kg	--
Total Pu	--	7.2E+00g

REFERENCES:
- DOE/RL-2001-66
- DOE/RL-2005-61
- DOE/RL-2006-56
- RPP-26744
- WIDS general summary reports

Basis of Knowledge (Data Types)

- Process History (PH)
- Geologic Log (GL)
- Downhole Geophysics- Spectral (DG-S)
- Downhole Geophysics – Scintillation (DG-SC)

Site Plan View
(not to scale)

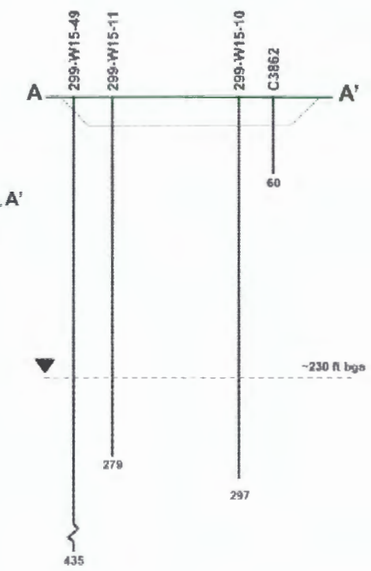


Legend
- ⊕ = Existing Borehole
- ▼ = Groundwater Surface
- bgs = Below ground surface
- PFP = Plutonium Finishing Plant
- SIM = Soil Inventory Model
- WIDS = Waste Information Data System

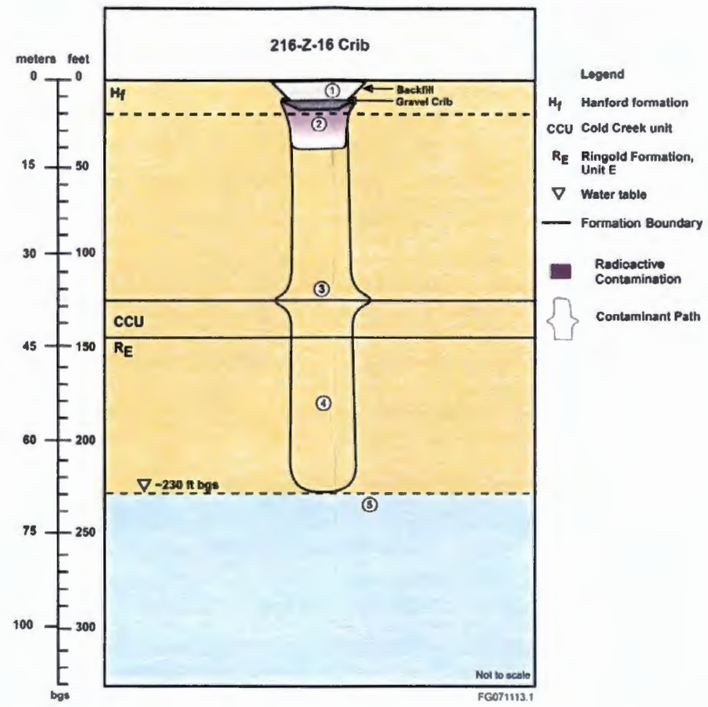
Characterization Summary

Investigation of the 216-Z-16 Crib as an analogous site assigned to the 216-Z-7 Crib was performed under DOE/RL-2001-66.

Site Section View
(not to scale)



Conceptual Contaminant Distribution Model



1. A total of 102,000,000 L (27,000,000 gal) of liquid waste were discharged to the 216-Z-16 Crib from 1968-1977.
2. Liquid waste was released at the crib bottom, where immobile contaminants (e.g., plutonium) sorbed to soils. A zone of higher contamination likely extends from 4.5 m (15 ft) bgs down to 9 m (30 ft) bgs, based on data from similar sites. Concentrations are expected to decrease quickly with depth.
3. Fine-grained zones in the vadose zone slowed water movement and allowed contaminants to spread laterally along the interfaces between fine-grained and coarser-grained sediments, such as the interface between the Hanford formation and the Cold Creek unit.
4. The effluent volume and fluoride inventory likely are sufficient to have impacted groundwater during operations.
5. Future groundwater impacts from this crib, particularly associated with fluoride, may be possible.

Table AD2-6. Data Needs Priority Summary –
Model Group 6 – 216-Z-16 Crib
(200-LW-1/2) (RL/FH) (RPP) (Ecology). (2 Pages)

Background	
Site Identification	216-Z-16 Crib
Site Location	200 West Area, Plutonium Finishing Plant Zone, northwest of 231-Z Building
Type of Site	Crib
Operating History	The site is a rectangular excavation with gravel filling the bottom third. A perforated pipe runs the length of the excavation. The gravel is covered with a polyethylene barrier. The excavation is backfilled to grade. The crib was used to dispose of 231-Z Laboratory waste to the soil column. One gage well, two monitoring wells adjacent to the crib, a vent riser, and the waste transfer line from the 231-Z Building comprise structures associated with this trench. The crib is 55 m (180 ft) long, and 3 m (10 ft) wide at the bottom, and is 5 m (16 ft) deep with 3 m (9 ft) of overburden. The waste site received 102,000,000 L (27,000,000 gal) of liquid effluent containing 72 g (2.5 oz) of total plutonium. The Soil Inventory Model (RPP-26744) inventory includes 5,800,000 kg (12,800,000 lb) of fluoride.

