DOE/RL-2007-02-VOL II-ADD 4
Revision 0

Site-Specific Field-Sampling Plans for the 216-B-7A&B Crib, 216-B-8 Crib and Tile Field, 216-T-3 Injection/Reverse Well, 216-T-5 Trench, 216-T-6 Cribs, 216-T-7 Crib and Tile Field, 216-T-15 Trench, and 216-T-32 Crib in the 200-TW-2 Operable Unit

Addendum 4

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

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March 2008

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Printed in the United States of America

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APPROVAL PAGE

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

Addendum 4 – Site-Specific Field-Sampling Plans for 216-B-7A&B Crib, 216-B-8 Crib and Tile Field, 216-T-3 Injection/Reverse Well, 216-T-5 Trench, 216-T-6 Cribs, 216-T-7 Crib and Tile Field, 216-T-15 Trench, and 216-T-32 Crib in the 200-TW-2 Operable Unit

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

Signature ______________________ Date 4/23/08

Lead Regulatory Agency:

☐ U.S. Environmental Protection Agency

☒ Washington State Department of Ecology

Signature ______________________ Date 5/29/08

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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TABLES

TERMS

ALARA	as low as reasonably achievable
bgs	below ground surface
COPC	contaminants of potential concern
cps	counts per second
DOE	U.S. Department of Energy
DG	downhole geophysics
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
ERC	electrical resistivity characterization
GL	geologic log
HRR	high resolution resistivity
MESC/MNA/IC	maintain existing soil cover, monitored natural attenuation, institutional controls
N/A	not applicable
NMLS	neutron moisture logging system
OU	operable unit
PH	process history
PUREX	plutonium-uranium extraction (plant or process)
REDOX	reduction-oxidation (plant or process)
RI/FS	remedial investigation/feasibility study
QA/QC	quality assurance/quality control
QAPjP	quality assurance project plan
SAP	sampling and analysis plan
SGE	surface geophysical exploration
SIM	*Soil Inventory Model, Rev.1*
SSSP	site-specific field sampling plan
TBD	to be determined
TD	total depth
Tri-Parties	U.S. Department of Energy, U.S. Environmental Protection Agency, and Washington State Department of Ecology
WIDS	*Waste Information Data System* database

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

AD4-1.0 INTRODUCTION

Addendum 4 of Work Plan Volume II contains the site-specific field-sampling plans (SSSP) for the 216-B-7A&B Crib, 216-B-8 Crib and Tile Field, 216-T-3 Injection/Reverse Well, 216-T-5 Trench, 216-T-6 Crib, 216-T-7 Crib and Tile Field, 216-T-15 Trench, and 216-T-32 Crib in the 200-TW-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 objectives (DQO) process in the data-needs priority summary tables (Volume I, Appendix C).

Volume I 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-B-7A&B Crib, 216-B-8 Crib and Tile Field, 216-T-3 Injection/Reverse Well, 216-T-5 Trench, 216-T-6 Crib, 216-T-7 Crib and Tile Field, 216-T-15 Trench, and 216-T-32 Crib. 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, as low as reasonably achievable (ALARA) control technology 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-2007-02, Vol. I) and provide limitations on the analytical batch quality control analyses that can be completed. Additionally, operational constraints and detection limits may reduce the number of contaminants of potential concern (COPC) that can be analyzed.

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 Chapters 2.0 through 9.0 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]

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[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.

Activities associated with surface geophysical exploration (SGE) or high resolution resistivity (HRR), now referred to as electrical resistivity characterization (ERC), as identified in Volume I, Appendix C, have been (are currently) completed and will not be discussed further in this SSSP. ERC results will be reported as follows: waste sites in surrounding area of the B, BX, and BY Tank Farms are included in RPP-34690, *Surface Geophysical Exploration of the B, BX, and BY Tank Farms at the Hanford Site* ; waste sites in the surrounding area of the TX and TY Tank Farms are to be included in a report issued by CH2M Hill Hanford Group, Inc., expected October 2008; and remaining waste sites are to be included in a report issued by Pacific Northwest National Laboratory, expected March 2008. ERC areas are not included in the figures of this SSSP, as they extend well beyond the waste-site boundaries, but can be accessed from their corresponding reports.

AD4-2.0 216-B-7A&B CRIBS SITE-SPECIFIC FIELD-SAMPLING PLAN

The characterization planned for the 216-B-7A&B Cribs includes drilling three drive points, to depths of 40 ft, and geophysical logging of these drive points. The drilling and logging efforts are planned to reduce the uncertainty associated with the extent and volume of plutonium released at these cribs. The 216-B-7A&B Cribs received varying waste streams including liquid waste from Tank 5-6 in the 221-B Plant Canyon Building and cell drainage and decontamination waste from the 224-B Waste Storage Facility. The planned characterization would provide additional information on contaminant distribution below the cribs and address the potential for removal and disposal at this site.

Because no samples will be collected from these drive points and the stratigraphy figure serves to justify sample depths, this figure is not warranted. Geologic logs will be generated during drilling providing additional information on the lithology immediately below the crib.

The locations of the three drive points, two on the edge of the 216-B-7A Crib and one at the center of the 216-B-7B Crib, were chosen as characterization for this set of cribs based on surface geophysical exploration conducted by CH2M Hill Hanford Group Inc. utilizing their quality assurance/quality control (QA/QC) procedures (RPP-34690). The two drive points at 216-B-7A will provide information on lateral extent of plutonium contamination at the crib believed to have received the higher volume of liquid waste, while the one drive point at 216-B-7B will provide information at the source of the other crib. The location of these drive points may change as directed by the integrated project team (IPT) or as additional information becomes available at nearby drilling activities.

The following figures and tables provide the site-specific field-sampling plan for the 216-B-7A&B Cribs.

Figure AD4 2-1. 216-B-7A&B Cribs Data-Collection Locations

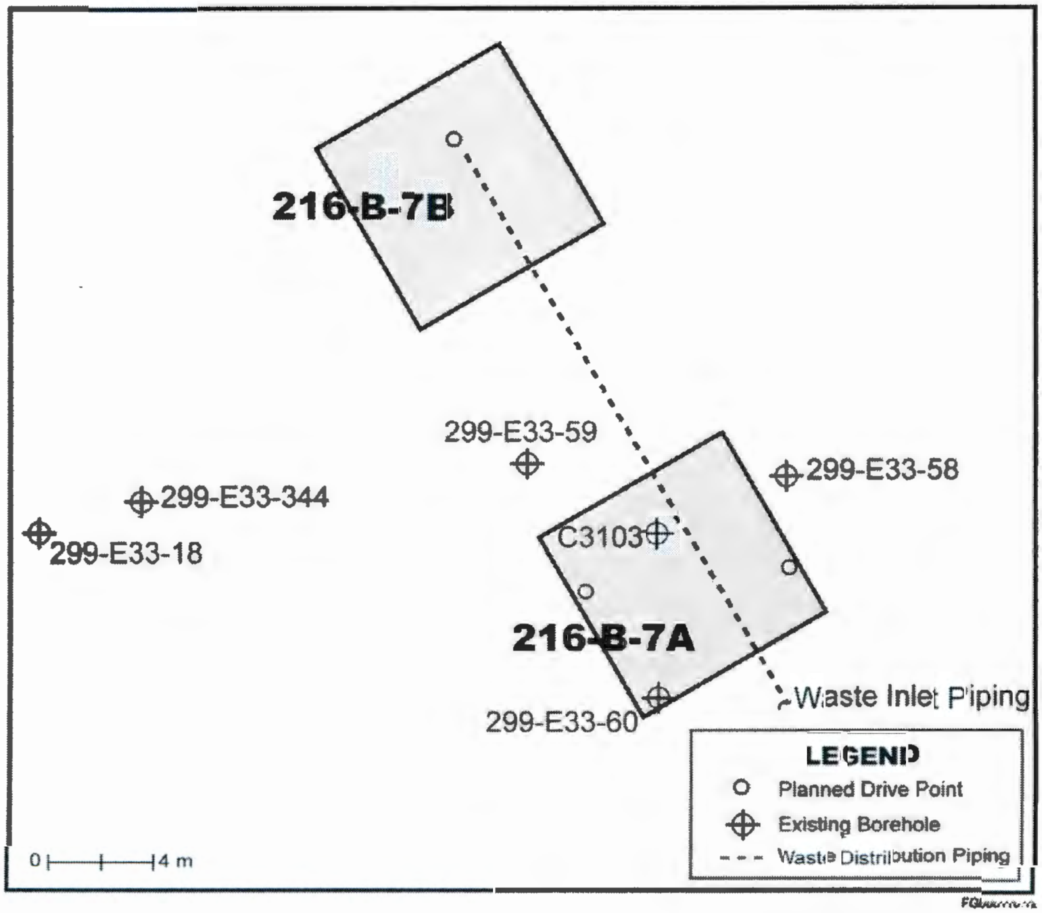

Table AD4 2-1. 216-B-7A&B Cribs Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investi-gation	Sample Interval Depth (ft bgs)	Analyte List	Physical Properties	
					Sample Interval	Parameters
Three drive points	Two on edge of 216-B-7A, one near center of 216-B-7B as depicted in Figure AD4 2-1.	40 ft bgs	N/A	N/A	N/A	N/A

Non-Sample Data Collection	Maximum Depth of Investigation
Downhole gamma-spectroscopy log, neutron moisture, and passive neutron logs	Surface to TD in new drive points ~40 ft bgs

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Figure AD4 2-2. 216-B-7A&B Cribs Conceptual Model and Data Summary.

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

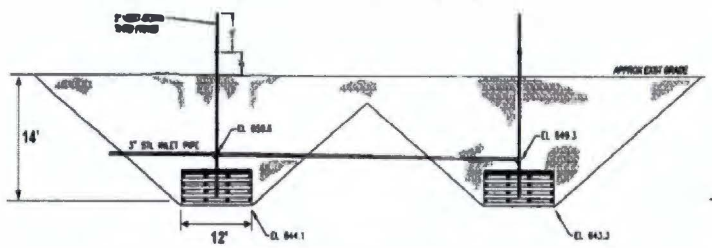
216-B-7A&B Cribs

B Farm Zone

History

216-B-7A&B Cribs are subsurface liquid waste disposal sites that operated from 1946 to 1967 receiving process waste from the 221-B and 224-B Buildings via 241-B-201, 241-B-202, 241-B-203 and 241-B-204 settling tanks. They are marked and posted with Underground Radioactive Material and Cave-In Potential signs.

CONSTRUCTION:
The cribs are square excavations of 14 ft by 14 ft by 14 ft deep containing 12 ft by 12 ft by 4 ft deep wooden timbers (6 inch by 6 inch) placed at the bottom of the excavation and connected by underground piping. The cribs are located about 28 ft apart; a pipeline feeds both cribs simultaneously through a T-fitting from 201-B settling tanks.



WASTE VOLUME: 43,600,000 L (11,500,000 gal) (WIDS)

DURATION: September 1946 to May 1967 (WIDS)

ESTIMATED DISCHARGED INVENTORY (DOE/RL-2003-64, RHO-CD-673, RPP-26744):

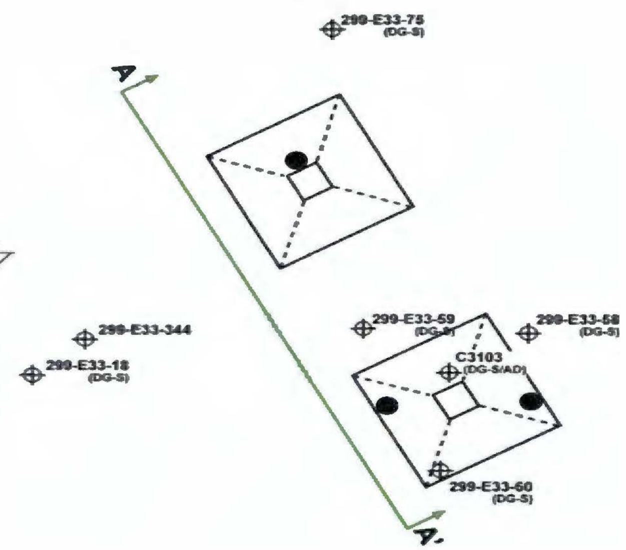
Contaminant	Historical	2008	SIM
Plutonium	4300 g	–	–
Nitrate	1,800,000 kg	–	2,714,525 kg
Sr-90	5600 Ci	1447.6 Ci	1636 Ci
Tc-99	0.509 Ci	0.509 Ci	0.095 Ci
Cs-137	100 Ci	28.7 Ci	373.5 Ci
Uranium	180 kg	–	197 kg
Total beta	24,000 Ci	–	–

REFERENCES:
- WIDS general summary reports
- RPP-26744
- RHO-CD-673
- DOE/RL-2003-64

Basis of Knowledge (Data Types)

- Process History (PH)
- Downhole Geophysics – Spectral (DG-S)
- Geologic Logs (GL)
- Soil Sampling Analytical Data (AD)

Site Plan View
(not to scale)

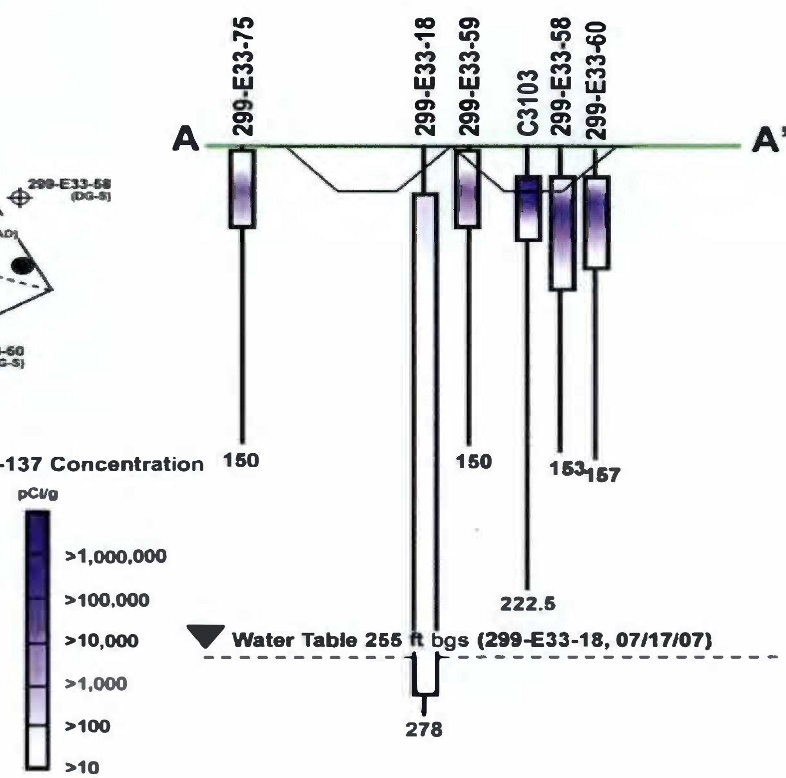


Legend
- ⊕ = Existing Borehole (data type)
- ▼ = Groundwater Surface
- ● = Planned Drive Point
- bgs = Below Ground Surface
- WIDS = *Waste Information Data System* database
- SIM = *Soil Inventory Model, Rev.1*

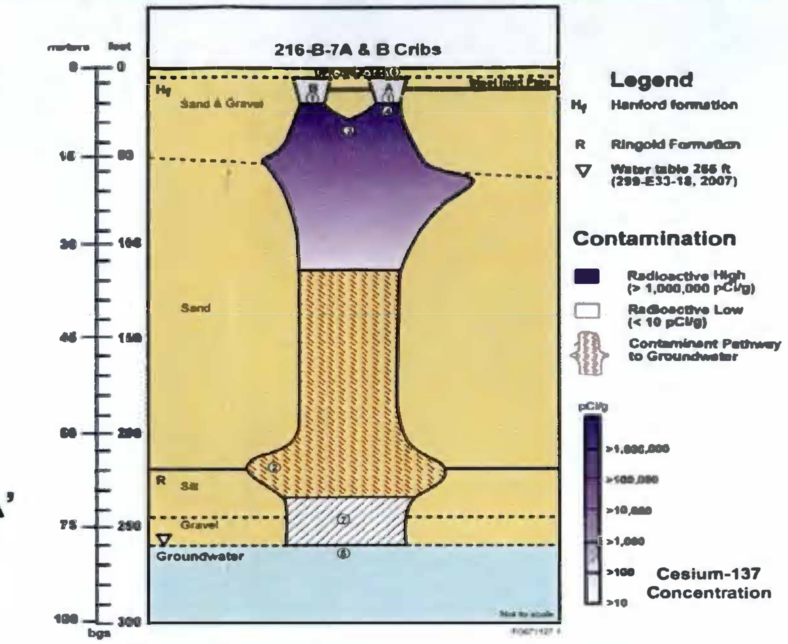
Characterization Summary

216-B-7A is a representative site and 216-B-7B is analogous to 216-B-7A; they were evaluated under DOE/RL-2003-64. The highest concentration of Cs-137 in borehole C3103 was 300,000 pCi/g at 23 ft bgs based on geophysical logging, while soil samples provided Pu-239/240 concentrations of 153,000 pCi/g at 20 ft bgs.

Site Section View
(not to scale)



Conceptual Contaminant Distribution Model



1. High salt, neutral/basic, low organic radioactive liquid waste containing cesium-137, plutonium, uranium, strontium-90, and other contaminants from the cell drainage of 224-B and Tank 5-6 within 221-B via 241-BY-201 settling tank were discharged to the crib between September 1946 and May 1967. The cribs received a total volume of 43,600,000 L (11,500,000 gal) of wastewater.

2. The wetting front and contaminants move vertically beneath the cribs. Lateral spreading of liquids is associated mainly with the Hanford gravel and sand contact, and at intersections with silt layers or other finely grained lenses. As the effluent traveled downward after discharge, contaminants may have been deposited along the top of these zones.

3. Constituents with large distribution coefficients (e.g., cesium-137, strontium-90, europium-154, and plutonium) sorb to soils resulting in higher concentrations near the bottom of the cribs. Concentrations generally decrease with depth. However, enhanced mobility is indicated at this site as the highly contaminated zone of cesium-137 extends to 110 ft bgs.

4. The highest concentrations reported from borehole C3103 are as follows:
   - Cesium-137: 300,000 pCi/g at 23 ft (geophysical log)
   - Plutonium: 153,000 pCi/g at 20 ft (soil sample)
   - Uranium: 147 mg/kg at 30 ft (soil sample)
   - Nitrate: 493 mg/kg at 155 ft (soil sample)
   - Cobalt-60: 650 pCi/g at 234 ft (299-E33-18) (geophysical log)

5. Wastewater and mobile contaminants (uranium, cobalt-60, and nitrate) from the crib impact groundwater.

6. The cribs are located beneath a larger area of scraped contaminated soil, from the UPR-200-E-144 stabilization. The contaminated soil from the unplanned release area and the cribs was covered with clean backfill and posted with Underground Radioactive Material signs.

7. A region of high uranium concentration (>100 pCi/g) is expressed in geophysical logging results from borehole C3103 at depth ranges between 230 and 254 ft bgs.

Table AD4 2-2. Data Needs Priority Summary – Model Group 4 – 216-B-7A&B Cribs (200-TW-2)(RL/FH)(RPP)(Ecology). (4 Pages)

Background

Site Identification	216-B-7A & -7B and UPR-200-E-144
Site Location	200 E, B Farm Zone
Type of Site	Cribs (216-B-7A & 7B) and Unplanned Release (UPR-200-E-144)
Operating History	**216-B-7A & -7B (from WIDS database):** The site consists of two wooden cribs, placed 28 ft apart, and connected by underground piping. Effluent drained into 216-B-7A and 216-B-7B simultaneously through a T-fitting in the pipeline from the 241-B settling tanks (241-B-201, 241-B-202, 241-B-203 and 241-B-204) located inside the 241-B Tank Farm. Process effluent from 221-B and 224-B was routed to the settling tanks from 1946 through 1967 and dispersed to the cribs. In 1951, cell drainage from 221-B was diverted to the 216-B-9 Crib. In 1954, the 224-B waste stream was diverted to the 216-B-8 Crib when the 216-B-7A&B Cribs exceeded their infiltration capacity. The 216-B-7A&B Cribs were reactivated and used intermittently from December 1954 through May 1967 when it was determined that they had reached their radionuclide capacity. A letter written by G. L. Hanson in September 1967, states that the cribs received approximately 49 million liters (13 million gallons) of process waste from 221-B and 224-B from 1946 through 1958 (WIDS). These wastes contained 4300 grams of plutonium and 5400 curies of beta/gamma emitters. After 1958, the cribs received an additional 752,000 liters (198,000 gallons) of B Plant waste containing 2100 curies of beta/gamma emitters that included 14 curies of cesium-137 and 2080 curies of strontium-90. Cesium-137, cobalt-60, tritium and alpha contamination were detected in groundwater samples taken from well 299-E33-18 in 1967, which monitors these cribs. The cribs are located beneath a larger area of scraped contaminated soil, from the UPR-200-E-144 which covered the cribs and surrounding area. The contaminated soil from the unplanned release area and the cribs were covered with clean backfill and posted with Underground Radioactive Material signs. Historical data has the contamination concentrations as follows: 4300 g total plutonium, 24000 Ci total beta, 5600 Ci strontium-90, 100 Ci cesium-137, 180 kg total uranium and 1,800,000 kg nitrate. Although these values differ from those presented in the SIM table below, they still fall within the range of the model's uncertainty. The following table represents the mean values as determined by the SIM model.

Soil Inventory Model - 216-B-7A & B Cribs (RPP-26744)

Na (kg) 1.177E+06	Al (kg) 0.000E+00	Fe (kg) 3.457E+03	Cr (kg) 1.163E+04	Bi (kg) 2.979E+03	La (kg) 4.224E+00	Hg (kg) 1.227E-02	Zr (kg) 0.000E+00	Pb (kg) 7.690E+00
Ni (kg) 3.077E+03	Ag (kg) 8.346E+00	Mn (kg) 9.353E+02	Ca (kg) 5.115E+03	K (kg) 2.814E+05	NO3 (kg) 2.715E+06	NO2 (kg) 1.476E+03	CO3 (kg) 7.312E+03	PO4 (kg) 9.770E+04
SO4 (kg) 1.160E+04	Si (kg) 1.440E+02	F (kg) 1.616E+05	Cl (kg) 3.237E+04	CCl4 (kg) 0.000E+00	Butanol (kg) 0.000E+00	TBP (kg) 0.000E+00	NPH (kg) 0.000E+00	NH3 (kg) 1.024E+00
Fe(CN)6 (kg) 0.000E+00	H-3 (Ci) 7.810E-03	C-14 (Ci) 2.151E-02	Ni-59 (Ci) 5.368E-02	Ni-63 (Ci) 5.037E+00	Co-60 (Ci) 3.605E-01	Se-79 (Ci) 1.155E-03	Sr-90 (Ci) 1.636E+03	Y-90 (Ci) 1.632E+03
Zr-93 (Ci) 1.166E-01	Nb-93m (Ci) 1.020E-01	Tc-99 (Ci) 9.475E-02	Ru-106 (Ci) 7.637E-07	Cd-113m (Ci) 4.274E-02	Sb-125 (Ci) 7.651E-02	Sn-126 (Ci) 4.449E-03	I-129 (Ci) 6.673E-04	Cs-134 (Ci) 2.965E-04
Cs-137 (Ci) 3.735E+02	Ba-137m (Ci) 3.525E+02	Sm-151 (Ci) 8.422E+02	Eu-152 (Ci) 8.319E-02	Eu-154 (Ci) 6.523E+00	Eu-155 (Ci) 3.567E+00	Ra-226 (Ci) 4.385E-06	Ra-228 (Ci) 4.885E-08	Ac-227 (Ci) 1.601E-04
Pa-231 (Ci) 3.464E-03	Th-229 (Ci) 1.938E-07	Th-232 (Ci) 3.965E-08	U-232 (Ci) 2.174E-02	U-233 (Ci) 1.290E+00	U-234 (Ci) 9.569E-02	U-235 (Ci) 3.677E-03	U-236 (Ci) 4.107E-03	U-238 (Ci) 6.571E-02
U-Total (kg) 1.970E+02	Np-237 (Ci) 1.832E-02	Pu-238 (Ci) 2.146E+00	Pu-239 (Ci) 2.168E+01	Pu-240 (Ci) 6.841E+00	Pu-241 (Ci) 1.247E+02	Pu-242 (Ci) 1.145E-03	Am-241 (Ci) 5.616E+00	Am-243 (Ci) 2.497E-03
Cm-242 (Ci) 5.402E-04	Cm-243 (Ci) 1.992E-05	Cm-244 (Ci) 4.701E-04						

Table AD4 2-2. Data Needs Priority Summary – Model Group 4 – 216-B-7A&B Cribs (200-TW-2)(RL/FH)(RPP)(Ecology). (4 Pages)

	UPR-200-E-144 (from WIDS database): The site is a large area posted as Underground Radioactive Material. There is no specific occurrence date for this contamination. Speck contamination is assumed to have originated from activities in the 241-B Tank Farm. The original surface contaminated posted area was approximately 25 acres. The contamination was consolidated into a large spoil pile adjacent to the north side of the B Tank Farm in an approximate 3 to 4 acre area (see WIDS and WHC-SD-DD-TI-078, 1993). The 216-B-7A&B Cribs and the 216-B-11A&B French Drains were also covered. The scraped area was released from radiological control using a combination of soil samples and radiation surveys.
Vicinity Waste Sites	216-B-11A&B French Drains are east of the cribs, but within the original boundary of UPR-200-E-144; 216-B-8 and 200-E-45 are north of the cribs; B Tank Farm is south of the cribs.
Current Status	216-B-7A is a representative site evaluated under the 216-TW-1/2 Work Plan (DOE/RL-2000-38). The site was investigated with borehole C3103, drilled to just above the water table. The data are reported in the RI Report (DOE/RL-2002-42); the site was evaluated in the 200-TW-1/2/200-PW-5 feasibility study (DOE/RL-2003-64). Capping was identified as the preferred alternative in the FS. 216-B-7B is an analogous site to 216-B-7A; 216-B-7B was evaluated in the 200-TW-1/2/200-PW-5 feasibility study (DOE/RL-2003-64). Capping was identified as the preferred alternative. UPR-200-E-144 is an unplanned release associated with consolidation of contaminated surface soils over the area of 216-B-7A&B Cribs. This unplanned release is assumed to be addressed with the 216-B-7A& B Cribs.

Potential Remedial Alternatives

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

Data Evaluation and Gaps Analysis

Data	Knowns	Data Uncertainties	Are supplemental data required to support decision making?
Geophysical logging at 216-B-7A: C3103 (222.5 ft) (Spectral, 2001) Soil samples collected during drilling.	**<u>Characterization of contaminants from soil samples and field screening</u>** **Uranium (total and isotopes):** Uranium was located between 20 and 50 ft bgs with maximum concentration of 147 mg/kg at 30 ft bgs based on soil samples from borehole C3103. Uranium was also detected in well 299-E33-18 through geophysical logging at 234 ft bgs. This mass coincides with historic water levels and may be the result of contamination from another source. This contamination is believed to be residual contamination left in the soil from the decline of the water table.	Several logs and a borehole provide information on nature and extent to approximately 150 ft. Extent of contamination at depths greater than 150 ft is less certain due to fewer data points.	Yes – the extent of plutonium at concentrations above 100 nCi/g is significant to the decision process in terms of balancing costs for removal and disposal against costs for capping and long-term maintenance and for balancing worker risk against long-term risks. Logs in nearby existing wells show cesium-137 has spread beyond the waste site boundaries. Supplemental data collection activities would define the extent of plutonium movement and provide a better understanding of plutonium distribution and volume, especially in relation to concentrations above 100 nCi/g.
	Nitrate: Nitrate was detected in soil samples from borehole C3103 throughout the soil column; the maximum concentration of 493 mg/kg was detected at ~ 150 ft bgs; other detections included a maximum of 110 mg/kg at depths less than 18 ft bgs and a maximum of 126 mg/kg between 18 and 38 ft bgs.	The lateral extent of the nitrate is not known.	
	Plutonium-239/240: Maximum concentrations of plutonium-239/240	Extent of plutonium and	

Table AD4 2-2. Data Needs Priority Summary – Model Group 4 – 216-B-7A&B Cribs (200-TW-2)(RL/FH)(RPP)(Ecology). (4 Pages)

	(153,000 pCi/g) were found at 20 ft below ground surface. The mass of plutonium range between ~ 20 ft and 50 ft bgs; similar to cesium-137.	the volume of plutonium above 100 nCi/g is uncertain.	
	Cobalt-60: Cobalt-60 was detected in soil samples at around 230 to 250 ft bgs to be < 2 pCi/g in borehole C3103.	Cobalt-60 has a short half life (5 years) and is not considered to be a risk driver.	
	Cesium-137: Cesium-137 was found between 20 and 50 ft bgs in both logs and in the borehole samples. The maximum concentration detected in borehole C3103 is 153,000 pCi/g at 25 ft bgs; the maximum concentration in the top 15 ft is 42.5 pCi/g at 8 ft bgs. The contamination from 0 to 15 ft bgs is associated with the unplanned release.	Nature and extent of cesium-137 are generally well understood from the existing data with the exception of the south side of the waste site, where extent is not well defined. This area can be inferred, however, based on the other data for the cribs.	
Six Geophysical Logs at 216-B-7A&B: C3103 (222.5 ft) (Spectral, 2001) 299-E33-18 (278 ft) (Spectral, 2001) 299-E33-58 (153 ft) (Spectral, 2001)	C3103: located near the center of the 216-B-7A Crib. Cesium-137 is detected continuously from near the ground surface to about 56 ft in depth with the highest concentration of about 300,000 pCi/g measured at about 23 ft. Europium-154 is detected between 16 and 18 ft. The highest moisture content occurs at 20 ft. 299-E33-18: located approximately 16 m southeast of the 216-B-7B Crib. Cesium-137 was detected between 5 and 10 ft bgs at a concentration of less than 2 pCi/g. Uranium-235, uranium-238 and cobalt-60 were detected below about 234 ft with a maximum concentration of about 2, 50, and 650 pCi/g, respectively. It appears the contamination coincides with the historical water levels in the area, which range from about 238 to 255 ft bgs. 299-E33-58: located approximately 1 m east of the 216-B-7A Crib. Cesium-137 was detected at about 2 ft bgs with a maximum concentration of 19 pCi/g at the 8.5 ft bgs. Continuous cesium-137 was detected between 21 ft and 89.5 ft bgs at concentrations ranging from just above 0.2 pCi/g to a maximum of about 3600 pCi/g at the 35 ft bgs. Between 94.5 and 104.5 ft cesium-137 contamination exists at concentrations less than 3 pCi/g. At the 146 ft depth, a single detection of cesium-137 contamination occurs at about 0.3 pCi/g.		

