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ATTACHMENT 1

Remaining Sites Verification Package for the 216-N-5 Waste Site, 212-P Building Cooling Water Trench Located Within the 200-CW-3 Operable Unit, DOE/RL-2007-36

consisting of 45 pages, including this coversheet

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Revision 0

Remaining Sites Verification Package for the 216-N-5 Waste Site, 212-P Building Cooling Water Trench Located Within the 200-CW-3 Operable Unit

Documentation for Waste Site Reclassification Form 2007-013

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

Approved for Public Release.
Further Dissemination Unlimited

DOE/RL-2007-36
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Date Published
July 2007

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Release Approval Date

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Date Submitted:	**WASTE SITE RECLASSIFICATION FORM**	Control Number: 2007-013
Originator: D.L. Klages	Operable Unit(s): 200-CW-3	
Phone: 373-6312	Waste Site Code: 216-N-5	
	Type of Reclassification Action:	
	Closed Out ☐ Interim Closed Out ☒ No Action ☐	
	RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	

This form documents agreement among parties listed authorizing classification of the subject unit as Closed Out, Interim Closed Out, No Action, RCRA Postclosure, Rejected, or Consolidated. This form also authorizes backfill of the waste management unit, if appropriate, for Closed Out and Interim Closed Out units. Final removal from the NPL of No Action and Closed Out waste management units will occur at a future date.

Description of Current Waste Site Condition

The 216-N-5 Waste Site was a trench that received basin water and sludge cleanout from the 212-P Building Basin during shutdown of the area. The results of focused sampling through the use of test pits for the 216-N-5 Waste Site identified levels of contaminants of concern above the Remedial Action Goals (RAGs). Consequently, the trench was excavated to a depth of 4.6 meters (15 feet) to remove contaminated soil and debris for remediation of the waste site. After excavation and disposal of the contaminated soil and debris were completed, waste site sampling was conducted on March 16, 2007, and analyses were performed in accordance with the *Sampling and Analysis Plan for Remediation of Select 200 North Area Waste Sites (216-N-2, -3, -5, and -7) in the 200-CW-3 Operable Unit*, DOE/RL-2006-65, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

The sample results indicate that the 216-N-5 Waste Site achieved compliance with the remedial action objectives and goals established in the *Remedial Design/Remedial Action Work Plan for Select 200 North Area Waste Sites (216-N-2, -3, -5, & -7) in the 200-CW-3 Operable Unit* (DOE/RL-2006-69), U.S. Department of Energy, Richland Operations Office, Richland, Washington, and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD), 1999, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. The results of the waste site sampling after remediation are used to make reclassification decisions for the 216-N-5 Waste Site. A baseline, quantitative ecological risk assessment of Hanford began in 2004. That baseline risk assessment will be used to support a future final closeout decision for the 216-N-5 Waste Site.

Basis for Reclassification

The current site conditions achieve the remedial action objectives and the corresponding remedial action goals specified in the Remaining Sites ROD. These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil [i.e., surface to 4.6 meters (15 feet)] and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. There is no deep zone for the 216-N-5 Waste Site therefore no institutional controls are required. The basis for reclassification to interim closed out is described in detail in the *Remaining Sites Verification Package for the 216-N-5 Waste Site, 212-P Building Cooling Water Trench Located Within the 200-CW-3 Operable Unit* (DOE/RL-2007-36), U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Waste Site Controls

Engineered Controls: Yes ☐ No ☒ Institutional Controls: Yes ☐ No ☒ O&M requirements: Yes ☐ No ☒

L. D. Romine	Ray Romine	7-19-07
DOE Federal Project Director (printed)	Signature	Date
N/A		
Ecology Project Manager (printed)	Signature	Date
D. A. Faulk	D A Faulk	7/19/07
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 216-N-5 WASTE SITE, 212-P BUILDING COOLING WATER TRENCH LOCATED WITHIN THE 200-CW-3 OPERABLE UNIT

EXECUTIVE SUMMARY

The 216-N-5 Waste Site was a trench that received basin water and sludge cleanout from the 212-P Building Basin during shutdown of the area. The Waste Information Data System (WIDS) describes the 216-N-5 Waste Site as a trench that was approximately 24 meters (80 feet) in length by 4.6 meters (15 feet) in width and 1.8 meters (6 feet) deep prior to backfilling. When the trench was no longer needed for disposal, it was backfilled. Any aboveground piping was placed in the trench prior to backfilling. The 216-N-5 Waste Site is located approximately 30 meters (100 feet) northwest of 212-P Building.

The 216-N-5 Waste Site was initially investigated through field observations and focused sampling and analysis for the purpose of determining if hazardous or radiological contaminants were present. The results of the focused sampling of test pits identified levels of contaminants of concern above the Remedial Action Goals (RAGs). Consequently, the trench was excavated to a depth of 4.6 meters (15 feet) to remove contaminated soil and debris for remediation of the waste site.

Once the excavation and disposal of the contaminated soil and debris was completed, radiological field surveys were conducted utilizing a cesium-137 tracer (i.e., indicator) to confirm the removal of detectable contamination, and waste site sampling and analysis were conducted using a multi-incremental sampling design. Multi-incremental sampling was implemented on March 16, 2007, in accordance with the *Sampling and Analysis Plan for Remediation of Select 200 North Area Waste Sites (216-N-2, -3, -5, and -7) in the 200-CW-3 Operable Unit* (SAP) (DOE/RL-2006-65).

The sample results indicate that the 216-N-5 Waste Site achieved compliance with the remedial action objectives (RAOs) and the RAGs. A summary of the cleanup evaluation for the soil results against the applicable criteria is presented in Table 1. The results of the waste site sampling after remediation are used to make reclassification decisions for the 216-N-5 Waste Site in accordance with the TPA-MP-14 (DOE-RL 2007) process.

In accordance with this evaluation, the waste site post-remediation sampling results support a reclassification of this site to interim closed out. The current site conditions achieve the RAOs and the corresponding RAGs established in the *Remedial Design/Remedial Action Work Plan for Select 200 North Area Waste Sites (216-N-2, -3, -5, & -7) in the 200-CW-3 Operable Unit* (DOE/RL-2006-69) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil [i.e., surface to 4.6 meters (15 feet)] and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. There is no deep zone for the 216-N-5 Waste Site therefore no institutional controls are required. The site has been backfilled in accordance with the RD/RAWP and will be re-vegetated with native grasses.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against

ecological risk screening levels has been made for the site contaminants of concern. Screening levels were not exceeded for the site constituents. A baseline risk assessment for the river corridor portion of Hanford began in 2004, which includes a more complete quantitative ecological risk assessment. That baseline risk assessment will be used to support a future final closeout decision for the 216-N-5 Waste Site.

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REMAINING SITES VERIFICATION PACKAGE FOR THE 216-N-5 WASTE SITE, 212-P BUILDING COOLING WATER TRENCH LOCATED WITHIN THE 200-CW-3 OPERABLE UNIT

1.0 STATEMENT OF PROTECTIVENESS

This report demonstrates that the 216-N-5 Waste Site meets the objectives for reclassification to Interim Closed Out as established in the TPA-MP-14 procedure (DOE-RL 2007), following the cleanup standards in the *Remedial Design/Remedial Action Work Plan for Select 200 North Area Waste Sites (216-N-2, -3, -5 & -7) in the 200-CW-3 Operable Unit* (RD/RAWP) (DOE/RL-2006-69) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites Rod) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil [i.e., surface to 4.6 meters (15 feet)] and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. There is no deep zone for the 216-N-5 Waste Site therefore no institutional controls are required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based on a limited ecological risk assessment. These soil cleanup levels are referred to as Look-Up Values. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern. Screening levels were not exceeded for the site constituents. A baseline risk assessment for the river corridor portion of Hanford began in 2004, which includes a more complete quantitative ecological risk assessment. That baseline risk assessment will be used to support a future final closeout decision for the 216-N-5 Waste Site.

2.0 GENERAL SITE INFORMATION AND BACKGROUND

The Waste Information Data System (WIDS) describes the 216-N-5 Waste Site as a trench that was approximately 24 meters (80 feet) in length by 4.6 meters (15 feet) in width and 1.8 meters (6 feet) deep. The trench received basin water and sludge cleanout from the 212-P Building Basin during shutdown of the area. When the trench was no longer needed for disposal, it was backfilled. Any aboveground piping was placed in the trench prior to backfilling.

The 216-N-5 Waste Site is located approximately 30 meters (100 feet) northwest of 212-P Building (Figure 1). The Waste Site is located at Hanford Site coordinates N 55470, W 63150 based on geophysical surveys.

3.0 SUMMARY OF REMEDIAL ACTION OBJECTIVES FOR THE 216-N-5 WASTE SITE

The results from the sampling and analysis of the 216-N-5 Waste Site soils after remediation indicate achievement of compliance with the remedial action objectives (RAOs) and the remedial action goals (RAGs) identified in the Remaining Sites ROD (EPA 1999) and the RD/RAWP (DOE/RL-2006-69). The summary of the cleanup evaluation for the soil results against the applicable criteria is presented in Table 1. Detailed analysis results are presented by both Waste Sampling and Characterization Facility (WSCF) and Hanford Environmental Information System (HEIS) numbers in Appendix G. NOTE: Although the 216-N-5 Waste Site was divided into two decision units for sampling and analysis (trench side-walls and trench bottom), the highest (i.e., maximum) analytical result from the combined test data

was used for comparison to the soil cleanup levels for direct exposure, groundwater protection and river protection.

Table 1. Summary of Attainment of Remedial Action Objectives for the 216-N-5 Waste Site.

Regulatory Requirement	Remedial Action Goals*	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain 15-mrem/year dose rate above background over 1,000 years.	Residual concentrations of radionuclide COCs are below background or less than one-tenth the single radionuclide soil concentration equivalent to a 15 mrem/year dose rate calculated by RESRAD (see Appendix A).	Yes
Direct Exposure – Nonradionuclides	Attain individual COC RAGs.	All individual COC concentrations are below the direct exposure criteria presented in Appendix B and Appendix G, Table G-1.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	Manganese is the only COC that was detected above its Hanford Specific background value (see Appendix B and Appendix G, Table G-1). Therefore manganese was the only COC used in the hazard quotient calculation. The hazard quotient for manganese (5.5×10^{-2}) is less than 1. See Appendix C.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient (5.5×10^{-2}) is less than 1. See Appendix C.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	No carcinogens were detected above background levels. See Appendix C.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	There is no cumulative excess cancer risk for the COCs. See Appendix C.	
Groundwater/River Protection – Radionuclides	Attain single COC groundwater and river protection RAGs.	Maximum residual concentrations of radionuclide COCs were detected below groundwater and river protection exposure criteria (Table 2 and Appendix D). RESRAD calculated values that are protective of the groundwater are also protective of the Columbia River, since contaminant access to the Columbia River is through the groundwater. **NOTE**: For uranium-233/234 and uranium-238, the groundwater MCL of 21.2 pCi/L corresponds to a soil concentration of 0.185 pCi/g. However, the Hanford specific background for these two uranium isotopes is 1.1 pCi/g. The RAG therefore defaults to 1.1 pCi/g[c].	Yes
	Attain national primary drinking water standards:[a] 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.	Maximum residual concentrations of beta/gamma radionuclide COCs were detected below groundwater and river protection exposure criteria (Table2 and Appendix A, Footnote a).	