Soil Inventory Model 216-Z-16 (RPP-26744)

Na (kg)	Al (kg)	Fe (kg)	Cr (kg)	Bi (kg)	La (kg)	Hg (kg)	Zr (kg)	Pb (kg)
2.345E+06	0.000E+00	0.000E+00	1.273E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni (kg)	Ag (kg)	Mn (kg)	Ca (kg)	K (kg)	NO3 (kg)	NO2 (kg)	CO3 (kg)	PO4 (kg)
1.301E+01	0.000E+00	0.000E+00	0.000E+00	2.386E+07	0.000E+00	0.000E+00	1.224E+05	0.000E+00
SO4 (kg)	Si (kg)	F (kg)	Cl (kg)	CCl4 (kg)	Butanol (kg)	TBP (kg)	NPH (kg)	NH3 (kg)
0.000E+00	0.000E+00	5.812E+06	1.071E+06	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe(CN)6 (kg)	H-3 (Ci)	C-14 (Ci)	Ni-59 (Ci)	Ni-63 (Ci)	Co-60 (Ci)	Se-79 (Ci)	Sr-90 (Ci)	Y-90 (Ci)
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	9.486E-08	4.390E-05	4.388E-05
Zr-93 (Ci)	Nb-93m (Ci)	Tc-99 (Ci)	Ru-106 (Ci)	Cd-113m (Ci)	Sb-125 (Ci)	Sn-126 (Ci)	I-129 (Ci)	Cs-134 (Ci)
1.226E-06	0.000E+00	5.453E-06	2.549E-12	3.770E-10	3.255E-09	0.000E+00	0.000E+00	5.083E-08
Cs-137 (Ci)	Ba-137m (Ci)	Sm-151 (Ci)	Eu-152 (Ci)	Eu-154 (Ci)	Eu-155 (Ci)	Ra-226 (Ci)	Ra-228 (Ci)	Ac-227 (Ci)
4.840E-05	4.580E-05	2.902E-04	1.056E-07	1.110E-05	1.568E-07	8.865E-09	9.116E-14	4.061E-08
Pa-231 (Ci)	Th-229 (Ci)	Th-232 (Ci)	U-232 (Ci)	U-233 (Ci)	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)
6.304E-08	4.810E-11	9.500E-14	2.613E-08	2.267E-08	1.637E-04	6.835E-06	5.797E-06	1.386E-04
U-Total (kg)	Np-237 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Pu-241 (Ci)	Pu-242 (Ci)	Am-241 (Ci)	Am-243 (Ci)
4.157E-01	1.064E-02	2.348E-01	2.748E+00	8.244E-01	1.241E+01	1.093E-04	2.747E+00	2.303E-03
Cm-242 (Ci)	Cm-243 (Ci)	Cm-244 (Ci)						
3.909E-03	3.749E-04	9.060E-03						

Radionuclide Inventories of Liquid Waste Disposal Sites on the Hanford Site (HNF-1744) (Curie Content Based on 12/31/98)

Sr-90 (Ci)	Tc-99 (Ci)	Cs-137 (Ci)
4.39E-05	3.64E-06	4.84E-05

Table AD2-6. Data Needs Priority Summary –
Model Group 6 – 216-Z-16 Crib
(200-LW-1/2) (RL/FH) (RPP) (Ecology). (2 Pages)

Vicinity Waste Sites	231-Z Building.
Current Status	Analogous site; preliminarily assigned to 216-Z-7; evaluated in 200-LW-1/2 feasibility study (in progress); capping preliminarily identified as preferred alternative.

Potential Remedial Alternatives

X for viable alternatives	No Action	MESC/MNA/IC	Removal/Disposal	Barrier	Partial Removal / Barrier	In Situ Treatment	Other
		X	X	X			

Data Evaluation and Gaps Analysis

Data	Knowns	Data Uncertainties	Are supplemental data required to support decision making?
Geophysical Logging: 299-W15-10 (91 m [300 ft]) Spectral, 2003 299-W15-49 (133 m [435 ft]) Spectral 2004 299-W15-10 & 216-W15-11, Scintillation logs dated 1968, 1970, and 1976	<u>299-W15-10</u> Located on the south edge of the crib near the east end. Cesium-137 was detected at 1 m (3 ft), 5 m (18 ft), 19 m (63 ft), and 34 m (110 ft) with a concentration near the detection limit of 0.2 pCi/g. <u>299-W15-49</u> Located west of the crib. Cesium-137 was detected at a few sporadic places throughout the borehole near the minimum detection level of approximately 0.2 pCi/g. These detections using the routine processing software probably are the result of statistical fluctuations and are not considered valid.	Potential impacts to groundwater from fluoride discharged to crib	Yes. SIM inventory indicates a large volume of fluoride went to this crib. The impacts to groundwater associated with fluoride are uncertain. The deep borehole is intended to reduce uncertainty regarding the vertical extent of vadose zone contamination and potential impacts to groundwater. ERC would provide an indication of potential elevated conductivity that may be associated with vadose-zone contamination and elevated moisture.