Table AD4 2-2. Data Needs Priority Summary – Model Group 4 – 216-B-7A&B Cribs (200-TW-2)(RL/FH)(RPP)(Ecology). (4 Pages)

299-E33-59 (150 ft) (Spectral, 2001)	299-E33-59: located approximately 2 m north of the 216-B-7A Crib. Cesium-137 was detected between 3 ft and 8 ft bgs with a maximum concentration of about 10 pCi/g. Cesium-137 was also detected at depths from about 32 ft to 55 ft bgs. The maximum concentration is about 1000 pCi/g.		
299-E33-60 (157 ft) (Spectral, 2001)	299-E33-60: located approximately 17 m south of the 216-B-7A Crib. Cesium-137 was detected at 5 to 8 ft bgs and from about 24 to 80 ft bgs. The highest concentration exists between 33 and 61 ft with the maximum concentration of about 4000 pCi/g measured at 36.5 ft bgs.		
299-E33-75 (150 ft) (Spectral, 2001)	299-E33-75: located approximately 8 m north of 216-B-7B Crib. Cesium-137 was detected at 4 through 18 ft bgs with 0.3 to about 60 pCi/g of contamination. Cesium-137 was also detected between 34 and 57 ft. The maximum concentration was about 7600 pCi/g at 40.5 ft bgs.		

References:

- DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group OU & 200_TW-2 Tank Waste Group Operable Unit RI/FS Work Plan*
- DOE/RL-2002-42, Remedial Investigation Report for the 200-TW-1 and 200-TW-2 Operable Units (Includes the 200-PW-5 Operable Units)
- DOE/RL-2003-64, Draft A, *Feasibility Study for the 200-TW-1 Scavenged Waste Group & the 200-TW-2 Tank Waste Group & the 200-PW-5 Fission-Product Rich Waste Group OU*
- BHI-01607, *Borehole Summary Report (C3103, C3104, C3340 to C3344), 200-TW-2 OU*
- *Waste Information Data System* database
- RPP-26744, *Hanford Soil Inventory Model, Rev. 1*
- G. L. Hanson to O. V. Smiset (9-29-1967), Deactivation of the 216-B-7 Cribs

Proposed Activities and Path Forward:

- Drill three drive points to define extent of plutonium concentration.

AD4-3.0 216-B-8 CRIB AND TILE FIELD AND 200-E-45 HEALTH INSTRUMENT SHAFT SITE-SPECIFIC FIELD-SAMPLING PLAN

The characterization planned for the 216-B-8 Crib and Tile Field includes drilling a drive point, to a depth of 70 ft, and sampling of this same drive point. The drilling and sampling efforts are planned to reduce the uncertainty associated with the possible contaminant release from contaminated run-in pump tests conducted in the 200-E-45 Health Instrument (HI) Shaft following the 216-B-8 Crib operation. The 200-E-45 HI Shaft was constructed to obtain soil and liquid samples of the 216-B-8 Crib at depths of 10 and 20 ft below the bottom of the crib. These sites received varying process waste streams including cell drainage from Tank 5-6 and 2nd cycle supernatant waste from the 221-B Plant Canyon Building, decontamination and cleanup waste from the 224-B Waste Storage Facility shutdown, and sludge from the 241-B-104 tank.

Sample barrel samples will be collected at depths of interest, as depicted in Figure AD4 3-2; the samples will be analyzed for analytes presented in Volume I, Table A2-3, the 200-TW-2 column. The sample analysis will provide information on contamination released from the HI Shaft due to pump tests and aid in the decision-making process for these sites.

The selection of the drive point location was determined, utilizing existing borehole geophysical logs and surface geophysical exploration conducted by CH2M Hill Hanford Group Inc. utilizing their QA/QC procedures (RPP-34690), to be between the 216-B-8 Crib and the 200-E-45 HI Shaft. This location would ensure that the characterization efforts would focus on the zone of highest contamination and address possible contaminant release from the HI Shaft.

The following figures and tables provide the site-specific field-sampling plan for the 216-B-8 Crib and Tile Field.

Figure AD4 3-1. 216-B-8 Crib and Tile Field Data-Collection Locations

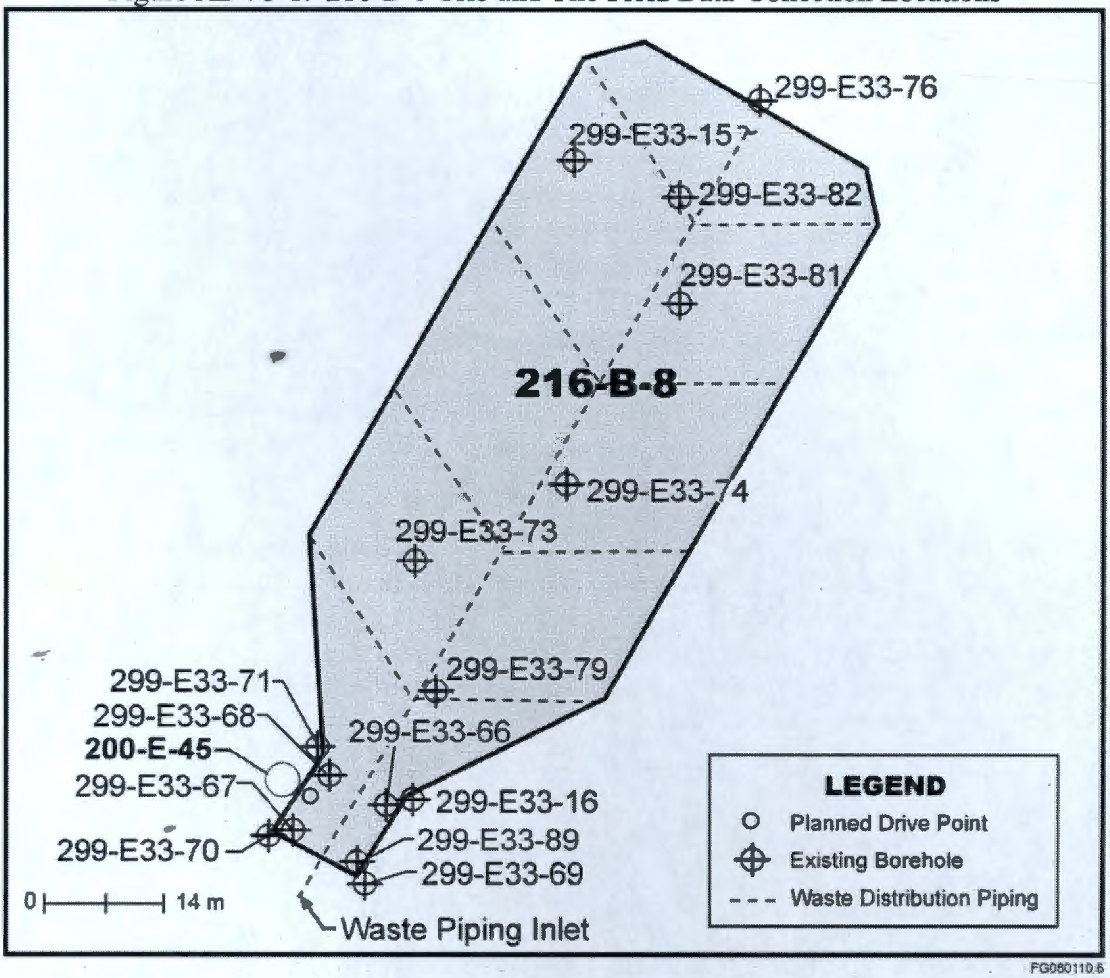


Figure AD4 3-2. 216-B-8 Crib and Tile Field Stratigraphy and Sample-Collection Intervals.

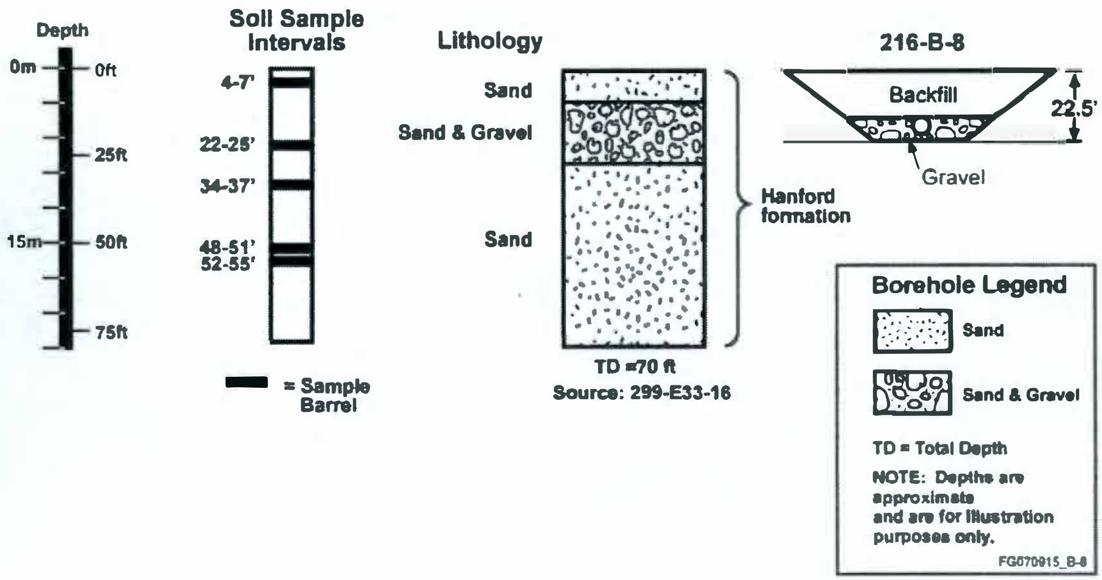


Table AD4 3-1. 216-B-8 Crib and Tile Field Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft bgs) [a]	Analyte List [b]	Physical Properties	
					Sample Interval	Parameters
Direct push with sample barrel samples	One direct push between 216-B-8 Crib and 200-E-45 HI Shaft	70 ft bgs	Sample barrel sample at depths: 4 – 7 ft bgs 22 – 25 ft bgs 34 – 37 ft bgs 48 – 51 ft bgs 52 – 55 ft bgs	Analytes are presented in Volume I, Table A2-3, the 200-TW-2 column.	One sample at the interface of the gravel-dominated and sand-dominated Hanford formations (approximately 22 to 25 ft bgs)	pH, specific conductance, bulk density, moisture, particle size distribution
Number of sample barrel samples		5				
Approximate number of field quality-control samples [c]		3				
Approximate number of physical-property samples		1				
Approximate total number of soil samples collected		9				
Approximate total number of soil samples analyzed [d]		9				

[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, and A2-5 for detection limits and other analytical parameters.
[c] One duplicate, one split*, and one equipment blank (if possible and plausible).
[d] Number of samples analyzed includes five sample barrel samples, three field quality-control samples, and one physical-property sample.

* Optional (Volume 1, p. A2-17)

Figure AD4 3-3. 216-B-8 Crib and Tile Field Conceptual Model and Data Summary.

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

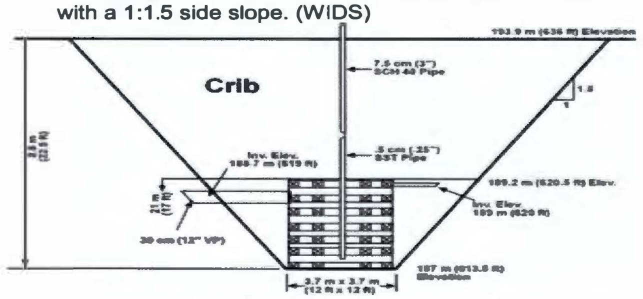
216-B-8 Crib & Tile Field

B Farm Zone

History

The 216-B-8 Crib is a subsurface liquid waste disposal site that operated from 1948 to 1954 receiving 2nd cycle waste from B Plant via 241-B-110, 241-B-111 and 241-B-212 cascading tanks. It is marked and posted with Underground Radioactive Material and Cave-In Potential signs. (WIDS)

CONSTRUCTION:
The crib is 12 ft by 12 ft by 7 ft deep wooden timbers (6 inch by 6 inch) placed in a 14 ft by 14 ft by 22.5 ft deep excavation. The crib overflowed to a tile field 300 ft long by 100 ft wide. The crib is connected to the tile field by a 12 inch diameter vitrified clay pipeline containing eight, 70 ft long side branches. The excavation for the tile field has 4 ft bottom dimensions with a 1:1.5 side slope. (WIDS)



WASTE VOLUME: 27,200,000 L (7,200,000 gal) (WIDS)

DURATION: March 1948 to December 1954 (WIDS)

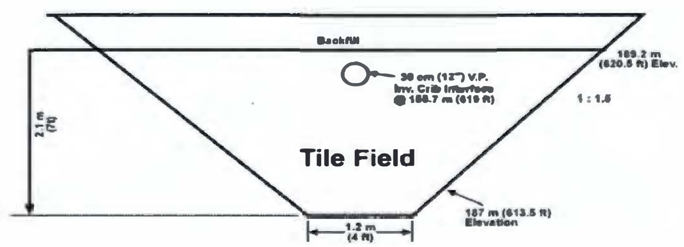
ESTIMATED DISCHARGED INVENTORY (DOE/RL-2003-64, RHO-CD-673, RPP-26744):

Contaminant	Historical	2008	SIM
Plutonium	30 g	--	--
Chromium	--	--	6226 kg
Nitrate	1,400,000 kg	--	1,937,000 kg
Sr-90	15 Ci	3.7 Ci	145.9 Ci
Tc-99	0.321 Ci	0.321 Ci	0.08 Ci
Cs-137	50 Ci	13.2 Ci	168.2 Ci
Uranium	45 kg	--	191.4 kg
Fluoride	--	--	105,400 kg

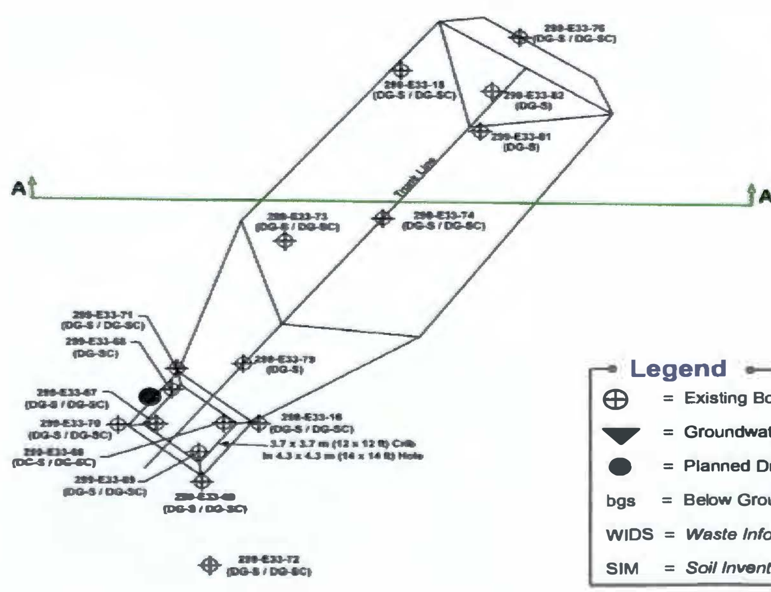
REFERENCES:
- WIDS general summary reports
- RPP-26744
- RHO-CD-673
- DOE/RL-2003-64
- DOE/RL-2004-10

Basis of Knowledge (Data Types)

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



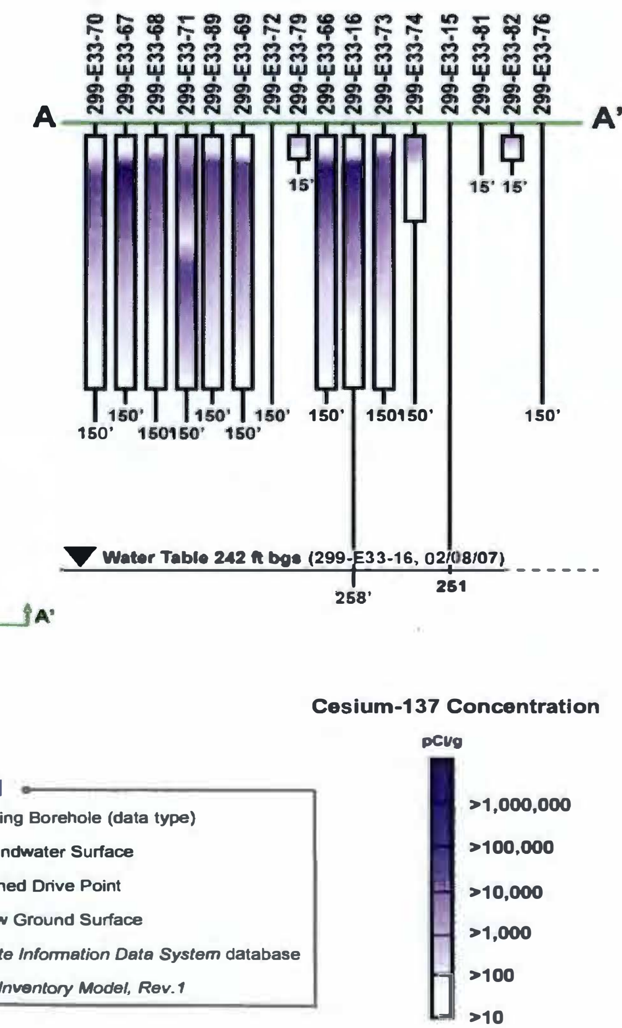
Site Plan View
(not to scale)



Characterization Summary

216-B-8 is analogous to 216-B-7A and was evaluated in DOE/RL-2003-64. Fifteen boreholes were drilled and geophysically logged. The maximum cesium-137 contamination of 150,000 pCi/g was detected at 35 ft in borehole 299-E33-67.

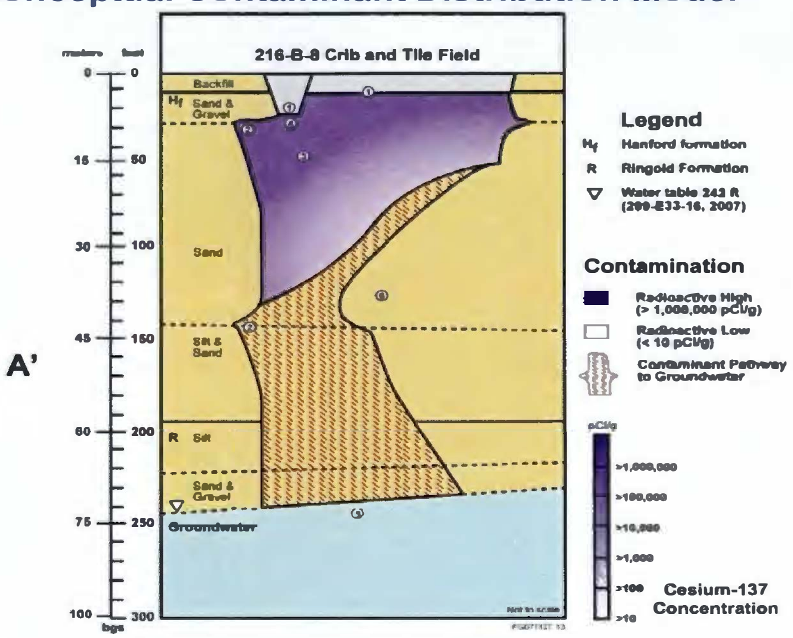
Site Section View
(not to scale)



Legend

⊕	= Existing Borehole (data type)
▼	= Groundwater Surface
●	= Planned Drive Point
bgs	= Below Ground Surface
WIDS	= *Waste Information Data System* database
SIM	= *Soil Inventory Model, Rev.1*

Conceptual Contaminant Distribution Model



1. High salt, neutral/basic, radioactive 2nd cycle supernatant waste from 221-B via 241-B-110, 241-B-111, and 241-B-112 Cascading Tanks along with cell drainage from Tank 5-6 in 221-B, decontamination waste from 221-B and 224-B shutdown and sludge from the 241-B-104 Tank were disposed of at this crib and tile field. The crib and tile field received a total volume of 27,200,000 L (7,200,000 gal) of wastewater containing plutonium, uranium, cesium-137, strontium-90 and other contaminants between March 1948 and December 1954.
2. The wetting front and contaminants move vertically beneath the crib and tile field. Lateral spreading of liquids is associated mainly with the Hanford gravel and sand contact. As the effluent traveled downward after discharge, contaminants may have been deposited along the top of these zones.
3. Constituents with large distribution coefficients (e.g., plutonium, strontium-90, and cesium-137) sorb to soils resulting in higher concentrations near the bottom of the crib and tile field. Concentrations generally decrease with depth.
4. The highest cesium-137 concentration was 150,000 pCi/g at 35 ft bgs in well 299-E33-67, while wells 299-E33-16 and 299-E33-15 detected the highest cobalt-60 contamination of 11 pCi/g at 243 and 240 ft bgs, respectively.
5. Wastewater and mobile contaminants (cobalt-60, chromium, and nitrate) from the crib impact groundwater.
6. Geophysical logs of existing wells suggest that the majority of contamination is located near the crib and head-end (southwestern) of the tile field. However, mobile contaminants have been detected in the groundwater below the tail-end (northeastern) of the tile field.

Table AD4 3-2. Data-Needs Priority Summary – Model Group 6 – 216-B-8 Crib and Tile Field (200-TW-2)(RL/FH)(RPP)(Ecology). (5 Pages)

Background	
Site Identification	216-B-8
Site Location	200 East Area; B Farm Zone, north of 241-B Tank Farm
Type of Site	Crib and Tile Field
Operating History	The crib and tile field are identified with concrete AC-540 monuments and posted with Underground Radioactive Material signs. The crib is delineated with light post and chain with Cave-In Potential signs. The surface is covered with gravel. B Plant operated from April 1945 through October 1952, separating plutonium from irradiated fuel rods using the bismuth phosphate process. The first separation step removed the metal coating from the fuel rods. Next the uranium was dissolved and the plutonium was extracted. The waste from this step was called Metal Waste. This waste stream contained all of the uranium and about 95% of the fission products and was stored in the single shell tanks. The extracted plutonium went through two decontamination cycles to further purify it. The first cycle waste was combined with the coating waste. It contained 2% of the fission products and <1% of plutonium. The second decontamination cycle waste contained less than 0.1% of the fission products. The first and second cycle waste were originally discharged to the single shell tanks. In 1948, due to the lack of waste storage space in the tank farms, second cycle waste stored in the tank farms began to be released to cribs, including the 216-B-8 Crib. The 216-B-8 Crib is 12 ft wide by 12 ft long and 7 ft deep with an associated tile field 300 ft long by 100 ft wide. The main trunk is 12 in. diameter PVC pipe running northeast from the crib. Eight side pipes branch from the main trunk each extending at a 45 degree angle to trunk. The excavations for the side branches of the tile field have 4 ft wide bottom dimensions with a 1: 1.5 side slope. The 216-B-8 Crib received second cycle waste from B Plant via the 241-B-110, 241-B-111 and 241-B-112 cascading tanks, located in the 241-B Tank Farm. The site is associated with 221-B, 224-B, 241-B, 200-E-45 (Health Instrument Shaft) and UPR-200-E-144. There are many service date discrepancies in the reference documents. Several documents agree that B Plant began to release second cycle waste to cribs in 1948; the 216-B-8 Crib began receiving this waste in March 1948. More than one reference states that the 216-B-8 Crib stopped receiving effluent in December 1951. Lundgren (1970) states that the pipeline to the 216-B-8 Crib was blanked and the effluent was re-routed to the 216-B-7A Crib in December 1954. The Health Instrument (HI) Shaft (200-E-45) is located adjacent to the west side of the 216-B-8 Crib. The HI Shaft was originally installed to allow Health Instrument technicians to descend a ladder and collect liquid and soil samples from depths of approximately 3 meters (10 feet) and 6 meters (20 feet) below the bottom of the 216-B-8 Crib through openings in the shaft. Perforated lateral pipes extending beneath the crib allowed liquid waste from the crib to enter the pipes and collect in sample cups. Other holes were made in the side of the shaft facing the crib to collect sediment samples. Samples were collected for several years and ended on December 31, 1949. The shaft structure was later filled with water and used to test contaminated tank farm pumps. The last known pump test was done in 1973. In 1949, radiological readings up to 4 rad/hour were recorded at the bottom of the shaft. As of December 1949, 105 liquid samples, 4 sludge samples and 7 sediment samples had been collected and analyzed to characterize the operation of the 216-B-8 Crib. Liquid samples collected at the 3 meter (10 foot) level and the 6 meter (20 foot) level both contained an average of 0.5 microcuries per liter. In August 1948, sludge from the 241-B-104 tank was inadvertently jetted to the 216-B-8 Crib. A sudden decrease in the crib capacity led to the discovery of approximately 37.5 centimeters (15 inches) of sludge in the crib. Some sludge washed to at least 6.1 meters (20 feet) below the crib bottom and was collected in the HI Shaft sample cups. The plutonium activity in the sludge samples was 900 μCi/kg of sludge. This is 1000 times higher than the plutonium content of the supernatant liquid usually discharged to cribs. The fission product activity in the sludge samples was 9,000 μCi/kg of sludge. This is roughly 5,000 times greater that the fission product activity in supernatant liquid. Liquid samples collected in the HI Shaft prior to the sludge discharge contained less than 1000 disintegrations per minute per liter of alpha contamination. Liquid samples collected after the sludge release contained an average of 17,500 disintegrations per minute per liter of alpha contamination. Sediment samples collected from approximately 5.5 meters (18 feet) below the crib through the HI Shaft prior to the sludge release contained beta-gamma activity of 0.13 μCi/kg. After the sludge release the activity increased to 0.33 microcuries per kilogram. No alpha contamination was found in the sediment samples.

Table AD4 3-2. Data-Needs Priority Summary – Model Group 6 – 216-B-8 Crib and Tile Field (200-TW-2)(RL/FH)(RPP)(Ecology). (5 Pages)

Citric and hydrochloric acids were added to the crib to help clear the sludge from the crib. The acids did not significantly reduce the sludge so the tile field was built to receive overflow from the plugged crib. Total effluent volume discharged was 27,200,000 liters.

Historical data suggests that the crib and tile field received that following contamination: 30 g total plutonium, 50 Ci cesium-137, 15 Ci strontium-90, 0.321 Ci technetium-99, 1,400,000 kg nitrate and 45 kg uranium; as well as chromium and fluoride. Although these values may differ from those presented in the SIM table below, they still fall within the model's uncertainty. The following table represents the mean values as determined by the SIM model.

