0075057

Date Submitted: 11/14/07 Originator: L. M. Dittmer Phone: 372-9227	**WASTE SITE RECLASSIFICATION FORM** Operable Unit(s): 100-BC-1 Waste Site Code: 100-B-18 Type of Reclassification Action: Closed Out ☐ Interim Closed Out ☒ No Action ☐ RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	Control Number: 2007-020

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-18 Powerhouse Debris Pile contained miscellaneous demolition waste from the decommissioning activities of the 184-B Powerhouse. The debris covered an area roughly 15 m (49 ft) by 30 m (98 ft) and included materials such as concrete blocks, mixed aggregate/concrete slabs, stone rubble, asphalt rubble, traces of tar/coal, broken fluorescent lights, brick chimney remnants, and rubber hoses. Remediation of the site was performed on June 26, 2007, and July 16, 2007. Site remediation was accomplished by selective removal of suspect hazardous items (e.g.., tar/mastic material) and potentially impacted soils. Remediation activities included the removal of 70 BCM (bank cubic meters) of tar/mastic material along with their surrounding soils. Light ballasts were expected at the site, however, none were found. The numerous intact and broken fluorescent light tubes located at the site (approximately 50) were picked up and disposed. 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-18 Powerhouse Debris Pile* (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.

S. L. Charboneau DOE Federal Project Director (printed)	Stacy Charboneau Signature	11/27/07 Date
N/A Ecology Project Manager (printed)	Signature	Date
L. C. Buelow EPA Project Manager (printed)	Signature	11/30/07 Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-B-18, 184-B POWERHOUSE DEBRIS PILE

Attachment to Waste Site Reclassification Form 2007-020

December 2007

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-B-18, 184-B POWERHOUSE DEBRIS PILE

EXECUTIVE SUMMARY

This remaining sites verification package documents evaluation of the verification sampling results to support reclassification of the 100-B-18 waste site to Interim Closed Out.

The 100-B-18 waste site is located approximately 450 m (1,500 ft) northwest of the former location of the 184-B Powerhouse in the 100-BC-1 Operable Unit of the Hanford Site. The 100-B-18 site consisted of a debris pile containing inert, miscellaneous demolition waste from the decommissioning of the 184-B Powerhouse. The debris covers an area roughly 15 m (49 ft) by 30 m (98 ft). The scattered debris includes materials such as concrete blocks, mixed aggregate/concrete slabs, stone rubble, asphalt rubble, rusted metal piping and plumbing, tar/mastic material, paint, broken fluorescent lights, creosote timbers, brick chimney remnants, and rubber hoses. Non-friable asbestos-containing material (ACM) is present at the site and include fragments of corrugated ACM siding (the 184-B Powerhouse was sided with 1,563 m^2 [16,800 ft^2] of ACM). The site was determined to require remediation because of the tar/mastic material present at the site and the potential for the presence of light ballasts; all other inert demolition debris was not considered a threat to human health or the environment and, as such, did not require remediation.

Remediation of the site was performed on June 26, 2007, and July 16, 2007. Because the majority of the material disposed of at the site was inert demolition debris (e.g., concrete blocks and asphalt rubble), the Environmental Protection Agency (EPA) and the Department of Energy, Richland Operations Office (DOE-RL) agreed that site remediation would be accomplished by selective removal of suspect hazardous items (specifically, light ballasts and tar/mastic material) and potentially impacted soils (BHI 2005c, Capron 2007a). The ACM present at the site were in a non-friable form and do not present a potential release to the environment; therefore, no cleanup action was required for the non-friable ACM. Remediation activities included the removal of 70 BCM (bank cubic meter) of tar/mastic material along with underlying soils. Light ballasts were expected at the site, however, none were found. The numerous intact and broken fluorescent light tubes located at the site (approximately 50) were picked up and disposed. No other hazardous debris or stained soil requiring remediation was identified at the site. Asphalt that has been used for structural and construction purposes is excluded from consideration as a dangerous waste in *Washington Administrative Code* (WAC) 173-303-071(3)(e), is listed as an inert waste in WAC 173-350-990(2)(b), and does not present a significant risk to human health or the environment; therefore, asphalt debris present at the site was not removed.

Verification sampling was performed concurrently with the site remediation conducted in June and July of 2007. One focused sample, composed of 25 random aliquots and a duplicate, were collected of the soils underlying the removed tar/mastic debris. Ten focused samples were collected of the soils underlying the fluorescent light tubes. These samples were used to demonstrate that site remediation was complete and that the underlying soil meets the remedial action objectives.

The analytical results for the verification samples indicated no elevated residual concentrations exceeding cleanup criteria, except antimony, barium, lead, mercury, zinc, and aroclor-1260. These constituents exceeded their respective groundwater and/or river protection remedial action goals,

however, the results of vertical migration modeling 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-18 site in accordance with the TPA-MP-14 (DOE-RL 2007b) 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-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). 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-18 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.	All individual COPC concentrations are below the direct exposure criteria.	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 (8.6×10^{-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 $\leq 1 \times 10^{-6}$.	
	Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess cancer risk value (1.1×10^{-6}) is $\leq 1 \times 10^{-5}$.	

Table ES-1. Summary of Remedial Action Goals for the 100-B-18 Site. (2 pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river protection RAGs.	No radionuclide COPCs were identified.	Yes
	Attain national primary drinking water regulations:[a] 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.[b]		
	Meet total uranium standard of 21.2 pCi/L.[c]		
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Residual concentrations of antimony, barium, lead, mercury, zinc, and aroclor-1260 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.[d]	Yes

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

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

[c] 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).

[d] Based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a), these constituents are not predicted to migrate more than 3 m (10 ft) vertically in 1,000 years (based on the lowest soil-partitioning coefficient [barium] of 25 mL/g). The vadose zone underlying this site is approximately 10 m (33 ft) thick.

COPC = contaminant of potential concern
MCL = maximum contaminant level
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose model)

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-18 contaminants of potential concern. Screening levels were exceeded at the site for the following constituents: antimony, barium, boron, cadmium, lead, manganese, mercury, selenium, vanadium, and total petroleum hydrocarbons (TPHs). Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors because manganese, selenium, and vanadium are below site background, and antimony, lead, and mercury are within the range of Hanford Site background levels. Barium, boron, cadmium and TPH exceeded screening values and were not within the range of natural Hanford site background levels; the exceedance of soil screening values by these constituents will be evaluated in the context of additional lines of evidence for ecological effects. A baseline risk assessment for the river corridor portion of the

Hanford Site began in 2004, which includes a more complete quantitative ecological risk assessment. That baseline risk assessment will be used as part of the final closeout decision for this site. Draft A of the baseline risk assessment concludes that no ecological risks are associated with Hanford contaminants of potential concern at upland remediated waste sites and riparian operational soil areas (DOE-RL 2007a).

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-B-18, 184-B POWERHOUSE DEBRIS PILE

STATEMENT OF PROTECTIVENESS

This report demonstrates that the 100-B-18 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-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 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.

