Date Submitted: TBD Originator: J. M. Capron Phone: 372-9227	**WASTE SITE RECLASSIFICATION FORM** Operable Unit(s): 100-BC-1 Waste Site Code: 100-B-23 Type of Reclassification Action: Closed Out ☐ Interim Closed Out ☒ No Action ☐ RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	Control Number: 2008-027

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

Description of current waste site condition:

The 100-B-23, 100-B/C Surface Debris, waste consisted of multiple locations of surface debris and chemical stains that were identified during an Orphan Site Evaluation of the 100-B/C Area. Evaluation of the collected information for the surface debris features yielded four generic waste groupings: asbestos-containing material (ACM); lead debris; oil and oil filters; and treated wood. The various forms of scattered surface debris were thought to have been created during the construction, operating, decontamination and decommissioning (D&D), and remedial action activities at the 100-B/C Area. Remediation of the surface debris occurred between June 2007 and February 2008. Focused verification sampling was performed concurrently with remediation. Site remediation was accomplished by selective removal of the suspect hazardous items and potentially impacted soils. Remediation activities included the removal of 680 metric tons (750 US tons) of stained soils. Verification sampling and evaluation of this site have been performed in accordance with remedial action objectives and goals established by the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington. The selected action involved: (1) remediation of the site through removal of hazardous debris and impacted soils, (2) demonstrating through verification sampling that cleanup goals have been achieved, and (3) proposing the site for reclassification to Interim Closed Out.

Basis for reclassification:

In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the Remaining Sites ROD. The results of verification sampling show 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 demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Site contamination did not extend into the deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-B/C, 100-B-23 Surface Debris* (attached).

Waste Site Controls:

Engineered Controls: Yes ☐ No ☒ Institutional Controls: Yes ☐ No ☒ O&M Requirements: Yes ☐ No ☒
If any of the Waste Site Controls are checked Yes, specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents.

R. F. Guercia DOE Federal Project Director (printed)	Signature	5/23/08 Date
NA Ecology Project Manager (printed)	Signature	Date
L. C. Buelow EPA Project Manager (printed)	Signature	6/16/08 Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-B-23, 100-B/C AREA SURFACE DEBRIS, WASTE SITE

Attachment to Waste Site Reclassification Form 2008-027

June 2008

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-B-23, 100-B/C AREA SURFACE DEBRIS, WASTE SITE

EXECUTIVE SUMMARY

This remaining sites verification package documents evaluation of the verification sampling results to support reclassification of the 100-B-23 waste site to Interim Closed Out.

The 100-B-23 waste site, located in the 100-B/C-1 Operable Unit of the Hanford Site, consisted of multiple locations of surface debris and chemical stains that were identified in 2004 as part of an Orphan Site Evaluation of the 100-B/C Area (WCH 2007a) conducted to identify potential waste sites in the river corridor that are not currently listed in existing *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) decision documents. The waste site covered the entire 100-B/C Area and consisted of various sizes and forms of surface debris that were identified as CERCLA wastes and/or "potentially dangerous" wastes under Washington Administrative Code (WAC) regulations. Evaluation of the collected information for the surface debris features yielded four generic waste groupings: asbestos-containing material (ACM); lead debris; oil and oil filters; and treated wood. The various forms of scattered surface debris were thought to be created during the construction, operating, decontamination and decommissioning, at the 100-B/C Area.

Remediation and verification sampling of the site was performed between June 2007 and February 2008. The remediation design consisted of the removal of suspect hazardous material identified at the surface of the site (friable ACM, lead sheeting and batteries, oil filters, and treated wood) along with any associated stained soils. In total, approximately 680 metric tons (750 US tons) of debris and stained soils were removed from the 100-B-23 waste site and disposed at the Environmental Restoration Disposal Facility. All nonfriable ACM material and most of the inert wood material was left in-place at the site. The nonfriable ACM and inert wood material do not present a potential release to the environment; therefore, no cleanup action was required for these items.

Focused verification sampling of underlying stained soils was performed concurrently with the cleanup action to support waste site closure per agreement with the U.S. Environmental Protection Agency and the U.S. Department of Energy, Richland Operations Office (BHI 2005b, WCH 2007d, Capron 2008). Focused samples were collected from remediated oil-stained soil sites, soils underlying remediated treated wood sites, and soils underlying a leaking lead battery cache. The results of these samples were used to demonstrate that site remediation was complete and that the underlying soil meets the remedial action objectives.

Several polycyclic aromatic hydrocarbons (PAHs) were detected in the verification samples for the 100-B-23 site above the direct exposure remedial action goals. These samples were collected from the soils underlying a remediated treated wood site. A site-specific risk assessment evaluation was performed, and it was determined that the mass of contamination was too small to cause a direct exposure risk of greater than 1×10^{-6} for the rural-residential scenario

(Appendix D). Additionally, cadmium, lead, mercury, zinc, aroclor-1260, dibenzo(a,h)anthracene, indeno(1,2,3-cd) pyrene, and several PAHs exceeded the groundwater and/or river protection remedial action goals. The results of vertical migration modeling, however, predict that none of these constituents will migrate to groundwater (and, thus, the Columbia River) within 1,000 years, and their residual concentrations are therefore protective of groundwater and the Columbia River (BHI 2005a). A summary of the evaluation of the sampling results against the applicable criteria is presented in Table ES-1.

The results of verification sampling are used to make reclassification decisions for the 100-B-23 site in accordance with the TPA-MP-14 (DOE-RL 2007) procedure. In accordance with this evaluation, the verification sampling results support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b) and the *Interim Action Record of Decision for the 100-B/C-1, 100-B/C-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). The results of verification sampling show 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 demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Site contamination did not extend into the deep-zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

Table ES-1. Summary of Remedial Action Goals for the 100-B-23 Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure Radionuclides	Attain 15 mrem/yr dose rate above background over 1,000 years.	No radionuclide COPCs were identified.	Yes
Direct Exposure Nonradionuclides	Attain individual COPC RAGs.	Several PAHs exceeded the direct exposure RAGs. However, a site specific risk assessment was performed and determined that the mass of contamination did not cause a direct exposure risk of greater than 1×10^{-6}.[a]	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	All individual hazard quotients are ≤ 1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient (6.4×10^{-1}) is ≤ 1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk values for individual carcinogens are $\leq 1 \times 10^{-6}$.	

Table ES-1. Summary of Remedial Action Goals for the 100-B-23 Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
	Attain a total excess cancer risk of <1 x 10^{-5} for carcinogens.	The total excess cancer risk value (1.1x 10^{-6}) is ≤ 1 x 10^{-5}.	
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river protection RAGs.	No radionuclide COPCs were identified.	Yes
	Attain national primary drinking water regulations:[b] 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.		
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide from DOE Order 5400.5.[c]		
	Meet total uranium standard of 21.2 pCi/L.[d]		
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Residual concentrations of cadmium, lead, mercury, zinc, aroclor-1260, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and several PAHs exceeded their respective soil RAGs for groundwater and/or river protection. However, vertical migration modeling predicts that these constituents will not reach groundwater (and, therefore, the Columbia River) within 1,000 years.[e]	Yes

[a] Site-specific risk assessment evaluation determined that the mass of contamination was too small to cause a direct exposure risk of greater than 1 x 10^{-6} (Appendix D).

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

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

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

[e] Based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a), these constituents are not predicted to migrate more than 2 m (7 ft) vertically in 1,000 years (based on the lowest soil-partitioning coefficient of 30 mL/g). The vadose zone underlying this site is approximately 10 m (33 ft) thick.

COPC = contaminant of potential concern
MCL = maximum contaminant level
PAH = polycyclic aromatic hydrocarbons
RAG = remedial action goal

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999), based on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the 100-B-23 contaminants of potential concern. Screening levels were exceeded at the site for the following constituents: antimony, barium, boron, cadmium, lead, manganese, mercury, selenium, vanadium, zinc, PAHs, and total petroleum hydrocarbons (TPH). Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors because antimony, barium, cadmium, manganese, selenium, and vanadium are below site background. Boron concentrations are consistent with those seen elsewhere at the Hanford Site (no established background value is available for boron). Exceedances for lead, mercury, zinc, PAHs, and TPH will be evaluated in the context of additional lines of evidence for ecological effects. The presence of PAHs is believed to be due to residual fragments of wood treated with PAHs as preservatives. The TPH is believed to be due to dumping of small quantities of oil at individual oil changes of vehicles.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-B-23, 100-B/C AREA SURFACE DEBRIS, WASTE SITE

STATEMENT OF PROTECTIVENESS

This report demonstrates that the 100-B-23 waste site meets the objectives for Interim Closed Out as established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005b) and the *Interim Action Record of Decision for the 100-B/C-1, 100-B/C-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Site contamination did not extend into the deep-zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

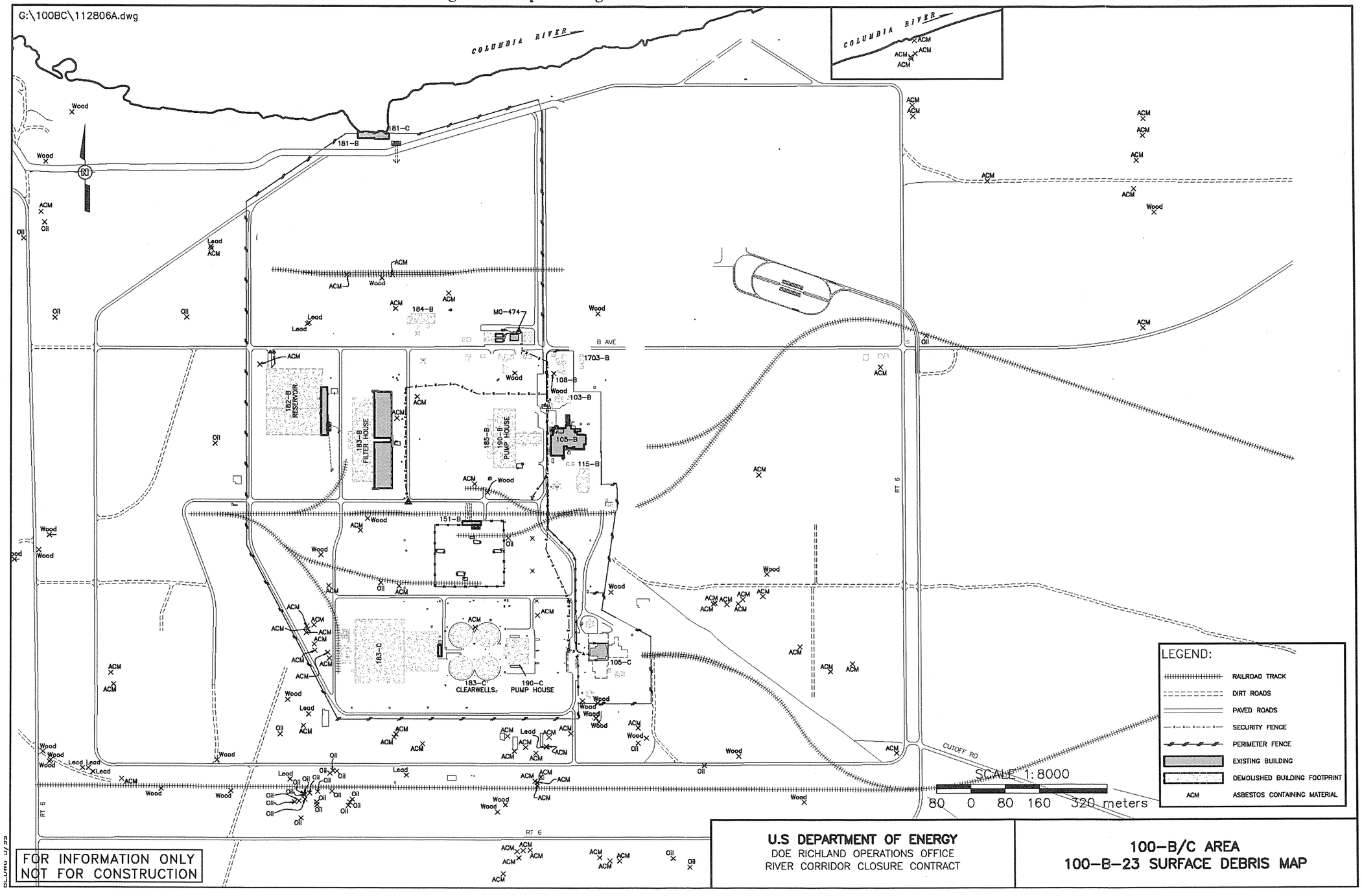
GENERAL SITE INFORMATION AND BACKGROUND

The 100-B-23 waste site, located in the 100-B/C-1 Operable Unit of the Hanford Site, consisted of multiple locations of surface debris and chemical stains that were identified in 2004 during an Orphan Site Evaluation the 100-B/C Area (WCH 2007a) (Figure 1) conducted to identify potential waste sites in the river corridor that are not currently listed in existing *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) decision documents. The waste site covered the entire 100-B/C Area and consisted of various sizes and forms of surface debris that were identified as CERCLA wastes. The various forms of scattered surface debris were thought to be created during the construction, operating, and decontamination and decommissioning of the 100-B/C Area. A few of the wood debris items included in the waste site, however, were determined to be pre-Hanford upon closer inspection and did not warrant further remedial action. At the time of the Orphan Site Evaluation, the location of all debris was recorded using Global Position System (GPS) technology. Photographic documentation was obtained for selected surface debris and is provided in Appendix A.

Evaluation of the collected information for the surface debris features yielded four generic waste groupings: asbestos-containing material (ACM); lead debris; oil and oil filters; and treated wood. The ACM group contained various sizes of miscellaneous surface solid waste that was primarily nonfriable asbestos. Debris items such as broken building tiles and roofing paper were observed in this category. The nonfriable ACM does not present a potential release to the environment; therefore, no cleanup action was required for the nonfriable ACM (BHI 2005b). As such, only the friable asbestos items were addressed during remediation.

The second group, lead debris, consisted of solid pieces of lead sheeting and lead batteries. Oil filters and stained soil comprise the third group. Oil filters were observed to be distributed

Figure 1. Map Showing the Locations of the 100-B-23 Surface Debris.



across the 100-B/C Area. An additional six oil filters were identified during remediation that had not been previously identified in the Orphan Site Evaluation. These oil filters were added to the 100-B-23 site.

The fourth group, treated wood, consisted of isolated wood locations that were not part of existing or abandoned railroad beds or utility laydown yards. The wood debris locations contained railroad ties, wood-covered manholes, and posts or poles that were either embedded or resting on the surface. Six additional wood debris items were identified during remediation activities and added to the listed wood debris items. These six items consisted of downed power poles, railroad ties, and planks.

Figure 1 provides an overview of the surface debris locations identified in 2004 Orphan Site Evaluation. The GPS coordinates for the observed surface debris, along with a description of the debris, are provided in Table 1. Only the ACM material requiring a cleanup action (i.e., the friable ACM) was included in Table 1. The nonfriable ACM does not require a remedial action because it does not present a potential release to the environment (BHI 2005b). The Waste Information Data System (WIDS) General Summary Report for 100-B-23 contains the coordinates for the remaining 72 documented miscellaneous pieces of nonfriable ACM debris.

REMEDIATION AND VERIFICATION SAMPLING ACTIVITIES

A meeting between the U.S. Environmental Protection Agency (EPA), the U.S. Department of Energy, Richland Operations Office (DOE-RL), and the Environmental Restoration Contractor (ERC) Team was held on May 5, 2005, to determine a path forward for the 100-B-23 waste site (BHI 2005b). EPA and DOE-RL agreed that a general cleanup action would occur at the 100-B-23 waste site to remove the friable ACM, oil filters, oil-stained soil, lead debris, and wood debris. Sampling of stained soils associated with the 100-B-23 debris items was performed to support a determination that residual contaminant concentrations at the site meet the cleanup criteria specified in the RDR/RAWP (DOE-RL 2005b) and the Remaining Sites ROD (EPA 1999). The following sections describe the remediation and verification activities for the 100-B-23 waste site, as well as the verification sample results.

Geophysical Investigation

No geophysical survey was performed for the 100-B-23 waste site because the position and character of debris was well established by visual reconnaissance.

