Cleanup Verification Package for the 118-F-7, 100-F Miscellaneous Hardware Storage Vault

**Prepared for the U.S. Department of Energy
by Washington Closure Hanford**

October 2006

EXECUTIVE SUMMARY

This cleanup verification package documents completion of remedial action for the 100-F, Miscellaneous Hardware Storage Vault (also referred to as the 118-F-7 site). The 118-F-7 site is located within the 100-FR-2 Operable Unit in the 100-F Area of the Hanford Site in southeastern Washington State. The site consisted of an inactive solid waste storage vault used from 1945 to 1965 for temporary storage of slightly contaminated reactor parts that could be recovered and reused for the 100-F Area reactor operations. The storage vault was approximately 23 m² (247.5 ft²) and 2.4 m (8 ft) deep and was covered with a wooden lid. The site was located south of the 105-F Reactor Building and east of the railroad line connecting to the 105-F Reactor Building.

Remediation of the 118-F-7 site was completed in April 2006. Remedial activities included complete removal of the storage vault, the wooden roof structure, and underlying contaminated soil. Results of the sampling, laboratory analyses, and data evaluations for the 118-F-7 site (which includes the remediation footprint, below cleanup level overburden [stockpiled soil], and the above cleanup level staging pile footprint) indicate that all remedial action objectives and goals for direct exposure, protection of groundwater, and protection of the Columbia River have been met (see Table ES-1).

The site meets cleanup standards and has been reclassified as "interim closed out" in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989) and the Waste Site Reclassification Guideline TPA-MP-14 (RL-TPA-90-0001) (DOE-RL 1998). A copy of the waste site reclassification form is included as Attachment ES-1.

**Table ES-1. Summary of Cleanup Verification Results for the
118-F-7 Burial Ground. (2 Pages)**

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?	Ref.
Direct Exposure – Radionuclides	1. Attain 15 mrem/yr dose rate above background over 1,000 years.	1. Maximum activities for cesium-137 and strontium-90 (the only radionuclide COCs detected) are below the cumulative 15 mrem/yr dose rate.	Yes	d,e
Direct Exposure – Nonradionuclides	1. Attain individual COC RAGs.	1. All individual COC concentrations are below the direct exposure criteria.	Yes	d,e
Meet Nonradionuclide Risk Requirements	1. Hazard quotient of <1 for noncarcinogens.	1. All individual hazard quotients are less than 1.	Yes	e
	2. Cumulative hazard quotient of <1 for noncarcinogens.	2. All cumulative hazard quotients are less than 1.		e
	3. Excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	3. Cadmium, the only carcinogenic nonradionuclide COC for this site, was not detected.	Yes	d,e
	4. Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	4. Cadmium, the only carcinogenic nonradionuclide COC for this site, was not detected.	Yes	d,e
Groundwater/ River Protection – Radionuclides	1. Attain single COC groundwater and river protection RAGs.	1. Groundwater and river RAGs for cesium-137 and strontium-90, have been attained.	Yes	d,e
	2. Attain National Primary Drinking Water Standards: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs. ^a	2. RESRAD modeling predicts that residual concentrations of cesium-137 and strontium-90 meet the dose rate limit of 4 mrem/yr.		d
	3. Meet drinking water standards for alpha emitters: the more stringent of the 15 pCi/L MCL or 1/25th of the derived concentration guide per DOE Order 5400.5. ^b	3. There are no alpha-emitting COCs for this site.	NA	
	4. Meet total uranium standard of 21.2 pCi/L. ^c	4. Uranium is not a COC for this site.	NA	

**Table ES-1. Summary of Cleanup Verification Results for the
118-F-7 Burial Ground. (2 Pages)**

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?	Ref.
Groundwater/ River Protection – Nonradionuclides	1. Attain individual nonradionuclide groundwater and river cleanup requirements.	1. Lead and copper exceeded groundwater and/or river protection RAGs. However, results of the <i>100 Area Analogous Sites RESRAD Calculations</i> (BHI 2005) indicate that these constituents will not reach groundwater (and, therefore, the Columbia River) within 1,000 years. Therefore, the residual concentrations achieve the remedial action objectives for groundwater and river protection.	Yes	d
Other supporting Information	118-F-7 cleanup verification 95% UCL calculation (Appendix C). ^e 118-F-7 cleanup verification sample location design (Appendix C). ^f			

^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 Hanford Site background, the 30 µg/L MCL (65 *Federal Register* 76708) 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 The *Cleanup Verification Package for the 118-F-7, Miscellaneous Hardware Storage Vault*, CVP-2006-00007, Washington Closure Hanford, Richland, Washington.

^e *118-F-7 Verification 95% UCL Calculations*, 0100F-CA-V0269, Rev. 0, Washington Closure Hanford, Richland, Washington.

^f *118-F-7 Shallow Zone, ACL, and BCL Overburden Sampling Plan*, 0100F-CA-V0267, Rev. 0, Washington Closure Hanford, Richland, Washington.

COC = contaminant of concern

MCL = maximum contaminant level

NA = not applicable

RESRAD = RESidual RADioactivity (dose model)

Attachment ES-1

Waste Site Reclassification Form

Date Submitted: 9/18/06 Originator: L. M. Dittmer Phone: 372-9664	Operable Unit(s): 100-FR-2 Waste Site ID: 118-F-7, 100-F Miscellaneous Hardware Storage Vault Type of Reclassification Action: Rejected ☐ Closed Out ☐ Interim Closed Out ☒ No Action ☐	Control Number: 2006-056 Lead Agency: EPA
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This form documents agreement among the parties listed below authorizing classification of the subject unit as rejected, closed out, or no action and authorizing backfill of the site, if appropriate. Final removal from the National Priorities List (NPL) of no action or closed-out sites will occur at a future date.

Description of current waste site condition:

Remedial action at this site has been performed in accordance with remedial action objectives and goals established by the U.S. Environmental Protection Agency and the Washington State Department of Ecology, in concurrence with the U.S. Department of Energy, Richland Operations Office. The selected remedial action involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility at the 200 Areas of the Hanford Site, and (3) backfilling the site with clean soil to adjacent grade elevations. The excavation and disposal activities have been completed.

Basis for reclassification:

The results of verification sampling of the soils at the 118-F-7 waste site demonstrated that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also showed that residual contaminant concentrations are protective of groundwater and the Columbia River. The waste site does not have a deep zone; therefore, no institutional controls are required. The basis for reclassification is described in detail in the *Cleanup Verification Package for the 118-F-7, 100-F Miscellaneous Hardware Storage Vault* (CVP-2006-00007), Washington Closure Hanford, Richland, Washington.

D. C. Smith
DOE Project Manager

Signature

Date
10/2/06

NA
Ecology Project Manager

Signature

Date

R. A. Lobos
EPA Project Manager

Signature

Date
10-30-06

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ACRONYMS AND ABBREVIATIONS

ACL	above cleanup level
BCL	below cleanup level
COC	contaminant of concern
DQA	data quality assessment
EPA	U.S. Environmental Protection Agency
ERDF	Environmental Restoration Disposal Facility
RAG	remedial action goal
RDR/RAWP	remedial design report/remedial action work plan
RESRAD	RESidual RADioactivity dose assessment model
ROD	record of decision
SAP	sampling and analysis plan
UCL	upper confidence limit
WAC	<i>Washington Administrative Code</i>

1.0 INTRODUCTION

The purpose of this cleanup verification package is to document that the 118-F-7 waste site was remediated in accordance with the *Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-2, 100-HR-2, and 100-KR-2 Operable Units, Hanford Site (100 Area Burial Grounds), Benton County, Washington* (ROD) (EPA 2000). Remedial action objectives and goals for the 118-F-7 site were established by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy, Richland Operations Office, in concurrence with the Washington State Department of Ecology. These goals and objectives are documented in the 100 Area Burial Grounds ROD (EPA 2000) and the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005). The ROD (EPA 2000) provides the U.S. Department of Energy, Richland Operations Office the authority, guidance, and objectives to conduct this remedial action.

The preferred remedy specified in the ROD (EPA 2000) and conducted for the 118-F-7 site included (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility (ERDF) at the 200 Areas of the Hanford Site, and (3) backfilling the site with overburden (stockpiled soil) and clean soil to average adjacent grade elevation. Excavation was driven by remedial action objectives for direct exposure, protection of groundwater, and protection of the Columbia River. For the respective points of compliance, remedial action goals (RAGs) summarized in Table 1 were established for the radionuclide and nonradionuclide contaminants of concern (COCs). Waste site COCs were identified in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005) and are listed in Table 1. At the request of EPA cesium-137 and strontium-90 were added to the site verification COC list (WCH 2006). Additionally, copper was added as a COC as a result of a single detection above the RAGs within the above cleanup level (ACL) staging pile footprint.

Soil cleanup levels were established in the interim action ROD based on a limited ecological risk assessment. Although not required by the ROD (EPA 2000), a comparison against ecological risk screening levels has been made for the site COCs, as identified in the RDR/RAWP. Copper and lead exceeded screening level values; however, exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. The exceedance of soil screening values by lead and copper concentrations at the site will be evaluated in the context of additional lines of evidence for ecological effects. A baseline risk assessment for the river corridor portion of the Hanford Site began in 2004, which includes a more complete quantitative ecological risk assessment. That baseline risk assessment will be used as part of the final closeout decision for this site.

Table 1. Summary of Remedial Action Goals.

COCs	Direct Exposure RAG	Groundwater Protection RAG (pCi/L)	Columbia River Protection RAG (pCi/L)
Radionuclides			
Cobalt-60	15 mrem/yr (cumulative) ^a	4 mrem/yr (cumulative) ^b	4 mrem/yr (cumulative) ^b
Cesium-137			
Silver-108M			
Strontium-90		8 ^{c,d}	8 ^{c,d}
COCs	Direct Exposure RAGs (mg/kg)	Soil RAG for Groundwater Protection (mg/kg)	Soil RAG for Columbia River Protection (mg/kg)
Nonradionuclides			
Cadmium	13.9	0.81 ^e	0.81 ^e
Copper	2,960	59.2	22.0 ^e
Lead	353 ^f	10.2 ^e	10.2 ^e

^a Lookup values that correspond to the 15 mrem/yr dose rate are based on a generic site model and are presented in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005).

^b Lookup values based on individual radionuclide 4 mrem/yr dose rate equivalent for beta and gamma emitters per national drinking water standards as presented in the *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (DOE-RL 2001). Alpha emitters must meet drinking water standards based on the more conservative of the 15 pCi/L maximum contaminant level or 1/25th of the derived concentration guide per DOE Order 5400.5.

^c Strontium-90 contributes to the 4 mrem/yr (cumulative) RAG for groundwater and river protection.

^d Promulgated groundwater protection standard (40 CFR 141).

^e Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996).

^f *Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children* (EPA 1994).

COC = contaminant of concern

RAG = remedial action goal

WAC = Washington Administrative Code

2.0 SITE DESCRIPTION AND SUPPORTING INFORMATION

The 118-F-7 site is located in the 100-FR-2 Operable Unit of the 100-F Area at the Hanford Site. The site is south of the 105-F Reactor Building and east of the railroad line connecting to the 105-F Reactor Building (Figure 1). This site was an inactive solid waste storage vault used from 1945 to 1965 for temporary storage of slightly contaminated reactor parts that could be recovered and reused for the 100-F Area reactor operations. The vault was a concrete box measuring approximately 23 m² (247.5 ft²) by 2.4 m (8 ft) deep. The concrete box extended 46 cm (18 in.) above grade and was covered with a wooden lid. Underground Radioactive Material signs were posted on the wooden lid.

Figure 1. Hanford Site Map and 118-F-7 Site Plan.

3.0 REMEDIAL ACTION FIELD ACTIVITIES

3.1 EXCAVATION AND DISPOSAL

Remedial action at the 118-F-7 site began on January 31, 2006, with load out completed in April 2006. Excavation of the site involved removing the concrete vault structure, the wooden roof structure, and any underlying contaminated soil. A single lead/cadmium reactor poison piece, measuring 15 cm (6 in.) in length and 3.8 cm (1.5 in) in diameter, was discovered in the vault during excavation (WCH 2006). All contaminated materials were disposed at ERDF.

Pre- and post-remediation topographic maps are shown in Figures 2 and 3, respectively. At the conclusion of excavation activities, the elevation at the bottom of the excavation was 123 m (403.5 ft). The excavation area was 138 m² (1,487 ft²) with an approximate depth of 3.0 m (9.8 ft). An estimated 104 metric tons (115 U.S. tons) of material from the site was disposed at ERDF.

3.2 FIELD SCREENING

Radiological field screening was conducted during the site remedial actions as specified in the SAP (DOE-RL 2001). Field screening was used to guide the excavation to quickly assess the presence and level of contamination. Field screening at the site included using a radiological data mapping system survey. The radiological mapping survey was performed over more than 50% of the site excavation surface area using a Global Positioning Environmental Radiological Surveyor (GPERS). No significant levels of radiological activity were detected during the radiological field screening, as shown in Figure 4, and, therefore, no further remediation was required prior to collection of the final cleanup verification samples.

