WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-HR-1 **Control No.:** 2014-111

Waste Site Code(s)/Subsite Code(s): 100-H-49:1

Reclassification Category: Interim ☒ Final ☐

Reclassification Status: Closed Out ☒ No Action ☐ Rejected ☐
RCRA Postclosure ☐ Consolidated ☐ None ☐

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 100-H-49:1, 184-H Boiler House and 1717-H Hot Shop French Drains subsite is part of the 100-H-49 Potentially Contaminated French Drains waste site, which was added to 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* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 1999), as a candidate site for confirmatory sampling via the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2009). Confirmatory sampling determined that several contaminants failed direct exposure and groundwater and/or river protection remedial action goals (RAGs); therefore, the 100-H-49:1 subsite was recommended for remediation.

Remedial action at the 100-H-49:1 subsite was conducted from May 7 through May 20, 2014. French drains FD4, FD5, and FD16 were excavated to approximately 2.7 m (9 ft) below ground surface, and the 100-H-28:7 french drain TP3 was excavated to approximately 1.8 m (6 ft) below ground surface. The waste from the site included soil, rock, and debris consisting of concrete and various types of pipe.

Approximately 170 bank cubic meters (222 bank cubic yards) of contaminated soil and debris were removed and staged at the staging pile area pending loadout and disposal. Loadout of the staging pile area material was conducted in July 2014, and is addressed in the 100-H-43 closure document. All material removed from the 100-H-49:1 subsite was disposed at the Environmental Restoration Disposal Facility; therefore, no overburden was retained for backfill.

Verification samples from the 100-H-49:1 subsite were collected on August 25, 2014. The sampling was performed to determine if the site met the remedial action objectives and RAGs established by the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP), DOE/RL-97-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2009b), and the Remaining Sites ROD (EPA 1999). The selected remedy involved (1) excavating the site to the extent required to meet specified soil cleanup levels, (2) disposing of contaminated excavation materials at the Environmental Restoration Disposal Facility, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification to Interim Closed Out.

Basis for reclassification:

The verification sampling and modeling results for the 100-H-49:1 subsite demonstrate that the site meets the remedial action objectives and corresponding RAGs established in the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999) to support a reclassification to Interim Closed Out. These sampling and modeling results established 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. Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-H-49:1, 184-H Boiler House and 1717-H Hot Shop French Drains Subsite* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-HR-1 **Control No.:** 2014-111

Waste Site Code(s)/Subsite Code(s): 100-H-49:1

Regulator comments:

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:

J. P. Neath		3/16/15
DOE Federal Project Director (printed)	Signature	Date
N. Menard		3/18/15
Ecology Project Manager (printed)	Signature	Date
NA		
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-49:1, 184-H BOILER HOUSE AND 1717-H HOT SHOP FRENCH DRAINS SUBSITE

Attachment to Waste Site Reclassification Form 2014-111

April 2015

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-49:1, 184-H BOILER HOUSE AND 1717-H HOT SHOP FRENCH DRAINS SUBSITE

EXECUTIVE SUMMARY

The 100-H-49:1, 184-H Boiler House and 1717-H Hot Shop French Drains subsite is part of the 100-H-49 Potentially Contaminated French Drains waste site, located within the 100-HR-1 Operable Unit. The 100-H-49:1 subsite consisted of four french drains, their associated below grade piping components, and the underlying soil. Confirmatory sampling determined that several contaminants failed direct exposure and groundwater and/or river protection remedial action goals; therefore, the 100-H-49:1 subsite was recommended for remediation (WCH 2011).

Remedial action at the 100-H-49:1 subsite began on May 7, 2014, and was completed May 20, 2014. The waste from the site included soil, rock, and debris consisting of concrete and various types of pipe. The french drain FD4, FD5, and FD16 excavations extended to a maximum depth of approximately 2.7 m (9 ft) below ground surface (bgs), and the 100-H-28:7 french drain TP3 excavation extended to approximately 1.8 m (6 ft) bgs.

Approximately 170 bank cubic meters (222 bank cubic yards) of contaminated soil and debris were removed and staged at the staging pile area (SPA) pending loadout and disposal. Waste loadout of the SPA with disposal at the Environmental Restoration Disposal Facility was conducted in July 2014. The SPA will be addressed in the 100-H-43 closure document. All material removed from the 100-H-49:1 subsite was disposed at the Environmental Restoration Disposal Facility; therefore, no overburden was retained for backfill.

Following remediation, verification soil sampling was conducted on August 25, 2014. The verification sampling results indicate that the waste removal action achieved compliance with the remedial action objectives and RAGs established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) 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).

A summary of the cleanup evaluation for the results from verification sampling compared to applicable criteria is presented in Table ES-1. The results of verification sampling are used to make reclassification decisions for the 100-H-49:1 subsite in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011).

Table ES-1. Summary of Remedial Action Goals for the 100-H-49:1 Subsite.

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain dose rate of <15 mrem/yr above background for 1,000 years.	Radionuclides were not COPCs for the 100-H-49:1 subsite.	NA
Direct Exposure – Nonradionuclides	Attain individual COPC direct exposure RAGs.	All individual COPC concentrations are below the direct exposure RAGs.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	The hazard quotients for individual nonradionuclide COPCs are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient for the 100-H-49:1 subsite (9.4×10^{-3}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk for individual carcinogens are $<1 \times 10^{-6}$.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The cumulative excess cancer risk for the 100-H-49:1 subsite is 1.3×10^{-6}, which is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single-COPC groundwater and river protection RAGs.	Radionuclides were not COPCs for the 100-H-49:1 subsite.	NA
	Attain national primary drinking water standards [a]: 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.		
	Meet drinking water standards for alpha emitters: the most stringent of 15 pCi/L MCL or 1/25th of the derived concentration guides from DOE Order 5400.5 [b].		
	Meet total uranium standard of 30 µg/L (21.2 pCi/L) [c].		
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	Copper, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, aroclor-1260, and 4-4'-DDE exceeded soil RAGs for groundwater and/or river protection. However, based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), it is predicted that the residual concentrations of these contaminants will not reach groundwater (and thus 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 the Environment* (DOE Order 5400.5).

[c] Based on the isotopic distribution of uranium in the 100 Area, 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 RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of copper, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, aroclor-1260, and 4-4'-DDE are not predicted to migrate more than 2.6 m (8.5 ft) vertically within 1,000 years (based on the lowest soil-partitioning coefficients [K_d] of the contaminants [copper with a K_d of 22 mL/g). The vadose zone underlying the 100-H-49:1 subsite is approximately 11 m (36 ft) thick. Therefore, residual concentrations of copper, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, aroclor-1260, and 4-4'-DDE are predicted to be protective of groundwater and the Columbia River.

COPC = contaminant of potential concern
DDE = dichlorodiphenyldichloroethylene
DOE = U.S. Department of Energy
MCL = maximum contaminant level
NA = not applicable
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)

In accordance with this evaluation, the verification sampling results support a reclassification of this subsite to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding RAGs of the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999). The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (surface to 4.6 m [15 ft] bgs), and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based in part 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-H-49:1 subsite contaminants of potential concern and other constituents (Appendix A). The higher of the maximum values were considered for comparison. Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for arsenic, boron, and vanadium. The U.S. Environmental Protection Agency's ecological soil screening levels were exceeded for antimony, lead, manganese, vanadium, zinc, and the total of the high molecular weight polycyclic aromatic hydrocarbons (PAH). Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of antimony, manganese, vanadium, and zinc are below Hanford Site or Washington State background values (note that state background values are only used when Hanford Site background values are not available), it is believed that the presence of these constituents does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for this site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-49:1, 184-H BOILER HOUSE AND 1717-H HOT SHOP FRENCH DRAINS SUBSITE

STATEMENT OF PROTECTIVENESS

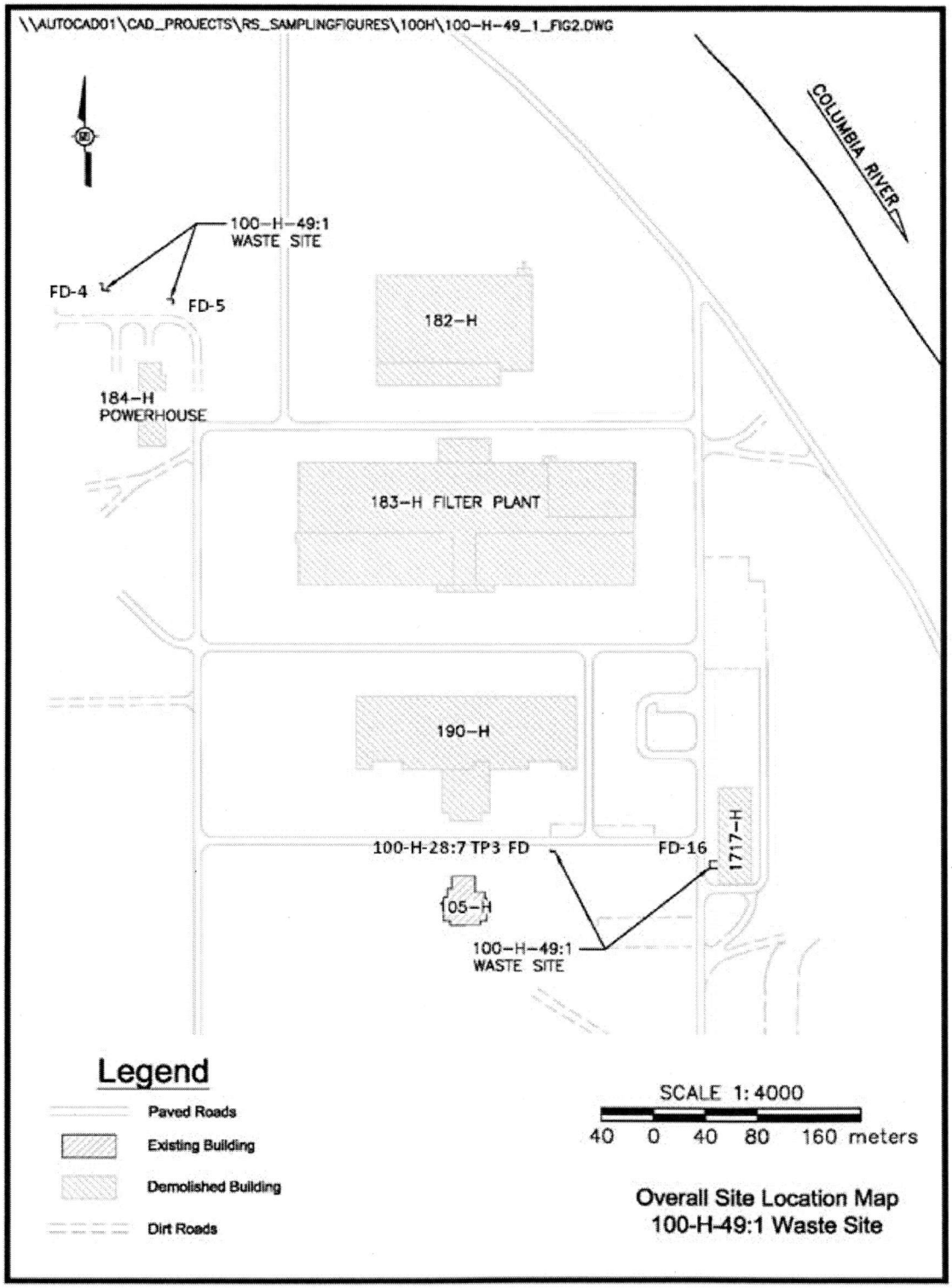
The 100-H-49:1 subsite verification sampling data, site evaluations, and supporting documentation demonstrate that this site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of 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. Contamination above direct exposure levels was not observed in shallow zone soils and is concluded to not exist in deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone soil are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based in part 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-H-49:1 subsite contaminants of potential concern (COPCs) and other constituents (Appendix A). The higher of the maximum values were considered for comparison. Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for arsenic, boron, and vanadium. The U.S. Environmental Protection Agency's (EPA) ecological soil screening levels were exceeded for antimony, lead, manganese, vanadium, zinc, and the total of the high molecular weight polycyclic aromatic hydrocarbons (PAH). Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because concentrations of antimony, manganese, vanadium, and zinc are below Hanford Site or Washington State background values (note that state background values are only used when Hanford Site background values are not available), it is believed that the presence of these constituents does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for risk to ecological receptors as part of the final closeout decision for this site.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-H-49:1, 184-H Boiler House and 1717-H Hot Shop French Drains subsite was located in the 100-HR-1 Operable Unit and consisted of four french drains, the underlying soil, and their associated below grade piping components. The overall site location map is provided in Figure 1. The descriptions for each french drain are as follows.

Figure 1. 100-H-49:1 Overall Site Location Map.



French drain (FD) 4 consisted of a 0.9-m (36-in.)-diameter french drain with an 11-m (36-ft) long, 0.1-m (4-in.)-diameter steam condensate drain line from the 184-H Boiler House Reclaiming Hopper. The french drain was located at N 153006.45, E 577504.29.

The FD5 consisted of a 0.6-m (24-in.)-diameter french drain with a 7.2-m (24-ft) long, 0.1-m (4-in.)-diameter vitrified clay pipe steam condensate drain line from the 184-H Boiler House Transfer House to the french drain. The french drain was located at N 152996.60, E 577553.28.

The FD16 consisted of a 0.9-m (36-in.)-diameter french drain with a 5.2-m (17-ft) long pipeline and an 11-m (36-ft) long pipeline. Each pipeline was a 0.08-m (3-in.)-diameter heating/steam return line from the west side of the 1717-H Hot Shop to the french drain. The french drain was located at N 152553.58, E 577970.71

French drain 100-H-28:7 test pit (TP) 3 was discovered along the edge of a test pit that was excavated in support of the 100-H-28:7 confirmatory sampling. The french drain consisted of a 0.9-m (36-in.)-diameter vitrified clay french drain and was located at N 152567, E 577848.

CONFIRMATORY SAMPLING ACTIVITIES

Confirmatory sampling was performed at the 100-H-28:7 TP3 location on March 23, 2009, per the *Work Instruction for Confirmatory Sampling of the 100-H-28:7, 183-H Process Water Lines* (WCH 2007) as described in the field logbook (WCH 2009). Confirmatory sampling was performed at the 100-H-49:1 subsite on October 4 and 11, 2010, per the *Work Instruction for Confirmatory Sampling of the 100-H-49, Potentially Contaminated French Drains* (WCH 2010b) as described in the field logbook (WCH 2010a).

A summary of the confirmatory samples collected is provided in Table 1.