Contaminants of Potential Concern

The contaminants of potential concern (COPCs) for the 100-B-23 site were identified based on process knowledge and site visit observations. The identified COPCs for the oil-stained soils were total petroleum hydrocarbons (TPH), inductively coupled plasma (ICP) metals (antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc), mercury, polychlorinated biphenyls (PCBs), and semivolatile organic compounds (SVOCs). The oil-stained soil sites were screened

first using TPH, a primary contaminant associated with the presence of automobile oil. The results of the TPH analysis were evaluated to determine if further laboratory analysis or remediation of the oil-stained soils was required. The full list of COPCs for the oil-stained soils was analyzed only if TPH was detected, but below the screening level of 200 mg/kg (*Washington Administrative Code* [WAC] 173-340).

Table 1. Description of Surface Debris and Global Positioning Survey Coordinates. (3 Pages)

Identification Number	Description	GPS Coordinates	
		Northing	Easting
Friable Asbestos Containing Material[a]			
5	ACM pipe wrap	143956.8	564217.7
45	posted ACM	144406.7	565074.7
Lead			
75	lead sheet	144788.8	564683.2
76	lead sheet	144787.2	564679.5
77	lead battery	143783.1	565239.6
78	battery burned	143731.3	564151.9
79	battery	143722.0	564176.1
80	battery	143731.4	564165.4
81	burned battery	143705.6	564639.0
82	battery	143715.2	564912.2
83	battery/metal	143859.8	564682.9
84	wood, batteries	144283.5	564072.7
85	battery	144970.0	564452.8
Oil Filters and Oil Stained Soil			
86	button oil filters (many)	143612.6	564664.5
87	oil filter and packing (5)	143651.1	564649.5
88	oil filter	143653.4	564659.7
89	oil filter elements, aerosol	143812.9	564616.0
90	oil filter metal	143671.9	564684.8
91	oil filter metal	143671.8	564670.5
92	oil filter metal	143669.2	564671.4
93	oil filter metal	143667.1	564672.5
94	oil filters	143657.3	564673.7
95	oil filter	143644.2	564701.7
96	oil filters	143650.8	564701.0
97	oil filters	143675.8	564703.6
98	oil filter elements	143676.9	564736.8
99	oil filter element	143719.1	564732.3
100	oil filter element	143725.8	564739.2
101	oil filter element	143724.5	564748.3
102	oil filter element	143657.5	564784.5
103	oil filters with packings	143650.3	564779.1
104	oil filter element	143643.0	564775.1

Table 1. Description of Surface Debris and Global Positioning Survey Coordinates. (3 Pages)

Identification Number	Description	GPS Coordinates	
		Northing	Easting
105	oil filter	143791.7	565456.5
106	oil grease tube	143738.3	565612.3
107	oil filter	144172.5	564852.7
108	oil filter	144278.6	565153.6
109	oil filter	144502.1	564463.5
110	oil filter	144799.9	564084.8
111	oil filter	145026.1	564060.0
112	oil filter	144801.7	564396.1
113	oil filter	144759.9	566137.4
114	oil filter	143495.9	565577.3
115	oil filter	143516.7	565537.7
116	oil filter	144988.3	564011.1
oil filter #1	oil filter[b]	143706.5	564669.2
oil filter #2	oil filter[b]	143676.5	564666
oil filter #3	oil filter[b]	143671.3	564675.9
oil filter #4	oil filter[b]	143769.5	565278.2
oil fiter #5	oil filter[b]	143516.2	565578.7
oil filter #6	oil filter[b]	144355	564965
Treated Wood			
117	wood covered manholes	144150.0	565393.0
118	power poles	144670.0	565260.0
119	railroad ties	144247.7	564048.0
120	3 cans, metals, wood post	143749.8	564076.6
121	3 down power poles	144192.6	565760.5
122	loading ramp with wood	144812.3	565364.0
123	top of fallen power pole	145053.7	566675.5
124	wood post	143650.9	565845.4
125	wood post	143803.3	565475.7
126	wood post	143760.3	565693.5
127	wood post	143891.8	565325.5
128	wood post	144238.1	564711.4
129	railroad tie	144324.7	564821.4
130	wood post	144670.8	565169.4
131	railroad tie	143751.0	564468.0
132	wood post	144386.7	565105.0
133	wood post	145286.9	564123.0
134	railroad tie	143746.2	564074.3
135	railroad tie	143770.0	564058.6
136	wooden posts	143682.6	564336.9
137	railroad tie	143677.5	564500.7
138	wooden posts	143894.2	564633.6
139	railroad tie	144896.3	564855.5
140	railroad tie	143644.4	565144.7

Table 1. Description of Surface Debris and Global Positioning Survey Coordinates. (3 Pages)

Identification Number	Description	GPS Coordinates	
		Northing	Easting
141	railroad ties	143627.3	565126.5
Pole #1	downed power pole[b]	143886.2	565361
Pole #2	scrapped telephone poles[b]	145170	564062.7
Planks #1	wooden planks[b]	143842	565363.2
Planks #2	wooden planks/ties[b]	143850.7	565356.7
Ties #2	small pile of railroad ties[b]	144225	563991
Ties #3	degraded railroad ties[b]	144210	563964.8

[a] Asbestos-containing material (ACM) requiring removal (i.e., friable ACM) is provided in Table 1.
[b] Identified during remediation activities (Not part of original Waste Information Data System listing).
ACM = asbestos-containing material
GPS = Global Positioning System

The COPCs for the stained soils associated with the treated wood included TPH, ICP metals (antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc), mercury, PCBs, SVOCs, and pesticides.

The sampling of stained soils associated with lead batteries was added as an addendum to the work instruction (Capron 2008) because a cache of leaking batteries was discovered during cleanup activities. The COPCs for the stained soils associated with the leaking batteries included ICP metals (antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc) and mercury.

Radionuclides were not COPCs for this site. However, the presence of radiological contaminants was evaluated during removal and sampling activities using field radiological survey instrumentation (capable of detecting alpha, beta, and gamma radiation). No radionuclides were detected during field screening, and therefore additional radionuclide analyses were not required.

Field screening for volatile organic compounds (VOCs) was also performed during excavation and sampling activities. No VOCs were detected and, therefore, VOCs were not included as COPCs for this site.

Site Remediation

Remediation of the 100-B-23 waste site was performed in accordance with the site-specific remediation approach outlined in the work instruction (WCH 2007e) and the site specific soil-sampling approach detailed by Capron (2008). The design consisted of the removal of suspect hazardous material identified at the surface of the site (friable ACM, lead sheeting and batteries, oil filters, and treated wood) along with any associated stained soils. Verification sampling of underlying stained soils was performed concurrently with the cleanup action to

support waste site closure. The sampling approach was agreed to by EPA and DOE-RL (BHI-2005b, WCH 2007d, Capron 2008).

Remediation activities were performed from June 2007 to January 2008 with removal of additional stained soils caused by leaking batteries in February 2008. In total, approximately 680 metric tons (750 US tons) of debris and stained soils were removed from the 100-B-23 waste site and disposed at the Environmental Restoration Disposal Facility (ERDF). All nonfriable ACM material and inert wood material was left in place at the site. Further remediation details for each debris category (e.g., friable ACM, lead, oil filters and oil-stained soil, and treated wood) are provided in the following sections.

Friable Asbestos-Containing Materials

Two of the identified locations in the ACM category required a removal action (Table 1). Identification (ID) number 45 was a posted ACM area (Figure A-1, Appendix A). This ACM area was used to store bagged asbestos materials during D&D activities in the 100-B/C Area. After completion of D&D activities, the bagged asbestos was removed, but the ACM posting signs were left in place. An asbestos competent person certified, by visual inspection on December 12, 2006, that the posted area did not contain asbestos debris or residue, and, therefore, the signs were removed as part of the cleanup action (Appendix B).

The ACM associated with ID number 5 consisted of a single piece of pipe wrap (Figure A-2, Appendix A). The pipe wrap appeared to contain friable asbestos and was removed and disposed as instructed in the work instruction (WCH 2007e). Per agreement between the EPA and DOE-RL, no further action was required for the remaining 72 nonfriable asbestos debris locations depicted in Figure 1 because the residual nonfriable ACM debris does not present a potential release to the environment (BHI 2005b).

Lead Sheeting and Batteries

All lead debris items listed in Table 1 were removed and the underlying soils were field screened with x-ray fluorescence (XRF) following the debris removal. During debris removal, item #85 (Table 1) was discovered to be a cache of leaking batteries. The soils underlying the batteries had high XRF readings of lead and mercury. The leaking batteries and stained soils (less than 5 bank cubic meters [BCM]) were removed. The extent of soil removal was guided using XRF readings and visual inspection. Verification samples were collected of the remediated soils per an addendum to the original sample design (Capron 2008).

Oil Filters and Oil-Stained Soil

The oil filter debris (Table 1) was removed along with any underlying stained soils. The soils were concurrently sampled for TPH to ensure that remediation was complete. Five locations exceeded the TPH screening level of 200 mg/kg. These areas were further remediated and re-sampled for TPH. All subsequent TPH samples passed. An example of the oil-stained soil and oil filters prior to remediation activities is provided in Appendix A, Figure A-3.

Instead of a general trash pick-up action, the dense filter area south of the railroad tracks (Figure 1) was scraped per agreement with EPA and DOE-RL in order to remove the debris and underlying soil (Capron 2007). The scraped area was approximately 6 m (20 ft) by 70 m (230 ft) and is shown in Figure 2. No further verification sampling was required for the scrape area per regulatory agreement (Capron 2007).

Treated Wood

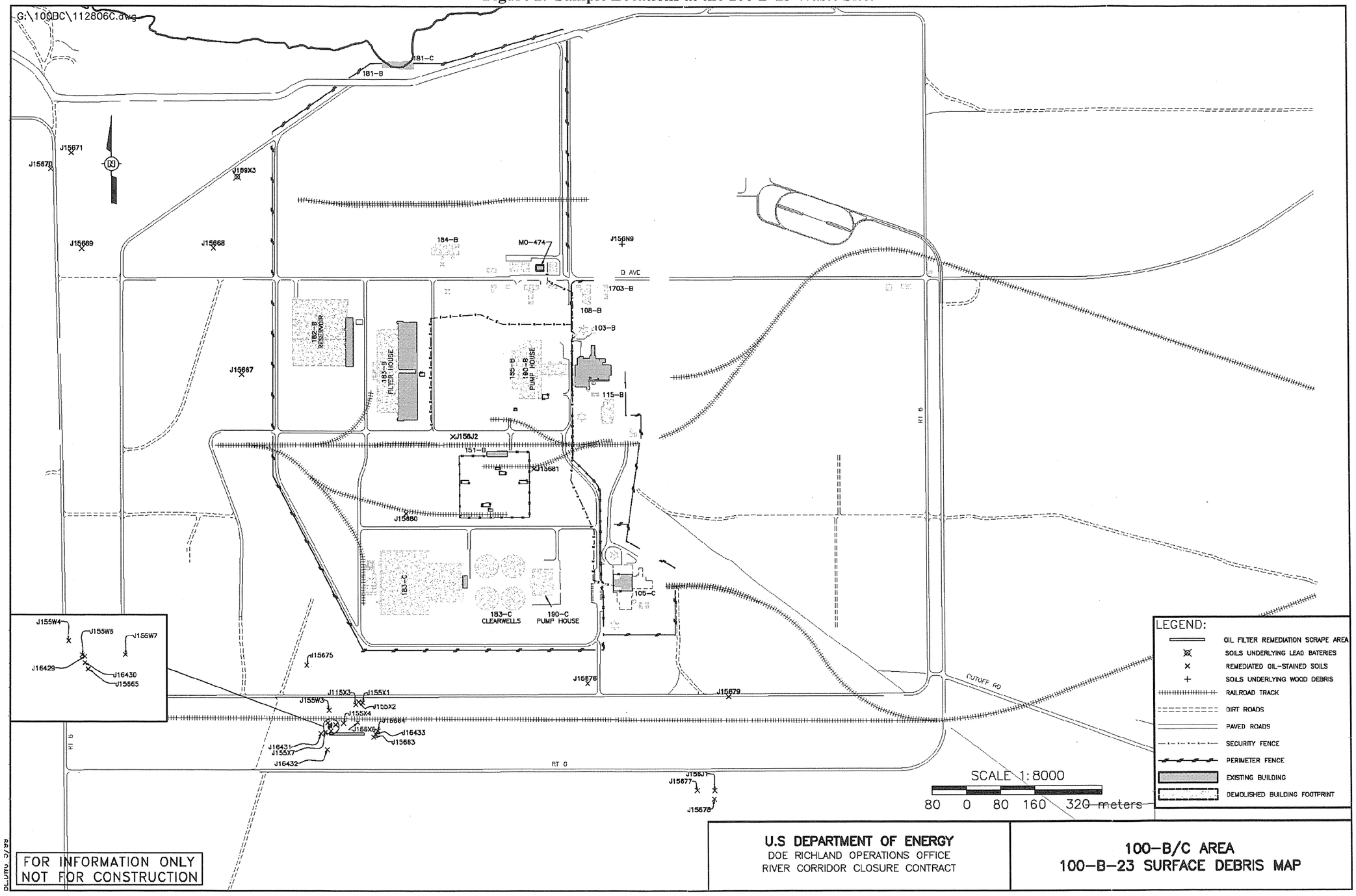
Many of the debris items identified in the 2004 Orphan Site Evaluation were removed during previous 100-B/C remediation activities and, therefore, did not warrant any further remedial action. Approval was provided by EPA (Buelow 2007) to leave all but five of the remaining wood debris items in place. Two wood posts (ID numbers 120 and 130) along with two downed power poles (pole #1 and pole #2) were removed in agreement with EPA and DOE-RL. Additionally, wood associated with the "loading ramp" (ID number 122) was removed and the underlying soils were scraped (Appendix A, Figure A-7). Examples of the wood debris removed are provided in Appendix A, Figures A-4 through A-6. A summary of all the 100-B-23 treated wood debris items and their current disposition is provided in Appendix B, Table B-1.

Verification Sample Design

Verification sampling of underlying stained soils was performed concurrent with the cleanup action to support waste site closure. The sampling approach was agreed to by EPA and DOE-RL (BHI 2005b, WCH 2007d, Capron 2008). A focused verification sampling approach was outlined in the work instruction (WCH 2007e) and implemented at the 100-B-23 site. According to the work instruction (WCH 2007e) focused samples were to be collected from remediated oil-stained soil sites and any stained soil associated with the treated wood (based on visual observation). The focused samples were to be composed of soils underlying the location of the former surface staining.

Specifically, the oil-stained soil sites were to be screened using TPH, a primary contaminant associated with the presence of automobile oil. The results of the TPH analysis were to be evaluated to determine if further laboratory analysis or remediation of the oil-stained soils was required. If TPH was detected, but below the screening level of 200 mg/kg (WAC 173-340), the full list of COPCs for oil-stained soils were to be analyzed. If TPH was detected above 200 mg/kg, then additional remediation was performed and the soils were then resampled for TPH.

Figure 2. Sample Locations at the 100-B-23 Waste Site.



All soils underlying removed lead debris were to be field screened using XRF to verify that no release to the soil had occurred. An addendum was made to the verification sampling approach in order to include remediation and focused sampling of soils underlying a cache of leaking batteries (Capron 2008). The sampling approach included the use of XRF to locate areas of elevated lead or mercury. If one soil area was observed to have significantly higher readings, then a single discreet grab sample was to be collected from that location. Otherwise, up to three aliquots were to be collected from the locations with the highest relative measurements and combined into one sample for analysis purposes.

Verification Sampling Activities

Lead Sheeting and Batteries

Sampling of the soils underlying the cache of leaking batteries (debris item #85) was performed in February 2008. XRF instrumentation was used to locate areas of elevated lead and/or mercury for sample collection. One grab sample and a duplicate were collected from the underlying soils and analyzed for ICP metals and mercury as instructed in Capron (2008). The primary sample and duplicate were composed of three aliquots that were taken from the areas with the highest XRF readings. As outlined in the verification sampling approach (WCH 2007e), no sampling was performed for the soils underlying the other remediated lead debris items listed in Table 1.