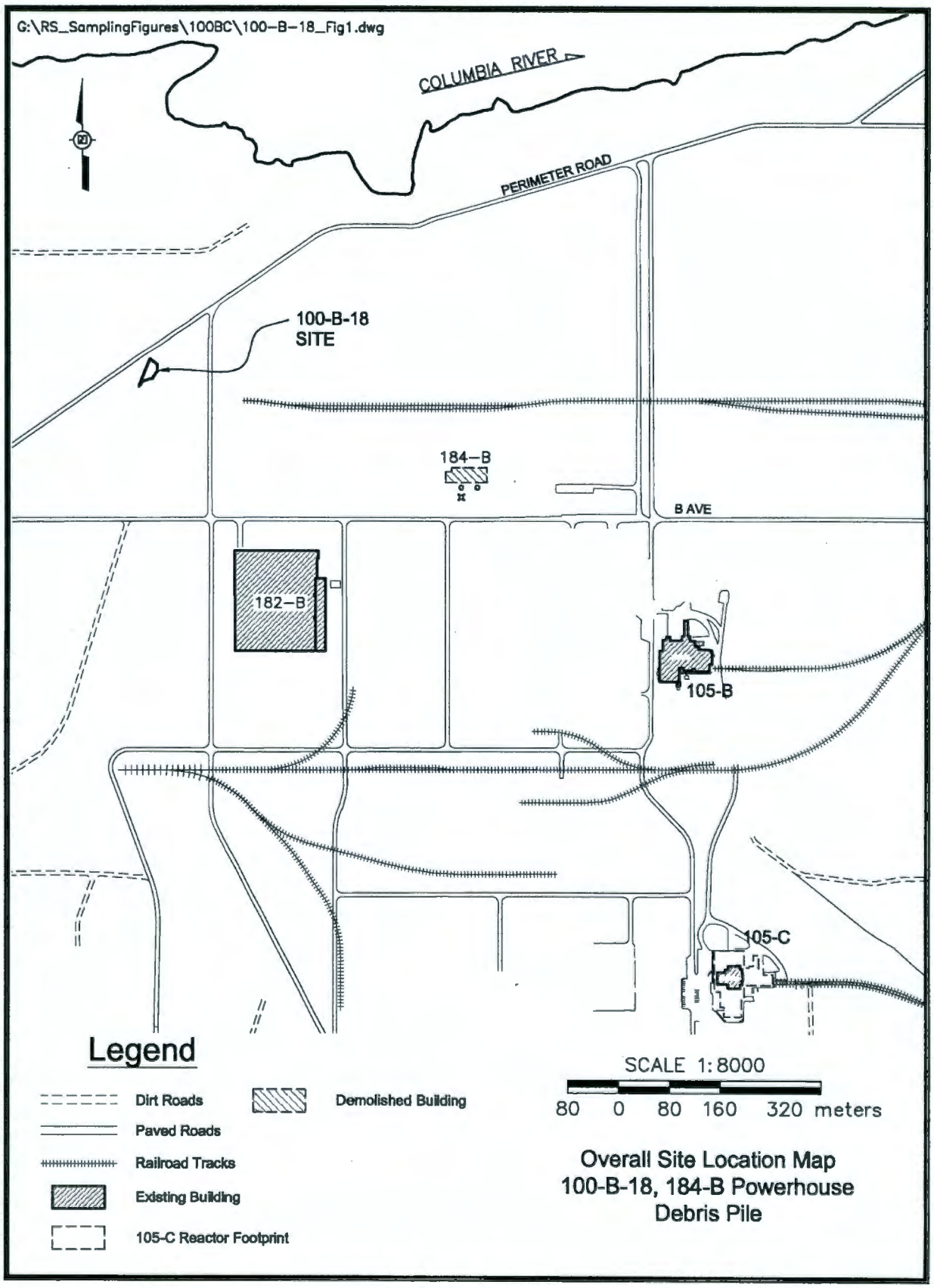
GENERAL SITE INFORMATION AND BACKGROUND

The 100-B-18 waste site is located approximately 450 m (1,500 ft) northwest of the former location of the 184-B Powerhouse in the 100-BC-1 Operable Unit of the Hanford Site (Figure 1). The 100-B-18 site is a debris pile containing miscellaneous demolition waste from the decommissioning activities of the 184-B Powerhouse. The debris covers an area roughly 15 m (50 ft) by 30 m (100 ft). Materials observed at the site included numerous concrete blocks, mixed aggregate/concrete slabs, stone rubble, asphalt rubble, rusted metal piping and plumbing, traces of tar/coal, paint, broken fluorescent lights, creosote timbers, brick chimney remnants, and rubber hoses. Non-friable asbestos-containing material (ACM) was observed at the site and included fragments of corrugated ACM siding (the 184-B Powerhouse was sided with 1,563 m^2 [16,800 ft^2] of ACM) and remnants of an asbestos-cloth fire hose.

Constructed in 1944, the coal-fired 184-B Powerhouse provided steam and emergency electrical power for the secondary coolant system located at the 181-B Pumphouse (Du Pont 1945). The 184-B Powerhouse also supplied office heat and other heating needs for 100-B/C Area facilities through overhead steam lines throughout the 100-B/C Area (Du Pont 1945). A small turbine generator in 184-B also supplied emergency electrical power for area building lights and motors (Gerber 1993, Du Pont 1945).

The 184-B Powerhouse was closed in the mid-1970s, and parts of the facility and all of the equipment were removed in 1979 (Whalen 1989). Final demolition of the building, including the smoke stacks, was completed by 1983 (Whalen 1989). All the above-ground structures were removed, leaving the foundation slabs, tunnels, pits, and other associated concrete structures at or near grade level (Griffin 1988). In 1988, the foundation and the other below-grade features, including the salt dissolving pits, were demolished to at least 0.9 m (3 ft) below grade, backfilled with rubble, and buried in situ (Griffin 1988).

Figure 1. Location of the 100-B-18 Waste Site.



REMEDIATION AND VERIFICATION SAMPLING ACTIVITIES

Historical data, process knowledge, site visit observations, and other available information were used to develop a site-specific remediation approach and sample design. The 100-B-18 waste site was determined to require remedial action based on the presence of a small amount of potentially hazardous debris material. The materials requiring removal were solid debris items, predominantly located above inert debris. These debris items were not believed to have caused any releases to underlying soils. Where potentially hazardous tar/mastic debris items were in contact with soil, verification sampling was performed concurrently with remediation to ensure sampling of appropriate residual material. Samples were also to be collected from every location where light ballasts were found. Sampling of 100-B-18 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 as well as the verification sample results.

Geophysical Investigation

No geophysical survey was performed for the 100-B-18 waste site, as the position and character of debris is well-established by visual reconnaissance, and subsurface characterization is not expected to provide meaningful data due to the presence of overlying debris.

Contaminants of Potential Concern

The contaminants of potential concern (COPCs) for the 100-B-18 site were identified based on process knowledge and site visit observations. The COPCs identified include metals, mercury, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and TPHs.

Radionuclides were not COPCs for this site as the decommissioning report for the 184-B Powerhouse (Griffin 1988) states that the facility was never a radiologically controlled site, that radioactive materials were never stored at the site, and that no radiologically contaminated material was identified prior to or during decommissioning activities. However, the presence of radiological contaminants was evaluated during excavation and sampling activities using field radiological survey instrumentation (capable of detecting alpha, beta, and gamma radiation). Although no elevated radiological activity was detected during field activities, samples were submitted for further radionuclide evaluation.

Field screening for volatile organic compounds, using an organic vapor monitor, was also performed during excavation and sampling activities. No volatile organic compounds were detected; however, volatile organic analysis (VOA) was inadvertently included in the requested analyses for the soils underlying tar/mastic debris and, therefore, included as a COPC for this site. No suspect friable asbestos-containing material was observed during field activities (WCH 2007a); therefore, additional analyses were not required.

Site Remediation

Remediation of the 100-B-18 waste site was performed in accordance with the site-specific remediation approach outlined in WCH 2007b. The design consisted of the removal of suspect hazardous material (e.g., light tubes, tar/mastic debris) identified at the surface of the site. Because the majority of the material disposed of at the site was inert demolition debris (e.g., concrete blocks and asphalt rubble), site remediation was accomplished by selective removal of suspect hazardous items (specifically, light ballasts and tar/mastic material) and potentially impacted soils. The asbestos-containing materials present at the site were in a non-friable form and do not present a potential release to the environment; therefore, no cleanup action was required for the non-friable ACM. The sampling approach was agreed to by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy, Richland Operations Office (DOE-RL) (BHI 2005c, Capron 2007a). Excavation was performed in June 2007 with removal of additional light tubes in July 2007. Seventy BCM (bank cubic meter) of tar/mastic material along with surrounding soils were removed for disposal at the Environmental Restoration Disposal Facility (ERDF). Light ballasts were expected at the site, however, none were found. The numerous intact and broken fluorescent light tubes located at the site (approximately 50) were picked up and disposed. Inert debris material was left in-place at the site. No other hazardous debris or stained soil requiring remediation was identified at the site. A photograph of the remediation activities is provided in Figure 2.

Asphalt that has been used for structural and construction purposes is excluded from consideration as a dangerous waste in *Washington Administrative Code* (WAC) 173-303-071(3)(e), is listed as an inert waste in WAC 173-350-990(2)(b), and does not present a significant risk to human health or the environment; therefore, asphalt debris present at the site was not removed.

