Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

15-AMRP-0071

JAN 26 2015

Ms. J. A. Hedges, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton Blvd.
Richland, Washington 99354

Dear Ms. Hedges:

TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM AND SUPPORTING DOCUMENTATION FOR THE 100-D-84:2, SANITARY SEWER PIPELINES – AREAS 3 AND 4 SUBSITE, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2014-096 and supporting documentation for the, "Remaining Sites Verification Package for the 100-D-84, Sanitary Sewer Pipelines – Areas 3 and 4 Subsite" Rev. 0. If you have questions, please contact me or your staff may contact Tom Post, of my staff, at (509) 376-3232.

Sincerely,

Mark S. French, Director
River Corridor Division

AMRP:TCP

Attachment

cc w/attach:
N. M. Menard, Ecology
Administrative Record, H6-08

cc w/o attach:
R. D. Cantwell, WCH
S. L. Feaster, WCH
D. L. Plung, WCH
J. P. Shearer, CHPRC

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-DR-1 **Control No.:** 2014-096

Waste Site Code(s)/Subsite Code(s): 100-D-84:2

Reclassification Category: Interim ☒ Final ☐

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

Approvals Needed: DOE ☒ Ecology ☒ EPA ☐

Description of current waste site condition:

The 100-D-84:2, Sanitary Sewer Pipelines – Areas 3 and 4 subsite, part of the 100-DR-1 Operable Unit, 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). The 100-D-84:2 subsite was subsequently recommended for remedial action.

Remedial action at the 100-D-84:2 Area 3 pipeline segment was performed on April 7, 2014. The depth of the remediation extends approximately 3 m (10 ft) below ground surface resulting in approximately 170 bank cubic meters (222 bank cubic yards) of soil and debris being removed for disposal at the Environmental Restoration Disposal Facility (ERDF). The waste material was staged prior to loadout to ERDF; therefore, a waste staging pile area was created. There is no overburden soil stockpile associated with the 100-D-84:2 subsite. No stained soil or anomalous materials were encountered during the remediation.

Due to the location of the 100-D-84:2 Area 4 pipeline segment being in close proximity to an active water line, the Area 4 pipeline segment is closed in place without remediation. Several small potholes approximately 46 to 61 cm (18 to 24 in.) deep were excavated by hand to locate the 100-D-84:2 Area 4 pipeline to collect a sample of the pipe contents and the underlying soil. No pipeline was encountered; therefore, a focused verification soil sample was collected from the pothole location closest to where the pipeline would have entered the drain field.

Verification sampling continued on July 14, 15, and 30, 2014. The sampling was performed to determine if the waste site met the remedial action objectives (RAOs) and remedial action goals (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 ERDF, (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-D-84:2 subsite demonstrate that the site meets the RAOs 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-D-84:2, Sanitary Sewer Pipelines – Areas 3 and 4 Subsite* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-DR-1 **Control No.:** 2014-096

Waste Site Code(s)/Subsite Code(s): 100-D-84:2

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	J P Neath	12/12/14
DOE Federal Project Director (printed)	Signature	Date
N. Menard	Nina M. Menard	12/16/14
Ecology Project Manager (printed)	Signature	Date
NA		
EPA Project Manager (printed)	Signature	Date

Rev. 0

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-D-84:2, SANITARY SEWER PIPELINES – AREAS 3 AND 4 SUBSITE

Attachment to Waste Site Reclassification Form 2014-096

January 2015

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-D-84:2, SANITARY SEWER PIPELINES – AREAS 3 AND 4 SUBSITE

EXECUTIVE SUMMARY

The 100-D-84:2, Sanitary Sewer Pipelines – Areas 3 and 4 subsite, part of the 100-DR-1 Operable Unit, is part of the 100-D-84, 100-D Sanitary Sewer pipelines waste site. The 100-D-84 waste site 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, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (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* (EPA 2009). The *Work Instruction for Confirmatory Sampling of the 100-D-84, 100-D Sanitary Sewer Pipelines* (WCH 2010) included Areas 3 and 4; however, they were not sampled. Areas 3 and 4 were administratively moved to the 100-D-84:2 subsite, and the subsite was recommended for remedial action (WCH 2011a).

Remedial action at the 100-D-84:2 Area 3 pipeline segment was performed on April 7, 2014. The depth of the remediation extends approximately 3 m (10 ft) below ground surface resulting in approximately 170 bank cubic meters (222 bank cubic yards) of soil and debris being removed for disposal at the Environmental Restoration Disposal Facility (ERDF). The waste material was staged prior to loadout to ERDF; therefore, a waste staging pile area was created. There is no overburden soil stockpile associated with the 100-D-84:2 subsite. No stained soil or anomalous materials were encountered during the remediation.

Due to the location of the 100-D-84:2 Area 4 pipeline segment being in close proximity to an active water line, the Area 4 pipeline segment is closed in place without remediation as discussed at the April 9, 2104 100-D-/H weekly interface meeting and documented in the 100-D/H Interface Meeting Minutes (WCH 2014b). Several small potholes approximately 46 to 61 cm (18 to 24 in.) deep were excavated by hand to locate the 100-D-84:2 Area 4 pipeline to collect a sample of the pipe contents and the underlying soil. No pipeline was encountered; therefore, a focused verification soil sample was collected on April 7, 2014, from the pothole location closest to where the pipeline would have entered the drain field.

Verification sampling continued on July 14, 15, and 30, 2014. A summary of the cleanup evaluation for the soil sampling results against the applicable remedial action goals (RAGs) is presented in Table ES-1.

Table ES-1. Summary of Remedial Action Goals for the 100-D-84:2 Subsite. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain a dose rate of <15 mrem/yr above background over 1,000 years.	Radionuclides were not COPCs for the 100-D-84:2 subsite.	NA
Direct Exposure – Nonradionuclides	Attain individual COPC direct exposure RAGs.	All individual COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	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-D-84:2 subsite (3.3×10^{-2}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk for individual carcinogens is $<1 \times 10^{-6}$.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The cumulative excess cancer risk (3.8×10^{-7}) is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not COPCs for the 100-D-84:2 subsite.	NA
	Attain National Primary Drinking Water Regulations [a]: 4 mrem/yr (beta/gamma) dose standard to target receptor/organ.		
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5 [b].		
	Meet total uranium standard of 30 µg/L (21.2 pCi/L) [c].		

Table ES-1. Summary of Remedial Action Goals for the 100-D-84:2 Subsite. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and Columbia River cleanup requirements.	Benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene 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 the 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 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), residual concentrations of benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene are not predicted to migrate vertically in 1,000 years (based on the lowest soil-partitioning coefficient of these contaminants [benzo(a)anthracene] of 360 mL/g). A contaminant with a soil-partitioning coefficient of 80 mL/g or greater is not predicted to migrate vertically through the soil. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and consequently are protective of the Columbia River.

COPC = contaminant of potential concern
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)

The results of the verification sampling were used to make reclassification decisions for the 100-D-84:2 subsite in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011).

In accordance with this evaluation, the verification sampling results and modeling support a reclassification of this site to Interim Closed Out. The current site conditions achieve the remedial action objectives and the corresponding RAGs established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2009b) and the 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 sampling and modeling results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft] deep), and 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-D-84:2 subsite contaminants of potential concern and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* 173-340, "Model Toxics Control Act – Cleanup," were exceeded for barium, boron, selenium, and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, cadmium, manganese, selenium, and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the concentrations of antimony, cadmium, manganese, and vanadium are below the Hanford Site or Washington State background values, 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-D-84:2, SANITARY SEWER PIPELINES – AREAS 3 AND 4 SUBSITE