Oil-Stained Soils

The remediated oil-stained soils were sampled in June and July 2007 with additional sampling performed January 2008. Each sample was composed of 25 aliquots collected at equal intervals across the base of the remediation footprint. All but eight of the remediated oil-stained soil sites had TPH levels that were either undetected or below the screening level of 200 mg/kg (WAC 173-340) and, therefore, did not require additional remediation. Three of the eight sites requiring further remediation (i.e., the TPH levels were greater than 200 mg/kg) fell within the mechanical scrape area and were subsequently removed during this remedial action. Per agreement with EPA (Capron 2007), no further verification sampling was required within the scrape area. The other five locations failing for TPH were re-sampled after additional soil removal. TPH was not detected in any of the re-sampled areas.

TPH was detected in two soil samples (J155X2 and J15665) but was below the screening level of 200 mg/kg (WAC 173-340). These samples were analyzed for ICP metals, mercury, PCBs, and SVOCs as directed by the verification sampling work instruction (WCH 2007e).

Stained Soils Associated with Treated Wood

Focused verification samples were collected July 2007 of soils underlying the remediated "loading ramp." No visual staining was observed for these soils; however, because of the larger size of the remediated area (approximately 4.5 m by 6.0 m [15 ft by 20 ft]), one sample and a duplicate were collected. The verification sample was composed of 25 aliquots, collected at equal intervals across the base of the remediation footprint. Both samples were analyzed for

TPH, ICP metals (antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc), mercury, PCBs, SVOCs, and pesticides.

A summary of all the samples collected for the 100-B-23 waste site and the laboratory analyses performed are provided in Table 2. Figure 2 identifies the verification sample locations.

Table 2. 100-B-23 Verification Sample Summary Table. (3 Pages)

Sample Media and Location	Sample Number	Coordinate Locations	Depth	Sample Analysis
Soils Underlying Lead Batteries				
Soils beneath lead battery cache (ID number 85)	J169X3	N 144970.0 E 564452.8	Surface soils	ICP metals and mercury
Duplicate of J169X3 (soils beneath leaking batteries)	J169X4	N 144970.0 E 564452.8	Surface soils	
Remediated Oil-Stained Soils				
Soil beneath oil filters (ID number 86)	J16432	N 143612.6 E 564664.5	Surface soils	TPH
Soil beneath oil filters (ID number 87)	J16431	N 143651.1 E 564649.5	Surface soils	TPH
Soil beneath oil filters (ID number 88)	J155X7	N 143653.4 E 564659.7	Surface soils	TPH
Soil beneath oil filters (ID number 89)	J15675	N 143812.9 E 564616.0	Surface soils	TPH
Soil beneath oil filters (ID number 90)	J155W7	N 143671.9 E 564684.8	Surface soils	TPH
Soil beneath oil filters (ID number 91)	J155W6	N 143671.8 E 564670.5	Surface soils	TPH
Soil beneath oil filters (ID number 92)	J16430	N 143669.2 E 564671.4	Surface soils	TPH
Soil beneath oil filters (ID number 93)	J15665	N 143667.1 E 564672.5	Surface soils	TPH, ICP metals, mercury, PCBs, and SVOAs
Soil beneath oil filters (ID number 97)	J155X4	N 143675.8 E 564703.6	Surface soils	TPH
Soil beneath oil filters (ID number 98)	J155X5	N 143676.9 E 564736.8	Surface soils	TPH
Soil beneath oil filters (ID number 99)	J155X3	N 143719.1 E 564732.3	Surface soils	TPH
Soil beneath oil filters (ID number 100)	J155X2	N 143725.8 E 564739.2	Surface soils	TPH, ICP metals, mercury, PCBs, and SVOAs
Soil beneath oil filters (ID number 101)	J155X1	N 143724.5 E 564748.3	Surface soils	TPH
Soil beneath oil filters ID number 102)	J15664	N 143657.5 E 564784.5	Surface soils	TPH
Soil beneath oil filters (ID number 103)	J16433	N 143650.3 E 564779.1	Surface soils	TPH

Table 2. 100-B-23 Verification Sample Summary Table. (3 Pages)

Sample Media and Location	Sample Number	Coordinate Locations	Depth	Sample Analysis
Soil beneath oil filters (ID number 104)	J15663	N 143643.0 E 564775.1	Surface soils	TPH
Soil beneath oil filters (ID number 106)	J15679	N 143738.3 E 565612.3	Surface soils	TPH
Soil beneath oil filters (ID number 107)	J15680	N 144172.5 E 564852.7	Surface soils	TPH
Soil beneath oil filters (ID number 108)	J15681	N 144278.6 E 565153.6	Surface soils	TPH
Soil beneath oil filters (ID number 109)	J15667	N 144502.1 E 564463.5	Surface soils	TPH
Soil beneath oil filters (ID number 110)	J15669	N 144799.9 E 564084.8	Surface soils	TPH
Soil beneath oil filters (ID number 111)	J15671	N 145026.1 E 564060.0	Surface soils	TPH
Soil beneath oil filters (ID number 112)	J15668	N 144801.7 E 564396.1	Surface soils	TPH
Soil beneath oil filters (ID number 113)	J156J0	N 144759.9 E 566137.4	Surface soils	TPH
Soil beneath oil filters (ID number 114)	J15678	N 143495.9 E 565577.3	Surface soils	TPH
Soil beneath oil filters (ID number 115)	J15677	N 143516.7 E 565537.7	Surface soils	TPH
Soil beneath oil filters (ID number 116)	J15670	N 144988.3 E 564011.1	Surface soils	TPH
Soil beneath oil filters (oil filter #1)	J155W3	N 143706.5 E 564669.2	Surface soils	TPH
Soil beneath oil filters (oil filter #2)	J155W4	N 143676.5 E 564666.0	Surface soils	TPH
Soil beneath oil filters (oil filter #3)	J16429	N 143671.3 E 564671.4	Surface soils	TPH
Soil beneath oil filters (oil filter #4)	J15676	N 143769.5 E 565278.2	Surface soils	TPH
Soil beneath oil filters (oil filter #5)	J156J1	N 143516.2 E 565578.7	Surface soils	TPH
Soil beneath oil filters (oil filter #6)	J156J2	N 144355.0 E 564965.0	Surface soils	TPH
Equipment blank (silica sand)	J15672	N/A	N/A	TPH

Table 2. 100-B-23 Verification Sample Summary Table. (3 Pages)

Sample Media and Location	Sample Number	Coordinate Locations	Depth	Sample Analysis
Soils Underlying Wood Debris				
Wood debris "loading ramp" (ID number 122)	J156N9	N 144812.3 E 565364.0	Surface soils	TPH, ICP metals, mercury, PCBs, SVOAs, and pesticides
Duplicate of J156N9 (ID number 122)	J156P0	N 144812.3 E 565364.0	Surface soils	TPH, ICP metals, mercury, PCBs, SVOAs, and pesticides
Equipment blank (silica sand)	J156P1	N/A	N/A	ICP metals, mercury, and SVOAs

Source: Field logbook EFL-1173-12, pp. 93-94, 100 (WCH 2007b), Field logbook EFL-1173-13, pp. 5-10, 17-21, 32-33 (WCH 2007c), Field logbook EFL-1173-14, pp. 64, 92-93 (WCH 2008).

ICP = inductively coupled plasma
ID = identification
N/A = not applicable
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbons

Verification Sample Results

Verification samples were analyzed using analytical methods approved by the U.S. Environmental Protection Agency. The analytical results are stored in the Environmental Restoration (ENRE) project-specific database prior to being provided to the Hanford Environmental Information System (HEIS) and are included in Appendix C of this document.

The analytical results for the COPCs that were identified for the 100-B-23 waste site were compared to the cleanup criteria specified in the RDR/RAWP (DOE-RL 2005b). A comparison of the maximum concentrations of detected analytes and the site remedial action goals (RAGs) are summarized in Table 3. The 100-B-23 waste site was considered as a whole, using the maximum value for each analyte from the data set of all soil locations sampled. Contaminants that were not detected by laboratory analysis are excluded from this table. Calculated cleanup levels are not presented in the *Cleanup Levels and Risk Calculations Database* (Ecology 2005) under WAC 173-340-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium; therefore, these constituents are not considered site COPCs and are also not included in Table 3. Phosphorous was detected in the samples, but is present as an essential nutrient (phosphate) and therefore not included in these tables (EPA 1989).

Table 3. Comparison of Maximum Contaminant Concentrations to Action Levels for the 100-B-23, 100-B/C Surface Debris. (2 Pages)

COPC	Maximum Result (mg/kg)	Remedial Action Goals[a] (mg/kg)			Does the Maximum Result Exceed RAGs?	Does the Maximum Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony[b]	0.27 (<BG)	32	5[c]	5[c]	No	--
Arsenic	4.4 (<BG)	20	20	20	No	--
Barium	118 (<BG)	5,600	132[c]	224	No	--
Beryllium	0.45 (<BG)	10.4[d]	1.51[c]	1.51[c]	No	--
Boron[e]	14.1	16,000	320	--[f]	No	--
Cadmium[b]	1.7	13.9[d]	0.81[c]	0.81[c]	Yes	Yes[g]
Chromium (total)	14.0 (<BG)	80,000	18.5[c]	18.5[c]	No	--
Cobalt	7.7 (<BG)	1,600	32	--[f]	No	--
Copper	21.6 (<BG)	2,960	59.2	22.0[c]	No	--
Lead	73.8	353	10.2[c]	10.2[c]	Yes	Yes[g]
Lithium	8.6 (<BG)	1,600	33.5	--[f]		
Manganese	352 (<BG)	11,200	512[c]	512[c]	No	--
Mercury	8.2	24	0.33[c]	0.33[c]	Yes	Yes[g]
Molybdenum[e]	0.71	400	8	--[f]	No	--
Nickel	13.6 (<BG)	1,600	19.1[c]	27.4	No	--
Selenium[b]	0.57 (<BG)	400	5	1	No	--
Strontium	25.1	48,000	960	--[f]	No	--
Tin	3.2	48,000	960	--[f]	No	--
Vanadium	42.9 (<BG)	560	85.1[c]	--[f]	No	--
Zinc	1,310	24,000	480	67.8[c]	Yes	Yes[g]
TPH	173	--	200	200	No	--
Aroclor-1254	0.0054	0.5	0.017[h]	0.017[h]	No	--
Aroclor-1260	0.021	0.5	0.017[h]	0.017[h]	Yes	Yes[g]
Acenapthene	0.200	4,800	96	129	No	--
Anthracene	1.90	24,000	240	1,920	No	--
Benzo(a)anthracene	0.490	0.137	0.015[h]	0.015[h]	Yes	Yes[i]
Benzo(a)pyrene	0.220	0.137	0.015[h]	0.015[h]	Yes	Yes[i]
Benzo(b)fluoranthene	0.270	0.137	0.015[h]	0.015[h]	Yes	Yes[i]
Benzo(g,h,i)perylene[j]	0.050	2,400	48	192	No	--

Table 3. Comparison of Maximum Contaminant Concentrations to Action Levels for the 100-B-23, 100-B/C Surface Debris. (2 Pages)

COPC	Maximum Result (mg/kg)	Remedial Action Goals[a] (mg/kg)			Does the Maximum Result Exceed RAGs?	Does the Maximum Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Benzo(k)fluoranthene	0.290	0.137	0.015[h]	0.015[h]	Yes	Yes[i]
Bis(2-ehylhexyl) phthalate	0.210	71.4	0.6	0.36	No	--
Butylbenzyphthalate	0.020	16,000	320	250	No	--
Carbazole	0.370	50	0.437	--[f]	No	--
Chrysene	1.40	0.137	0.1[h]	0.1[h]	Yes	Yes[i]
Di-n-butylphthalate	0.031	8,000	160	540	No	--
Dibenzo(a,h)anthracene	0.050	0.137	0.03[h]	0.03[h]	Yes	Yes[g]
Dibenzofuran	0.220	160	3.20	--[f]	No	--
Fluoranthene	1.60	3,200	64	18.0	No	--
Fluorene	0.390	3,200	64	260	No	--
Indeno(1,2,3-cd) pyrene	0.083	1.37	0.03[h]	0.03[h]	Yes	Yes[g]
Phenanthrene[j]	2.40	24,000	240	1,920	No	--
Pyrene	1.20	2,400	48	192	No	--

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

[b] 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).

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

[d] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3]) (1996) and an airborne particulate mass-loading rate of 0.0001 g/m^3 (WDOH 1997).

[e] No Hanford Site-specific or Washington State background value available.

[f] No cleanup level is available from the *Cleanup Levels and Risk Calculations (CLARC) Database* (Ecology 2005), and no bioconcentration factor or ambient water quality criteria values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

[g] Based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a), these constituents are not predicted to migrate more than 2 m (7 ft) vertically in 1,000 years (based on the lowest soil-partitioning coefficient distribution of 30 mL/g). The vadose zone underlying this site is approximately 10 m (32.8 ft) thick.

[h] Where cleanup levels are less than RDLs, cleanup levels default to RDLs (WAC 173-340-707(2)) (1996).

[i] Site-specific risk assessment evaluation determined that the mass of contamination was too small to cause a direct exposure risk of greater than 10^{-6}. Based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a), these constituents are not predicted to migrate more than 1 m (3.3 ft) vertically in 1,000 years (based on the lowest soil-partitioning coefficient distribution of 200 mL/g). The vadose zone underlying this site is approximately 10 m (32.8 ft) thick.

[j] Toxicity data for this chemical are not available. Cleanup levels are based on surrogate chemicals:
Contaminant: benzo(g,h,i)perylene; surrogate: pyrene
Contaminant: phenathrene; surrogate: anthracene

-- = not applicable
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDL = required detection limit
RESRAD = RESidual RADioactivity (dose assessment model)
TPH = *total petroleum hydrocarbons*
WAC = *Washington Administrative Code*
WDOH = Washington Department of Health

DATA EVALUATION

Several PAHs shown in Table 3 (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and chrysene) were detected in the verification samples for the 100-B-23 site, above the direct exposure, groundwater, and river protection RAGs presented in the RDR/RAWP. These samples were collected of the soils underlying the remediated wooden "loading ramp" (ID number 122). A site-specific risk assessment evaluation was performed (Appendix D) which concluded that the mass of PAH contamination was too small to cause a direct exposure risk of greater than 1×10^{-6}. Also, based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a), these constituents are not predicted to migrate more than 1 m (3.3 ft) vertically in 1,000 years (based on the lowest soil-partitioning distribution coefficient of 200 mL/g for chrysene). The vadose zone underlying the site is at least 10 m (33 ft) thick. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and, consequently, the Columbia River.

In addition to PAHs, the following constituents exceeded groundwater and/or river protection RAGs at the 100-B-23 waste site: cadmium, lead, mercury, zinc, aroclor-1260, dibenzo(a,h)anthracene, and indeno(1,2,3-cd) pyrene. Based on the lowest soil-partitioning coefficient of these contaminants, 30 mL/g, RESRAD modeling predicts that these contaminants will not migrate more than 2 m (7 ft) vertically in 1,000 years (BHI 2005a). The vadose zone beneath the 100-B-23 waste site is at least 10 m (33 ft) thick. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and, consequently, the Columbia River. All other residual concentrations of waste site COPCs, as listed in Table 3, were determined to be below the established soil RAGs and are, therefore, demonstrated to be protective of the environment and human health.

Assessment of the risk requirements for the 100-B-23 waste site is determined by calculation of the hazard quotient and excess cancer risk values for nonradionuclides. These calculations are located in Appendix D. The requirements include an individual hazard quotient of less than or equal to 1.0, a cumulative hazard quotient of less than or equal to 1.0, an individual contaminant carcinogenic risk of less than or equal to 1×10^{-6}, and a cumulative carcinogenic risk of less than or equal to 1×10^{-5}. These risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. The results (Appendix D) indicate that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the noncarcinogenic constituents is 6.4×10^{-1}. All individual carcinogen risk values for carcinogenic constituents are less than 1×10^{-6}. The cumulative carcinogenic risk value is 1.1×10^{-6}. Therefore, nonradionuclide risk requirements are met.

When using a statistical sampling approach, a RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. However, this test is not applicable to the focused sampling results because maximum detected concentrations are used as the compliance basis and evaluated individually against the cleanup criteria.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the confirmatory 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 100-B-23 site established that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. The analytical data were found to be acceptable for decision-making purposes. The detailed DQA is presented in Appendix E.