Figure 2. Remediation of the 100-B-18 Waste Site.

Verification Sample Design

A focused verification sampling approach was outlined in WCH 2007b and implemented at the 100-B-18 site. Verification sampling was to be performed at residual soils underlying/adjacent to suspect hazardous materials or from soils that may have received a release of hazardous materials that were identified based on visual observation (e.g., soil staining). Specifically, the verification sampling work instruction (WCH 2007b) called for focused soil samples to be taken under locations where tar/mastic debris and light ballasts were removed. Samples associated with the removal of tar/mastic material were to be analyzed for the full list of COPCs, whereas samples associated with light ballasts were to be submitted for PCB analysis only. Additionally, focused samples were to be collected from soils underlying other suspect hazardous debris items in contact with the soil. The analytical requirements for soils associated with any other suspect hazardous debris items were to be determined at the time of sampling by the Resident Engineer in conjunction with the Sample Design & Cleanup Verification Lead.

Verification Sampling Activities

Verification sampling at the 100-B-18 site was performed on June 27, 2007, of the soils underlying the locations where the tar/mastic debris had been removed. One focused sample, composed of 25 random aliquots, was collected and analyzed for GEA, gross alpha, gross beta, inductively coupled plasma (ICP) metals, mercury, PCBs, PAHs, and VOA. The sampling area for the soil underlying the tar/mastic debris is shown in Figure 3.

No light ballasts were found at the site during remediation activities; however, 10 "caches" of light tubes were found at the site and removed. Verification samples were collected in July 2007 of the soils underlying locations where the light tubes were remediated. A total of 10 focused samples were collected of these soils (one from each remediated cache) (Figure 3) and analyzed for PCBs, ICP metals, and mercury. No other suspect hazardous debris items or hazardous materials were located at the site and, therefore, no further verification sampling was performed.

A summary of the samples collected and the laboratory analyses performed are provided in Table 1. Figure 3 identifies the verification sample locations.

Table 1. 100-B-18 Verification Sample Summary Table. (2 Pages)

Sample Media and Location	Sample Number	Coordinate Locations	Depth	Sample Analysis
Soils underlying tar/mastic material	J156F8	N/A	Surface soils	ICP metals, mercury, PCBs, PAH, VOA, GEA, gross alpha, gross beta
Duplicate of J156F8 (soils underlying tar/mastic material)	J156F9	N/A	Surface soils	

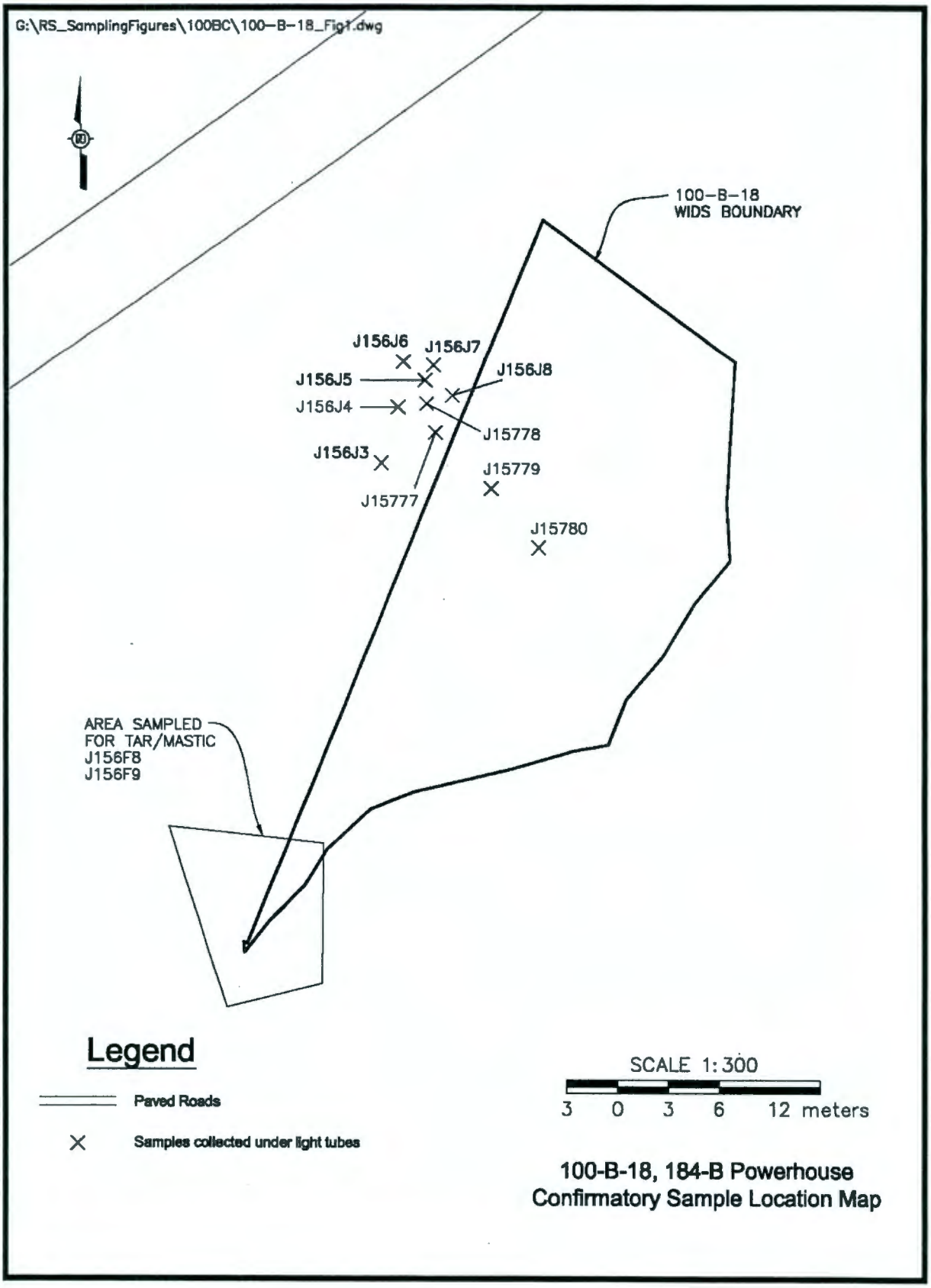
Table 1. 100-B-18 Verification Sample Summary Table. (2 Pages)

Sample Media and Location	Sample Number	Coordinate Locations	Depth	Sample Analysis
Soil underlying light tube debris	J156J3	N 144967 E 564440	Surface soils	ICP metals, mercury, PCBs
Soil underlying light tube debris	J156J4	N 144971 E 564441	Surface soils	
Soil underlying light tube debris	J156J5	N 144972 E 564443	Surface soils	
Soil underlying light tube debris	J156J6	N 144973 E 564442	Surface soils	
Soil underlying light tube debris	J156J7	N 144973 E 564443	Surface soils	
Soil underlying light tube debris	J156J8	N 144971 E 564444	Surface soils	ICP metals, mercury, PCBs
Soil underlying light tube debris	J15777	N 144969 E 564443	Surface soils	
Soil underlying light tube debris	J15778	N 144971 E 564443	Surface soils	
Soil underlying light tube debris	J15779	N 144966 E 564447	Surface soils	
Soil underlying light tube debris	J15780	N 144962 E 564450	Surface soils	
Equipment blank (silica sand)	J156H0	N/A	N/A	ICP metals, mercury

Source: Field logbook EFL-1173-13, pp. 12-13, 32 (WCH 2007a)

GEA = gamma energy analysis
ICP = inductively coupled plasma
N/A = not applicable
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
VOA= volatile organic analysis

Figure 3. Sample Locations at the 100-B-18 Waste Site.



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 A of this document.

The analytical results for the COPCs that were identified for the 100-B-18 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 2. The 100-B-18 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 2. Potassium-40, radium-226, radium-228, thorium-228, and thorium-232 were detected in samples collected at the site, but are not included in Table 2, as these isotopes are unrelated to the operational history of the site and were detected below background levels (based on an assumption of secular equilibrium, the background activities for radium-228 and thorium-228 are equal to the statistical background activity of 1.32 pCi/g for thorium-232 provided in DOE-RL [1996]).