Table 1. Summary of Attainment of Remedial Action Objectives for the 216-N-5 Waste Site.

Regulatory Requirement	Remedial Action Goals*	Results	Remedial Action Objectives Attained?
	Meet drinking water standards for alpha emitters: the most stringent of 15 pCi/L MCL or 1/25th of the derived concentration guides from DOE Order 5400.5.[b]	Maximum residual concentrations of alpha emitting radionuclide COCs were detected below groundwater and river protection exposure criteria (Table 2 and Appendix D). RESRAD calculations predict that the only alpha emitting radionuclide COCs with the potential to reach groundwater within 1,000 years are the uranium isotopes. **NOTE**: For uranium-233/234 and uranium-238, the groundwater MCL of 21.2 pCi/L corresponds to a soil concentration of 0.185 pCi/g. However, the Hanford specific background for these two uranium isotopes is 1.1 pCi/g. The RAG therefore defaults to 1.1 pCi/g[c].	
	Meet total uranium standard of 21.2 pCi/L.[c]	For uranium-233/234 and uranium-238, the groundwater MCL of 21.2 pCi/L corresponds to a soil concentration of 0.185 pCi/g (Appendix D). However, the Hanford specific background for these two uranium isotopes is 1.1 pCi/g. The RAG therefore defaults to 1.1 pCi/g[c].	
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Maximum detected results for all nonradionuclides are below the RAGs for protection of groundwater and the river with the exception of manganese (Appendices E and G). The maximum manganese result of 619 mg/kg exceeds the Hanford Site-Specific background of 512 mg/kg. However, the RESRAD calculation predicts that manganese, which has a Kd value of 50 mL/g, will not reach groundwater within 1,000 years based on the 100 Area generic site model using soil column layers and depths[d].	Yes

* Remaining Sites Rod

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).

[b] *Radiation Protection of the Public and the Environment* (DOE Order 5400.5).

[c] Based on the isotopic distribution of uranium in the 100 Areas, 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038 (BHI 2001).

[d] RESRAD calculation predicts that manganese, which has a Kd value of 50 mL/g, will not reach groundwater within 1,000 years based on the 100 Area generic site model using soil column layers and depths. Described in the text of Calculation Number 0100X-CA-V0046, *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision* (BHI 2004) July 2004, Bechtel Hanford, Inc., Richland, WA.

COC = contaminant of concern
MCL = maximum contaminant level (drinking water standard)
RAG = remedial action goal

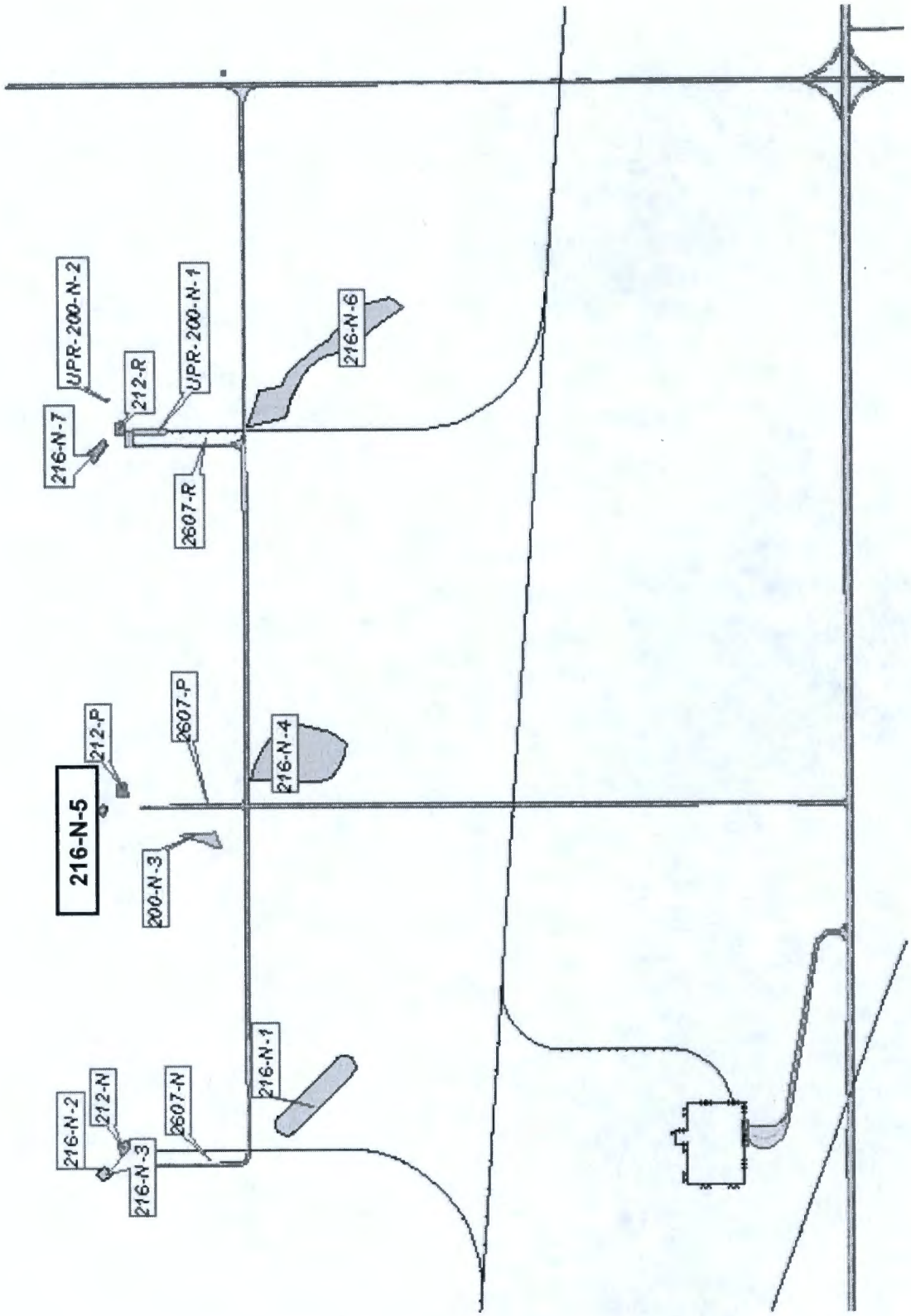

Figure 1. 216-N-5 Cooling Water Waste Site Location Map.

4.0 PRE-REMEDIATION WASTE SITE CHARACTERIZATION AND CONCEPTUAL MODEL CONFIRMATION SAMPLING

To determine if remediation of waste site 216-N-5 was required, the waste site was characterized and the conceptual model of Removal, Treatment and Disposal was confirmed through radiological soil screening, sampling and analysis.

4.1 Geophysical Survey Results

Geophysical survey data for this site indicated a northwest-southeast trending feature in the geophysical data that has the characteristics typically associated with soil that has been disturbed by excavation or trenching. The disturbed area is roughly six meters (20 feet) wide and 22 meters (72 feet) long. The northwest end of the area is not distinct but appears to be slightly outside of the monuments surrounding the trench. The geophysical data suggests that the disturbed area is roughly two meters deep.

There were no concentrations of buried debris or piping/hose identified in the disturbed area but there is one notable anomaly within the trench boundaries. A very large boulder was identified, which could not be moved or broken up, but no other significant subsurface objects were found.

4.2 Contaminants of Concern

The contaminants of concern (COCs) for the 216-N-5 Waste Site were identified based on existing information for the site and the COCs listed in the Remaining Sites ROD. The COC list identified in the *Sampling and Analysis Plan for Remediation of Select 200 North Area Waste Sites (216-N-2, -3, -5, & -7) in the 200-CW-3 Operable Unit* (SAP) (DOE/RL-2006-65) includes americium-241, cobalt-60, cesium-137, europium-152, europium-154, europium-155, tritium, strontium-90, plutonium-238, plutonium-239/240, nickel-63, thorium-232, technetium-99, uranium-233/234, uranium-235, uranium-238, hexavalent chromium, mercury, lead, barium, trivalent chromium, cadmium, antimony, arsenic, manganese, zinc, and polychlorinated biphenyls.

4.3 Waste Site Sample Design for Waste Site Characterization and Conceptual Model Confirmation Activities

For waste characterization, focused, discrete sampling designs are appropriate to ensure compliance with the receiving facilities' waste acceptance criteria. In addition, this sampling technique is being used for conceptual model remedy confirmation.

To confirm the conceptual model, a pre-remediation characterization of the site was performed. Due to the rocky backfill material that had previously been placed in the 216-N-5 Waste Site, focused, discrete samples were collected from four test pits dug using an excavator down to a depth of between 3.0 meters (10 feet) and 4.6 meters (15 feet). In addition, one duplicate sample was collected from the waste site plus one field blank, one equipment blank, and one trip blank for laboratory analysis for the sampling day. The trip blank was analyzed for tritium only.

For the sampling effort, field screening was used to establish site radiological contamination levels. In addition, field screening for radiological contamination (cesium-137) was used as a "tracer" (i.e., indicator) to locate areas of chemical contamination. When field-screening results indicated the presence of radiological contamination, the areas were further characterized with laboratory analytical samples.

4.4 Sample Summary

On February 26, 2007, focused, discrete samples were collected from four specific test pits [2 samples at 3.0-meter (10-foot) depths and 2 samples at 4.6-meter (15-foot) depths], with collection of an additional sample at 2 meters (8 feet), composed of small, crushed shards of what appeared to be pieces of clay pipe, which represented the highest radiological field reading during the test pit excavations [i.e., 15,000 counts per minute (cpm) including a 1,300 cpm background using a Sodium Iodide Detector]. During this initial characterization investigation, each bucket of soil was radiologically surveyed, with readings recorded in a survey report at each foot in depth. On average, the readings below 3 meters (9 feet) were comparable to the background readings[1]. No other hose or piping was found during the test pit excavation. While awaiting the analytical results, all soil was placed back into the excavated trench, and the area was stabilized.