Additional Notes: None

References/Bibliography:

- ARH-ST-156, *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells*
- DOE/RL-2001-66, Rev. 0, *Chemical Laboratory Waste Group Operable Units RI/FS Work Plan, Includes: 200-LW-1 and 200-LW-2 Operable Units*
- DOE/RL-91-58, Rev. 0, *Z Plant Source Aggregate Area Management Study Report*
- DOE/RL-96-81, Rev. 0, *Waste Site Grouping for 200 Areas Soil Investigations*
- HNF-1744, Rev. 0, *Radionuclide Inventories of Liquid Waste Disposal Sites on the Hanford Site*
- Logs
- RHO-CD-673, *Handbook 200 Areas Waste Sites*
- RHO-LD-114, *Existing Data on the 216 Z Liquid Waste Sites*
- RHO-RE-SR-84-24 P, *Results of Separations Area Groundwater Monitoring Network for 1983*
- RPP-26744, *Hanford Soil Inventory Model, Rev. 1*
- *Waste Information Data System* database.

Proposed Activities and Path Forward:

- ERC to evaluate presence of subsurface conductivity that may be indicative of moisture and contamination.
- One deep borehole near the inlet of the crib to assess potential impacts to groundwater.

ERC = electrical resistivity characterization.
NPH = normal paraffin hydrocarbon.
RPP = RCRA past practice.
SIM = *Hanford Soil Inventory Model, Rev. 1* (RPP-26744).
TBP = tributyl phosphate.

AD2-5.0 216-B-10A CRIB SITE-SPECIFIC FIELD SAMPLING PLAN

The supplemental characterization planned for the 216-B-10A includes driving a shallow borehole, collecting soil samples, electrical resistivity characterization data, and borehole geophysical data. Split spoon samples will be collected at the locations specified in Table AD2-7. The collected samples will be analyzed for contaminants of potential concern presented in Volume I Table A2-3.

The 216-B-10A site received a large quantity of effluent with a small inventory of contaminants. Supplemental characterization data is intended to help support evaluation and selection of a less costly remedial action alternative, such as MESC/MNA/IC, and would provide better data for balancing the decision making between leave in place and removal alternatives.

The following figures and tables provide the site-specific field sampling plan for the 216-B-10A Crib.

Figure AD2-10. 216-B-10A Crib Data-Collection Locations.