Table 2. Comparison of Maximum Contaminant Concentrations to Action Levels for the 100-B-18 Powerhouse Debris Pile. (3 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]	9.3	32	5[c]	5[c]	Yes	Yes[d]
Arsenic	4.1 (<BG)	20	20	20	No	--
Barium	1300	5,600	132[c]	224	Yes	Yes[e]
Beryllium	0.64 (<BG)	10.4[f]	1.51[c]	1.51[c]	No	--
Boron[g]	34.2	16,000	320	--[h]	No	--
Cadmium[b]	13.2	13.9[f]	0.81[c]	0.81[c]	No	--
Chromium (total)	11.3 (<BG)	80,000	18.5[c]	18.5[c]	No	--
Cobalt	8.2 (<BG)	1,600	32	--[h]	No	--
Copper	18.9 (<BG)	2,960	59.2	22.0[c]	No	--

Table 2. Comparison of Maximum Contaminant Concentrations to Action Levels for the 100-B-18 Powerhouse Debris Pile. (3 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		
Lead	25.3	353	10.2[c]	10.2[c]	Yes	Yes[e]
Manganese	356 (<BG)	11,200	512[c]	512[c]	No	--
Mercury	2.2	24	0.33[c]	0.33[c]	Yes	Yes[e]
Molybdenum[g]	0.96	400	8	--[h]	No	--
Nickel	12.1 (<BG)	1,600	19.1[c]	27.4	No	--
Selenium[b]	0.73 (<BG)	400	5	1	No	--
Vanadium	46.5 (<BG)	560	85.1[c]	--[h]	No	--
Zinc	77.6	24,000	480	67.8[c]	Yes	Yes[e]
TPH	194[i]	N/A	200	200	No	--
Aroclor-1260	0.095	0.5	0.017[j]	0.017[j]	Yes	Yes[e]
Acetone	0.018	72,000	720	NA	No	--
Acenapthene	0.170	4,800	96	129	No	--
Acenapthylene[k]	0.079	4,800	96	129	No	--
Anthracene	0.550	24,000	240	1,920	No	--
Benzo(a)anthracene	0.250	0.137	0.015[j]	0.015[j]	Yes	No[l]
Benzo(a)pyrene	0.300	0.137	0.015[j]	0.015[j]	Yes	No[l]
Benzo(b)fluoranthene	0.240	0.137	0.015[j]	0.015[j]	Yes	No[l]
Benzo(g,h,i)perylene[k]	0.150	2,400	48	192	No	--
Benzo(k)fluoranthene	0.100	0.137	0.015[j]	0.015[j]	Yes	No[l]
Chrysene	0.270	0.137	0.015[j]	0.015[j]	Yes	No[l]
Dibenzo(a,h)anthracene	0.030	0.137	0.03[j]	0.03[j]	No	No[l]
Fluoranthene	0.300	3,200	64	18.0	No	--
Fluorene	0.530	3,200	64	260	No	--
Indeno(1,2,3-cd) pyrene	0.190	1.37	0.03[j]	0.03[j]	Yes	No[l]
Naphthalene	0.440	1,600	16.0	988	No	--
Phenanthrene[k]	0.120	24,000	240	1,920	No	--

Table 2. Comparison of Maximum Contaminant Concentrations to Action Levels for the100-B-18 Powerhouse Debris Pile. (3 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		
Pyrene	0.510	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, 173-340-730, and 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] Based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a), antimony is not predicted to migrate more than 1 m (3.3 ft) vertically in 1,000 years by applying a Kd value for antimony of 45 mL/g. The vadose zone underlying this site is approximately 10 m (32.8 ft) thick.
[e] Based on the *100 Area Analogous Sites RESRAD Calculations* (BHI 2005a), these constituents are not predicted to migrate more than 3 m (10 ft) vertically in 1,000 years (based on the lowest soil-partitioning coefficient distribution [barium] of 25 mL/g). The vadose zone underlying this site is approximately 10 m (32.8 ft) thick.
[f] 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).
[g] No Hanford Site-specific or Washington State background value available.
[h] 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]).
[i] The value presented for TPH is the average of the primary (165 mg/kg) and the duplicate sample (222 mg/kg).
[j] Where cleanup levels are less than RDLs, cleanup levels default to RDLs (WAC 173-340-707(2)) (1996).
[k] Toxicity data for this chemical are not available. Cleanup levels are based on surrogate chemicals:
Contaminant: acenapthylene; surrogate: acenapthene
Contaminant: benzo(g,h,i)perylene; surrogate: pyrene
Contaminant: phenathrene; surrogate: anthracene
[l] Constituent is the result of asphalt cross-contamination of the sample matrix. Asphalt that has been used for structural and construction purposes is excluded from consideration as a dangerous waste by WAC 173-303-071(3)(e), 2004, is listed as an inert waste in WAC 173-350-990(2)(b), 2005, and does not present a significant human health risk.

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

DATA EVALUATION

Several PAHs were detected in the verification samples for the 100-B-18 site, above the direct exposure, groundwater, and river protection RAGs presented in the RDR/RAWP (Table 2). These samples were collected of soils underlying areas that had been remediated for potentially hazardous tar/mastic material. The detections of PAHs in the samples were determined to be the result of asphalt cross-contamination in the samples. The 100-B-18 site contains high amounts of asphalt roofing and residual fragments of asphalt material in the soils where the remediation occurred. Figure 4 is a photograph of the residual asphalt material present in the remediation footprint. Residual fragments of asphalt roofing within the verification samples collected after remediation would result in the observed elevated detections of PAHs. A comparison of the detected PAHs in the verification data set to a known asphalt sample (Table 3) shows a reasonable correlation, as indicated by the "ratio" column. Asphalt that has been used for structural and construction purposes is excluded from consideration as a dangerous waste in WAC 173-303-071 (3)(e), and is listed as an inert waste in WAC 173-350-990(2)(b). As such, the

PAHs detected in the verification samples do not present a significant risk to human health or the environment and, consequently, do not warrant further remediation per agreement between the EPA and DOE-RL (Capron 2007b).

Table 3. Comparison of 100-B-18 Focused Verification Sample Results to a Known Asphalt Sample.

Analyte	Asphalt Sample Result (mg/kg)	100-B-18 Verification Result (mg/kg)	Ratio[a] ($x\ 10^{-4}$)
2-Methylnaphthalene	394	ND	--
Acenaphthene	1,783	0.17	0.95
Anthracene	3,699	0.55	1.49
Benzo(a)anthracene	5,792	0.25	0.43
Benzo(a)pyrene	5,533	0.30	0.54
Benzo(b)fluoranthene	4,619	0.24	0.52
Benzo(g,h,i)perylene	2,839	0.15	0.53
Benzo(k)fluoranthene	4,527	0.10	0.22
Carbazole	2,049	ND	--
Chrysene	5,580	0.27	0.48
Dibenzo(a,h)anthracene	1,531	0.030	0.20
Dibenzofuran	1,135	ND	--
Fluoranthene	10,665	0.30	0.28
Fluorene	1,756	0.53	3.02
Indeno(1,2,3-cd) pyrene	2,751	0.19	0.69
Naphthalene	1,917	0.44	--
Phenanthrene	10,975	0.12	0.11
Pyrene	10,205	0.51	0.50

ND = not detected

[a]Determined by dividing the maximum 100-B-18 site result by the asphalt sample result.

Figure 4. Visible Residual Asphalt Material Present in the Remediation Footprint at the 100-B-18 Site.

The evaluation of the results listed in Table 2 from verification sampling at the 100-B-18 waste site indicates that residual concentrations of all site COPCs are below soil RAGs, except for antimony, barium, lead, mercury, zinc, and aroclor-1260. Antimony was detected above the soil RAGs for the groundwater/river protection in one of ten focused verification samples collected from beneath the removed light tubes. Antimony was undetected or quantified below background levels in the other nine samples, and was not detected in the primary/duplicate pair collected beneath the remediated mastic material. Conservative vertical migration modeling will not demonstrate protectiveness given the current soil-partitioning coefficient for antimony of 1.4 mL/g. In a discussion with the EPA, and documented in Capron 2007b, it was determined to extend a previous agreement applied to the 100-F Area (BHI 2005b) in which the existing Hanford Site-specific Kd value for antimony is replaced with the more representative Kd value of 45 mL/g. This Kd value is based on the current site soil and groundwater conditions.