SUMMARY FOR INTERIM CLOSED OUT

The 100-B-23 waste site has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2005b). Verification sampling was performed, and the analytical results indicate that the residual concentrations of COPCs at this site meet the remedial action objectives for direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the verification sampling results support a reclassification of the 100-B-23 waste site to Interim Closed Out. Site contamination did not extend into the deep-zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

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APPENDIX A

PHOTOGRAPHS OF 100-B-23, 100-B/C SURFACE DEBRIS AND REMEDIATION

Figure A-1. Posted ACM Area Signs (ID #45). Posting Has Been Removed.

Figure A-2. Photograph of Potential Friable ACM Material (Pipe Wrapping – ID #5).

Figure A-3. Example of Oil-stained Soil and Oil Filters (ID #88).

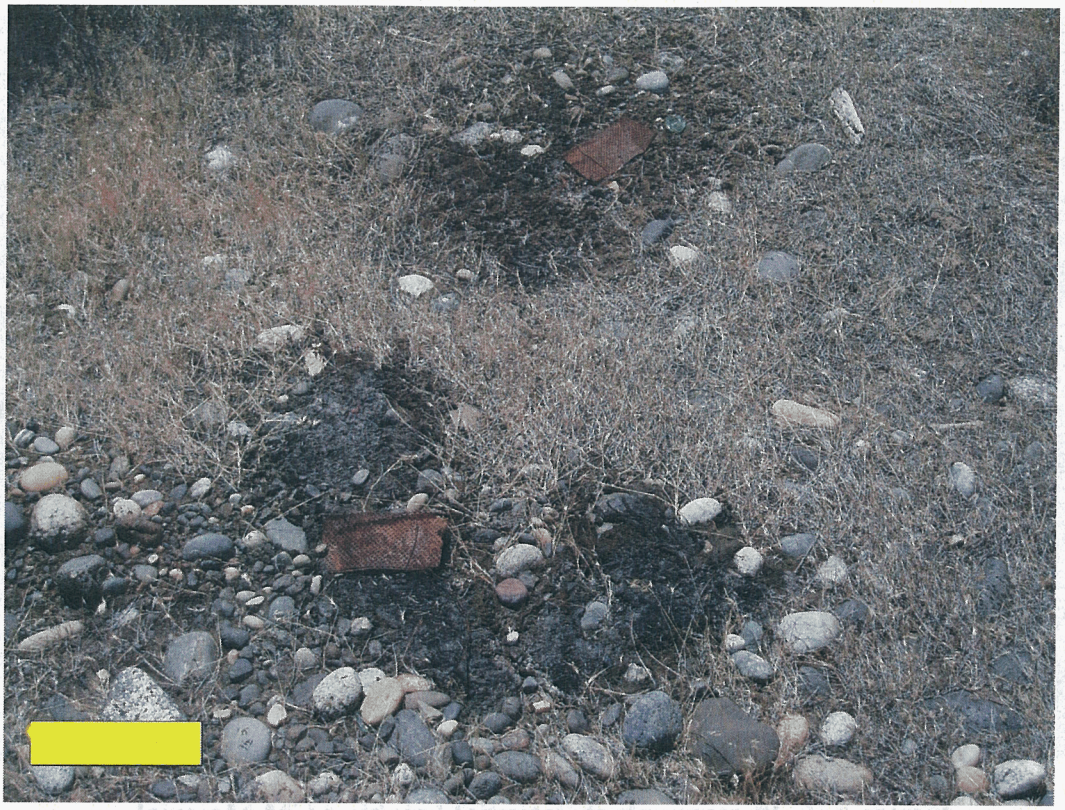

Figure A-4. Example of Treated Wood Debris (ID #130). Removed.

Figure A-5. Example of Treated Wood Debris (Pole #1). Removed.

Figure A-6. Example of Treated Wood Debris (Pole #1). Removed.

Figure A-7. Remediation of Treated Wood Debris – Loading Ramp (ID #122).

Figure A-8. Stained Soil Underlying Leaking Battery Cache (ID #85).

APPENDIX B

CERTIFICATION OF VISUAL INSPECTION FOR DOWNPOSTING OF ACM WASTE SITE (ID #45)

AND

SUMMARY OF CURRENT DISPOSITION FOR 100-B-23 TREATED WOOD DEBRIS

CERTIFICATION OF VISUAL INSPECTION FOR DOWNPOSTING OF ACM WASTE SITE (ID #45)

CERTIFICATION OF VISUAL INSPECTION

In accordance with the Work Package for Asbestos Abatement, the Competent Person hereby certifies that a visual inspection of the Work Area (all surfaces including pipes, beams, ledges, walls, ceiling and floor, decontamination area, sheet plastic, etc.) has been performed and no dust, debris or asbestos residue was found.

Work Area Inspected: Building # SW OF 190 B (100 B23) Work Area: 100 B

by: (Signature) S.M. Hamblin Date 12-12-06

(Print Name) S.M. HAMBLIN

(Print Title) Certified Competent Person FIELD SUPERINTENDENT

Perform clearance monitoring.

Clearance results: N/A OUT DOOR AREA f/cc (PCM) Sample Number: N/A

Washington Closure Hanford, LLC:

WCH hereby certifies that the work area has been inspected and verifies that to the best of WCH's knowledge and belief, the work area as indicated above is cleared for unrestricted access (abatement complete).

by: (Signature) S.M. Hamblin Date 12-12-06

(Print Name) S.M. HAMBLIN

(Print Title) Certified Competent Person FIELD SUPERINTENDENT

Safety and Health Representative Denise A. Pitts / Denise A. Pitts Date 12-12-06

WCH-SH-488 (09/01/2006)

SUMMARY OF CURRENT DISPOSITION FOR 100-B-23 TREATED WOOD DEBRIS

Table B-1. Disposition of Treated Wood Debris. (2 Pages)

ID NUMBER	Northing	Easting	Description	Comment
117	144150.0	565393.0	Wood covered manholes	Removed during previous 100-B/C remediation activities.
118	144670.0	565260.0	Power poles	Removed during 1607-B2 remediation.
119	144247.7	564048.0	Railroad ties	Left in place – determined no further remedial action required.
120	143749.8	564076.6	Wood post, 3 cans	Removed during 100-B-23 remediation.
121	144192.6	565760.5	Three down power poles	Removed during previous 100-B/C remediation activities. Area has been remediated and re-vegetated.
122	144812.3	565364.0	Loading ramp with wood	Remediated during 100-B-23 remediation. Verification samples collected.
123	145053.7	566675.5	Top of fallen power pole	Left in place – determined no further remedial action required.
124	143650.9	565845.4	Wood post.	Left in place – determined no further remedial action required.
125	143803.3	565475.7	Wood post	Removed. Part of 118-C-1 backfill area.
126	143760.3	565693.5	Wood post	Removed.
127	143891.8	565325.5	Wood post	Removed.
128	144238.1	564711.4	Wood post	Removed.
129	144324.7	564821.4	Railroad tie	Removed. Part of the 100-B-19 SS-100BC-004 remediation.
130	144670.8	565169.4	Wood post	Removed per agreement with EPA and DOE-RL.
131	143751.0	564468.0	Railroad tie	Removed.
132	144386.0	565105.0	Wood post	Left in place – determined no further remedial action required.
133	145286.9	564123.0	Wood post	Appears to be part of historical fenceline; assorted similar items in general vicinity. Left in place.
134	143746.2	564074.3	Railroad tie	Removed.
135	143770.0	564058.6	Railroad tie	Removed.
136	143682.6	564336.9	Wooden posts	Removed.
137	143677.5	564500.7	Railroad tie	In state of decomposition. No visible discolored soil. Left in place – no further remediation required.
138	143894.2	564633.6	Wood posts	Left in place – no further remediation required.
139	144896.3	564855.5	Railroad tie	Removed. Part of the 126-B-3 remediation. Area backfilled and re-vegetated.

Table B-1. Disposition of Treated Wood Debris. (2 Pages)

ID NUMBER	Northing	Easting	Description	Comment
140	143644.4	565144.7	Railroad tie	South end of an existing trough. Left in place – no further remediation required.
141	143627.3	565126.5	Railroad tie	South end of an existing trough. Left in place – no further remediation required.
Pole #1	143886.2	565361.0	Power pole	Not originally included in 100-B-23. Removed per agreement with EPA and DOE-RL.
Ties #1	144283.5	564072.7	Wood	Not originally included in 100-B-23. Left in place – no further remediation required.
Planks #1	143842	565363.2	Pile of wooden planks	Not originally included in 100-B-23. Left in place – no further remediation required.
Planks #2	143850.7	565356.7	Wooden planks	Not originally included in 100-B-23. Left in place – no further remediation required.
Ties #2	144225.0	563991.0	Railroad ties	Not originally included in 100-B-23. Left in place – no further remediation required.
Ties #3	144210	563964.8	Railroad ties	Not originally included in 100-B-23. Left in place – no further remediation required.
Pole #2	145170	564062.7	Downed power pole	Not originally included in 100-B-23. Removed per agreement with EPA and DOE-RL.

APPENDIX C

100-B-23, 100-B/C SURFACE DEBRIS VERIFICATION DATA

Table C-1. 100-B-23 Verification Sampling Results. (8 Pages)

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Bismuth			Boron			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soils beneath batteries (ID number 85)	J169X3	2/19/2008	7640		10.6	0.79	U	0.79	3.4		1.3	118		0.26	0.38		0.13				12.5		1.3	1.6		0.13
Duplicate of J169X3	J169X4	2/19/2008	7950		9.7	0.73	U	0.73	3.6		1.2	106		0.24	0.45		0.12				14.1		1.2	1.7		0.12
Soil beneath oil filters (ID number 93)	J15665	6/21/2007	4570		4.8	0.63	U	0.63	2.3		1.2	50.1	C	0.06	0.16		0.03	1.2	U	1.2	1	U	1	0.14	U	0.14
Soil beneath oil filters (ID number 100)	J155X2	6/19/2007	6580	C	4.8	0.64	U	0.64	2.1		1.2	76.5	C	0.06	0.34		0.03	1.2	U	1.2	1.7		1	0.44		0.15
Wood debris "loading ramp" (ID number 122)	J156N9	7/16/2007	4430		1.7	0.21	UJ	0.21	4.4		0.39	71.8		0.02	0.15		0.01				3.2		0.34	0.1		0.05
Duplicate of J15672 (ID number 122)	J156P0	7/16/2007	5870		1.7	0.27	J	0.21	3.2		0.39	71.5		0.02	0.09		0.01				2.6		0.35	0.11		0.05
Equipment blank (silica sand)	J156P1	7/16/2007	46.8		1.7	0.21	UJ	0.21	0.4	U	0.4	1.2		0.02	0.01	U	0.01				0.35	U	0.35	0.05	U	0.05

Sample Location	HEIS Number	Sample Date	Calcium			Chromium			Cobalt			Copper			Iron			Lead			Lithium			Magnesium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soils beneath batteries (ID number 85)	J169X3	2/19/2008	8320	C	10.6	11		0.53	7.4		0.53	19.2	C	53	18500		11.9	59.4		0.79				3490		6.6
Duplicate of J169X3	J169X4	2/19/2008	8900	C	9.7	12.3		0.49	7.3		0.49	21.6	C	0.49	20700		10.9	73.8		0.73				3340		6.1
Soil beneath oil filters (ID number 93)	J15665	6/21/2007	2780	C	2	8.1	C	0.29	5.1		0.23	14.9	C	0.26	13400	C	6.9	11.9		0.95	4.5	C	0.09	2930	C	2.3
Soil beneath oil filters (ID number 100)	J155X2	6/19/2007	3680	C	2.1	14		0.29	5.8		0.23	16.1	C	0.26	13800	C	7	13.4		0.96	8.6	C	0.09	4350	C	2.4
Wood debris "loading ramp" (ID number 122)	J156N9	7/16/2007	5100	J	0.68	7.3	J	0.1	6.6		0.08	15.5	J	0.09	14300	C	0.32	6.7		0.31				3310	C	0.77
Duplicate of J15672 (ID number 122)	J156P0	7/16/2007	5550	J	0.68	13.1	J	0.1	7.7		0.08	16.3	J	0.09	18100	C	0.33	6.9		0.32				4070	C	0.78
Equipment blank (silica sand)	J156P1	7/16/2007	21.8	UJ	0.69	0.19	UJ	0.1	0.08	U	0.08	0.29	UJ	0.09	106	C	0.33	0.32	U	0.32				7	C	0.79

Acronyms and notes apply to all of the tables in this appendix.

Note: Data qualified with B, C, and/or J are considered acceptable values.

B = blank contamination (organic constituents)

C = blank contamination (inorganic constituents)

D = dilution

HEIS = Hanford Environmental Information System

J = estimate

MDA = minimum detectable activity

PQL = practical quantitation limit

Q = qualifier

R = rejected

SVOA = semivolatile organic analysis

TPH = total petroleum hydrocarbon

U = undetected

Table C-1. 100-B-23 Verification Sampling Results. (8 Pages)

Sample Location	HEIS Number	Sample Date	Manganese			Mercury			Molybdenum			Nickel			Phosphorus			Potassium			Selenium			Silicon		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soils beneath batteries (ID number 85)	J169X3	2/19/2008	325	C	0.11	7.9		0.1	0.79	U	0.79	11.8		0.53				1020		10.6	1.6	U	1.6	463		10.6
Duplicate of J169X3	J169X4	2/19/2008	352	C	0.1	8.2		0.08	0.73	U	0.73	12.2		0.49				1070		9.7	1.5	U	1.5	287		9.7
Soil beneath oil filters (ID number 93)	J15665	6/21/2007	205		0.2	0.003	U	0.02	0.71		0.46	7.7		0.78	757		4	1040		9.2	1.2	U	1.2	1280	C	2.5
Soil beneath oil filters (ID number 100)	J155X2	6/19/2007	250		0.2	0.04		0.02	0.47	U	0.47	13.6		0.79	803	C	4.1	1370	C	9.3	1.3	U	1.2	1630	C	2.5
Wood debris "loading ramp" (ID number 122)	J156N9	7/16/2007	261		0.07	1.4		0.01	0.49	UJ	0.15	8.3		0.26				901		3	0.57		0.41	1230	C	0.82
Duplicate of J15672 (ID number 122)	J156P0	7/16/2007	282		0.07	1.3		0.02	0.73	UJ	0.15	11.7		0.26				1080		3.1	0.55		0.41	924	C	0.83
Equipment blank (silica sand)	J156P1	7/16/2007	5		0.07	0.02	U	0.02	0.25	UJ	0.16	0.26	U	0.26				24.2		3.1	0.42	U	0.42	66	C	0.84

Sample Location	HEIS Number	Sample Date	Silver			Sodium			Strontium			Thallium			Tin			Uranium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soils beneath batteries (ID number 85)	J169X3	2/19/2008	0.26	U	0.26	252	C	1.8													34.5		0.37	474		1.6
Duplicate of J169X3	J169X4	2/19/2008	0.24	U	0.24	294	C	1.6													41.8		0.34	1310		1.5
Soil beneath oil filters (ID number 93)	J15665	6/21/2007	0.26	U	0.26	131	C	2	15.4	C	0.03	2.3	U	2.3	3.2	C	1.8	4.2	U	4.2	28.7		0.23	45.2	C	0.12
Soil beneath oil filters (ID number 100)	J155X2	6/19/2007	0.26	U	0.26	118	C	2	25.1	C	0.03	2.3	U	2.3	2.7	C	1.8	4.2	U	4.2	24.9		0.23	57.9	C	0.12
Wood debris "loading ramp" (ID number 122)	J156N9	7/16/2007	0.09	U	0.09	156	C	0.67													27.9	J	0.08	34.3	C	0.04
Duplicate of J15672 (ID number 122)	J156P0	7/16/2007	0.09	U	0.09	218	C	0.67													42.9	J	0.08	42.2	C	0.04
Equipment blank (silica sand)	J156P1	7/16/2007	0.09	U	0.09	11.4	UJ	0.68													0.08	U	0.08	2.4	UJ	0.04

Table C-1. 100-B-23 Verification Sampling Results. (8 Pages)