STATEMENT OF PROTECTIVENESS

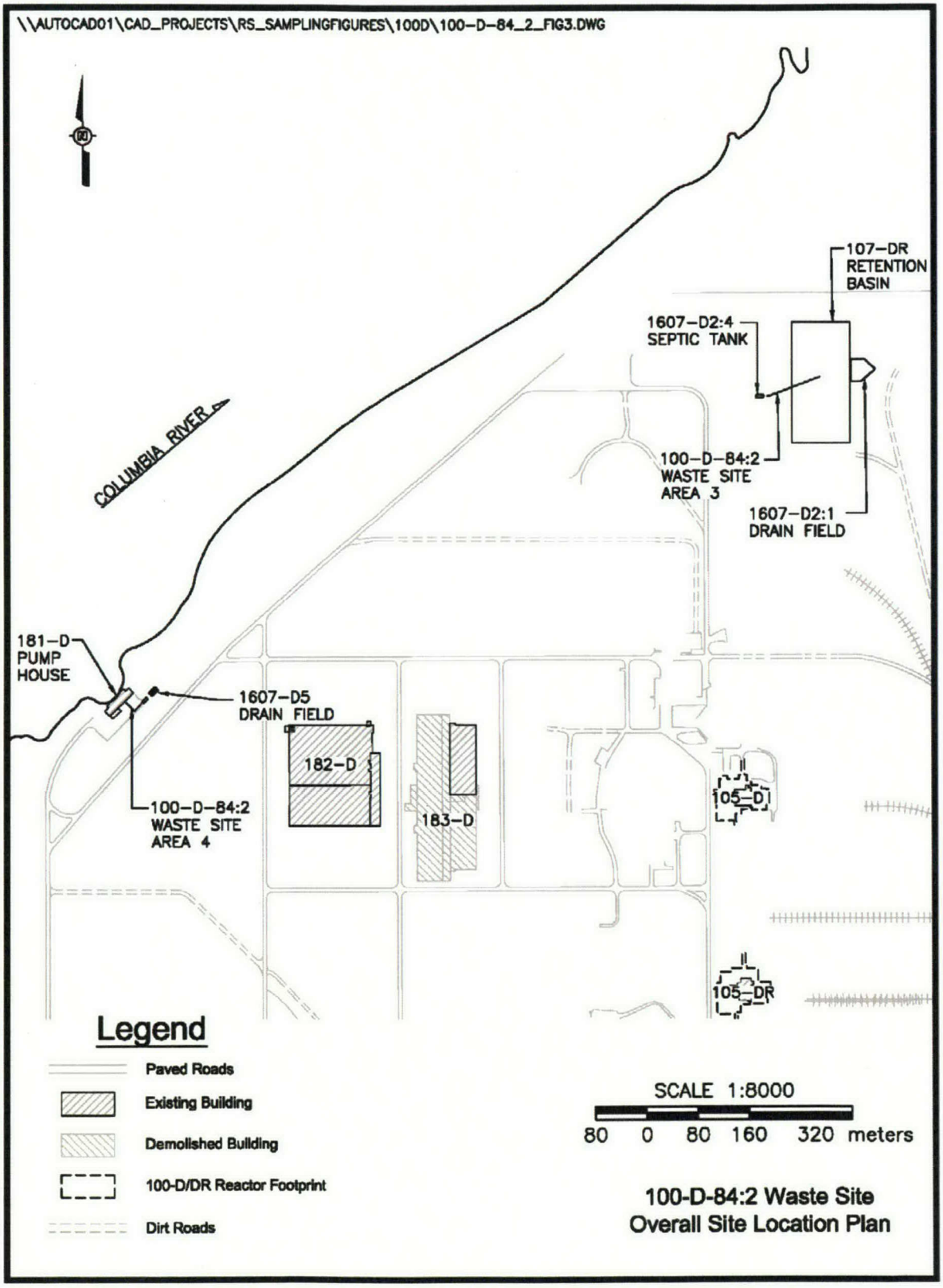
The 100-D-84:2 subsite cleanup verification sampling data, site evaluations, and supporting documentation demonstrate that this site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record 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* (Remaining Sites ROD) (EPA 1999). The results of verification sampling and modeling show that residual soil 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.

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-D-84:2 subsite contaminants of potential concern (COPCs) and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for barium, boron, selenium, and vanadium. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for antimony, cadmium, manganese, selenium, and vanadium. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the concentrations of antimony, cadmium, manganese, and vanadium are below the Hanford Site or Washington State background values, 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-D-84:2, Sanitary Sewer Pipelines – Areas 3 and 4 subsite, located within the 100-DR-1 Operable Unit, is part of the 100-D-84, 100-D Sanitary Sewer pipelines waste site. The 100-D-84:2 subsite consists of piping located in two separate areas associated with the 1607-D2 and 1607-D5 septic systems (Figure 1).

Figure 1. 100-D-84:2 Areas 3 and 4 Waste Site Location Map.



Area 3 includes one pipeline segment approximately 40 m (132 ft) long located adjacent to the location of the former 116-DR-9, 107-DR Retention Basin, shown in Figure 1. This pipeline segment was associated with the 1607-D2:4 septic tank and originally carried waste from the septic tank to the location of the 1607-D2:1 Abandoned Tile Field (BHI 1999a, 1999b). Most of the 100-D-84:2 Area 3 pipeline was removed in 1950 when the 107-DR Retention Basin was built.

Area 4 includes one pipeline segment east of the 181-D River Pump House that carried sanitary waste from the 181-D River Pump House to the 1607-D5 septic tank.

CONFIRMATORY SAMPLING ACTIVITIES

The 100-D-84:2, Sanitary Sewer Pipelines – Areas 3 and 4 subsite, located within the 100-DR-1 Operable Unit, is part of the 100-D-84, 100-D Sanitary Sewer Pipelines waste site. The 100-D-84 waste site was added to the Remaining Sites ROD (EPA 1999) by the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (EPA 2009) as a candidate site for confirmatory sampling.

The *Work Instruction for Confirmatory Sampling of the 100-D-84, 100-D Sanitary Sewer Pipelines* (WCH 2010) included Areas 3 and 4; however, they were not sampled. Areas 3 and 4 were administratively moved to the 100-D-84:2 subsite, and the subsite was recommended for remediation based on historical information and professional knowledge about related waste sites (WCH 2011a).

REMEDIAL ACTION SUMMARY

Remedial action at the 100-D-84:2 Area 3 subsite was performed on April 7, 2014. The depth of the remediation extended approximately 3 m (10 ft) below ground surface resulting in approximately 170 bank cubic meters (222 bank cubic yards) of soil and debris being removed for disposal at the Environmental Restoration Disposal Facility (ERDF). The debris consisted primarily of the vitrified clay pipeline. The waste material was staged prior to loadout to ERDF; therefore, a waste staging pile area (SPA) was created. No overburden soil was stockpiled for use as backfill. No stained soil or anomalous materials were encountered during the remediation.

Due to the location of the 100-D-84:2 Area 4 pipeline segment being in close proximity to an active water line, the Area 4 pipeline segment is closed in place without remediation (WCH 2014b). Several small potholes approximately 46 to 61 cm (18 to 24 in.) deep were excavated by hand to locate the 100-D-84:2 Area 4 pipeline to collect a sample of the pipe contents and the underlying soil. No pipeline was encountered; therefore, a focused verification soil sample was collected from the pothole location closest to where the pipeline would have entered the drain field. The verification soil sample is further discussed in the "Verification Sampling Activities" section of this remaining sites verification package.

A post-remediation boundary survey of the 100-D-84:2 Area 3 excavation and the waste staging pile area was conducted following remedial action activities (Figure 2). The waste site boundary survey overlaid on the Waste Information Data System boundary is provided in Figure 3. A photograph of the waste site during remediation is provided in Figure 4.

No in-process soil samples were collected from the 100-D-84:2 subsite.

VERIFICATION SAMPLING ACTIVITIES

One focused verification soil sample (J1THH2) was collected on April 7, 2014, from the Area 4 pothole location closest to where the pipeline would have entered the drain field.

Verification soil sampling was continued on July 14, 15, and 30, 2014, per the *Work Instruction for Verification Sampling of the 100-D-84:2, Sanitary Sewer Pipelines – Areas 3 and 4* (WCH 2014c). 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 B and indicate that the waste removal action achieved compliance with the remedial action objectives (RAOs) and remedial action goals (RAGs) for the 100-D-84:2 subsite. The following subsections provide additional discussion of the information used to develop the verification sampling design. The statistical results of verification sampling are also summarized to support interim closure of the site.

Contaminants of Potential Concern

The 100-D-84:2, Sanitary Sewer Pipelines – Areas 3 and 4 subsite consisted of piping located in two separate areas associated with the 1607-D2 and 1607-D5 septic systems (Figure 1).

Area 3 included one pipeline segment associated with the 1607-D2:4 septic tank and originally carried waste from the septic tank to the location of the 1607-D2:1 Abandoned Tile Field (BHI 1999a, 1999b). The COPCs identified for the 1607-D2:4 septic tank and 1607-D2:1 tile field included europium-152, uranium-235, uranium-238, hexavalent chromium, lead, mercury, bis(2-ethylhexyl)phthalate, and polychlorinated biphenyls (PCBs) (BHI 1999b). No radiological contamination was detected during remediation; therefore, radionuclides were eliminated as COPCs for the 100-D-84:2 Area 3 pipeline segment. Nitrate and nitrite were added because the pipeline carried septic waste.

The COPCs for the 100-D-84:2 Area 3 pipeline segment included hexavalent chromium, lead, mercury, nitrate, nitrite, PCBs, and semivolatile organic compounds (SVOCs). Although not considered COPCs, the expanded list of inductively coupled plasma (ICP) metals also included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

Figure 2. 100-D-84:2 Area 3 Post-Excavation Boundary and Waste Staging Pile Area.