Given the soil-partitioning coefficients for antimony (45 mL/g), barium (25 mL/g), lead (30 mL/g), mercury (30 mL/g), zinc (30 mL/g), and aroclor-1260 (530 mL/g), RESidual RADioactivity (RESRAD) modeling predicts that these contaminants will not migrate more than 3 m (10 ft) vertically in 1,000 years (BHI 2005a). The vadose zone beneath the 100-B-18 excavation is approximately 10 m (32.8 ft) thick. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and, consequently, the Columbia River.

Assessment of the risk requirements for the 100-B-18 waste site is determined by calculation of the hazard quotient and excess cancer risk values for nonradionuclides. These calculations are located in Appendix B. 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. Additionally, the detections of PAHs were not included in the calculations as they were determined to be the result of asphalt cross-contamination. The results

(Appendix B) indicate that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the noncarcinogenic constituents is 8.6×10^{-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

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 designs (DOE-RL 2005a, WCH 2007b). This DQA was performed in accordance with site specific data quality objectives found in the SAP (DOE-RL 2005a).

A review of the sample design (WCH 2007b), the field logbook (WCH 2007a), and applicable analytical data packages has been performed as part of this DQA. All samples were collected per the sample designs. To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical and radiochemical analysis (BHI 2000a, 2000b) 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).

Verification sample data collected at the 100-B-18 waste site were provided by the laboratories in two sample delivery groups (SDGs), SDG K0853 and SDG K0876. SDG K0853 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed below.

SDG K0853

This SDG comprises a field duplicate pair (J156F8/J156F9), and an equipment blank (J156H0), from the 100-B-18 site soil where tar and mastic had been located. The field duplicate pair was analyzed for ICP metals, mercury, PCBs, PAHs, TPH, and by alpha spectroscopy, beta counting, and gamma spectroscopy. The equipment blank was analyzed for ICP metals and mercury. SDG K0853 was submitted for formal third-party validation. No major deficiencies were found in SDG K0853. Minor deficiencies are as follows:

For the radionuclide analysis, 15 analytes exceeded the required quantitation limit (RQL). Under the Washington Closure Hanford (WCH) statement of work, no qualification is required, and these small exceedances were not qualified by third-party validation.

The PAH results for SDG K0853 were all qualified as estimates and "J" flagged by third-party validation because of a matrix spike (MS) recovery of 159.6%, outside the acceptance criteria range of

50% to 150%, and a laboratory duplicate relative percent difference (RPD) of 44.3%, greater than the RPD limit of 30%. The data are useable for decision-making purposes.

In the volatile organic analysis, the MS recoveries for acetone are above the acceptance criteria with the MS recovery of 373%, and the matrix spike duplicate (MSD) recovery is 316%. The laboratory control sample (LCS) recovery for acetone is also above the acceptance criteria, at 235%. Field sample data for these analyses may contain high bias. Detected results are considered estimated and flagged "J" by third-party validation. However, high biased data and/or estimated data are useable for decision-making purposes.

Methylene chloride results for sample J156F8 were raised to the RQL and qualified as undetected with a "U" flag by third-party validation, as the sample results are less than the contract required quantitation limit (CRQL) and less than five times the highest associated blank result. Methylene chloride results in sample J156F9 were qualified as undetected with a "U" flag by third-party validation as the sample results are less than five times the highest associated blank result. The data are useable for decision-making purposes.

In the PAH analysis, all results are considered estimated and flagged "J" by third-party validation because of surrogate recoveries outside the acceptance criteria, and because of interference in the MS and MSD. The data are useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for six ICP metals (iron, magnesium, manganese, mercury, antimony, and silicon) are out of acceptance criteria. For iron, mercury, manganese, and silicon, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. For these analytes, the deficiency in the MS 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 the analytes with results in the range of 92.8% to 109.8%. The analytes, antimony and magnesium did not have mismatched spike and native concentrations in the original MS. The original MS recoveries for antimony and magnesium were 46.4% and 63.2%, respectively. The antimony and magnesium data for SDG K0853 were qualified as estimates and "J" flagged.

For silicon, the LCS recovery is below the acceptance criteria at 59.7%. Silicon has been qualified by third-party validation as estimated with "J" flags for all samples in SDG K0853. Estimated, or "J" flagged, data are considered acceptable for the intended use of the data.

The analytes arsenic, barium, calcium, copper, molybdenum, sodium, nickel, and zinc were reported in the MB at concentrations that were below the CRQLs but not less than $1/5^{th}$ of some of the concentrations reported in the field samples (i.e., the field sample concentrations were low enough that the MB concentration is of similar magnitude). Third-party validation has qualified the analytical data for barium, calcium, copper, nickel, sodium, and zinc in sample J156H0 (equipment blank) as estimated nondetects with "UJ" flags. The arsenic and molybdenum results in sample J156F8 are qualified as estimated nondetects with "UJ" flags by third-party validation. Sample J56F9 arsenic results are qualified as estimated nondetects with "UJ" flags by third-party validation.

One field (equipment) blank (J156H0) was submitted for analysis. Aluminum, iron, magnesium, manganese, and silicon were detected in the equipment blank. Under the WCH statement of work, no qualification is required.

The RPD value for lead in the laboratory duplicate samples is outside the acceptance criteria at 186.9%. Third-party validation qualified the lead results for SDG K0853 as estimated with "J" flags. The data are usable for decision-making purposes.

All selenium results exceeded the RQL. Under the WCH statement of work, no qualification is required.

SDG K0876

This SDG comprises ten samples (J156J3 through J156J8, and J15777 through J15780) from the 100-B-18 site soil where fluorescent lights had been located. The samples were analyzed for ICP metals, mercury, and PCBs. No major deficiencies were found in SDG K0876. Minor deficiencies are as follows:

A surrogate in the PCB analysis for sample J156J5 was above the acceptance criteria, at 124%. This suggests a high bias in the data. However, the data is listed as nondetected and a high bias has no affect on nondetected analytical data. The data are useable for decision-making purposes.

In the ICP metals analysis, the MS recoveries for six ICP metals (aluminum, iron, magnesium, manganese, antimony, and silicon) are out of acceptance criteria. For aluminum, iron, and silicon, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. For these analytes, the deficiency in the MS 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 six analytes with results in the range of 89.7% to 97.3%. The analytes magnesium, manganese, and antimony did not have mismatched spike and native concentrations in the original MS. The original MS recoveries for magnesium and manganese were high, indicating a potential high bias in the sample results for these analytes. The original MS recovery for antimony was 69.6%. The antimony data for SDG K0876 may be considered estimated. All ICP metals data are useable for decision-making purposes.

The RPDs calculated for aluminum (42.1%), arsenic (51.9%), beryllium (34.2%), chromium (49.2%), iron (41.3%), magnesium (35.6%), sodium (43.7%), nickel (32.8%), and vanadium (53.8%) in the laboratory duplicate pair (sample J156J3, and J156J3 duplicate) 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.

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/quality control (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 logbook (WCH 2007a), for the 100-B-18 site are composed of a field duplicate pair (J156F8/J156F9) from the 100-B-18 site soil where tar and mastic had been located.

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 sample results are presented in Appendix A; the discussion of the field duplicate RPDs is below.

Radionuclides. For SDG K0853, the third-party validation calculated the field duplicates' (J156F8/J156F9) RPD for thorium-232 at 52.6%. This RPD result exceeds the criteria (30%); however, there is no requirement to qualify the data and no qualifier flags were assigned. As elevated RPDs are attributed to heterogeneity naturally occurring in the soil matrix, the data are found by this program to be useable for decision-making purposes.

Nonradionuclides. For SDG K0853, the third-party validation calculated the field duplicates (J156F8/J156F9) RPD for acetone at 235%, naphthalene at 103%, acenaphthene at 52%, phenanthrene at 41%, and aroclor-1260 at 114%. These RPD results exceed the criteria (30%); however, there is no requirement to qualify the data and no qualifier flags were assigned. As elevated RPDs are attributed to heterogeneity naturally occurring in the soil matrix, the data are found by this program to be useable for decision-making purposes.