3.3 CLEANUP VERIFICATION SAMPLING AND ANALYSIS

Final cleanup verification samples were collected on June 5, 2006, to confirm acceptability of residual contaminant concentrations in the soil at the 118-F-7 waste site. The verification samples were submitted to offsite laboratories for analysis using approved EPA analytical methods, as required per the *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2001). The 118-F-7 site was excavated to a depth of approximately 3 m (9.8 ft). Therefore, the 118-F-7 remediation excavation footprint was classified as one shallow zone decision unit based on its size and depth. The below cleanup level (BCL) overburden (stockpiled soil) and the ACL staging pile footprint are separate shallow zone decision units. As specified in the SAP (DOE-RL 2001), four composite samples were collected from each of the waste site decision units, in addition to the single focused sample collected from beneath the location of the former vault.

Figure 2. 118-F-7 Pre-Remediation Topographic Map.

**Figure 3. 118-F-7 Post-Remediation Topographic Map
Showing Focused Sample Location.**

Figure 4. GPRS Radiological Survey Gamma Track Map of the 118-F-7 Remediation Footprint (February 2, 2006).

Verification sampling was performed by dividing each shallow zone decision unit (i.e., the excavation footprint, stockpiled soil, and ACL staging pile footprint) into four sampling areas (A1, A2, A3, and A4) with the sampling areas further divided into 16-node sample grids. One statistical verification sample was collected per sampling area by compositing soil collected at four randomly selected nodes. As such, each decision unit was represented by four composite statistical verification samples. Additionally, one focused soil sample was collected from the bottom of the remediation excavation beneath the location of the former vault. The sample design methodology and sample location figures are presented in the verification sample design calculation brief in Appendix C, and the location of the focused sample is provided in Figure 3.

4.0 CLEANUP VERIFICATION DATA EVALUATION

This section presents the evaluation and modeling of the 118-F-7 cleanup verification data for comparison with the data quality criteria and RAGs.

4.1 DATA QUALITY ASSESSMENT PROCESS

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 118-F-7 site determined that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. All analytical data were found to be acceptable for decision-making purposes. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in the Environmental Restoration project-specific database for data evaluation prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification data are summarized in Appendix A. The detailed DQA is presented in Appendix B.

4.2 CONTAMINANTS OF CONCERN 95% UPPER CONFIDENCE LIMIT

The primary statistical calculation to support cleanup verification is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. The 95% UCL values for each COC are computed for each decision unit (e.g., for the shallow zone, BCL overburden [stockpiled soil], and ACL staging pile footprint). Prior to calculating the 95% UCL, the individual sample results are reviewed and, as appropriate, adjusted per the SAP (DOE-RL 2001) and RDR/RAWP (DOE-RL 2005). This process is summarized below.

For radionuclides, the laboratory-reported value is used in the calculation of the 95% UCL. In cases where the laboratory does not report a value for data qualified with a “U” (i.e., less than the detection limit), one-half of the minimum detectable activity is used in the calculation of the 95% UCL. For nonradionuclides, a value equal to one-half the practical quantitation limit is used for data flagged with a “U” (i.e., less than the detection limit) in the calculation of the 95% UCL, as required by *Washington Administrative Code* (WAC) 173-340-740[7][g]. If greater than half of the sample results for a given nonradionuclide COC are below detection, the statistical value is set equal to the maximum concentration detected (i.e., versus computing a 95% UCL).

Verification sampling summary statistics (95% UCL values) are listed in Table 2. Individual sample cleanup verification results are presented in Appendix A. The columns on the left side of Table 2 are the COCs and the 95% UCL values before subtraction of background. The fifth column of Table 2 presents the background, where values exist, and the last three columns present the statistical values adjusted for background, if appropriate, which becomes the cleanup verification data set used for further evaluation and modeling.

Table 2. Cleanup Verification Data Set.

COCs	95% UCL Statistical Values ^a (pCi/g)			Hanford Site Background ^b (pCi/g)	Cleanup Verification Data Set ^c (pCi/g)		
	Shallow Zone	BCL Overburden	ACL Staging Pile Footprint		Shallow Zone	BCL Overburden	ACL Staging Pile Footprint
Cobalt-60	0.230 (ND)	0.190 (ND)	0.150 (ND)	0.008	0.230 (ND)	0.182 (ND)	0.150 (ND)
Cesium-137	0.301	0.0587 (ND)	0.205	1.1	0.301	0 (<BG) (ND)	0.205
Silver-108m	0.0351 (ND)	0.0281 (ND)	0.0298 (ND)	NA	0.0351 (ND)	0.0281 (ND)	0.0298 (ND)
Strontium-90	0.183	0.0418 (ND)	0.573	0.18	0.183	0 (< BG) (ND)	0.573
COCs	95% UCL Statistical Values ^a (mg/kg)			Hanford Site Background ^b (mg/kg)	Cleanup Verification Data Set (mg/kg)		
	Shallow Zone	BCL Overburden	ACL Staging Pile Footprint		Shallow Zone	BCL Overburden	ACL Staging Pile Footprint
Cadmium	0.21 (ND)	0.21 (ND)	0.21 (ND)	0.81 ^d	0.21 (ND)	0.21 (ND)	0.21 (ND)
Copper	12.2	10.8	369	22.0	12.2	10.8	369
Lead	10.9	5.2	25.4	10.2	10.9	5.2	25.4

^a The shallow zone, ACL staging pile footprint, and BCL overburden are from the *118-F-7 Cleanup Verification 95% UCL Calculations*, 0100F-CA-V0269, Rev. 0. Refer to Appendix C for additional details on determination of statistical values.

^b Represents the 90th percentile of the lognormal distribution (DOE-RL 1996).

^c For overburden (stockpiled soil) the anthropogenic background (DOE-RL 1996) and naturally occurring background is subtracted from all radionuclides. For other decision units (i.e., shallow zone and ACL staging pile footprint), only naturally occurring background (uranium) is subtracted. Refer to the 95% UCL calculation brief in Appendix C for additional details on determination of statistical values.

Table 2. Cleanup Verification Data Set.

COCs	95% UCL Statistical Values ^a (pCi/g)			Hanford Site Background ^b (pCi/g)	Cleanup Verification Data Set ^c (pCi/g)		
	Shallow Zone	BCL Overburden	ACL Staging Pile Footprint		Shallow Zone	BCL Overburden	ACL Staging Pile Footprint

^a Hanford Site-specific background value is not available; not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

ACL = above cleanup level

BCL = below cleanup level

COC = contaminant of concern

NA = not applicable

ND = not detected (in all samples in the data set)

UCL = upper confidence limit

4.3 FOCUSED SAMPLE RESULTS

One focused sample was collected from the bottom of the excavation underlying the former concrete vault structure and analyzed for the site COCs. Statistical analysis (e.g., calculation of a 95% UCL value) is inappropriate to use for evaluation of the focused sample; therefore, the sample results are evaluated using a direct comparison of the detected values to the cleanup levels. Table 3 provides a comparison of the focused sample results against the cleanup criteria.

Table 3. Comparison of Focused Sample Results to Remedial Action Goals.

COCs	Maximum Result (pCi/g)	Generic Site Lookup Values ^a (pCi/g)			Does the Maximum Result Exceed Lookup values?	Does the Maximum Result Pass Modeling?
		Shallow Zone Lookup Value ^b	Soil Concentration for Groundwater Protection	Soil Concentration for River Protection		
Cesium-137	0.110 (ND)	6.2	1,465 ^c	1,465 ^c	No	NA
Cobalt-60	0.180 (ND)	1.4	13,900 ^c	13,900 ^c	No	NA
Silver-108m	0.0590 (ND)	2.38 ^d	NV ^d	NV ^d	No	NA
Strontium-90	0.168 (ND)	4.5	27.6 ^c	27.6 ^e	No	NA
COCs	Maximum Result (mg/kg)	Remedial Action Goals ^a (mg/kg)			Does the Maximum Result Exceed RAGs?	Does the Maximum Result Pass Modeling?
		Direct Exposure	Soil Concentration for Groundwater Protection	Soil Concentration for River Protection		
Cadmium ^e	0.21 (ND)	13.9	0.81 ^f	0.81 ^f	No	NA
Copper	11.3	2960	59.2	22.0 ^f	No	NA
Lead	63.8	353	10.2 ^f	10.2 ^f	Yes	Yes ^g

Table 3. Comparison of Focused Sample Results to Remedial Action Goals.

COCs	Maximum Result (pCi/g)	Generic Site Lookup Values ^a (pCi/g)			Does the Maximum Result Exceed Lookup values?	Does the Maximum Result Pass Modeling?
		Shallow Zone Lookup Value ^b	Soil Concentration for Groundwater Protection	Soil Concentration for River Protection		

^a Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2005) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.

^b Activity corresponding to a single-radionuclide 15 mrem/yr exposure as calculated using a generic RESRAD model (DOE-RL 2005).

^c Revised lookup value per *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision* (BHI 2004).

^d Radionuclide was not included in the 100 Area RDR/RAWP (DOE-RL 2005); lookup value presented obtained from *100 Area Radionuclide and Nonradionuclide Lookup Values for the 1995 Interim Remedial Action Record of Decision* (BHI 2004).

^e Hanford Site-specific background value is not available; not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

^f Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996).

^g Based on *100 Area Analogous Sites RESRAD Calculations* (BHI 2005), with a groundwater table elevation of 114 m (374 ft) and a clean zone extending from groundwater to an elevation of 123 m (404 ft) lead is not predicted to reach groundwater within 1,000 years.

COC = contaminant of concern

NA = not applicable

ND = not detected

NV = no value

RAG = remedial action goal

RESRAD = RESidual RADioactivity (dose model)

WAC = Washington Administrative Code

4.4 RESRAD MODELING

A site-specific RESidual RADioactivity (RESRAD) model was not developed for the 118-F-7 waste site. The statistical sampling results, shown in Table 2, meet the remedial action goals summarized in Table 1. Additionally, no radionuclides were detected in the focused soil sample, as shown in Table 3.

5.0 EVALUATION OF REMEDIAL ACTION GOAL ATTAINMENT

This section demonstrates that remedial actions at the 118-F-7 site have achieved the applicable RAGs. Sections 5.1, 5.2, and 5.3 address attainment of direct exposure RAGs, groundwater protection RAGs, and Columbia River protection RAGs, respectively. Section 5.4 documents application of the WAC 173-340 three-part test to the shallow zone, BCL overburden (stockpiled soil), and the ACL staging pile footprint. This test is required for nonradionuclide COCs only and is based on the most restrictive RAG for each zone.

5.1 DIRECT EXPOSURE SOIL REMEDIAL ACTION GOALS ATTAINED

5.1.1 Radionuclides

Cesium-137 and strontium-90 were the only radionuclide COCs detected in the shallow zone remediation footprint and ACL staging pile footprint. The cumulative radionuclide dose was calculated separately for the shallow zone remediation footprint and ACL staging pile footprint, using the sum-of-fractions method as shown in Tables 4 and 5. The columns on the left side of Tables 4 and 5 are the COCs and the 95% UCL values. The third column of Tables 4 and 5 presents the single radionuclide 15 mrem/yr dose-equivalence activity, and the last column presents the statistical values divided by the dose-equivalence activity. The cumulative dose (1.4 mrem/yr) for the shallow zone remediation footprint is less than the 15 mrem/yr RAG. The cumulative dose (2.4 mrem/yr) for the ACL staging pile footprint is also less than the 15 mrem/yr RAG.

Table 4. Attainment of Radionuclide Direct Exposure RAG for the Shallow Zone Remediation Footprint.

Contaminants of Potential Concern	Maximum Activity (pCi/g)	Activity Equivalent to 15 mrem/yr Dose (pCi/g)	Fraction
Cesium-137	0.301	6.2	0.049
Strontium-90	0.183	4.5	0.041
Sum of Fractions			0.090
Equivalent Dose (mrem/yr)			1.4

Table 5. Attainment of Radionuclide Direct Exposure RAG for the ACL Staging Pile Footprint.

Contaminants of Potential Concern	Maximum Activity (pCi/g)	Activity Equivalent to 15 mrem/yr Dose (pCi/g)	Fraction
Cesium-137	0.205	6.2	0.033
Strontium-90	0.573	4.5	0.127
Sum of Fractions			0.16
Equivalent Dose (mrem/yr)			2.4

The statistical values for the BCL overburden (stockpiled soil) radionuclide COCs were either not detected or detected below the statistical background levels as reported in the *Hanford Site Background: Part 2, Soil Background for Radionuclides* (DOE-RL 1996). No radionuclide COCs were detected in the focused sample collected from the bottom of the remediation excavation. All applicable radionuclide RAGs have been met for direct exposure at the 118-F-7 waste site.