Sample Location	HEIS Number	Sample Date	TPH		
			mg/kg	Q	PQL
Soil beneath oil filters (ID number 86)	J16432	1/8/2008	143	U	143
Soil beneath oil filters (ID number 87)	J16431	1/8/2008	154	U	154
Soil beneath oil filters (ID number 88)	J155X7	6/19/2007	134	U	134
Soil beneath oil filters (ID number 89)	J15675	6/28/2007	133	U	133
Soil beneath oil filters (ID number 90)	J155W7	6/13/2007	134	U	134
Soil beneath oil filters (ID number 91)	J155W6	6/13/2007	133	U	133
Soil beneath oil filters (ID number 92)	J16430	1/8/2008	143	U	143
Soil beneath oil filters (ID number 93)	J15665	6/21/2007	173		133
Soil beneath oil filters (ID number 97)	J155X4	6/19/2007	133	U	133
Soil beneath oil filters (ID number 98)	J155X5	6/19/2007	133	U	133
Soil beneath oil filters (ID number 99)	J155X3	6/19/2007	133	U	133
Soil beneath oil filters (ID number 100)	J155X2	6/19/2007	144		134
Soil beneath oil filters (ID number 101)	J155X1	6/19/2007	134	U	134
Soil beneath oil filters (ID number 102)	J15664	6/21/2007	133	U	133
Soil beneath oil filters (ID number 103)	J16433	1/8/2008	147	U	147
Soil beneath oil filters (ID number 104)	J15663	6/21/2007	133	U	133
Soil beneath oil filters (ID number 106)	J15679	6/28/2007	133	U	133
Soil beneath oil filters (ID number 107)	J15680	7/2/2007	133	U	133
Soil beneath oil filters (ID number 108)	J15681	7/2/2007	133	U	133
Soil beneath oil filters (ID number 109)	J15667	6/25/2007	133	U	133
Soil beneath oil filters (ID number 110)	J15669	6/28/2007	134	U	134
Soil beneath oil filters (ID number 111)	J15671	6/28/2007	135	U	135
Soil beneath oil filters (ID number 112)	J15668	6/25/2007	133	U	133
Soil beneath oil filters (ID number 113)	J156J0	7/2/2007	133	U	133
Soil beneath oil filters (ID number 114)	J15678	6/28/2007	133	U	133
Soil beneath oil filters (ID number 115)	J15677	6/28/2007	133	U	133
Soil beneath oil filters (ID number 116)	J15670	6/28/2007	134	U	134
Soil beneath oil filters (oil filter #1)	J155W3	6/13/2007	134	U	134
Soil beneath oil filters (oil filter #2)	J155W4	6/13/2007	134	U	134
Soil beneath oil filters (oil filter #3)	J16429	1/8/2008	142	U	142
Soil beneath oil filters (oil filter #4)	J15676	6/28/2007	133	U	133
Soil beneath oil filters (oil filter #5)	J156J1	7/2/2007	133	U	133
Soil beneath oil filters (oil filter #6)	J156J2	7/2/2007	133	U	133
Equipment blank (silica sand)	J15672	6/28/2007	133	U	133
Wood debris "loading ramp" (ID number 122)	J156N9	7/16/2007	133	UJ	133
Duplicate of J156N9 (ID number 122)	J156P0	7/16/2007	133	UJ	133

Table C-1. 100-B-23 Verification Sampling Results. (8 Pages)						
Constituents	J15665 Soil beneath oil filters (ID number 93) Sample Date 6/21/07			J155X2 Soil beneath oil filters (ID number 100) Sample Date 6/19/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls (PCB)						
Aroclor-1016	13	U	13	13	U	13
Aroclor-1221	13	U	13	13	U	13
Aroclor-1232	13	U	13	13	U	13
Aroclor-1242	13	U	13	13	U	13
Aroclor-1248	13	U	13	13	U	13
Aroclor-1254	13	U	13	5.4	J	13
Aroclor-1260	13	U	13	13	U	13
Semivolatile Organic Analysis (SVOAs)						
1,2,4-Trichlorobenzene	670	UJD	670	330	UJ	330
1,2-Dichlorobenzene	670	UJD	670	330	UJ	330
1,3-Dichlorobenzene	670	UJD	670	330	UJ	330
1,4-Dichlorobenzene	670	UJD	670	330	UJ	330
2,4,5-Trichlorophenol	1700	UJD	1700	840	UJ	840
2,4,6-Trichlorophenol	670	UJD	670	330	UJ	330
2,4-Dichlorophenol	670	UJD	670	330	UJ	330
2,4-Dimethylphenol	670	UJD	670	330	UJ	330
2,4-Dinitrophenol	1700	UJR	1700	840	UJ	840
2,4-Dinitrotoluene	670	UJD	670	330	UJ	330
2,6-Dinitrotoluene	670	UJD	670	330	UJ	330
2-Chloronaphthalene	670	UJD	670	330	UJ	330
2-Chlorophenol	670	UJD	670	330	UJ	330
2-Methylnaphthalene	670	UJD	670	330	UJ	330
2-Methylphenol (cresol, o-)	670	UJD	670	330	UJ	330
2-Nitroaniline	1700	UJR	1700	840	UJ	840
2-Nitrophenol	670	UJD	670	330	UJ	330
3+4 Methylphenol (cresol, m+p)	670	UJD	670	330	UJ	330
3,3'-Dichlorobenzidine	670	UJD	670	330	UJR	330
3-Nitroaniline	1700	UJD	1700	840	UJ	840
4,6-Dinitro-2-methylphenol	1700	UJR	1700	840	UJ	840
4-Bromophenylphenyl ether	670	UJD	670	330	UJ	330
4-Chloro-3-methylphenol	670	UJD	670	330	UJ	330
4-Chloroaniline	670	UJD	670	330	UJ	330
4-Chlorophenylphenyl ether	670	UJD	670	330	UJ	330
4-Nitroaniline	1700	UJD	1700	840	UJ	840

Table C-1. 100-B-23 Verification Sampling Results. (8 Pages)						
Constituents	J15665 Soil beneath oil filters (ID number 93)			J155X2 Soil beneath oil filters (ID number 100)		
	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Analysis (SVOAs) - Continued						
Acenaphthene	670	UJD	670	330	UJ	330
Acenaphthylene	670	UJD	670	330	UJ	330
Anthracene	670	UJD	670	330	UJ	330
Benzo(a)anthracene	670	UJD	670	330	UJ	330
Benzo(a)pyrene	670	UJD	670	330	UJ	330
Benzo(b)fluoranthene	670	UJD	670	330	UJ	330
Benzo(ghi)perylene	50	JBD	670	330	UJ	330
Benzo(k)fluoranthene	670	UJD	670	330	UJ	330
Bis(2-chloro-1-methylethyl)ether	670	UJD	670	330	UJ	330
Bis(2-Chloroethoxy)methane	670	UJD	670	330	UJ	330
Bis(2-chloroethyl) ether	670	UJD	670	330	UJ	330
Bis(2-ethylhexyl) phthalate	84	JBD	670	210	JB	330
Butylbenzylphthalate	670	UJD	670	330	UJ	330
Carbazole	670	UJD	670	330	UJ	330
Chrysene	41	JD	670	22	J	330
Di-n-butylphthalate	670	UJD	670	31	J	330
Di-n-octylphthalate	670	UJD	670	330	UJ	330
Dibenz[a,h]anthracene	50	JD	670	330	UJ	330
Dibenzofuran	670	UJD	670	330	UJ	330
Diethylphthalate	670	UJD	670	330	UJ	330
Dimethyl phthalate	670	UJD	670	330	UJ	330
Fluoranthene	670	UJD	670	330	UJ	330
Fluorene	670	UJD	670	330	UJ	330
Hexachlorobenzene	670	UJD	670	330	UJ	330
Hexachlorobutadiene	670	UJD	670	330	UJ	330
Hexachlorocyclopentadiene	670	UJD	670	330	UJ	330
Hexachloroethane	670	UJD	670	330	UJ	330
Indeno(1,2,3-cd)pyrene	46	JD	670	330	UJ	330
Isophorone	670	UJD	670	330	UJ	330
N-Nitroso-di-n-dipropylamine	670	UJD	670	330	UJ	330
N-Nitrosodiphenylamine	670	UJD	670	330	UJ	330
Naphthalene	670	UJD	670	330	UJ	330
Nitrobenzene	670	UJD	670	330	UJ	330
Pentachlorophenol	1700	UJD	1700	840	UJ	840
Phenanthrene	670	UJD	670	330	UJ	330
Phenol	670	UJD	670	330	UJ	330
Pyrene	670	UJD	670	330	UJ	330

Table C-1. 100-B-23 Verification Sampling Results. (8 Pages)						
Constituents	J156N9 Soil beneath wood debris (ID number 122) Sample Date 7/16/07			J156P0 Duplicate of J156N9 Sample Date 7/16/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls (PCB)						
Aroclor-1016	13	U	13	13	U	13
Aroclor-1221	13	UJ	13	13	UJ	13
Aroclor-1232	13	UJ	13	13	UJ	13
Aroclor-1242	13	UJ	13	13	UJ	13
Aroclor-1248	13	UJ	13	13	UJ	13
Aroclor-1254	13	UJ	13	13	UJ	13
Aroclor-1260	13	UJ	13	21	J	13
Pesticides						
Aldrin	1.3	UD	1.3	1.3	UD	1.3
Alpha-BHC	1.3	UD	1.3	1.3	UD	1.3
alpha-Chlordane	1.3	UD	1.3	1.3	UD	1.3
Hexachlorocyclohexane	1.3	UD	1.3	1.3	UD	1.3
Delta-BHC	1.3	UD	1.3	1.3	UD	1.3
Dichlorodiphenyldichloroethane	1.3	UD	1.3	1.3	UD	1.3
Dichlorodiphenyldichloroethylene	1.3	UDJ	1.3	1.3	UDJ	1.3
Dichlorodiphenyltrichloroethane	1.3	UD	1.3	1.3	UD	1.3
Dieldrin	1.3	UD	1.3	1.3	UD	1.3
Endosulfan I	1.3	UD	1.3	1.3	UD	1.3
Endosulfan II	1.3	UD	1.3	1.3	UD	1.3
Endosulfan sulfate	1.3	UD	1.3	1.3	UD	1.3
Endrin	1.3	UD	1.3	1.3	UD	1.3
Endrin aldehyde	1.3	UD	1.3	1.3	UD	1.3
Endrin ketone	1.3	UD	1.3	1.3	UD	1.3
Gamma-BHC (Lindane)	1.3	UD	1.3	1.3	UD	1.3
gamma-Chlordane	1.3	UD	1.3	1.3	UD	1.3
Heptachlor	1.3	UD	1.3	1.3	UD	1.3
Heptachlor epoxide	1.3	UD	1.3	1.3	UD	1.3
Methoxychlor	1.3	UD	1.3	1.3	UD	1.3
Toxaphene	13	UDJ	13	13	UDJ	13

Table C-1. 100-B-23 Verification Sampling Results. (8 Pages)									
Constituents	J156N9 Soil beneath wood debris (ID number 122)			J156P0 Duplicate of J156N9 Sample Date 7/16/07			J156P1 Equipment Blank Sample Date 7/16/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Analysis (SVOAs)									
1,2,4-Trichlorobenzene	330	UJ	330	330	UJ	330	330	UJ	330
1,2-Dichlorobenzene	330	UJ	330	330	UJ	330	330	UJ	330
1,3-Dichlorobenzene	330	UJ	330	330	UJ	330	330	UJ	330
1,4-Dichlorobenzene	330	UJ	330	330	UJ	330	330	UJ	330
2,4,5-Trichlorophenol	840	U	840	840	U	840	840	UJ	840
2,4,6-Trichlorophenol	330	UJ	330	330	UJ	330	330	UJ	330
2,4-Dichlorophenol	330	U	330	330	U	330	330	UJ	330
2,4-Dimethylphenol	330	U	330	330	U	330	330	U	330
2,4-Dinitrophenol	840	U	840	840	U	840	840	U	840
2,4-Dinitrotoluene	330	U	330	330	U	330	330	U	330
2,6-Dinitrotoluene	330	UJ	330	330	UJ	330	330	UJ	330
2-Chloronaphthalene	330	UJ	330	330	UJ	330	330	UJ	330
2-Chlorophenol	330	UJ	330	330	UJ	330	330	UJ	330
2-Methylnaphthalene	330	U	330	330	U	330	330	U	330
2-Methylphenol (cresol, o-)	330	UJ	330	330	UJ	330	330	UJ	330
2-Nitroaniline	840	U	840	840	U	840	840	U	840
2-Nitrophenol	330	UJ	330	330	UJ	330	330	UJ	330
3+4 Methylphenol (cresol, m+p)	330	U	330	330	U	330	330	U	330
3,3'-Dichlorobenzidine	330	UJ	330	330	UJ	330	330	UJ	330
3-Nitroaniline	840	UJ	840	840	UJ	840	840	UJ	840
4,6-Dinitro-2-methylphenol	840	U	840	840	U	840	840	U	840
4-Bromophenylphenyl ether	330	U	330	330	U	330	330	UJ	330
4-Chloro-3-methylphenol	330	U	330	330	U	330	330	U	330
4-Chloroaniline	330	UJ	330	330	UJ	330	330	UJ	330
4-Chlorophenylphenyl ether	330	U	330	330	U	330	330	UJ	330
4-Nitroaniline	840	UJ	840	840	UJ	840	840	UJ	840
4-Nitrophenol	840	UJ	840	840	UJ	840	840	UJ	840
Acenaphthene	170	J	330	200	J	330	330	U	330
Acenaphthylene	330	UJ	330	330	UJ	330	330	UJ	330
Anthracene	220	J	330	1900		330	330	U	330
Benzo(a)anthracene	260	J	330	490		330	330	U	330
Benzo(a)pyrene	120	J	330	220	J	330	330	U	330
Benzo(b)fluoranthene	150	J	330	270	J	330	330	U	330
Benzo(ghi)perylene	660	UJ	330	660	UJ	330	330	UJ	330
Benzo(k)fluoranthene	200	J	330	290	J	330	330	U	330
Bis(2-chloro-1-methylethyl)ether	330	U	330	330	U	330	330	U	330
Bis(2-Chloroethoxy)methane	330	UJ	330	330	UJ	330	330	UJ	330

Table C-1. 100-B-23 Verification Sampling Results. (8 Pages)									
Constituents	J156N9 Soil beneath wood debris (ID number 122)			J156P0 Duplicate of J156N9 Sample Date 7/16/07			J156P1 Equipment Blank Sample Date 7/16/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Semivolatile Organic Analysis (SVOAs) - Continued									
Bis(2-chloroethyl) ether	330	UJ	330	330	UJ	330	330	UJ	330
Bis(2-ethylhexyl) phthalate	660	UJ	330	660	UJ	330	660	UJ	330
Butylbenzylphthalate	330	U	330	20	J	330	330	U	330
Carbazole	85	J	330	370	J	330	330	U	330
Chrysene	570		330	1400		330	330	U	330
Di-n-butylphthalate	660	UJ	330	660	UJ	330	660	UJ	330
Di-n-octylphthalate	330	U	330	330	U	330	330	U	330
Dibenz[a,h]anthracene	23	J	330	45	J	330	330	U	330
Dibenzofuran	150	J	330	220	J	330	330	U	330
Diethylphthalate	330	UJ	330	330	UJ	330	330	UJ	330
Dimethyl phthalate	330	UJ	330	330	UJ	330	330	UJ	330
Fluoranthene	770		330	1600		1600	330	U	330
Fluorene	230	J	330	390	J	390	330	U	330
Hexachlorobenzene	330	U	330	330	U	330	330	U	330
Hexachlorobutadiene	330	UJ	330	330	UJ	330	330	UJ	330
Hexachlorocyclopentadiene	330	UJ	330	330	UJ	330	330	UJ	330
Hexachloroethane	330	UJ	330	330	UJ	330	330	UJ	330
Indeno(1,2,3-cd)pyrene	43	J	330	83	J	330	330	U	330
Isophorone	330	UJ	330	330	UJ	330	330	UJ	330
N-Nitroso-di-n-dipropylamine	330	UJ	330	330	UJ	330	330	UJ	330
N-Nitrosodiphenylamine	330	U	330	330	U	330	330	U	330
Naphthalene	330	UJ	330	330	UJ	330	330	UJ	330
Nitrobenzene	330	UJ	330	330	UJ	330	330	UJ	330
Pentachlorophenol	840	U	840	840	U	840	840	UJ	840
Phenanthrene	1000	J	330	2400	J	330	330	U	330
Phenol	330	UJ	330	330	UJ	330	330	UJ	330
Pyrene	620		330	1200		330	330	U	330

APPENDIX D

CALCULATION BRIEF EXCERPTS

APPENDIX D

CALCULATION BRIEF EXCERPTS

The following calculation is provided in this appendix:

100-B-23 Surface Debris Human Health Risk Assessment Calculation Brief, 0100B-CA-V0314, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-B-23 Relative Percent Difference (RPD),Hazard Quotient and Carcinogenic Risk Calculations, 0100B-CA-V0315, Rev. 1, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

The calculation provided in this appendix has been generated to document compliance with established cleanup levels. This calculation should be used in conjunction with other relevant documents in the administrative record.