Table 1. 100-H-49:1 Confirmatory Sampling Summary. (2 Pages)

Sample Location	HEIS Sample Number	Sample Description	WSP Coordinates		Depth (bgs)	Sample Analysis
			Northing (m)	Easting (m)		
100-H-28:7 TP3 French drain	J18LX2	Gray fibrous material attached to tar paper under lid of french drain	152567	577848	Under french drain lid	Asbestos
	J18KV4	French drain contents	152567	577848	0.6 m	ICP metals [a], mercury, PCBs, PAH, TPH, pesticides, GEA, gross alpha, gross beta
	J18KW6	French drain contents	152567	577848	0.6 m	Hexavalent chromium
	J18KV1	Soil below french drain	152567	577848	3.0 m	ICP metals [a], mercury, hexavalent chromium, PCBs, PAH, TPH, pesticides, GEA, gross alpha, gross beta

Table 1. 100-H-49:1 Confirmatory Sampling Summary. (2 Pages)

Sample Location	HEIS Sample Number	Sample Description	WSP Coordinates		Depth (bgs)	Sample Analysis
			Northing (m)	Easting (m)		
FD4	J1C2X6	Influent pipe contents	153006.5	577504.3	2.4 m	ICP metals [a], mercury, hexavalent chromium PCBs, PAH, TPH, pesticides
	J1C2R4	Soil underlying the pipeline	153006.5	577504.3	2.4 m	
FD5	J1C2X5	Influent pipe contents	152996.6	577553.3	1.5 m	ICP metals [a], mercury, PCBs, PAH, TPH, pesticides,
	J1C3M7	Influent pipe contents	152996.6	577553.3	1.5 m	Hexavalent chromium
	J1C2R1	Soil underlying the pipeline	152996.6	577553.3	1.5 m	ICP metals [a], mercury, hexavalent chromium, PCBs, PAH, TPH, pesticides
FD16	J1C2T2	French drain contents	152553.6	577970.7	1.0 m	ICP metals [a], mercury, hexavalent chromium, PCBs, PAH, TPH, pesticides
	J1C2T3	Duplicate of J1C2T2	152553.6	577970.7	1.0 m	
Equipment blank	J1C2T1	Silica sand	NA	NA	NA	ICP metals [a], mercury, PAH

[a] Sample analysis for ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc

bgs = below ground surface
FD = french drain
GEA = gamma energy analysis
HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
TP = test pit
TPH = total petroleum hydrocarbons
WSP = Washington State Plane

Contaminants of Potential Concern for Confirmatory Sampling at 100-H-49

The list of COPCs for the 100-H-49 waste site confirmatory sampling was developed using process knowledge, historical information, and construction drawings for each french drain and the facility the drain was identified as servicing (WCH 2010b). The COPCs identified for french drains FD4, FD5, and FD16 included inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, PAH, polychlorinated biphenyls (PCBs), pesticides, and total petroleum hydrocarbons (TPH). The COPCs identified for the 100-H-28:7 TP3 french drain included ICP metals, mercury, hexavalent chromium, PAH, PCBs, pesticides, TPH, cobalt-60, cesium-137, europium-152, europium-154, strontium-90, and asbestos.

Confirmatory Sample Results

An evaluation of the confirmatory sample results shows that the FD4 pipeline contents failed the direct exposure remedial action goal (RAG) for motor oil; the FD5 pipeline contents failed the direct exposure RAGs for arsenic, lead, diesel oil, and motor oil; the FD16 pipeline contents failed the direct exposure RAG for arsenic; and the 100-H-28:7 TP3 french drain failed the direct exposure RAGs for diesel oil and benzo(a)pyrene. Additionally, antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, zinc, benzo(a)anthracene,

benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h,)anthracene, indeno(1,2,3-cd)pyrene, beta-BHC, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endosulfan I, endrin, gamma-chlordane, aroclor-1254, and aroclor-1260 failed groundwater and/or river protection RAGs at one or more of the sample locations. Therefore, the 100-H-49 waste site was divided into subsites. The FD4, FD5, FD16, and 100-H-28:7 TP3 french drain were included in the 100-H-49:1 subsite, and the 100-H-49:1 subsite was subsequently recommended for remediation (WCH 2011). The confirmatory sample results are provided in Appendix B.

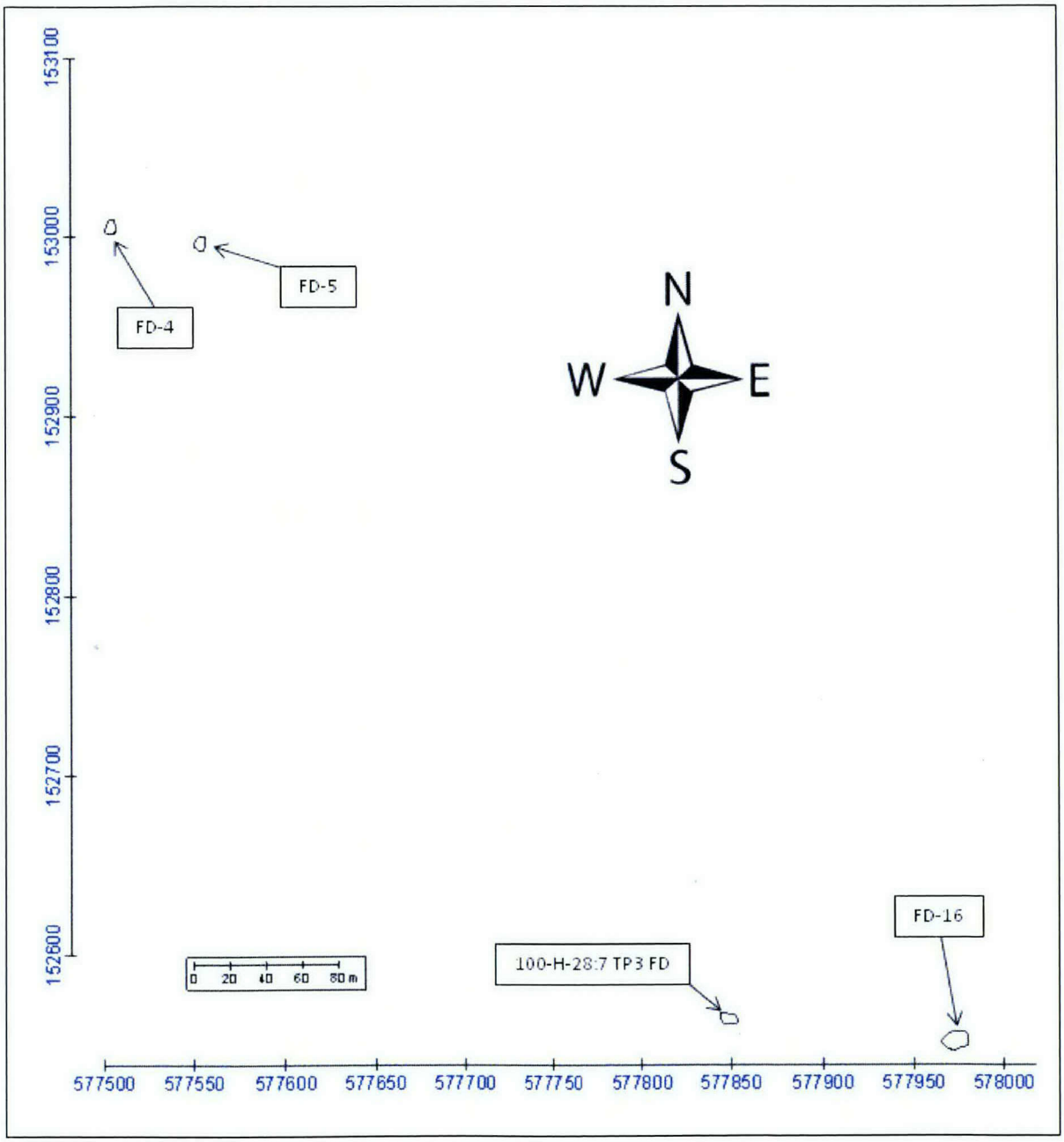
REMEDIAL ACTION SUMMARY

Remedial action at the 100-H-49:1 subsite was conducted from May 7 through May 20, 2014. French drains FD4, FD5, and FD16 were excavated to approximately 2.7 m (9 ft) below ground surface (bgs). Because of its proximity to an adjacent utility pole, 100-H-28:7 TP3 was excavated to approximately 1.8 m (6 ft) bgs (Figure 2). A total of approximately 170 bank cubic meters (222 bank cubic yards) of soil and debris were removed from the excavations. The debris consisted of rock, concrete, and various types of pipe. Coal ash is present on the ground surface near french drains FD4 and FD5. All four french drains are located in close proximity to asphalt roadways. Asphalt is visible in the photograph provided in Figure 2. No anomalies were found during remediation of the subsite. No in-process soil samples were collected.

Figure 2. Photograph of the Remediated 100-H-49:1, 100-H-28:7 TP3 French Drain, Looking Northeast, May 20, 2014.

Waste material from the 100-H-49:1 subsite was staged in a staging pile area (SPA) prior to loadout. Waste loadout of the SPA with disposal at the Environmental Restoration Disposal Facility was conducted in July 2014. The verification sampling design for the SPA was addressed in the 100-H-43 verification work instruction and the verification samples were collected in August 2014. The result results are reported in the 100-H-43 closure document. No overburden material was stockpiled for use as clean backfill. No anomalies were discovered during remediation. The post-remediation walk around boundary surveys of the 100-H-49:1 excavations are provided in Figure 3.

Figure 3. 100-H-49:1 Post-Excavation Boundaries.



VERIFICATION SAMPLING ACTIVITIES

Verification soil sampling was conducted on August 25, 2014, per the *Work Instruction for Verification Sampling of the 100-H-49:1, 184-H Boiler House and 1717-H Hot Shop French Drains Waste Site* (WCH 2014b). Sampling was conducted to support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified in the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999).

The verification sample results are provided in Appendix C and indicate that the waste removal action achieved compliance with the remedial action objectives and RAGs for the 100-H-49:1 subsite. The following subsections provide additional discussion of the information used to develop the verification sampling design. The results of verification sampling are also summarized to support interim closure of the site.

Contaminants of Potential Concern for Verification Sampling

The COPCs for verification sampling at the 100-H-49:1 subsite were determined based on the confirmatory sampling results (Appendix B). Total petroleum hydrocarbons (diesel and motor oil range), arsenic, lead, and benzo(a)pyrene were detected above the direct exposure RAG; and antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, beta-BHC, 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, dieldrin, endosulfan I, endrin, gamma-chlordane, aroclor-1254, and aroclor-1260 were detected above the groundwater and/or river protection RAG in the confirmatory samples; therefore, they were retained as site COPCs. While not considered site COPCs, analysis for the expanded list of ICP metals (which also includes beryllium, boron, cobalt, manganese, selenium, silver, and vanadium) was also requested.

Radionuclides were identified as site COPCs for confirmatory sampling at the 100-H-28:7 pipelines subsite. However, cesium-137 was the only radionuclide detected (0.434 pCi/g), which is below the background value of 1.1 pCi/g. Therefore, radionuclides were excluded as COPCs for the 100-H-28:7 TP3 french drain location. Asbestos was added as a COPC for confirmatory sampling at the 100-H-28:7 TP3 location because fibrous material was identified on the inside of the french drain lid. However, asbestos was not detected in the confirmatory sampling results; therefore, it was excluded as a COPC for the 100-H-28:7 TP3 french drain. Hexavalent chromium was undetected in the confirmatory samples; therefore, it was excluded as a COPC for the 100-H-49:1 subsite.

The analytical methods that were performed to evaluate the site COPCs are provided in Table 2.

Table 2. 100-H-49:1 Subsite Analytical Methods. (2 Pages)

Analytical Method	Contaminant of Potential Concern
ICP metals [a] – EPA Method 6010	Antimony, arsenic, barium, cadmium, chromium, copper, lead, molybdenum, nickel, zinc
Mercury – EPA Method 7471	Mercury

Table 2. 100-H-49:1 Subsite Analytical Methods. (2 Pages)

Analytical Method	Contaminant of Potential Concern
Pesticides – EPA Method 8081	Beta-BHC, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endosulfan I, Endrin, gamma-chlordane
TPH – EPA Method NWTPH-Dx	Total petroleum hydrocarbons (diesel and motor oil range)
PAH – EPA Method 8310	Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene
PCB – EPA Method 8082	Aroclor-1254, aroclor-1260

[a] The expanded list of ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc in the final data package.

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
NWTPH = Northwest total petroleum hydrocarbons
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbons

Verification Sampling Design

A focused sample design was used to evaluate the 100-H-49:1 subsite excavations. One discrete grab soil sample was collected from each of the excavated areas at the location where confirmatory samples were collected and failed direct exposure RAGs for one or more contaminants. Because the confirmatory sampling location for the 100-H-28:7 TP3 is positioned near the edge of the excavation boundary, an additional focused sample was collected from the approximate center of the excavation to provide sufficient sample coverage of the french drain components. The remediated area of 100-H-28:7 TP3 is 49.6 m^2 (533.9 ft^2). An additional focused sample was collected from the approximate center of the FD16 excavation to provide sufficient sample coverage. The remediated area of FD16 is 122.1 m^2 (1,314.3 ft^2). The remediated areas of FD4 and FD5 are 38.5 m^2 and 40.8 m^2 (414.4 ft^2 and 439.2 ft^2), respectively. One duplicate soil sample was also collected from the FD4 location. Additionally, one equipment blank sample was collected.

All sampling was performed in accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2009a). Additional information related to verification sampling can be found in the field sampling logbook (WCH 2014a). The verification sample locations are shown in Figures 4, 5, and 6, and the sample summary is provided in Table 3.

Verification Sampling Results

All verification samples were collected for full protocol laboratory analysis and analyzed using EPA-approved analytical methods. Evaluation of the verification data from the 100-H-49:1 subsite was performed by direct comparison of the maximum sample results for each COPC against the cleanup criteria.

Figure 4. 100-H-49:1, FD4, and FD5 Verification Sample Locations.