5.1.2 Nonradionuclides

5.1.2.1 Direct Comparison to RAGs. Table 6 compares the cleanup verification statistical values presented in Tables 2 and 3 to the direct exposure RAGs presented in Table 1. All residual concentrations are below the direct exposure RAG, and as such all applicable nonradionuclide RAGs have been met for direct exposure.

Table 6. Attainment of Nonradionuclide Direct Exposure Standards. (2 Pages)

Nonradionuclides	Cleanup Verification Data Set (mg/kg)	Direct Exposure RAG ^a (mg/kg)	Direct Exposure RAGs Attained? ^b
Shallow Zone			
Cadmium	0.21 (ND)	13.9	Yes
Copper	12.2	2,960	Yes
Lead	10.9	353	Yes
BCL Overburden			
Cadmium	0.21 (ND)	13.9	Yes
Copper	10.8	2,960	Yes
Lead	5.2	353	Yes
ACL Staging Pile Footprint			
Cadmium	0.21 (ND)	13.9	Yes
Copper	369	2,960	Yes
Lead	25.4	353	Yes
Focused Sample			
Cadmium	0.21 (ND)	13.9	Yes
Copper	11.3	2,960	Yes
Lead	63.8	353	Yes

^a Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.

^b Criterion is comparison to the cleanup criteria (RAG).

ACL = above cleanup level

BCL = below cleanup level

ND = not detected (in all samples in the data set)

RAG = remedial action goal

WAC = Washington Administrative Code

5.1.2.2 Noncarcinogenic Hazard Quotient RAG Attained. For noncarcinogenic COCs, WAC 173-340-740(5)(a) and (b) specify the evaluation of the hazard quotient, which is given as the daily intake divided by a reference dose (DOE-RL 2005). This

evaluation is shown for the ACL staging pile footprint in the 95% UCL calculation brief (Appendix C). A hazard quotient was not evaluated for the BCL overburden (stockpiled soil) as all nonradionuclide COCs were detected below background. Because lead was the only COC detected above background levels in the shallow zone remediation footprint, no further evaluation of the hazard quotient was required.

The calculated hazard quotient for residual concentrations of copper and lead in the ACL staging pile footprint is 2.0×10^{-1} . These values are below the individual and cumulative RAGs (a hazard quotient of <1.0 in both cases).

5.1.2.3 Carcinogenic Risk RAG Attained. For individual nonradionuclide carcinogenic COCs, the WAC 173-340 Method B cleanup limits are based on an incremental cancer risk of 1×10^{-6} . For nonradionuclide carcinogenic COCs, the total excess cancer risk must be less than 1×10^{-5} (DOE-RL 2005).

Cadmium is the only carcinogenic COC at this site. Cadmium was not detected in any of the samples collected at the 118-F-7 waste site; therefore, the calculation for carcinogenic risk is not required.

5.2 GROUNDWATER REMEDIAL ACTION GOALS ATTAINED

5.2.1 Radionuclides

Strontium-90 and cesium-137 were detected in the verification samples for the 118-F-7 shallow zone remediation footprint and ACL staging pile footprint. RESRAD modeling, using distribution coefficient (K_d) values of 50 mL/g for cesium-137 and 25 mL/g for strontium-90, predicts that the soil concentrations of cesium-137 and strontium-90 will be protective of groundwater (and therefore the Columbia River) at the maximum contaminant level that meets the 4 mrem/yr drinking water standard.

5.2.2 Nonradionuclides

Table 7 illustrates the comparison of cleanup verification values to the groundwater protection RAGs. The table shows that residual concentrations of lead in the shallow zone remediation footprint and lead and copper in the ACL staging pile footprint exceeded the soil RAGs for groundwater protection. Given the soil-partitioning coefficient of lead (30 mL/g) and copper (22 mL/g), the results of the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005) indicate that these constituents will not reach groundwater (and therefore the Columbia River) in 1,000 years given a clean zone extending at least 3 m (9.8 ft).

Table 7. Attainment of Nonradionuclide Remedial Action Goals for Protection of Groundwater and the Columbia River. (2 Pages)

Nonradionuclides	Cleanup Verification Data Set (mg/kg)	Soil RAG for Groundwater Protection ^a (mg/kg)	Soil RAG for Columbia River Protection ^a (mg/kg)	Groundwater and/or River Protection RAGs Exceeded?	Does RESRAD Predict Migration to Groundwater in 1,000 Years?
Shallow Zone					
Cadmium	0.21 (ND)	0.81 ^b	0.81 ^b	No	NA
Copper	12.2	59.2	22.0 ^b	No	NA
Lead	10.9	10.2 ^b	10.2 ^b	Yes	No ^c
BCL Overburden					
Cadmium	0.21 (ND)	0.81 ^b	0.81 ^b	No	NA
Copper	10.8	59.2	22.0 ^b	No	NA
Lead	5.2	10.2 ^b	10.2 ^b	No	NA
ACL Staging Pile Footprint					
Cadmium	0.21 (ND)	0.81 ^b	0.81 ^b	No	NA
Copper	369	59.2	22.0 ^b	Yes	No ^c
Lead	25.4	10.2 ^b	10.2 ^b	Yes	No ^c
Focused Sample					
Cadmium	0.21 (ND)	0.81 ^b	0.81 ^b	No	NA
Copper	11.3	59.2	22.0 ^b	No	NA
Lead	63.8	10.2 ^b	10.2 ^b	Yes	No ^c

^a Lookup values and RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2005) or calculated per WAC 173-340-720, WAC 173-340-730, and WAC 173-340-740, Method B, 1996, unless otherwise noted.

^b Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d]) (1996).

^c Based on *100 Area Analogous Sites RESRAD Calculations* (BHI 2005), with a groundwater table elevation of 114 m (374 ft) and a clean zone extending from groundwater to an elevation of 123 m (403 ft) the constituents are not predicted to reach groundwater within 1,000 years.

ACL = above cleanup level

BCL = below cleanup level

NA = Not applicable. RESRAD modeling was not performed because residual concentrations meet the groundwater and river protection RAGs.

ND = not detected (in all samples in the data set)

RAG = remedial action goal

RESRAD = RESidual RADioactivity (dose model)

WAC = Washington Administrative Code

5.3 COLUMBIA RIVER REMEDIAL ACTION GOALS ATTAINED

5.3.1 Radionuclides

The river protection RAGs for radionuclides are identical to the groundwater protection RAGs. The results indicated that radionuclides are not predicted to reach groundwater (and, by extension, not predicted to reach the Columbia River) at levels above 4 mrem/yr; therefore, the Columbia River protection RAGs have been attained.

5.3.2 Nonradionuclides

Table 7 illustrates the comparison of cleanup verification statistical values to the Columbia River protection RAGs. Residual concentrations of lead in the remediation footprint and lead and copper in the ACL staging pile footprint exceeded the soil RAGs for river protection. Given the soil-partitioning coefficients of lead (30 mL/g) and copper (22 mL/g), the results of the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005) indicate that these constituents will not reach groundwater (and therefore the Columbia River) in 1,000 years given a clean zone extending at least 3 m (9.8 ft).

5.4 WAC 173-340 THREE-PART TEST FOR NONRADIONUCLIDES

Sections 5.1, 5.2, and 5.3 looked separately at compliance with direct exposure RAGs, groundwater protection soil RAGs, and Columbia River protection soil RAGs. Section 5.4 documents application of the WAC 173-340 three-part test for nonradionuclides using the most restrictive RAGs applicable to each decision unit (i.e., shallow zone, overburden [stockpiled soil], and ACL staging pile footprint). The most restrictive RAG is defined as the lowest of the direct exposure, groundwater protection, and river protection RAGs. The direct exposure, groundwater protection, and river protection RAGs are applicable to the shallow zone, overburden (stockpiled soil), and ACL staging pile footprint. The WAC 173-340 three-part test consists of the following criteria: (1) the cleanup verification statistical value must be less than the cleanup level, (2) no single detection can exceed two times the cleanup criteria, and (3) the percentage of samples exceeding the cleanup criteria must be less than 10%.

Table 8 summarizes the results of the WAC 173-340 three-part test (WAC 173-340-740[7]) for the shallow zone, overburden (stockpiled soil), and ACL staging pile footprint sample data sets. For cadmium, copper, and lead, the table lists the most restrictive applicable RAG (selected from the RAGs in Table 1), the maximum detected value, the total number of samples collected, and the number of samples exceeding the most restrictive RAG. The final column of the table describes the result of applying the three WAC 173-340 criteria using the values listed in the preceding columns. Table 8 shows that cadmium, copper and lead pass the WAC 173-340 three-part test for all data sets.

Table 8. Application of the WAC 173-340 Three-Part Test. (2 Pages)

Nonradionuclides	Most Stringent Applicable RAG (mg/kg)	Statistical Value (mg/kg) ^a	Maximum Detected Value (mg/kg) ^b	Total Number of Samples ^c	Number Exceeding Criteria ^d	RAGs Attained? (Yes/No)
Shallow Zone						
Cadmium	0.81 ^e	0.21 (ND)	0.21 (ND)	5	0	Yes
Copper	22.0 ^e	12.2	12.5	5	0	Yes
Lead	10.2 ^e	10.9	18.8	5	1	Yes ^f
BCL Overburden						
Cadmium	0.81 ^e	0.21 (ND)	0.21 (ND)	5	0	Yes
Copper	22.0 ^e	10.8	11.5	5	0	Yes
Lead	10.2 ^e	5.2	5.3	5	0	Yes
ACL Staging Pile Footprint						
Cadmium	0.81 ^e	0.21 (ND)	0.21 (ND)	5	0	Yes
Copper	22.0 ^e	369	552	5	1	Yes ^g
Lead	10.2 ^e	25.4	31.1	5	1	Yes ^f

^a Criterion is comparison to the cleanup criteria (RAG).

^b Criterion is no single detection can exceed two times the cleanup criteria.

^c The total number of samples includes field duplicate samples, which are included in the evaluation as separate samples.

^d Criterion is the percentage of samples exceeding the cleanup criteria must be less than 10%.

^e Where cleanup levels are less than background or required detection limits (RDLs), cleanup levels default to background or RDLs per WAC 173-340-700(4)(d), and WAC 173-340-707(2), respectively.

^f Lead does not meet all three criteria of the WAC 173-340 three part test for the shallow zone and ACL staging pile footprint. However, because lead has a distribution coefficient value of 30 mL/g, an evaluation based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005) shows that lead will not reach groundwater (and therefore the Columbia River) within 1,000 years.

^g Copper does not meet all three criteria of the WAC 173-340 three part test for the ACL staging pile footprint. However, because copper has a distribution coefficient value of 22 mL/g, an evaluation based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005) shows that copper will not reach groundwater (and therefore the Columbia River) within 1,000 years.

ACL = above cleanup level

BCL = below cleanup level

ND = not detected (in all samples in the data set)

RAG = remedial action goal

WAC = Washington Administrative Code

6.0 STATEMENT OF PROTECTIVENESS

This cleanup verification package demonstrates that remedial action at the 118-F-7 site has achieved the remedial action objectives and corresponding RAGs established in the ROD (EPA 2000) and RDR/RAWP (DOE-RL 2005). The contaminated materials from the site have been excavated and disposed at ERDF. The remaining soils at the 118-F-7 site have been sampled, analyzed, and evaluated. The results of this effort

indicate that residual concentrations will support future land uses that can be represented (or bounded) by a rural-residential scenario and that residual concentrations throughout the site pose no threat to groundwater or the Columbia River. This site has no deep zone; therefore, no institutional controls are required. The 118-F-7 site is verified to be remediated in accordance with the ROD (EPA 2000) and may be backfilled.

7.0 REFERENCES

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APPENDIX A

SUMMARY OF VERIFICATION SOIL SAMPLING RESULTS FOR THE 118-F-7 WASTE SITE CONTAMINANTS OF CONCERN

118-F-7 Shallow Zone Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Cesium-137			Cobalt-60			Silver-108m			Strontium-90		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J12L42	6/6/06	4.03E-01		1.40E-01	2.30E-01	U	2.30E-01	5.90E-02	U	5.90E-02	2.49E-01		2.30E-01
A2	J12L43	6/6/06	1.50E-01		1.10E-01	1.20E-01	U	1.20E-01	7.70E-02	U	7.70E-02	8.00E-03	U	2.20E-01
A3	J12L44	6/6/06	1.00E-01	U	1.00E-01	6.30E-02	U	6.30E-02	4.80E-02	U	4.80E-02	7.00E-02	U	2.60E-01
A4	J12L45	6/6/06	9.80E-02	U	9.80E-02	1.10E-01	U	1.10E-01	5.70E-02	U	5.70E-02	5.70E-02	U	1.80E-01
Duplicate of J12L45	J12L46	6/6/06	1.40E-01	U	1.40E-01	2.00E-01	U	2.00E-01	5.70E-02	U	5.70E-02	6.50E-02	U	2.20E-01
Split of J12L45	J12L49	6/6/06	7.77E-02		2.91E-02	1.11E-02	U	3.04E-02	5.77E-03	U	2.29E-02	5.05E-02	U	1.05E-01
Focused Sample	J12LY7	6/6/06	1.10E-01	U	1.10E-01	1.80E-01	U	1.80E-01	5.90E-02	U	5.90E-02	1.68E-01	U	2.30E-01

Sample Location	HEIS Number	Sample Date	Cadmium			Copper			Lead		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A1	J12L42	6/6/06	0.20	U	0.20	11.5		0.35	5.1		0.89
A2	J12L43	6/6/06	0.20	U	0.20	12.5		0.35	5.3		0.91
A3	J12L44	6/6/06	0.20	U	0.20	11.6		0.34	6.1		0.88
A4	J12L45	6/6/06	0.20	U	0.20	11.0		0.35	8.5		0.89
Duplicate of J12L45	J12L46	6/6/06	0.21	U	0.21	11.1		0.36	18.8		0.93
Split of J12L45	J12L49	6/6/06	0.14	U	0.14	11.2		0.32	18.4		0.16
Focused Sample	J12LY7	6/6/06	0.21	U	0.21	11.3		0.35	63.8		0.92

Note: The following abbreviations apply to all Appendix A tables.