Soil Inventory Model - 216-B-8 Crib and Tile Field (RPP-26744)

Na (kg) 1.055E+06	Al (kg) 0.000E+00	Fe (kg) 2.541E+03	Cr (kg) 6.226E+03	Bi (kg) 2.329E+03	La (kg) 4.680E-02	Hg (kg) 0.000E+00	Zr (kg) 0.000E+00	Pb (kg) 0.000E+00
Ni (kg) 2.362E+03	Ag (kg) 6.466E+00	Mn (kg) 1.028E+01	Ca (kg) 3.646E+03	K (kg) 9.436E+03	NO3 (kg) 1.937E+06	NO2 (kg) 9.118E+01	CO3 (kg) 5.459E+03	PO4 (kg) 1.615E+05
SO4 (kg) 1.183E+05	Si (kg) 7.080E+03	F (kg) 1.054E+05	Cl (kg) 2.692E+04	CCl4 (kg) 0.000E+00	Butanol (kg) 0.000E+00	TBP (kg) 0.000E+00	NPH (kg) 0.000E+00	NH3 (kg) 1.105E-04
Fe(CN)6 (kg) 0.000E+00	H-3 (Ci) 1.323E-02	C-14 (Ci) 1.496E-01	Ni-59 (Ci) 3.911E-02	Ni-63 (Ci) 3.364E+00	Co-60 (Ci) 8.724E-02	Se-79 (Ci) 6.708E-03	Sr-90 (Ci) 1.459E+02	Y-90 (Ci) 1.460E+02
Zr-93 (Ci) 4.065E+00	Nb-93m (Ci) 3.636E+00	Tc-99 (Ci) 8.005E-02	Ru-106 (Ci) 1.380E-09	Cd-113m (Ci) 1.736E-01	Sb-125 (Ci) 3.480E-03	Sn-126 (Ci) 2.460E-02	I-129 (Ci) 2.665E-05	Cs-134 (Ci) 7.060E-07
Cs-137 (Ci) 1.682E+02	Ba-137m (Ci) 1.588E+02	Sm-151 (Ci) 1.404E+03	Eu-152 (Ci) 2.958E-02	Eu-154 (Ci) 2.481E+00	Eu-155 (Ci) 1.696E+00	Ra-226 (Ci) 4.306E-05	Ra-228 (Ci) 1.597E-10	Ac-227 (Ci) 3.690E-04
Pa-231 (Ci) 7.829E-03	Th-229 (Ci) 3.179E-07	Th-232 (Ci) 2.672E-09	U-232 (Ci) 6.165E-07	U-233 (Ci) 5.298E-08	U-234 (Ci) 6.276E-02	U-235 (Ci) 2.822E-03	U-236 (Ci) 5.889E-04	U-238 (Ci) 6.388E-02
U-Total (kg) 1.914E+02	Np-237 (Ci) 3.292E-02	Pu-238 (Ci) 5.489E-01	Pu-239 (Ci) 1.260E+02	Pu-240 (Ci) 9.740E+00	Pu-241 (Ci) 1.266E+01	Pu-242 (Ci) 7.424E-05	Am-241 (Ci) 1.123E+00	Am-243 (Ci) 1.145E-04
Cm-242 (Ci) 1.979E-04	Cm-243 (Ci) 2.143E-06	Cm-244 (Ci) 5.033E-05						

Vicinity Waste Sites	216-B-7A & 216-B-7B Cribs
Current Status	Analogous site; assigned to 216-B-7A; evaluated in 200-TW-1/2/200-PW-5 feasibility study, DOE/RL-2003-64. Capping identified as preferred alternative in FS.

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		

Table AD4 3-2. Data-Needs Priority Summary – Model Group 6 – 216-B-8 Crib and Tile Field (200-TW-2)(RL/FH)(RPP)(Ecology). (5 Pages)

Data Evaluation and Gaps Analysis			
Data	**Knowns**	**Data Uncertainties**	**Are supplemental data required to support decision making?**
Geophysical logging at 216-B-8: 299-E33-72 (150 ft) (Spectral, 2001) 299-E33-66 (150 ft) (Spectral, 2001)	299-E33-72: located approximately 20 m south of the 216-B-8 Crib. Maximum cesium-137 concentration of 14 pCi/g occurred at 6.5 ft bgs. Cesium-137 activity of 0.3 pCi/g also detected at 84 ft bgs. 299-E33-66: located in the northeast end of the 216-B-8 Crib. Cesium-137 was detected throughout this borehole. Highest concentrations were between 28 and 36 ft. A maximum concentration of 40,000 pCi/g was detected at 31 ft bgs.	None; existing data provide adequate information on nature and extent of contamination.	Yes - groundwater wells being planned near 216-B-8 will be sampled to obtain vadose zone information. A drive point will provide information on the extent of contamination. The geophysical resistivity characterization information will help locate both the groundwater wells and the drive point. Additionally — the groundwater wells planned for this site have been relocated to other waste sites, so vadose zone information will not be gathered from these wells.
299-E33-67 (150 ft) (Spectral, 2001)	299-E33-67: located in the southwest end of the 216-B-8 Crib. Cesium-137 concentration of 129 pCi/g from 0 to 15 ft bgs. Maximum concentration of 150,000 pCi/g at 35 ft. Concentration <4,000 pCi/g at 95 ft bgs; contamination continues to a depth of 127 ft bgs.		
299-E33-17 (244 ft) (Spectral, 2002)	299-E33-17: located approximately 68 m east of the 216-B-8 Tile Field. Maximum cesium-137 concentration of 2 pCi/g. Cobalt-60 also detected at maximum concentration of 11 pCi/g at 243 ft bgs.		
299-E33-14 (230 ft) (Spectral, 2002)	299-E33-14: located approximately 140 m northeast of the 216-B-8 Tile Field. Cesium-137 was detected near the MDL (about 0.3 pCi/g) at log depths of 168.5, 214, and 214.5 ft bgs. Cobalt-60 was detected at 186 ft near the MDL (about 0.1 pCi/g) and from about 214.5 ft to total depth with concentrations ranging from 0.1 to 4.1 pCi/g. Cobalt-60 was detected below the groundwater level (223.8 ft) at a maximum concentration of 4.1 pCi/g.		
299-E33-13 (235 ft) (Spectral, 2002)	299-E33-13: located approximately 110 m northwest of the 216-B-8 Tile Field. Cobalt-60 detected at maximum concentration of 7.5 pCi/g at 236 ft bgs. Maximum cesium-137 concentration was 17.9 pCi/g at 212 ft bgs.		
299-E33-12 (415 ft) (Spectral, 2002)	299-E33-12: located approximately 85 m north of the 216-B-8 Tile Field. Cobalt-60 detected at maximum concentration of 5.7 pCi/g at 232 ft bgs and also detected from 218 to 325 ft. Maximum cesium-137 concentration of 1.7 pCi/g from 3 to 5 ft bgs.		
299-E33-11 (230 ft) (Spectral, 2002)	299-E33-11: located approximately 112 m northeast of the 216-B-8 Tile Field. Cobalt-60 was detected from 214 to 227 ft bgs at a maximum concentration of 8 pCi/g. Maximum cesium-137 concentration of 1.9 pCi/g from 2 to 3 ft bgs.		

299-E33-79 (12 ft) (Spectral, 2002	299-E33-79: located in the southwest end of the 216-B-8 Tile Field. Maximum cesium-137 concentration of 100 pCi/g at 4.5 ft bgs.		
299-E33-89 (150 ft) (Spectral, 2002)	299-E33-89: located in the southwest end of the 216-B-8 Crib. Cesium-137 detected between 23 and 82 ft bgs at concentrations ranging from 1,000 pCi/g to 40,470 pCi/g with the maximum at 31 ft bgs.		
299-E33-74 (150 ft) (Spectral, 2001)	299-E33-74: located near the center portion of the 216-B-8 Tile Field. Maximum cesium-137 concentration of 218 pCi/g at 3.5 ft bgs.		
299-E33-15 (251 ft) (Spectral, 2002)	299-E33-15: located on the northwest portion of the 216-B-8 Tile Field. Maximum concentration of cobalt-60 was 11 pCi/g at 240 ft. Cesium-137 was detected near its MDL of 0.3 pCi/g at the ground surface, 98 ft, and about 223 ft bgs.		
299-E33-69 (150 ft) (Spectral, 2001)	299-E33-69: located in the southeast corner of the 216-B-8 Crib. Cesium-137 was detected between 3 and 8 ft bgs with concentrations ranging from 0.3 to 53.3 pCi/g. Cesium-137 was also detected at intervals between 25.5 to 115 ft with the maximum cesium-137 concentration at 30.5 ft of 50,000 pCi/g.		
299-E33-73 (150 ft) (Spectral, 2002)	299-E33-73: located near the center of the 216-B-8 Tile Field on the southwestern end. Cesium-137 was detected from 20 to 58 ft bgs with a maximum concentration of 1,400 pCi/g at 27 ft. Cesium-137 was also detected at 4 inches bgs at a concentration of 200 pCi/g.		
299-E33-82 (15 ft) (Spectral, 2001)	299-E33-82: located near the center close to the northeast end of the 216-B-8 Tile Field. Cesium-137 was detected from the surface at 47 pCi/g to 12.5 ft bgs with a maximum concentration of 100 pCi/g at 5 ft.		
299-E33-81 (15 ft) (Spectral, 2001)	299-E33-81: located along the center of the 216-B-8 Tile Field. Cesium-137 was detected at ground surface (1.5 ft bgs) with a concentration of 0.7 pCi/g. Cesium-137 was also observed at 11.5 and 12 ft bgs with concentrations of 0.3 and 0.8 pCi/g, respectively.		
299-E33-76 (150 ft) (Spectral, 2001)	299-E33-76: located near the center at the northeastern end of the 216-B-8 Tile Field. Cesium-137 was detected at a maximum concentration 3.9 pCi/g at intervals between 2.5 and 8 ft bgs.		
299-E33-70 (150 ft) (Spectral, 2001)	299-E33-70: located in the southwest corner of the 216-B-8 Crib. Cesium-137 detected between 3 and 7 ft bgs with a concentration of 95.3 pCi/g. The maximum cesium-137 concentration within the well was 48,000 pCi/g at 32 ft.		

Table AD4 3-2. Data-Needs Priority Summary – Model Group 6 – 216-B-8 Crib and Tile Field (200-TW-2)(RL/FH)(RPP)(Ecology). (5 Pages)

299-E33-71 (150 ft) (Spectral, 2001) 299-E33-68 (150 ft) (Spectral, 2001) 299-E33-16 (258 ft) (Spectral, 2002) Scintillation logs for these wells were dated 1959, 1963, 1968, and 1976	<u>299-E33-71:</u> located near the north corner of the 216-B-8 Crib. Cesium-137 detected between 3 and 11 ft bgs with a concentration of 178.3 pCi/g. The maximum cesium-137 concentration of 20,000 pCi/g occurred at 33 ft bgs. <u>299-E33-68:</u> located near the north end of the 216-B-8 Crib. Maximum cesium-137 concentration of 35,000 pCi/g at 34 ft bgs. <u>299-E33-16:</u> located in the east corner of the 216-B-8 Crib. Maximum cesium-137 concentration exceeded 1,000 pCi/g between 27 and 36 ft bgs. Cobalt-60 detected with a maximum concentration of 8 pCi/g at 252 ft.		

References:

- *Waste Information Data System* database
- RHO-CD-673, *Handbook for 200 Area Waste Sites*
- DOE/RL-2003-64, *Feasibility Study for the 200-TW-1 Scavenged Waste Group & the 200-TW-2 Tank Waste Group & the 200_PW-5 Fission-Product Rich Waste Group OU*
- PNNL-14120, *Laboratory-Scale Bismuth Phosphate Extraction Process Simulation to Track Fate of Fission Products*
- RPP-26744, *Hanford Soil Inventory Model*

Proposed Activities and Path Forward:

- Install a drive point with sampling to evaluate possible contamination release from the 200-E-45 HI Shaft.

AD4-4.0 216-T-3 INJECTION/REVERSE WELL SITE-SPECIFIC FIELD-SAMPLING PLAN

The characterization planned for the 216-T-3 Injection/Reverse Well includes a deep borehole to groundwater, approximately 271 ft, and geophysical logging of this same borehole. The drilling and logging efforts are planned to reduce the uncertainty in nature and extent of plutonium contamination associated and the protection of groundwater. The 216-T-3 Injection/Reverse Well received cell drainage from Tank 5-6 in the 221-T Plant Canyon Building and liquid waste from the 224-T Waste Storage Facility. The planned characterization would provide information to determine if shallow waste migrated from another source or if possible leaks occurred at casing change, along with determination of the extent of contamination released through the perforations in this well (from 98 ft bgs to total depth of 206 ft bgs).

Split-spoon samples will be collected at both ends of the 216-T-3 Injection/Reverse Well casing perforated zone and lithology changes within this zone, as depicted in Figure AD4 4-2; the samples will be analyzed for analytes presented in Volume I, Table A2-3, the 200-TW-2 column. Documentation for groundwater samples, if requested by an operable unit manager, will be provided by the requesting party. The sample analysis will provide information on depth-discrete contamination concentrations and issues facing groundwater protection. 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 analysis.

The 299-W11-79 well, which monitors this waste site, is too far removed from the contaminant source to accurately describe the contamination distribution adjacent to the 216-T-3 Injection/Reverse Well. The location of the planned deep borehole, within 5 ft of 216-T-3, was determined to focus on the release from this injection/reverse well rather than possible contamination from other sources.

The following figures and tables provide the site-specific field-sampling plan for the 216-T-3 Injection/Reverse Well.

Figure AD4 4-1. 216-T-3 Injection/Reverse Well Data-Collection Locations.

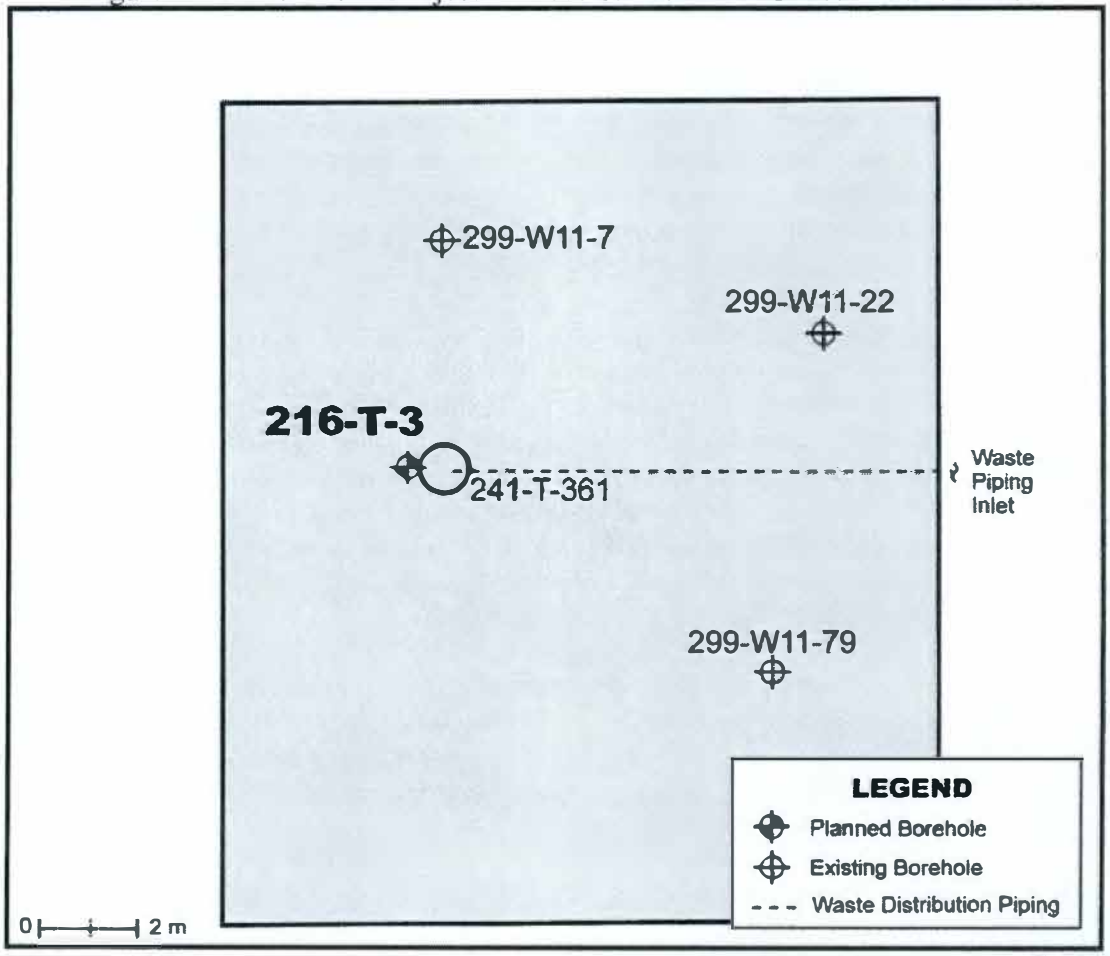


Figure AD4 4-2. 216-T-3 Injection/Reverse Well Stratigraphy and Sample-Collection Intervals.

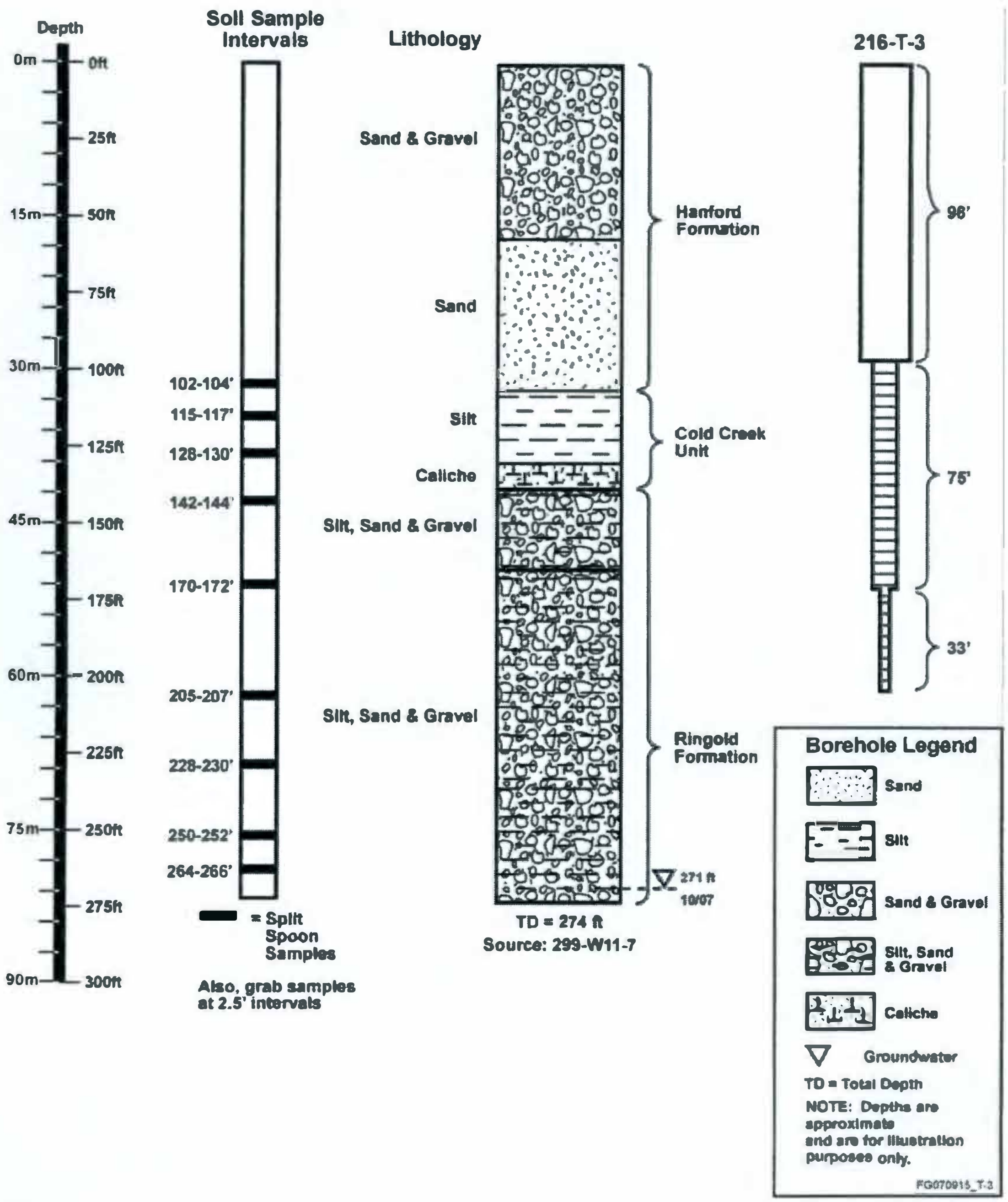


Table AD4 4-1. 216-T-3 Injection/Reverse Well Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft bgs) [a]	Analyte List [b]	Physical Properties	
					Sample Interval	**Parameters**
Deep borehole with sampling	One borehole adjacent to the well	To groundwater (approximately 271 ft bgs)	Split-spoon sample at depths: 102 – 104 ft bgs 115 – 117 ft bgs 128 – 130 ft bgs 142 – 144 ft bgs 170 – 172 ft bgs 205 – 207 ft bgs 228 – 230 ft bgs 250 – 252 ft bgs 264 – 266 ft bgs Also, grab samples at 2.5 ft intervals throughout borehole	Analytes are presented in Volume I, Table A2-3, the 200-TW-2 column. Grab samples will be analyzed for contaminants within the pore volume.	One sample at each change in lithology within the 216-T-3 perforated zone (between 98 and 206 ft bgs). As shown in Figure AD4 4-2.	pH, specific conductance, bulk density, moisture, particle size distribution

Number of split-spoon samples	9
Approximate number of field quality-control samples [c]	3
Approximate number of physical-property samples	5
Approximate number of grab samples	106
Approximate total number of soil samples collected	123
Approximate total number of soil samples analyzed [d]	68

Non-Sample Data Collection	Maximum Depth of Investigation
Downhole gamma-spectroscopy log, neutron moisture, and passive neutron logs	Surface to TD in new borehole ~271 ft bgs

[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 I, Appendix A, Tables A2-1, A2-2, A2-4, A2-5, and A3-2 for detection limits and other analytical parameters.
[c] One duplicate, one split*, and one equipment blank.
[d] Number of samples analyzed includes nine split-spoon samples, three field quality-control samples, five physical-property samples and 51 grab samples.

* Optional (Volume I, p. A2-17)

Figure AD4 4-3. 216-T-3 Injection/Reverse Well Conceptual Model and Data Summary.

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

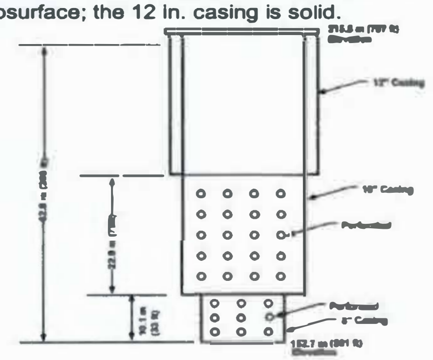
216-T-3 Injection/Reverse Well

T Farm Zone

History

The 216-T-3 Injection/Reverse Well is identified with concrete AC-540 markers and Underground Radioactive Material signs. The reverse well is constructed of steel pipe extending deep into the ground. The well was tested by pumping 7,980 L (2100 gal) of water into the well at a rate of 342 L (90 gal) per minute. This reverse well received liquid disposal from the 221-T and the 224-T facilities via the 241-T-361 Settling Tank. Discharge to the reverse well was discontinued in 1946 and the effluent was routed to the 216-T-6 Crib. (WIDS)

CONSTRUCTION:
The well was drilled in November 1944 to a depth of 62.8 m (206 ft). The deepest casing, from 173 to 206 ft bgs, is 20 cm (8 in.) in diameter; the middle portion of the casing, from 98 to 173 ft bgs, is 25 cm (10 in.) in diameter. The casing, from the surface to 98 ft bgs, is 30 cm (12 in.) in diameter. The 8 and 10 in. diameter casings are perforated to discharge waste directly to subsurface; the 12 in. casing is solid.



WASTE VOLUME: 11,300,000 L (2,990,000 gal) (WIDS)

DURATION: June 1945 to August 1946 (WIDS)

ESTIMATED DISCHARGED INVENTORY (DOE/RL-2003-64, RHO-CD-673, RPP-26744):

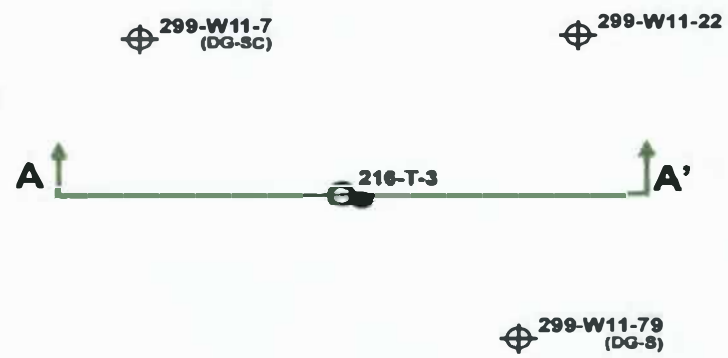
Contaminant	Historical	2008	SIM
Plutonium	3350 g	--	--
Nitrate	290,000 kg	--	646,826 kg
Sr-90	55.7 Ci	11.6 Ci	1.70 Ci
Cs-137	59.5 Ci	13.5 Ci	1.95 Ci

REFERENCES:
- WIDS general summary reports
- RPP-26744
- RHO-CD-673
- DOE/RL-2003-64

Basis of Knowledge (Data Types)

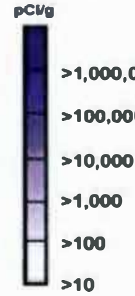
- Process History (PH)
- Downhole Geophysics – Spectral (DG-S)
- Downhole Geophysics – Scintillation (DG-SC)
- Geologic Logs (GL)

Site Plan View
(not to scale)



Legend
- ⊕ = Existing Borehole (data type)
- ▼ = Groundwater Surface
- ● = Planned Deep Borehole
- bgs = Below Ground Surface
- WIDS = *Waste Information Data System* database
- SIM = *Soil Inventory Model, Rev.1*

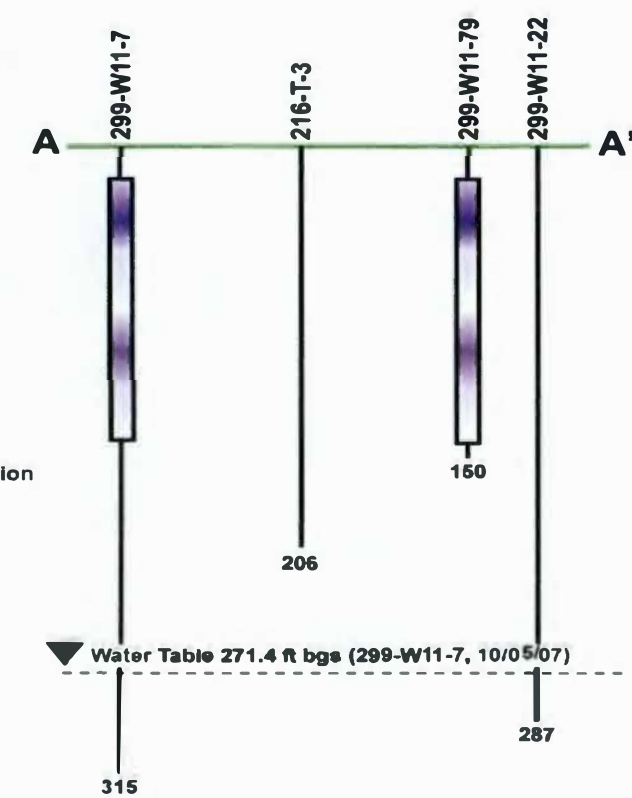
Cesium-137 Concentration



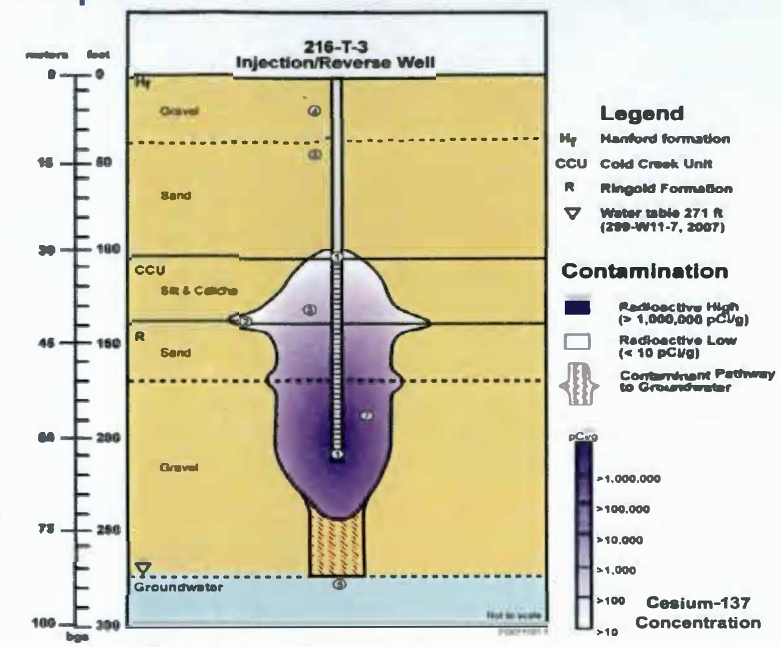
Characterization Summary

The 216-T-3 Injection/Reverse Well is analogous to 216-B-5 Injection/Reverse Well and was evaluated in DOE/RL-2003-64. Cesium-137 was detected over the entire length of borehole 299-W11-7 with the maximum concentration of 54,100 pCi/g detected at 19 ft.