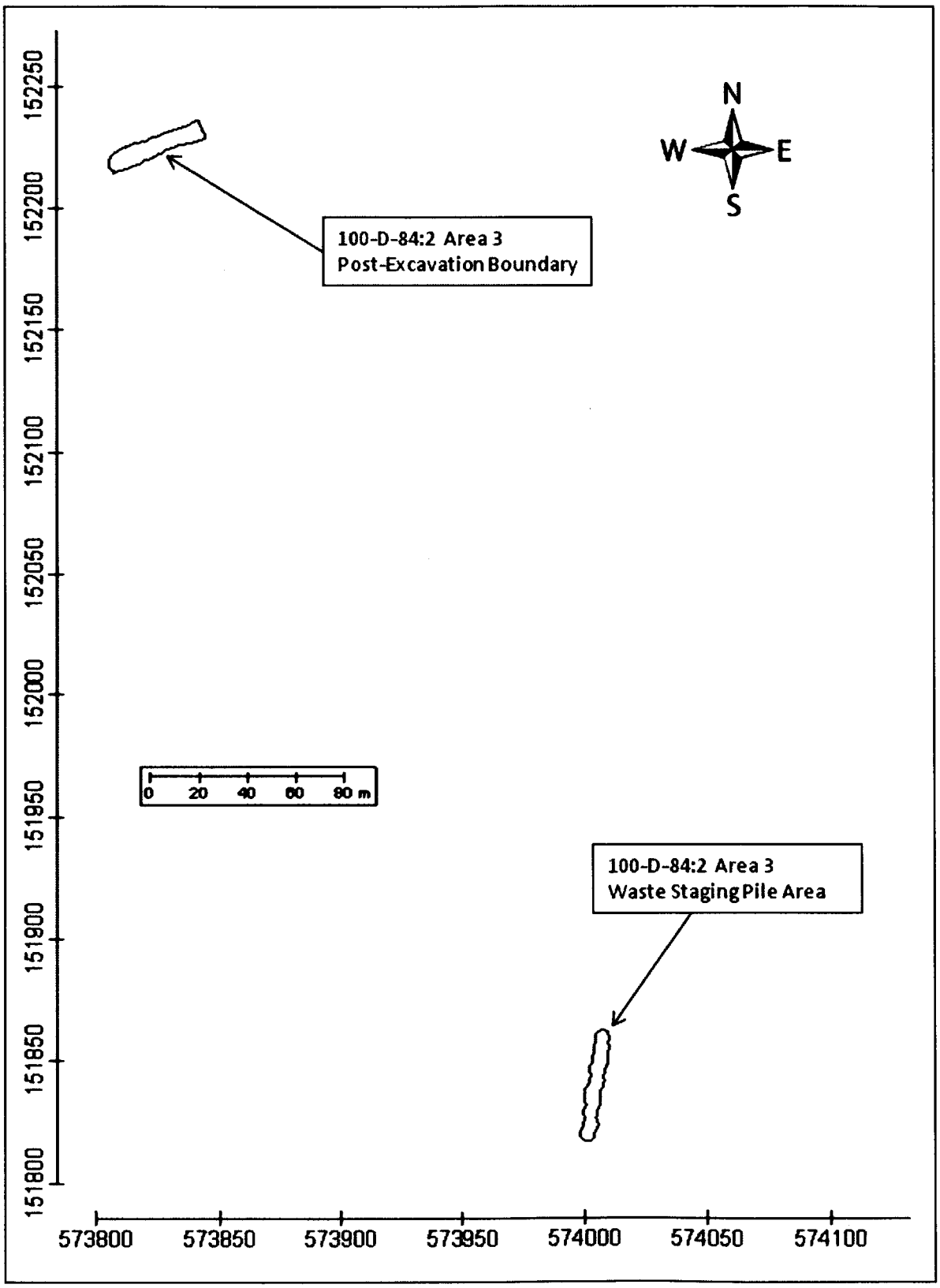


Figure 3. 100-D-84:2 Area 3 Post-Remediation Boundary with Waste Information Data System Boundary Overlaid.

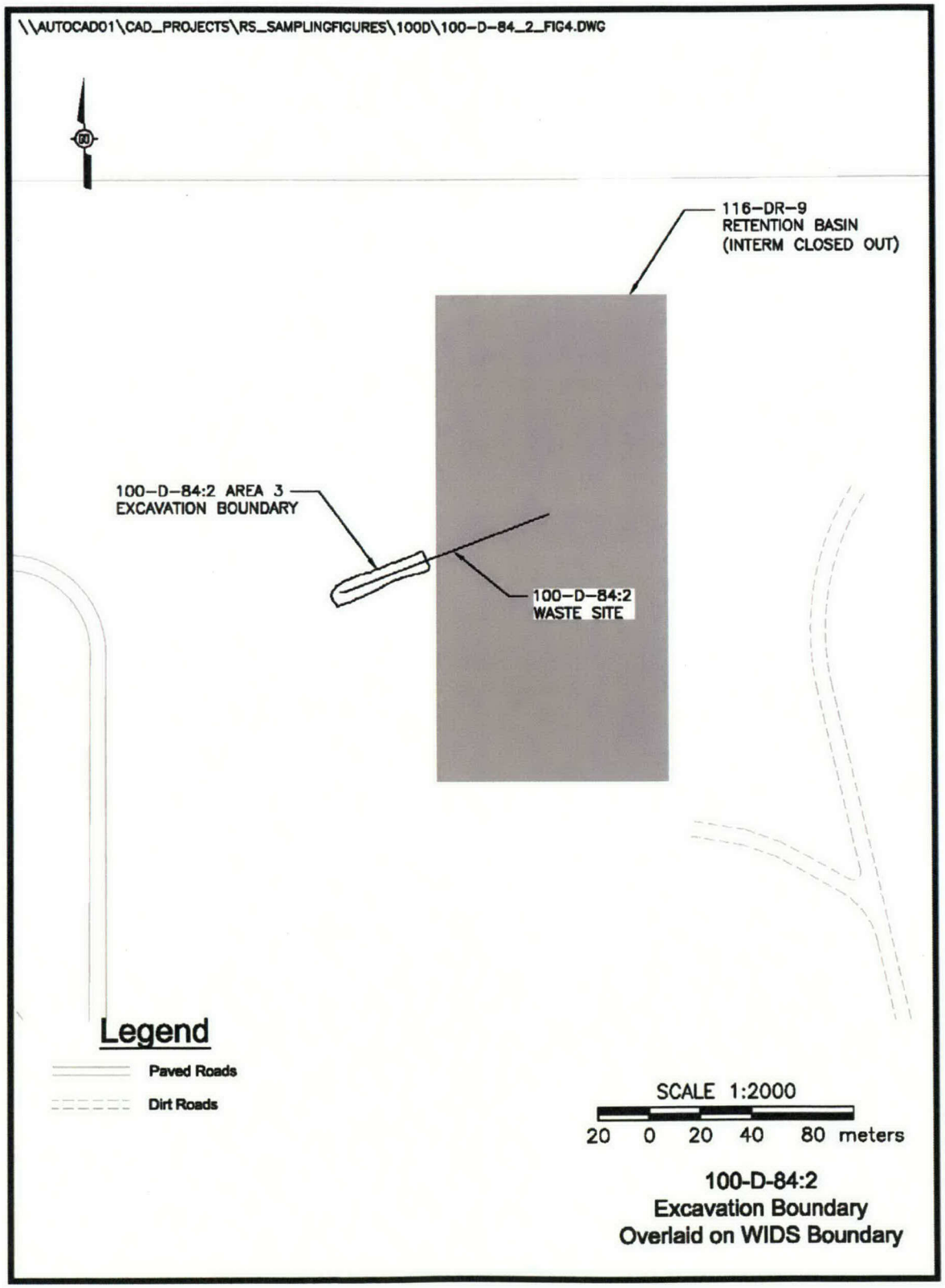


Figure 4. Photograph of the 100-D-84:2 Subsite During Remediation.

100-D-84:2 Area 4

Area 4 included one pipeline segment east of the 181-D River Pump House that carried sanitary waste from the pump house to the 1607-D5 septic tank. The COPCs identified for the 1607-D5 septic tank and drain field, which was remediated in 2010 (WCH 2011b), included antimony, barium, cadmium, chromium, copper, lead, molybdenum, selenium, zinc, mercury, hexavalent chromium, nitrate, nitrite, pesticides, polycyclic aromatic hydrocarbons (PAH), PCBs, SVOCs, and total petroleum hydrocarbons (TPH). These COPCs were retained for the focused verification soil sample collected to support closure of the 100-D-84:2 Area 4 pipeline segment. Although not considered COPCs, the expanded list of ICP metals also included arsenic, beryllium, boron, cobalt, manganese, nickel, silver, and vanadium.

The analytical methods that were performed to evaluate the site COPCs are provided in Table 1.

Table 1. Laboratory Analytical Methods for 100-D-84:2 Areas 3 and 4.

Analytical Method	Contaminants of Potential Concern
ICP metals [a] – EPA Method 6010	Antimony, barium, cadmium, chromium, copper, lead, molybdenum, selenium, and zinc
Mercury – EPA Method 7471	Mercury
Hexavalent chromium – EPA Method 7196	Hexavalent chromium
Nitrate/Nitrite – EPA Method 353.2	Nitrate, nitrite
PAH – EPA Method 8310	Polycyclic aromatic hydrocarbons
PCBs – EPA Method 8082	Polychlorinated biphenyls
Pesticides – EPA Method 8081	Pesticides
SVOA – EPA Method 8270	Semivolatile organic compounds
TPH – NWTPH-Dx	Total petroleum hydrocarbons

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

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
NWTPH-Dx = Northwest total petroleum hydrocarbons – diesel range organics
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbons

Verification Sample Design

Three decision units were identified for the 100-D-84:2 pipeline subsite; specifically, the Area 3 excavation, the Area 4 pipeline segment, and the waste SPA. Twelve statistical soil samples were collected from the Area 3 and waste SPA decision units, and 1 focused soil sample was collected from the Area 4 decision unit. Additionally, one duplicate and one split sample were collected from the Area 3 and SPA decision units, and one equipment blank was collected for the 100-D-84:2 subsite.