Note: Data qualified with N and J are considered acceptable values.

ACL = above cleanup levels

BCL = below cleanup levels

J = estimated

MDA = minimum detectable activity

N = Spiked analyte recovery is outside stated control limits.

PQL = practical quantitation limit

Q = qualifier

U = undetected

118-F-7 BCL Overburden Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Cesium-137			Cobalt-60			Silver-108m			Strontium-90		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J12L32	6/6/06	1.10E-01	U	1.10E-01	1.90E-01	U	1.90E-01	5.70E-02	U	5.70E-02	6.00E-02	U	1.60E-01
A2	J12L33	6/6/06	9.40E-02	U	9.40E-02	1.40E-01	U	1.40E-01	4.90E-02	U	4.90E-02	3.00E-03	U	1.80E-01
Duplicate of J12L33	J12L34	6/6/06	8.50E-02	U	8.50E-02	1.00E-01	U	1.00E-01	5.90E-02	U	5.90E-02	-7.00E-03	U	1.90E-01
A3	J12L35	6/6/06	1.20E-01	U	1.20E-01	1.80E-01	U	1.80E-01	5.40E-02	U	5.40E-02	-2.40E-02	U	1.90E-01
A4	J12L36	6/6/06	9.90E-02	U	9.90E-02	1.60E-01	U	1.60E-01	5.40E-02	U	5.40E-02	3.20E-02	U	2.00E-01
Split of J12L33	J12L47	6/6/06	-4.12E-03	U	1.88E-02	6.85E-03	U	2.00E-02	1.05E-03	U	1.29E-02	7.92E-03	U	1.36E-01

Sample Location	HEIS Number	Sample Date	Cadmium			Copper			Lead		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A1	J12L32	6/6/06	0.21	U	0.21	10.4		0.36	5.3		0.93
A2	J12L33	6/6/06	0.21	U	0.21	11.5		0.35	3.7		0.92
Duplicate of J12L33	J12L34	6/6/06	0.21	U	0.21	10.5		0.35	3.8		0.91
A3	J12L35	6/6/06	0.20	U	0.20	10.4		0.35	4.8		0.90
A4	J12L36	6/6/06	0.21	U	0.21	10.7		0.35	4.4		0.91
Split of J12L33	J12L47	6/6/06	0.14	UN	0.14	12.3		0.32	4.0		0.16

118-F-7 ACL Staging Pile Footprint Verification Sampling Results.

Sample Location	HEIS Number	Sample Date	Cesium-137			Cobalt-60			Silver-108m			Strontium-90		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J12L37	6/6/06	1.14E-01		6.60E-02	9.60E-02	U	9.60E-02	5.20E-02	U	5.20E-02	8.50E-02	U	2.00E-01
A2	J12L38	6/6/06	1.30E-01	U	1.30E-01	1.50E-01	U	1.50E-01	5.80E-02	U	5.80E-02	8.23E-01		2.10E-01
A3	J12L39	6/6/06	1.91E-01		7.00E-02	7.50E-02	U	7.50E-02	4.90E-02	U	4.90E-02	1.32E-01	U	2.30E-01
Duplicate of J12L40	J12L40	6/6/06	2.25E-01		8.90E-02	9.50E-02	U	9.50E-02	5.90E-02	U	5.90E-02	9.80E-02	U	2.10E-01
A4	J12L41	6/6/06	2.04E-01		9.10E-02	1.10E-01	U	1.10E-01	6.10E-02	U	6.10E-02	5.10E-02	U	2.10E-01
Split of J12L40	J12L48	6/6/06	1.63E-01		2.16E-02	2.77E-03	U	2.51E-02	2.72E-03	U	1.72E-02	1.57E-01		1.03E-01

Sample Location	HEIS Number	Sample Date	Cadmium			Copper			Lead		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
A1	J12L37	6/6/06	0.21	U	0.21	12.2		0.35	17.4		0.92
A2	J12L38	6/6/06	0.20	U	0.2	11.0		0.35	12.2		0.91
A3	J12L39	6/6/06	0.21	U	0.21	11.3		0.36	7.4		0.92
Duplicate of J12L40	J12L40	6/6/06	0.21	U	0.21	10.9		0.35	7.6		0.97
A4	J12L41	6/6/06	0.21	U	0.21	552		0.36	31.1		0.93
Split of J12L40	J12L48	6/6/06	0.14	UN	0.14	10.4		0.32	7.6		0.16

APPENDIX B
DATA QUALITY ASSESSMENT

B1.0 DATA QUALITY ASSESSMENT FOR THE 118-F-7 WASTE SITE

B1.1 OVERVIEW

The data quality assessment (DQA) completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process. The DQA includes a review of the field logbook information (WCH 2006d) to verify sample location, date, and time. It also involves a scientific and statistical evaluation of the data to determine if they are of the right type, quality, and quantity to support their intended use for closeout decisions (EPA 2000).

This DQA was performed in accordance with data quality objectives found in the *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2001). The DQA is based on the guidelines presented in *Guidance for Data Quality Assessment* (EPA 2000). Statistical tests used in this DQA were performed as specified in the SAP and the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005). This DQA was performed with respect to the contaminants of concern (COCs) for the 118-F-7 waste site (cesium-137, cobalt-60, silver-108m, strontium, cadmium, copper, and lead) (WCH 2006a).

Prior to performing statistical tests, the field logbook (WCH 2006d), the sample design (WCH 2006b), and sample analytical data are evaluated. A portion of the cleanup verification sample analytical data are validated for compliance requirements (DOE-RL 2001). An evaluation is performed to determine if the laboratory carried out all steps required by the SAP and the laboratory contract governing the conduct of analysis and reporting of the data. Data validation in accordance with validation procedures specified in "*Data Validation Procedure for Chemical Analysis*" (BHI 2000a) and *Data Validation Procedure for Radiochemical Analysis* (BHI 2000b) is performed as part of data evaluation. After data evaluation and validation, the appropriate statistical analyses are performed on the adjusted raw analytical data (Appendix C) to determine statistical values for each contaminant. The cleanup verification sample analytical data are stored in the Environmental Restoration project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database and are also summarized in Appendix A.

B1.2 LABORATORY QUALITY MEASURES

All verification samples are subject to laboratory-specific quality assurance (QA) requirements, including instrument procurement, maintenance, calibration, and operation. Additional laboratory quality control (QC) checks are performed, as appropriate, for the analytical method at a rate of one per sample delivery group (SDG), or 1 in 20, whichever is more frequent. Laboratory internal QC checks include the following:

- Laboratory Contamination. Each analytical batch contains a laboratory (method) blank (material of similar composition as the samples with known/minimal contamination of the analytes of interest) carried through the complete analytical process. The method blank is used to evaluate samples for false-positive results due to contamination during handling at the laboratory.
- Analytical Accuracy. For most analyses, a known quantity of representative analytes of interest (matrix spike/matrix spike duplicate [MS/MSD]) are added to a separate aliquot of a sample from the analytical batch. The recovery percentage of the added MS is used to evaluate analytical accuracy. For analyses not amenable to MS techniques (e.g., gamma energy analysis) or where analytical recovery is corrected via internal standards (e.g., alpha spectral analyses), accuracy is evaluated from recovery of the QC reference sample (e.g., laboratory control spike or blank spike sample).
- Analytical Precision. Separate aliquots removed from the same sample container (replicate samples) are analyzed for each analytical batch. The replicate sample results (evaluated as relative percent differences [RPDs]) are used to assess analytical precision. However, this method is subject to natural heterogeneities
- QC Reference Samples. A QC reference sample is prepared from an independent standard at a concentration other than that used for calibration, but within the calibration range. Reference samples provide an independent check on analytical technique and methodology.

Laboratories are also subject to periodic and random assessments of the laboratory performance, systems, and overall program. These assessments are performed by the Washington Closure Hanford QA group to ensure that the laboratories are performing within laboratory contract requirements.

B1.3 DATA VALIDATION

After sampling was completed, all of the fixed-base laboratory data from SDG K0411 were submitted for third-party validation to Level C. Level C validation procedures are specified in *Data Validation Procedure for Radiochemical Analysis* (BHI 2000b) and *Data Validation Procedure for Chemical Analysis* (BHI 2000a).

Level C validation procedures were used in the review of the following items, as appropriate, for each analytical method:

- Sample holding times
- Method blanks
- MS/MSD recovery
- Surrogate recovery
- Sample replicates (duplicates)

- Associated batch laboratory control sample results
- Data package completeness
- Achievement of required (or contractual) detection limits (RDLs).

Data flagged by the validator as estimated (i.e., "J") indicate that the associated concentration is an estimate, but that the data may be used for decision-making purposes. Data flagged as below all detection limits (i.e., "U") indicate the contaminant was analyzed for but not detected, and that the concentration is below the minimum detectable activity (MDA) for radionuclides or the practical quantitation limit (PQL) (i.e., reporting limit) for nonradionuclides. For nonradionuclides, nondetects are reported at the PQL. For radionuclides, nondetects report the actual value obtained from analysis (positive or negative but less than the MDA) except for limited analyses where no value can be calculated. In these cases, the MDA is reported. This situation is applicable for sample results that are below detection limits. All other validated results are considered to be accurate within the standard errors associated with the methods.

The adequacy of laboratory QA/QC was evaluated for precision, accuracy, completeness, and RDLs pursuant to the SAP (DOE-RL 2001). The organization performing the data validation reported that, of the data given formal validation, the laboratory met the standards for performance for precision ($\pm 30\%$), accuracy ($\pm 30\%$), and completeness ($>90\%$). Comparison of the RDL with the respective MDA or PQL is discussed in Section B1.4.

SDG K0411 contains 18 samples (J12L32, J12L33, J12L34, J12L35, J12L36, J12L37, J12L38, J12L39, J12L40, J12L41, J12L42, J12L43, J12L44, J12L45, J12L46, J12L48, J12L49, J12LY7). Samples J12L34, J12L40, and J12L46 are field duplicates of samples J12L33, J12L39, and J12L45, respectively. Sample J12LY7 is a focus sample. No equipment blank was collected for this site. SDG K0411 was submitted for third-party validation.

- **Radionuclides.** No major or minor deficiencies were found in the SDG K0411 COC radiological data.
- **Nonradionuclides.** No major deficiencies were found in the SDG K0411 COC nonradiological data. Minor deficiencies are as follows:

In the field duplicate pair of samples J12L45 and J12L46 there is an elevated RPD for lead of 75%. No qualification is required for elevated RPDs in field duplicate samples. The data are useable for decision-making purposes.

B1.4 LABORATORY DATA EVALUATION

The following paragraphs include a data evaluation of the remaining verification sample SDGs for the 118-F-7 waste site. Those SDGs are SDGJ 00078, SDG J00080, and

SDG J00081. SDG J00078 consists of one sample (J12L47), a split of sample J12L33. SDG J00080 consists of one sample (J12L48), which is a split of sample J12L39. SDG J00081 consists of one field sample (J12L49) a split of sample J12L45. The split samples (SDGs J00078, J00080, and J00081) were sent to Severn Trent Laboratories while the bulk of the samples (SDG K0411) were sent to Eberline Analytical Services.

The metals analyses for SDGs J00078, J00080, and J00081 were analyzed at Severn Trent Laboratories' St. Louis, Missouri facility. It is worth noting that not all of the qualifier flags used by the St. Louis laboratory are the same as the standard qualifiers used in the rest of the data set. Because of laboratory reporting conventions forced by shared use of the analytical services contract, some results in SDGs J00078, J00080, and J00081 (samples J12L47, J12L48, and J12L49) were qualified with "N" qualifiers. The "N" qualifier appears in the COC data in Appendix A, qualifying the cadmium results in samples J12L47 and J12L48. The "N" qualifier in this case indicates that there was a problem with the associated MS for cadmium.

The context for assessing the data includes evaluating the sample data using the statistical methodology and parameters specified in the SAP (DOE-RL 2001). This section summarizes the results of the comparison and presents an evaluation of the data.