Site Section View
(not to scale)



Conceptual Contaminant Distribution Model



1. Low salt, neutral/basic, radioactive liquid waste containing cesium-137, plutonium, strontium-90 and other contaminants mainly from cell drainage of Tank 5-6 within 221-T; additionally, decontamination waste during 224-T reactivation was released to this injection/reverse well. The well received a total volume of 11,300,000 L (2,990,000 gal) of wastewater between June 1945 and August 1946.
2. The wetting front and contaminants radiate from the perforations in the well beginning 98 ft bgs. Lateral spreading of liquids is associated mainly at intersections with silt layers or other finely grained lenses. As the effluent traveled downward after discharge, contaminants may have been deposited along the top of these zones.
3. Constituents with large distribution coefficients (e.g., cesium-137, strontium-90, and plutonium) sorb to soils resulting in higher concentrations near the perforated sections of the well. Concentrations generally decrease with distance from the well.
4. The highest concentration of cesium-137 was detected at 19 ft bgs to be 54,100 pCi/g in well 299-W11-7.
5. Wastewater and at least mobile contaminants (nitrate) from the well impact groundwater.
6. Little information is available about the nature and extent of contamination between the surface and the beginning of the perforations (98 ft bgs); it is believed that the contamination within this zone may be attributed to that released at the 216-T-6 Cribs.
7. A new borehole will serve to determine contamination within this zone as well as to further define the horizontal spread of contamination released through the well perforations.

Table AD4 4-2. Data-Needs Priority Summary – Model Group 7 – 216-T-3 Injection/Reverse Well (200-TW-2)(RL/FH)(RPP)(Ecology). (2 pages)

Background	
Site Identification	**216-T-3 Injection/Reverse Well**
Site Location	200 West Area, T Plant Zone; northwest of 241-T-361; northeast of 216-T-6
Type of Site	Injection/Reverse Well

Operating History

The 216-T-3 injection/reverse well is identified with concrete AC-540 markers and Underground Radioactive Material signs. The reverse well is constructed of steel pipe extending deep into the ground. There are two wells inside the posted area. The one on the north side of the posted area, 299-W11-22, has a cap with the remnants of a gauge. The one near the southwest side of the area, 216-T-3, has a plain well cap. This reverse well received liquid disposal from the 221-T and the 224-T facilities via the 241-T-361 Settling Tank. The reverse well was active from June 1945 to August 1946. The site was deactivated, in 1946, by blanking the inlet pipe when the effluent flow rate exceeded the infiltration rate. The effluent was rerouted to the 216-T-6 Crib.

The 216-T-3 Injection/Reverse Well was drilled in November 1944 to a depth of 62.8 m (206 ft). It was constructed of well casings with varying diameters. The deepest casing, from 173 to 206 ft bgs, is 20 cm (8 in.) in diameter; the middle portion of the casing, from 98 to 173 ft bgs, is 25 cm (10 in.) in diameter. The 8 and 10 in diameter casing are perforated to discharge waste to the subsurface. The casing from the surface to 30 m (98 ft) below the surface is 30 cm (12 in.) in diameter and constructed of solid steel. The well was tested by pumping 7,980 L (2100 gallons) of water into the well at a rate of 342 L (90 gallons) per minute. HW-9671 states that a different well, 299-W11-22 was drilled first. The first well struck groundwater at a depth of 285 ft bgs and was not used for waste disposal, but was planned to be used as a monitoring well.

Scintillation probe profiles done in 1977 do not agree with the disposal history for this site. Radioactive contaminants were identified between 15 ft and 108 ft bgs. The well casing perforations did not begin until 98 ft bgs in the 216-T-3 Injection/Reverse Well. The zone of contamination could have been caused by a failure in the well casing or the contamination source may be the 216-T-6 Cribs or the 241-T-361 settling tank. The intensity of the radioactive contamination, as illustrated in these scintillation profiles, has decreased since 1959. No measurable lateral migration of the contaminants in the sediments was documented in consecutive scintillation profiles. Breakthrough to groundwater is believed to have occurred at this site. (WIDS, ARH-ST-156)

The waste site received 11,300,000 L of process effluent containing an inventory of 3350 g plutonium, 2800 Ci total beta, 59.5 Ci cesium-137, 55.7 Ci strontium-90, and 290,000 kg nitrates. Some of these historical contaminant values do not fall within the uncertainty ranges of the SIM model results (presented in the table below). The model may need some refining to more accurately reflect historical data. The following table represents the mean values as determined by the SIM model.

Soil Inventory Model – 216-T-3 Injection/Reverse Well (RPP-26744)

Na (kg) 2.875E+05	Al (kg) 0.000E+00	Fe (kg) 3.406E+03	Cr (kg) 2.646E+03	Bi (kg) 4.554E+03	La (kg) 1.750E+03	Hg (kg) 0.000E+00	Zr (kg) 0.000E+00	Pb (kg) 0.000E+00
Ni (kg) 6.970E+02	Ag (kg) 1.985E+00	Mn (kg) 1.049E+03	Ca (kg) 3.027E+03	K (kg) 6.638E+04	NO3 (kg) 6.468E+05	NO2 (kg) 1.117E+00	CO3 (kg) 4.563E+03	PO4 (kg) 2.559E+04
SO4 (kg) 3.184E+03	Si (kg) 6.866E+01	F (kg) 3.862E+04	Cl (kg) 7.726E+03	CCl4 (kg) 0.000E+00	Butanol (kg) 0.000E+00	TBP (kg) 0.000E+00	NPH (kg) 0.000E+00	NH3 (kg) 9.130E-07
Fe(CN)6 (kg) 0.000E+00	H-3 (Ci) 2.023E-05	C-14 (Ci) 4.140E-03	Ni-59 (Ci) 1.083E-03	Ni-63 (Ci) 9.233E-02	Co-60 (Ci) 1.963E-03	Se-79 (Ci) 1.850E-04	Sr-90 (Ci) 1.700E+00	Y-90 (Ci) 1.700E+00
Zr-93 (Ci) 3.573E-02	Nb-93m (Ci) 3.217E-02	Tc-99 (Ci) 9.571E-04	Ru-106 (Ci) 7.132E-12	Cd-113m (Ci) 4.349E-03	Sb-125 (Ci) 5.697E-05	Sn-126 (Ci) 6.672E-04	I-129 (Ci) 4.236E-07	Cs-134 (Ci) 2.621E-09
Cs-137 (Ci) 1.951E+00	Ba-137m (Ci) 1.842E+00	Sm-151 (Ci) 1.008E+02	Eu-152 (Ci) 1.249E-03	Eu-154 (Ci) 1.209E-01	Eu-155 (Ci) 9.808E-02	Ra-226 (Ci) 1.359E-06	Ra-228 (Ci) 4.557E-12	Ac-227 (Ci) 4.312E-05
Pa-231 (Ci) 9.078E-04	Th-229 (Ci) 3.368E-08	Th-232 (Ci) 2.818E-10	U-232 (Ci) 5.745E-09	U-233 (Ci) 5.088E-10	U-234 (Ci) 6.576E-04	U-235 (Ci) 2.969E-05	U-236 (Ci) 5.616E-06	U-238 (Ci) 6.689E-04
U-Total (kg) 2.005E+00	Np-237 (Ci) 3.347E-03	Pu-238 (Ci) 5.754E-02	Pu-239 (Ci) 1.660E+01	Pu-240 (Ci) 1.119E+00	Pu-241 (Ci) 1.083E+00	Pu-242 (Ci) 5.078E-06	Am-241 (Ci) 7.257E-02	Am-243 (Ci) 3.139E-06
Cm-242 (Ci) 5.496E-06	Cm-243 (Ci) 3.255E-08	Cm-244 (Ci) 7.612E-07						

Table AD4 4-2. Data-Needs Priority Summary – Model Group 7 – 216-T-3 Injection/Reverse Well (200-TW-2)(RL/FH)(RPP)(Ecology). (2 pages)

Vicinity Waste Sites	241-T-361; 216-T-6						
Current Status	Analogous site; assigned to 216-B-5; evaluated in 200-TW-1/2/200-PW-5 feasibility study (DOE/RL-2003-64). MESC/MNA/IC identified as preferred alternative in FS						
Potential Remedial Alternatives							
X for viable alternatives	**No Action**	**MESC/MNA/IC**	**Removal/Disposal**	**Barrier**	**Partial Removal / Barrier**	**In Situ Treatment**	**Other**
		X		X			

Data Evaluation and Gaps Analysis

Data	**Knowns**	**Data Uncertainties**	**Are supplemental data required to support decision making?**
Geophysical logging: 299-W11-79 (150 ft) (Spectral, 2003)	299-W11-79: located 8 m southeast of the 216-T-3 Injection/Reverse Well. Cesium-137 was detected over the entire length of the borehole at concentrations ranging from 0.4 pCi/g to 54,100 pCi/g. The maximum concentration was measured at 19 ft bgs. Elevated cesium-137 was encountered at 63 ft with a concentration of 50 pCi/g and in the interval from 106 to 109 ft bgs at concentrations above 1,000 pCi/g. Most of these depths are much higher in the vadose zone than the reverse well discharge depths between 98 and 206 ft.	The nature and extent of contamination in the near surface (above the casing perforations) is uncertain. Historical information suggests this contamination may be associated with 216-T-6 Cribs or 241-T-361 settling tank.	Yes – existing data for this site are limited; a deep borehole would provide information on the plutonium concentrations and would support a better risk assessment and evaluation of protectiveness. Groundwater protection may be an issue.
Scintillation log for well 299-W11-7 dated 1959, 1970 & 1976	299-W11-7: located 5 m north of the 216-T-3 Injection/Reverse Well. Scintillation logs from 1959, 1970, and 1976 show elevated gamma activity in multiple zones; 10 to 25 ft bgs, 40 to 65 ft bgs, and 95 to 105 ft bgs (ARH-ST-156). Decay between 1959 and 1976 reduced concentrations of shorter-lived gamma emitting radionuclides, leaving a maximum concentration in 1976 of about 9 x 10^5 counts per minute.		

Reference:

- WIDS, *Waste Information Data System* database
- DOE/RL-2004-10, *Proposed Plan for the 200-TW-1 Scavenged Waste Group & the 200-TW-2 Tank Waste Group & the 200-PW-5 Fission–Product Rich Waste Group OU*
- DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group OU & 200-TW-2 Tank Waste Group OU RI/FS Work Plan*
- ARH-ST-156, *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells*
- DOE/RL-2003-64, *Feasibility Study for the 200-TW-1 Scavenged Waste Group & the 200-TW-2 Tank Waste Group & the 200-PW-5 Fission-Product Rich Waste Group OU*
- RPP-26744, *Hanford Soil Inventory Model, Rev.1*
- HW-9671, *Underground Waste Disposal at Hanford Works, An Interim Report Covering the 200-West Area*

Proposed Activities and Path Forward:

- Drill a deep borehole to evaluate plutonium concentrations and to assess contamination in the zone between the surface and the discharge point for the reverse well.

AD4-5.0 216-T-5 TRENCH SITE-SPECIFIC FIELD-SAMPLING PLAN

The characterization planned for the 216-T-5 Trench includes drilling four drive points, to depths of 40 ft, and geophysical logging of these same drive points. The drilling and logging efforts are planned to reduce the uncertainty associated with plutonium released to the trench. The 216-T-5 Trench received 2nd cycle supernatant waste from the 221-T Plant Canyon Building. The planned characterization would provide information on the nature on plutonium contamination within the vicinity of the bottom of the trench.

Because no samples will be collected from these drive points and the stratigraphy figure serves to justify sample depths, this figure is not warranted Geologic logs will be generated during drilling activities, providing additional information on the lithology below the trench.

The locations of the four drive points, one on each edge of the trench, were chosen to characterize the lateral extent of the plutonium contamination at this trench. The location of these drive points may change as directed by the integrated project team (IPT) or if additional information becomes available for drilling activities planned at the 216-T-7 Tile Field.

The following figures and tables provide the site-specific field-sampling plan for the 216-T-5 Trench.

Figure AD4 5-1. 216-T-5 Trench Data-Collection Locations.

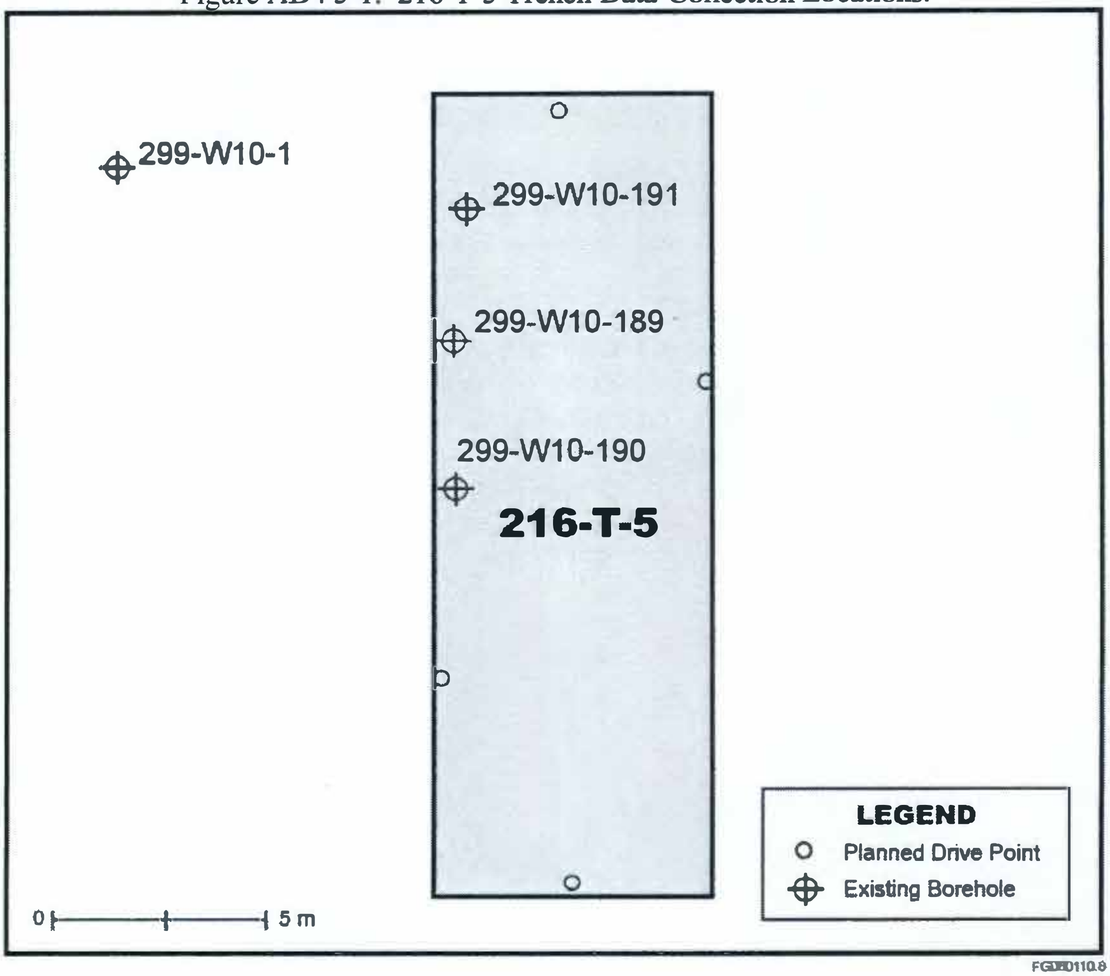


Table AD4 5-1. 216-T-5 Crib Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investi-gation	Sample Interval Depth (ft bgs)	Analyte List	Physical Properties	
					Sample Interval	Parameters
Four drive points	One on each edge of the 216-T-5 Trench as depicted in Figure AD4 5-1.	40 ft bgs	N/A	N/A	N/A	N/A

Non-Sample Data Collection	Maximum Depth of Investigation
Downhole gamma-spectroscopy log, neutron moisture, and passive neutron logs	Surface to TD in new drive points ~40 ft bgs

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Figure AD4 5-2. 216-T-5 Trench Conceptual Model and Data Summary.

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

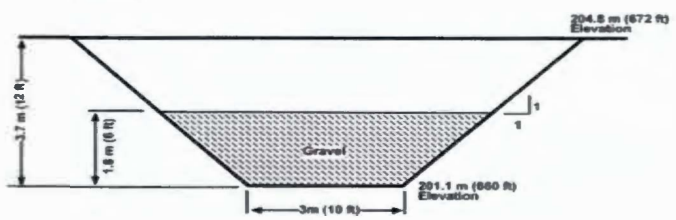
216-T-5 Trench

T Farm Zone

History

The 216-T-5 Trench is a subsurface liquid waste disposal site that operated during 1955 receiving 2nd cycle supernatant from the 221-T Canyon Building via the 241-T-112 Tank. Because the lack of waste storage space in the tank farms, second cycle waste from the bismuth phosphate fuel separation operations, which had been stored in the tank farms, began to be released to cribs and specific retention trenches in 1948. The trench is associated with the 221-T Building and the 241-T Tank Farm. The site was deactivated when the specific retention capacity was reached. The above-ground piping was removed and the trench was backfilled. (WIDS)

CONSTRUCTION:
The trench is 50 ft long by 10 ft wide by 12 ft deep. (WIDS)



WASTE VOLUME: 2,600,000 L (690,000 gal) (WIDS)

DURATION: May 1955 (WIDS)

ESTIMATED DISCHARGED INVENTORY (DOE/RL-2003-64, RHO-CD-673, RPP-26744):

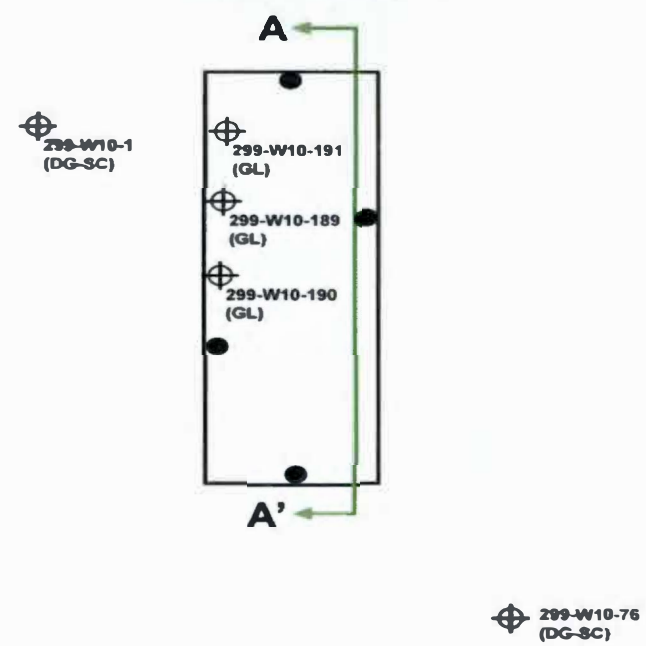
Contaminant	Historical	2008	SIM
Plutonium	180 g	–	–
Chromium	–	–	1208 kg
Nitrate	140,000 kg	–	241,590 kg
Sr-90	1 Ci	0.28 Ci	29.4 Ci
Tc-99	0.239 Ci	0.239 Ci	0.015 Ci
Cs-137	70 Ci	20.7 Ci	34.3 Ci
Uranium	4.54 kg	–	24.2 kg

REFERENCES:
- WIDS general summary reports
- RPP-26744
- RHO-CD-673
- DOE/RL-2000-38
- DOE/RL-2002-42
- DOE/RL-2003-64

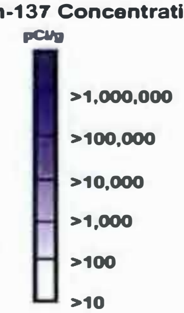
Basis of Knowledge (Data Types)

- Process History (PH)
- Downhole Geophysics – Scintillation (DG-SC)
- Geologic Logs (GL)

Site Plan View
(not to scale)



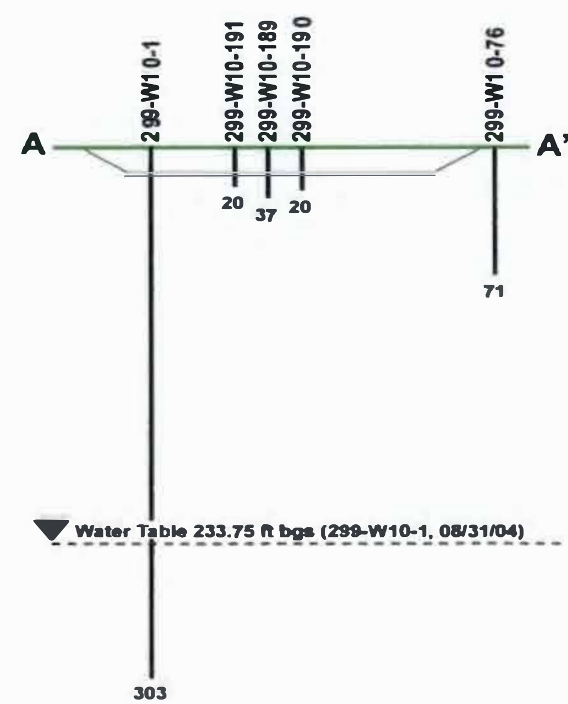
Legend
- ⊕ = Existing Borehole (data type)
- ▼ = Groundwater Surface
- ● = Planned Drive Point
- bgs = Below Ground Surface
- WIDS = *Waste Information Data System* database
- SIM = *Soil Inventory Model, Rev.1*



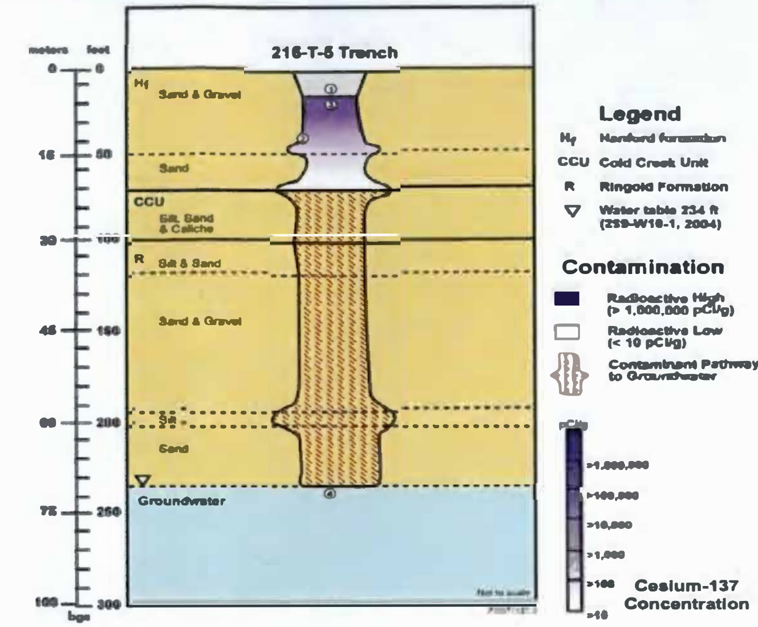
Characterization Summary

216-T-5 is analogous to 216-B-7A and was evaluated in DOE/RL-2003-64. Five boreholes have been installed over time, but little information is available.

Site Section View
(not to scale)



Conceptual Contaminant Distribution Model



1. High salt, neutral/basic, and radioactive 2nd cycle supernatant waste from 221-T via 241-T-112 Tank containing plutonium, uranium, and cesium-137 was discharged to the trench in May 1955. The trench received a total volume of 2,600,000 L (690,000 gal) of wastewater.
2. The wetting front and contaminants move vertically beneath the trench. Lateral spreading of liquids is associated mainly with the Hanford gravel and sand contact and at the intersection with Cold Creek unit. As the effluent traveled downward after discharge, contaminants may have been deposited along the top of these zones.
3. Constituents with large distribution coefficients (e.g., plutonium and cesium-137) sorb to soils resulting in higher concentrations near the bottom of the trench. Concentrations generally decrease with depth.
4. The amount of mobile contaminant nitrate discharged to the trench and groundwater samples at well 299-W10-1 suggest that groundwater may have been impacted by the waste from this trench.

Table AD4 5-2. Data-Needs Priority Summary – Model Group 4 – 216-T-5 Trench (200-TW-2)(RL/FH)(RPP)(Ecology). (3 Pages)

Background	
Site Identification	216-T-5 Trench
Site Location	200 West Area, T Farm Zone, west of T-Tank Farm
Type of Site	Trench
Operating History	The 216-T-5 trench is marked and posted with Underground Radioactive Material signs. This trench received 2.6 million liters of 221-T second cycle supernatant that had been stored in the 241-T-112 tank via an over ground pipeline. The trench was only active in May 1955. Due to the lack of waste storage space in the tank farms, second cycle waste from the bismuth phosphate fuel separation operations, which had been stored in the tank farms, began to be released to cribs and specific retention trenches in 1948. The extracted plutonium went through two decontamination cycles to further purify it. The first cycle waste was combined with the coating waste. It contained 10% of the fission products and 1% of plutonium. The second decontamination cycle waste contained less than 0.1% of the fission products. The trench is associated with the 221-T Building and the 241-T Tank Farm. The site was deactivated when the specific retention capacity was reached. The above-ground piping was removed and the trench was backfilled. The waste site is 50 ft by 10 ft and about 12 ft deep (WIDS). Historical data has been presented as follows: 180 g total plutonium, 70 Ci cesium-137, 1 Ci strontium-90, 0.239 Ci technetium-99, 140,000 kg nitrate and 4.54 kg uranium. Although these values may differ than those presented in the SIM table below, they still fall within the range of the model's uncertainty. The following table represents the mean values as determined by the SIM model.

Soil Inventory Model - 216-T-5 Trench (RPP-26744)

Na (kg) 1.370E+05	Al (kg) 0.000E+00	Fe (kg) 6.514E+02	Cr (kg) 1.208E+03	Bi (kg) 6.036E+02	La (kg) 0.000E+00	Hg (kg) 0.000E+00	Zr (kg) 0.000E+00	Pb (kg) 0.000E+00
Ni (kg) 2.950E+02	Ag (kg) 8.079E-01	Mn (kg) 0.000E+00	Ca (kg) 5.465E+02	K (kg) 8.334E+02	NO3 (kg) 2.416E+05	NO2 (kg) 1.548E+01	CO3 (kg) 8.186E+02	PO4 (kg) 2.242E+04
SO4 (kg) 1.496E+04	Si (kg) 1.015E+03	F (kg) 1.312E+04	Cl (kg) 3.473E+03	CCl4 (kg) 0.000E+00	Butanol (kg) 0.000E+00	TBP (kg) 0.000E+00	NPH (kg) 0.000E+00	NH3 (kg) 2.452E-05
Fe(CN)6 (kg) 0.000E+00	H-3 (Ci) 8.768E-03	C-14 (Ci) 2.767E-02	Ni-59 (Ci) 7.218E-03	Ni-63 (Ci) 6.374E-01	Co-60 (Ci) 2.537E-02	Se-79 (Ci) 1.254E-03	Sr-90 (Ci) 2.942E+01	Y-90 (Ci) 2.944E+01
Zr-93 (Ci) 7.544E-01	Nb-93m (Ci) 6.612E-01	Tc-99 (Ci) 1.498E-02	Ru-106 (Ci) 9.577E-10	Cd-113m (Ci) 4.132E-02	Sb-125 (Ci) 1.450E-03	Sn-126 (Ci) 4.826E-03	I-129 (Ci) 0.000E+00	Cs-134 (Ci) 4.089E-07
Cs-137 (Ci) 3.430E+01	Ba-137m (Ci) 3.237E+01	Sm-151 (Ci) 2.558E+02	Eu-152 (Ci) 1.221E-02	Eu-154 (Ci) 8.979E-01	Eu-155 (Ci) 4.934E-01	Ra-226 (Ci) 4.523E-06	Ra-228 (Ci) 2.667E-11	Ac-227 (Ci) 3.942E-05
Pa-231 (Ci) 8.838E-04	Th-229 (Ci) 5.288E-08	Th-232 (Ci) 4.502E-10	U-232 (Ci) 1.208E-07	U-233 (Ci) 9.474E-09	U-234 (Ci) 7.924E-03	U-235 (Ci) 3.506E-04	U-236 (Ci) 1.076E-04	U-238 (Ci) 8.090E-03
U-Total (kg) 2.422E+01	Np-237 (Ci) 6.206E-03	Pu-238 (Ci) 1.460E-01	Pu-239 (Ci) 1.648E+01	Pu-240 (Ci) 2.089E+00	Pu-241 (Ci) 4.587E+00	Pu-242 (Ci) 3.336E-05	Am-241 (Ci) 4.348E-01	Am-243 (CI) 6.732E-05
Cm-242 (Ci) 1.159E-04	Cm-243 (Ci) 1.400E-06	Cm-244 (CI) 3.290E-05						

Table AD4 5-2. Data-Needs Priority Summary – Model Group 4 – 216-T-5 Trench (200-TW-2)(RL/FH)(RPP)(Ecology). (3 Pages)

Vicinity Waste Sites	216-T-32, 216-T-7, 200-W-52, T Tank Farm
Current Status	Analogous site; likely assigned to 216-B-7A; evaluated in 200-TW-1/2/200-PW-5 feasibility study (DOE/RL-2003-64); Draft A submitted to EPA and Ecology March 2004. Capping was identified as preferred alternative in FS.