The analytical results[2] from the sampling campaign were compared to the Deep Zone [≥4.6 meters (15 feet) below surface to groundwater] and Shallow Zone [surface to 4.6 meters (15 feet)] Look-Up Values, to determine whether further remediation was required. The analytical results from the crushed clay pipe sample exceeded the Shallow Zone Look-Up Values for americium-241, cesium-137, cobalt-60, europium-152, plutonium-239/240, and strontium-90. The 3.0-meter (10-foot) and the 4.6-meter (15-foot) test pit samples were below their applicable Look-Up Values.

Photographs and results for the 216-N-5 Waste Site waste characterization/conceptual model remedy confirmation sampling and analysis data are presented in Appendix F. The HEIS and WSCF sample numbers are listed for each sample with a description of the sample depth and the trench area where the sample was collected. The shaded analytical results exceeded the applicable Look-Up Values.

5.0 WASTE SITE SAMPLING AFTER REMEDIATION ACTIVITIES

Pre-remediation waste characterization confirmed the conceptual model that the 216-N-5 Waste Site was contaminated. The site was remediated by excavation to 4.6 meters (15 feet) and the material removed was disposed at the Environmental Remediation Disposal Facility (ERDF). Pre-remediation sampling was completed on February 26, 2007. Remediation of the 216-N-5 Waste Site began on April 30, 2007 and was completed on May 11, 2007. The excavation was approximately 316 meters^2 (3,360 feet^2) in area at the top of the excavation with a 1.5 to 1 slope down to 4.6 meters (15 feet). Approximately 1,288 metric tons (1,420 tons) of material from the site were disposed at ERDF. After remediation the waste site was radiologically screened and sampled on May 16, 2007. Laboratory analysis was performed to verify that remediation was complete.

5.1 Post-Remediation Survey Results

Figure 2 provides the coordinates for the top and bottom of the 216-N-5 Trench.

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[1] "Project Hanford Radiological Survey Reports" RSR-FD-N-07-06 (02/22/07) and RSR-FD-N-07-09 (02/26/07).
[2] Internal Memo, M4W41-SLF-07-208, S.L. Fitzgerald to D.L. Klages, dated April 13, 2007; and Certificate of Analysis, SAF Number R07-007, Sherryl A. Adam, Severn Trent, to John Trechter, FH, dated March 30, 2007.

Coordinate System: US State Plane 1983 Zone: Washington South 4602
Project Datum: NAD 1983 (Conus)
Vertical Datum: NAVD 1988 Geoid Model: Geoid03
Coordinate Units: Meters

Equipment Used: Trimble GPS 5800 RTK

STATION	Northing	Easting	Description
100	140359.57	570638.67	SE COR TOP
101	140369.13	570649.74	NE COR TOP
102	140385.00	570631.50	NW COR TOP
103	140374.06	570622.43	SW COR TOP
104	140374.41	570632.61	SW COR BOTTOM
105	140374.99	570633.11	NW COR BOTTOM
106	140369.44	570639.81	NE COR BOTTOM
107	140368.19	570638.74	SE COR BOTTOM

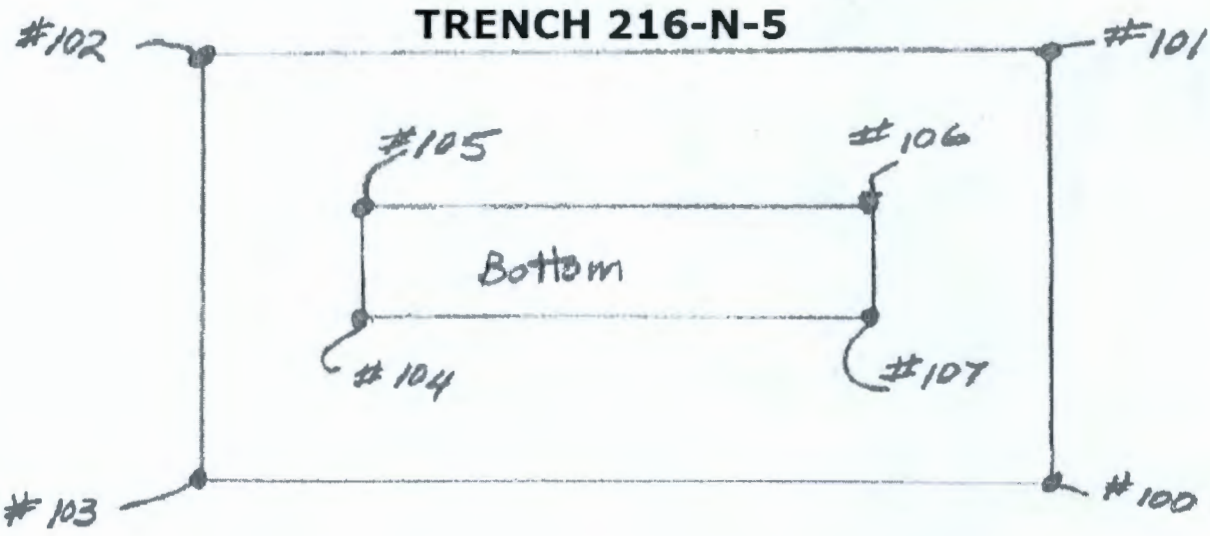

Figure 2. Survey Results for 216-N-5 Trench.

5.2 Contaminants of Concern

The COCs for the 216-N-5 Waste Site were identified based on existing information for the site and the COCs listed in the Remaining Sites ROD. The COC list identified in the SAP (DOE/RL-2006-65) includes americium-241, cobalt-60, cesium-137, europium-152, europium-154, europium-155, tritium, strontium-90, plutonium-238, plutonium-239/240, nickel-63, thorium-232, technetium-99, uranium-233/234, uranium-235, uranium-238, hexavalent chromium, mercury, lead, barium, trivalent chromium, cadmium, antimony, arsenic, manganese, zinc, and polychlorinated biphenyls.

5.3 Waste Site Sample Design after Remediation Activities

Radiological field screening was ongoing during remediation to determine the remedial action boundaries for both depth and width of the excavation. Once the trench was excavated and contaminated soil and debris disposed, the site was divided into grids and radiologically surveyed prior to sampling and analysis for verification that the remediation had been completed*. The survey results identified that all grids were below site background, therefore, all radiological postings were removed prior to the final sampling campaign. The trench was divided into two decision units consisting of the side-walls as one decision unit and the trench bottom as the other decision unit. One sample plus two replicate samples were collected from each decision unit along with equipment, field and trip blanks. Two samples for tritium also were collected as discrete samples, with no subsampling from each decision unit.

A multi-incremental sampling design was implemented on March 16, 2007, in accordance with the SAP. The multi-incremental method of sampling is used to control the fundamental error, as well as the grouping and segregation error for a representation of the decision unit, based on collecting an adequate sample mass (Ramsey et al. 1989, Pitard 1993, Gy 1998, Gerlach and Nocerino 2000, Ramsey 2004, Smith 2004).

As depicted in Figure 3 for the multi-incremental sampling effort in each decision unit, each unit was divided into 100 grids, with a sample portion collected from each grid from 0-4 inches in depth, and accumulated in one container, which is referred to as the "parent" sample. The parent sample is then sub-sampled in a hundred increment tray. Each sample bottle for analysis holds one portion of each of the 100 increments. The minimum sample amount for analysis is 20 grams in each bottle. At a minimum, at least two bottles of sample material are used per analysis. The entire sample volume in a bottle was processed for one analysis.

Photographs and analytical data for the 216-N-5 Waste Site post-remediation sampling and analyses are presented in Appendix G.

* "Project Hanford Radiological Survey Report," RSR-FD-N-07-46 (05/15/07).

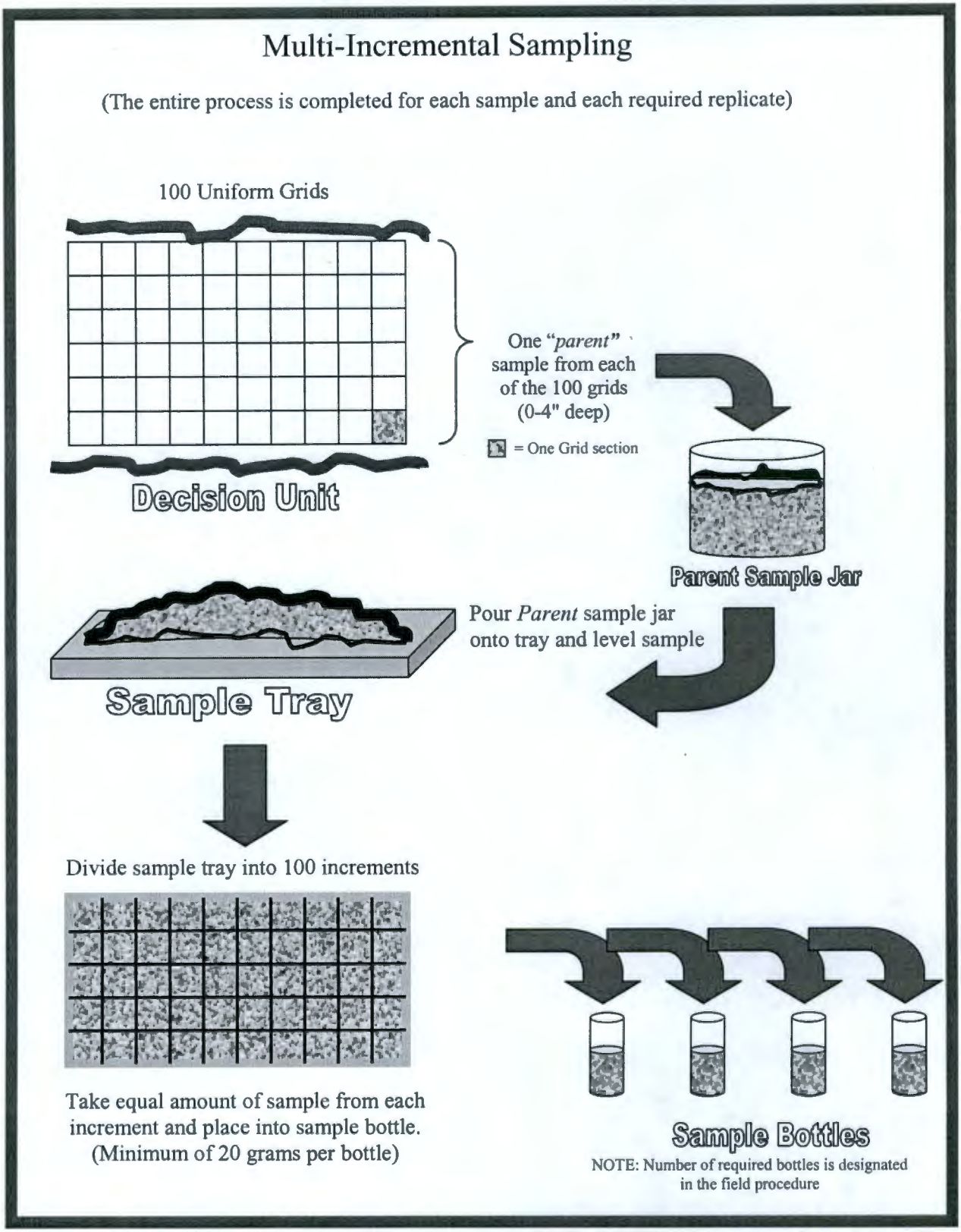

Figure 3. Multi-Incremental Sampling Process.