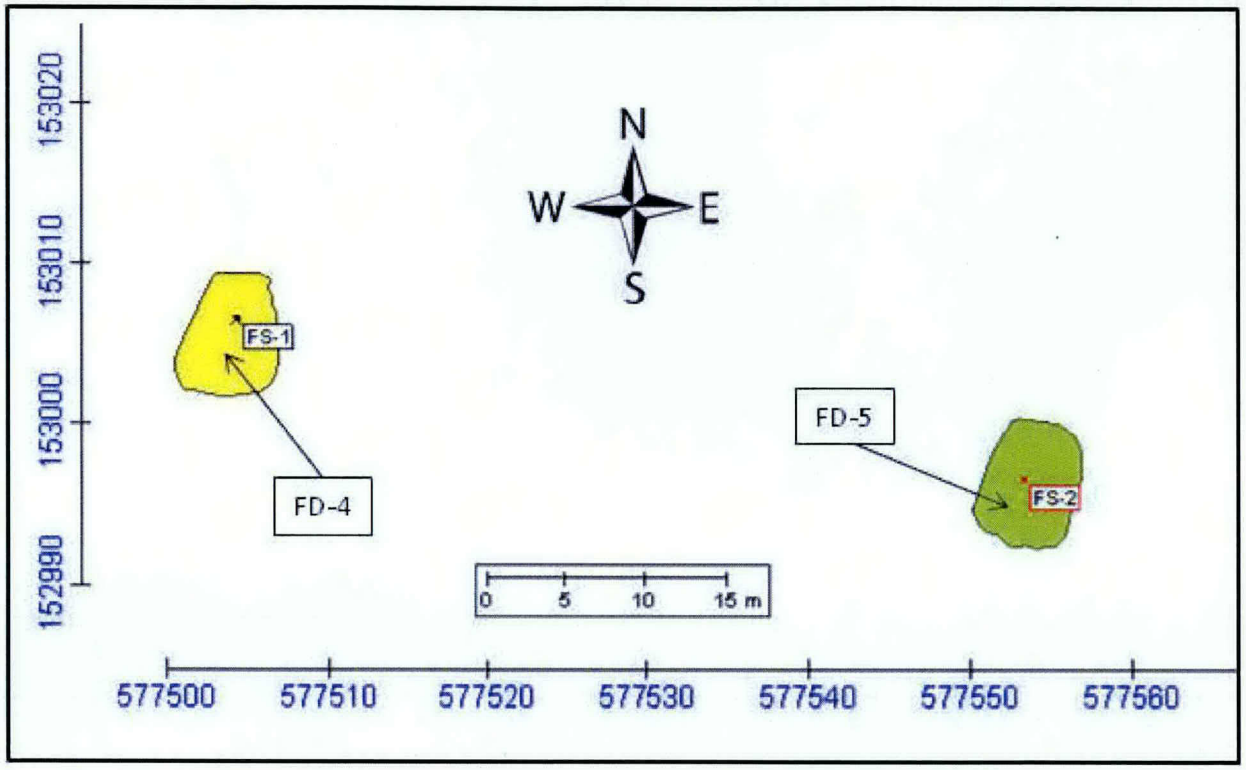


Figure 5. 100-H-28:7 TP3 Verification Sample Locations.

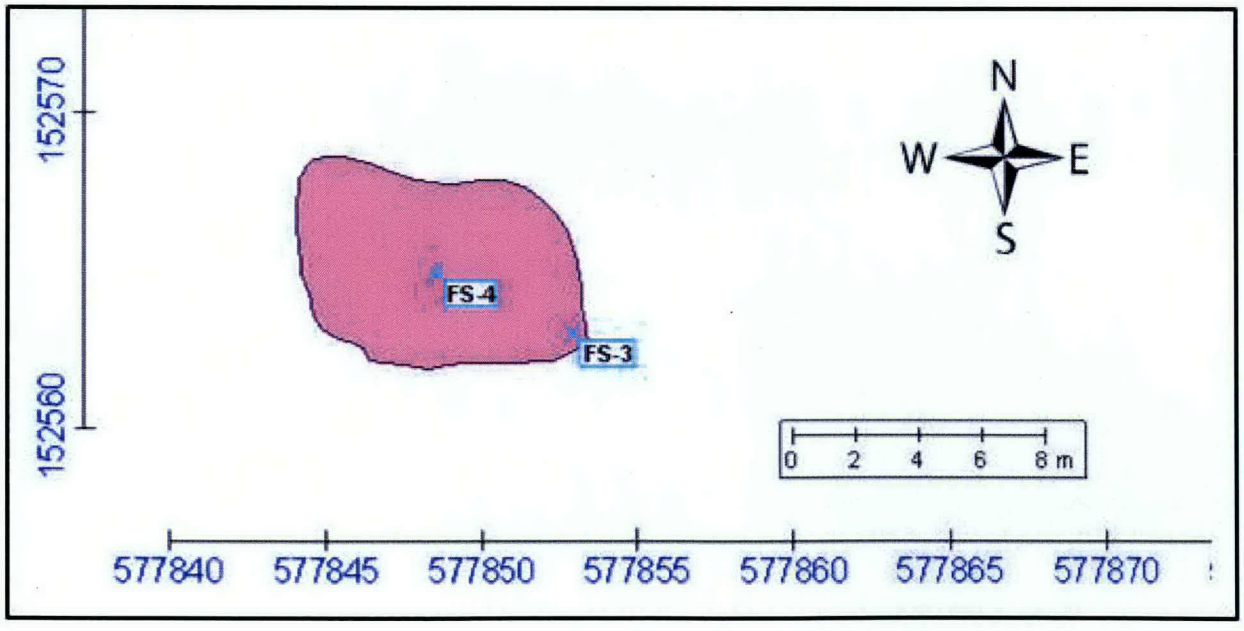


Figure 6. FD-16 Verification Sample Locations.

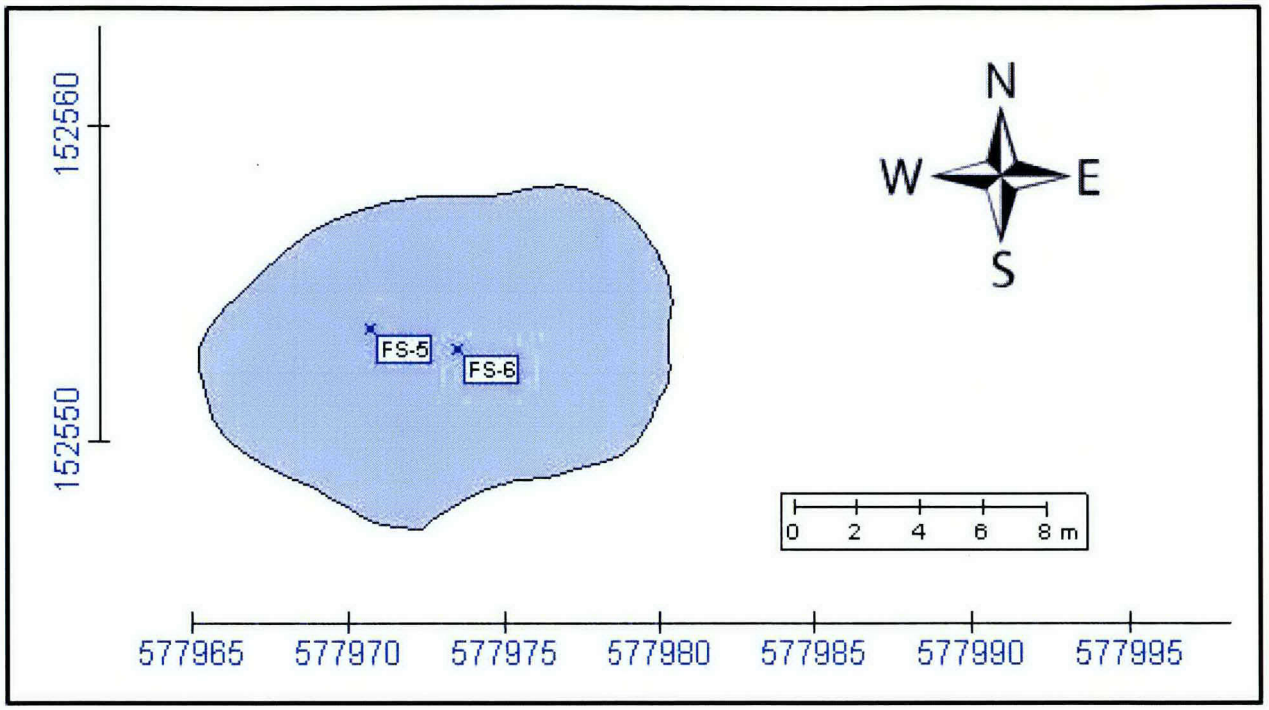


Table 3. 100-H-49:1 Subsite Verification Sample Summary.

Sample Location	Location Description	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
			Northing	Easting	
FS-1 (m)	FD4	J1TXL1	153006.5	577504.3	ICP metals [a], mercury, PAH, PCB, pesticides, TPH
FS-2	FD5	J1TXL2	152996.6	577553.3	
FS-3	TP3	J1TXL3	152563.0	577853.0	
FS-4	TP3	J1TXL4	152564.9	577848.6	
FS-5	FD16	J1TXL5	152553.6	577970.7	
FS-6	FD16	J1TXL6	152552.9	577973.5	
Dup of FS-1	FD4	J1TXL7	153006.5	577504.3	
Equipment blank	NA	J1TXL8	NA	NA	ICP metals [a], mercury, PAH

[a] The expanded list of ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

FD = french drain
FS = focused sample
HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
TP = test pit
TPH = total petroleum hydrocarbons

Comparisons of the results for site COPCs from the 100-H-49:1 subsite against the RAGs are summarized in Table 4. Contaminants that were not detected by laboratory analysis are excluded from these tables. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2014) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COPCs and are also not included in the table.

Table 4. Comparison of Contaminant Concentrations to Remedial Action Goals for the 100-H-49:1 Excavation Focused Verification Samples. (2 Pages)

COPC	Maximum Result [b] (mg/kg)	Remedial Action Goals [a]			Do the Results Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony [c]	0.40 (<BG)	32	5 [d]	5 [d]	No	--
Arsenic	7.8	20 [d]	20 [d]	20 [d]	No	--
Barium	88.7 (<BG)	5,600	200	400	No	--
Boron [e]	4.1	7,200	320	-- [f]	No	--
Cadmium [c]	0.11 (<BG)	13.9 [g]	0.81 [d]	0.81 [d]	No	--
Chromium (total)	14.9 (<BG)	80,000	18.5 [d]	18.5 [d]	No	--
Cobalt	6.8 (<BG)	24	15.7 [d]	-- [f]	No	--
Copper	23.1	2,960	59.2	22.0 [d]	Yes	Yes [h]
Lead	27.5	353	10.2 [d]	10.2 [d]	Yes	Yes [h]
Manganese	280 (<BG)	3,760	512 [d]	512 [d]	No	--
Mercury	0.063 (<BG)	24	0.33 [d]	0.33 [d]	No	--
Molybdenum [e]	0.25	400	8	-- [f]	No	--
Nickel	12.2 (<BG)	1,600	19.1 [d]	27.4	No	--
Vanadium	46.1 (<BG)	560	85.1 [d]	-- [f]	No	--
Zinc	55.2 (<BG)	24,000	480	67.8 [d]	No	--
TPH – diesel range, ext.	170	200	200	200	No	--
TPH – diesel range	89	200	200	200	No	--
TPH – gasoline range	1.6	200	200	200	No	--
Acenaphthene	0.082	4,800	96	129	No	--
Benzo(a)anthracene	0.160	1.37	0.015 [i]	0.015 [i]	Yes	Yes [h]
Benzo(a)pyrene	0.120	0.137	0.015 [i]	0.015 [i]	Yes	Yes [h]
Benzo(b)fluoranthene	0.130	1.37	0.015 [i]	0.015 [i]	Yes	Yes [h]
Benzo(ghi)perylene [j]	0.140	2,400	48	192	No	--
Benzo(k)fluoranthene	0.068	1.37	0.015 [i]	0.015 [i]	Yes	Yes [h]
Chrysene	0.150	13.7	0.12	0.1 [i]	Yes	Yes [h]
Fluoranthene	0.310	3,200	64	18.0	No	--
Fluorene	0.021	3,200	64	260	No	--
Indeno(1,2,3-cd)pyrene	0.067	1.37	0.33 [i]	0.33 [i]	No	--
Naphthalene	0.013	1,600	16.0	988	No	--
Phenanthrene [j]	0.450	24,000	240	1,920	No	--
Pyrene	0.280	2,400	48	192	No	--

Table 4. Comparison of Contaminant Concentrations to Remedial Action Goals for the 100-H-49:1 Excavation Focused Verification Samples. (2 Pages)

COPC	Maximum Result [b] (mg/kg)	Remedial Action Goals [a]			Do the Results Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Aroclor-1260	0.035	0.5	0.017 [i]	0.017 [i]	Yes	Yes [h]
4-4'-DDE	0.0040	2.94	0.0257	0.0033 [i]	Yes	Yes [h]
4-4'-DDT	0.0023	2.94	0.0257	0.0033 [i]	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] Maximum value as described in the *100-H-49:1 Subsite Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations* (Appendix C).
[c] Hanford Site-specific background value is not available. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[d] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (WAC 1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the 100 Area RDR/RAWP (DOE-RL 2009b).
[e] No Hanford Site-specific or Washington State background value available.
[f] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2014) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii] [1996], [Method B for surface waters]).
[g] Carcinogenic cleanup level calculated based on the inhalation exposure pathway per WAC 173-340-750(3) (1996), (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[h] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of copper, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene, chrysene, aroclor-1260, and 4-4'-DDE are not expected to migrate more than 2.6 m (8.5 ft) vertically in 1,000 years (based on the lowest soil-partitioning coefficient [Kd] of the contaminants [copper with a Kd of 22 mL/g]). The vadose zone underlying the 100-H-49:1 subsite is approximately 11 m (36 ft) thick. Therefore, residual concentrations of copper, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene, chrysene, aroclor-1260, and 4-4'-DDE are predicted to be protective of groundwater and the Columbia River.
[i] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (WAC 1996).
[j] Toxicity data for this chemical are not available. Cleanup levels are based on surrogate chemicals. Contaminant – phenanthrene, surrogate is anthracene; benzo(ghi)perylene, surrogate is pyrene.

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
K_d = soil-partitioning coefficient
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

The complete laboratory results for all constituents are stored in a Washington Closure Hanford (WCH) project-specific database prior to archival in the Hanford Environmental Information System (HEIS) and are presented in Attachment 1 of the *100-H-49:1 Subsite Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations* (Appendix C).

DATA EVALUATION

This section demonstrates that contaminant concentrations at the 100-H-49:1 subsite achieves the applicable RAGs developed to support unrestricted land use at the 100 Area as established in the Remaining Sites ROD (EPA 1999) and documented in the 100 Area RDR/RAWP (DOE-RL 2009b).

Attainment of Nonradionuclide RAGs

Table 4 compares the cleanup verification sample values for the 100-H-49:1 subsite to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River. All COPCs were quantified below direct exposure RAGs. All COPCs were quantified below groundwater and/or river protection soil RAGs with the exception of copper, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, aroclor-1260, and 4-4'- dichlorodiphenyldichloroethylene (DDE). However, based on the lowest soil-partitioning coefficient (K_d) of these contaminants (copper with a K_d of 22), none would be expected to migrate more than 2.6 m (8.5 ft) vertically in 1,000 years based on RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). The vadose zone beneath the 100-H-49:1 subsite is approximately 11 m (36 ft) thick. Therefore, residual concentrations of copper, lead, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, aroclor-1260, and 4-4'-DDE are predicted to be protective of groundwater and the Columbia River.