Potential Remedial Alternatives

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

Data Evaluation and Gaps Analysis

Data	Knowns	Data Uncertainties	Are supplemental data required to support decision making?
Scintillation log for 299-W10-76, located southeast of the trench	Gamma emitters are at background in this well on 1963 log. Indicates gamma contamination has not spread laterally.	Available data are from locations outside and adjacent to the trench; no site-specific data are available inside the trench boundaries. The nature of contamination is known only by the inventory. The nature of plutonium in the trench is unknown in relation to its representative site. The 216-T-5 Trench received 180 g plutonium, while the 216-B-7A&B Cribs received 4,300 g. The maximum concentration in 216-B-7A was 153,000 pCi/g of plutonium-239/240. Based on these data, the plutonium concentration at 216-T-5 may be below 100 nCi/g, which could influence disposal options for any waste material associated with remediation. The	Yes - supplemental data will help resolve uncertainties associated with the nature of the plutonium contamination near the bottom of the crib structure and below, and will support evaluation of a broader range of alternatives, including disposal options. ERC data do not indicate a conductivity plume beneath this site. No supplemental data collection activities are required at this time for this crib. Data with depth in the area will be collected through a boring at 216-T-7, which will provide data for use in assessing the deep vadose zone in the area, including at 216-T-5. The 216-T-7 data will be evaluated and if needed, a follow on DQO for the area will be conducted. The extent of contamination at the crib is defined well enough by the analogous site approach, by the small size of the crib, by geophysical logging of nearby wells, and by planned characterization efforts. No supplemental data on extent are required to support decision making.
Scintillation log dated 1959, 1963 & 1976, for 299-W10-1, located northwest of the trench	Gamma emitters are at background in this well on 1976 log. Earlier logs show some activity that has decayed away by 1976. Indicates gamma contamination has not spread laterally.		

Table AD4 5-2. Data-Needs Priority Summary – Model Group 4 – 216-T-5 Trench (200-TW-2)(RL/FH)(RPP)(Ecology). (3 Pages)

Scintillation log dated 1959, 1963 & 1976, for 299-W10-1, located northwest of the trench	Gamma emitters are at background in this well on 1976 log. Earlier logs show some activity that has decayed away by 1976. Indicates gamma contamination has not spread laterally.	inventory of nitrate, chromium, and/or fluoride may pose potential groundwater risk; however, this is not indicated based on ERC.	
Electrical Resistivity Characterization (ERC)	ERC surveys in the area indicate high conductivity beneath adjacent sites 216-T-7 and 200-W-52. The plume appears to originate either with the 200-T-7/200-W-52 sites or the tank farm. 216-T-5 does not appear to be associated with the conductivity plume.	Validation of ERC likely required at 216-T-7; these data would also be used to evaluate 216-T-5.	

References:

- *Waste Information Data System* database
- RPP-26744, *Hanford Soil Inventory Model, Rev. 1*
- DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group OU & 200-TW-2 Tank Waste Group OU RI/FS Work Plan*
- DOE/RL-2002-42, *Remedial Investigation Report for the 200-TW-1 and 200-TW-2 Tank Waste Group Operable Units (Includes the 200-PW-5 Operable Unit)*
- DOE/RL-2003-64, *Feasibility Study for the 200-TW-1 Scavenged Waste Group & the 200-TW-2 Tank Waste Group & the 200-PW-5 Fission-Product rich Waste Group OU*

Proposed activities:

1. Investigation of deep contamination will be addressed through boring at 216-T-7 or 200-W-52; potential opportunity to integrate with groundwater.

2. Drill four drive points to investigate nature of near-surface contamination and plutonium concentrations; analogous relationship with 216-B-7A has some uncertainty, especially in terms of plutonium concentration; this would represent some accelerated confirmatory sampling to strengthen the decision process.

AD4-6.0 216-T-6 CRIBS SITE-SPECIFIC FIELD-SAMPLING PLAN

The characterization planned for the 216-T-6 Cribs includes drilling four drive points, to depths of 40 ft, geophysical logging of these same drive points, and electrical resistivity characterization (ERC). The drilling and logging efforts are planned to reduce the uncertainty associated with the extent and volume of plutonium released to this crib system, while the ERC may provide information on the extent of deeper, mobile contamination. The 216-T-6 Cribs received cell drainage from Tank 5-6 in the 221-T Plant Canyon Building and liquid waste from the 224-T Waste Storage Facility.

Because no samples will be collected from these drive points and the stratigraphy figure serves to justify sample depths, this figure is not warranted. Geologic logs will be generated during drilling activities, providing additional information on the lithology below the trench.

The locations of the four drive points were chosen to gain information on plutonium contamination throughout the crib structures. The two drive points within the cribs will provide information near the source of liquid release and help verify that the eastern crib (right crib in Figure AD4 6-1) received the liquid waste and overflowed into the other crib. The drive point between the two cribs serves to identify possible contaminant release through leaks, while the drive point located to the east will provide information on possible lateral spread of contamination towards the 216-T-3 Injection/Reverse Well. The locations of these drive points may change as information becomes available on the ERC data of this waste site. The report is to be issued by PNNL, expected March 2008, following their QA/QC procedures.

The following figures and tables provide the site-specific field sampling plan for the 216-T-6 Cribs.

Figure AD4 6-1. 216-T-6 Cribs Data-Collection Locations.

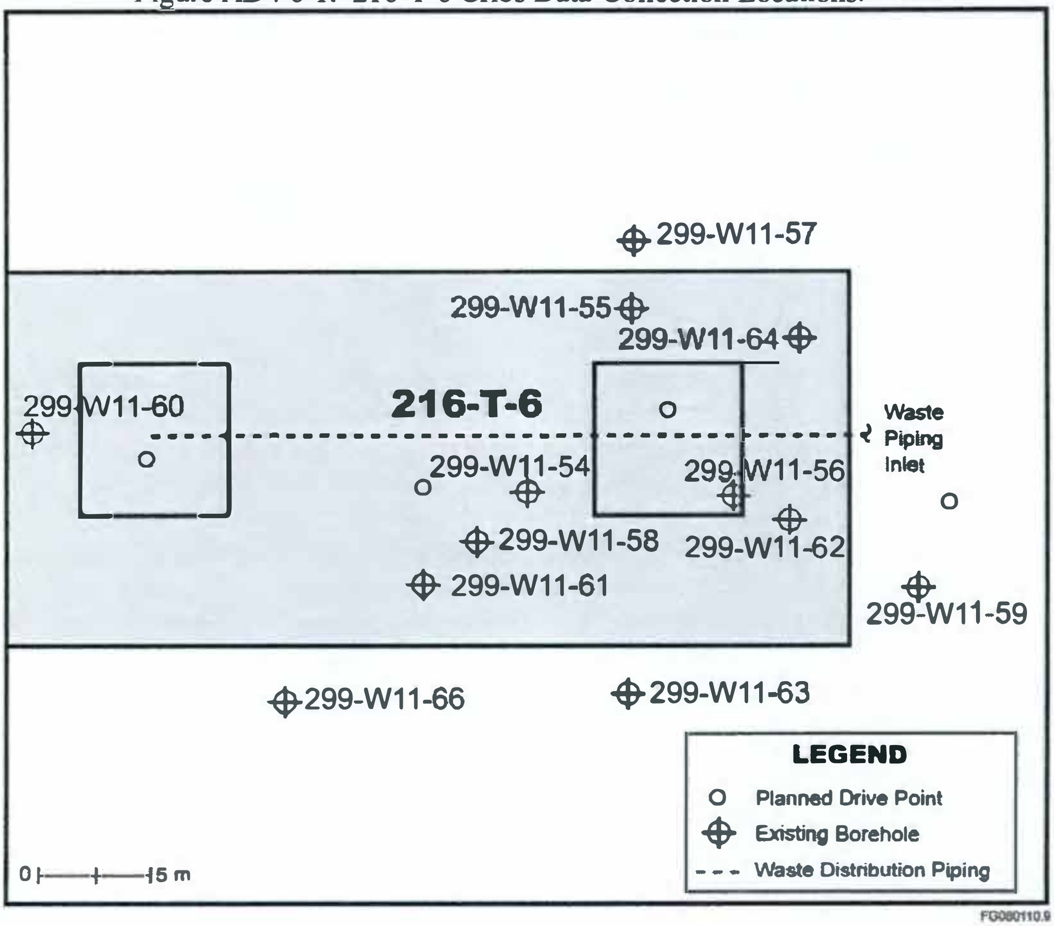


Table AD4 6-1. 216-T-6 Cribs Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investi-gation	Sample Interval Depth (ft bgs)	Analyte List	Physical Properties	
					Sample Interval	Parameters
Four drive points	One at each crib, one in between cribs and one east of cribs as depicted in Figure AD4 6-1.	40 ft bgs	N/A	N/A	N/A	N/A

Non-Sample Data Collection	Maximum Depth of Investigation
Downhole gamma-spectroscopy log, neutron moisture, and passive neutron logs	Surface to TD in new drive points ~40 ft bgs

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Figure AD4 6-2. 216-T-6 Cribs Conceptual Model and Data Summary.

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

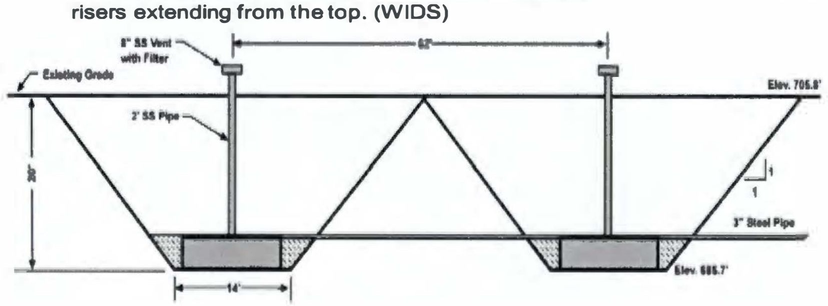
216-T-6 Cribs

T Farm Zone

History

The 216-T-6 Cribs are delineated with light post and chain with Cave-in Potential signs. The area is surrounded with concrete AC-540 markers and Underground Radioactive Material signs. The cribs received liquid waste from the 221-T and 224-T facilities via the 241-T-361 Settling Tank. The cribs were built to replace the 216-T-3 Injection/Reverse Well when it was abandoned in August 1946. In June 1951, the 241-T-361 Settling Tank was deactivated, and the 224-T Building effluent was rerouted to the 216-T-32 Cribs. (WIDS)

CONSTRUCTION:
The crib consists of two wooden crib boxes, each box set into a pit with sloping sides. The two 4.3-m (14-foot) square crib boxes are set 19 m (62 feet) apart and are connected in series by a pipe, with one crib overflowing into the other. The cribs are 14 ft by 14 ft and approximately 25 feet deep. Each box has two risers extending from the top. (WIDS)



WASTE VOLUME: 45,000,000 L (11,900,000 gal) (WIDS)

DURATION: August 1946 to June 1951 (WIDS)

ESTIMATED DISCHARGED INVENTORY (DOE/RL-2003-64, RHO-CD-673, RPP-26744):

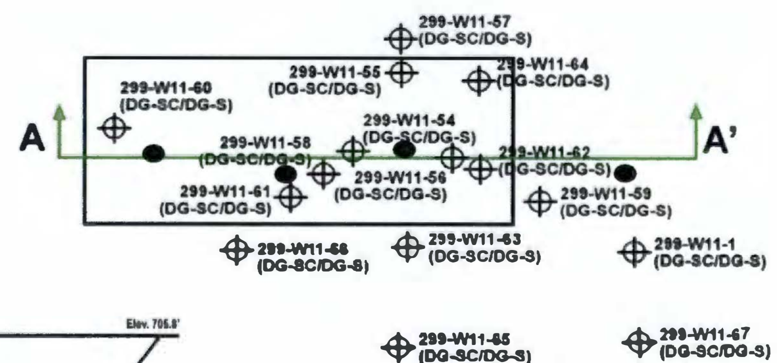
Contaminant	Historical	2008	SIM
Plutonium	390 g	–	–
Nitrate	180,000 kg	–	230,259 kg
Sr-90	360 Ci	81.6 Ci	14 Ci
Tc-99	0.138 Ci	0.138 Ci	0.0079 Ci
Cs-137	300 Ci	73.6 Ci	16.05 Ci
Uranium	23 kg	–	20.8 kg

REFERENCES:
- WIDS general summary reports
- RPP-26744
- RHO-CD-673
- DOE/RL-2003-64

Basis of Knowledge (Data Types)

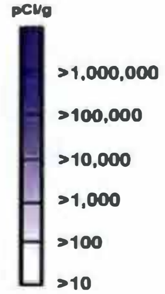
- Process History (PH)
- Downhole Geophysics – Spectral (DG-S)
- Downhole Geophysics – Scintillation (DG-SC)
- Geologic Logs (GL)

Site Plan View
(not to scale)



Legend
- ⊕ = Existing Borehole (data type)
- ▼ = Groundwater Surface
- ● = Planned Drive Point
- bgs = Below Ground Surface
- WIDS = *Waste Information Data System* database
- SIM = *Soil Inventory Model, Rev. 1*

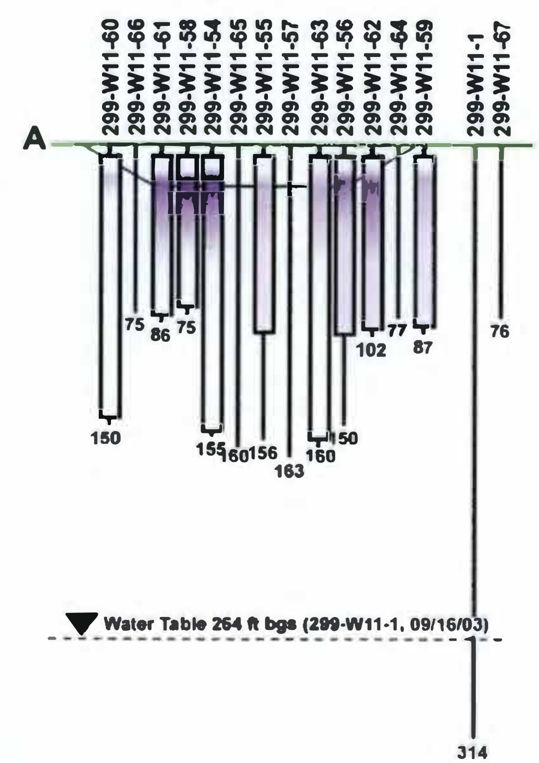
Cesium-137 Concentration



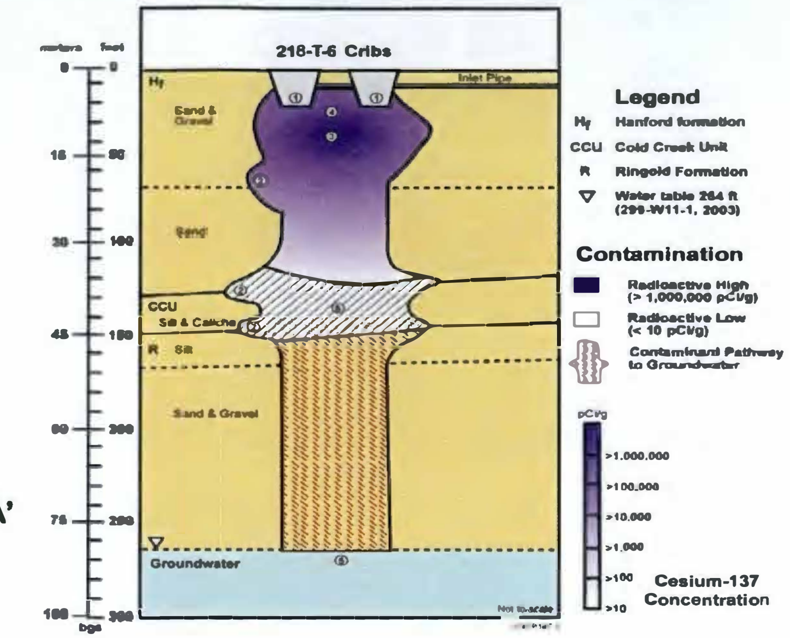
Characterization Summary

216-T-6 is analogous to 216-B-7A and was evaluated in DOE/RL-2003-64. Maximum cesium-137 contamination detected was 9600 pCi/g at 34 ft in borehole 299-W11-54.

Site Section View
(not to scale)



Conceptual Contaminant Distribution Model



1. Low salt, neutral/basic, radioactive liquid waste containing plutonium, uranium, strontium-90, and cesium-137 from cell drainage of Tank 5-6 in 221-T and additional waste from 224-T via 241-T-361 settling tank was released to this crib. The crib received a total volume of 45,000,000 L (11,900,000 gal) of wastewater between August 1946 and June 1951.
2. The wetting front and contaminants move vertically beneath the cribs. Lateral spreading of liquids is associated mainly with the Hanford gravel and sand contact, and at intersections with silt layers or other finely grained lenses. As the effluent traveled downward after discharge, contaminants may have been deposited along the top of these zones.
3. Constituents with large distribution coefficients (e.g., plutonium, strontium-90, and cesium-137) sorb to soils resulting in higher concentrations near the bottom of the cribs. This site is unique in that the zone of maximum concentration does not begin at the bottom of the cribs (25 ft bgs), rather it occurs between 37 and 45 ft bgs.
4. The highest cesium-137 concentration was 9600 pCi/g at 34 ft bgs in well 299-W11-54, while the highest concentration of uranium-238 occurred at 45 ft bgs to be 34 pCi/g within the same well.
5. The volume of release and mobility of some contaminants (e.g., nitrate) from the crib suggest groundwater may have been impacted.
6. Geophysical logs of multiple wells within these cribs showed an elevated zone of uranium-238 in the vicinity of the Cold Creek unit and its interfaces with the Hanford and Ringold Formations.

Table AD4 6-2. Data-Needs Priority Summary – Model Group 4 – 216-T-6 Cribs (200-TW-2)(RL/FH)(RPP)(Ecology). (5 pages)

Background	
Site Identification	216-T-6 Crib
Site Location	200 West; T Plant Zone; north of 23rd Street, southwest of the 221-T building, adjacent to 216-T-3 Reverse Well and 241-T-361 Tank
Type of Site	Crib
Operating History	The 216-T-6 Cribs consists of two wooden crib boxes, each box set into a pit with sloping sides. The two 4.3-meter (14 ft) square crib boxes are set 19 meters (62 ft) apart and are connected in series by a 3 inch diameter pipe, with one crib overflowing into the other. The cribs are approximately 25 ft deep with waste entering at a depth of 17 ft. Each box has two risers extending from top. After construction the excavations were backfilled to grade. The effluent filled the first crib and then overflowed into the second crib. The 216-T-6 Cribs are delineated with light post and chain and Cave-in Potential signs. The area is surrounded with concrete AC-540 markers and Underground Radioactive Material signs. The cribs received liquid waste from the 221-T and 224-T Facilities via the 241-T-361 Settling Tank. The liquid waste received was low-salt neutral/basic liquid waste from the cell drainage. The cribs were built to replace the 216-T-3 Reverse Well when it was abandoned in August 1946. From August 1946 to October 1946, the cribs received cell drainage from Tank 5-6 in the 221-T Building and waste from the 224-T Building via the overflow from 241-T-361 Settling Tank. From October 1946 to June 1951, the site received cell drainage from Tank 5-6 in the 221-T Building. The total amount of effluent discharged was 45,000,000 liters. In June 1951, the site and 241-T-361 Settling Tank was deactivated to evaluate the radionuclide disposal characteristics of the crib. The crib pipeline was blanked south of the 241-T-361 Settling Tank and the 224-T Building effluent was rerouted to 216-T-32 Crib. The 221-T waste was rerouted to the 216-T-7 Crib. Historical data have been presented as follows: 390 g total plutonium, 360 Ci strontium-90, 300 Ci cesium-137, 0.138 Ci technetium-99, 180,000 kg nitrate and 23 kg uranium. Some of these historical contaminant values do not fall within the uncertainty ranges of the SIM model (present in the table below). The model may need some refining to more accurately reflect historical data. The following table represents the mean values as determined by the SIM model. Soil Inventory Model - 216-T-6 Crib (RPP-26744)

Na (kg) 1.232E+05	Al (kg) 0.000E+00	Fe (kg) 5.345E+02	Cr (kg) 6.830E+02	Bi (kg) 6.186E+02	La (kg) 1.567E+02	Hg (kg) 0.000E+00	Zr (kg) 0.000E+00	Pb (kg) 0.000E+00
Ni (kg) 2.778E+02	Ag (kg) 7.620E-01	Mn (kg) 8.221E+01	Ca (kg) 6.017E+02	K (kg) 3.095E+03	NO3 (kg) 2.303E+05	NO2 (kg) 9.244E+00	CO3 (kg) 9.020E+02	PO4 (kg) 1.842E+04
SO4 (kg) 1.292E+04	Si (kg) 7.698E+02	F (kg) 1.264E+04	Cl (kg) 3.141E+03	CCl4 (kg) 0.000E+00	Butanol (kg) 0.000E+00	TBP (kg) 0.000E+00	NPH (kg) 0.000E+00	NH3 (kg) 1.019E-05
Fe(CN)6 (kg) 0.000E+00	H-3 (Ci) 2.127E-04	C-14 (Ci) 1.484E-02	Ni-59 (Ci) 3.882E-03	Ni-63 (Ci) 3.310E-01	Co-60 (Ci) 7.034E-03	Se-79 (Ci) 6.632E-04	Sr-90 (Ci) 1.399E+01	Y-90 (Ci) 1.399E+01
Zr-93 (Ci) 4.006E-01	Nb-93m (Ci) 3.608E-01	Tc-99 (Ci) 7.872E-03	Ru-106 (Ci) 1.276E-11	Cd-113m (Ci) 1.559E-02	Sb-125 (Ci) 2.042E-04	Sn-126 (Ci) 2.392E-03	I-129 (Ci) 3.485E-06	Cs-134 (Ci) 2.158E-08
Cs-137 (Ci) 1.605E+01	Ba-137m (Ci) 1.516E+01	Sm-151 (Ci) 1.416E+02	Eu-152 (Ci) 1.754E-03	Eu-154 (Ci) 1.699E-01	Eu-155 (Ci) 1.378E-01	Ra-226 (Ci) 4.871E-06	Ra-228 (Ci) 1.633E-11	Ac-227 (Ci) 4.263E-05
Pa-231 (Ci) 8.957E-04	Th-229 (Ci) 3.324E-08	Th-232 (Ci) 2.782E-10	U-232 (Ci) 5.967E-08	U-233 (Ci) 5.283E-09	U-234 (Ci) 6.827E-03	U-235 (Ci) 3.081E-04	U-236 (Ci) 5.832E-05	U-238 (Ci) 6.949E-03
U-Total (kg) 2.082E+01	Np-237 (Ci) 3.308E-03	Pu-238 (Ci) 5.230E-02	Pu-239 (Ci) 1.511E+01	Pu-240 (Ci) 1.020E+00	Pu-241 (Ci) 9.875E-01	Pu-242 (Ci) 4.619E-06	Am-241 (Ci) 7.168E-02	Am-243 (Ci) 3.100E-06
Cm-242 (Ci) 5.430E-06	Cm-243 (Ci) 3.210E-08	Cm-244 (Ci) 7.525E-07						

Vicinity Waste Sites	216-T-3, 241-T-361

Table AD4 6-2. Data-Needs Priority Summary – Model Group 4 – 216-T-6 Cribs (200-TW-2)(RL/FH)(RPP)(Ecology). (5 pages)

Current Status	Analogous site; assigned to 216-B-7A; evaluated in feasibility study (DOE/RL-2003-64 Draft A), submitted to EPA and Ecology March 2004. Capping was identified as preferred alternative in FS.						
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?**
	Cesium-137 was identified from 25 to 40 ft zone with maximum values near 10,000 pCi/g. Nitrate: A large volume of nitrate was reported as being discharged to this site. Limited additional information is available regarding the nature and extent of this constituent. Uranium: Low activities were detected in the several logs.	Uncertainties exist regarding the extent of nitrate and plutonium contamination.	Yes — Analogous relationships and inventory can be used for decision making. However, more refined data on plutonium concentrations could reduce uncertainty in evaluation of disposal options and associated costs. Because of the large nitrate inventory, ERC was completed to help resolve extent of deeper mobile contaminants.
299-W11-1 (314 ft) (Spectral, 2003) 299-W11-54 (155.33 ft) (Spectral, 2003)	**Refer to Figure AD4 6-1 for general locations of existing wells** 299-W11-1 Cesium-137 was detected at 1 ft log depth with a concentration of 0.4 pCi/g. The interval between 22 and 29 ft contained the highest concentrations of cesium-137 with the maximum of 9.3 pCi/g occurring at 23 ft. 299-W11-54 Cesium-137 was detected from the surface to a depth of 70 ft. The range of concentrations was from the MDL of 0.2 pCi/g to 9600 pCi/g, which was measured at 34 ft. Cesium-137 was also detected from 71 ft to 154 ft. Uranium-238 was detected at 45 ft with a concentration of 34 pCi/g; the MDL was 16 pCi/g.		

299-W11-55 (155.8 ft) (Spectral, 2003)	299-W11-55 Cesium-137 was detected between 6 and 8 ft. The range of concentration was from 0.2 pCi/g to 1 pCi/g. Cesium-137 was also detected from 29 ft through 67 ft. The range of concentrations was from the MDL to 187 pCi/g, which was measured at 31 ft. Cesium-137 was also detected near the MDL at 71 ft and 73 ft bgs.		
299-W11-56 (150 ft) (Spectral, 2003)	299-W11-56 Cesium-137 was detected from 6 to 65 ft and from 133 to 143 ft at concentrations ranging from 0.2 pCi/g to 7100 pCi/g. The maximum concentration of Cesium-137 was measured at 31 ft. Cesium-137 was also detected at 75 ft, 89 ft, and 127 ft bgs.		
299-W11-57 (163 ft) (Spectral, 2003)	299-W11-57 Cesium-137 was detected near the surface at 6 and 7 ft bgs. The range of concentrations was from 0.6 pCi/g to a maximum of 1.0 pCi/g at 6 ft. 0.2 pCi/g of cesium-137 was also detected at 30 ft.		
299-W11-58 (75 ft) (Spectral, 2003)	299-W11-58 Cesium-137 was detected near the ground surface at 4 through 17 ft at concentrations ranging from the MDL of 0.2 pCi/g to 12.5 pCi/g, which was at 8 ft bgs. Cesium-137 was also detected from 26 through 75 ft. The range of concentrations was from the MDL to 4740 pCi/g at 34 ft bgs.		
299-W11-59 (87.2 ft) (Spectral, 2003)	299-W11-59 Cesium-137 was detected at 1 ft to 44 ft. The range of concentrations was from the MDL of 0.2 pCi/g to 410 pCi/g, which was detected at 24 ft bgs. Cesium-137 was also detected near the MDL at 48 and 82 ft bgs.		
299-W11-60 (150 ft) (Spectral, 2003)	299-W11-60 Cesium-137 was detected from 6 ft to 12 ft and between 28 and 39 ft bgs. Cesium-137 was also detected near the MDL of 0.2 pCi/g at 84 ft bgs.		
299-W11-61 (85.9 ft) (Spectral, 2003)	299-W11-61 Cesium-137 was detected from 6 ft to 13 ft bgs at concentrations ranging from the MDL of 0.2 pCi/g to 1.0 pCi/g. Cesium-137 was also detected from 23 to 66 ft with ranges from the MDL to 1970 pCi/g, which was		

	measured at 34 ft bgs.		
299-W11-62 (101.9 ft) (Spectral, 2003)	299-W11-62 Cesium-137 was detected over the entire length of the borehole at concentrations ranging from 0.2 pCi/g to 8600 pCi/g. The maximum concentration was measured at 30 ft.		
299-W11-63 (160 ft) (Spectral, 2003)	299-W11-63 Cesium-137 was detected at 1 ft at a concentration of 0.8 pCi/g. Cesium-137 was also detected from 33 to 48 ft bgs. The range of concentrations was from 0.3 to 23 pCi/g, which was detected at 40 ft bgs.		
299-W11-64 (77.7 ft) (Spectral, 2003)	299-W11-64 Cesium-137 was detected at 5 to 7 ft in the concentration range of 0.2 pCi/g to 0.5 pCi/g. Cesium-137 was also detected at log depths of 27 ft, 28 ft, and 75 ft bgs near the MDL.		
299-W11-65 (160 ft) (Spectral, 2003)	299-W11-65 Cesium-137 was detected near the ground surface, 1 to 3 ft, with a maximum concentration of 1.4 pCi/g at 1 ft. Cesium-137 was also detected in the interval from 40 to 43 ft bgs in the concentration range 0.3 pCi/g to 3.3 pCi/g with maximum at 41 ft bgs.		
299-W11-66 (75 ft) (Spectral, 2003)	299-W11-66 Cesium-137 was detected at 1.5 ft with a concentration of 0.9 pCi/g. It was also detected at 74.5 ft with a concentration of 2.3 pCi/g. Cesium-137 was also measured slightly above the MDL of 0.2 pCi/g at 40.5 ft bgs.		
299-W11-67 (75.6 ft) (Spectral, 2003)	299-W11-67 Cesium-137 was detected near the ground surface, 1 to 2 ft with a maximum concentration of 1.7 pCi/g.		