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CALCULATION COVER SHEET

Project Title: Field Remediation **Job No. 14655**

Area: 100-BC

Discipline: Environmental *Calculation No: 0100B-CA-V0314

Subject: 100-B-23 Surface Debris Human Health Risk Assessment Calculation Brief

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 pg Summary – 7 pg Total – 8 pages	S. W. Clark	H. M. Sulloway	N/A	D. N. Strom	3-27-08

SUMMARY OF REVISION

WCH-DE-018 (05/08/2007)

*Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	5/6/08	Calc. No.:	0100B-CA-V0314	Rev.:	0
Project:	100-BC Field Remediation	Job No:	14655	Checked:	H. M. Sullaway	Date:	5/26/08
Subject:	100-B-23 Surface Debris Human Health Risk Assessment Calculation Brief					Sheet No.	1 of 7

PURPOSE:

Calculate the incremental cancer risk from residual concentrations of the polyaromatic hydrocarbons (PAHs) benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and chrysene at the 100-B-23 100-B/C Surface Debris Waste Site.

GIVEN/REFERENCES:

1) Maximum residual concentrations of PAHs from the *Remaining Sites Verification Package for the 100-B-23, 100-B/C Surface Debris Waste Site* (RSVP), Attachment to Waste Site Reclassification Form 2008-025, reported in Table 1, below.
2) *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.
3) Equations for calculating contaminant intake from Appendix D of *Hanford Site Risk Assessment Methodology* (HSRAM), DOE/RL-91-45, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) Use of area factors and occupancy factors to account for small waste site size and actual period of occupancy in the rural-residential scenario is discussed in the *User's Manual for RESRAD Version 6*, ANL/EAD-4, Environmental Assessment Division, Argonne National Laboratory, Argonne, Illinois.

SOLUTION:

1) Table 1 shows the maximum concentrations of the polyaromatic hydrocarbons (PAHs) benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and chrysene reported at the 100-B-23 100-B/C Surface Debris Waste Site, in the RSVP.

Table 1. Cleanup Verification Data Set [a]

Polyaromatic Hydrocarbons (PAHs)	Concentration (mg/kg)
benzo(a)anthracene	0.490
benzo(a)pyrene	0.220
benzo(b)fluoranthene	0.270
benzo(k)fluoranthene	0.290
chrysene	1.40
Total PAHs	2.67

[a] Soil concentration values are from the *Remaining Sites Verification Package for the 100-B-23 Surface Debris Waste Site*, Attachment to Waste Site Reclassification Form 200x-xxx, Table 2.

2) Table 2 shows the risk assessment input parameters shared with RESRAD for calculation of area factors and occupancy factors.

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	3/26/08	Calc. No.:	0100B-CA-V0314	Rev.:	0
Project:	100-BC Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	3/26/08
Subject:	100-B-23 Surface Debris Human Health Risk Assessment Calculation Brief					Sheet No.	2 of 7

Table 2. Risk Assessment Input Parameters Shared with RESRAD

Parameter	Units	Value	Citation
Area of surface debris waste site	m^2	27	Site specific
Exposure duration	years	30	100 Area RDR/RAWP
Fraction of time spent indoors	unitless	0.6	100 Area RDR/RAWP
Fraction of time spent outdoors (on site)	unitless	0.2	100 Area RDR/RAWP
Soil ingestion rate	g/yr	73	100 Area RDR/RAWP
Inhalation rate	m^3/yr	7,300	100 Area RDR/RAWP
Mass dust loading for inhalation	g/m^3	0.0001	100 Area RDR/RAWP
Wind speed	m/s	3.4	100 Area RDR/RAWP

3) Table 3 shows the contaminant-specific risk assessment input parameters for the inhalation and soil ingestion pathways. The PAHs at 100-B-23 have high distribution coefficient (Kd values) per the 100 Area RDR/RAWP and will not move through the vadose zone in water-dependent pathways within 1,000 years. Only the inhalation and soil ingestion pathways will be affected by the PAHs. There are no noncarcinogenic reference doses for soil ingestion or inhalation (RfDo or RfDi) for the PAHs so there is no hazard quotient calculation.

Table 3. Contaminant-Specific Risk Assessment Input Parameters

Contaminant	Pathway: Inhalation (Fugitive Dust)		Pathway: Soil Ingestion	
	RfDi [a] (mg/kg-d)	CSFi [b] (kg-d/mg)	RfDo [a] (mg/kg-d)	CSFo [b] (kg-d/mg)
Total PAHs	N/A	6.1E+00	N/A	7.3E+00

[a] RfDi or RfDo = Noncarcinogenic Reference Dose for dust inhalation or soil ingestion. Refers to chemical-specific toxicity values used to evaluate noncarcinogenic effects resulting from exposures to chemicals. Obtained from the EPA IRIS (Integrated Risk Information System) database.

[b] CSFi or CSFo = Cancer Slope Factor for dust inhalation or soil ingestion. Refers to chemical-specific Cancer Slope Factors used to calculate carcinogenic risk Obtained from the EPA IRIS (Integrated Risk Information System) database.

N/A = Not Available

PAHs = Polyaromatic Hydrocarbons benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and chrysene reported at the 100-B-23 100-B/C Surface Debris Waste Site.

METHODOLOGY:

1) Incremental Cancer Risk:

The incremental cancer risk is calculated from the following general formula:

ICR = (Daily Intake) CSF

Where CSF = the cancer slope factor with units of kg - day/mg. As applicable, the EPA provides separate values of the cancer slope factor for the inhalation and oral ingestion pathways (CSFi and CSFo, respectively).

Washington Closure Hanford	CALCULATION SHEET						
Originator:	S. W. Clark		Date:	9/26/08	Calc. No.:	0100B-CA-V0314	Rev.:	0
Project:	100-BC Field Remediation		Job No:	14655	Checked:	H. M. Sullway	Date:	9/26/08
Subject:	100-B-23 Surface Debris Human Health Risk Assessment Calculation Brief						Sheet No.	3 of 7

2) Daily Intake for the Soil Ingestion Pathway:

Daily Intake for the soil ingestion pathway is calculated from the following formula from HSRAM Equation D-23, including the area factor and occupancy factor from the *User's Manual for RESRAD Version 6*:

$$DIS = \frac{C \times SI \times ED \times AFS \times OFS}{BW \times AL \times 365(d/yr)}$$

Where: C is contaminant concentration, (site-specific concentration, mg/kg)

SI is Soil Ingestion Rate, (73 g/yr)

AFS is an area factor for soil ingestion: AFS = A/1000 for A < 1000 m^2

AFS = 1 for A > 1000 m^2

A is the area of the contaminated zone, m^3

OFS is the occupancy factor for soils: OFS = (IT) + (OT)

IT is the Indoor Time Factor (0.6)

OT is the Outdoor Time Factor (0.2)

OFS = 0.6 + 0.2 = 0.8

ED is exposure duration (30 yr)

BW is body weight (70 kg)

AL is average lifetime (70 yr)

3) Daily Intake for the Inhalation Pathway:

Daily Intake for the inhalation pathway is calculated using the following formula from HSRAM Equation D-30, including the area factor and occupancy factor from the *User's Manual for RESRAD Version 6*:

$$DII = \frac{C \times IR \times ML \times ED \times AFI \times OFI}{BW \times AL \times 365(d/yr)}$$

Where: C is contaminant concentration, (site-specific concentration, mg/kg)

IR is Inhalation Rate, (7,300 m^3/yr

ML is Mass Loading, (0.0001 g/m^3)

ED is exposure duration (30 yr)

AFI is the site specific area factor for dust inhalation calculated from formula B.4 of the *User's Manual for RESRAD Version 6*:

$$AFI = \frac{a}{1 + b\left(\sqrt{A}\right)^c}$$

In this equation, A is the area of the contaminated zone, m^2, and a, b, and c are least squares regression coefficients dependent upon the average wind speed as

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	5/25/07	Calc. No.:	0100B-CA-V0314	Rev.:	0
Project:	100-BC Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	3/26/08
Subject:	100-B-23 Surface Debris Human Health Risk Assessment Calculation Brief					Sheet No.	4 of 7

described in Table B.2 of the *User's Manual for RESRAD Version 6*. Calculation results are shown in the RESULTS section of this Calculation Summary.

OFI is the occupancy factor for inhalation: OFI = (IT x IDF) + (OT)
IT is the Indoor Time Factor (0.6)
IDF = Indoor dust filtration factor (0.4)
OT is the Outdoor Time Factor (0.2)
OFI = (0.6 x 0.4) + 0.2 = 0.44

BW is body weight (70 kg)
AL is average lifetime (70 yr)

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	3/26/08	Calc. No.:	0100B-CA-V0314	Rev.:	0
Project:	100-BC Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	3/26/08
Subject:	100-B-23 Surface Debris Human Health Risk Assessment Calculation Brief					Sheet No.	5 of 7

RESULTS:

Calculations were performed using an Excel spreadsheet, incorporating the formulas shown in the METHODOLOGY section of this Calculation Summary.

1) Incremental Cancer Risk from the Soil Ingestion Pathway:

The following Excel spreadsheet incorporates the formulas for calculation of incremental cancer risk from total polyaromatic hydrocarbons in the soil ingestion pathway:

Table 3. Excel Calculation of Incremental Cancer Risk in the Soil Ingestion Pathway

	A	B	C	D	E	F	G	H
	Area factor for soil ingestion pathway is calculated per the *User's Manual for RESRAD Version 6.0*, Formula F.3:							
1		Area, m^2	AFS = Area/1000 for Area < 1000 m^2					
3	100-B-23	27	0.027					
4								
5	Soil Ingestion Intake = (C*SI*ED*AFS*OFS*UCF1)/(BW*AL*UCF2)							
6	Variable		Description					
7	C	2.67	mg/kg, Maximum concentration of PAHs					
8	SI	73	g/yr, Soil Ingestion rate					
9	ED	30	years, Exposure Duration					
10	AFS	0.027	unitless area factor					
11	OFS	0.8	unitless occupancy factor					
12	UCF1	0.001	kg/gm, Units conversion factor					
13	BW	70	kg, Body weight					
14	AL	70	years, Average lifetime					
15	UCF2	365	days/year, Units conversion factor					
16	CFSo	7.3	kg - d / mg, Cancer slope factor for PAHs					
17	Ingestion Daily Intake = E22 = (B7*B8*B9*B10*B11*B12)/(B13*B14*B15)							
18	Ingestion Incremental Cancer Risk = E23 = (E22*B16)							
21					100-B-23			
22			Calculated Ingestion Daily Intake =		7.06E-08	mg / kg - day		
23			Ingestion Incremental Cancer Risk =		5.16E-07			

Washington Closure Hanford		CALCULATION SHEET					
Originator:	S. W. Clark	Date:		Calc. No.:	0100B-CA-V0314	Rev.:	0
Project:	100-BC Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	3/26/08
Subject:	100-B-23 Surface Debris Human Health Risk Assessment Calculation Brief					Sheet No.	6 of 7

2) Incremental Cancer Risk from the Inhalation Pathway:

The following Excel spreadsheet incorporates the formulas for calculation of incremental cancer risk from total polyaromatic hydrocarbons in the inhalation pathway:

Table 4. Excel Calculation of Incremental Cancer Risk in the Inhalation Pathway

	A	B	C	D	E	F	G	H
1	Area factor for inhalation pathway is calculated per the *User's Manual for RESRAD Version 6.0*, Formula B.4, calculating least squares regression coefficients for a wind speed of 3.4 m/s per the *User's Manual for RESRAD Version 6.0*, Formula B.2:							
2	Coefficient a for 3.4 m/s Wind Speed = B7 = (B6-((A8-A7)/(A8-A6))*(B6-B8))							
3	Coefficient b for 3.4 m/s Wind Speed = C7 = (C6-((A7-A6)/(A8-A6))*(C6-C8))							
4	Coefficient c for 3.4 m/s Wind Speed = D7 = (D6-((A7-A6)/(A8-A6))*(D6-D8))							
5	Wind Speed, m/s	a	b	c				
6	2	1.6819	25.5076	-0.2278				
7	3.4	1.2029	28.3173	-0.2315				
8	5	0.7837	31.5283	-0.2358				
	Area Factor for Inhalation Pathway = AFI = (B7/(1 +C7(((SQRT(A10))^D7)))							
9		Area, m^2	AFI					
10	100-B-23	27	0.0592					
12	Inhalation Intake = (C*IR*ML*ED*AFI*OFI*UCF1)/(BW*AL*UCF2)							
13	Variable	100-B-23	Description					
14	C	2.67	mg/kg, Maximum concentration of PAHs					
15	IR	7,300	m^3/yr, Inhalation rate					
16	ML	0.0001	gm/m^3, Mass dust loading for inhalation					
17	ED	30	years, Exposure Duration					
18	AFI	0.0592	unitless area factor					
19	OFI	0.44	unitless occupancy factor					
20	UCF1	0.001	kg/gm, Units conversion factor					
21	BW	70	kg, Body weight					
22	AL	70	years, Average lifetime					
23	UCF2	365	days/year, Units conversion factor					
24	CFSi	6.1	kg - d / mg, Cancer slope factor for PAHs					
26	Inhalation Daily Intake = E30 = (B14*B15*B16*B17*B18*B19*B20)/(B21*B22*B23)							
26	Inhalation Incremental Cancer Risk = E31 = (E30*B24)							
29					100-B-23			
30				Calculated Inhalation Daily Intake =	8.52E-10	mg / kg - day		
31				Inhalation Incremental Cancer Risk =	5.19E-09			

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	3/26/08	Calc. No.:	0100B-CA-V0314	Rev.:	0
Project:	100-BC Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	3/26/08
Subject:	100-B-23 Surface Debris Human Health Risk Assessment Calculation Brief					Sheet No.	7 of 7

CONCLUSIONS:

- **Total Polyaromatic Hydrocarbons at 100-B-23 Surface Debris Waste Site**
  - The incremental cancer risk due to total polyaromatic hydrocarbons in the soil ingestion pathway is 5.16E-07.
  - The incremental cancer risk due to total polyaromatic hydrocarbons in the inhalation pathway is 5.19E-09.
  - The total human health excess cancer risk due to total polyaromatic hydrocarbons at the 100-B-23 Surface Debris Waste Site is sum of the incremental cancer risks from the soil ingestion and inhalation pathways: 5.21E-07.

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CALCULATION COVER SHEET

Project Title: Field Remediation **Job No. 14655**

Area: 100-B/C

Discipline: Environmental *Calculation No: 0100B-CA-V0315

Subject: 100-B-23 Relative Percent Difference (RPD), Hazard Quotient and Carcinogenic Risk Calculation

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 Calcs. = 6 Total = 7	M. J. Appel (Rev. 0 signed)	S.W. Clark (Rev. 0 signed)	N/A	D. N. Strom (Rev. 0 signed)	Approved 04-01-08
1	Cover = 1 Calcs. = 6 Total = 7	M. J. Appel	S.W. Clark	N/A	D. N. Strom	4.24.08

SUMMARY OF REVISION

1	The hazard quotient and carcinogen risk calculations were revised to include anthracene and the total value for PAHs. Additionally, the carcinogen RAG value for dibenzo(a,h)anthracene was changed from 0.33 to 0.137 and the maximum acenapthene value in Table 1 was changed from 0.17 mg/kg to 0.20 mg/kg. For convenience the entire calculation brief was replaced.