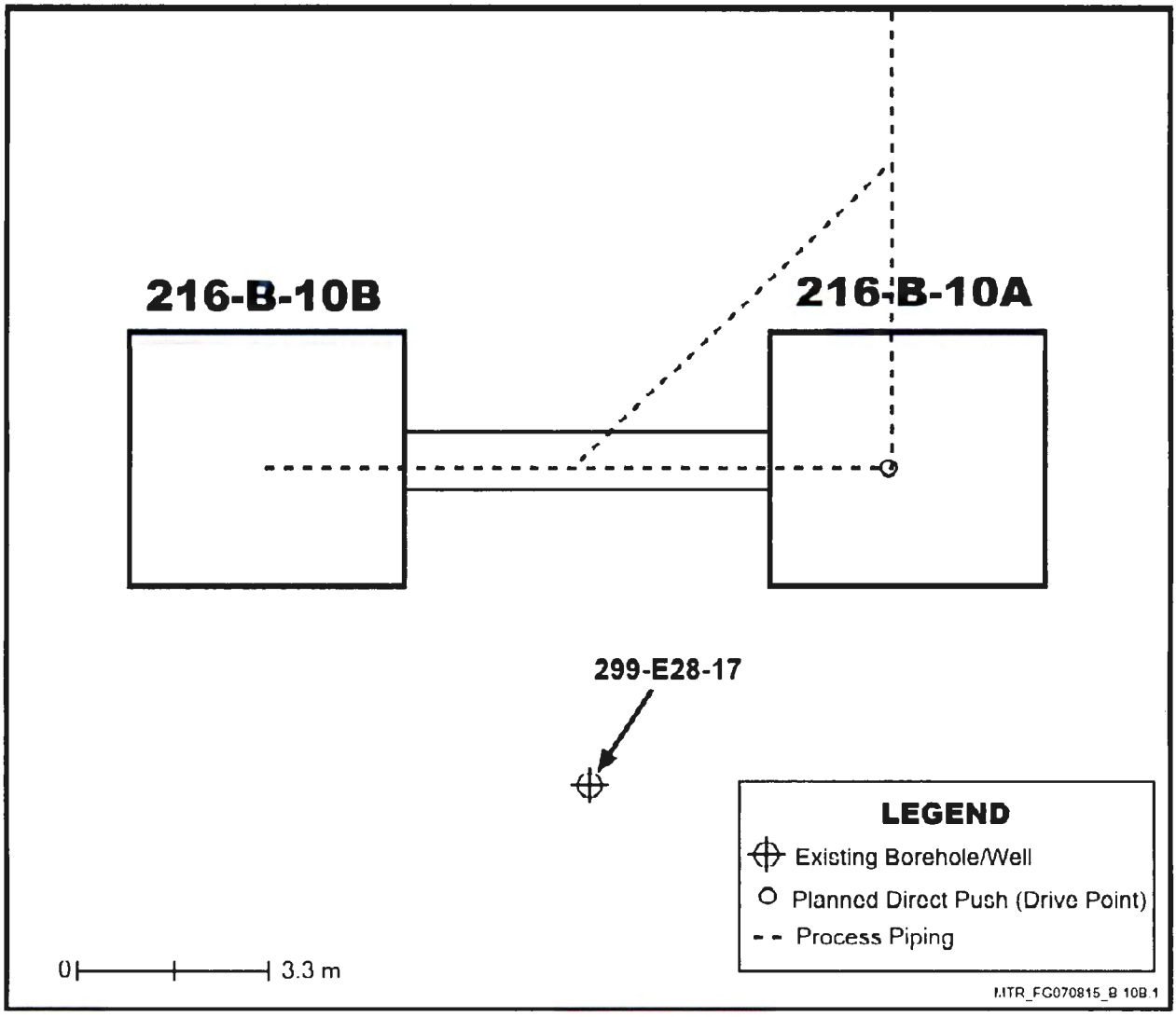


Figure AD2-11. 216-B-10A Crib Stratigraphy and Sample-Collection Intervals.

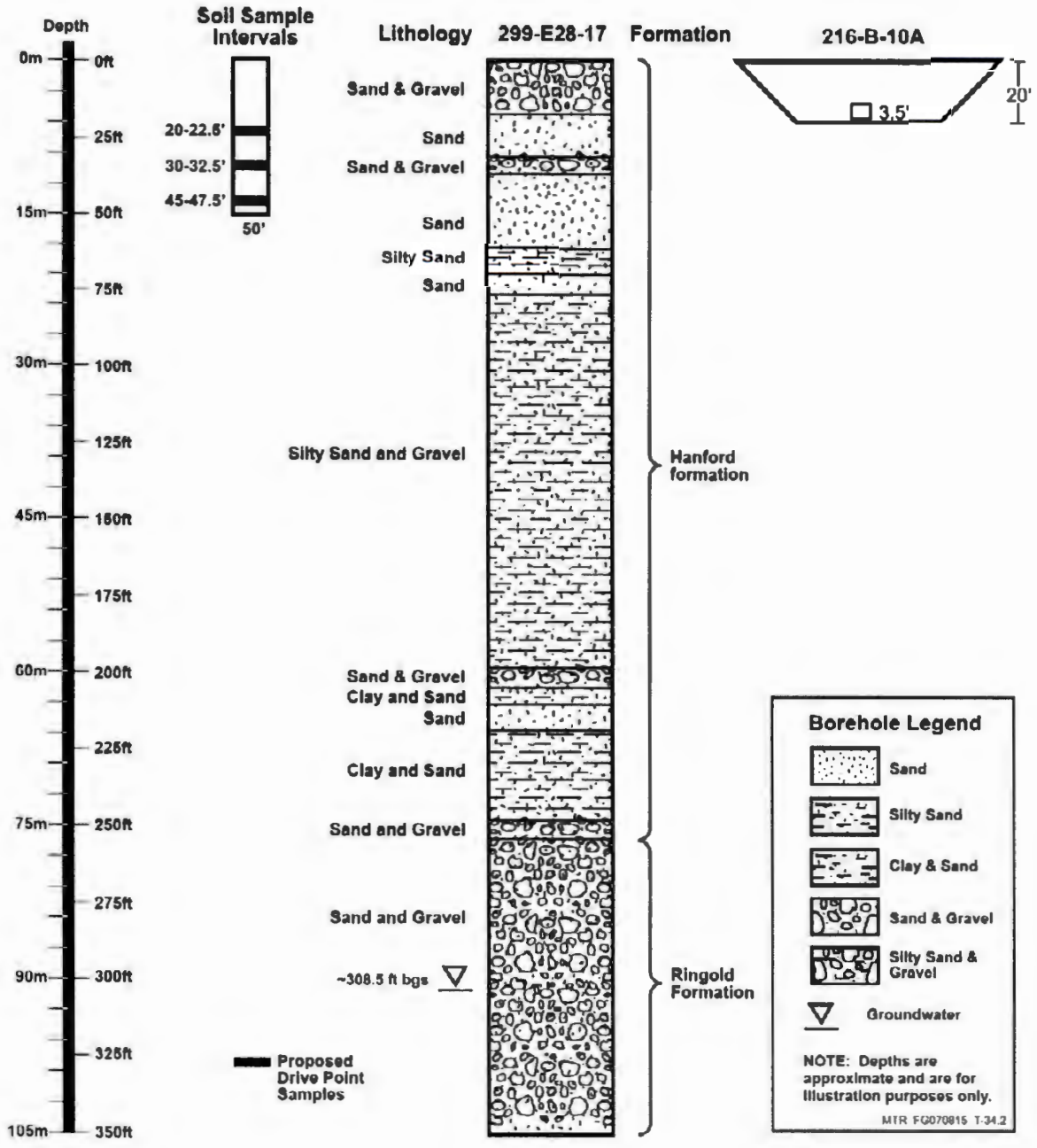


Table AD2-7. 216-B-10A Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investi-gation	Sample Interval Depth (ft bgs) [a]	Analyte List [b]	Physical Properties	
					Sample Interval	Parameters
1 drive point	Near center of 216-B-10A	50.0 ft bgs	Sample at depths of: 20 – 22.5 ft bgs 30 – 32.5 ft bgs 45 – 47.5 ft bgs	Analytes are presented in Volume I, tables for 200-LW-1/ 200-LW-2 column	N/A	N/A