Table AD4 6-2. Data-Needs Priority Summary – Model Group 4 – 216-T-6 Cribs (200-TW-2)(RL/FH)(RPP)(Ecology). (5 pages)

References: • *Waste Information Data System* database • DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group OU & 200_TW-2 Tank Waste Group Operable Unit RI/FS Work Plan* • DOE/RL-2002-42, Remedial Investigation Report for the 200-TW-1 and 200-TW-2 Operable Units (Includes the 200-PW-5 Operable Units) • DOE/RL-2003-64, Draft A, *Feasibility Study for the 200-TW-1 Scavenged Waste Group & the 200-TW-2 Tank Waste Group & the 200-PW-5 Fission-Product Rich Waste Group OU* • ARH-ST-156, *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells* • RPP-26744, *Hanford Soil Inventory Model, Rev. 1*
Proposed Activities and Path Forward: • Conduct ERC to evaluate potential for elevated conductivity that may be associated with nitrate. • Install four drive points into crib to evaluate plutonium concentrations.

AD4-7.0 200-W-52 CRIB AND 216-T-7 TILE FIELD SITE-SPECIFIC FIELD-SAMPLING PLAN

The characterization planned for the 216-T-7 Tile Field includes drilling a drive point and shallow borehole, to depth of 40 and 225 ft, respectively; and geophysical logging of the borehole. The drilling and logging efforts are planned to reduce the uncertainty associated with extent and volume of plutonium released to the tile field. The 216-T-7 Tile Field received 2nd cycle supernatant waste, liquid effluent and cell drainage from the 221-T Plant Canyon Building and liquid waste from the 224-T Waste Storage Facility.

Split-spoon samples will be collected at the bottom of the tile field and at changes in lithology as indicated in Figure AD3 6-2; the samples will be analyzed for analytes presented in Volume I, Table A2-3, the 200-TW-2 column. A groundwater well will be installed as part of the Tc-99 DQO process and provide information on mobile contaminant distribution in the deep vadose zone and groundwater. The sample analysis will provide information on depth-discrete contaminant concentrations. 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 analysis.

The location of the planned borehole, at the eastern end of the waste site just outside of the tank farm fence boundary, was determined, utilizing existing geophysical logs, to capture a zone of high plutonium contamination and remain outside of the Tank Farm area. Geophysical logs of wells 299-W10-69 and 299-W10-73 have shown plutonium concentrations above 10,000 pCi/g at 42 ft bgs. Information from this characterization would aid in the determination if this plutonium was released from the 216-T-7 Tile Field or if other waste sites in close proximity may have contributed to this zone of contamination. The location of this borehole may change if information becomes available on the drilling of the groundwater well within the vicinity of this waste site.

The following figures and tables provide the site-specific field-sampling plan for the 200-W-52 Crib and 216-T-7 Tile Field.

Figure AD4 7-1. 200-W-52 Crib and 216-T-7 Tile Field Data-Collection Locations.

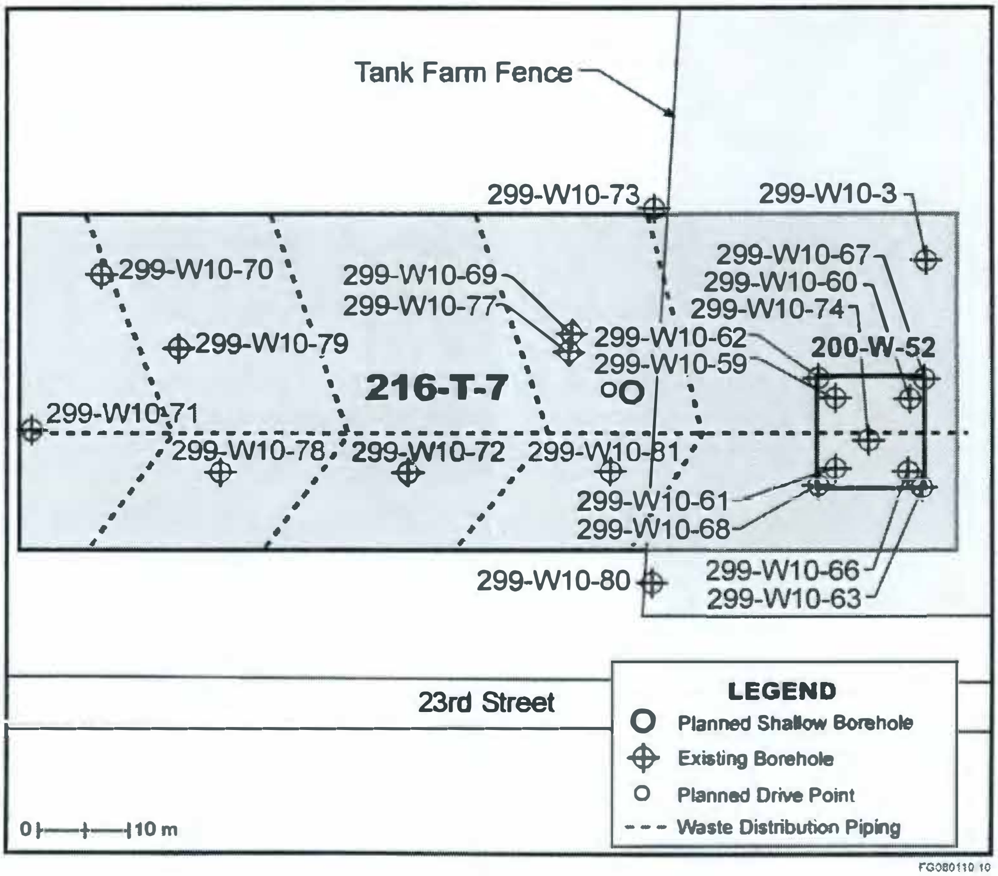


Figure AD4 7-2. 200-W-52 Crib and 216-T-7 Tile Field Stratigraphy and Sample-Collection Intervals.

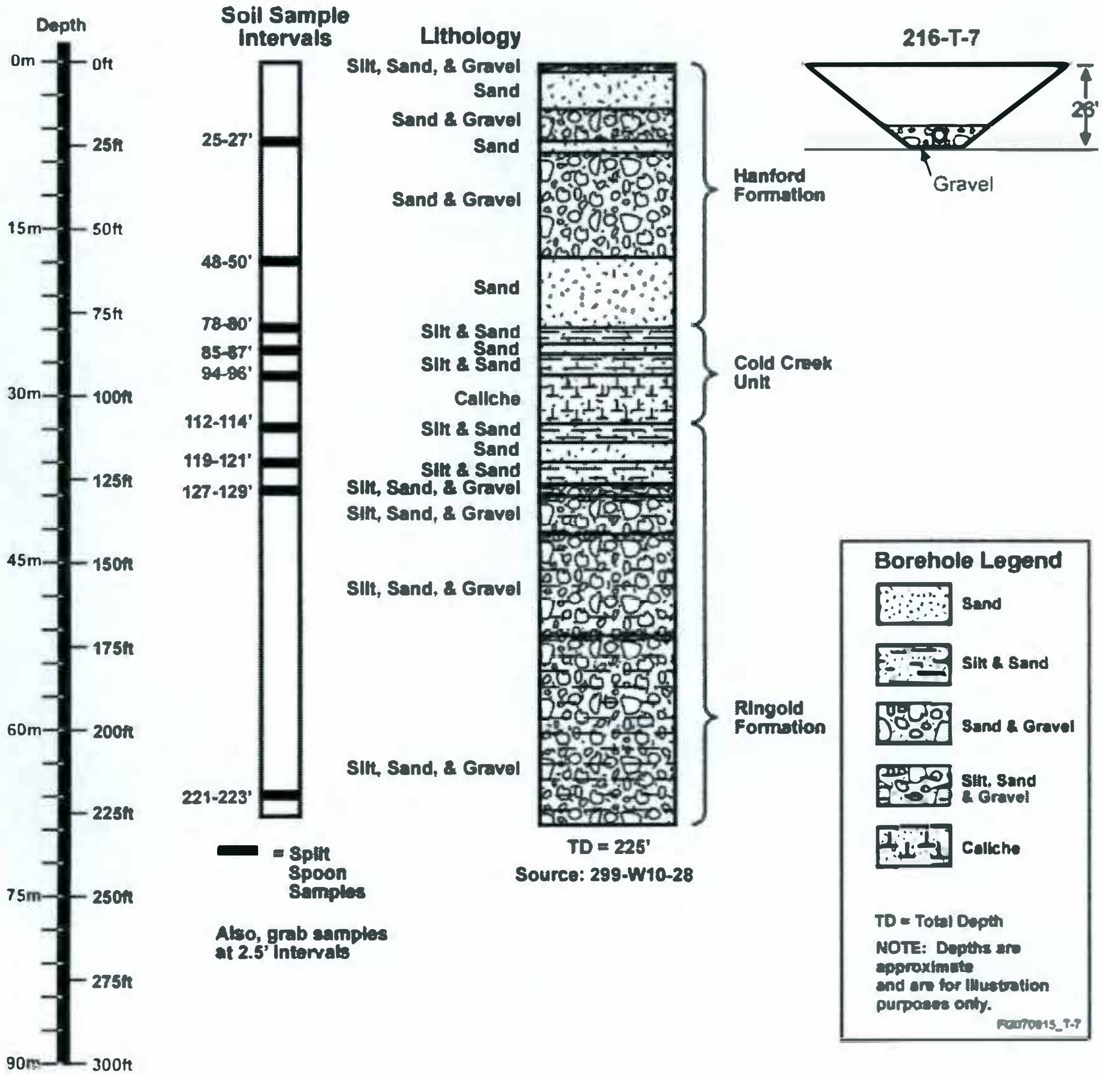


Table AD4 7-1. 216-T-7 Tile Field Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft bgs) [a]	Analyte List [b]	Physical Properties	
					Sample Interval	Parameters
Shallow borehole with sampling and drive point	One shallow borehole near eastern end of tile filed (immediately west of the tank farm fence); drive point adjacent to borehole (for health and safety)	225 ft bgs	Split-spoon sample at depths: 25 – 27 ft bgs 48 – 50 ft bgs 78 – 80 ft bgs 85 – 87 ft bgs 94 – 96 ft bgs 112 – 114 ft bgs 119 – 121 ft bgs 127 – 129 ft bgs 221 – 223 ft bgs Also, grab samples at 2.5 ft intervals throughout borehole	Analytes are presented in Volume I, Table A2-3, the 200-TW-2 column. Grab samples will be analyzed for contaminants within the pore volume.	One sample at each change in lithology or other fine-grained intervals (same as split-spoon sample intervals between 45 and 130 ft bgs). As shown in Figure AD4 7-2.	pH, specific conductance, bulk density, moisture, particle size distribution

Number of split-spoon samples	9
Approximate number of field quality-control samples [c]	3
Approximate number of physical-property samples	7
Approximate number of grab samples	90
Approximate total number of soil samples collected	109
Approximate total number of soil samples analyzed [d]	63

[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, A2-4, A2-5, and A3-2 for detection limits and other analytical parameters.
[c] One duplicate, one split*, and one equipment blank.
[d] Number of samples analyzed includes nine split-spoon samples, three field quality-control samples, seven physical-property samples and 44 grab samples.

* Optional (Volume I, p. A2-17)

Figure AD4 7-3. 200-W-52 Crib and 216-T-7 Tile Field Conceptual Model and Data Summary.

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

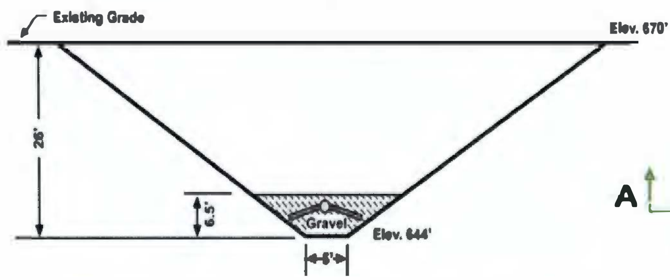
216-T-7 Tile Field

T Farm Zone

History

The 216-T-7 Tile Field is a subsurface liquid waste disposal site that operated from 1948 to 1955 receiving effluent from the 221-T Canyon and the 224-T Building via the 200-W-52 Crib. The tile field is marked and posted with Underground Radioactive Material signs. (WIDS)

CONSTRUCTION:
The tile field is 310 ft long by 84 ft wide by 25 ft deep. It is located adjacent to the 200-W-52 Crib, outside the west fence of the 241-T Tank Farm. (WIDS)



WASTE VOLUME: 110,000,000 L (29,100,000 gal) (WIDS)

DURATION: April 1948 to November 1955 (WIDS)

ESTIMATED DISCHARGED INVENTORY (DOE/RL-2003-64, RHO-CD-673, RPP-26744):

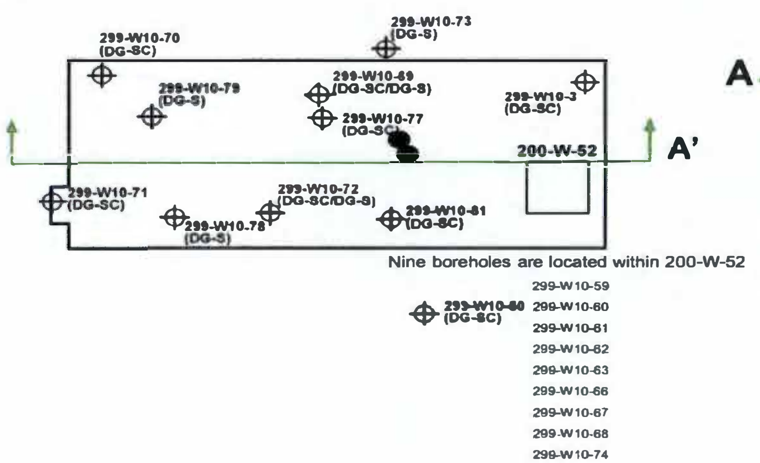
Contaminant	Historical	2008	SIM
Plutonium	130 g	–	–
Nitrate	2,300,000 kg	–	6,550,216 kg
Sr-90	60 Ci	15.7 Ci	366.5 Ci
Tc-99	2.03 Ci	2.03 Ci	0.19 Ci
Cs-137	50 Ci	14.1 Ci	425.9 Ci
Uranium	9.1 kg	–	339.2 kg
Eu-154	–	–	12.42 Ci
Am-241	–	–	6.57 Ci

REFERENCES:
- WIDS general summary reports
- RPP-26744
- RHO-CD-673
- DOE/RL-2000-38
- DOE/RL-2002-42
- DOE/RL-2003-64

Basis of Knowledge (Data Types)

- Process History (PH)
- Downhole Geophysics – Spectral (DG-S)
- Downhole Geophysics – Scintillation (DG-SC)
- Geologic Logs (GL)
- Electrical Resistivity Characterization

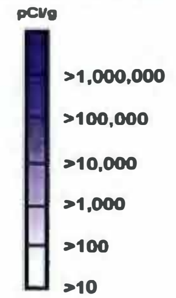
Site Plan View
(not to scale)



Legend

⊕	= Existing Borehole (data type)
▼	= Groundwater Surface
●	= Planned Shallow Borehole & Drive Point (Drive Point for Health & Safety)
bgs	= Below Ground Surface
WIDS	= *Waste Information Data System* database
SIM	= *Soil Inventory Model, Rev.1*

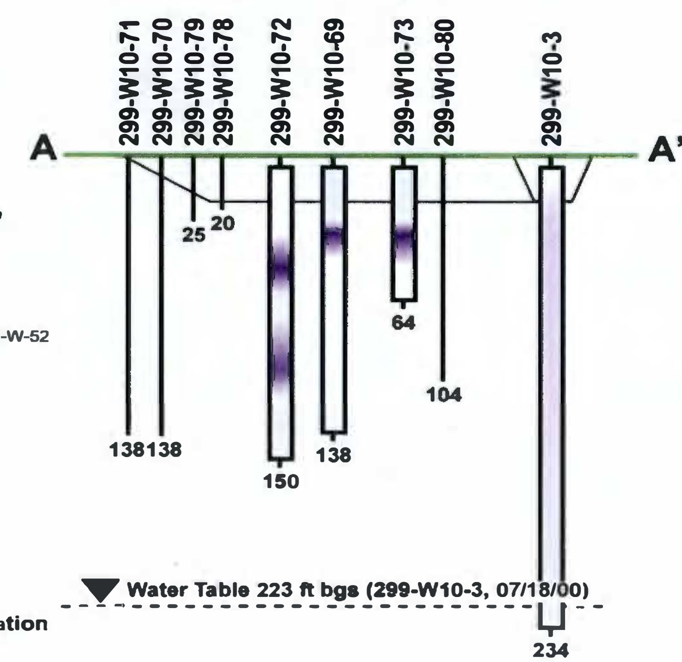
Cesium-137 Concentration



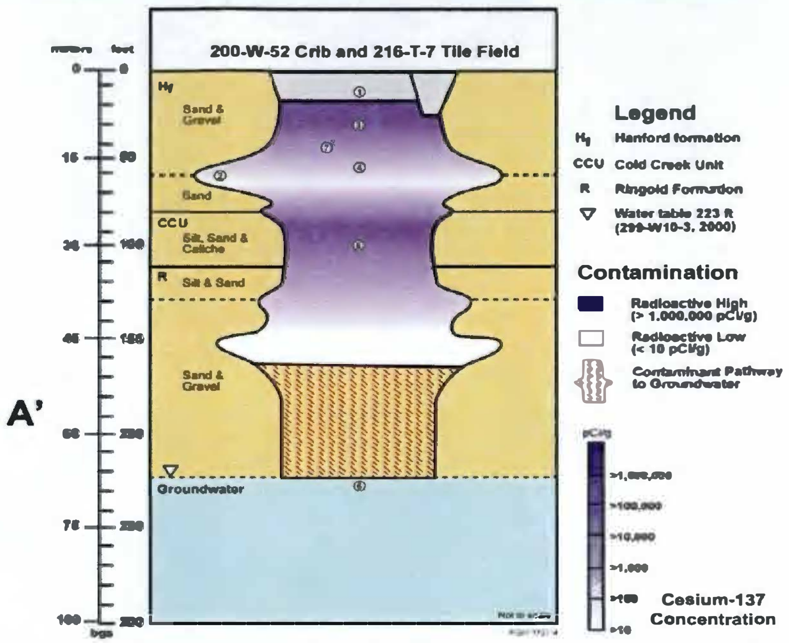
Characterization Summary

The 216-T-7 Tile Field is analogous to the 216-B-7A Crib and was evaluated in DOE/RL-2000-38. The maximum amount of Cs-137 detected was 40,000 pCi/g at 54 ft in borehole 299-W10-72; 29,000 pCi/g of Pu-239 was detected in 299-W10-69 at 42 ft; Am-241 and Eu-154 also were detected in this waste site.

Site Section View
(not to scale)



Conceptual Contaminant Distribution Model



1. High salt, neutral/basic, radioactive liquid waste containing cesium-137, plutonium, americium-241, strontium-90, technetium-99 and europium-154 from the 2nd cycle supernatant of 221-T via the 241-T-112 Tank, effluent from 221-T and 224-T, and cell drainage of Tank 5-6 in 221-T were discharged to this crib and tile field. The crib and tile field received a total volume of 110,000,000 L (29,100,000 gal) of wastewater between April 1948 and November 1955.

2. The wetting front and contaminants move vertically beneath the crib and tile field. Lateral spreading of liquids is associated mainly with the Hanford gravel and sand contact, Cold Creek unit, and at intersections with silt layers or other finely grained lenses. As the effluent traveled downward after discharge, contaminants may have been deposited along the top of these zones.

3. Constituents with large distribution coefficients (e.g., cesium-137, plutonium, americium-241, and europium-154) sorb to soils resulting in higher concentrations near the bottom of the crib and tile field. Concentrations generally decrease with depth.

4. The highest concentration reported for selected contaminants and associated wells are as follows:
   - Cesium-137: 40,000 pCi/g at 54 ft bgs (299-W10-72)
   - Plutonium-239: 62,000 pCi/g at 39.5 ft bgs (299-W10-73)
   - Americium-241: 64,000 pCi/g at 40 ft bgs (299-W10-73)
   - Europium-154: 0.8 pCi/g at 39 ft bgs (299-W10-73)

5. There is believed to be two distinct zones of contamination from 35 to 71 ft and from 83 to 130 ft. This separation of contamination may suggest that there are two sources.

6. Wastewater and mobile contaminants (technetium-99 and nitrate) from the crib impact groundwater.

Table AD4 7-2. Data-Needs Priority Summary – Model Group 4 – 200-W-52 Crib and 216-T-7 Tile Field (200-TW-2)(RL/FH)(RPP)(Ecology). (4 pages)

Background	
Site Identification	200-W-52 Crib and 216-T-7 Tile Field
Site Location	200 West Area, T Farm Zone, west of T-Tank Farm
Type of Site	Crib and Associated Tile Field

Operating History

The 200-W-52 Crib is located inside the 241-T Tank Farm fence. The fence is posted with Radiological Buffer Area/Underground Radioactive Material signs. The tank farm has a gravel surface. The crib is not separately identified. The site consists of one wooden crib box with inlet and outlet piping and a riser pipe. The 200-W-52 Crib is 12 ft by 12 ft and about 25 ft deep (WIDS). The box is set into a gravel layer in the bottom of a pit with sloping sides. It is connected to the 216-T-7 Tile Field that is located west of the crib. The crib received 221-T supernatant waste via tank 241-T-112 overflow and effluent from 224-T from April 1948 to November 1955 when it reached the prescribed radiological disposal guide limit. The effluent from the 221-T Canyon and the 224-T Building were rerouted to 216-T-19 Crib and Tile Field. The crib and tile field are connected by underground piping. The pipeline to the crib has been capped.

The majority 216-T-7 Tile Field is located outside the west fence of the 241-T Tank Farm and is delineated with concrete AC-540 markers and posted with Underground Radioactive Material signs. The 216-T-7 Tile Field is 310 ft long by 84 ft wide and about 25 ft deep (WIDS). The 216-T-7 Tile Field received overflow from the 200-W-52 Crib. The total amount of effluent was 110,000,000 liters, but discrepancies exist in historical documentation.

Historical data has the contamination concentrations as follows: 130 g total plutonium, 60 Ci strontium-90, 50 Ci cesium-137, 9.1 kg total uranium, 2.03 Ci technium-99 and 2,300,000 kg nitrate. Although some of these contaminant values do not fall within the uncertainty of the model, the SIM model is not perfect and may need some refining to more accurately represent historical data. The following table represents the mean values as determined by the SIM model.

Soil Inventory Model - 216-T-7 Crib (RPP-26744)

Na (kg) 3.269E+06	Al (kg) 0.000E+00	Fe (kg) 1.339E+04	Cr (kg) 2.805E+04	Bi (kg) 1.276E+04	La (kg) 5.485E+02	Hg (kg) 0.000E+00	Zr (kg) 0.000E+00	Pb (kg) 0.000E+00
Ni (kg) 7.531E+03	Ag (kg) 2.107E+01	Mn (kg) 1.373E+03	Ca (kg) 1.357E+04	K (kg) 3.471E+05	NO3 (kg) 6.550E+06	NO2 (kg) 2.008E+02	CO3 (kg) 2.047E+04	PO4 (kg) 4.239E+05
SO4 (kg) 2.191E+05	Si (kg) 1.403E+04	F (kg) 3.735E+05	Cl (kg) 8.579E+04	CCl4 (kg) 0.000E+00	Butanol (kg) 0.000E+00	TBP (kg) 0.000E+00	NPH (kg) 0.000E+00	NH3 (kg) 2.956E-04
Fe(CN)6 (kg) 0.000E+00	H-3 (Ci) 9.156E-02	C-14 (Ci) 3.703E-01	Ni-59 (Ci) 9.670E-02	Ni-63 (Ci) 8.489E+00	Co-60 (Ci) 3.115E-01	Se-79 (Ci) 1.675E-02	Sr-90 (Ci) 3.665E+02	Y-90 (Ci) 3.666E+02
Zr-93 (Ci) 9.470E+00	Nb-93m (Ci) 8.342E+00	Tc-99 (Ci) 1.898E-01	Ru-106 (Ci) 1.188E-08	Cd-113m (Ci) 5.254E-01	Sb-125 (Ci) 1.696E-02	Sn-126 (Ci) 6.378E-02	I-129 (Ci) 1.494E-05	Cs-134 (Ci) 4.349E-06
Cs-137 (Ci) 4.259E+02	Ba-137m (Ci) 4.020E+02	Sm-151 (Ci) 3.932E+03	Eu-152 (Ci) 1.668E-01	Eu-154 (Ci) 1.242E+01	Eu-155 (Ci) 7.018E+00	Ra-226 (Ci) 7.097E-05	Ra-228 (Ci) 3.658E-10	Ac-227 (Ci) 7.457E-04
Pa-231 (Ci) 1.646E-02	Th-229 (Ci) 9.014E-07	Th-232 (Ci) 7.655E-09	U-232 (Ci) 1.500E-06	U-233 (Ci) 1.204E-07	U-234 (Ci) 1.109E-01	U-235 (Ci) 4.932E-03	U-236 (Ci) 1.359E-03	U-238 (Ci) 1.131E-01
U-Total (kg) 3.392E+02	Np-237 (Ci) 1.033E-01	Pu-238 (Ci) 1.774E+00	Pu-239 (Ci) 2.363E+02	Pu-240 (Ci) 2.641E+01	Pu-241 (Ci) 5.310E+01	Pu-242 (Ci) 3.764E-04	Am-241 (Ci) 6.572E+00	Am-243 (Ci) 9.856E-04
Cm-242 (Ci) 1.696E-03	Cm-243 (Ci) 2.034E-05	Cm-244 (Ci) 4.780E-04						

Table AD4 7-2. Data-Needs Priority Summary – Model Group 4 – 200-W-52 Crib and 216-T-7 Tile Field (200-TW-2)(RL/FH)(RPP)(Ecology). (4 pages)

Vicinity Waste Sites	216-T-5, 216-T-32, 216-T-36, and T Tank Farm
Current Status	200-W-52 Crib: analogous site; excluded from the feasibility study (DOE/RL-2003-64) because inside the waste management area. 216-T-7 Tile Field: analogous site; likely assigned to the 216-B-7A Crib; evaluated in Work Plan (DOE/RL-2000-38). The feasibility study (DOE/RL-2003-64, Draft A) was submitted to EPA and Ecology March 2004. Capping was identified as preferred alternative in FS.

Potential Remedial 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 for wells 299-W10-3, W10-59, W10-61, W10-63, W10-67, W10-68, W10-69, W10-70, W10-71, W10-72, W10-77, W10-80 and W10-81 dated 1959, 1963, 1970 & 1976	Logs show contamination mainly between the crib bottom (25 ft) and 100 ft bgs.	Plutonium concentrations are uncertain in these sites, but are expected to be high.	Yes – The plutonium concentration is uncertain and should be resolved to support a stronger evaluation of protectiveness, disposal options, and cost. Eight borings in 216-T-7 and 200-W-52 have recently been geophysically logged. A borehole to groundwater would provide site-specific information for the waste sites and would provide additional information on the nature of the conductivity plume. A combined borehole to address waste site and groundwater needs may be an opportunity but would need to be drilled adjacent to the waste sites. If so, a shallow borehole through the waste sites (located based on the results of the geophysical logging of the 8 borings) would provide site-specific information on the plutonium concentrations.
Geophysical logging at 216-T-7: 299-W10-72 (150 ft) (Spectral, 2005); (Moisture, 2005)	299-W10-72: located in the southern middle section of the 216-T-7 Tile Field. Cesium-137 was detected in this borehole at 36 and 37 ft and from 47 to 130 ft bgs. The maximum concentration measured was 40,000 pCi/g at 54 and 86 ft bgs. It appears there may be two distinct zones of contamination from approximately 50 to 71 ft and from 83 to 130 ft bgs. Even though the depth interval from 71 to 83 ft suggests contamination, the detector may be receiving scattered gamma rays originating from the intense zones of gamma activity residing above and below the relative position of the detector. Therefore, it is possible the lower zone of contamination is separate from the higher zone. This separation may suggest that the lower zone represents lateral movement from another source. The neutron moisture logging system (NMLS) shows a maximum of approximately 25 percent volumetric moisture at 51 ft bgs.	None; cesium-137 nature and extent is well understood based on existing logging.	