MAJOR DEFICIENCIES

Any data anomaly that causes final data to be qualified as rejected (R flagged) is considered a major deficiency. No major deficiencies were identified in the data.

MINOR DEFICIENCIES

Sample Holding Times. All of the method-specific holding times were met for all samples in the 118-F-7 data set.

Method Blanks. The method blank is used to evaluate false-positive results in samples due to contamination during handling at the laboratory.

Radionuclides. All of the COC radionuclide method blank results were within the acceptance criteria.

Nonradionuclides. All of the COC nonradionuclide method blank results were within the acceptance criteria.

MS/MSDs Recoveries. Recovery of spiked analytes in the MS/MSD pair(s) are used to evaluate method efficiency and the effect of the sample matrix on the environmental sample results.

Radionuclides. All MS/MSD recoveries for radionuclide COCs were within acceptance criteria.

Nonradionuclides. All MS/MSD recoveries for nonradionuclide COCs were within the project-specified acceptance criteria. The MS recovery for cadmium was below the laboratory-specified acceptance criteria at 70%. The laboratory qualified the cadmium data for samples J12L47 and J12L48 with "N" qualifiers to indicate the MS was below their criteria (75% to 125%). The data are within project specified criteria and are useable for decision-making purposes.

RDL Comparison. Reported analytical detection levels for nondetected analytes were compared to the RDLs specified in the RDR/RAWP (DOE-RL 2005). When detected results were obtained, evaluation of detection limits was not performed. The data validation and supplemental data evaluation noted any analyses in which the detection limit (MDA or PQL) was above the SAP RDLs for nondetected analytes.

Radionuclides. All of the reported COC MDAs are sufficiently low for decision-making purposes. All values meet the site cleanup criteria as demonstrated in the calculation briefs (Appendix C) and discussed in this cleanup verification package.

Nonradionuclides. All of the reported COC MDLs are sufficiently low for decision-making purposes. All values meet the site cleanup criteria as demonstrated in the calculation briefs (Appendix C) and discussed in this cleanup verification package.

Precision and Accuracy Evaluation. Analytical accuracy and precision were evaluated by examination of the RPD of the main, duplicate, and split samples (WCH 2006c). Only the COCs detected at five times the target detection limit (or greater) are used for data analysis with respect to accuracy and precision.

Radionuclides. RPDs for the radionuclide analytes were not calculated because an evaluation of the data shows none of the analytes were detected in both the main and duplicate (or split) sample at more than five times the target detection limit.

Nonradionuclides. The RPDs for copper were calculated in the split and duplicate analyses for the shallow zone, overburden (stockpiled soil), and waste staging area footprint. All calculated RPDs for copper were within the range of 0.9% to 9.1% and are within the acceptance criterion (<30%). The data are useable for decision-making purposes.

RPDs for the remaining COC nonradionuclide analytes were not calculated because an evaluation of the data shows none of the analytes were detected in both the main and duplicate (or split) sample at more than five times the target detection limit. RPDs of analytes detected at low concentrations (less than five times the detection limit) are not considered to be indicative of the analytical system performance. The data are useable for decision-making purposes.

B1.5 FIELD QUALITY ASSURANCE/QUALITY CONTROL

Field QA/QC measures were used to assess potential sources of error and cross contamination of soil samples that could bias results. Field QA/QC samples listed in the field logbook (WCH 2006d) are summarized in Table B-1. The main and QA/QC sample results are presented in Appendix A.

Table B-1. Summary of Field Quality Control Samples.

Main Sample	Duplicate	Split
J12L33	J12L34	J12L47
J12L39	J12L40	J12L48
J12L45	J12L46	J12L49

Field duplicate samples were collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by computing the RPD of the duplicate samples for each COC. Only analytes with values above five times the detection limits for both the main and duplicate samples are compared. The 95% upper confidence limit (UCL) calculation briefs in Appendix C provide details on duplicate pair evaluation and RPD calculation. The data are suitable for the intended purpose of cleanup verification.

Split samples were collected to provide a relative measure of the degree of variability in the sampling, sample handling, and analytical techniques used by commercial laboratories. The field main and split samples are evaluated by computing the RPD of the split samples for each COC to determine the usability of the verification data. The U.S. Environmental Protection Agency Contract Laboratory Program duplicate sample comparison methodology, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 1994), is used as an initial test of the data from the splits. Only analytes that had values above five times the contractual RDL for both the main and split sample were compared. The 95% UCL calculation briefs in Appendix C provide details on split pair RPD calculation. The results are useable for decision-making purposes.

B1.6 SUITABILITY OF DATA

The DQA for the 118-F-7 waste site determined that the data are of the right type, quality, and quantity to support site cleanup verification decisions within specified error tolerances. The DQA verified that the sample design was sufficient for the purpose of clean site verification. All analytical data were found to be acceptable for decision-making purposes.

B2.0 REFERENCES

- BHI, 2000a, *Data Validation Procedure for Chemical Analysis*, BHI-01435, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- BHI, 2000b, *Data Validation Procedure for Radiochemical Analysis*, BHI-01433, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.
- DOE-RL, 2001, *100 Area Burial Grounds Remedial Action Sampling and Analysis Plan*, DOE/RL-2001-35, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- DOE-RL, 2005, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- EPA, 1994, *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94/013, U.S. Environmental Protection Agency, Washington, D.C.
- EPA, 2000, *Guidance for Data Quality Assessment*, EPA QA/G-9, QA00 Update, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.
- WCH, 2006a, *100-F Field Remediation Cleanup Verification*, CCN 127646, Washington Closure Hanford, Richland, Washington.
- WCH, 2006b, *118-F-7 Shallow Zone, ACL, and BCL Overburden Sampling Plan*, 0100F-CA-V0267, Rev. 0, Washington Closure Hanford, Richland, Washington.
- WCH, 2006c, *118-F-7 Waste Site Cleanup Verification 95% UCL Calculations*, 0100F-CA-V0269, Rev. 0, Washington Closure Hanford, Richland, Washington.
- WCH, 2006d, *Remedial Sampling*, Logbook EFL-1174-1, Washington Closure Hanford, Richland, Washington.

APPENDIX C
CALCULATION BRIEF EXCERPTS

DISCLAIMER FOR CALCULATIONS

The calculations that are provided in the following appendix have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents in the Administrative Record.

CALCULATION BRIEFS

The following calculation briefs have been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculations," Washington Closure Hanford, Richland, Washington.

118-F-7 Shallow Zone, ACL, and BCL Overburden Sampling Plan, 0100F-CA-V0267, Rev. 0, Calculation No. 0100F-CA-V0267, Rev. 0, Washington Closure Hanford, Richland, Washington.

118-F-7 Cleanup Verification 95% UCL Calculations, Calculation No. 0100F-CA-V0269, Rev. 0, Washington Closure Hanford, Richland, Washington.

NOTE: The calculation briefs referenced in this appendix are kept in the active Washington Closure Hanford project files and are available upon request. When the project is completed, the files will be stored in a U.S. Department of Energy, Richland Operations Office repository. Only excerpts of the calculation briefs are included in this appendix.

CALCULATION COVER SHEET

Project Title:	118-F-7 Burial Ground Sample Design	Job No.	14655
Area	100-F		
Discipline	Environmental Engineering	*Calc. No.	0100F-CA-V0267
Subject	118-F-7 Shallow Zone, ACL, and BCL Overburden Sampling Plan		
Computer Program	Excel	Program No.	Excel 2003

The attached calculations have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sht Calc = 2 Shts Attach1 = 1 Sht Attach2 = 1 Sht Attach3 = 3 Shts Total = 8 Shts	<i>GC</i> G. Cruz 7-26-06	<i>AB</i> C.A. Bentz 7/27/06	<i>RTC</i> R.T. Coffman 7/31/06	<i>SWC</i> S.W. Callison 7-31-06	7-31-06
SUMMARY OF REVISIONS						

WCH-DE-018 (4/14/06)

*Obtain Calc. No. from R&DC and Form from Intranet

Washington Closure Hanford

CALCULATION SHEET

Originator G. Cruz Date 7/26/2006 Calc. No. 0100F-CA-V0267 Rev. No. 0
Project 118-F-7 Burial Ground Sample Design Job No. 14655 Checked AB Date 7/27/06
Subject 118-F-7 Shallow Zone, ACL, and BCL Overburden Sampling Plan Sheet No. 1of2

1	Problem:	Calculate and display required sampling nodes in concurrence with 100 Area Burial Grounds Remedial Action Sampling and Analysis Plan, DOE/RL-2001-35 Rev. 0, for verification and closure.
2		
3		
4	Given:	-SAP (DOE/RL-2001-35 Rev. 0) requirements
5		-Shallow Sampling Area (Surface area of each zone determined from CAD program,
6		Attachment 3, Sht 1 of 3, CAD file 1F:072606A, 118-F-7 Burial Ground Shallow Zone Sampling Plan)
7		
8		-ACL Overburden Sampling Area (Surface area of each zone determined from CAD program,
9		Attachment 3, Sht 2 of 3, CAD file 1F:072606B, 118-F-7 Burial Ground ACL Overburden Sampling Plan)
10		-BCL Overburden Sampling Area (Surface area of each zone determined from CAD program,
11		Attachment 3, Sht 3 of 3, CAD file 1F:072606C, 118-F-7 Burial Ground BCL Overburden Sampling Plan)
12		
13		
14		
15	SAP Requirements:	
16		-Develop a 16 node sampling grid for the sampling area
17	Shallow Zone:	-Use table 3-2 of the SAP to determine which four of the sixteen nodes will be sampled
18		to collect clean up verification samples
19		
20		-Develop a 16 node sampling grid for the sampling area
21	Overburden:	-Use table 3-2 of the SAP to determine which four of the sixteen nodes will be sampled
22		to collect clean up verification samples
23		
24		-Develop a 16 node sampling grid for the sampling area
25	Deep Zone:	-Use table 3-2 of the SAP to determine which four of the sixteen nodes will be sampled
26		to collect clean up verification samples
27		
28	Determination of Shallow Zone Sampling Grid:	
29		
30	Shallow Zone Sampling Grid Area determined from Table 3-2, SAP	
31	Attachment 2, Number of Decision Subunits Based on Area (Converted to Sq Meters)	
32		
33	Total Area:	138.34 m ²
34	Area of Decision Subunits (total area 1 subunit)	138.34 m ²
35		
36	Decision Subunit divided into 4 Sampling Areas:	34.58 m ²
37		
38	Sampling Areas divided into a 16 node grid (node numbers 1-16):	2.16 m ²
39		
40	Nodes to be Sampled (as determined from Attachment 1, Table A-1, Sample Grid Point Lookup Table)	
41		See Attachment 3, Sht 1 of 3, 118-F-7 Burial Ground Shallow Zone Sampling Plan,
42		for Sample Location Table
43		
44		
45		
46		

Washington Closure Hanford

Originator G. Cruz Date 7/26/2006 Calc. No. 0100F-CA-V0267 Rev. No. 0
 Project 118-F-7 Burial Ground Sample Design Job No. 14655 Checked ALB Date 7/27/06
 Subject 118-F-7 Shallow Zone, ACL, and BCL Overburden Sampling Plan Sheet No 1 of 1

1 ATTACHMENT 1

2

3 Sample Grid Point Lookup Table.

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6	Default Plan	Sampling Area 1	Sampling Area 2	Sampling Area 3	Sampling Area 4	Sampling Area 5	Sampling Area 6	Sampling Area 7	Sampling Area 8	Sampling Area 9	Sampling Area 10
7	Closeout	3	6	1	4	5	1	3	3	4	16
8	Closeout	4	7	11	3	15	15	5	13	10	10
9	Closeout	16	3	2	7	7	10	11	4	3	14
10	Closeout	10	15	4	12	1	13	4	8	16	4
11	Not Sampling	2	14	5	9	13	12	8	2	14	8
12	Not Sampling	13	10	9	13	2	16	1	12	5	3
13	Not Sampling	6	1	10	8	14	4	16	5	8	6
14	Not Sampling	1	9	13	1	10	5	12	1	1	15
15	Not Sampling	9	12	7	5	6	2	6	7	15	9
16	Not Sampling	15	16	15	14	16	6	2	15	11	1
17	Not Sampling	8	13	8	10	12	11	13	14	2	12
18	Not Sampling	5	2	3	11	4	3	9	10	7	11
19	Not Sampling	7	11	14	15	11	14	14	6	13	2
20	Not Sampling	11	4	6	2	9	7	7	11	9	7
21	Not Sampling	12	8	16	16	3	8	15	9	6	13
22	Not Sampling	14	5	12	6	8	9	10	16	12	5

23 ** Note: Grid nodes for each sampling area in each waste site should be numbered consistently, e.g., begin numbering
 24 the nodes in the northwesternmost node. Then number consecutively left to right.