Number of split-spoon samples	3
Approximate number of field quality-control samples [c]	2
Approximate number of physical-property samples	0
Approximate total number of soil samples collected	5
Approximate total number of soil samples analyzed[d]	5

Non-Sample Data Collection	Maximum Depth of Investigation
ERC	Not defined
Downhole spectral gamma log, neutron moisture log	Surface to TD

[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 Volume 1, Appendix A, Tables A2-1, A2-2, A2-3, A2-5, and A3-2 for detection limits and other analytical parameters.
[c] One duplicate and one equipment blank. Field blanks also will be collected for volatile organic analysis, but are not included here.
[d] Number of samples analyzed includes: 3 split-spoon samples, and 2 QC samples.

bgs = below ground surface.
ERC = electrical resistivity characterization.

1

2

3

Figure AD2-12. 216-B-10A Crib Conceptual Model and Data Summary.

200-LW-2 Operable Unit
Waste Type: Process Effluent

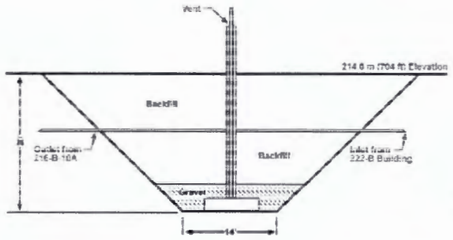
216-B-10 A Crib

B Plant Zone
Model Group 2

History

The 216-B-10A site received decontamination sink and sample slurper waste from the 222-B building and floor drainage from the 292-B Building from December 1949 to December 1951. After December 1951 to January 1952 the site received only the floor drainage from the 292-B Building. The waste is acidic and contains transuranics and fission products. The site received approximately 9,900,000 L (2,600,000 gal) of effluent.

CONSTRUCTION: The unit is a 3.7 by 3.7 by 1.1 m (12 by 12 by 3.5 ft) wooden structure in an excavation. The bottom of the excavation is 6.1 m (20 ft) below grade. The structure is not gravel-filled and has cave-in potential. The surface of the unit has subsided about 0.9 m (3 ft) in the center, possibly indicating deterioration of the lumber.



WASTE VOLUME: 9,990,000 L of effluent (WIDS)
DURATION: 1949 to 1952 (WIDS)

ESTIMATED DISCHARGED INVENTORY:

	WIDS	SIM
Sr-90	1.52E+00Ci	1.32E+00Ci
Cs-137	3.25E-01Ci	1.08E+01Ci
NO3	1.00E+03kg	1.17E+03kg

REFERENCES:
- DOE/RL-91-61
- DOE/RL-2001-66
- DOE/RL-2005-61
- RHO-CD-673
- RPP-26744
- WIDS general summary reports

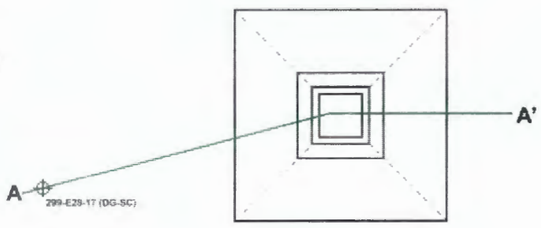
Basis of Knowledge (Data Types)

- Process History (PH)
- Downhole Geophysics-Scintillation (DG-SC)

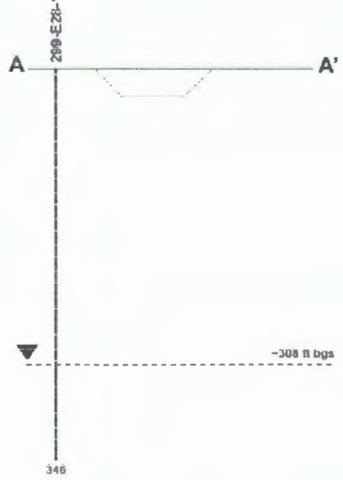
Characterization Summary

Well 299-E28-17 monitors the 216-B-10A and the 216-B-10B Cribs. Only background radiation was detected in the monitoring well which is south of the cribs. Characterization of the 216-B-10A Crib was performed under DOE/RL-2005-61.