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). All samples were grab samples collected at the predetermined coordinates.

Additional information related to verification sampling can be found in the field sampling logbook (WCH 2014a). The verification sample summary is provided in Table 2, and the sample locations are shown in Figures 5 and 6.

Table 2. 100-D-84:2 Verification Sample Summary Table.

Sample Location	HEIS Sample Number	Washington State Plane		Sample Analysis
		Northing (m)	Easting (m)	
Area 3 Excavation				
EXC-1	J1TW21	152219.1	573806.7	ICP metals [a], mercury, hexavalent chromium, NO_2/NO_3, PCB, SVOA
EXC-2	J1TW22	152219.1	573812.0	
EXC-3	J1TW23	152219.1	573817.4	
EXC-4	J1TW24	152223.7	573814.7	
EXC-5	J1TW25	152223.7	573820.0	
EXC-6	J1TW26	152223.7	573825.3	
EXC-7	J1TW27	152228.3	573822.7	
EXC-8	J1TW28	152228.3	573828.0	
EXC-9	J1TW29	152228.3	573833.3	
EXC-10	J1TW30	152228.3	573838.7	
EXC-11	J1TW31	152232.9	573836.0	
EXC-12	J1TW32	152232.9	573841.3	
Duplicate of EXC-2	J1TW33	152219.1	573812.0	
Waste Staging Pile Area				
SPA-1	J1TW34	151819.9	573999.0	ICP metals [a], mercury, hexavalent chromium, NO_2/NO_3, PCB, SVOA
SPA-2	J1TW35	151819.9	574004.0	
SPA-3	J1TW36	151824.2	574001.5	
SPA-4	J1TW37	151828.6	574004.0	
SPA-5	J1TW38	151832.9	574001.5	
SPA-6	J1TW39	151837.3	574004.0	
SPA-7	J1TW40	151841.6	574006.5	
SPA-8	J1TW41	151846.0	574004.0	
SPA-9	J1TW42	151850.3	574006.5	
SPA-10	J1TW43	151854.7	574004.0	
SPA-11	J1TW44	151854.7	574009.0	
SPA-12	J1TW45	151859.0	574006.5	
Duplicate of SPA-1	J1TW46	151819.9	573999.0	
Area 4 Focused Sample				
Area 4, FS	J1THH2	151738.3	572828.2	ICP metals [a], mercury, hexavalent chromium, NO_2/NO_3, PAH [b], PCB, pesticides, SVOA [b], TPH
Equipment blank	J1TW47	NA	NA	ICP metals [a], mercury, SVOA

[a] Analysis for the expanded list of ICP metals was performed to include antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

[b] Because Method 8310 (PAH) is specifically meant to analyze for PAH, data from this method will be used preferentially over Method 8270 (SVOA) data for evaluation of PAH analyses.

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbons

Figure 5. 100-D-84:2 Area 3 Pipeline Excavation Verification Sample Locations.

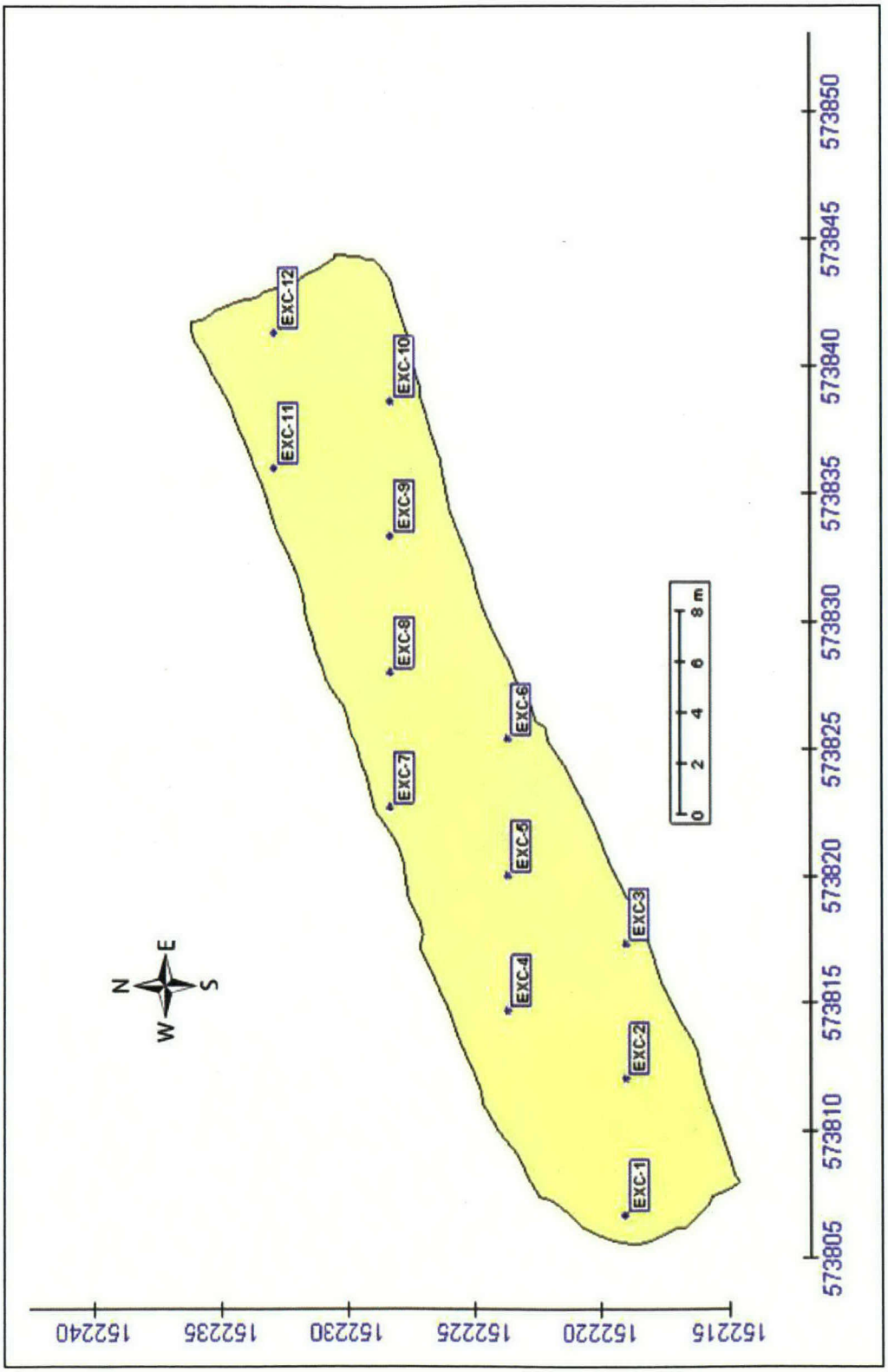
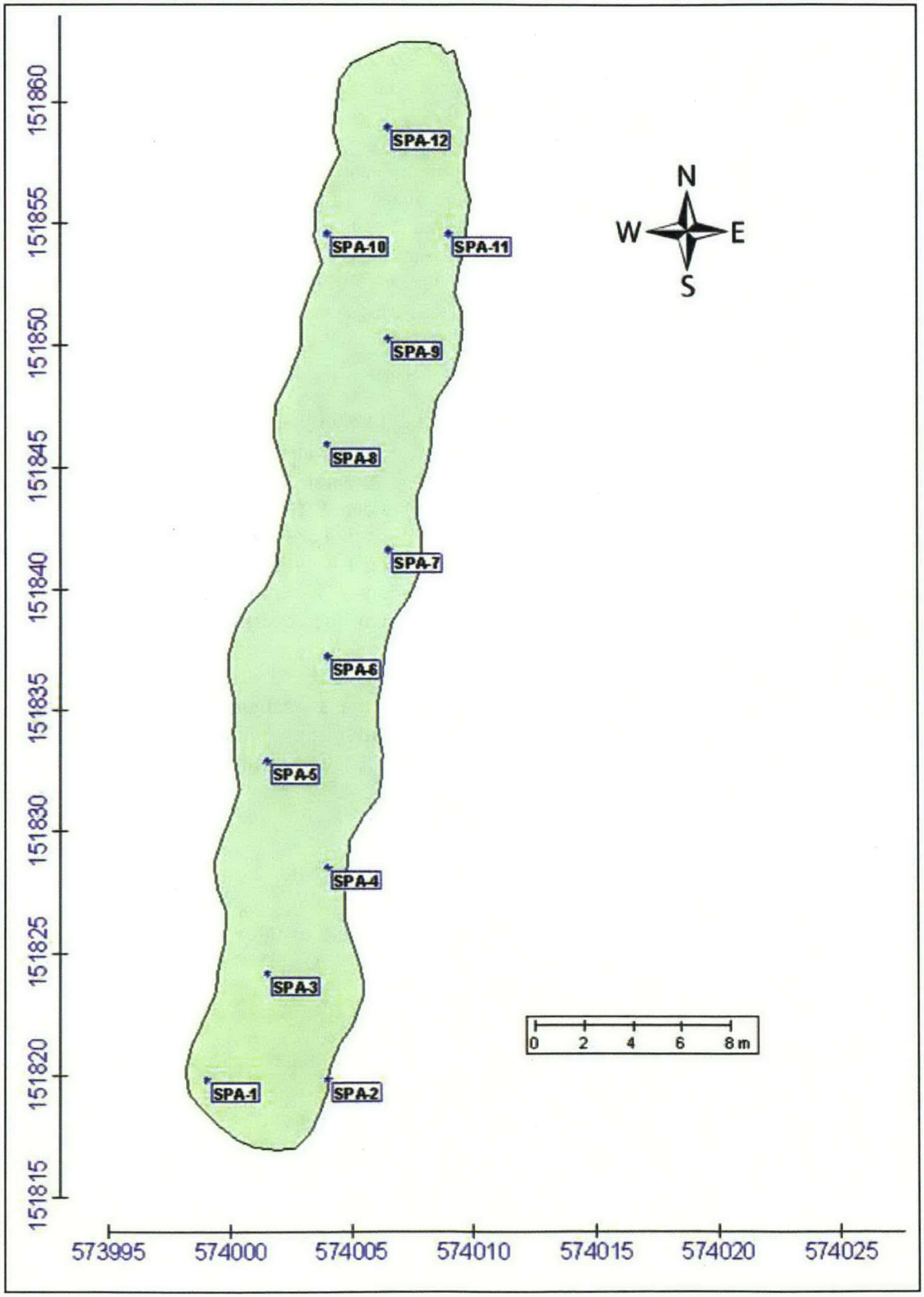