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Washington Closure Hanford

Originator G. Cruz Date 7/26/2006 Calc. No. 0100F-CA-V0267 Rev. No. 0
Project 118-F-7 Burial Ground Sample Design Job No. 14655 Checked CSB Date 7/27/06
Subject 118-F-7 Shallow Zone, ACL, and BCL Overburden Sampling Plan Sheet No. 1of1

1 ATTACHMENT 2

2

3 Number of Decision Subunits Based on Area.

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Site Verification Sampling Frequencies Based on Area.					
Decision Unit ^a	Waste Site Size ^b	Decision Subunits	Blocks ^c	Discrete Samples	Composite Samples
Shallow zone - 0 10 15 ft	Small: < 100,000 ft ²	1	4	16	4
	Medium: >100,000 ft ² < 400,000 ft ²	4	16	64	16
	Large: >400,000 ft ²	8	32	128	32
Deep Zone - >15 ft	Small: < 100,000 ft ²	1	4	16	4
	Medium: >100,000 ft ² < 400,000 ft ²	4	16	64	16
	Large: >400,000 ft ²	8	32	128	32
Overburden/layback stockpiles	Small: < 100,000 ft ²	1	4	16	4
	Medium: >100,000 ft ² < 400,000 ft ²	4	16	64	16
	Large: >400,000 ft ²	8	32	128	32
Staging pile areas (residual soil)	Small: < 100,000 ft ²	1	4	16	4
	Medium: >100,000 ft ² < 400,000 ft ²	4	16	64	16
	Large: >400,000 ft ²	8	32	128	32

^a The shallow zone, deep zone, overburden stockpile, and staging pile areas each represent single decision units. The total number of decision units will vary because individual waste sites may not have a deep zone, overburden stockpile, and/or staging pile areas.

^b Area of exposed surface after excavation or area of stockpile base (as applicable)

^c Decision subunits are divided into four blocks to ensure that random sampling locations are not bunched together in one area

1F:072606A

E 580450

N 147500

SCALE 1:150
1.5 0 1.5 3 6 meters

U.S. DEPARTMENT OF ENERGY
DOE RICHLAND OPERATIONS OFFICE
RIVER CORRIDOR CLOSURE CONTRACT

NOTES

1. SHALLOW ZONE NODE AREAS ARE APPROXIMATELY 2.16 SQUARE METERS.
2. SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER SQUARE METERS.
3. THE SHALLOW ZONE CONSISTS OF SAMPLING AREAS A1, A2, A3 AND A4 WITHIN DECISION SUBUNIT 1.

LEGEND

VARIANCE AND VERIFICATION
SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	S-A1-3	147503.32	580441.13
		S-A1-4	147502.40	580440.95
		S-A1-10	147505.83	580444.54
		S-A1-16	147502.82	580445.89
	A2	S-A2-3	147504.54	580447.18
		S-A2-6	147506.01	580448.49
		S-A2-7	147504.41	580448.49
		S-A2-15	147503.61	580451.68
	A3	S-A3-1	147501.52	580440.50
		S-A3-2	147500.69	580440.39
		S-A3-4	147498.32	580440.82
		S-A3-11	147497.72	580443.99
	A4	S-A4-3	147497.79	580446.53
		S-A4-4	147496.08	580446.52
		S-A4-7	147497.95	580447.84
		S-A4-12	147497.05	580449.34

Attachment 3 Sheet No. 1 of 3
Originator G. C. B. V. Date 7-26-06
Checked By G. C. B. V. Date 7-27-06
Case No. 0100F-CA-V0267 Rev. No. 0

ATTACHMENT 3

100-F AREA
118-F-7 BURIAL GROUND
SHALLOW ZONE SAMPLING PLAN

1F:072606B

E 580430

N 147480

SCALE 1:100
1 0 1 2 4 meters

U.S. DEPARTMENT OF ENERGY
DOE RICHLAND OPERATIONS OFFICE
RIVIER CORRIDOR CLOSURE CONTRACT

NOTES

1. ACL OVERBURDEN NODE AREAS ARE APPROXIMATELY 1.10 SQUARE METERS.
2. SAMPLES ARE TAKEN FROM THE APPROXIMATE CENTER SQUARE METERS.
3. THE ACL OVERBURDEN CONSISTS OF SAMPLING AREAS A1, A2, A3 AND A4 WITHIN DECISION SUBUNIT 1.

LEGEND

VARIANCE AND VERIFICATION SAMPLING NODE

SAMPLE LOCATION TABLE

DECISION SUBUNIT	SAMPLING AREA	SAMPLE NODE	NORTHING	EASTING
1	A1	O-A1-3	147473.33	580429.32
		O-A1-4	147472.67	580429.27
		O-A1-10	147475.07	580431.89
		O-A1-16	147472.96	580432.86
	A2	O-A2-3	147474.43	580433.72
		O-A2-6	147475.59	580434.55
		O-A2-7	147474.31	580434.56
		O-A2-15	147473.09	580437.19
	A3	O-A3-1	147472.09	580429.37
		O-A3-2	147471.57	580429.32
		O-A3-4	147470.15	580429.58
		O-A3-11	147469.73	580432.30
	A4	O-A4-3	147468.88	580434.13
		O-A4-4	147467.34	580434.15
		O-A4-7	147468.85	580434.92
		O-A4-12	147468.21	580435.83

Attachment 3 Sheet No. 2 of 3
Originator G. CRV Date 7-26-06
CLM By CLM Date 7-27-06
Calc. No. 600F-CA-V0267 Rev. No. 0

ATTACHMENT 3

100-F AREA
118-F-7 BURIAL GROUND
ACL OVERBURDEN SAMPLING PLAN

CALCULATION COVER SHEET

Project Title:	100-F Area Field Remediation	Job No.	14655
Area	100-F		
Discipline	Environmental	*Calc. No.	0100F-CA-V0269
Subject	118-F-7 Cleanup Verification 95% UCL Calculations		
Computer Program	Excel	Program No.	Excel 2003

The attached calculations have been generated to document compliance with established cleanup levels. These calculations should be used in conjunction with other relevant documents in the administrative record.

Committed Calculation ☒
 Preliminary ☐
 Superseded ☐
 Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 9 Total = 10	<i>M. J. Appel</i> 9/7/06 M. J. Appel	<i>T. M. Blakley</i> 9/14/06 T. M. Blakley	<i>L. M. Dittmer</i> 9/18/06 L. M. Dittmer	<i>S. W. Callison</i> mlper email S. W. Callison	9/18/06

SUMMARY OF REVISIONS

WCH-DE-018 (4/14/06)

*Obtain Calc. No. from R&DC and Form from Intranet

Washington Closure Hanford

CALCULATION SHEET

Originator M. J. Appel
Project 100-F Area Field Remediation
Subject 118-F-7 Cleanup Verification 95% UCL Calculations

Date 09/07/06
Job No. 14655

Calc. No. 0100F-CA-V0289
Checked T. M. Blakley

Rev. No. 0
Date 9/14/06
Sheet No. 1 of 9

Summary

Purpose:
Calculate the 95% upper confidence limit (UCL) to evaluate compliance with cleanup standards for the subject site. Also, calculate the carcinogenic risk for applicable nonradionuclide analytes, perform the Washington Administrative Code (WAC) 173-340 (Model Toxics Control Act [MTCOA]) 3-part test, if required, and calculate the relative percent difference (RPD) for each contaminant of concern (COC).

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Sheets 1 to 2 - Calculation Sheet Summary
Sheet 3 - Calculation Sheet Shallow Zone Verification
Sheet 4 - Calculation Sheet Overburden Verification
Sheet 5 - Calculation Sheet Waste Staging Area Verification
Sheets 6 to 8 - Calculation Sheet Split-Duplicate Analysis

Given/References:

- 1) Sample Results (Attachment 1).
- 2) Background values and remedial action goals (RAGs) are taken from DOE-RL (2005b), DOE-RL (2001), and Ecology (2005).
- 3) DOE-RL, 2001, Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes, DOE/RL-92-24, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- 4) DOE-RL, 2001, 100 Area Burial Grounds Remedial Action Sampling and Analysis Plan, DOE/RL 2001-35, Rev. 0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- 5) DOE-RL, 2005b, Remedial Design Report/Remedial Action Work Plan for the 100 Area (RDR/RAWP), DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
- 6) Ecology, 1992, Statistical Guidance for Ecology Site Managers, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
- 7) Ecology, 1993, Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets), Publication #92-54, Washington Department of Ecology, Olympia, Washington.
- 8) Ecology, 2005, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <<https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>>.
- 9) EPA, 1994, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540/R-94/013, U.S. Environmental Protection Agency, Washington, D.C.
- 10) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," Washington Administrative Code.

Solution:

Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 2005b). Use data from the attached worksheets to calculate the 95% UCL, hazard quotients, excess carcinogenic risk, perform the WAC 173-340 3-part test for nonradionuclides, and calculate the RPD for each COC in the primary-duplicate and primary-split sample pairs.

Calculation Description:

The subject calculations were performed on data from soil verification samples from the 118-F-7 waste site. The data were entered into an EXCEL 2003 spreadsheet and calculations performed by utilizing the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2005b) is documented by this calculation. Split and duplicate RPD results are used in evaluation of data quality and are presented in the cleanup verification package (CVP) for this site.

Methodology:

For nonradioactive analytes with <50% of the data below detection limits and all radionuclide analytes, the statistical value calculated to evaluate the effectiveness of cleanup is the 95% UCL. For nonradioactive analytes with >50% of the data below detection limits, the maximum value for the data set is used instead of the 95% UCL. All nonradionuclide data reported as being below detection limits are set to ½ the detection limit value for calculation of the statistics (Ecology 1993). For radionuclide data, calculation of the statistics was done on the reported value. In cases where the laboratory does not report a value below the minimal detectable activity (MDA), half of the MDA is used in the calculation. For the statistical evaluation of primary-duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above.

The COCs for the 118-F-7 Burial Ground are: Cadmium, Lead, Cobalt-60, Cesium-137, Silver-108m, and Strontium-90. Based on the metal analysis results, copper was added as a contaminant of concern because of a single detection that exceeded groundwater and river water protection in the above cleanup level (ACL) waste staging footprint. All other sampling results for the non-COC metal analyses (shallow zone, overburden, and the waste staging pile area) were below background and, therefore, not evaluated.

For nonradionuclides, the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data and the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets (n < 10) and all radionuclide data sets, the calculations are performed assuming nonparametric distribution, so no test for distribution is performed. For nonradionuclide data sets of ten or greater, distributional testing is done using Ecology's MTCAS1et software (Ecology 1993). Background values are subtracted for applicable radionuclides only. Comparison against background levels for nonradionuclides is included within the CVP.

Washington Closure Hanford

CALCULATION SHEET

Originator: M. J. Appel *mja*
 Project: 100-F Area Field Remediation
 Subject: 118-F-7 Cleanup Verification 95% UCL Calculations

Date: 09/07/06
 Job No.: 14655

Calc. No. 0100F-CA-V0269
 Checked: T. M. Blakley *TMB*

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 Sheet No. 2 of 9

Summary (continued)

Methodology (continued):

The hazard quotient (for shallow zone nonradionuclide COCs) is determined by dividing the statistical value (derived in this calculation) by the WAC 173-340 non-carcinogenic cleanup limit. The excess nonradionuclide carcinogenic risk is determined by dividing the statistical value by the WAC 173-340 carcinogenic cleanup limit and then multiplying by 10^{-6} .

The WAC 173-340 3-part test is performed for nonradionuclide analytes only and determines if:

- 1) the 95% UCL value exceeds the most stringent cleanup limit for each non-radionuclide COC,
- 2) greater than 10% of the raw data exceed the most stringent cleanup limit for each non-radionuclide COC,
- 3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each non-radionuclide COC.

The RPD is calculated when both the primary value and either the duplicate or split values are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method, listed in Table II-1 of the SAP (DOE-RL 2001). The RPD calculations use the following formula: $RPD = [M-S]/[(M+S)/2] \times 100$

where, M = Main Sample Value S = Split (or duplicate) Sample Value

For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than +/- 30% indicates the data compare favorably. For regulatory spills, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. Additional discussion as necessary is provided in the data quality assessment section of the applicable CVP.

If regulator split comparison is required, an additional parameter is evaluated. A control limit of +/- 2 times the TDL shall be used if either the main or regulator split value is less than 5 times the TDL and above detection. In the case where only one result is greater than 5 times the TDL and the other is below, the +/- 2 times the TDL criteria applies. Therefore, the following calculation is performed as part of the evaluation for these two cases involving regulator split data: difference = main - regulator split. If the difference is greater than +/- 2 times the TDL, then further investigation regarding the usability of the data is performed and presented in the applicable CVP data quality assessment section.

No regulatory split samples were collected for this site.