WCH-DE-018 (05/08/2007) *Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford		CALCULATION SHEET					
Originator:	M. J. Appel	Date:	04/23/08	Calc. No.:	0100B-CA-V0315	Rev.:	0 1
Project:	100-B/C Field Remediation	Job No:	14655	Checked:	S. W. Clark	Date:	4/23/08
Subject:	100-B-23 Relative Percent Difference (RPD) Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	1 of 6

DNS 9-24-08

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and carcinogenic (excess cancer) risk for the 100-B -23 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2005b), the following criteria must be met:

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

Also, calculate the relative percent difference (RPD) for primary-duplicate sample pairs from the 100-B-23 verification sampling, as necessary.

GIVEN/REFERENCES:

1) DOE-RL, 2005a, *100 Area Remedial Action Sampling and Analysis Plan (SAP)*, DOE/RL-96-22, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) DOE-RL, 2005b, *Remedial Design Report/Remedial Action Work Plan for the 100 Areas*, DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

3) 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.

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

5) WCH, 2008, 100-*B-23 Surface Debris Human Health Risk Assessment Calculation Brief*, Rev. 0, 0100B-CA-V0314, Washington Closure Hanford, Richland, Washington.

6) WCH, 2008, *Remaining Sites Verification Package for the 100-B-23, 100-B/C Surface Debris, Attachment* to Waste Site Reclassification Form 2008-027, Washington Closure Hanford, Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 2005b).

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

Washington Closure Hanford CALCULATION SHEET

Originator:	M. J. Appel	Date:	04/23/08	Calc. No.:	0100B-CA-V0315	Rev.:	0
Project:	100-B/C Field Remediation	Job No:	14655	Checked:	S. W. Clark	Date:	4/23/08
Subject:	100-B-23 Relative Percent Difference (RPD) Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	2 of 6

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the excess cancer risk of $<1 \times 10^{-6}$ (DOE-RL 2005b).

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

5) Use data from WCH (2008) to perform the RPD calculations for primary-duplicate sample pairs, as required.

METHODOLOGY:

Hazard quotient and carcinogenic risk calculations for the 100-B-23 waste site were conservatively calculated for the entire waste site using the highest of the focused results for each analyte (WCH 2008). Of the contaminants of potential concern for this site, cadmium, lead, mercury, and zinc are included because they were detected at concentrations above their respective Washington State or Hanford Site background value. Boron, molybdenum, strontium and tin require the HQ and carcinogenic risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Aroclor -1254, aroclor-1260 and multiple organic COPCs (as listed in Table 1) are included because they were detected by laboratory analysis and cannot be attributed to natural occurrence. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 14.1 mg/kg, divided by the noncarcinogenic RAG value of 16,000 mg/kg (calculated in accordance with the noncarcinogenic toxic effects WAC 173-340-740[3]), is 8.8×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. The sum of the HQ values is 6.4×10^{-1}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value, then multiplied by 1×10^{-6}. For example, the maximum value for bis(2ethylhexyl)phthalate is 0.21 mg/kg; divided by 71.4 mg/kg, and multiplied as indicated, is 2.9×10^{-9}. Comparing this value and all other individual values to the requirement of $<1 \times 10^{-6}$, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk can be obtained by summing the individual values. The sum of the excess cancer risk values is 1.1×10^{-6}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

The RPD is calculated when both the primary value and the duplicate value for a given analyte 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 and is listed in Table II-1 of the SAP (DOE-RL 2005a). Where direct evaluation of the attached sample data showed that a given analyte

Washington Closure Hanford		CALCULATION SHEET					
Originator:	M. J. Appel	Date:	04/23/08	Calc. No.:	0100B-CA-V0315	Rev.:	01
Project:	100-B/C Field Remediation	Job No:	14655	Checked:	S. W. Clark	Date:	4/23/08
Subject:	100-B-23 Relative Percent Difference (RPD) Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	3 of 6

was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

$$RPD = [\ |M-D|/((M+D)/2)]*100$$

where, M = main sample value D = duplicate sample value

When an analyte is detected in the primary or duplicate sample, but was quantified at less than 5 times the TDL in one or both samples, an additional parameter is evaluated. In this case, if the difference between the primary and duplicate results exceeds a control limit of 2 times the TDL, further assessment regarding the usability of the data is performed. This assessment is provided in the data quality assessment section of the RSVP.

For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably. For regulatory splits, 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. No split samples were collected for cleanup verification of the subject site. Calculations were not performed for the primary-duplicate pair collected of the soil beneath the remediated "wood ramp" (samples J156N9 and J156P0) because the calculated RPDs were calculated for these samples and captured within the data validation package (SDG K0875). Additional discussion is provided in the data quality assessment section of the applicable RSVP (WCH 2008), as necessary.

RESULTS:

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

Table 1 shows the results of the hazard quotient and excess cancer risk calculations.

None of the RPDs calculated in the field duplicate pair for sample delivery group (SDG) K1133 are above the acceptance criteria (30%), with the exception of silicon and zinc. The RPD calculated for silicon was 46.9% and the RPD calculated for zinc was 93.7%. The evaluation of the QA/QC duplicate RPD calculations is performed within the data quality assessment section of the RSVP (WCH 2008). Table 2 shows the results of the calculations for SDG K1133.

Washington Closure Hanford CALCULATION SHEET

Originator:	M. J. Appel	Date:	04/23/08	Calc. No.:	0100B-CA-V0315	Rev.:	01
Project:	100-B/C Field Remediation	Job No:	14655	Checked:	S. W. Clark	Date:	4/23/08
Subject:	100-B-23 Relative Percent Difference (RPD) Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	4 of 6

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-B-23 Waste Site.

Contaminants of Potential Concern[a]	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	14.1	16,000	8.8E-04	--	--
Cadmium	1.7	80	2.1E-02	13.9	1.2E-07
Lead[c]	73.8	353	2.1E-01	--	--
Mercury	8.2	24	3.4E-01	--	--
Molybdenum	0.71	400	1.8E-03	--	--
Strontium	25.1	48,000	5.2E-04	--	--
Tin	3.2	48,000	6.7E-05	--	--
Zinc	1310	24,000	5.5E-02	--	--
Semivolatiles					
Acenaphthene	0.20	4,800	4.2E-05	--	--
Anthracene	1.90	24,000	7.9E-05	--	--
Benzo(ghi)perylene	0.05	2,400	2.1E-05	--	--
Bis(2-ethylhexyl) phthalate	0.21	1,600	1.3E-04	71.4	2.9E-09
Butylbenzylphthalate	0.02	16,000	1.3E-06	--	--
Carbazole	0.37	--	--	50	7.4E-09
Dibenzo(a,h)anthracene	0.05	--	--	0.137	3.6E-07
Dibenzofuran	0.22	160	1.4E-03	--	--
Di-n-butylphthalate	0.031	8,000	3.9E-06	--	--
Fluoranthene	1.6	3,200	5.0E-04	--	--
Fluorene	0.39	3,200	1.2E-04	--	--
Indeno(1,2,3-cd) pyrene	0.083	--	--	1.37	6.1E-08
Phenanthrene	2.4	24,000	1.0E-04	--	--
Pyrene	1.2	2,400	5.0E-04	--	--
Total PAHs[d,e]	2.67	--	--	--	5.2E-07
Polychlorinated Biphenyls					
Aroclor-1254	0.0054	1.6	3.4E-03	0.5	1.1E-08
Aroclor-1260	0.021	--	--	0.5	4.2E-08
Totals					
Cumulative Hazard Quotient:			**6.4E-01**		
Cumulative Excess Cancer Risk:					**1.1E-06**

Notes:

PAH = polycyclic aromatic hydrocarbons

RAG = remedial action goal

-- = not applicable

[a] = From WCH (2008).

[b] = Value obtained from RDR/RAWP (DOE-RL 2005) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.

[c] = Value for the noncarcinogen RAG obtained from EPA (1994).

[d] = Value calculated in the 100-B-23 site-specific risk assessment (0100V-CA-V0314).

[e] = The site-specific risk assessment (0100V-CA-V0314) for total PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene) shows the Carcinogen Risk is 5.21E-07.

Washington Closure Hanford		CALCULATION SHEET					DNS 4-24-08
Originator:	M. J. Appel	Date:	04/23/08	Calc. No.:	0100B-CA-V0315	Rev.:	0 1
Project:	100-B/C Field Remediation	Job No:	14655	Checked:	S. W. Clark	Date:	4/23/08
Subject:	100-B-23 Relative Percent Difference (RPD) Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	5 of 6

Table 2. Relative Percent Difference Calculations for SDG K1133. (2 Pages)

Sampling Area	Sample Number	Sample Date	Aluminum			Antimony			Arsenic			Barium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soils beneath batteries (ID number 85)	J169X3	2/19/2008	7640		10.6	0.79	U	0.79	3.4		1.3	118		0.26
Duplicate of J169X3	J169X4	2/19/2008	7950		9.7	0.73	U	0.73	3.6		1.2	106		0.24

Analysis:

TDL		5	0.6	10	2
Duplicate Analysis	Both > PQL?	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)		No-Stop (acceptable)	Yes (calc RPD)
	RPD	4.0%			10.7%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable

Sampling Area	Sample Number	Sample Date	Beryllium			Boron			Cadmium			Calcium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soils beneath batteries (ID number 85)	J169X3	2/19/2008	0.38		0.13	12.5		1.3	1.6		0.13	8320	C	10.6
Duplicate of J169X3	J169X4	2/19/2008	0.45		0.12	14.1		1.2	1.7		0.12	8900	C	9.7

Analysis:

TDL		0.5	2	0.5	100
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		12.0%		6.7%
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable

Sampling Area	HEIS Number	Sample Date	Chromium			Cobalt			Copper			Iron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soils beneath batteries (ID number 85)	J169X3	2/19/2008	11		0.53	7.4		0.53	19.2	C	53	18500		11.9
Duplicate of J169X3	J169X4	2/19/2008	12.3		0.49	7.3		0.49	21.6	C	0.49	20700		10.9

Analysis:

TDL		1	2	1	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	11.2%			11.2%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

Sampling Area	Sample Number	Sample Date	Lead			Magnesium			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soils beneath batteries (ID number 85)	J169X3	2/19/2008	59.4		0.79	3490		6.6	325	C	0.11	7.88		0.1
Duplicate of J169X3	J169X4	2/19/2008	73.8		0.73	3340		6.1	352	C	0.1	8.2		0.08

Analysis:

TDL		5	75	5	0.2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD	21.6%	4.4%	8.0%	4.0%
	Difference > 2 TDL?	Not applicable	Not applicable	Not applicable	Not applicable

Washington Closure Hanford		CALCULATION SHEET					DNS 7-24-08
Originator:	M. J. Appel	Date:	04/23/08	Calc. No.:	0100B-CA-V0315	Rev.:	0
Project:	100-B/C Field Remediation	Job No:	14655	Checked:	S. W. Clark	Date:	4/23/08
Subject:	100-B-23 Relative Percent Difference (RPD) Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	6 of 6

Table 2. Relative Percent Difference Calculations for SDG K1133. (2 Pages)

Sampling Area	Sample Number	Sample Date	Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soils beneath batteries (ID number 85)	J169X3	2/19/2008	0.79	U	0.79	11.8		0.53	1020		10.6	1.6	U	1.6
Duplicate of J169X3	J169X4	2/19/2008	0.73	U	0.73	12.2		0.49	1070		9.7	1.5	U	1.5

Analysis:

TDL		2	4	400	1
Duplicate Analysis	Both > PQL?	No-Stop (accceptable)	**Yes (continue)**	**Yes (continue)**	No-Stop (acceptable)
	Both >5xTDL?		No-Stop (acceptable)	No-Stop (acceptable)	
	RPD				
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	No - acceptable

Sampling Area	Sample Number	Sample Date	Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Soils beneath batteries (ID number 85)	J169X3	2/19/2008	463		10.6	0.26	U	0.26	252	C	1.8	34.5		0.37
Duplicate of J169X3	J169X4	2/19/2008	287		9.7	0.24	U	0.24	294	C	1.6	41.8		0.34

Analysis:

TDL		2	0.2	50	2.5
Duplicate Analysis	Both > PQL?	**Yes (continue)**	No-Stop (acceptable)	**Yes (continue)**	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**		**Yes (calc RPD)**	**Yes (calc RPD)**
	RPD	*46.9%*		15.4%	19.1%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

Sampling Area	Sample Number	Sample Date	Zinc		
			mg/kg	Q	PQL
Soils beneath batteries (ID number 85)	J169X3	2/19/2008	474		1.6
Duplicate of J169X3	J169X4	2/19/2008	1310		1.5

Analysis:

TDL		1
Duplicate Analysis	Both > PQL?	**Yes (continue)**
	Both >5xTDL?	**Yes (calc RPD)**
	RPD	*93.7%*
	Difference > 2 TDL?	Not applicable

C = method blank contamination
PQL = practical quantitation limit
Q = qualifier
RPD = relative percent difference
TDL = target detection limit
U = undetected

CONCLUSION:

The calculations in Table 1 demonstrate that the 100-B-23 waste site meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk as identified in the RDR/RAWP (DOE-RL 2005). The hazard quotients and carcinogenic (excess cancer) risk and RPD calculations are for use in the RSVP for this site.

APPENDIX E

VERIFICATION SAMPLING DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (DOE-RL 2005b, WHC 2007a, Capron 2008). This DQA was performed in accordance with site specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2005a).

A review of the sample design (WCH 2007a, Capron 2008), the field logbooks (WCH 2007b, WCH 2007c, and WCH 2008), and applicable analytical data packages has been performed as part of this DQA. All samples were collected per the sample design. To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical analysis (BHI 2000) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2000).

The closeout sampling approach for the 100-B-23 waste site included a sample design with multiple subunit areas. Verification sample data collected at the 100-B-23 waste site were provided by the laboratories in nine sample delivery groups (SDGs). For the 100-B-23 treated wood subunit, verification sample data were provided in SDG K0875. SDG K0875 was submitted for third-party validation. For the 100-B-23 lead battery subunit, verification sample data were provided in SDG K1133. The 100-B-23 oil-stained areas, sample data were provided in seven SDGs: SDG K0836, SDG K0839, SDG K0847, SDG K0854, SDG K0860, SDG K0864, and SDG K1077. Major and minor deficiencies found in the analytical data set are discussed below.

SDG K0875

This SDG comprises one field duplicate pair (J156N9/ J156P0) and one equipment blank (J156P1) collected from the remediated treated wood sites. These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, and semivolatile organic compounds (SVOCs). In addition, the field duplicate pair was analyzed for total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCBs), and pesticides. SDG K0875 was submitted for formal third-party validation. No major deficiencies were found in SDG K0875. Minor deficiencies are as follows:

In the SVOC analysis, the common laboratory contaminants bis(2-ethylhexyl)phthalate and di-n-butyl phthalate were detected in the method blank (MB). Benzo(g,h,i)perylene was detected in the MB as well. Third-party validation raised the reported values for bis(2-ethylhexyl)phthalate and di-n-butyl phthalate for all samples to the required quantitation limit of 660 µg/kg and qualified them as undetected and flagged "U." The benzo(g,h,i)perylene reported values for all samples with the exception of J156P1 were raised to the required quantitation limit of 660 µg/kg, qualified as undetected, and flagged "U" by third-party

validation. The J156P1 benzo(g,h,i)perylene value was reported as undetected, and no further qualification was required. The data are useable for decision-making purposes.

Eight of 128 matrix spike (MS) recoveries in the SVOC analysis are below the acceptance criteria. The MS recoveries for 1,3-dichlorobenzene and 1,4-dichlorobenzene are both 47%. The 1,2,4-trichlorobenzene MS recovery is 55%. The hexachloroethane MS recovery is 42%. The MS for hexachlorocyclopentadiene is 17%, and the MS for phenanthrene is 142%. The matrix spike duplicate (MSD) recovery for carbozol is 122%, and the MSD recovery for 2-methylnaphthalene is 58%. One laboratory control sample (LCS) recovery was outside quality control (QC) limits for 2,4,6-trichlorophenol (46%). All results for analytes with low MS or LCS recoveries and all detected results for analytes with high MS or MSD recoveries were qualified as estimates and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

In the SVOC analysis, the 2,4,6-tribromophenol surrogate recovery for sample J156P1 was below the QC limits, at 14%. Third-party validation qualified the 2,4-dichlorophenol, 2,4,6-trichlorophenol, 2,4,5-trichlorophenol, pentachlorophenol, bis(2-chloroethyl)ether, bis(2-chlorethoxy)methane, 4-chlorophenyl phenyl ether, and 4-bromophenyl ether results for sample J156P1 as estimates and flagged "J." Estimated data are useable for decision-making purposes.