Figure 6. 100-D-84:2 Area 3 Waste Staging Pile Area Verification Sample Locations.



Verification Sample 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-D-84:2 subsite was performed by direct comparison of the statistical or maximum sample results for each COPC against the cleanup criteria.

The primary statistical calculation to evaluate compliance with cleanup standards is the 95% upper confidence limit (UCL) on the arithmetic mean of the data. The 95% UCL values for each detected COPC are computed for the 100-D-84:2 subsite decision units as specified by the 100 Area RDR/RAWP (DOE-RL 2009b). The calculations are provided in Appendix B. When a nonradionuclide COPC was detected in fewer than 50% of the verification samples collected for the decision unit, the maximum detected value was used for comparison to the RAGs. If no detections for a given COPC were reported in the data set, then no statistical calculation or evaluation was performed for that COPC.

Comparisons of the results for each COPC from the 100-D-84:2 subsite against the RAGs are summarized in Tables 3 through 5. 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 tables.

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 95% UCL calculations (Appendix B).

DATA EVALUATION

This section demonstrates that contaminant concentrations at the 100-D-84:2 subsite achieve 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).

Table 3. Comparison of Contaminant Concentrations to Action Levels for the 100-D-84:2 Area 3 Excavation Verification Samples. (2 Pages)

COPC	Statistical or Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony [c]	0.54 (<BG)	32	5 [d]	5 [d]	No	--
Arsenic	3.1 (<BG)	20 [d]	20 [d]	20 [d]	No	--
Barium	64.7 (<BG)	5,600	200	400	No	--
Beryllium	0.20 (<BG)	10.4 [e]	1.51 [d]	1.51 [d]	No	--
Boron [f]	1.4	7,200	320	-- [g]	No	--
Cadmium [c]	0.048 (<BG)	13.9 [e]	0.81 [d]	0.81 [d]	No	--
Chromium	9.0 (<BG)	80,000	18.5 [d]	18.5 [d]	No	--
Cobalt	8.7 (<BG)	24	15.7 [d]	-- [g]	No	--
Copper	13.6 (<BG)	2,960	59.2	22.0 [d]	No	--
Hexavalent chromium [f]	0.335	2.1 [e]	4.8	2	No	--
Lead	4.3 (<BG)	353	10.2 [d]	10.2 [d]	No	--
Manganese	306 (<BG)	3,760	512 [d]	512	No	--
Mercury	0.0094 (<BG)	24	0.33 [d]	0.33 [d]	No	--
Molybdenum [f]	0.55	400	8	-- [g]	No	--
Nickel	10.9 (<BG)	1,600	19.1 [d]	27.4	No	--
Selenium [c]	0.88	400	5	1	No	--
Vanadium	53.7 (<BG)	560	85.1 [d]	-- [g]	No	--
Zinc	43.6 (<BG)	24,000	480	67.8 [d]	No	--
Nitrogen in nitrate and nitrite	0.73 (<BG)	128,000	1,000	2,000	No	--
Benzo(a)anthracene	0.027	1.37	0.015 [h]	0.015 [h]	Yes	Yes [i]
Benzo(b)fluoranthene	0.033	1.37	0.015 [h]	0.015 [h]	Yes	Yes [i]
Chrysene	0.035	13.7	0.12	0.1 [h]	No	--
Fluoranthene	0.052	3,200	64	18.0	No	--

Table 3. Comparison of Contaminant Concentrations to Action Levels for the 100-D-84:2 Area 3 Excavation Verification Samples. (2 Pages)

COPC	Statistical or Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Phenanthrene [j]	0.017	24,000	240	1,920	No	--
Pyrene	0.027	2,400	48	192	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] Maximum or 95% upper confidence limit, depending on data censorship, as described in the *100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations* (Appendix B).
[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) (Ecology 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] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], Ecology 1996).
[f] No Hanford Site-specific or Washington State background value available.
[g] No parameters (bioconcentration factors or ambient water quality criteria values) are available from the Washington State Department of Ecology Cleanup Levels and Risk Calculations database or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], 1996 [Method B for surface waters]).
[h] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996).
[i] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of benzo(a)anthracene and benzo(b)fluoranthene are not predicted to migrate vertically within 1,000 years (based on the lowest soil-partitioning coefficient of the contaminants [benzo(a)anthracene] of 360 mL/g). A contaminant with a soil-partitioning coefficient of 80 mL/g or greater is not predicted to migrate vertically through the soil. Therefore, the residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River.
[j] Toxicity data for this chemical are not available. Cleanup levels are based on surrogate anthracene.

-- = not applicable
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

Table 4. Comparison of Contaminant Concentrations to Action Levels for the 100-D-84:2 Area 4 Focused Verification Sample. (2 Pages)

COPC	Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	2.9 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	146	5,600	200	400	No	--
Beryllium	0.43 (<BG)	10.4 [d]	1.51 [c]	1.51 [c]	No	--
Boron [e]	10.4	7,200	320	-- [f]	No	--
Chromium	8.4 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	7.4 (<BG)	24	15.7 [c]	-- [f]	No	--
Copper	13.0 (<BG)	2,960	59.2	22.0 [c]	No	--
Lead	4.2 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	285 (<BG)	3,760	512 [c]	512	No	--
Molybdenum [e]	0.38	400	8	-- [f]	No	--
Nickel	9.9 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	51.0 (<BG)	560	85.1 [c]	-- [f]	No	--
Zinc	41.7 (<BG)	24,000	480	67.8 [c]	No	--
TPH – diesel range	5.50	200	200	200	No	--
TPH – diesel range extended	12.0	200	200	200	No	--
Nitrogen in nitrate and nitrite	3.3 (<BG)	128,000	1,000	2,000	No	--
Benzo(a)anthracene	0.026 [g]	1.37	0.015 [h]	0.015 [h]	Yes	Yes [i]
Benzo(a)pyrene	0.022 [g]	0.137	0.015 [h]	0.015 [h]	Yes	Yes [i]
Benzo(b)fluoranthene	0.028 [g]	1.37	0.015 [h]	0.015 [h]	Yes	Yes [i]
Benzo(ghi)perylene [j]	0.019 [g]	2,400	48	192	No	--
Benzo(k)fluoranthene	0.0076 [g]	1.37	0.015 [h]	0.015 [h]	No	--
Chrysene	0.025 [g]	13.7	0.12	0.1 [h]	No	--
Fluoranthene	0.047 [g]	3,200	64	18.0	No	--
Indeno(1,2,3-cd)pyrene	0.015 [g]	1.37	0.33 [h]	0.33 [h]	No	--
Phenanthrene [j]	0.020 [g]	24,000	240	1,920	No	--
Pyrene	0.046 [g]	2,400	48	192	No	--

Table 4. Comparison of Contaminant Concentrations to Action Levels for the 100-D-84:2 Area 4 Focused Verification Sample. (2 Pages)

COPC	Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
DDE	0.0024	2.94	0.0257	0.0033 [h]	No	--
DDT	0.00085	2.94	0.0257	0.0033 [h]	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] Maximum, as described in the *100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations* (Appendix B).
[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (Ecology 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).
[d] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], Ecology 1996).
[e] No Hanford Site-specific or Washington State background value available.
[f] No parameters (bioconcentration factors or ambient water quality criteria values) are available from the Washington State Department of Ecology Cleanup Levels and Risk Calculations database or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], 1996 [Method B for surface waters]).
[g] Both EPA method 8310 (PAH) and method 8270 (SVOA) were requested. Because method 8310 is specifically meant to analyze for PAH, it is used preferentially over method 8270. Value reported is from method 8310.
[h] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996).
[i] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene are not predicted to migrate vertically within 1,000 years (based on the lowest soil-partitioning coefficient of the contaminants [benzo(a)anthracene] of 360 mL/g). A contaminant with a soil-partitioning coefficient of 80 mL/g or greater is not predicted to migrate vertically through the soil. Therefore, the residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River.
[j] Toxicity data for this chemical are not available. Cleanup levels are based on surrogate.
Contaminant: benzo(ghi)perylene; surrogate: pyrene
Contaminant: phenanthrene; surrogate: anthracene.