6.0 POST-REMEDIATION DATA EVALUATION

Results for the 216-N-5 Waste Site sampling and analysis for verification of remedy completion in "Data Validation Report for Fluor Hanford VSR07-008" (AQA 2007) are summarized in Appendix G. All detected analytes were reported at concentrations below direct exposure, groundwater protection, and river protection RAGs, or below the Hanford Specific Background default value RAGs in the case of uranium-233/234 and uranium-238.

Nonradionuclide risk requirements for the 216-N-5 Waste Site include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, individual contaminant carcinogenic risks of less than 1×10^{-6}, and a cumulative carcinogenic risk of less than 1×10^{-5}. Risk values are not calculated for constituents that are either not detected or are detected at concentrations below Hanford Site or Washington State background values (Appendix G).

- All individual hazard quotients for noncarcinogenic constituents were less than 1.0. Manganese was the only COC that was detected above its Hanford Specific Background value. Therefore, manganese was the only COC used in the hazard quotient calculation. The hazard quotient for manganese (5.5×10^{-2}) is less than 1.0.

- The cumulative hazard quotient for all noncarcinogenic constituents was less than 1.0. Again, manganese was the only COC that was detected above its Hanford Specific Background value. Therefore, manganese was the only COC used in the hazard quotient calculation. The cumulative hazard quotient for manganese (5.5×10^{-2}) is less than 1.0.

- The individual carcinogenic risk values for carcinogenic constituents above background are all below 1×10^{-6}. No carcinogens were detected above background levels, and there is no excess cancer risk value for manganese.

- The cumulative excess carcinogenic risk value for carcinogenic constituents above background are all below 1×10^{-5}. No carcinogens were detected above background levels, and there is no excess cancer risk value for manganese.

All calculations are provided in Appendix C.

7.0 POST-REMEDIATION DATA QUALITY ASSESSMENT

A data quality assessment (DQA) review was performed to compare the sampling approach and analytical data with the sampling and data requirements specified by the SAP (DOE/RL-2006-65). This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (EPA 2000). The assessment review completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality process.

The completed data package for the sampling and analysis activities conducted after the waste site was remediated was validated by Analytical Quality Associates, Inc., a qualified independent contractor (AQA 2007), thereby providing third-party validation.

Level C data validation as defined in the contractor's validation procedures, which are based on EPA functional guidelines [e.g., *Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses* (Bleyler 1988a); *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses* (Bleyler 1988b)], was performed for the entire sampling and analysis data package for the samples collected after remediation of the 216-N-5 Waste Site. Level C validation is a review of the

quality control (QC) data and specifically requires verification of deliverables and requested versus reported analyses and qualification of the results based on: analytical holding times; method blank results; matrix spike/matrix spike duplicate; surrogate recoveries; duplicates; and analytical method blanks.

Specific data quality objectives for the site are found in the SAP (DOE/RL-2006-65). All samples were collected per the sample design described in Sections 5.3. The COCs for the 216-N-5 Waste Site are in Section 5.2.

All of the sampling and analysis data generated from the sample collection after the 216-N-5 Waste Site was remediated are included in sample delivery group (SDG) WSCF20070837, excluding nickel-63, which was provided in SDG W05178 by Severn-Trent Laboratory. Third-party validation was performed on both SDG WSCF20070837 and SDG W05178 and summarized in the AQA 2007, and resulted in no major deficiencies. Minor deficiencies found are discussed in the following. The third-party validator also reviewed the analytical information for the equipment, field and trip blanks, and found all information to be acceptable. All of the 216-N-5 sampling and analysis data, from samples collected after remediation of the waste site, were found to be useable for decision-making purposes.

SDG WSCF20070837 and SDG W05178

ICP Metals Analysis: Minor deficiencies were identified by third-party validation, applying qualification of sample results as estimates ("J") for analysis of copper and tin, which are not COCs for the 216-N-5 Waste Site. ICP Metal COCs data are useable for decision-making purposes.

Chromium (VI) Analysis: Minor deficiencies were identified by third-party validation, applying qualification of sample results as estimates ("J") due to low Matrix Spike and Matrix Spike Duplicate recoveries for B1NHK1 through B1NHK6, and B1NHL1 and B1NHL2. The data remain useable for decision-making purposes.

PCB Analysis: Minor deficiencies were identified by third-party validation, applying qualification of sample results as estimates ("J") for the PCB analyses due to lack of matrix-specific accuracy and precision data for B1NHK1 through B1NHK6, and B1NHL1 and B1NHL2. The data remain useable for decision-making purposes.

Radiochemistry Analysis: Minor deficiencies were identified by third-party validation, applying qualification of sample results as estimates ("J") for americium-241 in samples B1NHK1 through B1NHK6, and B1NHL1; for uranium-235 in samples B1NHK1 through B1NHK3, and B1NHK5; and for strontium-89/90 in samples B1NHK1, B1NHK2, B1NHK5, and B1NHL1, all due to laboratory blank contamination. The data remain useable for decision-making purposes.

Relative to analytical data in sample media, physical data and/or field screening results are of lesser importance in making inferences of risk. Because of the secondary importance of such data, no validation for physical property data and/or field screening results was performed. However, field quality assurance/quality control (QA/QC) was reviewed to ensure that the data are useable. Field instrumentation, calibration, and QA checks were performed in accordance with the following.

- Calibration of radiological field instruments on the Hanford Site is performed under contract by Pacific Northwest National Laboratory, as specified in their program documentation.

- Daily calibration checks are performed and documented for each instrument used to characterize areas that are under investigation. These checks are made on standard materials that are sufficiently like the matrix under consideration that direct comparison of data can be made.

The approval of field-data collection plans by the radiological controls organization represents the data validation and usability review for handheld field radiological measurements.

The DQA review for the 216-N-5 Waste Site found the results to be accurate within the standard errors associated with the methods, including sampling and sample handling. The data are of the right type, quality, and quantity to support the intended use. Detection limits, precision, accuracy, and sampling data group completeness were assessed to determine if any analytical results should be rejected as a result of quality assurance and quality control deficiencies. All analytical data were found acceptable for decision-making purposes. All of the sampling analytical data are stored in the Hanford Environmental Information System and are summarized in Appendix G. All qualifiers have also been added accordingly into the data for Appendix G.

8.0 SUMMARY FOR INTERIM CLOSED OUT

On February 26, 2007 (pre-remediation), focused, discrete samples were collected from four specific test pits [2 samples at 3-meter (10-foot) depths and 2 samples at 4.6-meter (15-foot) depths], with collection of an additional sample at 2.4 meters (8 feet), composed of crushed clay pipe debris, which represented the highest radiological field reading during the test pit excavations. (During this initial investigation excavation, each bucket of soil was radiologically surveyed, with readings recorded in a survey report.) The analytical results were compared to the Deep and Shallow Zone Look-Up Values to determine whether further remediation was required. The analytical results from the crushed clay pipe shards sample exceeded the Shallow Zone Look-Up Values for americium-241, cesium-137, cobalt-60, europium-152, plutonium-239/240, and strontium-90. The 3-meter (10-foot) and the 4.6-meter (15-foot) test pit samples did not exceed the appropriate Look-Up Values.

Remediation of the 216-N-5 Waste Site proceeded with the excavation of the trench down to a depth of 4.6 meters (15 feet). Radiological field screening continued during remediation to determine the remedial action boundaries for both depth and width of the excavation. Once excavation was completed, the site was divided into grids and radiologically surveyed prior to sampling and analysis for verification that the remediation had been completed.

On March 16, 2007 (post-remediation), a multi-incremental sampling technique was utilized as described in Section 5.3 to verify that the site had been satisfactorily remediated to be interim closed out. The analytical results from the multi-incremental soil samples were shown to meet the cleanup objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the sampling results support a reclassification of the 216-N-5 Waste Site to Interim Closed Out, as recorded on Waste Site Reclassification Form 2007-013.