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.

QA/QC Conclusions

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above, are a potential challenge 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-18 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 the 100-B--18 waste site establishes 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. The verification sample analytical data are stored in the ENRE project-specific database prior to being submitted for inclusion in the HEIS database. The verification sample analytical data are also summarized in Appendix A of this document.

SUMMARY FOR INTERIM CLOSED OUT

The 100-B-18 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-18 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

VERIFICATION SAMPLING RESULTS

Table A-1. 100-B-18 Verification Sampling Results. (6 Pages)

Sample Location	Sample Number	Sample Date	Americium-241			Cesium-137			Cobalt-60			Europium-152			Europium-154			Europium-155		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil beneath tar removal	J156F8	6/27/07	0.32	U	0.32	0.088	U	0.088	0.076	U	0.076	0.228	U	0.228	0.221	U	0.221	0.237	U	0.237
Duplicate of J156F8	J156F9	6/27/07	0.034	U	0.034	0.037	U	0.037	0.035	U	0.035	0.098	U	0.098	0.109	U	0.109	0.113	U	0.113

Sample Location	Sample Number	Sample Date	Potassium-40			Radium-226			Radium-228			Silver-108			Thorium-228			Thorium-232		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Soil beneath tar removal	J156F8	6/27/07	10		0.879	0.465		0.185	0.521		0.283	0.065	U	0.065	0.641		0.151	0.521		0.283
Duplicate of J156F8	J156F9	6/27/07	11.6		0.333	0.488		0.065	0.893		0.157	0.026	U	0.026	0.676		0.049	0.893		0.157

Sample Location	Sample Number	Sample Date	Uranium-235			Uranium-238		
			pCi/g	Q	MDA	pCi/g	Q	MDA
Soil beneath tar removal	J156F8	6/27/07	0.348	U	0.348	9.58	U	9.58
Duplicate of J156F8	J156F9	6/27/07	0.14	U	0.14	4.19	U	4.19

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)

HEIS = Hanford Environmental Information System

J = estimate

MDA = minimum detectable activity

PAH = polyaromatic hydrocarbons

PQL = practical quantitation limit

Q = qualifier

TPH = total petroleum hydrocarbon

U = undetected

VOA = volatile organic analysis

Table A-1. 100-B-18 Verification Sampling Results. (6 Pages)

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			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
Equipment blank	J156H0	6/27/07	56	C	1.7	0.21	UJ	0.21	0.4	U	0.4	1.1	UJ	0.02	0.02	U	0.02	0.35	U	0.35	0.05	U	0.05
Soil beneath tar removal	J156F8	6/27/07	6100	C	5.4	0.66	UJ	0.66	3.8	UJ	1.2	91.8	C	0.06	0.32	C	0.06	6.1	C	1.1	0.15	U	0.15
Duplicate of J156F8	J156F9	6/27/07	7780	C	5.4	0.66	UJ	0.66	4.1	UJ	1.2	113	C	0.06	0.4	C	0.06	5.5	C	1.1	0.15	U	0.15
Soil beneath light tubes	J156J3	7/16/07	2990		1.7	0.21	U	0.21	1		0.39	54.3		0.02	0.09		0.01	1.2		0.35	0.19		0.05
Soil beneath light tubes	J156J4	7/16/07	5310		1.7	0.21	U	0.21	1.8		0.39	67.5		0.02	0.08		0.01	2.5		0.35	0.05	U	0.05
Soil beneath light tubes	J156J5	7/16/07	5250		1.8	0.39		0.22	1.7		0.41	88.3		0.02	0.06		0.01	3.3		0.36	1		0.05
Soil beneath light tubes	J156J6	7/16/07	5610		1.8	0.22	U	0.22	1.8		0.4	58.2		0.02	0.04		0.01	1.9		0.35	0.05	U	0.05
Soil beneath light tubes	J156J7	7/16/07	5510		1.7	1.7		0.21	2.1		0.39	71.3		0.02	0.07		0.01	1.9		0.35	1.3		0.05
Soil beneath light tubes	J156J8	7/16/07	4560		1.7	3.9		0.21	1.2		0.39	67.3		0.02	0.09		0.01	3.9		0.34	2.2		0.05
Soil beneath light tubes	J15777	7/16/07	4230		1.8	9.3		0.22	1.7		0.41	144		0.02	0.04		0.01	2.1		0.36	13.2		0.05
Soil beneath light tubes	J15778	7/16/07	6080		1.8	2.1		0.22	2.4		0.41	79.4		0.02	0.01		0.01	2.1		0.36	0.148		0.05
Soil beneath light tubes	J15779	7/16/07	5460		1.8	0.96		0.22	2.1		0.4	71.2		0.02	0.01	U	0.01	3.4		0.35	0.65		0.05
Soil beneath light tubes	J15780	7/16/07	11200		1.7	1.4		0.21	3		0.39	1300		0.02	0.64		0.01	34.2		0.35	2.2		0.05

Sample Location	HEIS Number	Sample Date	Calcium			Chromium			Cobalt			Copper			Iron			Lead			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
Equipment blank	J156H0	6/27/07	32	UJ	1.9	0.1	U	0.1	0.08	U	0.08	0.36	UJ	0.33	118	C	0.33	0.32	UJ	0.32	7.7	J	3.6
Soil beneath tar removal	J156F8	6/27/07	6210	C	6	9.8		0.3	7.8	C	0.24	16.5	C	0.69	17500	C	1	15.4	CJ	0.99	4020	J	11.1
Duplicate of soil beneath tar removal	J156F9	6/27/07	6780	C	6	10.9		0.3	8.2	C	0.24	18.3	C	0.69	21600	C	1	16.5	CJ	0.99	4750	J	11
Soil beneath light tubes	J156J3	7/16/07	2250	C	0.68	4.6	C	0.1	3.4		0.08	6	C	0.09	7000	C	0.33	3.8		0.32	1870	C	0.78
Soil beneath light tubes	J156J4	7/16/07	2680	C	0.68	8.7	C	0.1	5.1		0.08	9.6	C	0.09	12500	C	0.33	3.9		0.32	2880	C	0.78
Soil beneath light tubes	J156J5	7/16/07	3900	C	0.7	7.6	C	0.1	6.7		0.08	13.1	C	0.09	15000	C	0.34	5.3		0.33	2990	C	0.8
Soil beneath light tubes	J156J6	7/16/07	2660	C	0.7	10.6	C	0.1	5.1		0.08	9	C	0.09	14500	C	0.33	3.5		0.32	2900	C	0.79
Soil beneath light tubes	J156J7	7/16/07	3000	C	0.68	9.1	C	0.1	5.7		0.08	11.9	C	0.09	12600	C	0.33	4.5		0.32	3150	C	0.78
Soil beneath light tubes	J156J8	7/16/07	5450	C	0.68	4.4	C	0.1	7.8		0.08	16.4	C	0.09	18100	C	0.33	5.3		0.32	4480	C	0.78
Soil beneath light tubes	J15777	7/16/07	2970	C	0.71	6.6	C	0.1	3.9		0.08	8.2	C	0.09	9760	C	0.34	4.8		0.33	2250	C	0.8
Soil beneath light tubes	J15778	7/16/07	3170	C	0.71	11.3	C	0.1	5.8		0.08	10.6	C	0.09	14900	C	0.34	6.2		0.33	3170	C	0.8
Soil beneath light tubes	J15779	7/16/07	6200	C	0.7	10.1	C	0.1	6.9		0.08	13.8	C	0.09	16700	C	0.22	4.3		0.33	4280	C	0.8
Soil beneath light tubes	J15780	7/16/07	18400	C	0.68	8.2	C	0.1	4.1		0.08	18.9	C	0.09	9770	C	0.33	25.3		0.32	3120	C	0.78

Table A-1. 100-B-18 Confirmatory Sampling Results. (6 Pages)