Table AD4 7-2. Data-Needs Priority Summary – Model Group 4 – 200-W-52 Crib and 216-T-7 Tile Field (200-TW-2)(RL/FH)(RPP)(Ecology). (4 pages)

299-W10-69 (138 ft) (Spectral, 2006) 299-W10-73 (64 ft) (Spectral, 2006) 299-W10-78 (20 ft) (Spectral, 2006) 299-W10-79 (25 ft) (Spectral, 2006)	299-W10-69: located in the middle of the 216-T-7 Tile Field 30 ft west of the Tank Farm fence. Plutonium-239 was detected between 29 and 42 ft with a maximum concentration of approximately 29,000 pCi/g at 42 ft bgs. Americium- 241 was detected from 39 to 44.5 ft with a maximum concentration of approximately 54,000 pCi/g. It is estimated the maximum cesium-137 concentration is approximately 0.25 pCi/g. Europium-154 was detected from 40 to 43 ft with a maximum concentration of 0.3 pCi/g. The passive neutron log indicated a maximum count rate of approximately 0.1 counts per second at 40 ft. Although very small, the presence of any neutron flux is an indication of transuranic waste. 299-W10-73: located north of the 216-T-7 Tile Field between it and the 216-T-32 Crib. Plutonium-239 was detected from 37.5 to 40 ft. with a maximum concentration of approximately 62,000 pCi/g at 39.5 ft bgs. Americium-241 was detected at 37.5, 39 to 40, and 41.5 ft with a maximum concentration of approximately 64,000 pCi/g at 39.5 ft bgs. It is estimated the maximum cesium-137 concentration to be approximately 0.7 pCi/g. Europium-154 was detected from 38 to 40 ft with a maximum concentration of 0.8 pCi/g. The passive neutron log indicated a maximum count rate of approximately 0.13 counts per second at 38 ft bgs. Although very small, the presence of any neutron flux is an indication of transuranic waste. 299-W10-78: located in the southwestern end of the 216-T-7 Tile Field. Cesium-137 was identified at 0.5 and 23 ft bgs. The peak at 0.5 ft correlates to a cesium-137 concentration of 0.17 pCi/g. However, the peak at 23 ft was determined to be statistical fluctuations in the spectra. No other manmade radionuclides are identified in this borehole. 299-W10-79: located in the northwestern end of the 216-T-7 Tile Field. Cesium-137 was detected at 0 and 10 ft bgs at a concentration of 0.15 pCi/g. No other manmade radionuclides are identified in this borehole.		
Electrical Resistivity Characterization (ERC)	The ERC show an elevated conductivity plume beneath these waste sites.	Nature of conductivity plume	

Table AD4 7-2. Data-Needs Priority Summary – Model Group 4 – 200-W-52 Crib and 216-T-7 Tile Field (200-TW-2)(RL/FH)(RPP)(Ecology). (4 pages)

References: • WIDS, *Waste Information Data System* database • DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group OU & 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan* • DOE/RL-2002-42, *Remedial Investigation Report for the 200-TW-1 and 200-TW-2 Operable Units (Includes the 200-PW-5 Operable Unit)* • DOE/RL-2003-64, *Feasibility Study for the 200-TW-1 Scavenged Waste Group and the 200-TW-2 Tank Waste Group & the 200-PW-5 Fission-Product Rich Waste Group OU* • RPP-26744, *Hanford Soil Inventory Model, Rev. 1*
Proposed activities: 1. Shallow borehole to provide site-specific information on the plutonium uncertainty; drive point for health and safety. 2. Deep borehole at 216-T-7/200-W-52 to investigate vadose zone contamination associated with conductivity plume; may integrate with groundwater and their need for well to monitor Tc-99 plume. Integration may result in shallow borehole within waste site with step off borehole for deeper investigation and completion as monitoring well; this borehole would also help validate ERC in this area; waste site-specific data at the bottom of the site is desired to obtain plutonium concentrations.

AD4-8.0 216-T-15 TRENCH SITE-SPECIFIC FIELD-SAMPLING PLAN

The characterization planned for the 216-T-15 Trench includes drilling four drive points, to depths of 50 ft. The first three will be geophysically logged with the location of the fourth drive point being adjacent to the drive point with the highest contamination. The drilling, logging, and sampling efforts are planned to reduce the uncertainty associated with plutonium released to the trench. The 216-T-15 Trench received dissolved cladding and 1st cycle supernatant waste from the 221-T Plant Canyon Building. The planned characterization would provide information on the nature of plutonium contamination within the vicinity of the bottom of the trench.

A sample will be collected from the fourth drive point, at a depth determined by the initial logging efforts, and analyzed for contaminants presented in Volume I, Table A2-3, the 200-TW-2 column. Geologic logs will be generated during drilling activities, providing additional information on the lithology below the trench.

The locations of the three drive points, equally spaced down the north/south centerline of the trench, were chosen to characterize the longitudinal extent of the plutonium contamination at the centerline of this trench. The location of these drive points may change as directed by the integrated project team (IPT) or if additional information becomes available from drilling activities planned as part of the Tc-99 DQO process currently being investigated.

The following figures and tables provide the site-specific field-sampling plan for the 216-T-15 Trench.

Figure AD4 8-1. 216-T-15 Trench Data-Collection Locations.

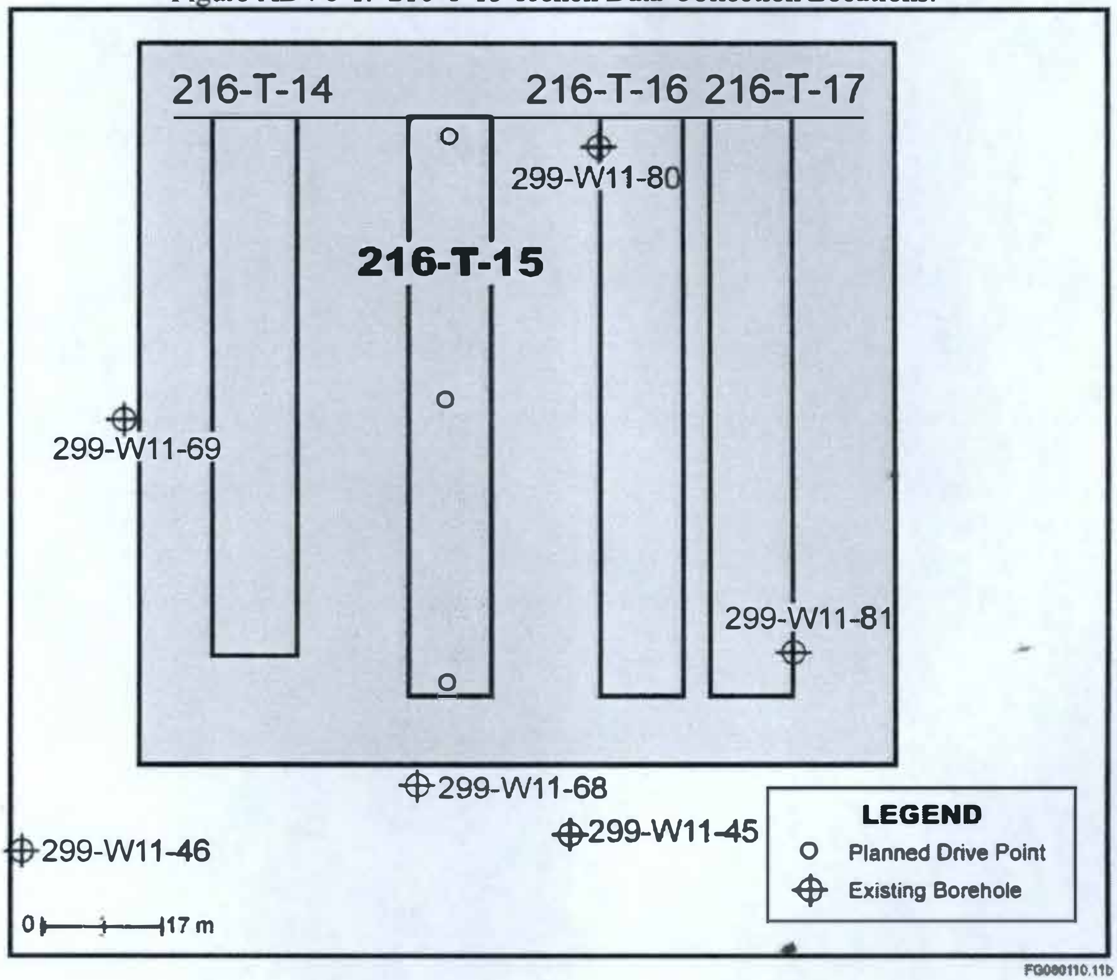


Table AD4 8-1. 216-T-15 Trench Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investi-gation	Sample Interval Depth (ft bgs)	Analyte List	Physical Properties	
					Sample Interval	Paramete rs
Four drive points (one with sampling)	Three drive points, equally spaced down the north/south centerline of the trench as depicted in Figure AD4 8-1. Fourth drive point installed adjacent to drive point of interest.	50 ft bgs	To be determined by geophysical logging activities.	Analytes are presented in Volume I, Table A2-3, the 200-TW-2 column.	N/A	N/A

Non-Sample Data Collection	Maximum Depth of Investigation
Downhole gamma-spectroscopy log, neutron moisture, and passive neutron logs	Surface to TD in new drive points ~50 ft bgs

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Figure AD4 8-2. 216-T-15 Trench Conceptual Model and Data Summary.

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

216-T-15 Trench

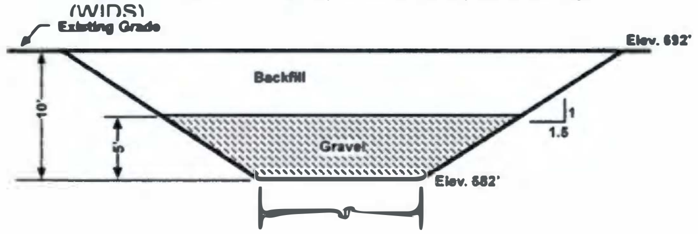
T Farm Zone

History

The 216-T-15 Trench is a subsurface liquid waste disposal site that operated during 1954 receiving 1st cycle supernatant from 221-T Building via the 241-T-104, 241-T-105 and 241-T-106 Tanks. It is marked and posted with Underground Radioactive Material signs. The trench was deactivated when the liquid waste volume was reached; the above-ground piping was removed and the unit backfilled. (WIDS & DOE/RL-2004-10)

CONSTRUCTION:

The trench is 10 ft wide by 10 ft deep by 275 ft long. (WIDS)



WASTE VOLUME: 1,000,000 L (260,000 gal) (WIDS)

DURATION: January 1954 to February 1954 (WIDS)

ESTIMATED DISCHARGED INVENTORY (DOE/RL-2003-64, RHO-CD-673, RPP-26744):

Contaminant	Historical	2006	SIM
Plutonium	0.94 g	–	–
Nitrate	80,000 kg	–	111,628 kg
Sr-90	21 Ci	5.6 Ci	75.0 Ci
Tc-99	1.31 Ci	1.31 Ci	0.21 Ci
Cs-137	1000 Ci	299.2 Ci	476.6 Ci
Uranium	27 kg	–	35.6 kg

REFERENCES:

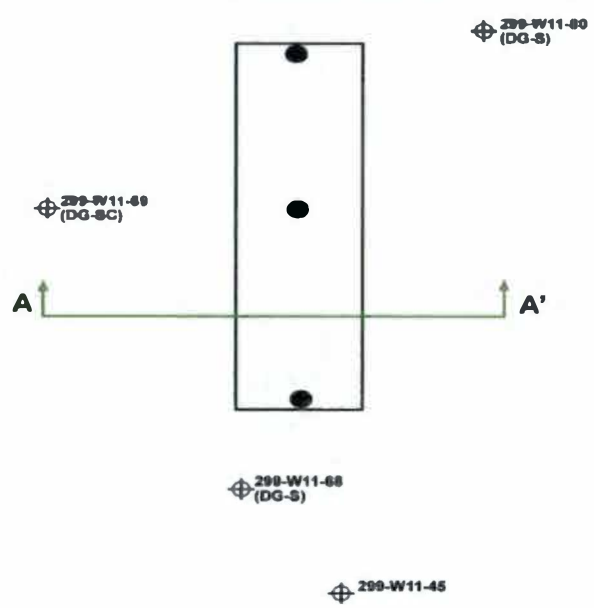
- WIDS general summary reports
- RPP-26744
- RHO-CD-673
- DOE/RL-2003-64
- DOE/RL-2004-10

Basis of Knowledge (Data Types)

- Process History (PH)
- Downhole Geophysics – Spectral (DG-S)
- Downhole Geophysics – Scintillation (DG-SC)
- Geologic Logs (GL)
- Electrical Resistivity Characterization

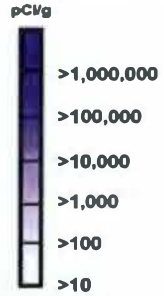
Site Plan View

(not to scale)



Legend

- ⊕ = Existing Borehole (data type)
- ▼ = Groundwater Surface
- ● = Planned Drive Point
- bgs = Below Ground Surface
- WIDS = *Waste Information Data System* database
- SIM = *Soil Inventory Model, Rev.1*

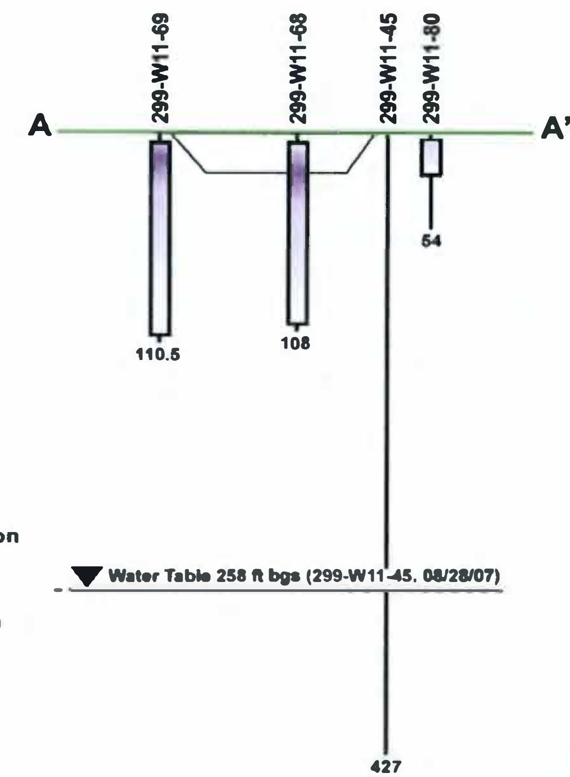


Characterization Summary

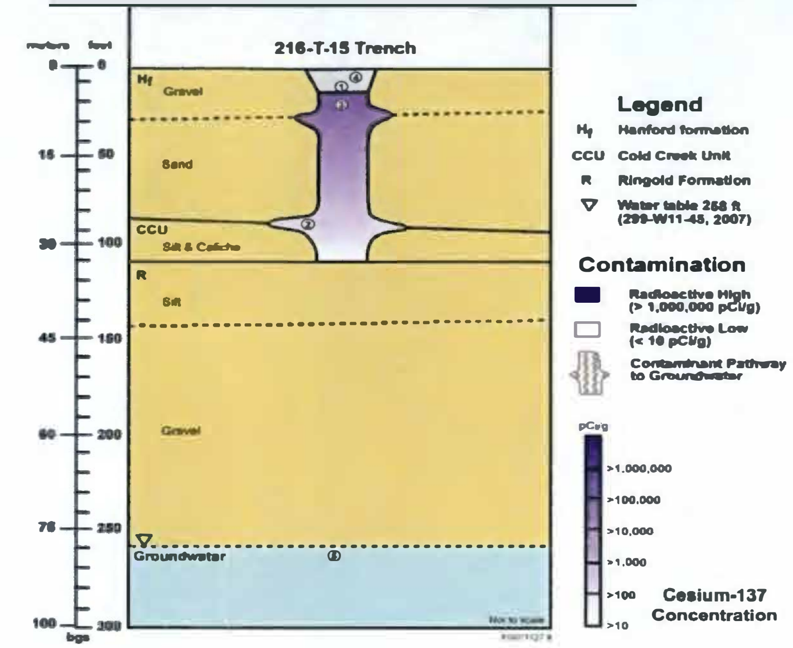
The 216-T-15 Trench is analogous to 216-B-38 Trench and evaluated in DOE/RL-2003-64. The maximum concentration of cesium-137 detected in borehole 299-W11-68 was 230 pCi/g at 4 ft.

Site Section View

(not to scale)



Conceptual Contaminant Distribution Model



1. High salt, neutral/basic, radioactive dissolved cladding and 1st cycle supernatant waste from 221-T via 241-T-104, 105 and 106 cascading tanks containing uranium, strontium-90, and cesium-137 were discharged to this trench. The trench received a total volume of 1,000,000 L (260,000 gal) of wastewater between January and February 1954.
2. The wetting front and contaminants move vertically beneath the trench. Lateral spreading of liquids is associated mainly with the Hanford gravel and sand contact, and at the intersection with the Cold Creek unit. As the effluent traveled downward after discharge, contaminants may have been deposited along the top of these zones.
3. Constituents with large distribution coefficients (e.g., strontium-90 and cesium-137) sorb to soils resulting in higher concentrations near the bottom of the trench. Concentrations generally decrease with depth.
4. The highest cesium-137 concentration was 230 pCi/g at 4 ft bgs in 299-W11-68.
5. The effluent volume discharged to the trench suggests that groundwater may not have been directly impacted by the wetting front unless a preferential pathway is present.

Table AD4 8-2. Data-Needs Priority Summary – Model Group 6 – 216-T-15 Trench (200-TW-2)(RL/FH)(RPP)(Ecology). (5 pages)

Background	
Site Identification	**The 216-T-14, 216-T-15, 216-T-16 and 216-T-17 Trenches**
Site Location	200 West Area, T Farm Zone, Northeast of T-Tank Farm
Type of Site	Trenches
Operating History	The 216-T-14, 216-T-15, 216-T-16, and 216-T-17 trenches were surface stabilized as a unit. These trenches are inactive waste sites located approximately 2,000 ft. west of the 224-T building and 150 ft north of the 207-T retention basin. The area is identified with concrete AC-540 markers and posted with Underground Radioactive Material signs. The surface has been planted with wheat grass. To provide the tank space needed to support the fuel separations operations in 200 East and West Areas, first cycle supernatant waste stored in the single shell tanks was intentionally discharged to specific retention trenches during 1953 and 1954. Specific retention disposal utilized the moisture retention capacity of the relatively dry soils above the regional groundwater table. The volume of liquid disposed to each trench was limited to ten percent of the soil volume between the bottom of the trench and the groundwater table. B Plant and T Plant used the bismuth phosphate process to separate plutonium from irradiated fuel from 1944 through 1956. The first step in the process was to dissolve the metal coating from the fuel rods. The next step dissolved the uranium and extracted the plutonium. The uranium waste was known as the metal waste stream. It contained the bulk of the uranium and 97.5 and 93.6% of the cesium-137 and strontium-90, respectively (PNNL-14120). The plutonium stream went through two additional decontamination cycles to purify it, producing the first and second cycle waste streams. The first cycle waste stream contained approximately 2% of the long lived fission products and <1% of the plutonium (PNNL-14120). The coating waste was combined with the first cycle waste. The liquid waste from these processes was initially stored in the single shell tanks in tank farms. By 1948, limited space in the tank farms resulted in the decision to discharge the second cycle waste to cribs. In 1951, the 242-B and 242-T Evaporators began to concentrate the first cycle waste to reduce the volume of waste stored in the tank farms. By 1953, the need for tank space resulted in the first cycle waste that was being stored in the single shell tanks, to be discharged via overground pipelines to specific retention trenches. The trenches are associated with 221-T, the 241-T Tank Farm and UPR-200-W-166. UPR-200-W-166 was an area of surface contamination about 60 ft west of 216-T-14 Trench and was scraped and consolidated on the hillside west of this trench in 1992. The site was deactivated after it reached the prescribed liquid waste volume for the specific retention trench. Total effluent volume was 1,000,000 liters in 216-T-14, 216-T-15, and 216-T-16 each and 785,000 liters in 216-T-17. The above-ground piping was removed and the unit backfilled. In May 1970, radioactive Russian thistles with contamination levels of a maximum of 15 mrad/h were found growing on trenches 216-T-14, 216-T-15 and 216-T-16. The contaminated weeds were removed and the surface of the four trenches (216-T-14 through 216-T-17) were treated with herbicides in 1970 (Trisden-dimenthylamine salts of Trichlor Obenzoic).
	Historical data has been presented as follows: 216-T-14: 0.88 g plutonium, 990 Ci total beta, 6 Ci strontium-90, 470 Ci cesium-137, and 30 kg uranium 216-T-15: 0.94 g plutonium, 2100 Ci total beta, 21 Ci strontium-90, 1000 Ci cesium-137, and 27 kg uranium 216-T-16: 0.65 g plutonium, 1050 Ci total beta, 8 Ci strontium-90, 522 Ci cesium-137, and 22.2 kg uranium 216-T-17: 0.53 g plutonium, 770 Ci total beta, 3 Ci strontium-90, 370 Ci cesium-137, and 20 kg uranium Although these values may differ from those presented in the SIM tables below, they still fall within the range of the model's uncertainty. The following tables represent the mean values as determined by the SIM model.

Table AD4 8-2. Data-Needs Priority Summary – Model Group 6 – 216-T-15 Trench (200-TW-2)(RL/FH)(RPP)(Ecology). (5 pages)

Soil Inventory Model - 216-T-14 Trench (RPP-26744)

Na (kg) 5.693E+04	Al (kg) 2.744E+01	Fe (kg) 1.495E+02	Cr (kg) 3.604E+02	Bi (kg) 1.355E+02	La (kg) 0.000E+00	Hg (kg) 3.595E-01	Zr (kg) 2.706E+01	Pb (kg) 0.000E+00
Ni (kg) 1.002E+02	Ag (kg) 2.749E-01	Mn (kg) 0.000E+00	Ca (kg) 1.608E+02	K (kg) 3.959E+02	NO3 (kg) 1.078E+05	NO2 (kg) 2.331E+03	CO3 (kg) 2.408E+02	PO4 (kg) 7.088E+03
SO4 (kg) 7.128E+03	Si (kg) 3.173E+02	F (kg) 3.768E+03	Cl (kg) 1.651E+03	CCl4 (kg) 0.000E+00	Butanol (kg) 0.000E+00	TBP (kg) 0.000E+00	NPH (kg) 0.000E+00	NH3 (kg) 1.450E+03
Fe(CN)6 (kg) 0.000E+00	H-3 (Ci) 6.134E+00	C-14 (Ci) 8.134E-02	Ni-59 (Ci) 2.674E-02	Ni-63 (Ci) 3.700E+00	Co-60 (Ci) 3.194E-01	Se-79 (Ci) 2.675E-03	Sr-90 (Ci) 7.234E+01	Y-90 (Ci) 7.239E+01
Zr-93 (Ci) 1.244E+00	Nb-93m (Ci) 1.094E+00	Tc-99 (Ci) 2.034E-01	Ru-106 (Ci) 1.325E-09	Cd-113m (Ci) 1.622E-01	Sb-125 (Ci) 4.667E-03	Sn-126 (Ci) 1.042E-02	I-129 (Ci) 1.775E-03	Cs-134 (Ci) 5.444E-06
Cs-137 (Ci) 4.601E+02	Ba-137m (Ci) 4.345E+02	Sm-151 (Ci) 2.131E+02	Eu-152 (Ci) 1.168E-02	Eu-154 (Ci) 8.164E-01	Eu-155 (Ci) 3.709E-01	Ra-226 (Ci) 8.805E-06	Ra-228 (Ci) 5.718E-11	Ac-227 (Ci) 2.668E-05
Pa-231 (Ci) 5.828E-04	Th-229 (Ci) 3.963E-08	Th-232 (Ci) 3.342E-10	U-232 (Ci) 2.038E-07	U-233 (Ci) 1.540E-08	U-234 (Ci) 1.125E-02	U-235 (Ci) 4.954E-04	U-236 (Ci) 1.667E-04	U-238 (Ci) 1.150E-02
U-Total (kg) 3.443E+01	Np-237 (Ci) 4.678E-03	Pu-238 (Ci) 4.136E-03	Pu-239 (Ci) 4.067E-01	Pu-240 (Ci) 5.753E-02	Pu-241 (Ci) 1.329E-01	Pu-242 (Ci) 1.005E-06	Am-241 (Ci) 5.229E-01	Am-243 (Ci) 6.015E-05
Cm-242 (Ci) 1.034E-04	Cm-243 (Ci) 1.258E-06	Cm-244 (Ci) 2.951E-05						

216-T-15 Trench (RPP-26744)

Na (kg) 5.894E+04	Al (kg) 2.843E+01	Fe (kg) 1.548E+02	Cr (kg) 3.732E+02	Bi (kg) 1.403E+02	La (kg) 0.000E+00	Hg (kg) 3.725E-01	Zr (kg) 2.803E+01	Pb (kg) 0.000E+00
Ni (kg) 1.037E+02	Ag (kg) 2.847E-01	Mn (kg) 0.000E+00	Ca (kg) 1.665E+02	K (kg) 4.101E+02	NO3 (kg) 1.116E+05	NO2 (kg) 2.415E+03	CO3 (kg) 2.494E+02	PO4 (kg) 7.342E+03
SO4 (kg) 7.383E+03	Si (kg) 3.287E+02	F (kg) 3.902E+03	Cl (kg) 1.710E+03	CCl4 (kg) 0.000E+00	Butanol (kg) 0.000E+00	TBP (kg) 0.000E+00	NPH (kg) 0.000E+00	NH3 (kg) 1.502E+03
Fe(CN)6 (kg) 0.000E+00	H-3 (Ci) 6.354E+00	C-14 (Ci) 8.425E-02	Ni-59 (Ci) 2.770E-02	Ni-63 (Ci) 3.834E+00	Co-60 (Ci) 3.309E-01	Se-79 (Ci) 2.770E-03	Sr-90 (Ci) 7.497E+01	Y-90 (Ci) 7.497E+01
Zr-93 (Ci) 1.288E+00	Nb-93m (Ci) 1.133E+00	Tc-99 (Ci) 2.107E-01	Ru-106 (Ci) 1.374E-09	Cd-113m (Ci) 1.680E-01	Sb-125 (Ci) 4.834E-03	Sn-126 (Ci) 1.080E-02	I-129 (Ci) 1.839E-03	Cs-134 (Ci) 5.640E-06
Cs-137 (Ci) 4.766E+02	Ba-137m (Ci) 4.501E+02	Sm-151 (Ci) 2.207E+02	Eu-152 (Ci) 1.210E-02	Eu-154 (Ci) 8.456E-01	Eu-155 (Ci) 3.842E-01	Ra-226 (Ci) 9.121E-06	Ra-228 (Ci) 5.923E-11	Ac-227 (Ci) 2.764E-05
Pa-231 (Ci) 6.038E-04	Th-229 (Ci) 4.104E-08	Th-232 (Ci) 3.463E-10	U-232 (Ci) 2.111E-07	U-233 (Ci) 1.594E-08	U-234 (Ci) 1.165E-02	U-235 (Ci) 5.133E-04	U-236 (Ci) 1.727E-04	U-238 (Ci) 1.189E-02
U-Total (kg) 3.567E+01	Np-237 (Ci) 4.845E-03	Pu-238 (Ci) 4.279E-03	Pu-239 (Ci) 4.212E-01	Pu-240 (Ci) 5.978E-02	Pu-241 (Ci) 1.377E-01	Pu-242 (Ci) 1.045E-06	Am-241 (Ci) 5.416E-01	Am-243 (Ci) 6.227E-05
Cm-242 (Ci) 1.072E-04	Cm-243 (Ci) 1.302E-06	Cm-244 (Ci) 3.060E-05						

Table AD4 8-2. Data-Needs Priority Summary – Model Group 6 – 216-T-15 Trench (200-TW-2)(RL/FH)(RPP)(Ecology). (5 pages)

216-T-16 Trench (RPP-26744)

Na (kg)	Al (kg)	Fe (kg)	Cr (kg)	Bi (kg)	La (kg)	Hg (kg)	Zr (kg)	Pb (kg)
5.771E+04	2.785E+01	1.515E+02	3.653E+02	1.374E+02	0.000E+00	3.646E-01	2.744E+01	0.000E+00
Ni (kg)	Ag (kg)	Mn (kg)	Ca (kg)	K (kg)	NO3 (kg)	NO2 (kg)	CO3 (kg)	PO4 (kg)
1.015E+02	2.787E-01	0.000E+00	1.631E+02	4.015E+02	1.093E+05	2.363E+03	2.441E+02	7.187E+03
SO4 (kg)	Si (kg)	F (kg)	Cl (kg)	CCl4 (kg)	Butanol (kg)	TBP (kg)	NPH (kg)	NH3 (kg)
7.227E+03	3.217E+02	3.820E+03	1.674E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.470E+03
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	6.220E+00	8.246E-02	2.712E-02	3.752E+00	3.238E-01	2.712E-03	7.336E+01	7.338E+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)
1.261E+00	1.109E+00	2.062E-01	1.345E-09	1.645E-01	4.730E-03	1.057E-02	1.800E-03	5.519E-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)
4.666E+02	4.405E+02	2.161E+02	1.184E-02	8.278E-01	3.761E-01	8.933E-06	5.799E-11	2.704E-05
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)
5.910E-04	4.018E-08	3.389E-10	2.067E-07	1.561E-08	1.141E-02	5.023E-04	1.690E-04	1.165E-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)
3.495E+01	4.743E-03	4.187E-03	4.132E-01	5.845E-02	1.346E-01	1.024E-06	5.302E-01	6.097E-05
Cm-242 (Ci)	Cm-243 (Ci)	Cm-244 (Ci)						
1.049E-04	1.275E-06	2.996E-05						

216-T-17 Trench (RPP-26744)

Na (kg)	Al (kg)	Fe (kg)	Cr (kg)	Bi (kg)	La (kg)	Hg (kg)	Zr (kg)	Pb (kg)
4.441E+04	2.141E+01	1.167E+02	2.811E+02	1.057E+02	0.000E+00	2.804E-01	2.112E+01	0.000E+00
Ni (kg)	Ag (kg)	Mn (kg)	Ca (kg)	K (kg)	NO3 (kg)	NO2 (kg)	CO3 (kg)	PO4 (kg)
7.815E+01	2.145E-01	0.000E+00	1.255E+02	3.090E+02	8.409E+04	1.819E+03	1.879E+02	5.531E+03
SO4 (kg)	Si (kg)	F (kg)	Cl (kg)	CCl4 (kg)	Butanol (kg)	TBP (kg)	NPH (kg)	NH3 (kg)
5.562E+03	2.476E+02	2.940E+03	1.288E+03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.131E+03
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	4.785E+00	6.347E-02	2.087E-02	2.888E+00	2.493E-01	2.087E-03	5.646E+01	5.651E+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)
9.705E-01	8.535E-01	1.587E-01	1.034E-09	1.265E-01	3.641E-03	8.133E-03	1.385E-03	4.247E-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)
3.591E+02	3.390E+02	1.663E+02	9.117E-03	6.372E-01	2.893E-01	6.872E-06	4.463E-11	2.080E-05
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)
4.548E-04	3.092E-08	2.609E-10	1.591E-07	1.201E-08	8.772E-03	3.866E-04	1.301E-04	8.966E-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)
2.687E+01	3.651E-03	3.235E-03	3.181E-01	4.495E-02	1.035E-01	7.852E-07	4.080E-01	4.691E-05
Cm-242 (Ci)	Cm-243 (Ci)	Cm-244 (Ci)						
8.079E-05	9.810E-07	2.304E-05						

Table AD4 8-2. Data-Needs Priority Summary – Model Group 6 – 216-T-15 Trench (200-TW-2)(RL/FH)(RPP)(Ecology). (5 pages)

Vicinity Waste Sites	241-T Tank Farm, 207-T Retention Basin						
Current Status	Analogous sites; assigned to the 216-B-38 Trench; evaluated in 200-TW-1/2-200-PW-5 feasibility study (DOE/RL-2003-64). Capping was identified as preferred alternative in the FS.						
Potential Remedial Alternatives							
X for viable alternative	**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?**
Data from 299-W11-45 (427 ft)	Geophysical logging of this well showed sporadic detection of cesium-137, near the MDL throughout the whole run.	Extent and nature of near surface contamination.	Yes – existing logging data provide some information on the extent of the shallow contamination. Drive points in the 216-T-15 Trench would augment the existing information and provide a stronger analysis of the partial removal alternative. Recently drilled groundwater wells will provide information on the deeper contamination; existing ERC surveys will be used in coordination with other data sources to enhance the understanding of contamination at these trenches. Additionally – analogous relationships provide information on the nature of contamination. Data from other specific retention trenches, such as 216-B-38 and BC Trenches, are representative of these types of waste sites and provide pertinent information for decision making.
Geophysical Logging	4 existing wells are associated with these sites, 2 of which are within trenches and 1 near the inlet end.		
299-W11-81 (52 ft) (Spectral, 2005)	299-W11-81: located at the south end near inlet to 216T-17 Trench on east side. Cesium-137 was detected from surface to bottom of borehole with a maximum concentration of 13,000pCi/g at 20 ft. At the 40 ft level concentration levels dropped to 4pCi/g and increased at 52 ft (bottom of borehole) to 20 pCi/g. Cobalt-60 was also detected at very low levels between 22 and 33 ft with a maximum concentration of 0.2 pCi/g at 28 ft bgs.		
299-W11-68 (108 ft) (Spectral, 2005) Scintillation logs dated 1963 and 1976	299-W11-68: located south of 216-T-15 Trench. Cesium -137 was detected from surface to 8 ft with the maximum concentration of 230 pCi/g at 4 ft bgs. Below 8 ft, cesium-137 was detected sporadically at levels near the MDL.		
299-W11-69 (110.5 ft) (Spectral, 2005) Scintillation logs dated 1963 and 1976	299-W11-69: located west of 216-T-14 Trench. Cesium-137 was detected from ground surface to 11 ft bgs with the maximum concentration of 16 pCi/g at 5.5 ft bgs. Below 11 ft, cesium-137 was detected sporadically at levels near the MDL.		