Table 2. Comparison of Maximum Post-Remediation Soil Analyses to Remedial Action Goals for the 216-N-5 Waste Site.*

Contaminant of Concern	Hanford Site-Specific Background Activity (pCi/g)	Maximum Soil Analyses (pCi/g)	Remedial Action Goals (pCi/g)			Does the Maximum Exceed RAGs?
			Direct Exposure (pCi/g)	Soil Cleanup Level for Groundwater Protection (pCi/g)	Soil Cleanup Level for River Protection (pCi/g)	
Americium-241	N/A	0.180	31.1	NA[c]	NA[c]	No
Cesium-137	1.1	0.293 (<BG)	6.2	1,465	1,465	No
Cobalt-60	0.008	<0.00818	1.4	13,900	13,900	No
Europium-152	N/A	0.154	3.3	NA[c]	NA[c]	No
Europium-154	0.033	<0.0112 (<BG)	3.0	NA[c]	NA[c]	No
Europium-155	0.054	<0.0494 (<BG)	125	NA[c]	NA[c]	No
Nickel-63	N/A	<2.51	4,013	83	83	No
Plutonium-238	0.004	<0.0220	34	NA[c]	NA[c]	No
Plutonium-239/240	0.025	0.960	35.1	NA[c]	NA[c]	No
Strontium-90	0.18	0.290	4.5	27.6	27.6	No
Technetium-99	N/A	<-0.100	5.7	0.46	0.46	No
Throium-232	1.3	0.329 (<BG)	1.0	NA[c]	NA[c]	No
Tritium (H-3)	N/A	<0.450	459	12.6	12.6	No
Uranium-233/234	1.1	0.230 (<BG)	0.57	1.1[a]	1.1[a]	No
Uranium-235	0.11	0.0260 (<BG)	0.61	1.0[b]	1.0[b]	No
Uranium	1.1	0.230 (<BG)	0.61	1.1[a]	1.1[a]	No
Contaminant of Concern	**Hanford Site-Specific Background Activity (mg/kg)**	**Maximum Soil Analyses (mg/kg)**	**Remedial Action Goals (mg/kg)**			**Does the Maximum Exceed RAGs?**
			Direct Exposure (mg/kg)	**Soil Cleanup Level for Groundwater Protection (mg/kg)**	**Soil Cleanup Level for River Protection (mg/kg)**	
Antimony	5[d]	<0.299 (<BG)	32	5[d]	5[d]	No
Arsenic	6.5	3.02 (<BG)	20	20[d]	20[d]	No
Barium	132	60.2 (<BG)	5,600	132	224	No
Cadmium[f]	0.81[d]	0.161 (<BG)	13.9	0.81[d]	0.81[d]	No
Chromium Total	18.5	6.81 (<BG)	120,000	18.5[d]	18.5[d]	No
Chromium (VI)	N/A	<0.1	2.1	4.8	2	No
Lead	10.2	4.86 (<BG)	353	10.2	10.2	No
Manganese	512	619	11,200	512	512	No[e]
Mercury	0.33	<0.0499 (<BG)	24	0.33	0.33	No
Zinc	67.8	34.5 (<BG)	24,000	480	67.8	No
Polychlorinated Biphenyl s	N/A	<0.0110	0.5	0.017	0.017	No

[a] The calculated soil concentration cleanup level of 0.185 pCi/g is below the Hanford Specific Background Activity of 1.1 pCi/g. Therefore the soil concentration protection of groundwater defaults to 1.1 pCi/g.

[b] The remedial action goal is below the practical quantitation limit (PQL). The value presented is the PQL.

[c] NA = Not Applicable. RESRAD predicts constituent will not reach groundwater within 1,000 years based on 100 Area generic site model using soil column layers and depths.

[d] Where cleanup levels are less than background or required detection limit (RDLs), cleanup levels default to background or RDLs per Ecology 1996, WAC 173-340-700(4)(d) and WAC 173-340-707(2), respectively. The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.

[e] The maximum manganese result of 619 mg/kg exceeds the Hanford Site-Specific background of 512 mg/kg. However, the RESRAD calculation predicts that manganese, which has a Kd value of 50 mL/g, will not reach groundwater within 1,000 years based on the 100 Area generic site model using soil column layers and depths.

* Site RAGs are taken from the RD/RAWP (DOE/RL-2006-69), where available, without further consideration of updated toxicity data or amendments (2004) to cleanup regulations in WAC 173-340.

BG = Hanford Site-Specific Background.
N/A = Not Available.
RAG = Remediation Action Goal.

9.0 REFERENCES

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APPENDIX A

COMPARISON OF MAXIMUM POST-REMEDIATION SOIL ANALYSES TO 100 AREA RADIONUCLIDE SOIL CONCENTRATIONS CORRESPONDING TO AN EQUIVALENT DOSE OF 15 MREM/YR.

Table A-1. Comparison of Maximum Post-Remediation Soil Analyses to 100 Area Radionuclide Soil Concentrations Corresponding to an Equivalent Dose of 15 mrem/yr.

Radionuclide	Soil Activity for 15 mrem/yr Dose (except as noted) (p/Ci/g)	Source of Single Radionuclide Soil Concentration	Maximum Results (pCi/g)
Americium-241	31.1	WDOH/320-015[c]	0.180
Cesium-137	6.2	WDOH/320-015[c]	0.293 (<BG)
Cobalt-60	1.4[a]	WDOH/320-015[c]	<0.00818
Europium-152	3.3[a]	WDOH/320-015[c]	0.154
Europium-154	3.0[a]	WDOH/320-015[c]	<0.0112 (<BG)
Europium-155	125[a]	RESRAD Calc[b]	<0.0494 (<BG)
Nickel-63	4,013[a]	RESRAD Calc[b]	<2.51
Plutonium-238	34	RESRAD Calc[b]	<0.0220
Plutonium-239/240	35.1	WDOH/320-015[c]	0.960
Strontium-90	4.5[a]	WDOH/320-015[c]	0.290
Technetium-99	5.7[a]	WDOH/320-015[c]	<-0.100
Thorium-232	1.0	RESRAD Calc[b]	0.329 (<BG)
Tritium (H-3)	459[a]	RESRAD Calc[b]	<0.450
Uranium-233/234	0.57	RESRAD Calc[b]	0.230 (<BG)
Uranium-235	0.61	RESRAD Calc[b]	0.0260 (<BG)
Uranium-238	0.61	RESRAD Calc[b]	0.230 (<BG)

[a] Radionuclide concentrations for beta/gamma in water corresponding to a 4 mrem/yr dose (C4 mrem/yr) from *Soil Screening Guidance for Radionuclides: User's Guide*, EPA/540-R-00-007, U.S. Environmental Protection Agency, Office or Radiation and Indoor Air, Washington D.C.

[b] Described in the text of Calculation Number 0100X-CA-V0046, *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision* (BHI 2004) July 2004, Bechtel Hanford, Inc., Richland, WA.

[c] From *State of Washington Department of Health Interim Regulatory Guidance: Hanford Guidance for Radiological Cleanup,* WDOH/320-015, Rev. 1 (WDOH 1997) Washington State Department of Health, Richland, Washington.

BG = Hanford Site-Specific Background.

APPENDIX B

COMPARISON OF MAXIMUM POST-REMEDIATION SOIL ANALYSES TO NONRADIONUCLIDE DIRECT EXPOSURE CLEANUP LEVELS

Table B-1. Comparison of Maximum Post-Remediation Soil Analyses to Nonradionuclide Direct Exposure Cleanup Levels.

Contaminant	Background (mg/kg)	RDL (mg/kg)	Direct Exposure Cleanup Levels (mg/kg)[a]		Direct Exposure Cleanup Level (mg/kg)	Maximum Results (mg/kg)
			Carcinogen	Noncarcinogen		
Metals						
Antimony	5[b]	0.6	N/A	32	32	<0.299 (<BG)
Arsenic	6.5	10	0.667	24	20[c]	3.02 (<BG)
Barium	132	2	N/A	5,600	5,600	60.2 (<BG)
Cadmium	0.81[b]	0.5	13.9[d]	80	13.9	0.161 (<BG)
Chromium, Total	18.5	1	N/A	120,000	120,000	6.81 (<BG)
Chromium VI	NA	0.5	2.1[d]	240	2.1	<0.1
Lead	10.2	5	N/A	353[e]	353	4.86 (<BG)
Manganese	512	5	N/A	11,200	11,200	619
Mercury	0.33	0.2	N/A	24	24	<0.0499 (<BG)
Zinc	67.8	1	N/A	24,000	24,000	34.5 (<BG)
PCBs						
Polychlorinated Biphenyls[f]	NA	0.017	0.5	N/A	0.5	<0.0110

[a] Calculated using the appropriate formulas from Ecology 1996, WAC 173-340-740, with toxicity values updated through July 2004, from the EPA Integrated Risk Information System (IRIS) at http://www.epa.gov/iris or from the Risk Assessment Information System (RAIS) database of the Oak Ridge National Laboratory (ORNL) on the Internet at http://risk.lsd.ornl.gov.

[b] Hanford Site-specific background not available. Value is from Ecology, 1994, *Natural Background Soil Metals Concentrations in Washington State,* Publication No. 94-115, Washington State Department of Ecology, Olympia, Washington.

[c] The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.

[d] Carcinogenic cleanup level calculated based on the inhalation exposure pathway; WAC 173-340-750(3), 1996.

[e] Calculated using EPA, 1994, *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children*, EPA/540/R-93/081, Publication No. 9285.7, U.S. Environmental Protection Agency, Washington, D.C.

[f] The soil cleanup value for PCBs is based on the formula presented in WAC 173-340-740(3)(a)(iii)(B), Ecology 1996, and the cancer potency factor for ingestion of PCBs of 2.0 kg-day/mg (soils) from the EPA Integrated Risk Information System (IRIS) on the internet at http://www.epa.gov/iris on January 3, 2006.

N/A =Not Applicable.
BG = Hanford Site-Specific Background.
NA = Not Available.
RDL = Required Detection Limit.

APPENDIX C

CALCULATION OF HAZARD QUOTIENTS AND EXCESS CARCINOGENIC RISK

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and carcinogenic (excess cancer) risk values for the 216-N-5 Waste Site remedial action. In accordance with the remedial action goals (RAGs) in the *Remedial Design/Remedial Action Work Plan for Select 200 North Area Waste Sites (216-N-2, -3, -5, and -7) in the 200-CW-3 Operable Unit* (DOE/RL-2006-69), the following criteria must be met:

1) An HQ of <1.0 for all individual noncarcinogens
2) A cumulative HQ of <1.0 for noncarcinogens
3) An excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens
4) A cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.

GIVEN/REFERENCES:

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WAC 173-340, "Model Toxics Control Act – Cleanup," *Washington Administrative Code*, 1996.

SOLUTION:

1) Calculate an HQ for each noncarcinogenic constituent detected above background and compare it to the individual HQ of <1.0 (DOE/RL-2006-69).

2) Sum the HQs and compare to the cumulative HQ criterion of <1.0.

3) Calculate an excess cancer risk value for each carcinogenic constituent detected above background and compare it to the individual excess cancer risk criterion of $<1 \times 10^{-6}$ (DOE/RL-2006-69).

4) Sum the excess cancer risk values and compare to the cumulative cancer risk criterion of $<1 \times 10^{-5}$.

METHODOLOGY:

Hazard quotient and carcinogenic risk calculations were computed using the data from Appendix G, Table G-1. Of the contaminants of concern listed in Appendix G, Table G-1, manganese requires the HQ and risk calculations because this analyte was detected above the Hanford Site background value. An explanation of the HQ and risk calculations is presented in the following:

1) For example, the maximum value for manganese is 619 mg/kg, divided by the noncarcinogenic RAG value of 11,200 mg/kg [manganese is identified as a noncarcinogen in WAC 173-340-740(3)], is 5.5×10^{-2}. Comparing this value to the requirement <1.0, this criteria is met.