-- = not applicable
BG = background
COPC = contaminant of potential concern
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
PAH = polycyclic aromatic hydrocarbons
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity (dose model)
SVOA = semivolatile organic analysis (EPA method 8270)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Table 5. Comparison of Contaminant Concentrations to Action Levels for the 100-D-84:2 Waste Staging Pile Area Verification Samples. (2 Pages)

COPC	Statistical or Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony [c]	0.34 (<BG)	32	5 [d]	5 [d]	No	--
Arsenic	3.4 (<BG)	20 [d]	20 [c]	20 [d]	No	--
Barium	86.8 (<BG)	5,600	200	400	No	--
Beryllium	0.34 (<BG)	10.4 [e]	1.51 [d]	1.51 [d]	No	--
Boron [f]	2.1	7,200	320	-- [g]	No	--
Cadmium [c]	0.46 (<BG)	13.9 [e]	0.81 [d]	0.81 [d]	No	--
Chromium	10.7 (<BG)	80,000	18.5 [d]	18.5 [d]	No	--
Cobalt	8.6 (<BG)	24	15.7 [d]	-- [g]	No	--
Copper	16.7 (<BG)	2,960	59.2	22.0 [d]	No	--
Hexavalent chromium [f]	0.260	2.1 [e]	4.8	2	No	--
Lead	4.4 (<BG)	353	10.2 [d]	10.2 [d]	No	--
Manganese	318 (<BG)	3,760	512 [d]	512	No	--
Mercury	0.0090 (<BG)	24	0.33 [d]	0.33 [d]	No	--
Molybdenum [f]	0.46	400	8	-- [g]	No	--
Nickel	12.0 (<BG)	1,600	19.1 [d]	27.4	No	--
Vanadium	53.9 (<BG)	560	85.1 [d]	-- [g]	No	--
Zinc	40.9 (<BG)	24,000	480	67.8 [d]	No	--
Nitrate and nitrite as nitrogen	13.1	128,000	1,000	2,000	No	--
Benzo(a)anthracene	0.022	1.37	0.015 [h]	0.015 [h]	Yes	Yes [i]

Table 5. Comparison of Contaminant Concentrations to Action Levels for the 100-D-84:2 Waste Staging Pile Area Verification Samples. (2 Pages)

COPC	Statistical or Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Fluoranthene	0.039	3,200	64	18.0	No	--
Pyrene	0.034	2,400	48	192	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] Maximum or 95% upper confidence limit, depending on data censorship, as described in the *100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations* (Appendix B).
[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) (Ecology 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] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[3], Ecology 1996).
[f] No Hanford Site-specific or Washington State background value available.
[g] No parameters (bioconcentration factors or ambient water quality criteria values) are available from the Washington State Department of Ecology Cleanup Levels and Risk Calculations database or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], 1996 [Method B for surface waters]).
[h] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996).
[i] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentration of benzo(a)anthracene is not predicted to migrate vertically within 1,000 years (based on the soil-partitioning coefficient of 360 mL/g). A contaminant with a soil-partitioning coefficient of 80 mL/g or greater is not predicted to migrate vertically through the soil. Therefore, the residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River.

-- = not applicable
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

Attainment of Nonradionuclide RAGS

Tables 3 through 5 compare the cleanup verification sample values for the 100-D-84:2 subsite Area 3 excavation, Area 4, and SPA 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 benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene. However, given the lowest soil-partitioning coefficient (K_d) of these contaminants (benzo[a]anthracene) of 360 mL/g, none would be expected to migrate vertically in 1,000 years based on RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). A contaminant with a soil-partitioning coefficient of 80 mL/g or greater is not predicted to migrate vertically through the soil. Therefore, the residual concentrations of benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene are predicated to be protective of groundwater and the Columbia River.

Three-Part Test for Nonradionuclides

A RAG requirement for nonradionuclides is the WAC 173-340-740(7)(e) three-part test, which consists of the following criteria: (1) the cleanup verification 95% UCL value must be less than the cleanup level, (2) no single detection shall exceed two times the cleanup criteria, and (3) the percentage of samples exceeding the cleanup criteria must be less than 10% of the data set.

The application of the three-part test for the 100-D-84:2 subsite is included in the *100-D-84:2 Subsite Cleanup Verification 95% UCL Calculation* in Appendix B of this remaining sites verification package, where half or more of the data set was detected. The results of this evaluation indicate that residual COPC concentrations pass the three-part test in comparison against applicable RAGs.

An additional application of the three-part test is included for the statistical data sets that default to the maximum because less than half of the data set was detected. The results of this evaluation indicate that residual COPC concentrations pass the three-part test in comparison against applicable RAGs with the exception of benzo(a)anthracene and benzo(b)fluoranthene, which fail one or more parts of the three-part test to be protective of groundwater and the Columbia River. However, based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentration of these contaminants are not predicted to migrate vertically within 1,000 years (based on the lowest soil-partitioning coefficient of the contaminants [benzo(a)anthracene] of 360 mL/g). A contaminant with a soil-partitioning coefficient of 80 mL/g or greater is not predicted to migrate vertically through the soil. Therefore, the residual concentrations of benzo(a)anthracene and benzo(b)fluoranthene are predicted to be protective of groundwater and the Columbia River.

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-D-84:2 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 3.3×10^{-2}, 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 3.8×10^{-7}, which is less than 1×10^{-5}. The 100-D-84:2 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-D-84:2 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 16 m (52 ft) in thickness, a K_d of 4.6 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-D-84:2 subsite is 1.1×10^{-1}, which is less than 1.0. No carcinogenic constituents met the criteria for groundwater protection evaluation at the 100-D-84:2 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 2014c), 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-D-84:2 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 B. The detailed DQA is presented in Appendix C.

SUMMARY FOR INTERIM CLOSURE

The 100-D-84:2 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-D-84:2 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-D-84:2 Subsite [a].

Hazardous Substance		2001 WAC 173-340 Table 749-3			EPA Ecological Soil Screening Levels [b]				Maximum Result
		Plants	Soil Biota	Wildlife	Plants	Soil Biota	Avian [c]	Mammalian [c]	
	Background	Metals (mg/kg)							
Antimony	5	5	NA	NA	NA	78	NA	0.27	0.54 (<BG)
Barium	132	500	NA	102	NA	330	NA	2,000	146
Boron	NA	0.5	NA	NA	NA	NA	NA	NA	10.4
Cadmium	0.82	4	20	14	32	140	0.77	0.36	0.46 (<BG)
Manganese	512	1,100 [d]	NA	1,500	220	450	4,300	4,000	318 (<BG)
Selenium	0.78	1	70	0.3	0.52	4.1	1.2	0.63	0.88
Vanadium	85.1	2	NA	NA	NA	NA	7.8	280	53.9 (<BG)

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] 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.

BG = background
EPA = U.S. Environmental Protection Agency
NA = not available
WAC= *Washington Administrative Code*

APPENDIX B

CALCULATIONS

APPENDIX B

CALCULATION BRIEFS

The calculations provided in this appendix are copies of originals that are kept in the active Washington Closure Hanford project files and are available upon request. When the project is completed, the file 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 the following:

100-D-84:2 Subsite Cleanup Verification 95% UCL Calculation, 0100D-CA-V0546, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-D-84:2 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations, 0100D-CA-V0547, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-D-84:2 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater, 0100D-CA-V0548, 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-D Field Remediation **Job No. 14655**

Area: 100-D

Discipline: Environmental *Calculation No: 0100D-CA-V0546

Subject: 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculation

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 Sheets = 17 Attm. 1 = 16 Total = 34	R. J. Nielson	I. B. Berezovskiy	J. D. Skoglie	S. G. Wilkinson	1/6/15

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	R. J. Nielson RN	**Date**	09/18/14	**Calc. No.**	0100D-CA-V0546	**Rev. No.**	0
Project	100-D Field Remediation	**Job No.**	14655	**Checked**	I. B. Berezovskiy	**Date**	09/18/14
Subject	100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations					**Sheet No.**	1 of 17

Summary

Purpose:
Calculate the 95% upper confidence limit (UCL) values to evaluate compliance with cleanup standards for the subject site. Also, perform the *Washington Administrative Code* (WAC) 173-340-740(7)(e) Model Toxics Control Act (MTCA) 3-part test for nonradionuclide analytes and calculate the relative percent difference (RPD) for primary-duplicate sample pairs for each contaminant of concern (COC) and contaminant of potential concern (COPC), as necessary.