Three-Part Test for Nonradionuclides

When using a statistical sampling approach, a RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test. Because there were no statistical verification samples for the 100-H-49:1 subsite, this test is not applicable.

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Nonradionuclide risk requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative carcinogenic risk of less than 1×10^{-5}. For the 100-H-49:1 subsite, these risk values were not calculated for constituents that were either not detected or were detected at concentrations below Hanford Site or Washington State background. All individual hazard quotients for noncarcinogenic constituents were less than 1.0. The cumulative hazard quotient for those noncarcinogenic constituents above background or detected levels is 9.4×10^{-3}, which is less than 1.0. The individual carcinogenic risk values for the carcinogenic constituents detected above background are less than 1×10^{-6}, and the cumulative carcinogenic risk value is 1.3×10^{-6}, which is less than 1×10^{-5}. The 100-H-49:1 subsite meets the requirements for the direct contact hazard quotient and excess carcinogenic risk as identified in the 100 Area RDR/RAWP (DOE-RL 2009b).

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 100-H-49:1 subsite included a calculation of the hazard quotient and carcinogenic (excess cancer) risk values for groundwater protection for nonradionuclides. The requirements include an individual and cumulative hazard quotient of less than 1.0, an individual excess carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. Risk values were calculated for constituents that were detected at concentrations above Hanford Site or Washington State background values or for which there is no background value. In addition, the soil-partitioning coefficients for these contaminants must be less than that necessary to show no migration to groundwater in 1,000 years based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). Based on this model and a vadose zone of approximately 11 m (36 ft) in thickness, a K_d of 6.6 or greater is required to show no predicted migration to groundwater in 1,000 years. All individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-H-49:1 subsite is 1.4×10^{-2}, which is less than 1.0. No carcinogenic constituents met the criteria for groundwater protection evaluation at the 100-H-49:1 subsite; therefore, no calculations of excess carcinogenic risk were performed. Therefore, nonradionuclide risk requirements related to groundwater are met.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach (WCH 2014b), the field logbook (WCH 2014a), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 100-H-49:1 subsite established that the data are of the right type, quality, and quantity to support site closeout decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in a WCH project-specific database for data evaluation prior to archival in HEIS and are summarized in Appendix C. The detailed DQA is presented in Appendix D.

SUMMARY FOR INTERIM CLOSURE

The 100-H-49:1 subsite has been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the 100 Area RDR/RAWP (DOE-RL 2009b). Verification sampling was performed, and the analytical results indicate that the residual concentrations of COPCs at the site meet the RAOs for direct exposure, groundwater protection, and river protection.

In accordance with this evaluation, the verification sampling results support a reclassification of the 100-H-49:1 subsite to Interim Closed Out. Contamination above direct exposure levels was not observed in the shallow zone soils and is concluded to not exist in deep zone soils. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the sites are not required.

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APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-H-49:1 Subsite [a].

Hazardous Substance		2007 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels [b]				Waste Site Analyses
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
	Background								
Antimony	5	5	--	--	--	78	--	0.27	0.40 (<BG)
Arsenic	6.5 [d]	--	--	7	18	--	43	46	7.8
Boron	--	0.5	--	--	--	--	--	--	4.1
Lead	10.2	50	500	118	120	1,700	11	56	27.5
Manganese	512	1,100 [e]	--	1,500	220	450	4,300	4,000	280 (<BG)
Vanadium	85.1	2	--	--	--	--	7.8	280	46.1 (<BG)
Zinc	67.8	86 [e]	200	360	160	120	46	79	55.2 (<BG)
High molecular weight PAH (total)	--	--	--	--	--	18	--	1.1	1.115
Benzo(a)anthracene	--	--	--	--	--	--	--	--	0.160
Benzo(a)pyrene	--	--	--	--	--	--	--	--	0.120
Benzo(g,h,i)perylene	--	--	--	--	--	--	--	--	0.140
Benzo(b)fluoranthene	--	--	--	--	--	--	--	--	0.130
Benzo(k)fluoranthene	--	--	--	--	--	--	--	--	0.068
Chrysene	--	--	--	--	--	--	--	--	0.150
Indeno[1,2,3-cd]pyrene	--	--	--	--	--	--	--	--	0.067
Pyrene	--	--	--	--	--	--	--	--	0.280

NOTE: Shaded cells indicate screening values that are exceeded.

[a] Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. All exceedances must be evaluated in the context of additional lines of evidence for ecological effects following a baseline risk assessment for the river corridor portion of the Hanford Site, which will include a more complete quantitative ecological risk assessment.

[b] Available on the Internet at www.epa.gov/ecotox/ecossl.

[c] Wildlife.

[d] The Hanford Site background for arsenic is 6.5 mg/kg. An arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

[e] Benchmark replaced by Washington state natural background concentration from Ecology, 1994, *Natural Background Soil Metals Concentrations in Washington State*, Publication 94-115, Washington State Department of Ecology, Olympia, Washington.

-- = not available
BG = background
EPA = U.S. Environmental Protection Agency
PAH = polycyclic aromatic hydrocarbons
RDR/RAWP = remedial design report/remedial action work plan
WAC = *Washington Administrative Code*

APPENDIX B

CONFIRMATORY SAMPLE DATA

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

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Aluminum			Antimony			Arsenic		
						mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	5500		1.6	0.4	U	0.4	4.9		0.69
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	8000		1.7	0.8	M	0.42	4.8		0.72
100-H-28:7	J18KW6	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848									
100-H-49	J1C2R1	10/4/2010 9:45	FD5	152997	577553	7220		4.16	0.499	U	0.5	3.92		0.83
100-H-49	J1C2R4	10/4/2010 12:00	FD4	153006	577504	7680		4.43	0.531	U	0.53	2.96		0.89
100-H-49	J1C2T1	10/11/2010 11:55	EB Tie To J1C2T2	152554	577971	199		3.34	0.4	U	0.4	0.667	U	0.67
100-H-49	J1C2T2	10/11/2010 12:00	FD16	152554	577971	9300		4.1	0.512		0.49	100		0.82
100-H-49	J1C2T3	10/11/2010 12:05	Duplicate of J1C2T2	152554	577971	10000		3.56	0.478		0.43	100		0.71
100-H-49	J1C2X5	10/4/2010 9:20	FD5	152997	577553	4340		12.7	7.32		1.53	43		2.54
100-H-49	J1C2X6	10/4/2010 9:50	FD4	153006	577504	5770		12.7	1.23	B	1.53	5.62		2.54
100-H-49	J1C3M7	10/4/2010 9:20	FD5	152997	577553									

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Barium			Beryllium			Boron		
						mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	52		0.08	0.85		0.035	1	U	1
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	310		0.083	1.1		0.036	38		1.1
100-H-28:7	J18KW6	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848									
100-H-49	J1C2R1	10/4/2010 9:45	FD5	152997	577553	73.8		0.42	0.274		0.17	1.62	B	1.66
100-H-49	J1C2R4	10/4/2010 12:00	FD4	153006	577504	144		0.44	0.329		0.18	12.9		1.77
100-H-49	J1C2T1	10/11/2010 11:55	EB Tie To J1C2T2	152554	577971	1.91		0.33	0.133	U	0.13	1.33	U	1.33
100-H-49	J1C2T2	10/11/2010 12:00	FD16	152554	577971	94		0.41	0.277		0.16	3.16		1.64
100-H-49	J1C2T3	10/11/2010 12:05	Duplicate of J1C2T2	152554	577971	91.5		0.36	0.289		0.14	2.24		1.42
100-H-49	J1C2X5	10/4/2010 9:20	FD5	152997	577553	45.7		1.27	0.22	B	0.51	2.69	B	5.08
100-H-49	J1C2X6	10/4/2010 9:50	FD4	153006	577504	260		1.27	0.244	B	0.51	2.46	B	5.08
100-H-49	J1C3M7	10/4/2010 9:20	FD5	152997	577553									

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Cadmium			Calcium			Chromium		
						mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	0.043	U	0.043	4400		15	8.5		0.061
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	0.26	M	0.045	8300		15	23	N	0.064
100-H-28:7	J18KW6	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848									
100-H-49	J1C2R1	10/4/2010 9:45	FD5	152997	577553	0.107	B	0.17	5880		83.1	9.83		0.17
100-H-49	J1C2R4	10/4/2010 12:00	FD4	153006	577504	0.128	B	0.18	5330		88.5	10.7		0.18
100-H-49	J1C2T1	10/11/2010 11:55	EB Tie To J1C2T2	152554	577971	0.133	U	0.13	41.9	B	66.7	0.175		0.13
100-H-49	J1C2T2	10/11/2010 12:00	FD16	152554	577971	1.35		0.16	4580		81.9	22.9		0.16
100-H-49	J1C2T3	10/11/2010 12:05	Duplicate of J1C2T2	152554	577971	1.42		0.14	4730		71.1	21.1		0.14
100-H-49	J1C2X5	10/4/2010 9:20	FD5	152997	577553	1.32		0.51	2340		254	194		0.51
100-H-49	J1C2X6	10/4/2010 9:50	FD4	153006	577504	0.707		0.51	4660		254	25.8		0.51
100-H-49	J1C3M7	10/4/2010 9:20	FD5	152997	577553									

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Cobalt			Copper			Hexavalent Chromium		
						mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	5.8		0.11	15		0.23	0.155	U	0.155
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	8.3		0.11	54	MN	0.24			
100-H-28:7	J18KW6	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848							0.154	U	0.154
100-H-49	J1C2R1	10/4/2010 9:45	FD5	152997	577553	5.74		1.66	13.2		0.83	0.52	U	0.52
100-H-49	J1C2R4	10/4/2010 12:00	FD4	153006	577504	5.83		1.77	18.7		0.89	0.51	U	0.51
100-H-49	J1C2T1	10/11/2010 11:55	EB Tie To J1C2T2	152554	577971	1.33	U	1.33	0.667	U	0.67			
100-H-49	J1C2T2	10/11/2010 12:00	FD16	152554	577971	6.52		1.64	25.7		0.82	0.52	U	0.52
100-H-49	J1C2T3	10/11/2010 12:05	Duplicate of J1C2T2	152554	577971	6.55		1.42	27.7		0.71	0.51	U	0.51
100-H-49	J1C2X5	10/4/2010 9:20	FD5	152997	577553	10.9		5.08	859		2.54			
100-H-49	J1C2X6	10/4/2010 9:50	FD4	153006	577504	5.18		5.08	490		2.54			
100-H-49	J1C3M7	10/4/2010 9:20	FD5	152997	577553							0.152	U	0.152

Qualifiers:
B = detected below the reporting limit, result is estimated
D = diluted
J = estimated value
M = sample duplicate precision not met
N = MS/MSD or LCS recovery is outside control limit
U = analyzed for but undetected
X = more than 40% difference between the primary and confirmatory detector results. The lower of the two results is reported.

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

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Iron			Lead			Magnesium		
						mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	16000		4	15		0.28	3600		3.9
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	40000	M	4.2	95	N	0.3	3300		4.1
100-H-28:7	J18KW6	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848									
100-H-49	J1C2R1	10/4/2010 9:45	FD5	152997	577553	17100		16.6	5.11		0.42	4140		62.4
100-H-49	J1C2R4	10/4/2010 12:00	FD4	153006	577504	16700		17.7	4.45		0.44	4100		66.4
100-H-49	J1C2T1	10/11/2010 11:55	EB Tie To J1C2T2	152554	577971	235		13.3	0.362		0.33	28.8	B	50.1
100-H-49	J1C2T2	10/11/2010 12:00	FD16	152554	577971	17700		16.4	55.8		0.41	4280		61.4
100-H-49	J1C2T3	10/11/2010 12:05	Duplicate of J1C2T2	152554	577971	18800		14.2	50.1		0.36	4570		53.4
100-H-49	J1C2X5	10/4/2010 9:20	FD5	152997	577553	249000		203	836		1.27	1520		191
100-H-49	J1C2X6	10/4/2010 9:50	FD4	153006	577504	38100		50.8	107		1.27	2620		191
100-H-49	J1C3M7	10/4/2010 9:20	FD5	152997	577553									

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Manganese			Mercury			Molybdenum		
						mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	230		0.11	0.0058	U	0.0058	0.27	U	0.27
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	320		0.11	0.26	M	0.0061	2.9	M	0.28
100-H-28:7	J18KW6	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848									
100-H-49	J1C2R1	10/4/2010 9:45	FD5	152997	577553	263		4.16	0.028	U	0.03	0.281	B	1.66
100-H-49	J1C2R4	10/4/2010 12:00	FD4	153006	577504	270		4.43	0.024	U	0.02	0.655	B	1.77
100-H-49	J1C2T1	10/11/2010 11:55	EB Tie To J1C2T2	152554	577971	3.99		3.34	0.024	U	0.02	1.33	U	1.33
100-H-49	J1C2T2	10/11/2010 12:00	FD16	152554	577971	287		4.1	0.117		0.03	1.35	B	1.64
100-H-49	J1C2T3	10/11/2010 12:05	Duplicate of J1C2T2	152554	577971	299		3.56	0.095		0.02	0.582	B	1.42
100-H-49	J1C2X5	10/4/2010 9:20	FD5	152997	577553	301		12.7	0.765		0.03	55.8		5.08
100-H-49	J1C2X6	10/4/2010 9:50	FD4	153006	577504	210		12.7	0.269		0.03	5.88		5.08
100-H-49	J1C3M7	10/4/2010 9:20	FD5	152997	577553									

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Nickel			Potassium			Selenium		
						mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	9.4		0.13	670		43	0.91	U	0.91
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	20		0.13	970		45	0.94	U	0.94
100-H-28:7	J18KW6	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848									
100-H-49	J1C2R1	10/4/2010 9:45	FD5	152997	577553	10.1		3.33	993		333	0.249	U	0.25
100-H-49	J1C2R4	10/4/2010 12:00	FD4	153006	577504	11.3		3.54	1050		354	0.266	U	0.27
100-H-49	J1C2T1	10/11/2010 11:55	EB Tie To J1C2T2	152554	577971	2.67	U	2.67	43.9	B	267	0.2	U	0.2
100-H-49	J1C2T2	10/11/2010 12:00	FD16	152554	577971	16.3		3.28	922		328	0.246	U	0.25
100-H-49	J1C2T3	10/11/2010 12:05	Duplicate of J1C2T2	152554	577971	15.2		2.85	1000		285	0.388		0.21
100-H-49	J1C2X5	10/4/2010 9:20	FD5	152997	577553	100		10.2	403	B	1020	0.763	U	0.76
100-H-49	J1C2X6	10/4/2010 9:50	FD4	153006	577504	17.7		10.2	719	B	1020	0.763	U	0.76
100-H-49	J1C3M7	10/4/2010 9:20	FD5	152997	577553									