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CALCULATION SHEET

Originator M. J. Appel *MJA*
Project 100-F Area Field Remediation
Subject 118-F-7 Cleanup Verification 95% UCL Calculations

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Calc. No. 0100F-CA-V0269
Checked T. M. Blakley *TMB*

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Date 9/14/06
Sheet No. 3 of 9

Summary (continued)

1 Results:
2 The results presented in the summary tables that follow are for use in the 118-F-7 CVP.

Analyte	Shallow Zone		Overburden		Waste Staging Area		Units
	Result	Qualifier	Result	Qualifier	Result	Qualifier	
Cadmium	2.1E-01	U	2.1E-01	U	2.1E-01	U	mg/kg
Copper ^a	1.22E+01		1.08E+01		3.69E+02		mg/kg
Lead	1.09E+01		5.2E+00		2.54E+01		mg/kg
Cobalt-60	2.30E-01	U	1.82E-01	U	1.50E-01	U	pCi/g
Cesium-137	3.01E-01		0 (< BG)	U	2.05E-01		pCi/g
Silver-108m	3.51E-02	U	2.81E-02	U	2.98E-02	U	pCi/g
Strontium-90	1.83E-01		0 (< BG)	U	5.73E-01		pCi/g

14 ^a Included as a COPC for the Waste Staging Area due to a single detection that exceeded groundwater and river protection lookup values.

15 NA = not applicable

16 U = undetected

18 **WAC 173-340 Evaluation (Shallow Zone)**

20 3-Part Test:

21 95% UCL > Cleanup Limit? YES
22 > 10% above Cleanup Limit? YES
23 Any sample > 2x Cleanup Limit? NO

25 Because of the "yes" answers to the MTCA 3-part test,
26 additional site-specific evaluation will be performed for lead
27 within the CVP.

29 Risk Estimate:

30 Nonrad noncarcinogenic index sum: 3.1E-02
31 Nonrad carcinogenic risk: 0

33 **WAC 173-340 Evaluation (Waste Staging Area)**

35 3-Part Test:

36 95% UCL > Cleanup Limit? YES
37 > 10% above Cleanup Limit? YES
38 Any sample > 2x Cleanup Limit? YES

40 Because of the "yes" answers to the MTCA 3-part test,
41 additional site-specific evaluation will be performed for lead
42 within the CVP.

44 Risk Estimate:

45 Nonrad noncarcinogenic index sum: 2.0E-01
46 Nonrad carcinogenic risk: 0

49 **Relative Percent Difference Results* QA/QC Analysis**

Analyte	Shallow Zone		Overburden		Waste Staging Area	
	Duplicate Analysis**	Split Analysis**	Duplicate Analysis**	Split Analysis**	Duplicate Analysis**	Split Analysis**
Cadmium						
Copper ^a	0.9%	1.8%	9.1%	6.7%	3.6%	8.3%
Lead						
Cobalt-60						
Cesium-137						
Silver-108m						
Strontium-90						

59 *A blank cell indicates that RPD evaluation was not required.

60 **The significance of the reported RPD values, including values greater than 30%, is addressed within the Data Quality Assessment section of the CVP for this site.

61 ^a Included as a COPC for the Waste Staging Area due to a single detection that exceeded groundwater and river protection lookup values.

62 NA = not applicable

RPD = relative percent difference

63 QA/QC = quality assurance/quality control

U = undetected

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1 Shallow Zone Sample Data

Sampling Area	Sample Number	Sample Date	Cadmium			Copper			Lead			Cobalt-60			Cesium-137			Silver-108m			Strontium-90		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J12L42	6/6/06	2.0E-01	U	2.0E-01	1.15E+01		3.5E-01	5.1E+00		8.9E-01	2.30E-01	U	2.30E-01	4.03E-01		1.40E-01	5.90E-02	U	5.90E-02	2.49E-01		2.30E-01
A2	J12L43	6/6/06	2.0E-01	U	2.0E-01	1.25E+01		3.5E-01	5.3E+00		9.1E-01	1.20E-01	U	1.20E-01	1.50E-01		1.10E-01	7.70E-02	U	7.70E-02	8.00E-03	U	2.20E-01
A3	J12L44	6/6/06	2.0E-01	U	2.0E-01	1.16E+01		3.4E-01	6.1E+00		8.8E-01	6.30E-02	U	6.30E-02	1.00E-01	U	1.00E-01	4.80E-02	U	4.80E-02	7.00E-02	U	2.60E-01
A4	J12L45	6/6/06	2.0E-01	U	2.0E-01	1.10E+01		3.5E-01	8.5E+00		8.9E-01	1.10E-01	U	1.10E-01	9.80E-02	U	9.80E-02	5.70E-02	U	5.70E-02	5.70E-02	U	1.80E-01
Duplicate of J12L45	J12L46	6/6/06	2.1E-01	U	2.1E-01	1.11E+01		3.6E-01	1.88E+01		9.3E-01	2.00E-01	U	2.00E-01	1.40E-01	U	1.40E-01	5.70E-02	U	5.70E-02	6.50E-02	U	2.20E-01

11 Statistical Computation Input Data

Sampling Area	Sample Number	Sample Date	Cadmium mg/kg	Copper mg/kg	Lead mg/kg	Cobalt-60 pCi/g	Cesium-137 pCi/g	Silver-108m pCi/g	Strontium-90 pCi/g
A1	J12L42	6/6/2006	1.0E-01	1.15E+01	5.1E+00	1.15E-01	4.03E-01	2.95E-02	2.49E-01
A2	J12L43	6/6/2006	1.0E-01	1.25E+01	5.3E+00	6.00E-02	1.50E-01	3.85E-02	8.00E-03
A3	J12L44	6/6/2006	1.0E-01	1.16E+01	6.1E+00	3.15E-02	5.00E-02	2.40E-02	7.00E-02
A4	J12L45/J12L46	6/6/2006	1.0E-01	1.11E+01	1.37E+01	7.75E-02	5.95E-02	2.85E-02	6.10E-02

20 Statistical Computations

	Cadmium			Copper			Lead			Cobalt-60			Cesium-137			Silver-108m			Strontium-90		
95% UCL based on	Nonradionuclide data set >50% censored. 95% UCL value not calculated.			Small data set. Use nonparametric z-statistic.			Small data set. Use nonparametric z-statistic.			Small data set. Use nonparametric z-statistic.			Small data set. Use nonparametric z-statistic.			Small data set. Use nonparametric z-statistic.			Small data set. Use nonparametric z-statistic.		
N	4			4			4			4			4			4			4		
% < Detection limit	100%			0%			0%			100%			75%			100%			75%		
mean	1.0E-01			1.2E+01			7.5E+00			7.1E-02			1.7E-01			3.0E-02			9.7E-02		
st. dev.	1.3E-03			6.1E-01			4.1E+00			3.5E-02			1.6E-01			6.1E-03			1.0E-01		
Z-statistic	1.645			1.645			1.645			1.645			1.645			1.645			1.645		
95% UCL on mean	NA			1.22E+01			1.09E+01			9.97E-02			3.01E-01			3.51E-02			1.83E-01		
max value	2.1E-01			1.25E+01			1.88E+01			2.30E-01			4.03E-01			7.70E-02			2.49E-01		
Statistical value	2.1E-01			1.22E+01			1.09E+01			2.30E-01			3.01E-01			3.51E-02			1.83E-01		
Background	0.81			10.2			10.2			NA			NA			NA			NA		
Statistical value above background	2.1E-01			1.22E+01			1.09E+01			2.30E-01			3.01E-01			3.51E-02			1.83E-01		

33	Most Stringent Cleanup Limit for nonradionuclide and RAG type	0.81	GW/River	22	BG/River	10.2	GW/River
34	WAC 173-340 3-PART Test						
35	95% UCL > Cleanup Limit?	NO		NO		YES	
36	> 10% above Cleanup Limit?	NO		NO		YES	
37	Any sample > 2X Cleanup Limit?	NO		NO		NO	
38	EXCESS RISK EVALUATION						
39	WAC 173-340 Non-Carcinogenic Cleanup:	80		2960		353	
40	Hazard quotient for each nonradionuclide:	0		0		3.1E-02	
41	WAC 173-340 Carcinogenic Cleanup:	13.9		NA		NA	
42	Risk for each carcinogenic nonradionuclide:	0		0		0	
43	WAC 173-340 3-Part-Test Compliance?	NO					
44	Nonrad noncarcinogenic Index sum:	3.1E-02					
45	Nonrad carcinogenic risk:	0					

BG = background
GW = groundwater
NA = not applicable
MDA = minimum detectable activity
PQL = practical quantitation limit
Q = qualifier
RAG = remedial action goal
U = undetected
UCL = upper confidence limit
WAC = Washington Administrative Code

CALCULATION SHEET

Washington Closure Hanford

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Rev. No. 0
Date 9/14/06
Sheet No. 5 of 9

1 Overburden Sample Data

Sampling Area	Sample Number	Sample Date	Cadmium			Copper			Lead			Cobalt-60			Cesium-137			Silver-108m			Strontium-90		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J12L32	6/6/06	2.1E-01	U	2.1E-01	1.04E+01		3.6E-01	5.3E+00		9.3E-01	1.90E-01	U	1.90E-01	1.10E-01	U	1.10E-01	5.70E-02	U	5.70E-02	6.00E-02	U	1.60E-01
A2	J12L33	6/6/06	2.1E-01	U	2.1E-01	1.15E+01		3.5E-01	3.7E+00		9.2E-01	1.40E-01	U	1.40E-01	9.40E-02	U	9.40E-02	4.90E-02	U	4.90E-02	3.00E-03	U	1.80E-01
Duplicate of J12L33	J12L34	6/6/06	2.1E-01	U	2.1E-01	1.05E+01		3.5E-01	3.8E+00		9.1E-01	1.00E-01	U	1.00E-01	8.50E-02	U	8.50E-02	5.90E-02	U	5.90E-02	-7.00E-03	U	1.90E-01
A3	J12L35	6/6/06	2.0E-01	U	2.0E-01	1.04E+01		3.5E-01	4.8E+00		9.0E-01	1.80E-01	U	1.80E-01	1.20E-01	U	1.20E-01	5.40E-02	U	5.40E-02	-2.40E-02	U	1.90E-01
A4	J12L36	6/6/06	2.1E-01	U	2.1E-01	1.07E+01		3.5E-01	4.4E+00		9.1E-01	1.60E-01	U	1.60E-01	9.90E-02	U	9.90E-02	5.40E-02	U	5.40E-02	3.20E-02	U	2.00E-01

11 Statistical Computation Input Data

Sampling Area	Sample Number	Sample Date	Cadmium mg/kg	Copper mg/kg	Lead mg/kg	Cobalt-60 pCi/g	Cesium-137 pCi/g	Silver-108m pCi/g	Strontium-90 pCi/g
A1	J12L32	6/6/2006	1.1E-01	1.04E+01	5.3E+00	9.5E-02	5.50E-02	2.85E-02	6.00E-02
A2	J12L33/J12L34	6/6/2006	1.1E-01	1.10E+01	3.8E+00	6.00E-02	4.48E-02	2.70E-02	-2.00E-03
A3	J12L35	6/6/2006	1.0E-01	1.04E+01	4.8E+00	9.00E-02	6.00E-02	2.70E-02	-2.40E-02
A4	J12L36	6/6/2006	1.1E-01	1.07E+01	4.4E+00	8.00E-02	4.95E-02	2.70E-02	3.20E-02

21 Statistical Computations

	Cadmium		Copper		Lead		Cobalt-60		Cesium-137		Silver-108m		Strontium-90	
95% UCL based on	Nonradionuclide data set >50% censored. 95% UCL value not calculated.		Small data set. Use nonparametric z-statistic.		Small data set. Use nonparametric z-statistic.		Small data set. Use nonparametric z-statistic.		Small data set. Use nonparametric z-statistic.		Small data set. Use nonparametric z-statistic.		Small data set. Use nonparametric z-statistic.	
N	4		4		4		4		4		4		4	
% < Detection limit	100%		0%		0%		100%		100%		100%		100%	
mean	1.0E-01		1.06E+01		4.6E+00		8.17E-02		5.33E-02		2.75E-02		1.13E-02	
st. dev.	2.5E-03		2.87E-01		6.5E-01		1.5E-02		6.6E-03		7.5E-04		3.7E-02	
Z-statistic	1.645		1.645		1.645		1.645		1.645		1.645		1.645	
95% UCL on mean	1.1E-01		1.08E+01		5.2E+00		9.44E-02		5.87E-02		2.81E-02		4.18E-02	
max value	2.1E-01 U		1.15E+01		5.3E+00		1.90E-01 U		1.20E-01 U		5.90E-02 U		6.00E-02 U	
Statistical value	2.1E-01 U		1.08E+01		5.2E+00		1.90E-01 U		5.87E-02 U		2.81E-02 U		4.18E-02 U	
Background	0.81		10.2		10.2		0.008		1.1		NA		0.18	
Statistical value above background	2.1E-01 U		1.08E+01		5.2E+00		1.82E-01 U		0 (< BG) U		2.81E-02 U		0 (< BG) U	
Most Stringent Cleanup Limit for nonradionuclide and RAG type	0.81 GW/River		22 GW/River		10.2 GW/River									
WAC 173-340 3-PART Test														
95% UCL > Cleanup Limit?	NO		NO		NO									
> 10% above Cleanup Limit?	NO		NO		NO									
Any sample > 2X Cleanup Limit?	NO		NO		NO									
EXCESS RISK EVALUATION														
WAC 173-340 Non-Carcinogenic Cleanup:	80		2960		353									
Hazard quotient for each nonradionuclide:	0		0		0									
WAC 173-340 Carcinogenic Cleanup:	13.9		NA		NA									
Risk for each carcinogenic nonradionuclide:	0		0		0									
WAC 173-340 3-Part-Test Compliance?	YES		Because all cadmium values are below background (0.81 mg/kg), calculation of excess risk is not required.		Because all copper values are below background (22 mg/kg), calculation of excess risk is not required.		Because all lead values are below background (10.2 mg/kg), calculation of excess risk is not required.							
Nonrad noncarcinogenic index sum:	0													
Nonrad carcinogenic risk:	0													