Table of Contents:
Sheets 1 to 5 - Calculation Sheet Summary
Sheets 6 to 11 - Calculation Sheet Verification Data Results - Excavation and Staging Pile Area
Sheets 12 to 15 - Ecology Software (MTCAStat) Results
Sheets 16 to 17 - Calculation Sheet Duplicate Analysis - Excavation and Staging Pile Area
Attachment 1 - 100-D-84:2, Verification Sampling Results (16 pages)

Given/References:
1) Sample Results (Attachment 1).
2) DOE-RL, 2009a, *100 Area Remedial Action Sampling and Analysis Plan* (SAP), DOE/RL-96-22, Rev.5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
3) DOE-RL, 2009b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
5) Ecology, 1993, *Statistical Guidance for Ecology Site Managers, Supplement S-6, Analyzing Site or Background Data with Below-detection Limit or Below-PQL Values (Censored Data Sets)*, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
6) Ecology, 2011, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
7) EPA, 1989, *Risk Assessment Guidance for Superfund:* Volume 1, *Human Health Evaluation Manual, Part A; Interim Final*, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D. C.
8) WAC 173-340, 1996, "Model Toxic Control Act - Cleanup," *Washington Administrative Code.*

Solution:
Calculation methodology is described in Ecology Pub. #92-54 (Ecology 1992, 1993), below, and in the RDR/RAWP (DOE-RL 2009b). Use data from attached worksheets to perform the 95% UCL calculation for each analyte, the WAC 173-340-740(7)(e) 3-part test for nonradionuclides, and the RPD calculations for each COC/COPC. The hazard quotient and carcinogenic risk calculations are located in a separate calculation brief as an appendix to the Remaining Sites Verification Package (RSVP).

Calculation Description:
The subject calculations were performed on statistical data from soil verification samples (Attachment 1) from the 100-D-84:2 subsite. The data were entered into an EXCEL 2010 spreadsheet and calculations performed by using the built-in spreadsheet functions and/or creating formulae within the cells. The statistical evaluation of data for use in accordance with the RDR/RAWP (DOE-RL 2009b) is documented by this calculation. Duplicate RPD results are used in evaluation of data quality within the RSVP for this site.

Methodology:
The 100-D-84:2 subsite underwent statistical sampling that consists of two decision units for verification sampling; excavation area and staging pile area. One focused sample was collected from Area 4.

Analytical results for all sampling locations are summarized in the tables provided on sheets 4 and 5. Further information of the sample data quality is presented in the data quality assessment section of the associated RSVP.

Washington Closure Hanford **CALCULATION SHEET**

Originator R. J. Nielson	**Date** 09/09/14	**Calc. No.** 0100D-CA-V0546	**Rev. No.** 0
Project 100-D Field Remediation	**Job No.** 14655	**Checked** I. B. Berezovskiy	**Date** 09/09/14
Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations			**Sheet No.** 2 of 17

Summary (continued)

Methodology, continued:

For nonradioactive analytes with ≤50% of the data below detection limits, the statistical value calculated to evaluate the effectiveness of cleanup is the 95% UCL. For nonradioactive analytes with >50% of the data below detection limits, as determined by direct inspection of the sample results (Attachment 1), the maximum detected value for the data set is used instead of the 95% UCL, and no further calculations are performed for those data sets. For convenience, these maximum detected values are included in the summary tables that follow. The 95% UCL was not calculated for data sets with no reported detections. Calculated cleanup levels are not available in Ecology (2011) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance* for Superfund (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 COCs/COPCs and are also not included in these calculations.

All nonradionuclide data reported as being undetected are set to ½ the detection limit value for calculation of the statistics (Ecology 1993). For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above. For radionuclide data, calculation of the statistics is done using the reported value. In cases where the laboratory does not report a value below the minimum detectable activity (MDA), half of the MDA is used in the calculation. For the statistical evaluation of duplicate sample pairs, the samples are averaged before being included in the data set, after adjustments for censored data as described above.

For nonradionuclides, the WAC 173-340 statistical guidance suggests that a test for distributional form be performed on the data and the 95% UCL calculated on the appropriate distribution using Ecology software. For nonradionuclide small data sets (n<10), the calculations are performed assuming nonparametric distribution, so no tests for distribution are performed. For nonradionuclide data sets of ten or greater, as for the subject site, distributional testing is done using Ecology's MTCAStat software (Ecology 1993). Due to differences in addressing censored data between the RDR/RAWP (DOE-RL 2009b) and MTCAStat coding and due to a limitation in the MTCAStat coding (no direct capability to address variable quantitation limits within a data set), substitutions for censored data are performed before software input and the resulting data set treated as uncensored.

The WAC 173-340-740(7)(e) 3-part test is performed for nonradionuclide analytes only and determines if:
1) the 95% UCL exceeds the most stringent cleanup limit for each COPC/COC,
2) greater than 10% of the raw data exceed the most stringent cleanup limit for each COPC/COC,
3) the maximum value of the raw data set exceeds two times the most stringent cleanup limit for each COPC/COC.

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 TDLs are pre-determined values for analytical methods and constituents with cleanup levels as listed in Table 2-1 of the SAP (DOE-RL 2009a). Table 2-1 includes nominal TDLs for identified methods based organic analyses. The nominal TDLs are also used in support of the RPD calculation for the methods based analytes. TDLs not included in Table 2-1 are based on the laboratory and/or methods 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:

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

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

For quality assurance/quality control (QA/QC) split and duplicate RPD calculations, a value less than 30% indicates the data compare favorably. If the RPD is greater than 30%, further investigation regarding the usability of the data is performed. To assist in the identification of anomalous sample pairs, 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. Additional discussion as necessary is provided in the data quality assessment section of the applicable RSVP.

Washington Closure Hanford **CALCULATION SHEET**

Originator	R. J. Nielson	**Date**	09/10/14	**Calc. No.** 0100D-CA-V0546	**Rev. No.** 0
Project	100-D Field Remediation	**Job No.**	14655	**Checked** I. B. Berezovskiy	**Date** 09/10/14
Subject	100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations				**Sheet No.** 3 of 17

Summary (continued)

QUALIFIER LIST

B = estimated result. Result isless than the RL, but greater than the MDL
J = estimate
K = Benzo(b&k)fluoranthene are unresolved due to matrix, result is reported as benzo(b)fluoranthene
N = MS/MSD or LCS recovery is outside control limits
U = undetected
X = (metals) serial dilution in the analytical batch indicates that physical and chemical interferences are present
(organics) = >40% difference between primary and confirmation detector results.
R = rejected
T = recovery outside control limits

ACRONYM LIST

-- = not applicable
DE = direct exposure
EXC = excavation
GW = groundwater
MTCA = *Model Toxics Control Act*
PQL = practical quantitation limit
Q = qualifier
QA/QC = quality assurance/quality control
RAG = remedial action goal
RDR/RAWP = remedial design report/remedial action work plan
RESRAD = RESidual RADioactivity (dose model)
RPD = relative percent difference
RSVP = remaining sites verification package
SAP = sampling and analysis plan
SPA = staging pile area
TDL = target detection limit
UCL = upper confidence limit
WAC = Washington Administrative Code

Washington Closure Hanford RN

CALCULATION SHEET

Originator	R. J. Nielson	**Date**	09/18/14	**Calc. No.**	0100D-CA-V0546
Project	100-D Field Remediation	**Job No.**	14655	**Checked**	I. B. Berezovskiy
Subject	100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations				

Rev. No. 0
Date 09/18/14
Sheet No. 4 of 17

Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations and/or maximum for the excavation area and the staging pile area, the WAC 173-340-740(7)(e) 3-part test evaluation, and the RPD calculations, and are for use in risk analysis and the RSVP for this site.

Results Summary [a]

Analyte	Excavation Area 3		SPA		100-D-84:2 Area 4	Units
	95% UCL Result	Maximum Result	95% UCL Result	Maximum Result	Maximum	
Antimony	0.54	--	--	0.34	--	mg/kg
Arsenic	3.1	--	3.4	--	2.9	mg/kg
Barium	64.7	--	86.8	--	146	mg/kg
Beryllium	0.20	--	0.34	--	0.43	mg/kg
Boron	1.4	--	2.1	--	10.4	mg/kg
Cadmium	--	0.048	--	0.46	--	mg/kg
Chromium	9.0	--	10.7	--	8.4	mg/kg
Cobalt	8.7	--	8.6	--	7.4	mg/kg
Copper	13.6	--	16.7	--	13.0	mg/kg
Hexavalent chromium	0.335	--	0.260	--	--	mg/kg
Lead	4.3	--	4.4	--	4.2	mg/kg
Manganese	306	--	318	--	285	mg/kg
Mercury	0.0094	--	0.0090	--	--	mg/kg
Molybdenum	--	0.55	--	0.46	0.38	mg/kg
Nickel	10.9	--	12.0	--	9.9	mg/kg
Selenium	--	0.88	--	--	--	mg/kg
Vanadium	53.7	--	53.9	--	51.0	mg/kg
Zinc	43.6	--	40.9	--	41.7	mg/kg
Nitrogen in nitrite and nitrate	0.73	--	13.1	--	3.3	mg/kg
Benzo(a)anthracene (SVOA)	--	0.027	--	0.022	--	mg/kg
Benzo(b)fluoranthene (SVOA)	--	0.033	--	--	--	mg/kg
Chrysene (SVOA)	--	0.035	--	--	--	mg/kg
Fluoranthene (SVOA)	--	0.052	--	0.039	--	mg/kg
Phenanthrene (SVOA)	--	0.017	--	--	--	mg/kg
Pyrene (SVOA)	0.027	--	--	0.034	0.026	mg/kg
Benzo(a)anthracene (PAH)	--	--	--	--	0.026	mg/kg
Benzo(a)pyrene (PAH)	--	--	--	--	0.022	mg/kg
Benzo(b)fluoranthene (PAH)	--	--	--	--	0.028	mg/kg
Benzo(ghi)perylene (PAH)	--	--	--	--	0.019	mg/kg
Benzo(k)fluoranthene (PAH)	--	--	--	--	0.0076	mg/kg
Chrysene (PAH)	--	--	--	--	0.025	mg/kg
Fluoranthene (PAH)	--	--	--	--	0.047	mg/kg
Indeno(1,2,3-cd)pyrene (PAH)	--	--	--	--	0.015	mg/kg
Phenanthrene (PAH)	--	--	--	--	0.020	mg/kg
Pyrene (PAH)	--	--	--	--	0.046	mg/kg
DDE	--	--	--	--	0.0024	mg/kg
DDT	--	--	--	--	0.00085	mg/kg
TPH - Diesel	--	--	--	--	5.5	mg/kg
TPH - Diesel extended	--	--	--	--	12	mg/kg