Site Plan View
(not to scale)

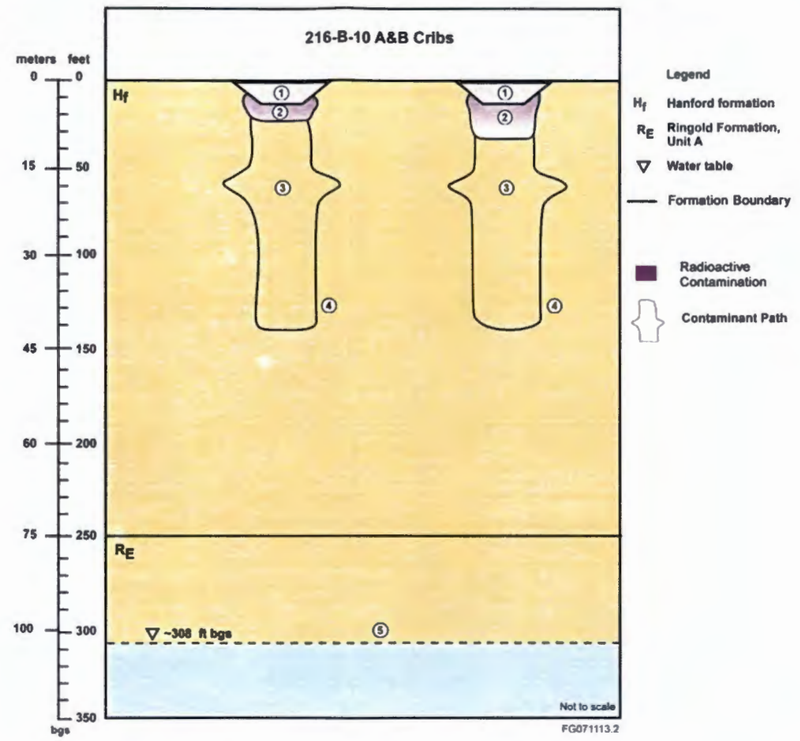


Site Section View
(not to scale)



Legend
- ⊕ = Existing Borehole
- ▼ = Groundwater Surface
- bgs = Below ground surface
- SIM = Soil Inventory Model
- WIDS = Waste Information Data System

Conceptual Contaminant Distribution Model



1. A total of 9,990,000 L (2,600,000 gal.) of liquid waste were discharged to the 216-B-10A/10B Crib from 1949-1952.
2. Liquid waste was released at the crib bottom, where immobile contaminants (e.g. cesium) sorbed to soils. A zone of higher contamination likely extends from 6.1 m (20 ft) bgs down to 10.7 m (35 ft) bgs, based on data from similar sites. Concentrations are expected to decrease quickly with depth.
3. Fine-grained zones in the vadose zone slowed water movement and allowed contaminants to concentrate and move laterally along the interfaces between fine-grained and coarser-grained sediments, such as the interface between the Hanford formation and the Cold Creek unit.
4. As the moisture front moved downward, more mobile contaminants (e.g., nitrate) were carried along toward groundwater. The effluent volume and nitrate inventory likely are sufficient to have impacted groundwater during operations.
5. Because the waste inventory is relatively low, significant future impacts are not expected.

Table AD2-8. Data Needs Priority Summary –
Model Group 2 – 216-B-10A&B Crib (200-LW-1/2)
(RL/FH) (RPP) (Ecology). (3 Pages)

Background

Site Identification	216-B-10A&B
Site Location	200 East, B Plant Zone, south of the west end of B Plant
Type of Site	Cribs

Operating History

The units are 3.7 by 3.7 by 1.1 m (12- by 12- by 3.5-ft) wooden structures in an excavation with side slopes of 1:1. The bottoms of the excavations are 6.1 m (20 ft) below grade. The structure is not gravel-filled and has cave-in potential. The surfaces of the units have subsided about 0.9 m (3 ft) in the center, possibly indicating deterioration of the lumber. Some of the 216-B-10A Crib waste cascaded into the 216-B-10B Crib. The 216-B-10A site was deactivated by blanking the 222-B Building waste line at the decontamination sink. The 216-B-10B site was deactivated by blanking the pipeline between 216-B-10A and 216-B-10B and both sites were stabilized in 1983.

The 216-B-10A site received decontamination sink and sample slurper waste from the 222-B Building and floor drainage from the 292-B Building from December 1949 to December 1951. From December 1951 to January 1952, the site received only the floor drainage from the 292-B Building. The waste is acidic and contains transuranics and fission products. The site received approximately 9,900,000 L (2,600,000 gal) of effluent.

The 216-B-10B site received the same decontamination sink and sample slurper waste from the 222-B Building and floor drainage from the 292-B Building that cascaded from 216-B-10A from December 1949 to December 1951. From December 1951 to May 1969, the site received only the floor drainage from the 292-B Building. From June 1969 to October 1973, the site directly received only the decontamination sink and shower waste from the 221-BC Building. The site received 28,000 L (7,500 gal) of effluent.

Soil Inventory Model 216-B-10A (RPP-26744)