46 BG = background
47 GW = groundwater
48 NA = not applicable
49 MDA = minimum detectable activity

PQL = practical quantitation limit
Q = qualifier
RAG = remedial action goal

U = undetected
UCL = upper confidence limit
WAC = Washington Administrative Code

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Date 7/18/06
Sheet No. 6 of 9

1 Waste Staging Pile Sample Data

Sampling Area	Sample Number	Sample Date	Cadmium			Copper			Lead			Cobalt-60			Cesium-137			Silver-108m			Strontium-90		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A1	J12L37	6/6/06	2.1E-01	U	0.21	1.22E+01		3.5E-01	1.74E+01		9.2E-01	9.60E-02	U	9.60E-02	1.14E-01		6.60E-02	5.20E-02	U	5.20E-02	8.50E-02	U	2.00E-01
A2	J12L38	6/6/06	2.0E-01	U	0.2	1.10E+01		3.5E-01	1.22E+01		9.1E-01	1.50E-01	U	1.50E-01	1.30E-01	U	1.30E-01	5.80E-02	U	5.80E-02	8.23E-01		2.10E-01
A3	J12L39	6/6/06	2.1E-01	U	0.21	1.13E+01		3.6E-01	7.4E+00		9.2E-01	7.50E-02	U	7.50E-02	1.91E-01		7.00E-02	4.90E-02	U	4.90E-02	1.32E-01	U	2.30E-01
Duplicate of J12L39	J12L40	6/6/06	2.1E-01	U	0.21	1.09E+01		3.5E-01	7.6E+00		9.7E-01	9.50E-02	U	9.50E-02	2.25E-01		8.90E-02	5.90E-02	U	5.90E-02	9.80E-02	U	2.10E-01
A4	J12L41	6/6/06	2.1E-01	U	0.21	5.52E+02		3.6E-01	3.11E+01		9.3E-01	1.10E-01	U	1.10E-01	2.04E-01		9.10E-02	6.10E-02	U	6.10E-02	5.10E-02	U	2.10E-01

11 Statistical Computation Input Data

Sampling Area	Sample Number	Sample Date	Cadmium mg/kg	Copper mg/kg	Lead mg/kg	Cobalt-60 pCi/g	Cesium-137 pCi/g	Silver-108m pCi/g	Strontium-90 pCi/g
A1	J12L37	6/6/2006	1.05E-01	1.22E+01	1.74E+01	4.80E-02	1.14E-01	2.60E-02	8.50E-02
A2	J12L38	6/6/2006	1.00E-01	1.10E+01	1.22E+01	3.75E-02	6.50E-02	2.90E-02	8.23E-01
A3	J12L39/J12L40	6/6/2006	1.05E-01	1.11E+01	7.50E+00	4.25E-02	2.08E-01	2.70E-02	1.15E-01
A4	J12L41	6/6/2006	1.05E-01	5.52E+02	3.11E+01	5.50E-02	2.04E-01	3.05E-02	5.10E-02

20 Statistical Computations

	Cadmium	Copper	Lead	Cobalt-60	Cesium-137	Silver-108m	Strontium-90
95% UCL based on	Nonradionuclide data set >50% censored. 95% UCL value not calculated.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.	Small data set. Use nonparametric z-statistic.
N	4	4	4	4	4	4	4
% < Detection limit	100%	0%	0%	100%	0%	100%	75%
mean	1.0E-01	1.47E+02	1.71E+01	4.58E-02	1.48E-01	2.81E-02	2.69E-01
st. dev.	2.5E-03	2.70E+02	1.02E+01	7.51E-03	7.0E-02	2.02E-03	3.71E-01
Z-statistic	1.645	1.645	1.645	1.645	1.645	1.645	1.645
95% UCL on mean	NA	3.69E+02	2.54E+01	5.19E-02	2.05E-01	2.98E-02	5.73E-01
max value	2.1E-01 U	5.52E+02	3.11E+01	1.50E-01 U	2.25E-01	6.10E-02 U	8.23E-01
Statistical value	2.1E-01 U	3.69E+02	2.54E+01	1.50E-01 U	2.05E-01	2.98E-02 U	5.73E-01
Background	0.81	0.81	10.2	NA	NA	NA	NA
Statistical value above background	2.1E-01 U	3.69E+02	2.54E+01	1.50E-01 U	2.05E-01	2.98E-02 U	5.73E-01
Most Stringent Cleanup Limit for nonradionuclide and RAG type	0.81 GW/River	22 GW/River	10.2 GW/River				
WAC 173-340 3-PART Test							
95% UCL > Cleanup Limit?	NO	YES	YES				
> 10% above Cleanup Limit?	NO	YES	YES				
Any sample > 2X Cleanup Limit?	NO	YES	YES				
EXCESS RISK EVALUATION							
WAC 173-340 Non-Carcinogenic Cleanup:	80	2960	353				
Hazard quotient for each nonradionuclide:	0	1.2E-01	7.2E-02				
WAC 173 340 Carcinogenic Cleanup:	13.9	NA	NA				
Risk for each carcinogenic nonradionuclide:	0	0	0				
WAC 173-340 3-Part-Test Compliance?	NO						
Nonrad noncarcinogenic Index sum:	2.0E-01						
Nonrad carcinogenic risk:	0						

46 BG = background
47 DC = direct contact
48 GW = groundwater
49 MDA= minimum detectable activity

NA = not applicable
PQL = practical quantitation limit
Q = qualifier
RAG = remedial action goal

U = undetected
UCL = upper confidence limit
WAC = Washington Administrative Code

CALCULATION SHEET

Washington Closure Hanford

Originator M. J. Appel
Project 100-F Area Field Remediation
Subject 118-F-7 Cleanup Verification 95% UCL Calculations

Date 9/7/06
Job No. 14655

Calc. No. 0100F-CA-V0269
Checked T. M. Blakley

Rev. No. 0
Date 9/17/06
Sheet No. 7 of 9

Split-Duplicate Analysis

1 Shallow Zone Sample Results:

Sampling Area	Sample Number	Cadmium			Copper			Lead			Cobalt-60			Cesium-137			Silver-108m			Strontium-90		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A4	J12L45	2.0E-01	U	2.0E-01	1.10E+01		3.5E-01	8.50E+00		8.90E-01	1.10E-01	U	1.10E-01	9.80E-02	U	9.80E-02	5.70E-02	U	5.70E-02	5.70E-02	U	1.80E-01
Duplicate of J12L45	J12L46	2.1E-01	U	2.1E-01	1.11E+01		3.6E-01	1.88E+01		9.30E-01	2.00E-01	U	2.00E-01	1.40E-01	U	1.40E-01	5.70E-02	U	5.70E-02	6.50E-02	U	2.20E-01
Split of J12L45	J12L49	1.4E-01	U	1.4E-01	1.12E+01		3.20E-01	1.84E+01		1.60E-01	1.11E-02	U	3.04E-02	7.77E-02		2.91E-02	5.77E-03	U	2.29E-02	5.05E-02	U	1.05E-01

8 Sample Analysis:

TDL		0.2	1	5	0.05	0.1	0.1	1
Duplicate Analysis	Both > PQL or MDA?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?		Yes (calc RPD)	No-Stop (acceptable)				
	RPD		0.9%					
Split Analysis	Both > PQL?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?		Yes (calc RPD)	No-Stop (acceptable)				
	RPD		1.8%					

16 Note: The significance of the reported RPD values, including values greater than 30%, is addressed within the Data Quality Assessment for the Cleanup Verification Package for this site.

17 B = analyte found in method blank

RPD = relative percent difference

18 MDA = minimum detectable activity

TDL = target detection limit

19 PQL = practical quantitation limit

U = undetected

20 Q = qualifier

CALCULATION SHEET

Washington Closure Hanford

Originator M. J. Appel
Project 100-F Area Field Remediation
Subject 118-F-7 Cleanup Verification 95% UCL Calculations

Date 9/7/06
Job No. 14655

Calc. No. 0100F-CA-V0269
Checked T. M. Blakley

Rev. No. 0
Date 7/14/06
Sheet No. 8 of 9

Split-Duplicate Analysis

1 Overburden Sample Results:

Sampling Area	Sample Number	Cadmium			Copper			Lead			Cobalt-60			Cesium-137			Silver-108m			Strontium-90		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A2	J12L33	2.1E-01	U	2.1E-01	1.15E+01		3.5E-01	3.7E+00		9.2E-01	1.40E-01	U	1.40E-01	9.40E-02	U	9.40E-02	4.90E-02	U	4.90E-02	3.00E-03	U	1.80E-01
Duplicate of J12L33	J12L34	2.1E-01	U	2.1E-01	1.05E+01		3.5E-01	3.8E+00		9.1E-01	1.00E-01	U	1.00E-01	8.50E-02	U	8.50E-02	5.90E-02	U	5.90E-02	7.00E-03	U	1.90E-01
Split of J12L33	J12L47	1.4E-01	UN	1.4E-01	1.23E+01		3.20E-01	4.0E+00		1.6E-01	6.85E-03	U	2.00E-02	4.12E-03	U	1.88E-02	1.05E-03	U	1.29E-02	7.92E-03	U	1.36E-01

8 Sample Analysis:

TDL		0.2	1	5	0.05	0.1	0.1	1
Duplicate Analysis	Both > PQL or MDA?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?		Yes (calc RPD)	No-Stop (acceptable)				
	RPD		9.1%					
Split Analysis	Both > PQL?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?		Yes (calc RPD)	No-Stop (acceptable)				
	RPD		6.7%					

16 Note: The significance of the reported RPD values, including values greater than 30%, is addressed within the Data Quality Assessment for the Cleanup Verification Package for this site.

17 B = analyte found in method blank

Q = qualifier

18 MDA = minimum detectable activity

RPD = relative percent difference

19 N = Spiked analyte recovery is outside stated control limits

TDL = target detection limit

20 PQL = practical quantitation limit

U = undetected

CALCULATION SHEET

Washington Closure Hanford

Originator M. J. Appel *mja*
Project 100-F Area Field Remediation
Subject 118-F-7 Cleanup Verification 95% UCL Calculations

Date 9/7/06
Job No. 14655

Calc. No. 0100F-CA-V0269
Checked T. M. Blakley *TMB*

Rev. No. 0
Date 9/14/06
Sheet No. 9 of 9

Split-Duplicate Analysis

1 Waste Staging Area Sample Results:

Sampling Area	Sample Number	Cadmium			Copper			Lead			Cobalt-60			Cesium-137			Silver-108m			Strontium-90		
		mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
A3	J12L39	0.21	U	0.21	1.13E+01		0.36	7.4		0.92	7.50E-02	U	7.50E-02	1.91E-01		7.00E-02	4.90E-02	U	4.90E-02	1.32E-01	U	2.30E-01
Duplicate of J12L39	J12L40	0.21	U	0.21	1.09E+01		0.35	7.6		0.97	9.50E-02	U	9.50E-02	2.25E-01		8.90E-02	5.90E-02	U	5.90E-02	9.80E-02	U	2.10E-01
Split of J12L39	J12L48	0.14	UN	0.14	1.04E+01		0.32	7.6		0.16	2.77E-03	U	2.51E-02	1.63E-01		2.16E-02	2.72E-03	U	1.72E-02	1.57E-01		1.03E-01

8 Sample Analysis:

TDL		0.2	1	5	0.05	0.1	0.1	1
Duplicate Analysis	Both > PQL or MDA?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?		Yes (calc RPD)	No-Stop (acceptable)		No-Stop (acceptable)		
	RPD		3.6%					
Split Analysis	Both > PQL?	No-Stop (acceptable)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)	No-Stop (acceptable)	No-Stop (acceptable)
	Both > 5xTDL?		Yes (calc RPD)	No-Stop (acceptable)		No-Stop (acceptable)		
	RPD		8.3%					

16 Note: The significance of the reported RPD values, including values greater than 30%, is addressed within the Data Quality Assessment for the Cleanup Verification Package for this site.

17 B = analyte found in method blank

Q = qualifier

18 MDA = minimum detectable activity

RPD = relative percent difference

19 N = Spiked analyte recovery is outside stated control limits

TDL = target detection limit

20 PQL = practical quantitation limit

U = undetected

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