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Silicon			Silver			Sodium		
						mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	210		2.2	0.17	U	0.17	210		62
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	320		2.3	0.18	U	0.18	410		65
100-H-28:7	J18KW6	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848									
100-H-49	J1C2R1	10/4/2010 9:45	FD5	152997	577553	889		1.66	0.166	U	0.17	211		41.6
100-H-49	J1C2R4	10/4/2010 12:00	FD4	153006	577504	771		1.77	0.177	U	0.18	272		44.3
100-H-49	J1C2T1	10/11/2010 11:55	EB Tie To J1C2T2	152554	577971	202		1.33	0.133	U	0.13	33.4	U	33.4
100-H-49	J1C2T2	10/11/2010 12:00	FD16	152554	577971	695		1.64	0.164	U	0.16	275		41
100-H-49	J1C2T3	10/11/2010 12:05	Duplicate of J1C2T2	152554	577971	698		1.42	0.142	U	0.14	279		35.6
100-H-49	J1C2X5	10/4/2010 9:20	FD5	152997	577553	789		5.08	0.508	U	0.51	97.5	B	127
100-H-49	J1C2X6	10/4/2010 9:50	FD4	153006	577504	847		5.08	0.508	U	0.51	188		127
100-H-49	J1C3M7	10/4/2010 9:20	FD5	152997	577553									

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Vanadium			Zinc		
						mg/kg	Q	PQL	mg/kg	Q	PQL
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	44		0.099	53		0.42
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	48		0.1	570	XM	0.44
100-H-28:7	J18KW6	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848						
100-H-49	J1C2R1	10/4/2010 9:45	FD5	152997	577553	40.2		2.08	34.3		8.31
100-H-49	J1C2R4	10/4/2010 12:00	FD4	153006	577504	42.7		2.21	33.5		8.85
100-H-49	J1C2T1	10/11/2010 11:55	EB Tie To J1C2T2	152554	577971	0.315	B	1.67	0.878	B	6.67
100-H-49	J1C2T2	10/11/2010 12:00	FD16	152554	577971	40.6		2.05	239		8.19
100-H-49	J1C2T3	10/11/2010 12:05	Duplicate of J1C2T2	152554	577971	41.4		1.78	252		7.11
100-H-49	J1C2X5	10/4/2010 9:20	FD5	152997	577553	42.5		6.36	135		25.4
100-H-49	J1C2X6	10/4/2010 9:50	FD4	153006	577504	32.5		6.36	58.8		25.4
100-H-49	J1C3M7	10/4/2010 9:20	FD5	152997	577553						

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

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	TPH - Diesel Ext.			TPH - Diesel		
						TPH			TPH		
						ug/kg	Q	PQL	ug/kg	Q	PQL
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	1000	U	1000	710	U	710
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	5800000	D	110000	3000000	D	72000
100-H-28:7	J18KW6	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848						
100-H-49	J1C2R1	10/4/2010 9:45	FD5	152997	577553				41400		3400
100-H-49	J1C2R4	10/4/2010 12:00	FD4	153006	577504				3410	U	3410
100-H-49	J1C2T1	10/11/2010 11:55	EB Tie To J1C2T2	152554	577971						
100-H-49	J1C2T2	10/11/2010 12:00	FD16	152554	577971				3420	U	3420
100-H-49	J1C2T3	10/11/2010 12:05	Duplicate of J1C2T2	152554	577971				3390	U	3390
100-H-49	J1C2X5	10/4/2010 9:20	FD5	152997	577553				547000		13100
100-H-49	J1C2X6	10/4/2010 9:50	FD4	153006	577504				13300	U	13300
100-H-49	J1C3M7	10/4/2010 9:20	FD5	152997	577553						

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	TPH - Motor Oil		
						TPH		
						ug/kg	Q	PQL
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848			
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848			
100-H-28:7	J18KW6	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848			
100-H-49	J1C2R1	10/4/2010 9:45	FD5	152997	577553	68800		10200
100-H-49	J1C2R4	10/4/2010 12:00	FD4	153006	577504	9980	J	10200
100-H-49	J1C2T1	10/11/2010 11:55	EB Tie To J1C2T2	152554	577971			
100-H-49	J1C2T2	10/11/2010 12:00	FD16	152554	577971	49600		10300
100-H-49	J1C2T3	10/11/2010 12:05	Duplicate of J1C2T2	152554	577971	57500		10200
100-H-49	J1C2X5	10/4/2010 9:20	FD5	152997	577553	1180000		39300
100-H-49	J1C2X6	10/4/2010 9:50	FD4	153006	577504	384000		39900
100-H-49	J1C3M7	10/4/2010 9:20	FD5	152997	577553			

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Percent Moisture			Percent Solids		
						PHYSICAL			PHYSICAL		
						%	Q	PQL	%	Q	PQL
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	5		0			
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	8.7		0			
100-H-28:7	J18KW6	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848						
100-H-49	J1C2R1	10/4/2010 9:45	FD5	152997	577553				97		0.1
100-H-49	J1C2R4	10/4/2010 12:00	FD4	153006	577504				97.4		0.1
100-H-49	J1C2T1	10/11/2010 11:55	EB Tie To J1C2T2	152554	577971				99.9		0.1
100-H-49	J1C2T2	10/11/2010 12:00	FD16	152554	577971				96.9		0.1
100-H-49	J1C2T3	10/11/2010 12:05	Duplicate of J1C2T2	152554	577971				97.6		0.1
100-H-49	J1C2X5	10/4/2010 9:20	FD5	152997	577553						
100-H-49	J1C2X6	10/4/2010 9:50	FD4	153006	577504						
100-H-49	J1C3M7	10/4/2010 9:20	FD5	152997	577553						

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

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Cesium-137			Cobalt-60		
						pCi/g	Q	MDA	pCi/g	Q	MDA
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	-0.0198	U	0.0299	-0.00679	U	0.0303
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	0.434		0.0766	0.0221	U	0.0888

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Europium-152			Europium-154		
						pCi/g	Q	MDA	pCi/g	Q	MDA
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	-0.0162	U	0.0771	-0.0269	U	0.1
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	0.0437	U	0.205	-0.0671	U	0.226

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Europium-155		
						pCi/g	Q	MDA
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	0.0127	U	0.0809
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	0.0977	U	0.139

Site Code	Sample Number	Sample Date/Time	Sample Area	Northing	Easting	Gross alpha			Gross beta		
						pCi/g	Q	MDA	pCi/g	Q	MDA
100-H-28:7	J18KV1	3/23/2009 15:00	100-H-28:7 TP3 FD	152567	577848	8.11	U	4.3	19.8		4.65
100-H-28:7	J18KV4	3/23/2009 14:00	100-H-28:7 TP3 FD	152567	577848	3.02	U	3.5	23.9	U	4.75

Site Code	Sample	Sample Date/Time	Sample Area	Northing	Easting	Asbestos
100-H-28:7	J18LX2	3/23/2009 13:45	100-H-28:7 TP3 FD	152567	577848	Nondetected

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

Sample Number		J18KV1			J18KV4			J1C2R1			J1C2R4			J1C2T1		
Location		100-H-28:7 TP3 FD			100-H-28:7 TP3 FD			FD5			FD4			EB Tie To J1C2T2		
Constituent	Class	03/23/09 03:00			03/23/09 02:00			10/04/10 09:45			10/04/10 12:00			10/11/10 11:55		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	10	U	10	130		11	52.2		3.42	72.3		3.41	3.33	U	3.33
Acenaphthylene	PAH	9.1	U	9.1	9.8	U	9.8	3.42	U	3.42	153		3.41	3.33	U	3.33
Anthracene	PAH	3.1	U	3.1	190		3.3	3.42	U	3.42	3.41	U	3.41	3.33	U	3.33
Benzo(a)anthracene	PAH	3.2	U	3.2	300	X	3.5	11.7		3.42	3.72		3.41	3.33	U	3.33
Benzo(a)pyrene	PAH	6.5	U	6.5	370	N	7	8.36		3.42	1.5	J	3.41	3.33	U	3.33
Benzo(b)fluoranthene	PAH	4.2	U	4.2	4.6	U	4.6	25.7		3.42	2.41	J	3.41	3.33	U	3.33
Benzo(ghi)perylene	PAH	7.3	U	7.3	93	X	7.8	17.6		3.42	28.5		3.41	3.33	U	3.33
Benzo(k)fluoranthene	PAH	4	U	4	80	X	4.3	1.61	J	3.42	3.41	U	3.41	3.33	U	3.33
Chrysene	PAH	4.9	U	4.9	680		5.3	3.42	U	3.42	3.41	U	3.41	3.33	U	3.33
Dibenz[a,h]anthracene	PAH	11	U	11	12	U	12	3.42	U	3.42	3.41	U	3.41	3.33	U	3.33
Fluoranthene	PAH	13	U	13	1400		14	58.4		3.42	3.04	J	3.41	3.33	U	3.33
Fluorene	PAH	5.3	U	5.3	5.7	UN	5.7	19.4		3.42	3.41	U	3.41	3.33	U	3.33
Indeno(1,2,3-cd)pyrene	PAH	12	U	12	13	UN	13	3.42	U	3.42	3.41	U	3.41	3.33	U	3.33
Naphthalene	PAH	12	U	12	99	JXN	13	104		3.42	7.4		3.41	3.33	U	3.33
Phenanthrene	PAH	12	U	12	800		13	71.1		3.42	8.59		3.41	3.33	U	3.33
Pyrene	PAH	12	U	12	930	XN	13	23.5		3.42	3.43		3.41	3.33	U	3.33
Aroclor-1016	PCB	5.2	U	5.2	5.5	U	5.5	12.9	U	12.9	13.4	U	13.4			
Aroclor-1221	PCB	16	U	16	17	U	17	12.9	U	12.9	13.4	U	13.4			
Aroclor-1232	PCB	5.2	U	5.2	5.5	U	5.5	12.9	U	12.9	13.4	U	13.4			
Aroclor-1242	PCB	9.3	U	9.3	9.8	U	9.8	12.9	U	12.9	13.4	U	13.4			
Aroclor-1248	PCB	5.7	U	5.7	6	U	6	12.9	U	12.9	13.4	U	13.4			
Aroclor-1254	PCB	5.6	U	5.6	5.9	U	5.9	12.9	U	12.9	13.4	U	13.4			
Aroclor-1260	PCB	2.7	U	2.7	34		2.8	12.9	U	12.9	13.4	U	13.4			
Aldrin	PEST	0.25	U	0.25	1.4	UD	1.4	1.29	UD	1.29	1.34	UD	1.34			
Alpha-BHC	PEST	0.22	U	0.22	1.2	UD	1.2	1.29	UD	1.29	1.34	UD	1.34			
alpha-Chlordane	PEST	0.33	U	0.33	1.8	UD	1.8	1.29	UD	1.29	1.34	UD	1.34			
beta-1,2,3,4,5,6-Hexachlorocyclohexane	PEST	0.67	U	0.67	3.6	UD	3.6	2.62	JD	1.29	1.34	UD	1.34			
Delta-BHC	PEST	0.41	U	0.41	2.2	UD	2.2	1.29	UD	1.29	1.34	UD	1.34			
Dichloro-diphenyldichloroethane	PEST	0.55	U	0.55	3	UD	3	1.29	UD	1.29	1.34	UD	1.34			
Dichloro-diphenyldichloroethylene	PEST	0.83	J	0.24	34	D	1.3	1.72	JD	1.29	1.34	UD	1.34			
Dichloro-diphenyltrichloroethane	PEST	0.6	U	0.6	100	D	3.2	1.3	JD	1.29	1.34	UD	1.34			
Dieldrin	PEST	0.21	U	0.21	1.1	UD	1.1	1.29	UD	1.29	1.34	UD	1.34			
Endosulfan I	PEST	0.18	U	0.18	0.96	UD	0.96	1.94	JD	1.29	1.34	UD	1.34			
Endosulfan II	PEST	0.29	U	0.29	1.6	UD	1.6	1.29	UD	1.29	1.34	UD	1.34			
Endosulfan sulfate	PEST	0.28	U	0.28	1.5	UD	1.5	1.29	UD	1.29	1.34	UD	1.34			
Endrin	PEST	0.31	U	0.31	1.7	UD	1.7	1.29	UD	1.29	1.34	UD	1.34			
Endrin aldehyde	PEST	0.17	U	0.17	0.93	UD	0.93	1.29	UD	1.29	1.34	UD	1.34			
Endrin ketone	PEST	0.49	U	0.49	2.7	UD	2.7	1.29	UD	1.29	1.34	UD	1.34			
Gamma-BHC (Lindane)	PEST	0.47	U	0.47	2.5	UD	2.5	1.29	UD	1.29	1.34	UD	1.34			
gamma-Chlordane	PEST	0.27	U	0.27	1.5	UD	1.5	1.29	UD	1.29	1.34	UD	1.34			
Heptachlor	PEST	0.22	U	0.22	1.2	UD	1.2	1.29	UD	1.29	1.34	UD	1.34			
Heptachlor epoxide	PEST	0.43	U	0.43	2.3	UD	2.3	1.29	UD	1.29	1.34	UD	1.34			
Methoxychlor	PEST	0.45	U	0.45	2.5	UD	2.5	1.29	UD	1.29	1.34	UD	1.34			
Toxaphene	PEST	16	U	16	86	UD	86	19.4	UD	19.4	20.1	UD	20.1			