Na (kg)	Al (kg)	Fe (kg)	Cr (kg)	Bi (kg)	La (kg)	Hg (kg)	Zr (kg)	Pb (kg)
5.296E+02	0.000E+00	1.065E+01	4.215E+01	1.572E-01	6.447E-05	1.845E-04	1.036E-02	0.000E+00
Ni (kg)	Ag (kg)	Mn (kg)	Ca (kg)	K (kg)	NO3 (kg)	NO2 (kg)	CO3 (kg)	PO4 (kg)
1.087E+01	2.914E-05	1.421E-02	3.638E+01	6.842E+01	1.171E+03	1.119E+02	3.088E+01	1.169E+01
SO4 (kg)	Si (kg)	F (kg)	Cl (kg)	CCl4 (kg)	Butanol (kg)	TBP (kg)	NPH (kg)	NH3 (kg)
4.943E+01	3.075E-01	5.884E+00	1.292E+01	0.000E+00	2.510E-05	0.000E+00	0.000E+00	6.444E-01
Fe(CN)6 (kg)	H-3 (Ci)	C-14 (Ci)	Ni-59 (Ci)	Ni-63 (Ci)	Co-60 (Ci)	Se-79 (Ci)	Sr-90 (Ci)	Y-90 (Ci)
0.000E+00	6.371E-02	2.291E-04	6.779E-05	6.416E-03	2.654E-04	1.106E-05	1.316E+00	1.317E+00
Zr-93 (Ci)	Nb-93m (Ci)	Tc-99 (Ci)	Ru-106 (Ci)	Cd-113m (Ci)	Sb-125 (Ci)	Sn-126 (Ci)	I-129 (Ci)	Cs-134 (Ci)
5.381E-04	4.766E-04	5.352E-03	4.124E-13	3.552E-04	1.036E-05	4.180E-05	4.874E-06	9.634E-08
Cs-137 (Ci)	Ba-137m (Ci)	Sm-151 (Ci)	Eu-152 (Ci)	Eu-154 (Ci)	Eu-155 (Ci)	Ra-226 (Ci)	Ra-228 (Ci)	Ac-227 (Ci)
1.082E+01	1.022E+01	4.845E-01	1.796E-05	1.356E-03	7.760E-04	3.652E-08	1.755E-13	2.037E-07
Pa-231 (Ci)	Th-229 (Ci)	Th-232 (Ci)	U-232 (Ci)	U-233 (Ci)	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)
4.733E-07	3.430E-11	2.895E-13	2.365E-08	1.860E-09	1.578E-03	6.994E-05	2.112E-05	1.612E-03
U-Total (kg)	Np-237 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Pu-241 (Ci)	Pu-242 (Ci)	Am-241 (Ci)	Am-243 (Ci)
4.827E+00	3.017E-05	3.653E-05	5.582E-03	5.656E-04	1.044E-03	7.181E-09	1.714E-03	2.374E-07
Cm-242 (Ci)	Cm-243 (Ci)	Cm-244 (Ci)						
4.088E-07	4.848E-09	1.139E-07						

Radionuclide Inventories of Liquid Waste Disposal Sites on the Hanford Site (HNF-1744) (Curie Content Based on 12/31/98)

Co-60 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	Cs-137 (Ci)	Ra-226 (Ci)	Th-232 (Ci)	U (Gross) (Ci)		
1.63E-04	1.52E+00	6.54E-05	3.25E-01	5.29E-11	1.13E-15	3.02E-03		

B Plant Source Aggregate Area Management Study Report (DOE/RL-92-05)

HNO3 (kg)	NaCr2O7 (kg)	NO3 (kg)	SO4 (kg)
1.00E+03	1.00E+02	1.00E+03	1.00E+03

Table AD2-8. Data Needs Priority Summary –
Model Group 2 – 216-B-10A&B Crib (200-LW-1/2)
(RL/FH) (RPP) (Ecology). (3 Pages)

Soil Inventory Model 216-B-10B (RPP-26744)

Na (kg)	Al (kg)	Fe (kg)	Cr (kg)	Bi (kg)	La (kg)	Hg (kg)	Zr (kg)	Pb (kg)
1.258E+02	0.000E+00	2.933E+00	1.166E+01	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni (kg)	Ag (kg)	Mn (kg)	Ca (kg)	K (kg)	NO3 (kg)	NO2 (kg)	CO3 (kg)	PO4 (kg)
2.997E+00	0.000E+00	0.000E+00	1.009E+01	7.564E-01	2.724E+02	3.095E+01	3.309E+00	0.000E+00
SO4 (kg)	Si (kg)	F (kg)	Cl (kg)	CCl4 (kg)	Butanol (kg)	TBP (kg)	NPH (kg)	NH3 (kg)
1.077E+01	0.000E+00	0.000E+00	3.153E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe(CN)6 (kg)	H-3 (Ci)	C-14 (Ci)	Ni-59 (Ci)	Ni-63 (Ci)	Co-60 (Ci)	Se-79 (Ci)	Sr-90 (Ci)	Y-90 (Ci)
0.000E+00	5.107E-08	1.170E-09	1.868E-09	1.789E-07	9.426E-09	9.922E-11	1.039E-06	1.040E-06
Zr-93 (Ci)	Nb-93m (Ci)	Tc-99 (Ci)	Ru-106 (Ci)	Cd-113m (Ci)	Sb-125 (Ci)	Sn-126 (Ci)	I-129 (Ci)	Cs-134 (Ci)
5.900E-09	4.698E-09	3.128E-08	1.059E-09	6.409E-09	8.746E-09	4.132E-10	1.643E-05	9.799E-09
Cs-137 (Ci)	Ba-137m (Ci)	Sm-151 (Ci)	Eu-152 (Ci)	Eu-154 (Ci)	Eu-155 (Ci)	Ra-226 (Ci)	Ra-228 (Ci)	Ac-227 (Ci)
1.298E-04	1.226E-04	1.932E-06	3.565E-10	2.890E-08	1.552E-08	5.340E-15	5.319E-12	8.797E-14
Pa-231 (Ci)	Th-229 (Ci)	Th-232 (Ci)	U-232 (Ci)	U-233 (Ci)	U-234 (Ci)	U-235 (Ci)	U-236 (Ci)	U-238 (Ci)
1.278E-11	1.094E-14	4.087E-14	1.303E-12	7.989E-11	1.040E-11	4.055E-13	4.240E-13	8.768E-12
U-Total (kg)	Np-237 (Ci)	Pu-238 (Ci)	Pu-239 (Ci)	Pu-240 (Ci)	Pu-241 (Ci)	Pu-242 (Ci)	Am-241 (Ci)	Am-243 (Ci)
2.629E-08	1.267E-10	2.128E-10	4.270E-09	1.046E-09	1.323E-08	8.430E-14	3.685E-09	1.042E-12
Cm-242 (Ci)	Cm-243 (Ci)	Cm-244 (Ci)						
9.188E-12	2.682E-13	6.821E-12						