2) After the HQ calculations are completed for the appropriate analytes, the cumulative HQ is obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) Since there is only one analyte, the sum of the HQ values remains 5.5×10^{-2}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value, then multiplied by 1×10^{-6}. For example, the maximum value for hexavalent chromium, the sole carcinogen, is 0.24 mg/kg; divided by 2.1 mg/kg, multiplied as indicated is 1.1×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-6}$, this criteria is met. Because manganese is the sole analyte for this site and is not carcinogenic, the cumulative excess cancer risk is also not applicable. Comparing this value to the requirement of $<1 \times 10^{-5}$, this is also not applicable. Both cancer risk criteria are therefore met.

RESULTS:

1) List individual noncarcinogens and corresponding HQs >1.0: None.
2) List the cumulative noncarcinogenic HQ >1.0: None.
3) List individual carcinogens and corresponding excess cancer risk $>1 \times 10^{-6}$: None.
4) List the cumulative excess cancer risk for carcinogens $>1 \times 10^{-5}$: None.

Table C-1 shows the results of the calculation:

Table C-1. Hazard Quotient and Excess Cancer Risk Results for the 216-N-5 Waste Site.

Contaminants of concern	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard quotient	Carcinogen RAG (mg/kg)	Carcinogen risk
Metals					
Manganese	619	11,200	5.5×10^{-2}	NA	NA
Totals					
Cumulative Hazard Quotient:			**5.5×10^{-2}**		
Cumulative Excess Cancer Risk:					NA

Notes:
[a] From Appendix G, Table G-1.
[b] Value obtained from Washington Administrative Code (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.

RAG = Remedial Action Goal
NA = Not Applicable

CONCLUSION:

This calculation demonstrates that the 216-N-5 Waste Site meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk as identified in RD/RAWP (DOE/RL-2006-69).

APPENDIX D

COMPARISON OF MAXIMUM POST-REMEDIATION SOIL ANALYSES TO SOIL ACTIVITIES CALCULATED BY RESRAD TO BE PROTECTIVE OF 100 AREA GROUNDWATER

Table D-1. Comparison of Maximum Post-Remediation Soil Analyses to Soil Activities Calculated by RESRAD to be Protective of 100 Area Groundwater.

Radionuclide	Groundwater MCL[a] (pCi/L)	Soil Concentration Protective of Groundwater (pCi/g)	Maximum Results (pCi/g)
Americium-241	1.2	NA[b]	0.180
Cesium-137	60	1,465	0.293 (<BG)
Cobalt-60	100	13,900	<0.00818
Europium-152	200	NA[b]	0.154
Europium-154	60	NA[b]	<0.0112 (<BG)
Europium-155	600	NA[b]	<0.0494 (<BG)
Nickel-63	50	83	<2.51
Plutonium-238	1.6	NA[b]	<0.0220
Plutonium-239/240	1.2	NA[b]	0.960
Strontium-90	8	27.6	0.290
Technetium-99	900	0.46	<-0.100
Thorium-232	2	NA[b]	0.329 (<BG)
Tritium (H-3)	20,000	12.6	<0.450
Uranium-233/234	21.2	1.1[c]	0.230 (<BG)
Uranium-235	21.2	0.185	0.0260 (<BG)
Uranium-238	21.2	1.1[c]	0.230 (<BG)

[a] MCL = Maximum contaminant level calculated from National Bureau of Standards (NBS Handbook 69) maximum permissible concentration (MPC) as cited in EPA/540-R-00-007, the RAG from the RD/RAWP (DOE/RL-2006-69), or the MCL from 40 CFR 141.66.

[b] NA = Not Applicable. RESRAD predicts constituent will not reach groundwater within 1,000 years based on 100 Area generic site model using soil column layers and depths. Described in the text of Calculation Number 0100X-CA-V0046, *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision* (BHI 2004) July 2004, Bechtel Hanford, Inc., Richland, WA.

[c] The calculated soil concentration cleanup level of 0.185 pCi/g is below the Hanford Specific Background Activity of 1.1 pCi/g. Therefore the soil concentration protection of groundwater defaults to 1.1 pCi/g.

BG = Hanford Site-Specific Background.

APPENDIX E

SUMMARY OF COMPARISON OF MAXIMUM POST-REMEDIATION SOIL ANALYSES TO 100 AREA NONRADIONUCLIDE CLEANUP LEVELS FOR PROTECTION OF GROUNDWATER AND THE COLUMBIA RIVER

Table E-1. Summary of Comparison of Maximum Post-Remediation Soil Analyses to 100 Area Nonradionuclide Cleanup Levels for Protection of Groundwater and the Columbia River.

Contaminant	Soil Cleanup Levels (mg/kg)		Maximum Results (mg/kg)
	Protective of Groundwater	Protective of the Columbia River	
Metals			
Antimony	5[c]	5[c]	<0.299 (<BG)
Arsenic	20[e]	20[e]	3.02 (<BG)
Barium	132[c] (200[b])	224[a] (400[b])	60.2 (<BG)
Cadmium	0.81[c]	0.81[c]	0.161 (<BG)
Chromium, Total	18.5[c]	18.5[c]	6.81 (<BG)
Chromium VI	4.8	2	<0.1
Lead	10.2[c]	10.2[c]	4.86 (<BG)
Manganese	512[c]	512[a]	619[d]
Mercury	0.33[c]	0.33[c]	<0.0499 (<BG)
Zinc	480	67.8[c]	34.5 (<BG)
PCBs			
Polychlorinated Biphenyl	0.017[c]	0.017[c]	<0.0110

[a] Remedial action goal established in the RD/RAWP (DOE/RL-2006-69).

[b] Calculated using the appropriate formulas from Ecology 1996, WAC 173-340-740, with toxicity values updated through July 2004, from the EPA Integrated Risk Information System (IRIS) at http://www.epa.gov/iris or from the Risk Assessment Information System (RAIS) database of the Oak Ridge National Laboratory (ORNL) on the Internet at http://risk.lsd.ornl.gov. Parameters have been checked against Ecology's CLARC Database on the internet at https://fortress.wa.gov/ecy/clarc/CLARCOverview.html.

[c] Where cleanup levels are less than background or RDLs, cleanup levels default to background or RDLs consistent with Ecology 1996, WAC 173-340-700(4)(d) and WAC 173-340-707(2), respectively.

[d] RESRAD calculation predicts that manganese, which has a Kd value of 50 mL/g, will not reach groundwater within 1,000 years based on the 100 Area generic site model using soil column layers and depths. Described in the text of Calculation Number 0100X-CA-V0046, *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision* (BHI 2004) July 2004, Bechtel Hanford, Inc., Richland, WA.

[e] The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers.

BG = Hanford Site-Specific Background.
NA = Not Available.

APPENDIX F

PRE-REMEDIATION PHOTOGRAPHS AND WASTE CHARACTERIZATION AND CONCEPTUAL MODEL CONFIRMATION SAMPLING

Figure F-1. 200-CW-3 OU: Measurement of Excavation Depth.

Figure F-2. 200-CW-3 OU: Scanning Soil in Each Excavator Bucket During Test Pit Excavations.

NOTE: Field work was performed using approved work plans based on WIDS data and historical knowledge, with consideration of potential radiological and hazardous contaminant concerns. Field screening of potential contaminants confirmed work plan assumptions and ensured protection of personnel.

Figure F-3. 200-CW-3 OU: Scans for Each Bucket are Recorded on a Radiological Survey Report.

Figure F-4. 200-CW-3 OU: Soil Sampling of Test Pits.

NOTE: Field work was performed using approved work plans based on WIDS data and historical knowledge, with consideration of potential radiological and hazardous contaminant concerns. Field screening of potential contaminants confirmed work plan assumptions and ensured protection of personnel.

Values ary Action ow Zone eters t)][a] g)	Hanford Specific Background Activity (pCi/g)	WSCF#W070000218/ HEIS#B1ML78 Test Pit East End of Trench 3-Meter (10-Foot) Depth (pCi/g)	WSCF#W070000220/ HEIS #B1ML80 Test Pit West End of Trench 3-Meter (10-Foot) Depth (pCi/g)	WSCF#W070000221/ HEIS #B1ML81 Test Pit West End of Trench 3-Meter (10-Foot) Depth Duplicate (pCi/g)	WSCF#W070000224/ HEIS #B1ML99 Discrete Sample Highest Field Radiological Reading 2.4-Meter (8-Foot) Depth (pCi/g)	Soil Sample WSCF#W070000223/ HEIS#B1ML83 Field Blank (pCi/g)	Soil Sample WSCF#W070000222/ HEIS#B1ML82 Equipment Blank (pCi/g)
	NA	0.0550	U<0.0240	0.0300	57.0	U<0.00390	U<-0.00200
	1.1	0.194	U<-0.0102	U<0.00611	116	U<-0.00624	0.00836
	0.008	0.0109	U<-0.00245	U<-0.00118	1.87	U<-0.000878	U<-0.00395
	NA	0.106	U<-0.00324	U<0.0182	35.5	U<-0.00562	U<-0.00772
	0.033	U<0.0130	U<0.00214	U<0.0147	2.34	U<-0.000852	U<-0.00734
	0.054	U<0.0152	U<0.00334	U<0.0480	U<0.0335	U<0.0144	U<0.0145
	NA	U<-0.893	U<-1.90	U<-1.13	27.3	U<0.0709	U<-2.46
	0.004	U<0.0230	U<0.00570	U<0.00770	4.20	U<-0.0320	U<0.00780
	0.025	0.370	U<0.0130	0.0210	450	U<0.0120	0.00780
	0.18	0.700	0.370	U<-0.0320	71.0	U<-0.130	0.660
	NA	U<-0.200	U<-0.100	U<-0.100	U<0.0400	U<-0.100	U<-0.100
	1.3	D0.262	D0.371	D0.191	D0.275	0.027	0.026
	NA	U<-0.380	U<-0.390	U<-0.490	U<-0.220	U<-0.130	U<-0.460
	1.1	0.250	0.170	0.270	0.450	0.0750	0.0760
	0.11	0.0300	0.0270	U<0.0130	0.0410	0.0200	U<0.00300
	1.1	0.290	0.190	0.260	0.470	U<0.0270	0.0520

ieve the direct exposure remedial action objectives (RAO) and the groundwater/Columbia River RAO; therefore, the lowest value among the "protection from Direct Exposure," tective of the Columbia River" values is the applicable look-up value.
practical quantitation limit (PQL). The value presented is the PQL.
kground. The value presented is background.

est Results	Converted Test Results
.86 mg/kg	0.312 pCi/g
.40 mg/kg	0.262 pCi/g
.38 mg/kg	0.259 pCi/g
.40 mg/kg	0.371 pCi/g
.75 mg/kg	0.191 pCi/g
.238 mg/kg	0.026 pCi/g
.250 mg/kg	0.027 pCi/g
.52 mg/kg	0.275 pCi/g

-07 Ci/g*
1 g/10^6 µg)(10^{12} pCi/1 Ci)
d Radiological Health, Bernard Shleien, Lester A. Slaback, Jr., and Brian Kent Birky, 1998, Williams and Wilkins Co.

econdary dilution factor.
ove limiting criteria.
leted.