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

Sample Number		J1C2T2			J1C2T3			J1C2X5			J1C2X6		
Location		FD16			Duplicate of			FD5			FD4		
Constituent	Class	10/11/10 12:00			10/11/10 12:05			10/04/10 09:20			10/04/10 09:50		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	8.26		3.41	10.3		3.24	805	D	33	332	D	13.3
Acenaphthylene	PAH	3.41	U	3.41	2.12	J	3.24	1490	D	33	27.7	D	13.3
Anthracene	PAH	5.48		3.41	4.27		3.24	13.2	JD	33	13.1	JD	13.3
Benzo(a)anthracene	PAH	32.4		3.41	11.1		3.24	47.3	D	33	150	D	13.3
Benzo(a)pyrene	PAH	32		3.41	31.9		3.24	24.1	JD	33	7.93	JD	13.3
Benzo(b)fluoranthene	PAH	25.5		3.41	35.5		3.24	365	D	33	28.5	D	13.3
Benzo(ghi)perylene	PAH	21		3.41	35.6		3.24	142	D	33	7.88	JD	13.3
Benzo(k)fluoranthene	PAH	7.15		3.41	14.1		3.24	101	D	33	3.95	JD	13.3
Chrysene	PAH	122		3.41	27.2		3.24	33	UD	33	13.3	UD	13.3
Dibenz[a,h]anthracene	PAH	3.41	U	3.41	5.04		3.24	34.5	D	33	13.3	UD	13.3
Fluoranthene	PAH	106		3.41	195		3.24	800	D	33	309	D	13.3
Fluorene	PAH	1.26	J	3.41	1.43	J	3.24	286	D	33	591	D	13.3
Indeno(1,2,3-cd)pyrene	PAH	21.3		3.41	20.2		3.24	935	D	33	30.5	D	13.3
Naphthalene	PAH	3.41	U	3.41	3.24	U	3.24	101	D	33	64.2	D	13.3
Phenanthrene	PAH	34.3		3.41	27.8		3.24	362	D	33	127	D	13.3
Pyrene	PAH	311		3.41	20.6		3.24	42.8	D	33	17.1	D	13.3
Aroclor-1016	PCB	13.6	U	13.6	13.4	U	13.4	13.1	U	13.1	13.3	U	13.3
Aroclor-1221	PCB	13.6	U	13.6	13.4	U	13.4	13.1	U	13.1	13.3	U	13.3
Aroclor-1232	PCB	13.6	U	13.6	13.4	U	13.4	13.1	U	13.1	13.3	U	13.3
Aroclor-1242	PCB	13.6	U	13.6	13.4	U	13.4	13.1	U	13.1	13.3	U	13.3
Aroclor-1248	PCB	13.6	U	13.6	13.4	U	13.4	13.1	U	13.1	13.3	U	13.3
Aroclor-1254	PCB	22		13.6	18.7		13.4	13.1	U	13.1	13.3	U	13.3
Aroclor-1260	PCB	22		13.6	20.4		13.4	13.1	U	13.1	13.3	U	13.3
Aldrin	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
Alpha-BHC	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
alpha-Chlordane	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
beta-1,2,3,4,5,6-Hexachlorocyclohexane	PEST	1.36	UD	1.36	1.34	UD	1.34	14.3	D	1.31	2.83	JD	1.33
Delta-BHC	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
Dichloro-diphenyldichloroethane	PEST	1.7	JD	1.36	2.14	JD	1.34	2.52	D	1.31	1.33	UD	1.33
Dichloro-diphenyldichloroethylene	PEST	8.08	D	1.36	7.2	D	1.34	10.2	D	1.31	6.6	JD	1.33
Dichloro-diphenyltrichloroethane	PEST	14.8	D	1.36	12.5	D	1.34	9.48	D	1.31	12.7	D	1.33
Dieldrin	PEST	1.36	UD	1.36	1.34	UD	1.34	1.64	JD	1.31	1.33	UD	1.33
Endosulfan I	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
Endosulfan II	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
Endosulfan sulfate	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
Endrin	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	9.66	D	1.33
Endrin aldehyde	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
Endrin ketone	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
Gamma-BHC (Lindane)	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
gamma-Chlordane	PEST	1.7	JD	1.36	1.47	JD	1.34	1.31	UD	1.31	1.33	UD	1.33
Heptachlor	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
Heptachlor epoxide	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
Methoxychlor	PEST	1.36	UD	1.36	1.34	UD	1.34	1.31	UD	1.31	1.33	UD	1.33
Toxaphene	PEST	20.4	UD	20.4	20.1	UD	20.1	19.7	UD	19.7	20	UD	20

APPENDIX C

CALCULATIONS

APPENDIX C

CALCULATION BRIEFS

The calculations provided in this appendix are copies of the originals that are kept in the active Washington Closure Hanford project files and are available upon request. When the project is completed, the files will be stored in a U.S. Department of Energy, Richland Operations Office repository. These calculations have been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculations," Washington Closure Hanford, Richland, Washington. The calculations provided in this appendix include:

100-H-49:1Subsite Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations, 0100H-CA-V0212, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-H-49:1 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater, 0100H-CA-V0213, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

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

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-H Area Closure Operations **Job No. 14655**

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0212

Subject: 100-H-49:1 Subsite Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2010

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 Summary = 6 Attachment = 4 Total = 11	J. D. Skoglie	I. B. Berezovskiy	R. J. Nielson	S. G. Wilkinson	2/23/15

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:	J. D. Skoglie	Date:	10/22/2014	Calc. No.:	0100H-CA-V0212	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	10/22/2014
Subject:	100-H-49:1 Subsite Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 6	

PURPOSE:

Using sample data from Attachment 1 provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-H-49:1 subsite. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009b), 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 100-H-49:1 subsite verification sampling, as necessary.

GIVEN/REFERENCES:

1) DOE-RL, 2009a, *100 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-96-22, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) DOE-RL, 2009b, *Remedial Design Report/Remedial Action Work Plan for the 100 Areas,* DOE/RL-96-17, Rev. 6, 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.

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 2009b).

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

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 2009b).
4) Sum the excess cancer risk value(s) and compare it to the cumulative cancer risk of $<1 \times 10^{-5}$.

Washington Closure Hanford CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	10/22/2014	Calc. No.:	0100H-CA-V0212	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	10/22/2014
Subject:	100-H-49:1 Subsite Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 6	

5) Use data from Attachment 1 to perform the RPD calculations for primary-duplicate sample pairs, as required.

METHODOLOGY:

The 100-H-49:1 subsite underwent verification focused sampling at six locations including a duplicate sample. The direct contact hazard quotient and carcinogenic risk calculations for the 100-H-49:1 subsite were conservatively calculated using the maximum results from Attachment 1. Of the contaminants of potential concern (COPCs) and other analytes for this site, boron, molybdenum, aroclor-1260, the detected polycyclic aromatic hydrocarbons (PAHs), and the detected pesticides require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Copper requires HQ and risk calculation because this analyte was detected above the Hanford Site background value. Lead was detected above background; however, lead does not have a reference dose for calculation of a hazard quotient because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake. Also, total petroleum hydrocarbons (diesel range extended + gasoline) were detected; however, the risk associated with these does not contribute to the cumulative toxicity calculation. Additionally, arsenic was detected above background; however, the arsenic standard is not toxicity based. All other site nonradionuclide COPCs were either 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 4.1 mg/kg, divided by the noncarcinogenic RAG value of 7,200 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 5.7×10^{-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. 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 for COPCs is 9.4×10^{-3}. 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 1.0×10^{-6}. For example, the maximum value for benzo(a)pyrene is 0.120 mg/kg, divided by 0.137 mg/kg, and multiplied as indicated, is 8.8×10^{-7}. Comparing this value, the requirement of $<1 \times 10^{-6}$ 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. To avoid errors due to intermediate rounding, the individual cancer risk values prior to rounding are used for this calculation. The sum of the excess cancer risk values for COPCs is 1.3×10^{-6}. Comparing these values to the requirement of $<1 \times 10^{-5}$, this criterion is met.

5) 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 for certain analytes in Table II-1 of the SAP (DOE-RL 2009a). Other analytes will have their own pre-determined

Washington Closure Hanford		CALCULATION SHEET					
Originator:	J. D. Skoglie	Date:	10/22/2014	Calc. No.:	0100H-CA-V0212	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	10/22/2014
Subject:	100-H-49:1 Subsite Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 6	

constituents and will have their own TDLs based on the laboratory and method used. Where direct evaluation of the attached sample data showed that a given analyte 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 the verification sampling at the subject site.

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 for the 100-H-49:1 subsite.

5) The evaluation of the QA/QC duplicate RPD calculations are performed within the data quality assessment section of the RSVP.

Table 2 shows the results of the RPD calculations for the 100-H-49:1 subsite.

Washington Closure Hanford CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	10/22/2014	Calc. No.:	0100H-CA-V0212	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	10/22/2014
Subject:	100-H-49:1 Subsite Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 4 of 6	

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-H-49:1 Subsite.

Contaminants of Potential Concern	Maximum Value [a] (mg/kg)	Noncarcinogen RAG [b] (mg/kg)	Hazard Quotient	Carcinogen RAG [b] (mg/kg)	Carcinogen Risk
Metals					
Arsenic [c]	7.8	20	--	--	--
Boron	4.1	7,200	5.7E-04	--	--
Copper	23.1	2,960	7.8E-03	--	--
Lead [d]	27.5	353	--	--	--
Molybdenum	0.25	400	6.3E-04	--	--
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	0.082	4,800	1.7E-05	--	--
Benzo(a)anthracene	0.160	--	--	1.37	1.2E-07
Benzo(a)pyrene	0.120	--	--	0.137	8.8E-07
Benzo(b)fluoranthene	0.130	--	--	1.37	9.5E-08
Benzo(ghi)perylene [e]	0.140	2,400	5.8E-05	--	--
Benzo(k)fluoranthene	0.068	--	--	1.37	5.0E-08
Chrysene	0.150	--	--	13.7	1.1E-08
Fluoranthene	0.310	3,200	9.7E-05	--	--
Fluorene	0.021	3,200	6.6E-06	--	--
Indeno(1,2,3-cd)pyrene	0.067	--	--	1.37	4.9E-08
Naphthalene	0.013	1,600	8.1E-06	--	--
Phenanthrene [e]	0.450	24,000	1.9E-05	--	--
Pyrene	0.280	2,400	1.2E-04	--	--
Pesticides					
DDE, 4,4'-	0.0040	--	--	2.94	1.4E-09
DDT, 4,4'-	0.0023	40	5.8E-05	2.94	7.8E-10
Polychlorinated Biphenyls					
Aroclor-1260	0.035	--	--	0.5	7.0E-08
Total Petroleum Hydrocarbons					
TPH - Diesel Range extended + gasoline [f]	172	200	--	--	--
Totals					
Cumulative Hazard Quotient:			**9.4E-03**		
Cumulative Excess Cancer Risk:					**1.3E-06**

Notes:

[a] = From Attachment 1.

[b] = Value obtained from the 100 Area RDR/RAWP (DOE-RL 2009b) or *Washington Administrative Code* (WAC) 173-340-740(3), Method B, 1996, unless otherwise noted.

[c] = The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009a).

[d] = Value for the noncarcinogenic RAG calculated using Guidance Manual for the Integrated Exposure Uptake Biokinetic Model for Lead in Children, EPA/540/R 93/081, Publication No. 9285.7, U.S. Environmental Protection Agency, Washington, D.C.

[e] = Toxicity data for these chemicals are not available. The cleanup levels are based on use of surrogate chemicals.
benzo(g,h,i)perylene surrogate: pyrene
phenanthrene surrogate: anthracene

[f] = The risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation.

-- = not applicable

RAG = remedial action goal

Washington Closure Hanford		CALCULATION SHEET					
Originator:	J. D. Skoglie	Date:	10/22/2014	Calc. No.:	0100H-CA-V0212	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	10/22/2014
Subject:	100-H-49:1 Subsite Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 5 of 6	

Table 2. Relative Percent Difference Calculations for the 100-H-49:1 Subsite.

Duplicate Analysis - 100-H-49:1 Subsite

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TXL1	8/25/14	7430	X	1.3	4.3		0.57	80.2	X	0.066	2.5		0.84
Duplicate of J1TXL1	J1TXL7	8/25/14	7090	X	1.3	4.0		0.56	74.8	X	0.064	2.4		0.83

Analysis:

TDL		5	10	2	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	4.7%		7.0%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable

Duplicate Analysis - 100-H-49:1 Subsite

Sampling Area	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TXL1	8/25/14	0.064	B	0.035	10400	X	12.2	11.4		0.050	6.7		0.086
Duplicate of J1TXL1	J1TXL7	8/25/14	0.054	B	0.035	9280	X	12.0	10.5		0.049	6.8		0.085

Analysis:

TDL		0.2	100	1	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD		11.4%	8.2%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable

Duplicate Analysis - 100-H-49:1 Subsite

Sampling Area	Sample Number	Sample Date	Copper			Iron			Lead			Magnesium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TXL1	8/25/14	14.4	X	0.19	18400	X	3.3	8.4		0.23	4420	X	3.2
Duplicate of J1TXL1	J1TXL7	8/25/14	15.4	X	0.18	18300	X	3.2	7.4		0.23	4340	X	3.1

Analysis:

TDL		1	5	5	75
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	6.7%	0.5%		1.8%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Not applicable

Duplicate Analysis - 100-H-49:1 Subsite

Sampling Area	Sample Number	Sample Date	Manganese			Mercury			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TXL1	8/25/14	270	X	0.086	0.011	B	0.0054	10.7		0.11	1070		35.3
Duplicate of J1TXL1	J1TXL7	8/25/14	280	X	0.085	0.011	B	0.0055	10.8		0.10	909		34.8

Analysis:

TDL		5	0.2	4	400
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	3.6%			
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable

Duplicate Analysis - 100-H-49:1 Subsite

Sampling Area	Sample Number	Sample Date	Silicon			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TXL1	8/25/14	436	JNX	4.9	231		50.9	44.1	X	0.081	35.4	X	0.34
Duplicate of J1TXL1	J1TXL7	8/25/14	314	JX	4.8	252		50.1	46.1	X	0.080	35.6	X	0.34

Analysis:

TDL		2	50	2.5	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	32.5%		4.4%	0.6%
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable

Duplicate Analysis - 100-H-49:1 Subsite

Sampling Area	Sample Number	Sample Date	TPH - Diesel Range EXT			4-4'-DDE			4-4'-DDT		
			ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
FS-1	J1TXL1	8/25/14	8100	J	970	1.4	J	0.23	0.86	J	0.58
Duplicate of J1TXL1	J1TXL7	8/25/14	6000	J	960	1.1	J	0.24	0.72	J	0.59

Analysis:

TDL		5000	5	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD			
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable

Washington Closure Hanford CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	10/22/2014	Calc. No.:	0100H-CA-V0212	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	10/22/2014
Subject:	100-H-49:1 Subsite Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 6 of 6	

CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 100-H-49:1 subsite meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the RDR/RAWP (DOE-RL 2009b) and SAP (DOE-RL 2009a). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this site.

Attachment 1. 100-H-49:1 Subsite Verification Sample Results (Metals, TPH, and Physical).