Radionuclide Inventories of Liquid Waste Disposal Sites on the Hanford Site (HNF-1744) (Curie Content Based on 12/31/98)

Co-60 (Ci)	Sr-90 (Ci)	Tc-99 (Ci)	Cs-137 (Ci)	Ra-226 (Ci)	Th-232 (Ci)	U (Gross) (Ci)
<2.15E-08	1.60E-04	3.16E-09	5.67E-05	4.35E-15	9.32E-20	2.48E-07

B Plant Source Aggregate Area Management Study Report (DOE/RL-92-05)

HNO3 (kg)	NaCr2O7 (kg)	NO3 (kg)	SO4 (kg)
2.0E+00	--	--	--

Table AD2-8. Data Needs Priority Summary –
Model Group 2 – 216-B-10A&B Crib (200-LW-1/2)
(RL/FH) (RPP) (Ecology). (3 Pages)

Vicinity Waste Sites	None
Current Status	Analogous site; 216-B-10A preliminarily assigned to 216-T-28; 216-B-10B preliminarily assigned to 216-S-20; feasibility study in progress (DOE/RL-2006-56), preliminary preferred alternatives identified as capping for 216-B-10A and No Action for 216-B-10B

Potential Remedial Alternatives

X for viable alternatives	No Action	MESC/MNA/IC	Removal/Disposal	Barrier	Partial Removal / Barrier	In Situ Treatment	Other
	X (for 216-B-10B)	X	X	X	X		

Data Evaluation and Gaps Analysis

Data	Knowns	Data Uncertainties	Are supplemental data required to support decision making?
Geo Logs at one (1) well: 299-E28-17 (350 ft) – Scintillations logs dated 1976	*Geophysical Logging* – Background readings were observed in well E28-17 in 1976 located 18 m (60 ft) southeast of the 216-B-10A Crib.	Site-specific data that may be more reflective of inventory than the representative site.	Yes. The 216-B-10A site received a large volume of water (9,900,000 L) and a small inventory; however, site-specific data may help support a lesser alternative, such as MESC/MNA/IC, and would provide better data for balancing the decision making between leave-in-place and remove alternatives. 216-B-10B – No supplemental data are required due to the low volume and low inventory of waste received and the analogous relationship with 216-B-10A.

Additional Notes: None

References/Bibliography:

- ARH-ST-156, *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells*
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- DOE/RL-2001-66, *Chemical Laboratory Waste Group Operable Units RI/FS Work Plan, Includes: 200-LW-1 and 200-LW-2 Operable Units*
- DOE/RL-2005-61, *Remedial Investigation Report for the 200-LW-1 (300 Area Chemical Lab Waste Group) & 200-LW-2 (200 Area Chemical Lab Waste Group) Operable Units*
- DOE/RL-2006-56, Decisional Draft, *Feasibility Study for the 200-LW-1 (300 Area Chemical Lab Waste Group) and 200-LW-2 (200 Area Chemical Lab Waste Group) Operable Units*
- DOE/RL-92-05, *B Plant Source Aggregate Area Management Study Report*
- DOE/RL-96-81, Rev. 0, *Waste Site Grouping for 200 Areas Soil Investigations*
- HNF-1744, Rev. 0, *Radionuclide Inventories of Liquid Waste Disposal Sites on the Hanford Site*
- RPP-26744, *Hanford Soil Inventory Model, Rev. 1.*

Proposed Activities and Path Forward:

- Install direct push to collect soil sample at the base of the 216-B-10A Crib to provide site-specific data to support stronger evaluation of remedial alternatives, including the potential for a lesser alternative than the one currently identified based on analogous relationships.
- Data from the push would support evaluation of the 216-B-10B Crib.

MESC/MNA/IC = Maintain Existing Soil Cover, Monitored Natural Attenuation, Institutional Controls.
NPH = normal paraffin hydrocarbon.
RPP = RCRA past practice.
TBP = tributyl phosphate.

1

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AD2-6.0 REFERENCES

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DOE/RL-2005-61, 2006, *Remedial Investigation Report for the 200-LW-1 (300 Area Chemical Laboratory Waste Group) and 200-LW-2 (200 Area Chemical Laboratory Waste Group) Operable Units*, Draft A, U.S. Department of Energy, Richland Operations Office, Richland Washington.

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1

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