Values Summary Remedial Action Goals – Shallow Zone" column.
terization Facility

Table B-2. Pre-Remediation Results for Shallow Zone Test Pits for Nonradionuclide COCs.

Up Values mmary lial Action hallow Zone 6 Meters Feet)][a] ng/kg)	Hanford Specific Background Activity (mg/kg)	Soil Sample WSCF#W070000218/ HEIS#B1ML78 Test Pit East End of Trench 3-Meter (10-Foot) Depth (mg/kg)	Soil Sample WSCF#W070000220/ HEIS#B1ML80 Test Pit West End of Trench 3-Meter (10-Foot) Depth (mg/kg)	Soil Sample WSCF#W070000221/ HEIS#B1ML81 Test Pit West End of Trench 3-Meter (10-Foot) Depth Duplicate (mg/kg)	Soil Sample WSCF#W070000224/ HEIS#B1ML99 Discrete Sample Highest Field Radiological Reading (mg/kg)	Soil Sample WSCF#W070000223/ HEIS#B1ML83 Field Blank (mg/kg)	WS E
.0[b]	5[d]	DU<0.302	DU<0.311	DU<0.307	DU<0.311	U<0.299	
.5[c]	6.5	D1.63	D1.99	D1.97	D3.64	U<0.399	
	132	D60.7	D68.2	D64.8	D86.4	U<0.200	
	0.81[d]	D0.175	D0.131	D0.134	D1.73	U<0.0998	
	18.5	D8.04	D2.97	D3.40	162.71[e]	U<0.499	
.2	NA	U<0.10	U<0.10	U<0.10	0.290	U<0.10	
	10.2	D5.20	D3.00	D2.96	D82.6	0.102	
	512	DN289	DN363	DN433	DN305	N0.212	
	0.33	DU<0.0503	DU<0.0519	DU<0.0512	D0.0807	U<0.0499	
	67.8	D43.9	D41.4	D47.0	D262	C8.77	
.5	NA	U<0.010 to U<0.021	U<0.010 to U<0.020	U<0.010 to U<0.021	0.091 for Aroclor 1254	U<0.010 to U<0.020	U-

ieve the direct exposure remedial action objectives (RAO) and the groundwater/Columbia River RAO; therefore, the lowest value among the "protection from Direct Exposure," "Protective of ues is the applicable look-up value.

practical quantitation limit (PQL). The value presented is the PQL.

kground. The value presented is background.

ilable; therefore values were taken from *Natural Background Soil Metals Concentrations in Washington State*, Publication No. 94-115, Washington State Department of Ecology, Olympia, Wa

) = chromium (III): 163 mg/kg – 0.290 mg/kg – 162.71 mg/kg for chromium (III).

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d above limiting criteria.

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Table F-3. Pre-Remediation Results for Deep Zone Test Pits for Radionuclide COCs.

Up Values Summary edial Action Goal – Deep Zone Meters (15 Feet)][a,b] (pCi/g)	Soil WSCF#W0 Hanford Specific Background Activity (pCi/g)	Soil Sample WSCF#W070000217/ HEIS#B1ML77 Test Pit East End of Trench 4.6-Meter (15-Foot) Depth (pCi/g)	Soil Sample WSCF#W070000219/ HEIS#B1ML79 Test Pit West End of Trench 4.6-Meter (15-Foot) Depth (pCi/g)	Soil Sample WSCF#W070000223/ HEIS#B1ML83 Field Blank (pCi/g)	Soil Sample WSCF#W070000222/ HEIS#B1ML82 Equipment Blank (pCi/g)	WSC H
7,000	NA	U<0.0360	U<0.0350	U<0.00390	U<-0.00200	
N/A	1.1	U<0.0125	0.0415	U<-0.00624	0.00836	
N/A	0.008	U<-0.000304	U<0.0120	U<-0.000878	U<-0.00395	
N/A	NA	U<0.000799	U<0.0300	U<-0.00562	U<-0.00772	
N/A	0.033	U<-0.0162	U<-0.00791	U<-0.000852	U<-0.00734	
N/A	0.054	U<0.0184	U<0.0160	U<0.0144	U<0.0145	
N/A	NA	U<-1.04	U<-2.91	U<0.0709	U<-2.46	
1,123	0.004	U<0.0210	U<-0.00180	U<-0.0320	U<0.00780	
8,600	0.025	U<0.0160	0.150	U<0.0120	0.00780	
N/A	0.18	U<0.0710	0.500	U<-0.130	0.660	
15[c]	NA	U<-0.100	U<-1.00	U<-0.100	U<-0.100	
N/A	1.3	D0.312	D0.259	0.027	0.026	
35.5	NA	U<-0.270	U<-0.580	U<-0.130	U<-0.460	U
1.1[d]	1.1	0.230	0.180	0.0750	0.0760	
1.0[c]	0.11	0.0120	0.0230	0.0200	U<0.00300	
1.1[d]	1.1	0.260	0.160	U<0.0270	0.0520	

'e the groundwater/Columbia River RAO; therefore, the lowest value between the "Protective of Groundwater" and the "Protective of the Columbia River" values is the applicable look-up valu
ıot applicable for protection from direct exposure to radionuclides because a potentially exposed individual in a basement is protected from gamma radiation by 3 feet (0.9 meter) of soil and a c
practical quantitation limit (PQL). The value presented is the PQL.
:kground. The value presented is background.

est Results	Converted Test Results
.86 mg/kg	0.312 pCi/g
.40 mg/kg	0.262 pCi/g
.38 mg/kg	0.259 pCi/g
.40 mg/kg	0.371 pCi/g
.75 mg/kg	0.191 pCi/g
.238 mg/kg	0.026 pCi/g
.250 mg/kg	0.027 pCi/g
.52 mg/kg	0.275 pCi/g

-07 Ci/g*
1 g/10^6 µg)(10^{12} pCi/1 Ci)
d Radiological Health, Bernard Shleien, Lester A. Slaback, Jr., and Brian Kent Birky, 1998, Williams and Wilkins Co.

secondary dilution factor

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Table F-4. Pre-Remediation Results for Deep Zone Test Pits for Nonradionuclide COCs.

Look-Up Values Summary emedial Action Goal – Deep Zone [>4.6 Meters (15 Feet)][a,b] (mg/kg)	Hanford Specific Background Activity (mg/kg)	Soil Sample WSCF#W070000217/ HEIS#B1ML77 Test Pit East End of Trench 4.6-Meter (15-Foot) Depth (mg/kg)	Soil Sample WSCF#W070000219/ HEIS#B1ML79 Test Pit West End of Trench 4.6-Meter (15-Foot) Depth (mg/kg)	Soil Sample WSCF#W070000223/ HEIS#B1ML83 Field Blank (mg/kg)	Soil WSCF# HEIS Equip (r
6.0[c]	5[e]	DU<0.309	DU<0.307	U<0.299	U<0
6.5[d]	6.5	D3.32	D2.97	U<0.399	U<0
N/A	132	D83.4	D44.4	U<0.200	0
N/A	0.81[e]	D0.121	D0.114	U<0.0998	U<0
N/A	18.5	D7.63	D4.84	U<0.499	U<0
2.2	NA	U<0.10	U<0.10	U<0.10	U<0
N/A	10.2	D5.50	D4.17	0.102	0
N/A	512	DN385	DN304	N0.212	N0
N/A	0.33	DU<0.0516	DU<0.0512	U<0.0499	U<0
N/A	67.8	D47.6	D44.3	C8.77	U<0
N/A	NA	U<0.010 to U<0.021	U<0.011 to U<0.021	U<0.010 to U<0.020	U<0.00

'e the groundwater/Columbia River RAO; therefore, the lowest value between the "Protective of Groundwater" and the "Protective of the Columbia River" values is the applicable look-up valu
ıot applicable for protection from direct exposure to radionuclides because a potentially exposed individual in a basement is protected from gamma radiation by 3 feet (0.9 meter) of soil and a c
practical quantitation limit (PQL). The value presented is the PQL.
:kground. The value presented is background.
ilable; therefore values were taken from *Natural Background Soil Metals Concentrations in Washington State*, Publication No. 94-115, Washington State Department of Ecology, Olympia, Wa

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APPENDIX G

WASTE SITE SAMPLING PHOTOGRAPHS AND RESULTS AFTER REMEDIATION ACTIVITIES

Figure G-1. 200-CW-3 OU: Waste Site Gridded for Multi-Incremental Sample Collection(s).

Figure G-2. 200-CW-3 OU: Collection of One Parent Sample in Bottom of Trench.

NOTE: Field work was performed using approved work plans based on WIDS data and historical knowledge, with consideration of potential radiological and hazardous contaminant concerns. Field screening of potential contaminants confirmed work plan assumptions and ensured protection of personnel.

Figure G-3. 200-CW-3 OU: Subsampling of Parent Sample Prior to Laboratory Analysis of Entire Bottle.

NOTE: Field work was performed using approved work plans based on WIDS data and historical knowledge, with consideration of potential radiological and hazardous contaminant concerns. Field screening of potential contaminants confirmed work plan assumptions and ensured protection of personnel.

Table C-1. Post-Remediation Attainment of Nonradionuclide Soil Remedial Action Goals for the Trench Side-Walls.