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TXL1	8/25/14	7430	X	1.3	0.33	UJ	0.33	4.3		0.57	80.2	X	0.066	0.028	UN	0.028
Duplicate of J1TXL1	J1TXL7	8/25/14	7090	X	1.3	0.32	UJ	0.32	4.0		0.56	74.8	X	0.064	0.028	U	0.028
FS-2	J1TXL2	8/25/14	7540	X	1.3	0.40	JB	0.32	3.5		0.56	87.1	X	0.065	0.028	U	0.028
FS-3	J1TXL3	8/25/14	7300	X	1.5	0.37	UJ	0.37	5.7		0.64	77.6	X	0.073	0.032	U	0.032
FS-4	J1TXL4	8/25/14	6800	X	1.4	0.35	UJ	0.35	5.8		0.61	88.7	X	0.070	0.030	U	0.030
FS-5	J1TXL5	8/25/14	6080	X	1.4	0.34	UJ	0.34	5.7		0.58	51.1	X	0.067	0.029	U	0.029
FS-6	J1TXL6	8/25/14	6130	X	1.5	0.37	UJ	0.37	7.8		0.64	79.4	X	0.073	0.032	U	0.032
Equipment Blank	J1TXL8	8/25/14	101	X	1.4	0.34	U	0.34	0.59	U	0.59	1.1	X	0.067	0.029	U	0.029

Sample Location	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TXL1	8/25/14	2.5		0.84	0.064	B	0.035	10400	X	12.2	11.4		0.050	6.7		0.086
Duplicate of J1TXL1	J1TXL7	8/25/14	2.4		0.83	0.054	B	0.035	9280	X	12.0	10.5		0.049	6.8		0.085
FS-2	J1TXL2	8/25/14	4.1		0.83	0.11	B	0.035	5730	X	12.0	14.9		0.049	6.0		0.085
FS-3	J1TXL3	8/25/14	2.8		0.94	0.061	B	0.039	6200	X	13.6	12.4		0.056	6.1		0.096
FS-4	J1TXL4	8/25/14	3.5		0.90	0.083	B	0.038	6220	X	13.0	11.0		0.053	6.8		0.092
FS-5	J1TXL5	8/25/14	1.5	B	0.87	0.045	B	0.036	6120	X	12.5	9.3		0.051	5.5		0.088
FS-6	J1TXL6	8/25/14	1.9		0.94	0.066	B	0.040	6200	X	13.6	10.5		0.056	5.7		0.096
Equipment Blank	J1TXL8	8/25/14	0.87	U	0.87	0.036	U	0.036	23.4	BX	12.5	0.12	B	0.051	0.089	U	0.089

Sample Location	HEIS Number	Sample Date	Copper			Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TXL1	8/25/14	14.4	X	0.19	18400	X	3.3	8.4		0.23	4420	X	3.2	270	X	0.086
Duplicate of J1TXL1	J1TXL7	8/25/14	15.4	X	0.18	18300	X	3.2	7.4		0.23	4340	X	3.1	280	X	0.085
FS-2	J1TXL2	8/25/14	23.1	X	0.18	15500	X	3.2	13.9		0.23	4350	X	3.1	251	X	0.085
FS-3	J1TXL3	8/25/14	14.6	X	0.21	16700	X	3.7	22.7		0.26	4410	X	3.6	263	X	0.096
FS-4	J1TXL4	8/25/14	14.6	X	0.20	17700	X	3.5	20.8		0.25	4370	X	3.4	269	X	0.092
FS-5	J1TXL5	8/25/14	11.9	X	0.19	15100	X	3.4	16.4		0.24	3900	X	3.3	234	X	0.088
FS-6	J1TXL6	8/25/14	12.0	X	0.21	15400	X	3.7	27.5		0.26	3920	X	3.6	243	X	0.096
Equipment Blank	J1TXL8	8/25/14	0.35	BX	0.19	159	X	3.4	0.24	U	0.24	12.2	BX	3.3	2.6	X	0.089

Grey cells indicate not applicable or data will not be used.

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

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

B = blank contamination (inorganic constituents)

FS = focused sample

HEIS = Hanford Environmental Information System

J = estimate

N = recovery exceeds upper or lower control limit.

PQL = practical quantitation limit

Q = qualifier

RAG = remedial action goal

U = not detected.

X (metals) = serial dilution in the analytical batch indicates that physical and chemical interferences are present.

X (organics) = >40% between the primary and confirmation detector results. The lower of the two results is reported.

Attachment	1	Sheet No.	1 of 4
Originator	J. D. Skoglie	Date	10/22/2014
Checked	I. B. Berezovskiy	Date	10/22/2014
Calc. No.	0100H-CA-V0212	Rev. No.	0

Attachment 1. 100-H-49:1 Subsite Verification Sample Results (Metals, TPH, and Physical).

Sample Location	HEIS Number	Sample Date	Mercury			Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TXL1	8/25/14	0.011	B	0.0054	0.22	U	0.22	10.7		0.11	1070		35.3	0.74	U	0.74
Duplicate of J1TXL1	J1TXL7	8/25/14	0.011	B	0.0055	0.22	U	0.22	10.8		0.10	909		34.8	0.73	U	0.73
FS-2	J1TXL2	8/25/14	0.010	B	0.0052	0.22	U	0.22	12.2		0.10	1060		34.9	0.73	U	0.73
FS-3	J1TXL3	8/25/14	0.063		0.0049	0.25	B	0.25	11.1		0.12	1110		39.5	0.83	U	0.83
FS-4	J1TXL4	8/25/14	0.020		0.0056	0.24	U	0.24	10.3		0.11	987		37.8	0.79	U	0.79
FS-5	J1TXL5	8/25/14	0.0068	B	0.0051	0.23	U	0.23	9.6		0.11	845		36.2	0.76	U	0.76
FS-6	J1TXL6	8/25/14	0.051		0.0055	0.25	U	0.25	9.9		0.12	889		39.5	0.83	U	0.83
Equipment Blank	J1TXL8	8/25/14	0.0055	U	0.0055	0.23	U	0.23	0.11	U	0.11	36.4	U	36.4	0.76	U	0.76

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
FS-1	J1TXL1	8/25/14	436	JNX	4.9	0.14	U	0.14	231		50.9	44.1	X	0.081	35.4	X	0.34
Duplicate of J1TXL1	J1TXL7	8/25/14	314	JX	4.8	0.14	U	0.14	252		50.1	46.1	X	0.080	35.6	X	0.34
FS-2	J1TXL2	8/25/14	275	JX	4.8	0.14	U	0.14	194		50.2	33.7	X	0.080	39.6	X	0.34
FS-3	J1TXL3	8/25/14	236	JX	5.4	0.15	U	0.15	259		56.8	40.9	X	0.090	40.9	X	0.38
FS-4	J1TXL4	8/25/14	253	JX	5.2	0.15	U	0.15	279		54.3	43.5	X	0.087	43.0	X	0.37
FS-5	J1TXL5	8/25/14	291	JX	5.0	0.14	U	0.14	227		52.1	38.4	X	0.083	32.9	X	0.35
FS-6	J1TXL6	8/25/14	250	JX	5.5	0.15	U	0.15	193		56.9	36.9	X	0.091	55.2	X	0.38
Equipment Blank	J1TXL8	8/25/14	84.1	X	5.0	0.14	U	0.14	52.4	U	52.4	0.16	BX	0.083	0.57	BX	0.35

Sample Location	HEIS Number	Sample Date	TPH - Diesel Range EXT			TPH - Diesel Range			TPH - Gasoline			Percent moisture (wet sample)		
			ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	%	Q	PQL
FS-1	J1TXL1	8/25/14	8100	J	970	4800	JB	660	320	U	320	0.86		0.10
Duplicate of J1TXL1	J1TXL7	8/25/14	6000	J	960	5000	UJB	650	320	U	320	0.97		0.10
FS-2	J1TXL2	8/25/14	23000	J	1000	15000	JB	680	1600		340	1.2		0.10
FS-3	J1TXL3	8/25/14	170000	J	980	89000	JB	670	320	U	320	1.0		0.10
FS-4	J1TXL4	8/25/14	18000	JN	950	8700	JBN	650	330	U	330	1.3		0.10
FS-5	J1TXL5	8/25/14	15000	J	960	7200	JB	650	340	U	340	0.66		0.10
FS-6	J1TXL6	8/25/14	22000	J	980	12000	JB	660	320	U	320	1.2		0.10
Equipment Blank	J1TXL8	8/25/14										0.32		0.10

Attachment 1 Sheet No. 2 of 4
Originator J. D. Skoglie Date 10/22/2014
Checked I. B. Berezovskiy Date 10/22/2014
Calc. No. 0100H-CA-V0212 Rev. No. 0

Attachment 1. 100-H-49:1 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	FS-1 - J1TXL1			Duplicate of J1TXL1			FS-2 - J1TXL2			FS-3 - J1TXL3		
		8/25/14			8/25/14			8/25/14			8/25/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	9.5	U	9.5	10	U	10	9.3	U	9.3	82	JX	10
Acenaphthylene	PAH	8.5	U	8.5	9.0	U	9.0	8.3	U	8.3	9.1	UN	9.1
Anthracene	PAH	2.9	U	2.9	3.1	U	3.1	2.8	U	2.8	3.1	UJN	3.1
Benzo(a)anthracene	PAH	3.0	U	3.0	3.2	U	3.2	3.0	U	3.0	56	NX	3.2
Benzo(a)pyrene	PAH	6.1	U	6.1	6.4	U	6.4	5.9	U	5.9	120		6.5
Benzo(b)fluoranthene	PAH	4.0	U	4.0	4.2	U	4.2	7.2	JX	3.9	82	N	4.2
Benzo(ghi)perylene	PAH	6.8	U	6.8	7.2	U	7.2	6.7	U	6.7	91	NJX	7.3
Benzo(k)fluoranthene	PAH	3.7	U	3.7	4.0	U	4.0	3.6	U	3.6	68	N	4.0
Chrysene	PAH	4.6	U	4.6	4.9	U	4.9	4.5	U	4.5	150	N	4.9
Dibenz[a,h]anthracene	PAH	10	U	10	11	U	11	10	U	10	11	UN	11
Fluoranthene	PAH	12	U	12	13	U	13	12	U	12	310	JN	13
Fluorene	PAH	5.0	U	5.0	5.3	U	5.3	4.9	U	4.9	21	J	5.3
Indeno(1,2,3-cd)pyrene	PAH	11	U	11	12	U	12	11	U	11	45	NX	12
Naphthalene	PAH	11	U	11	12	U	12	11	U	11	12	U	12
Phenanthrene	PAH	11	U	11	12	U	12	45		11	450	N	12
Pyrene	PAH	11	U	11	12	U	12	11	U	11	280	N	12
Aroclor-1016	PCB	2.7	U	2.7	2.7	U	2.7	2.7	U	2.7	2.7	U	2.7
Aroclor-1221	PCB	7.9	U	7.9	7.9	U	7.9	8.0	U	8.0	7.8	U	7.8
Aroclor-1232	PCB	2.0	U	2.0	2.0	U	2.0	2.0	U	2.0	1.9	U	1.9
Aroclor-1242	PCB	4.6	U	4.6	4.6	U	4.6	4.6	U	4.6	4.5	U	4.5
Aroclor-1248	PCB	4.6	U	4.6	4.6	U	4.6	4.6	U	4.6	4.5	U	4.5
Aroclor-1254	PCB	2.6	U	2.6	2.6	U	2.6	2.6	U	2.6	2.5	U	2.5
Aroclor-1260	PCB	2.6	UJ	2.6	2.6	UJ	2.6	2.6	UJ	2.6	35	JN	2.5
Aldrin	PEST	0.25	U	0.25	0.25	U	0.25	0.25	U	0.25	2.5	UD	2.5
Alpha-BHC	PEST	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21	2.2	UD	2.2
alpha-Chlordane	PEST	0.32	U	0.32	0.32	U	0.32	0.32	U	0.32	3.3	UD	3.3
Beta-BHC	PEST	0.65	U	0.65	0.66	U	0.66	0.65	U	0.65	6.7	UD	6.7
Delta-BHC	PEST	0.39	U	0.39	0.40	U	0.40	0.40	U	0.40	4.0	UD	4.0
4-4'-DDD	PEST	0.54	U	0.54	0.55	U	0.55	0.54	U	0.54	5.5	UD	5.5
4-4'-DDE	PEST	1.4	J	0.23	1.1	J	0.24	4.0		0.23	2.4	UD	2.4
4-4'-DDT	PEST	0.86	J	0.58	0.72	J	0.59	2.3		0.58	5.9	UD	5.9
Dieldrin	PEST	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21	2.1	UD	2.1
Endosulfan I	PEST	0.17	U	0.17	0.18	U	0.18	0.17	U	0.17	1.8	UD	1.8
Endosulfan II	PEST	0.28	U	0.28	0.29	U	0.29	0.28	U	0.28	2.9	UD	2.9
Endosulfan sulfate	PEST	0.27	U	0.27	0.28	U	0.28	0.27	U	0.27	2.8	UD	2.8
Endrin	PEST	0.30	U	0.30	0.31	U	0.31	0.30	U	0.30	3.1	UD	3.1
Endrin aldehyde	PEST	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17	1.7	UD	1.7
Endrin ketone	PEST	0.48	U	0.48	0.49	U	0.49	0.48	U	0.48	4.9	UD	4.9
Gamma-BHC (Lindane)	PEST	0.46	U	0.46	0.46	U	0.46	0.46	U	0.46	4.7	UD	4.7
gamma-Chlordane	PEST	0.26	U	0.26	0.27	U	0.27	0.26	U	0.26	2.7	UD	2.7
Heptachlor	PEST	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21	2.2	UD	2.2
Heptachlor epoxide	PEST	0.42	U	0.42	0.43	U	0.43	0.42	U	0.42	4.3	UD	4.3
Methoxychlor	PEST	0.44	U	0.44	0.45	U	0.45	0.44	U	0.44	4.5	UD	4.5
Toxaphene	PEST	16	UJ	16	16	UJ	16	16	UJ	16	160	UJD	160

Attachment	1	Sheet No.	3 of 4
Originator	J. D. Skoglie	Date	10/22/2014
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Calc. No.	0100H-CA-V0212	Rev. No.	0