Sample Location	HEIS Number	Sample Date	Manganese			Mercury			Molybdenum			Nickel			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
Equipment blank	J156H0	6/27/07	4	C	0.07	0.02	U	0.02	0.16	U	0.16	0.75	UJ	0.26	47.8	U	47.8	0.42	U	0.42	64.8	CJ	0.84
Soil beneath tar removal	J156F8	6/27/07	317	C	0.21	2.2		0.04	0.67	UJ	0.48	10.7	C	0.81	1250		148	1.3	U	1.3	1150	CJ	2.6
Duplicate of soil beneath tar removal	J156F9	6/27/07	356	C	0.21	2.2		0.05	0.48	C	0.48	12.1	C	0.81	1380		147	1.3	U	1.3	1080	CJ	2.6
Soil beneath light tubes	J156J3	7/16/07	183		0.07	0.05		0.01	0.19	C	0.15	5.1		0.26	900		3.1	0.41	U	0.41	1230	C	0.83
Soil beneath light tubes	J156J4	7/16/07	248		0.07	0.02	U	0.02	0.34	C	0.15	8		0.26	1360		3.1	0.41	U	0.41	1210	C	0.83
Soil beneath light tubes	J156J5	7/16/07	246		0.07	0.12		0.02	0.32	C	0.16	9.9		0.27	1210		3.2	0.44		0.43	1190	C	0.85
Soil beneath light tubes	J156J6	7/16/07	238		0.07	0.03		0.02	0.24	C	0.16	8.5		0.26	1300		3.1	0.42	U	0.42	650	C	0.84
Soil beneath light tubes	J156J7	7/16/07	281		0.07	0.65		0.01	0.37	C	0.15	9.4		0.26	1390		3.1	0.41	U	0.41	1370	C	0.82
Soil beneath light tubes	J156J8	7/16/07	240		0.07	1.2		0.02	0.35	C	0.15	11.3		0.26	1470		3.1	0.47		0.41	1150	C	0.82
Soil beneath light tubes	J15777	7/16/07	206		0.07	1.3		0.03	0.35	C	0.16	6.7		0.27	843		3.2	0.43	U	0.43	1330	C	0.85
Soil beneath light tubes	J15778	7/16/07	275		0.07	1.5		0.03	0.4	C	0.16	9.6		0.27	1290		3.2	0.58		0.43	806	C	0.85
Soil beneath light tubes	J15779	7/16/07	276		0.07	0.04		0.01	0.46	C	0.16	11.5		0.27	1140		3.2	0.73		0.42	954	C	0.85
Soil beneath light tubes	J15780	7/16/07	348		0.07	0.44		0.01	0.96	C	0.15	8.2		0.26	1180		0.31	0.41	U	0.4	1510	C	0.83

Sample Location	HEIS Number	Sample Date	Silver			Sodium			TPH			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Equipment blank	J156H0	6/27/07	0.09	U	0.09	16.5	C	1.6				0.08	U	0.08	9.6	UJ	0.04
Soil beneath tar removal	J156F8	6/27/07	0.27	U	0.27	201	C	4.9	165		137	37.5	C	0.24	44.9	C	0.12
Duplicate of soil beneath tar removal	J156F9	6/27/07	0.27	U	0.27	254	C	4.9	222		136	46.5	C	0.24	49.6	C	0.12
Soil beneath light tubes	J156J3	7/16/07	0.09	U	0.09	68.4	C	0.67				13.6		0.08	25.4	C	0.04
Soil beneath light tubes	J156J4	7/16/07	0.09	U	0.09	116	C	0.67				28		0.08	32	C	0.04
Soil beneath light tubes	J156J5	7/16/07	0.09	U	0.09	154	C	0.69				34.8		0.08	37.7	C	0.04
Soil beneath light tubes	J156J6	7/16/07	0.09	U	0.09	123	C	0.69				35.6		0.08	32.3	C	0.04
Soil beneath light tubes	J156J7	7/16/07	0.09	U	0.09	116	C	0.67				27.8		0.08	36.4	C	0.04
Soil beneath light tubes	J156J8	7/16/07	0.09	U	0.09	163	C	0.67				21		0.08	36.9	C	0.04
Soil beneath light tubes	J15777	7/16/07	0.09	U	0.09	149	C	0.7				22.5		0.08	30.7	C	0.04
Soil beneath light tubes	J15778	7/16/07	0.09	U	0.09	145	C	0.7				36.9		0.08	38.8	C	0.04
Soil beneath light tubes	J15779	7/16/07	0.09	U	0.09	174	C	0.69				43.2		0.08	42.7	C	0.04
Soil beneath light tubes	J15780	7/16/07	0.09	U	0.09	654	C	0.67				21.5		0.08	77.6	C	0.04

Table A-1. 100-B-18 Verification Sampling Results. (6 Pages)

Constituents	J156F8 Soil beneath tar removal Sample Date 6/27/07			J156F9 Duplicate of J156F8 Sample Date 6/27/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls (PCB)						
Aroclor-1016	14	U	14	14	U	14
Aroclor-1221	14	U	14	14	U	14
Aroclor-1232	14	U	14	14	U	14
Aroclor-1242	14	U	14	14	U	14
Aroclor-1248	14	U	14	14	U	14
Aroclor-1254	14	U	14	14	U	14
Aroclor-1260	26		14	95		14
Polycyclic Aromatic Hydrogens (PAH)						
Acenaphthene	170	J	33.3	100	J	33.3
Acenaphthylene	79	J	33.3	88	J	33.3
Anthracene	550	J	3.33	580	J	3.33
Benzo(a)anthracene	250	J	3.33	220	J	3.33
Benzo(a)pyrene	300	J	3.33	230	J	3.33
Benzo(b)fluoranthene	240	J	3.33	240	J	3.33
Benzo(ghi)perylene	150	J	3.33	130	J	3.33
Benzo(k)fluoranthene	100	J	3.33	91	J	3.33
Chrysene	270	J	3.33	260	J	3.33
Dibenz[a,h]anthracene	30	J	3.33	24	J	3.33
Fluoranthene	300	J	3.33	290	J	3.33
Fluorene	530	J	3.33	410	J	3.33
Indeno(1,2,3-cd)pyrene	190	J	3.33	210	J	3.33
Naphthalene	440	J	33.3	140	J	33.3
Phenanthrene	120	J	3.33	79	J	3.33
Pyrene	510	J	3.33	490	J	3.33

Table A-1. 100-B-18 Verification Sampling Results. (6 Pages)

Constituents	J156F8 Soil beneath tar removal Sample Date 6/27/07			J156F9 Duplicate of J156F8 Sample Date 6/27/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL
Volatile Organic Analysis (VOA)						
1,1,1-Trichloroethane	5	U	5	5	U	5
1,1,2,2-Tetrachloroethane	5	U	5	5	U	5
1,1,2-Trichloroethane	5	U	5	5	U	5
1,1-Dichloroethane	5	U	5	5	U	5
1,1-Dichloroethene	5	U	5	5	U	5
1,2-Dichloroethane	5	U	5	5	U	5
1,2-Dichloroethene(Total)	5	U	5	5	U	5
1,2-Dichloropropane	5	U	5	5	U	5
2-Butanone	10	U	10	10	U	10
2-Hexanone	10	U	10	10	U	10
4-Methyl-2-Pentanone	10	U	10	10	U	10
Acetone	18	J	10	73	J	10
Benzene	5	U	5	5	U	5
Bromodichloromethane	5	U	5	5	U	5
Bromoform	5	U	5	5	U	5
Bromomethane	10	U	10	10	U	10
Carbon disulfide	5	U	5	5	U	5
Carbon tetrachloride	5	U	5	5	U	5
Chlorobenzene	5	U	5	5	U	5
Chloroethane	10	U	10	10	U	10
Chloroform	5	U	5	5	U	5
Chloromethane	10	U	10	10	U	10
cis-1,2-Dichloroethylene	5	U	5	5	U	5
cis-1,3-Dichloropropene	5	U	5	5	U	5
Dibromochloromethane	5	U	5	5	U	5
Ethylbenzene	5	U	5	5	U	5
Methylenechloride	10	U	5	14	U	5
Styrene	5	U	5	5	U	5
Tetrachloroethene	5	U	5	5	U	5
Toluene	5	U	5	5	U	5
trans-1,2-Dichloroethylene	5	U	5	5	U	5
trans-1,3-Dichloropropene	5	U	5	5	U	5
Trichloroethene	5	U	5	5	U	5
Vinyl chloride	10	U	10	10	U	10
Xylenes (total)	5	U	5	5	U	5