Up Values mmary lial Action hallow Zone 5 Meters Feet)][a] ng/kg)	Hanford Specific Background Activity (mg/kg)	Maximum Result Compared to Hanford Specific Background	Soil Sample WSCF#W070000553/ HEIS#B1NHK4 MIS Sample (mg/kg)	Soil Sample WSCF#W070000554/ HEIS#B1NHK5 MIS Replicate (mg/kg)	Soil Sample WSCF#W070000555/ HEIS#B1NHK6 MIS Replicate (mg/kg)	Soil Sample WSCF#W070000552/ HEIS#B1NHL2 Field Blank (mg/kg)
.0[b]	5[d]	<BG	U<0.293	U<0.296	U<0.295	U<0.296
.5[c]	6.5	<BG	2.74	2.85	2.44	U<0.394
	132	<BG	50.2	60.2	53.6	U<0.197
	0.81[d]	<BG	U<0.0978	0.107	U<0.0985	U<0.0986
	18.5	<BG	3.76	3.62	4.25	U<0.493
.2	NA	NA and not detected	JU<0.1	JU<0.1	JU<0.1	JU<0.1
	10.2	<BG	3.84	3.77	3.98	U<0.0986
	512	**>BG**	238	619	281	0.315
	0.33	<BG	U<0.0489	U<0.0493	U<0.0492	U<0.0493
	67.8	<BG	31.0	33.4	32.4	U<0.788
.5	NA	NA and not detected	JU<0.0045 to JU<0.0090	JU<0.0048 to JU<0.0095	JU<0.0044 to JU<0.0088	JU<0.0043 to JU<0.0086

ıieve the direct exposure remedial action objectives (RAO) and the groundwater/Columbia River RAO; therefore, the lowest value among the "protection from Direct Exposure," "Protective of ues is the applicable look-up value.

practical quantitation limit (PQL). The value presented is the PQL.

:kground. The value presented is background.

ilable; therefore values were taken from *Natural Background Soil Metals Concentrations in Washington State*, Publication No. 94-115, Washington State Department of Ecology, Olympia, Wa

nated due to a quality control deficiency identified during validation.

ıd not detected in the sample.

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Hanford Specific Background Activity (pCi/g)	Hanford Specific Background (BG)	WSCF#W070000535/ HEIS#B1NHK4 MIS Sample (pCi/g)	WSCF#W070000554/ HEIS#B1NHK5 MIS Replicate (pCi/g)	WSCF#W070000555/ HEIS#B1NHK6 MIS Replicate (pCi/g)	WSCF#W070000558/ HEIS#B1NHL0 Discrete Sample (pCi/g)	Soil Sample WSCF#W070000557/ HEIS#B1NHK9 Discrete Sample (pCi/g)	WSCF#W070000552/ HEIS#B1NHL2 Field Blank (pCi/g)	W
NA	NA	J0.0480	J0.0360	J0.0330	-----	-----	U<0.0150	
1.1	<BG	0.0543	0.0452	0.0253	-----	-----	U<-0.00332	
0.008	<BG	U<0.00249	U<-0.000404	U<-0.00346	-----	-----	U<0.000937	
NA	NA	U<0.0193	0.0416	U<0.0266	-----	-----	U<-0.00497	
0.033	<BG	U<-0.0213	U<0.00648	U<0.00472	-----	-----	U<-0.00222	
0.054	<BG	U<0.0286	U<0.0427	U<0.0494	-----	-----	U<0.0105	
NA	NA and not detected	U<0.514	U<0.163	U<0.700	-----	-----	U<1.01	
0.004	<BG	U<-0.0055	U<0.002	U<-0.0037	-----	-----	U<0.00220	
0.025	**>BG**	0.110	0.0510	0.0630	-----	-----	U<0.0110	
0.18	<BG	U<0.0620	J0.130	U<0.0150	-----	-----	U<-0.0200	
NA	NA and not detected	U<-0.100	U<-0.100	U<-0.100	-----	-----	U<-0.200	
1.3	<BG	0.209	0.208	0.209	-----	-----	U<0.011	
NA	NA and not detected	-----	-----	-----	U<0.450	U<-0.130	-----	
1.1	<BG	0.200	0.160	0.190	-----	-----	0.0560	
0.11	<BG	U<0.0110	J0.0260	U<0.0150	-----	-----	U<0.0120	
1.1	<BG	0.170	0.170	0.180	-----	-----	0.0480	

ieve the direct exposure remedial action objectives (RAO) and the groundwater/Columbia River RAO; therefore, the lowest value among the "protection from Direct Exposure," tective of the Columbia River" values is the applicable look-up value.
practical quantitation limit (PQL). The value presented is the PQL.
kground. The value presented is background.
erted from the Thorium metal mg/kg values reported by the laboratory.

est Results	Converted Test Results
mg/kg	0.267 pCi/g
mg/kg	0.296 pCi/g
mg/kg	0.329 pCi/g
4 mg/kg	0.016 pCi/g
0986 mg/kg	<0.011 pCi/g
mg/kg	0.209 pCi/g
mg/kg	0.208 pCi/g
mg/kg	0.209 pCi/g

-07 Ci/g*
1 g/10^6 µg)(10^{12} pCi/1 Ci)
d Radiological Health, Bernard Shleien, Lester A. Slaback, Jr., and Brian Kent Birky, 1998, Williams and Wilkins Co.

nated due to a quality control deficiency identified during validation.

id not detected in the sample.
terization Facility

Goal	Hanford Specific Background Activity (pCi/g)	Maximum Result Compared to Hanford Specific Background	Soil Sample WSCF#W070000548/ HEIS#B1NHK1 MIS Sample (pCi/g)	Soil Sample WSCF#W070000549/ HEIS#B1NHK2 MIS Replicate (pCi/g)	Soil Sample WSCF#W070000550/ HEIS#B1NHK3 MIS Replicate (pCi/g)	Soil Sample WSCF#W070000560/ HEIS#B1NHK7 Discrete Sample (pCi/g)	Soil Sample WSCF#W070000561/ HEIS#B1NHK8 Discrete Sample (pCi/g)	Soil Sample WSCF#W070000552/ HEIS#B1NHL2 Field Blank (pCi/g)	WSC H Eq
	NA	NA	J0.100	J0.0970	J0.180	-----	-----	U<0.0150	
	1.1	<BG	0.259	0.188	0.293	-----	-----	U<-0.00332	U<
	0.008	**>BG, but not detected**	U<0.00446	U<0.000271	U<0.00818	-----	-----	U<0.000937	U<
	NA	NA	0.105	0.0883	0.154	-----	-----	U<-0.00497	U<
	0.033	<BG	U<0.0112	U<0.0108	U<-0.00325	-----	-----	U<-0.00222	U<
	0.054	<BG	U<0.0446	U<0.0256	U<0.0376	-----	-----	U<0.0105	U<
	NA	NA and not detected	U<-0.347	U<-0.951	U<2.51	-----	-----	U<1.01	U
	0.004	**>BG, but not detected**	U<-0.0019	U<0.0130	U<0.0220	-----	-----	U<0.00220	U
	0.025	**>BG**	0.450	0.450	0.960	-----	-----	U<0.0110	U<
	0.18	**>BG**	J0.290	J0.0940	U<0.0460	-----	-----	U<-0.0200	
	NA	NA and not detected	U<-0.200	U<-0.200	U<-0.100	-----	-----	U<-0.200	U<
	1.3	<BG	0.267	0.296	0.329	-----	-----	U<0.011	
	NA	NA and not detected	-----	-----	-----	U<-0.0440	U<0.310	-----	--
	1.1	<BG	0.230	0.170	0.160	-----	-----	0.0560	
	0.11	<BG	J0.0210	J0.0095	J0.0170	-----	-----	U<0.0120	U
	1.1	<BG	0.230	0.160	0.140	-----	-----	0.0480	

ve the groundwater/Columbia River RAO; therefore, the lowest value between the "Protective of Groundwater" and the "Protective of the Columbia River" values is the applicable look-up valu
ıot applicable for protection from direct exposure to radionuclides because a potentially exposed individual in a basement is protected from gamma radiation by 3 feet (0.9 meter) of soil and a c
practical quantitation limit (PQL). The value presented is the PQL.
:kground. The value presented is background.
erted from the Thorium metal mg/kg values reported by the laboratory.

est Results	Converted Test Results
: mg/kg	0.267 pCi/g
: mg/kg	0.296 pCi/g
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-07 Ci/g*
1 g/10^6 µg)(10^{12} pCi/1 Ci)
d Radiological Health, Bernard Shleien, Lester A. Slaback, Jr., and Brian Kent Birky, 1998, Williams and Wilkins Co.

nated due to a quality control deficiency identified during validation.

ıd not detected in the sample.

mmary Action Goal – p Zone ers (15 feet)][a,b] ng/kg)	Background Activity (mg/kg)	Maximum Result Compared to Hanford Specific Background	WSCF#W070000548/ HEIS#B1NHJ3 MIS Sample (mg/kg)	WSCF#W070000549/ HEIS#B1NHK2 MIS Replicate (mg/kg)	WSCF#W070000550/ HEIS#B1NHK3 MIS Replicate (mg/kg)	WSCF#W070000552/ HEIS#B1NHL2 Field Blank (mg/kg)	WS F Ec
6.0[c]	5[e]	<BG	U<0.294	U<0.295	U<0.299	U<0.296	
6.5[d]	6.5	<BG	2.46	2.67	3.02	U<0.394	
N/A	132	<BG	58.3	58.1	59.7	U<0.197	
N/A	0.81e	<BG	0.0993	0.161	0.120	U<0.0986	
N/A	18.5	<BG	5.96	6.48	6.81	U<0.493	
2.2	NA	NA and not detected	JU<0.1	JU<0.1	JU<0.1	JU<0.1	
N/A	10.2	<BG	4.86	4.55	4.54	U<0.0986	
N/A	512	<BG	262	260	260	0.315	
N/A	0.33	<BG	U<0.0489	U<0.0492	U<0.0499	U<0.0493	
N/A	67.8	<BG	32.4	32.0	34.5	U<0.788	
N/A	NA	NA and not detected	JU<0.0048 to JU<0.0095	JU<0.0047 to JU<0.0094	JU<0.0048 to JU<0.0096	JU<0.0043 to JU<0.0086	JU<

ve the groundwater/Columbia River RAO; therefore, the lowest value between the "Protective of Groundwater" and the "Protective of the Columbia River" values is the applicable look-up valu
not applicable for protection from direct exposure to radionuclides because a potentially exposed individual in a basement is protected from gamma radiation by 3 feet (0.9 meter) of soil and a c
practical quantitation limit (PQL). The value presented is the PQL.
kground. The value presented is background.
ilable; therefore values were taken from *Natural Background Soil Metals Concentrations in Washington State*, Publication No. 94-115, Washington State Department of Ecology, Olympia, Wa

nated due to a quality control deficiency identified during validation.

id not detected in the sample.
terization Facility
rmation System

FH-0701773

ATTACHMENT 2

Remaining Sites Verification Package for the 216-N-2 Waste Site, 212-N Building Cooling Water Trench Located Within the 200-CW-3 Operable Unit, DOE/RL-2007-37

consisting of 32 pages, including this coversheet