Attachment 1. 100-H-49:1 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	FS-4 - J1TXL4			FS-5 - J1TXL5			FS-6 - J1TXL6			Equipment Blank - J1TXL8		
		8/25/14			8/25/14			8/25/14			8/25/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	38	JX	10	12	JX	9.9	14	JX	9.8	9.7	U	9.7
Acenaphthylene	PAH	9.1	U	9.1	8.9	U	8.9	8.8	U	8.8	8.8	U	8.8
Anthracene	PAH	3.1	U	3.1	3.0	U	3.0	3.0	U	3.0	3.0	U	3.0
Benzo(a)anthracene	PAH	160		3.2	21	X	3.2	79		3.1	3.1	U	3.1
Benzo(a)pyrene	PAH	94		6.5	24		6.3	110		6.3	6.2	U	6.2
Benzo(b)fluoranthene	PAH	110		4.3	29		4.2	130		4.1	4.1	U	4.1
Benzo(ghi)perylene	PAH	140		7.3	35		7.1	97	X	7.0	7.0	U	7.0
Benzo(k)fluoranthene	PAH	31		4.0	7.2	J	3.9	50		3.8	3.8	U	3.8
Chrysene	PAH	150		4.9	28	J	4.8	76	X	4.7	4.7	U	4.7
Dibenz[a,h]anthracene	PAH	11	U	11	11	U	11	11	U	11	11	U	11
Fluoranthene	PAH	230		13	62		13	99	X	13	13	U	13
Fluorene	PAH	12	JX	5.4	7.9	JX	5.2	11	JX	5.2	5.1	U	5.1
Indeno(1,2,3-cd)pyrene	PAH	64		12	17	J	12	67		12	12	U	12
Naphthalene	PAH	12	U	12	12	U	12	13	JX	12	12	U	12
Phenanthrene	PAH	73		12	43		12	89		12	12	U	12
Pyrene	PAH	230		12	64		12	130		12	12	U	12
Aroclor-1016	PCB	2.8	U	2.8	2.7	U	2.7	2.8	U	2.8			
Aroclor-1221	PCB	8.0	U	8.0	7.9	U	7.9	8.0	U	8.0			
Aroclor-1232	PCB	2.0	U	2.0	2.0	U	2.0	2.0	U	2.0			
Aroclor-1242	PCB	4.7	U	4.7	4.6	U	4.6	4.7	U	4.7			
Aroclor-1248	PCB	4.7	U	4.7	4.6	U	4.6	4.7	U	4.7			
Aroclor-1254	PCB	2.6	U	2.6	2.5	U	2.5	2.6	U	2.6			
Aroclor-1260	PCB	19	J	2.6	3.1	J	2.5	3.3	J	2.6			
Aldrin	PEST	0.25	U	0.25	0.25	U	0.25	0.24	U	0.24			
Alpha-BHC	PEST	0.21	U	0.21	0.21	U	0.21	0.20	U	0.20			
alpha-Chlordane	PEST	0.32	U	0.32	0.32	U	0.32	0.31	U	0.31			
Beta-BHC	PEST	0.66	U	0.66	0.66	U	0.66	0.63	U	0.63			
Delta-BHC	PEST	0.40	U	0.40	0.40	U	0.40	0.38	U	0.38			
4-4'-DDD	PEST	0.54	U	0.54	0.54	U	0.54	0.52	U	0.52			
4-4'-DDE	PEST	1.3	J	0.24	0.84	J	0.23	1.3	J	0.23			
4-4'-DDT	PEST	0.94	JX	0.59	1.6	J	0.58	1.9		0.56			
Dieldrin	PEST	0.21	U	0.21	0.21	U	0.21	0.20	U	0.20			
Endosulfan I	PEST	0.18	U	0.18	0.17	U	0.17	0.17	U	0.17			
Endosulfan II	PEST	0.29	U	0.29	0.28	U	0.28	0.27	U	0.27			
Endosulfan sulfate	PEST	0.28	U	0.28	0.27	U	0.27	0.26	U	0.26			
Endrin	PEST	0.30	U	0.30	0.30	U	0.30	0.29	U	0.29			
Endrin aldehyde	PEST	0.17	U	0.17	0.17	U	0.17	0.16	U	0.16			
Endrin ketone	PEST	0.49	U	0.49	0.48	U	0.48	0.46	U	0.46			
Gamma-BHC (Lindane)	PEST	0.46	U	0.46	0.46	U	0.46	0.44	U	0.44			
gamma-Chlordane	PEST	0.27	U	0.27	0.26	U	0.26	0.25	U	0.25			
Heptachlor	PEST	0.21	U	0.21	0.21	U	0.21	0.20	U	0.20			
Heptachlor epoxide	PEST	0.42	U	0.42	0.42	U	0.42	0.40	U	0.40			
Methoxychlor	PEST	0.45	U	0.45	0.44	U	0.44	0.43	U	0.43			
Toxaphene	PEST	16	UJ	16	16	UJ	16	15	UJ	15			

Attachment	1	Sheet No.	4 of 4
Originator	J. D. Skoglie	Date	10/22/2014
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Calc. No.	0100H-CA-V0212	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-H Area Closure Operations **Job No. 14655**

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0213

Subject: 100-H-49:1 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater

Computer Program: Excel Program No: Excel 2010

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 Summary = 3 Total = 4	J. D. Skoglie	L. B. Berezovsky	R. J. Nielson	S. G. Wilkinson	2/23/15

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:	J. D. Skoglie	Date:	10/28/2014	Calc. No.:	0100H-CA-V0213	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	10/28/2014
Subject:	100-H-49:1 Subsite Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and excess carcinogenic risk associated with soil contaminant levels compared to soil cleanup levels for protection of groundwater for the 100-H-49:1 subsite. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009), 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 x 10^{-6} for individual carcinogens
4) A cumulative excess cancer risk of ≤1 x 10^{-5} for carcinogens.

GIVEN/REFERENCES:

1) BHI, 2005, *100 Area Analogous Sites RESRAD Evaluation*, Calculation No. 0100X-CA-V0050 Rev 0, Bechtel Hanford, Inc., Richland, Washington.

2) DOE-RL, 2009, *Remedial Design Report/Remedial Action Work Plan for the 100 Areas,* DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

4) WCH, 2014, *100-H-49:1 Subsite Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations*, Calculation Number 0100H-CA-V0213, Washington Closure Hanford, Richland, Washington.

SOLUTION:

1) Generate a HQ for each noncarcinogenic constituent detected above background in soil and with a K_d less than that required to show no migration to groundwater in 1,000 years using the RESRAD generic site model (BHI 2005).

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

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background in soil and with a K_d less than that required to show no migration to groundwater in 1,000 years using the RESRAD generic site model (BHI 2005).

4) Sum the excess cancer risk value(s) and compare it to the cumulative cancer risk criterion of ≤1 x 10^{-5}.

Washington Closure Hanford CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	10/28/2014	Calc. No.:	0100H-CA-V0213	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	10/28/2014
Subject:	100-H-49:1 Subsite Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater					Sheet No.	2 of 3

METHODOLOGY:

The 100-H-49:1 subsite underwent verification focused sampling at six locations including one duplicate sample. The protection of groundwater hazard quotient and carcinogenic risk calculations for the 100-H-49:1 subsite were conservatively calculated for the entire waste site using the greatest of the maximum soil sample results (WCH 2014). Of the contaminants of potential concern (COPCs) for this site, boron and the detected polycyclic aromatic hydrocarbons required an HQ and risk calculation because these analytes were detected and a Washington State or Hanford Site background value is not available, and the distribution coefficient is less than that necessary to show no migration to groundwater in 1,000 years using the generic site RESRAD model (BHI 2005). Based on this model and a vadose zone of approximately 11 m (36 ft) thickness, a K_d of 6.6 or greater is required to show no predicted migration to groundwater in 1,000 years. Arsenic was detected above background and the distribution coefficient is less than that necessary; however, the arsenic cleanup level is not toxicity based, therefore HQ and risk calculations for arsenic are not performed. All other site nonradionuclide COPCs were not detected, quantified below background levels, or have a K_d greater than or equal to 6.6. An example of the HQ and risk calculations for soil constituents with a potential impact to groundwater is presented below:

1) The hazard quotient is defined as the ratio of the dose of a substance obtained over a specified time (mg/kg/day) to a reference dose for the same substance derived over the same specified time (mg/kg/day). The hazard quotient can also be calculated as the ratio of the concentration in soil (maximum or statistical value) (mg/kg) to the soil RAG (mg/kg) for protection of groundwater, where the RAG is the groundwater cleanup level (mg/L) (calculated with, and related to the hazard quotient through, WAC 173-340-720(3)(a)(ii)(A), 1996) x 100 x 1 mg/1000 mg (conversion factor). This is based on the "100 times rule" of WAC 173-340-740(3)(a)(ii)(A) (1996). For example, the maximum value for boron of 4.1 mg/kg divided by the noncarcinogenic RAG value of 320 mg/kg is 1.3×10^{-2}. Comparing this value 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. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The cumulative HQ for the 100-H-49:1 subsite is 1.4×10^{-2}. Comparing this value to the requirement of ≤1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value and multiplied by 1×10^{-6}. For this site, there were not any constituents detected above background and/or above a Kd value of 6.6 that had a carcinogenic RAG. Therefore, the requirement of ≤1×10^{-6} 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. To avoid errors due to intermediate rounding, the individual cancer risk values prior to rounding are used for this calculation. For this site, there were not any constituents detected above background and/or above a Kd value of 6.6 that had a carcinogenic RAG. Therefore, the requirement of ≤1×10^{-5} is met.

5) The soil cleanup RAGs for protection of groundwater are based on the "100 times" provision in WAC 173-340-740(3)(a)(ii)(A). WAC 173-340-740(3)(a)(ii)(A) (1996) provides the "100 times

Washington Closure Hanford		CALCULATION SHEET					
Originator:	J. D. Skoglie	Date:	10/28/2014	Calc. No.:	0100H-CA-V0213	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	10/28/2014
Subject:	100-H-49:1 Subsite Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater					Sheet No.	3 of 3

rule" but also states "unless it can be demonstrated that a higher soil concentration is protective of ground water at the site." When the "100 times rule" values are exceeded, RESRAD was used to demonstrate that higher soil concentrations may be protective of groundwater.

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 calculations.

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-H-49:1 Subsite.

Contaminants of Potential Concern	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Arsenic [c]	7.8	20	--	0.667	--
Boron	4.1	320	1.3E-02	--	--
Polycyclic Aromatic Hydrocarbons					
Acenapthene	0.082	96	8.5E-04	--	--
Naphthalene	0.013	16	8.1E-04	--	--
Totals					
Cumulative Hazard Quotient:			**1.4E-02**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:

[a] = From WCH (2014).

[b] = Value obtained from the Cleanup Levels and Risk Calculations (CLARC) database using Groundwater, Method B, results and the "100 times" model.

[c] = The arsenic cleanup level of 20 mg/kghas been agreed to by the Tri-Party Agreement Project Managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009b).

-- = not applicable

RAG = remedial action goal

CONCLUSION:

This calculation demonstrates that the 100-H-49:1 subsite meets the requirements for the hazard quotient and excess carcinogenic risk for protection of groundwater as identified in the RDR/RAWP (DOE-RL 2009).

APPENDIX D

DATA QUALITY ASSESSMENT

APPENDIX D

DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING

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 (WCH 2014b). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP) (DOE-RL 2009).

A review of the sample design (WCH 2014b), the field logbook (WCH 2014a), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design.

To ensure quality data, the 100 Area SAP (DOE-RL 2009) data assurance requirements *Data Validation Procedure for Chemical Analysis* (BHI 2000) is 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 2006).

Verification data from samples collected at the 100-H-49:1 subsite were provided by the laboratory in one sample delivery group (SDG): SDG JP0852. SDG JP0852 was submitted for third-party validation. No major deficiencies were noted. Minor deficiencies are discussed for the 100-H-49:1 data set, as follows below. If no comments are made about a specific analysis, it should be assumed that no deficiencies affecting the quality of the data were found.

MINOR DEFICIENCIES

SDG JP0852

This SDG comprises seven focused soil samples (J1TXL1 through J1TXL7) from the 100-H-49:1 excavations, where sample J1TXL7 is a duplicate of sample J1TXL1. All samples were analyzed for inductively coupled plasma (ICP) metals, mercury, pesticides, total petroleum hydrocarbons (TPH), diesel and motor oil range, polycyclic aromatic hydrocarbons (PAH), and polychlorinated biphenyls (PCBs). Additionally, an equipment blank (J1TXL8) is included in SDG JP0852, which was analyzed for ICP metals, mercury, and PAHs. SDG JP0852 was submitted for third-party validation. No major deficiencies were identified in these data. Minor deficiencies are as follows.

In the TPH analysis, diesel range organics (C10-C28) were detected in the method blank at low concentrations. Similar concentrations of TPH-diesel were detected in sample J1TXL7.

Third-party validation qualified this result as undetected with a "U" flag and raised the reported value to the required quantitation limit. This data point will have no impact on the evaluation of the 100-H-49:1 subsite. The data are usable for decision-making purposes.

In the TPH analysis, matrix spike (MS) (241%) and matrix spike duplicate (MSD) (173%), results for the diesel range organics are outside quality control (QC) limits. Third-party validation qualified all detected diesel range organic results in SDG JP0852 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the TPH analysis, relative percent differences (RPDs) calculated between the MSs and MSDs for diesel range organics are outside QC limits at 74% and 55%. Third-party validation qualified all diesel range organics as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, MS recoveries for antimony (53%) and silicon (15%) are outside QC limits. Third-party validation qualified all antimony and silicon results as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory control sample recovery for silicon (11%) is outside QC limits. Third-party validation qualified all silicon results as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the PAH analysis, due to MS recoveries outside the QC limits, the anthracene (0%) and benzo(g,h,i)perylene (48%) results in sample J1TXL3 were qualified as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the PAH analysis, due to RPDs outside the QC limits, the anthracene (200%) and benzo(g,h,i)perylene (46%) results in sample J1TXL3 were qualified by third-party validation as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the pesticide analysis, MS and MSD recoveries for aroclor-1260 (-1%, -6%) are outside QC limits. Third-party validation qualified all aroclor-1260 results as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the pesticide analysis, no MS, MSD, or laboratory control sample was prepared for toxaphene. Toxaphene is a mixture of compounds that would interfere with the other analytes if included in those QC samples. Third-party validation qualified all toxaphene results as estimated with "J" flags. Estimated data are usable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

Relative percent difference 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 logbook (WCH 2014a) are shown in Table D-1. The main and QA/QC sample results are presented in Appendix C.

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

Sample Area	Main Sample	Duplicate Sample
FS-1	J1TXL1	J1TXL7

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 sample/duplicate pair(s) for each contaminant of potential concern. Relative percent differences are not calculated for analytes that are not detected in both the main and duplicate sample at more than five times the target detection limit. Relative percent differences 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 calculation brief in Appendix C provides details on duplicate pair evaluation and RPD calculation.

Only the RPD calculated for silicon (32.5%) in the field duplicate pair (J1TXL1, J1TXL7) was above the acceptance criteria of 30%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. The data are usable 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) is less than five times the target detection limit, including undetected analytes. In these cases, a control limit of ±2 times the target detection limit is used (Appendix C) to indicate that a visual check of the data is required by the reviewer. None of the analytes in the 100-H-49:1 data set required this check.

A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are usable 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-H-49:1 subsite 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-H-49:1 subsite concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for decision-making purposes.

The verification sample analytical data are stored in the Washington Closure Hanford 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.

REFERENCES

BHI, 2000, *Data Validation Procedure for Chemical Analysis*, BHI-01435, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

DOE-RL, 2009, *100 Area Remedial Action Sampling and Analysis Plan,* DOE/RL-96-22, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 2006, *Guidance on Systematic Planning Using the Data Quality Objectives Process*, EPA QA/G-4, EPA/240/B-06/001, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.

WCH, 2014a, *100H Field Remediation and Sampling*, Logbook EL-1627-08, pp. 55-57, Washington Closure Hanford, Richland, Washington.

WCH, 2014b, *Work Instruction for Verification Sampling of the 100-H-49:1,184-H Boiler House and 1717-H Hot Shop French Drains Waste Site*, 0100H-WI-G0065, Rev. 0, Washington Closure Hanford, Richland, Washington.