Table A-1. 100-B-18 Verification Sampling Results. (6 Pages)

Constituents	J156J3 Soil underneath light tubes Sample Date 7/16/07			J156J4 Soil underneath light tubes Sample Date 7/16/07			J156J5 Soil underneath light tubes Sample Date 7/16/07			J156J6 Soil underneath light tubes Sample Date 7/16/07			J156J7 Soil underneath light tubes Sample Date 7/16/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls (PCB)															
Aroclor-1016	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Aroclor-1221	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Aroclor-1232	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Aroclor-1242	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Aroclor-1248	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Aroclor-1254	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Aroclor-1260	13	U	13	60		13	13	U	13	4.1		13	13	U	13

Constituents	J156J8 Soil underneath light tubes Sample Date 7/16/07			J15777 Soil underneath light tubes Sample Date 7/16/07			J15778 Soil underneath light tubes Sample Date 7/16/07			J15779 Soil underneath light tubes Sample Date 7/16/07			J15780 Soil underneath light tubes Sample Date 7/16/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls (PCB)															
Aroclor-1016	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Aroclor-1221	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Aroclor-1232	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Aroclor-1242	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Aroclor-1248	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Aroclor-1254	13	U	13	13	U	13	13	U	13	13	U	13	39		13
Aroclor-1260	13	U	13	22		13	75		13	54		13	13	U	13

APPENDIX B

HAZARD QUOTIENT AND CARCINOGENIC RISK CALCULATIONS

APPENDIX B

HAZARD QUOTIENT AND CARCINOGENIC RISK CALCULATIONS

The following calculation is provided in this appendix:

100-B-18 Hazard Quotient and Carcinogenic Risk Calculations, 0100B-CA-V0306, Rev. 0, 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.

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-B/C

Discipline: Environmental *Calculation No: 0100B-CA-V0306

Subject: 100-B-18 Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Calcs. = 3 Total = 4	10/11/07 M. J. Appel M J Appel	10/15/07 S. W. Clark S.W. Clark	N/A	J. M. Capron J M Capron	10/23/07

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:	M. J. Appel	Date:	10/11/07	Calc. No.:	0100B-CA-V0306	Rev.:	0
Project:	100-B/C Field Remediation	Job No:	14655	Checked:	S. W. Clark	Date:	10/15/07
Subject:	100-B-18 Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk values for the 100-B-18 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (DOE-RL 2005), 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 carcinogenic risk of $\leq 1 \times 10^{-6}$ for individual carcinogens
4) A cumulative excess carcinogenic risk of $\leq 1 \times 10^{-5}$ for carcinogens.

GIVEN/REFERENCES:

1) DOE-RL, 2005, *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.

2) WAC 170-303, 2004, "Dangerous Waste Regulations," *Washington Administrative Code.*

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

4) WAC 173-350, 2005, "Solid Waste Handling Standards," *Washington Administrative Code.*

5) WCH, 2007, Waste Site Reclassification Form 2007-020, and Attachment *Remaining Sites Verification Package for the 100-B-18 Powerhouse Debris Pile*, Washington Closure Hanford, Richland, Washington.

SOLUTION:

1) Calculate an HQ for each noncarcinogenic constituent detected above background and compare to the individual HQ of ≤ 1.0 (DOE-RL 2005).

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

3) Calculate an excess carcinogenic risk value for each carcinogenic constituent detected above background and compare to the individual excess carcinogenic risk criterion of $\leq 1 \times 10^{-6}$ (DOE-RL 2005).

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

Washington Closure Hanford CALCULATION SHEET

Originator:	M. J. Appel MJA	Date:	10/11/07	Calc. No.:	0100B-CA-V0306	Rev.:	0
Project:	100-B/C Field Remediation	Job No:	14655	Checked:	S. W. Clark SWC	Date:	10/15/07
Subject:	100-B-18 Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	2 of 3

METHODOLOGY:

Hazard quotient and carcinogenic risk calculations for the 100-B-18 waste site were performed using the results of sampling at this site, as summarized in Table 2 of WCH (2007). Of the contaminants of potential concern for this site, antimony, barium, cadmium, lead, mercury, and zinc are included because they were detected at concentrations above their respective Washington State or Hanford Site background value. Boron and molybdenum 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-1260 and acetone are included because they were detected above their required detection limit/practical quantitation limit and cannot be attributed to natural occurrence. Polycyclic aromatic hydrocarbons (PAHs) detected at the site are not included in the calculations because they are the result of asphalt cross-contamination in the sample matrix. The 100-B-18 site contains high amounts of asphalt roofing and residual fragments of asphalt material in the soils where the remediation occurred. Asphalt that has been used for structural and construction purposes is excluded from consideration as a dangerous waste in *Washington Administrative Code* (WAC) 173-303-071(3)(e), is listed as an inert waste in WAC 173-350-990(2)(b), and its constituents are, therefore, not considered in attainment of soil RAGs. All other nonradionuclide contaminants of potential concern for this site were either not detected or were quantified below background levels and are not included. An example of the HQ and carcinogenic risk calculations in Table 1 is presented below:

1) For example, the maximum detected value for barium is 1,300 mg/kg, divided by the noncarcinogenic RAG value of 5,600 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 2.3×10^{-1}. Comparing this value, and all other individual values, to the requirement of ≤ 1.0, this criterion is met.

2) After the HQ calculations are completed for the appropriate analytes, the cumulative HQ is obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The sum of the HQ values is 8.6×10^{-1}. Comparing this value to the requirement of ≤ 1.0, this criterion is met.

3) To calculate the excess carcinogenic risk, the maximum detected value for each carcinogenic analyte is divided by the carcinogenic RAG value, then multiplied by 1×10^{-6}. For example, the maximum detected value for aroclor-1260 is 0.095 mg/kg, divided by 0.50 mg/kg, and multiplied as indicated is 1.9×10^{-7}. Comparing this value, and all other individual values, to the requirement of $\leq 1 \times 10^{-6}$, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess carcinogenic risk is obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual values prior to rounding are used for this calculation.) The sum of the excess carcinogenic risk values is 1.1×10^{-6}. Comparing this value to the requirement of $\leq 1 \times 10^{-5}$, this criterion is met.

Washington Closure Hanford CALCULATION SHEET

Originator:	M. J. Appel	Date:	10/11/07	Calc. No.:	0100B-CA-V0306	Rev.:	0
Project:	100-B/C Field Remediation	Job No:	14655	Checked:	S. W. Clark	Date:	10/15/07
Subject:	100-B-18 Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	3 of 3

RESULTS:

Table 1 shows the results of the HQ and excess carcinogenic risk calculations for this site.

CONCLUSION:

These calculations demonstrate that the 100-B-18 waste site meets the requirements for hazard quotient and excess carcinogenic risk as identified in the remedial design report/remedial action work plan (DOE-RL 2005).

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-B-18 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					
Antimony	9.3	32	2.9E-01	--	--
Barium	1300	5,600	2.3E-01	--	--
Boron	34.2	16,000	2.1E-03	--	--
Cadmium	13.2	80	1.7E-01	13.9	9.5E-07
Lead[c]	25.3	353	7.2E-02	--	--
Mercury	2.2	24	9.2E-02	--	--
Molybdenum	0.96	400	2.4E-03	--	--
Zinc	77.6	24,000	3.2E-03	--	--
Polychlorinated Biphenyls					
Aroclor-1260	0.095	--	--	0.5	1.9E-07
Volatiles					
Acetone	0.018	72,000	2.5E-07	--	--
Totals					
Cumulative Hazard Quotient:			**8.6E-01**		
Cumulative Excess Cancer Risk:					**1.1E-06**

[a] = From WCH (2007).
[b] = Value obtained from *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.
[c] = Value for the noncarcinogen RAG obtained from EPA (1994).
-- = not applicable
COPC = contaminant of potential concern
RAG = remedial action goal