The relative percent difference (RPD) for 34 SVOC MS/MSD results were greater than 30%. The results for phenol, bis(2-chloroethyl)ether, 2-chlorophenol, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,2-dichlorobenzene, 2-methylphenol, 2,2-oxybis(1-chloropropane), n-nitroso-di-d-propylamine, hexachloroethane, nitrobenzene, isopherone, 2-nitrophenol, bis(2-chloroethoxy)methane, 1,2,4-trichlorobenzene, naphthalene, 4-chloroanaline, hexachlorobutadiene, hexachlorocyclopentadiene, 2-chloronaphthalene, dimethylphthalate, acenaphthylene, 2,6-dinitrotoluene, 3-nitroanaline, 4-nitrophenol, dibenzofuran, diethylphthalate, fluorine, 4-nitroanaline, 3,3-dichlorobenzidine, benzo(b)fluoranthene, ideno(1,2,3-cd)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene in all samples were qualified as estimates and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

In the SVOC analysis, 24 analytes exceeded the required quantitation limit (RQL). Under the Washington Closure Hanford statement of work, no qualification is required. The data are useable for decision-making purposes.

All of the toxaphene data in SDG K0875 were qualified by third-party validation as estimated with "J" flags, due to lack of a MS, MSD, or LCS analysis for the analyte. Estimated or "J"-flagged data are acceptable for decision-making purposes.

In the pesticides analysis, the RPD for 4,4'-DDE MS/MDS results (37%) exceeded the QC limit of 30%. All 4,4'-DDE results were qualified as estimates and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

All PCB results, with the exception of aroclor-1016, were qualified as estimates and flagged "J" by third-party-validation due to MS/MDS results (35%) exceeding the QC limit of 30%. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the calcium, chromium, copper, sodium, and zinc results for sample J156P1 (the equipment blank) and the molybdenum results for all samples in SDG K0875 are of similar magnitude as the MB results, and are qualified by third-party validation as undetected estimates with "UJ" flags, due to MB contamination. The data are useable for decision-making purposes.

Also in the ICP metals analysis, the MS recoveries for six ICP metals (aluminum, calcium, iron, manganese, antimony, and silicon) are out of acceptance criteria. For most of these analytes, the spiking concentration is insignificant compared to the native concentration in the sample from which the MS was prepared. Therefore, the deficiency in the MS result is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. To confirm quantitation, post-digestion spikes (PDSs) and serial dilutions were prepared for all three analytes with acceptable results. Antimony and calcium did not have mismatched spike and native concentrations in the original MS. The original MS recovery for antimony was 58.4%. The original MS recovery for calcium was 131%. All antimony results and the calcium results for the field duplicate pair in SDG K0875 were qualified as estimates and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

Also in the ICP metals analysis, the laboratory duplicate RPDs for chromium, copper, and vanadium are above the acceptance criteria at 35%, 34.2%, and 35.2%, respectively. All chromium, copper, and vanadium results in SDG K0875 were qualified as estimates and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

For the TPH analysis, the holding time of 14 days was exceeded by less than twice the limit, and all TPH results were qualified as estimates and flagged "J" by third-party validation. Estimated data are useable for decision making purposes.

SDG K1133

This SDG comprises one field duplicate pair (J169X3/J169X4) collected from soils beneath the 100-B-23 lead battery cache. These samples were analyzed for ICP metals and mercury. No major deficiencies were found in SDG K1133. Minor deficiencies are as follows:

In the ICP metals analysis, the MS recoveries for eight ICP metals (aluminum, calcium, copper, iron, lead, mercury, antimony, and zinc) are out of acceptance criteria. For most of these analytes, the spiking concentration is insignificant compared to the native concentration in the sample from which the MS was prepared. Therefore, the deficiency in the MS result is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. To confirm quantitation, PDSs and serial dilutions were prepared for all three analytes with acceptable results. Calcium, copper, lead, and antimony did not have mismatched spike and native concentrations in the original MS. The original MS recoveries for calcium, copper, and lead were high, indicating a potential high bias for the sample results.

The original MS recovery for antimony was 44.4%. All antimony results in SDG K1077 may be considered estimates. Estimated data are useable for decision-making purposes.

Also in the ICP metals analysis, the laboratory duplicate RPD for mercury is above the acceptance criteria at 48.3%. Elevated RPDs in environmental soil samples are generally attributed to heterogeneities in the sample matrix and not to deficiencies in the laboratory procedures. The data are useable for decision-making purposes.

SDG K0836

This SDG comprises four verification samples (J155W3, J155W4, J155W6, and J155W7) collected from soil beneath oil filters. In addition, this SDG reports the results for one in-process sample (J155W5). These samples were all analyzed for TPH. No major or minor deficiencies were found in SDG K0836.

SDG K0839

This SDG comprises eight verification samples (J155X1 through J155X5 and J155X7) collected from soil beneath oil filters. In addition, this SDG reports the results for four in-process samples (J155X6, J155X8, J155X9, and J155Y0). These samples were all analyzed for TPH. In addition, sample J155X2 was analyzed for ICP metals, mercury, PCBs, and SVOCs. Major and minor deficiencies are as follows:

The SVOC analysis for sample J155X2 was requested after the sample had been extracted and the holding time for SVOC analysis had been exceeded. The sample was collected on June 19, 2007, and extracted on July 13, 2007. The holding time of 14 days was exceeded by less than twice the limit, and all SVOC results are considered estimated and flagged "J" by the project. Estimated data are useable for decision-making purposes.

In the SVOC analysis, the common laboratory contaminants bis(2-ethylhexyl)phthalate and i-n-butyl phthalate are detected in the MB. Benzo(g,h,i)perylene, benzo(g,h,i)anthracene, indeno (1,2,3-cd)pyrene, and dibenzo(a,h)anthracene were detected in the MB as well. The reported values for these analytes for all samples below the required quantitation limit of 660 µg/kg are likely biased high. The data are useable for decision-making purposes.

Eighteen of 128 MS recoveries in the SVOC analysis are below the acceptance criteria. The MS and MSD recoveries for hexachloroethane are 36% and 39%, respectively. The MS and MSD recoveries for 2-methylnaphthalene are 110% and 119%, respectively. The nitrobenzene MS recovery is 113%. The MS and MSD recoveries for hexachlorocyclopentadiene are 12% and 11%, respectively. The MS and MSD recoveries for 4-nitrophenol are 154% and 145%, respectively. The 2,4-dinitrophenol MSD recovery is 15%. The 4,6-dinitro-2-methylphenol MS recovery is 21%, and the MSD recovery is 16%. The MS for pentachlorophenol is 137% and the MS for benzo(k)fluoranthene is 48%. The MS and MSD recoveries for carbozol are 158% and 157%, respectively. One LCS recovery was outside QC limits for carbazole (143%). The results for these analytes may be considered estimated. Estimated data are useable for decision making purposes. However, the MS and MSD results for 3,3'-dichlorobenzidine were each less than

10%, and the sample result reported for 3,3'-dichlorobenzidine within this SDG is flagged as rejected with an "R" flag by the program for decision-making purposes. Based on the sample results for the remaining SVOCs reported in SDG K0839, it is not likely that 3,3'-dichlorobenzidine is present in sample J155X2 in a concentration above the RQL. The deficiency in the 3,3'-dichlorobenzidine result does not impact the completeness of data for the 100-B-23 waste site.

In the ICP metals analysis, the MS recoveries for six ICP metals (aluminum, iron, manganese, mercury, antimony, and silicon) are out of acceptance criteria. For most of these analytes, the spiking concentration is insignificant compared to the native concentration in the sample from which the MS was prepared. Therefore, the deficiency in the MS result is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. To confirm quantitation, PDSs and serial dilutions were prepared for the analytes with acceptable results. Antimony did not have mismatched spike and native concentrations in the original MS. The original MS recovery for antimony was 58.4%. The antimony result for sample J155X2 may be considered estimated. Estimated data are useable for decision-making purposes.

Also in the ICP metals analysis, the laboratory duplicate RPD for arsenic is above the acceptance criteria at 32%. Elevated RPDs in environmental soil samples are generally attributed to heterogeneities in the sample matrix and not to deficiencies in the laboratory procedures. The data are useable for decision-making purposes.

SDG K0847

This SDG comprises three verification samples (J15663 through J15665) collected from soil beneath oil filters. In addition, this SDG reports the results for two in-process samples (J15662 and J15666). These samples were all analyzed for TPH. In addition, sample J15665 was analyzed for ICP metals, mercury, PCBs, and SVOCs. Major and minor deficiencies are as follows:

In the TPH analysis, the laboratory duplicate RPD is above the acceptance criteria at 37.4%. Elevated RPDs in environmental soil samples are generally attributed to heterogeneities in the sample matrix and not to deficiencies in the laboratory procedures. The data are useable for decision-making purposes.

Also in the TPH analysis, the MS recovery is above the acceptance criteria at 302.2%, indicating a potential high bias for the sample results. The data are useable for decision-making purposes.

The SVOC analysis for sample J15665 was requested after the sample had been extracted and the holding time for SVOC analysis had been exceeded. The sample was collected on June 21, 2007, and extracted on July 20, 2007. The SVOC analysis for sample J15665 was requested as an additional analysis because the TPH result for sample J15665 was detected but below the screening level of 200 mg/kg. The SVOCs that correlate with the TPH analysis would not have degraded significantly in the period of time between the sample J15665 collection data and SVOC extraction date. The SVOC results for sample J15665 are considered estimated and flagged "J" by the project. Estimated data are useable for decision-making purposes.

In the SVOC analysis, the common laboratory contaminants bis(2-ethylhexyl)phthalate and di-n-butyl phthalate are detected in the MB. Benzo(g,h,i)perylene was detected in the MB as well. The reported values for these analytes for all samples below the required quantitation limit of 660 µg/kg are likely biased high. The data are useable for decision-making purposes.

In the SVOC analysis, 16 of 128 MS recoveries are below the acceptance criteria. The MS and MSD for 2-nitrophenol are both 42%. The hexachloroethane MS and MSD are 38% and 45%, respectively. The 2-methylnaphthalene MS and MSD are 114% and 134%, respectively. The 2,6-dinitrotoluene MS and MSD are 46% and 40%, respectively. The 2,4-dinitrotoluene MS and MSD are 37% and 32%, respectively. The data may be considered estimated. Estimated data are useable for decision-making purposes. However, the MS and MSD results for 3-nitroaniline, 2,4-dinitrophenol, 4-nitroaniline, and 4,6-dinitro-2-methylphenol were each less than 10%, and the sample result reported for these analytes are flagged as rejected with an "R" flag by the program for decision-making purposes. Based on the sample results for the remaining SVOCs in SDG K0847, it is not likely that 3-nitroaniline, 2,4-dinitrophenol, 4-nitroaniline, and 4,6-dinitro-2-methylphenol are present in sample J15665 in concentrations above the RQL. The deficiencies in the 3-nitroaniline, 2,4-dinitrophenol, 4-nitroaniline, and 4,6-dinitro-2-methylphenol results do not impact the completeness of data for the 100-B-23 waste site.

In the PCB analysis, the BS sample was inadvertently not spiked, and the BS recoveries could not be evaluated as part of this DQA. All other QC results for the PCB data were within the acceptance criteria. The PCB data for sample J15665 may be considered estimated. Estimated data are useable for decision-making purposes.

The holding time requirement for mercury analysis for sample J15665 was exceeded by 5 days. The mercury data for sample J15665 may be considered estimated. Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the tin result for sample J15665 is of similar magnitude as the MB result, and may be considered estimated due to MB contamination. The data are useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for six ICP metals (aluminum, iron, manganese, phosphorous, and silicon) are out of acceptance criteria. For most of these analytes, the spiking concentration is insignificant compared to the native concentration in the sample from which the

MS was prepared. Therefore, the deficiency in the MS result is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. To confirm quantitation, PDSs and serial dilutions were prepared for the analytes with acceptable results. Manganese and phosphorous did not have mismatched spike and native concentrations in the original MS. The original MS recovery for manganese was 140.5 %. The original MS recovery for phosphorous was 159.9%. The reported values for these analytes for sample J15665 are likely biased high. The data are useable for decision-making purposes.

Also in the ICP metals analysis, the laboratory duplicate RPD for aluminum (33.7%), chromium (40%), lithium (40%), molybdenum (30.3%), sodium (38.6%), tin (41.5%), and vanadium (33.3%) are above the acceptance criteria of 30%. Elevated RPDs in environmental soil samples are generally attributed to heterogeneities in the sample matrix and not to deficiencies in the laboratory procedures. The data are useable for decision-making purposes.

SDG K0854

This SDG comprises two verification samples (J15667 and J15668) collected from soil beneath oil filters. These samples were both analyzed for TPH. No major or minor deficiencies were found in SDG K0854.

SDG K0860

This SDG comprises eight verification samples (J15669 through J15671 and J15675 through J15679) and one equipment blank (J15672) collected from soil beneath oil filters. In addition, this SDG reports the results for two in-process samples, a duplicate pair (J15673/J15674). These samples were all analyzed for TPH. No major or minor deficiencies were found in SDG K0860.

SDG K0864

This SDG comprises five verification samples (J15680 through J15681 and J156J0 through J156J2) collected from soil beneath oil filters. These samples were all analyzed for TPH. No major or minor deficiencies were found in SDG K0864.

SDG K1077

This SDG comprises five verification samples (J16429 through J16433) collected from soil beneath oil filters. These samples were all analyzed for TPH. No major or minor deficiencies were found in SDG K1077.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

RPD evaluations of main sample(s) versus the laboratory duplicate(s) are routinely performed and reported by the laboratory. Any deficiencies in those calculations are reported by SDG in the previous sections.

Field quality assurance (QA)/ QC measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples listed in the field logbooks (WCH 2007b, WCH 2007a, WCH 2008) are summarized in Table E-1. The main and QA/QC sample results are presented in Appendix C.

Table E-1. Field Quality Assurance/ Quality Control Samples.

Sample Area	Main Sample	Duplicate Sample
Treated wood subunit	J156N9	J156P0
Lead battery subunit	J169X3	J169X4

Field duplicate samples are 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 contaminant of concern. The results of the field duplicate RPD calculation for the treated wood subunit samples (J156N9/J156P0) were reported in the final validation package for SDG K0875. The RPD calculation brief in Appendix D provides details on duplicate pair evaluation and RPD calculation for the lead battery subunit samples (J156X3/J156X4). Field duplicates were requested in the sample design (WCH 2007a) for the oil-stained areas within the 100-B-23 waste site; however, the verification samples (J15673/J15674) were redesignated as in process samples. The RPDs for the samples (J15673/J15674) were within the acceptance criteria of 30%. The RPDs for the remaining QA/QC samples are summarized below.

The RPD calculated for silicon in the lead battery subunit was 45%. The RPDs calculated for phenanthrene, anthracene, chromium, and vanadium were 82%, 158%, 57%, and 43% respectively. These RPDs exceeded the acceptance criteria of 30%. Elevated RPD, such as these in the analysis of environmental soil samples are largely attributed to heterogeneities in the soil matrix and only in small part attributed to precision and accuracy issues at the laboratory. The data are useable for decision-making purposes.

RPDs for the remaining analytes are not calculated because an evaluation of the data shows the analytes are not detected in both the main and duplicate 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.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate or main and split) is less than five times the target detection limit (TDL), including undetected analytes. In these cases, a control limit of ± 2 times the TDL is used (Appendix D) to indicate that a visual check of the data is required by the reviewer. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are useable for decision-making purposes.

SUMMARY

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above, are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-B-23 verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for 100-B-23 waste site concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. Detection limits, precision, accuracy, and sampling data group completeness were assessed to determine if any analytical results should be rejected as a result of QA and QC deficiencies. The analytical data were found acceptable for decision-making purposes with the exception of the sample results reported for 3-nitroaniline, 2,4-dinitrophenol, 4-nitroaniline, and 4,6-dinitro-2-methylphenol within SDG K0847 and 3,3'-dichlorobenzidine within SDG K0839. The 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. The verification sample analytical data are also summarized in Appendix C.

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