299-W11-80 (54 ft) (Spectral, 2005)	299-W11-80: located at north end of 216-T-16 Trench on the west edge. Cesium-137 was detected from the surface to 12 ft bgs with a maximum concentration of 1 pCi/g at 10 ft bgs; was not detected below 12 ft.		
Electrical Resistivity Characterization (ERC)	Area of high conductivity identified beneath trenches. Research suggests that contamination associated with these trenches did not reach groundwater.		

References:

- *Waste Information Data System* database
- RHO-CD-673, *Handbook for the 200 Area Waste Sites*
- DOE/RL-2004-10, *Proposed Plan for the 200-TW-1 Scavenged Waste Group & the 200-TW-2 Tank Waste Group & the 200-PW-5 Fission-Product Rich Waste Group OU*
- DOE/RL-2003-64 *FS for the 200-TW-1 Scavenged Waste Group and the 200-TW-2 Tank Waste Group & the 200-PW-5 Fission-Product Rich Waste Group OU*
- PNNL-14120, *Laboratory-Scale Bismuth Phosphate Extraction Process Simulation to Track Fate of Fission Products*
- ARH-ST-156, *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells*
- RPP-26744, *Hanford Soil Inventory Model, Rev. 1*

Proposed Activities and Path Forward:

- Drill four drive points in the 216-T-15 Trench to augment the existing information and provide a stronger analysis of the partial removal alternative.

AD4-9.0 216-T-32 CRIBS SITE-SPECIFIC FIELD-SAMPLING PLAN

The characterization planned for the 216-T-32 Cribs include drilling one drive point to a depth of 40 ft, and geophysical logging of the same drive point and three existing boreholes (299-W10-56, 299-W10-57, and 299-W10-58). The drilling and logging efforts are planned to reduce the uncertainty associated with plutonium released to the cribs. Although Vol. I agrees to the drilling of four drive points, three existing in-use wells are located in proximity of the northeastern crib and could be used for desired characterization. The 216-T-32 Cribs received high-salt liquid waste from the 224-T Waste Storage Facility. The planned characterization would provide information on the nature of plutonium contamination within the vicinity of the cribs.

Because no samples will be collected from this drive point and the stratigraphy figure serves to justify sample depths, this figure is not warranted. Geologic logs will be generated during drilling activities, providing additional information on the lithology below the trench.

The location of the drive point, in the center of the southwestern crib, was chosen to characterize the secondary crib in this two crib structure. The logging of the northeastern crib would provide information on the primary crib contamination and minimize the amount of waste generated within the Tank Farm area. This would also minimize the desired access time to this controlled area. The location of this drive point may change as directed by the integrated project team (IPT) or if additional information becomes available from drilling activities planned as part of the Tc-99 DQO process currently being investigated.

The following figures and tables provide the site-specific field-sampling plan for the 216-T-32 Cribs.

Figure AD4 9-1. 216-T-32 Cribs Data-Collection Locations.

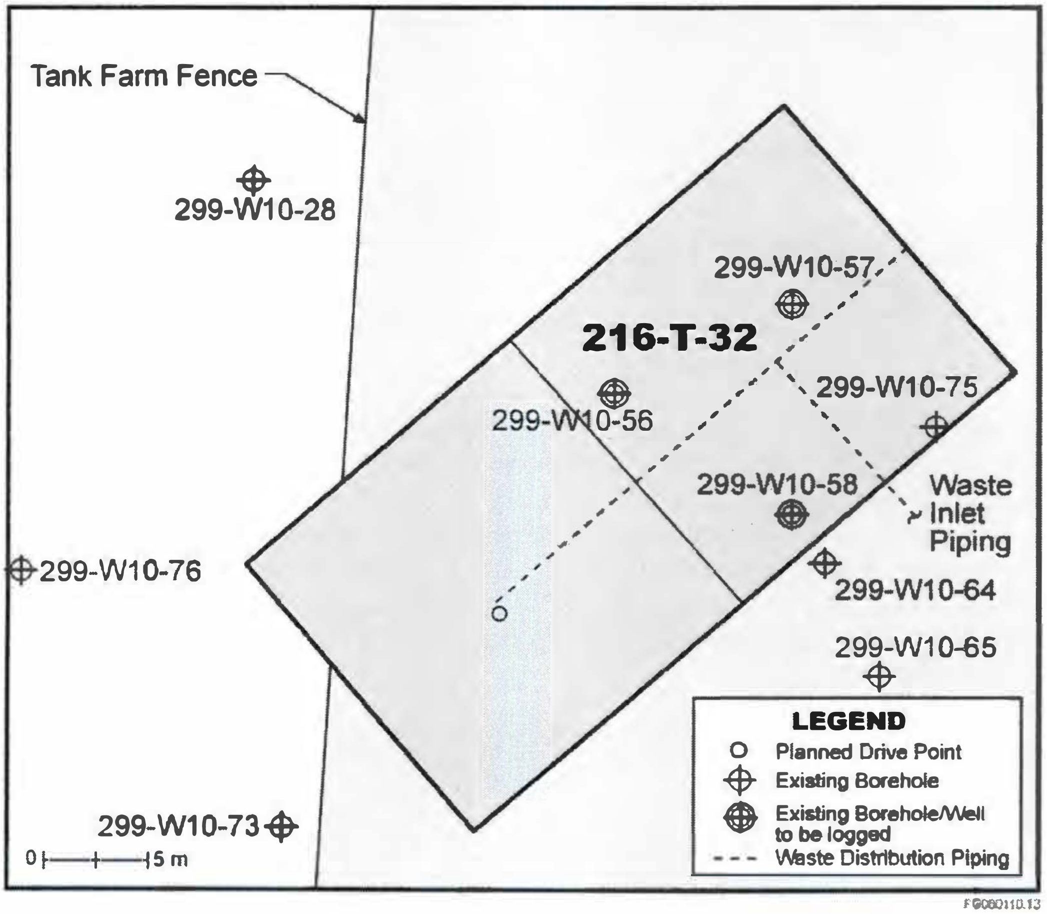


Table AD4 9-1. 216-T-32 Cribs Sampling Plan.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft bgs)	Analyte List	Physical Properties	
					Sample Interval	Parameters
One drive point	One drive point in the center of the southern crib and logging at three existing wells in northern crib as depicted in Figure AD4 8-1.	40 ft bgs	N/A	N/A	N/A	N/A

Non-Sample Data Collection	Maximum Depth of Investigation
Downhole gamma-spectroscopy log, neutron moisture, and passive neutron logs	Surface to TD (~40 ft bgs) in new drive point

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Figure AD4 9-2. 216-T-32 Cribs Conceptual Model and Data Summary.

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

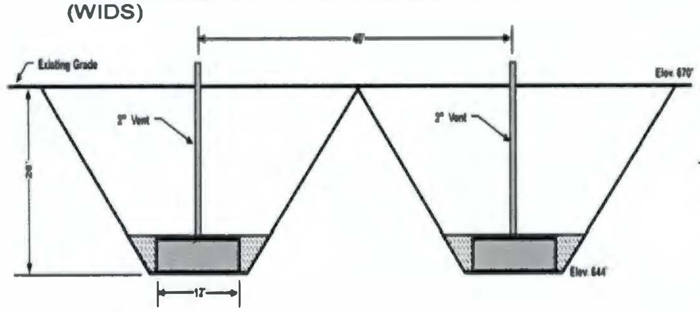
216-T-32 Cribs

T Farm Zone

History

The 216-T-32 Cribs are subsurface liquid waste disposal sites that operated from 1946 to 1952 receiving effluent waste from the 224-T Building via the 241-T-201 Tank. It is marked and posted with Underground Radioactive Material signs. In 1952, the cribs were deactivated due to sludge buildup in 241-T-201 Tank; the pipeline was blanked east of the 241-T-151 and 241-T-152 Diversion Boxes. (WIDS)

CONSTRUCTION:
The crib consists of two, 12 ft by 12 ft by 4 ft deep, wooden crib boxes connected in series by a pipe. The first crib overflows into the other. The crib is 68 ft long by 14 ft wide by 26 ft deep with sloping sides and backfilled to grade; they are separated by 40 ft. (WIDS)



WASTE VOLUME: 29,000,000 L (7,660,000 gal) (WIDS)

DURATION: November 1946 to May 1952 (WIDS)

ESTIMATED DISCHARGED INVENTORY (DOE/RL-2003-64, RHO-CD-673, RPP-26744):

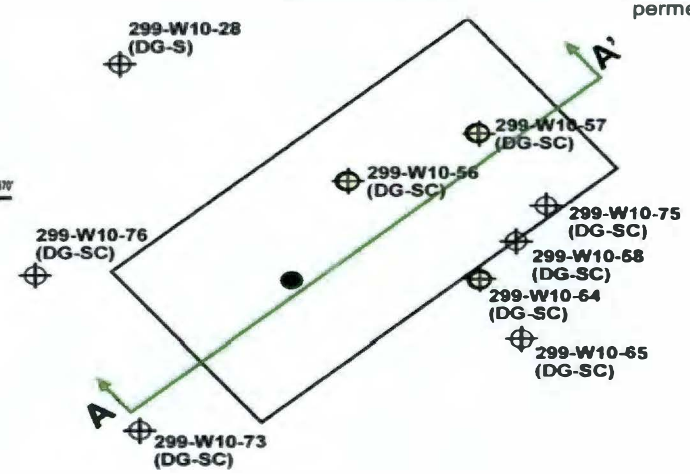
Contaminant	Historical	2008	SIM
Plutonium	3200 g	--	--
Nitrate	1,200,000 kg	--	2,496,768 kg
Sr-90	30 Ci	7.2 Ci	2.52 Ci
Tc-99	0.376 Ci	0.376 Ci	0.001 Ci
Cs-137	25 Ci	6.5 Ci	2.93 Ci
Uranium	23 kg	--	0.59 kg

REFERENCES:
- ARH-ST-156
- WIDS general summary reports
- RPP-26744
- RHO-CD-673
- DOE/RL-2000-38
- DOE/RL-2002-42
- DOE/RL-2003-64

Basis of Knowledge (Data Types)

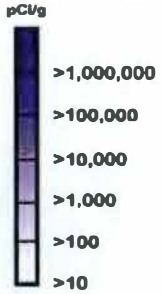
- Process History (PH)
- Downhole Geophysics – Spectral (DG-S)
- Downhole Geophysics – Scintillation (DG-SC)
- Geologic Logs (GL)
- Electrical Resistivity Characterization

Site Plan View
(not to scale)



Legend

- ⊕ = Existing Borehole (data type)
- ▼ = Groundwater Surface
- ● = Planned Drive Point
- ⊕ = Use Existing Well for Characterization
- bgs = Below Ground Surface
- WIDS = *Waste Information Data System database*
- SIM = *Soil Inventory Model, Rev. 1*

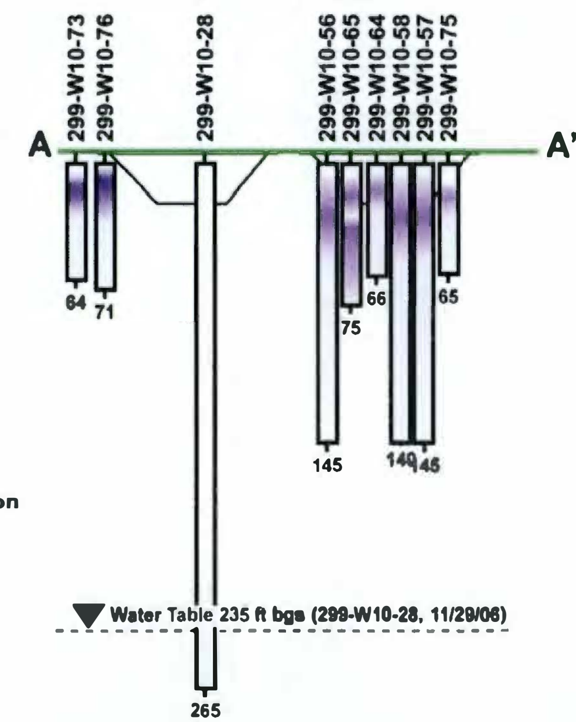


Characterization Summary

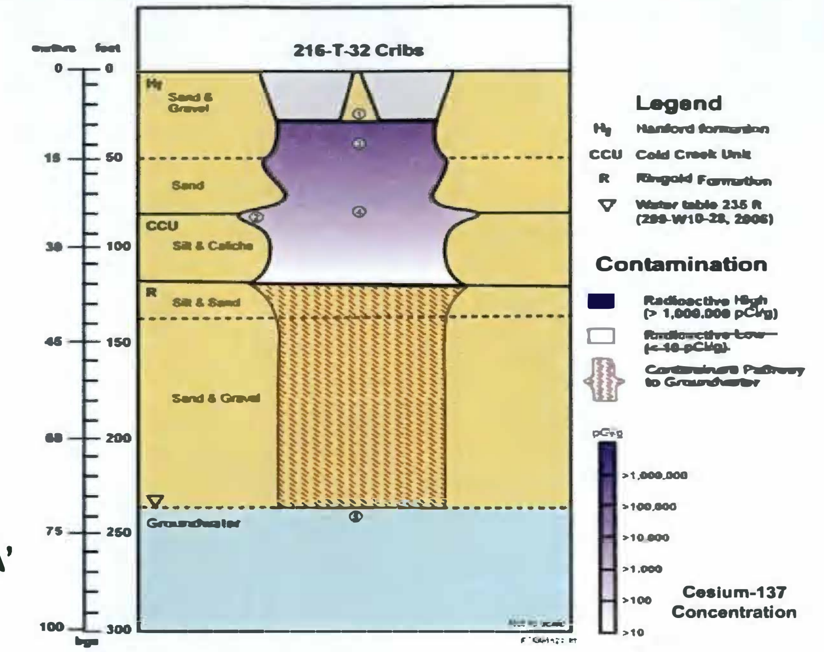
The 216-T-32 Cribs are analogous to 216-B-7A Crib and were evaluated in DOE/RL-2003-64. Low levels of radiation were detected between 26 and 115 ft (ARH-ST-156). Spectral log 299-W10-28 detected no man-made radionuclides. An increase of potassium-40 activity from about 10 to 13 pCi/g at 56 ft, resulted in increased gross gamma counts.

The neutron moisture log from well 299-W10-28 shows a potentially elevated moisture from 110 to 130 ft; casing change occurred at 110 ft. This may indicate a lower permeability zone.

Site Section View
(not to scale)



Conceptual Contaminant Distribution Model



1. High salt, neutral/basic, radioactive liquid waste containing plutonium, uranium, strontium-90, and cesium-137 from the 224-T via 241-T-201 Tank was discharged to these cribs between November 1946 and May 1952. The cribs received a total volume of 29,000,000 L (7,660,000 gal) of wastewater.
2. The wetting front and contaminants move vertically beneath the cribs. Lateral spreading of liquids is associated mainly with the Hanford gravel and sand contact, and at the intersection with the Cold Creek unit. As the effluent traveled downward after discharge, contaminants may have been deposited along the top of these zones.
3. Constituents with large distribution coefficients (e.g., plutonium, strontium-90, and cesium-137) sorb to soils resulting in higher concentrations near the bottom of the crib. Concentrations generally decrease with depth.
4. Low levels of radiation were detected between 26 and 115 ft bgs in scintillation logs dated to 1963 and 1976.
5. The effluent volume discharged to the trench and the amount of mobile contaminant nitrate suggest that groundwater may have been impacted.

Table AD4 9-2. Data-Needs Priority Summary – Model Group 4 – 216-T-32 Cribs (200-TW-2)(RL/FH)(RPP)(Ecology). (3 pages)

Background	
Site Identification	216-T-32 Crib
Site Location	200 West Area, T Farm Zone, west T-Tank Farm
Type of Site	Crib
Operating History	The crib is located inside the T Tank Farm fence. The waste site is 68 ft by 14 ft and about 26 ft deep (WIDS). The fence is posted with Radiological Buffer Area/Underground Radioactive Material signs. The tank farm has a gravel surface. The crib is not separately identified. The 216-T-32 Crib consists of two wooden crib boxes (12 ft by 12 ft by 4ft), each set into a square bottom, 26 ft deep, pit with sloping sides. The pits contain backfill. The crib boxes are 40 ft apart and are connected in series by a pipe, with one crib overflowing into the other. The cribs received liquid waste from the 224-T Building via the 241-T-201 Tank. Each box was constructed with a riser vent. The crib is associated with the 241-T-201 Tank, the 241-T-151 and 241-T-252 Diversion Boxes, and the 224-T Facility. The site operated from November 1946 to May 1952. It was deactivated due to the buildup of sludge in the 241-T-201 through 241-T-204 Tanks. The pipeline to the crib was blanked east of the 241-T-151 and the 241-T-152 Diversion Boxes. The effluent was rerouted to the 216-T-7 Crib. The total effluent volume discharged was 29,000,000 liters. Historical data suggests the contamination to be as follows: 3200 g total plutonium, 1500 total beta, 30 Ci strontium-90, 25 Ci cesium-137 and 23 kg uranium. Although some of these contaminant values do not fall within the uncertainty ranges of the SIM model results (presented in the table below), the model may need some refining to more accurately reflect the historical data. The following table represents the mean values as determined by the SIM model. Soil Inventory Model - 216-T-32 Crib (RPP-26744)

Na (kg) 1.079E+06	Al (kg) 0.000E+00	Fe (kg) 3.735E+03	Cr (kg) 1.030E+04	Bi (kg) 3.772E+03	La (kg) 4.703E+02	Hg (kg) 0.000E+00	Zr (kg) 0.000E+00	Pb (kg) 0.000E+00
Ni (kg) 2.681E+03	Ag (kg) 7.697E+00	Mn (kg) 1.097E+03	Ca (kg) 4.790E+03	K (kg) 2.636E+05	NO3 (kg) 2.497E+06	NO2 (kg) 1.411E+00	CO3 (kg) 7.290E+03	PO4 (kg) 8.901E+04
SO4 (kg) 8.100E+03	Si (kg) 0.000E+00	F (kg) 1.495E+05	Cl (kg) 2.968E+04	CCl4 (kg) 0.000E+00	Butanol (kg) 0.000E+00	TBP (kg) 0.000E+00	NPH (kg) 0.000E+00	NH3 (kg) 2.435E-08
Fe(CN)6 (kg) 0.000E+00	H-3 (Ci) 2.183E-04	C-14 (Ci) 1.462E-02	Ni-59 (Ci) 3.817E-03	Ni-63 (Ci) 3.327E-01	Co-60 (Ci) 1.088E-02	Se-79 (Ci) 6.590E-04	Sr-90 (Ci) 2.524E+00	Y-90 (Ci) 2.525E+00
Zr-93 (Ci) 0.000E+00	Nb-93m (Ci) 0.000E+00	Tc-99 (Ci) 1.334E-03	Ru-106 (Ci) 7.836E-10	Cd-113m (Ci) 1.932E-02	Sb-125 (Ci) 5.460E-04	Sn-126 (Ci) 2.475E-03	I-129 (Ci) 2.279E-07	Cs-134 (Ci) 2.376E-08
Cs-137 (Ci) 2.925E+00	Ba-137m (Ci) 2.763E+00	Sm-151 (Ci) 4.534E+02	Eu-152 (Ci) 1.535E-02	Eu-154 (Ci) 1.180E+00	Eu-155 (Ci) 7.043E-01	Ra-226 (Ci) 3.327E-06	Ra-228 (Ci) 1.487E-11	Ac-227 (Ci) 1.430E-04
Pa-231 (Ci) 3.099E-03	Th-229 (Ci) 1.474E-07	Th-232 (Ci) 1.246E-09	U-232 (Ci) 2.308E-09	U-233 (Ci) 1.898E-10	U-234 (Ci) 1.933E-04	U-235 (Ci) 8.640E-06	U-236 (Ci) 2.131E-06	U-238 (Ci) 1.970E-04
U-Total (kg) 5.903E-01	Np-237 (Ci) 1.617E-02	Pu-238 (Ci) 3.540E-02	Pu-239 (Ci) 5.416E+00	Pu-240 (Ci) 5.482E-01	Pu-241 (Ci) 1.013E+00	Pu-242 (Ci) 6.962E-06	Am-241 (Ci) 8.351E-01	Am-243 (Ci) 1.143E-04
Cm-242 (Ci) 1.970E-04	Cm-243 (Ci) 2.317E-06	Cm-244 (Ci) 5.445E-05						

Vicinity Waste Sites	216-T-7, 200-W-52, T Tank Farm, 241-T-201 Tank, 241-T-152 and 24-T-252 Diversion Boxes
Current Status	Analogous site; likely assigned to the 216-B-7A Crib; evaluated in 200-TW-1/2/200-PW-5 feasibility study (DOE/RL-2003-64, Draft A) submitted to EPA and Ecology March 2004. Capping was identified as preferred alternative in the FS.

Table AD4 9-2. Data-Needs Priority Summary – Model Group 4 – 216-T-32 Cribs (200-TW-2)(RL/FH)(RPP)(Ecology). (3 pages)

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	X	

Data Evaluation and Gaps Analysis

Data	Knowns	Data Uncertainties	Are supplemental data required to support decision making?
Scintillation Logs dated 1963 & 1976 for: 299-W10-56 (145 ft) 299-W10-57 (145 ft) 299-W10-58 (140 ft) 299-W10-64 (66 ft) 299-W10-65 (75 ft) 299-W10-73 (64 ft) 299-W10-75 (65 ft) 299-W10-76 (71 ft)	See map (Figure AD4 9-1) for generalized well locations. Low levels of radiation were detected between 8 and 35 m (26 and 115 ft). (ARH-ST-156)	No data uncertainties are identified in shallow zone (0 to 15 ft) because the site was constructed at 26 ft bgs. Uncertainties may be associated with plutonium concentrations because early inventories suggest a large plutonium (3200 g) inventory; however, the latest SIM inventory indicates only about 87 g, which would not likely result in concentrations above 100 nCi/g based on data from other boreholes (such as 216-B-7A, which received 4,300 g plutonium and had plutonium-239/240 concentrations of 153 nCi/g).	No supplemental data are required for the shallow zone from 0 to 15 ft as the site was constructed at 26 ft. Yes, the uncertainty associated with the plutonium inventory and resulting soil concentrations could impact the remedial alternative and should be resolved through supplemental data collection. The presence of high plutonium levels may influence the evaluation of remedial alternatives, especially in terms of protectiveness, disposal options, and cost. Identifying the plutonium concentrations may also permit assessment and use of a lesser alternative if concentrations are lower than the associated representative site. The uncertainty associated with the elevated conductivity plume in this area will be addressed through a borehole at 216-T-7; data collected at 216-T-7 will include an assessment of pore water contamination from analysis of grab samples to support the protection of groundwater evaluation. Based on the results of that borehole, a follow on DQO process may be conducted if uncertainties remain.
Geophysical logging: 299-W10-28 (265.1 ft) (Spectral, 2001)	No man-made radionuclides identified in borehole. The increase in gross gamma counts from about 45 cps to about 60 cps at a log depth of 56 ft corresponds with an increase in apparent potassium-40 activity from about 10 to 13 pCi/g.		
Neutron moisture log from 299-W10-28	Potentially elevated moisture from 110 to 130 ft; casing change occurred at 110 ft, natural occurring potassium, uranium, and thorium log (KUT) changes evident at the same depth; may indicate lower permeability zone.	Nature of contamination with depth is uncertain. Elevated moisture may be indicative of contamination at this depth.	

Electrical Resistivity Characterization (ERC)	Shows conductivity plume potentially near the crib area. Plume appears to be mainly associated with 216-T-7 and 200-W-52, but is near 216-T-32. Initial data on other plumes in the area indicate the conductivity plumes may be associated with elevated nitrate and technetium-99.	Nature of the conductivity plume near 216-T-32 is uncertain.	

References:

- *Waste Information Data System* database
- ARH-ST-156, *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells*
- DOE/RL-2000-38, *200-TW-1 Scavenged Waste Group OU & 200-TW-2 Tank Waste Group Operable Unit RI/FS Work Plan*
- DOE/RL-2002-42, *Remedial Investigation Report for the 200-TW-1 and 200-TW-2 Operable Units (Includes the 200-PW-5 Operable Unit)*
- DOE/RL-2003-64, *Feasibility Study for the 200-TW-1 Scavenged Waste Group and the 200-TW-2 Tank Waste Group & the 200-PW-5 Fission-Product Rich Waste Group OU*
- RPP-26744, *Hanford Soil Inventory Model, Rev. 1*

Proposed activities:

- Drill one drive point to test plutonium inventory through logging.
- Geophysically log three existing boreholes for plutonium concentrations.
- Coordinate deep investigation with 216-T-7 and 200-W-52 to obtain information on the conductivity plume near the 216-T-32 Crib and potential impacts to groundwater.

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RHO-CD-673, 1979, *Handbook for 200 Area Waste Sites*, 3 vols., Rockwell Hanford Operations, Richland, Washington.

RPP-26744, 2005, *Hanford Soil Inventory Model, Rev.1*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

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Shleien, Bernard, 1992, The Health Physics and Radiological Health Handbook, Scinta, Inc., Silver Spring, Maryland.

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