WAC 173-340-740(7)(e) Evaluation:

WAC 173-340 3-Part Test for most stringent RAG:	EXC		SPA	
95% UCL or maximum> Cleanup Limit?	NO	YES	NO	YES
> 10% above Cleanup Limit?	NO	YES	NO	NO
Any sample > 2x Cleanup Limit?	NO	YES	NO	NO

[a] The 95% UCL result or maximum value, depending on data censorship, as described in the methodology section.

Washington Closure Hanford **CALCULATION SHEET**

Originator R. J. Nielson **Date** 09/09/14 **Calc. No.** 0100D-CA-V0546 **Rev. No.** 0
Project 100-D Field Remediation **Job No.** 14655 **Checked** I. B. Berezovskiy **Date** 09/09/14
Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations **Sheet No.** 5 of 17

Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL calculations and/or maximum for the excavation area and the staging pile area, the WAC 173-340-740(7)(e) 3-part test evaluation, and the RPD calculations, and are for use in risk analysis and the RSVP for this site.

Relative Percent Difference Results and QA/QC Analysis[a]

Analyte	Duplicate Analysis	
	Excavation	SPA
Aluminum	7.0%	3.9%
Barium	7.0%	5.2%
Calcium	0.3%	1.7%
Chromium	**30.4%**	12.7%
Copper	2.9%	6.2%
Iron	0.4%	6.5%
Magnesium	5.8%	1.9%
Manganese	5.6%	7.4%
Silicon	**30.5%**	1.4%
Sodium	12.1%	21.1%
Vanadium	4.5%	11.1%
Zinc	3.8%	9.7%

[a]RPD listed where result produced, based on criteria. If RPD not required, no value is listed. The significance of the reported RPD values, including values greater than 30%, is addressed in the data quality assessment section of the RSVP.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson RN
Project 100-D Field Remediation
Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations

Date 09/23/14
Job No. 14655

Calc. No. 0100D-CA-V0546
Checked I. B. Berezovsky

Rev. No. 0
Date 09/23/14
Sheet No. 6 of 17

1 100-D-84:2 Statistical Calculations

2 Verification Data - Excavation

Sample Area	Sample Number	Sample Date	Antimony mg/kg	Q	POL	Arsenic mg/kg	Q	POL	Barium mg/kg	Q	POL	Beryllium mg/kg	Q	POL
EXC-2	J1TW22	7/14/14	0.52	BJ	0.34	3.0		0.60	63.0	X	0.069	0.19		0.030
Duplicate of J1TW22	J1TW33	7/14/14	0.64	BJ	0.35	3.5		0.61	67.6	X	0.071	0.21		0.031
EXC-1	J1TW21	7/14/14	0.46	BJ	0.37	2.9		0.64	66.3	X	0.074	0.21		0.032
EXC-3	J1TW23	7/14/14	0.52	BJ	0.38	2.9		0.66	64.2	X	0.076	0.19	B	0.033
EXC-4	J1TW24	7/14/14	0.36	BJ	0.35	2.7		0.61	65.4	X	0.070	0.18		0.031
EXC-5	J1TW25	7/14/14	0.50	BJ	0.36	2.4		0.62	58.4	X	0.071	0.18	B	0.031
EXC-6	J1TW26	7/14/14	0.60	J	0.35	2.9		0.60	65.4	X	0.069	0.20		0.030
EXC-7	J1TW27	7/14/14	0.71	J	0.35	2.3		0.62	65.1	X	0.071	0.17	B	0.031
EXC-8	J1TW28	7/14/14	0.46	BJ	0.32	2.9		0.56	62.2	X	0.064	0.19		0.028
EXC-9	J1TW29	7/14/14	0.59	J	0.37	3.2		0.65	68.0	X	0.074	0.21		0.032
EXC-10	J1TW30	7/15/14	0.32	UJ	0.32	3.2		0.56	61.8	X	0.065	0.19		0.028
EXC-11	J1TW31	7/15/14	0.33	UJ	0.33	3.3		0.57	54.1	X	0.066	0.18		0.029
EXC-12	J1TW32	7/15/14	0.33	UJ	0.33	2.8		0.58	52.4	X	0.067	0.18		0.029

Sample Area	Sample Number	Sample Date	Boron mg/kg	Q	POL	Chromium mg/kg	Q	POL	Cobalt mg/kg	Q	POL	Copper mg/kg	Q	POL	Hexavalent Chromium mg/kg	Q	POL
EXC-2	J1TW22	7/14/14	1.5	B	0.88	7.8	X	0.052	9.0	X	0.090	13.5		0.20	0.356		0.155
Duplicate of J1TW22	J1TW33	7/14/14	1.3	B	0.91	10.6	X	0.054	8.9	X	0.093	13.9		0.20	0.358		0.155
EXC-1	J1TW21	7/14/14	1.4	B	0.96	8.1	X	0.056	8.1	X	0.097	13.8		0.21	0.338		0.155
EXC-3	J1TW23	7/14/14	1.4	B	0.98	8.1	X	0.058	8.8	X	0.100	13.7		0.22	0.336		0.155
EXC-4	J1TW24	7/14/14	1.0	B	0.91	8.0	X	0.054	8.9	X	0.092	13.4		0.20	0.276		0.155
EXC-5	J1TW25	7/14/14	0.93	B	0.92	6.9	X	0.055	9.0	X	0.094	13.6		0.20	0.337		0.155
EXC-6	J1TW26	7/14/14	1.4	B	0.89	8.1	X	0.053	8.7	X	0.091	13.0		0.20	0.317		0.155
EXC-7	J1TW27	7/14/14	1.2	B	0.91	7.0	X	0.054	9.1	X	0.093	13.7		0.20	0.379		0.155
EXC-8	J1TW28	7/14/14	1.1	B	0.83	7.2	X	0.049	8.6	X	0.085	13.5		0.18	0.315		0.155
EXC-9	J1TW29	7/14/14	1.2	B	0.96	9.4	X	0.057	8.3	X	0.098	13.9		0.21	0.254		0.155
EXC-10	J1TW30	7/15/14	1.1	B	0.84	9.2	X	0.049	7.3	X	0.085	13.0		0.19	0.336		0.155
EXC-11	J1TW31	7/15/14	1.8		0.85	10.3	X	0.050	6.8	X	0.087	12.7		0.19	0.253		0.155
EXC-12	J1TW32	7/15/14	0.86	U	0.86	9.4	X	0.051	6.5	X	0.088	12.1		0.19	0.254		0.155

18 Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Antimony mg/kg	Arsenic mg/kg	Barium mg/kg	Beryllium mg/kg	Boron mg/kg	Chromium mg/kg	Cobalt mg/kg	Copper mg/kg	Hexavalent Chromium mg/kg
EXC-2	J1TW22/J1TW33	7/14/14	0.56	3.3	65.3	0.20	1.4	9.2	9.0	13.7	0.357
EXC-1	J1TW21	7/14/14	0.46	2.9	66.3	0.21	1.4	8.1	8.1	13.8	0.338
EXC-3	J1TW23	7/14/14	0.52	2.9	64.2	0.19	1.4	8.1	8.8	13.7	0.336
EXC-4	J1TW24	7/14/14	0.36	2.7	65.4	0.18	1.0	8.0	8.9	13.4	0.276
EXC-5	J1TW25	7/14/14	0.50	2.4	58.4	0.18	0.93	6.9	9.0	13.6	0.337
EXC-6	J1TW26	7/14/14	0.60	2.9	65.4	0.20	1.4	8.1	8.7	13.0	0.317
EXC-7	J1TW27	7/14/14	0.71	2.3	65.1	0.17	1.2	7.0	9.1	13.7	0.379
EXC-8	J1TW28	7/14/14	0.46	2.9	62.2	0.19	1.1	7.2	8.6	13.5	0.315
EXC-9	J1TW29	7/14/14	0.59	3.2	68.0	0.21	1.2	9.4	8.3	13.9	0.254
EXC-10	J1TW30	7/15/14	0.16	3.2	61.8	0.19	1.1	9.2	7.3	13.0	0.336
EXC-11	J1TW31	7/15/14	0.17	3.3	54.1	0.18	1.8	10.3	6.8	12.7	0.253
EXC-12	J1TW32	7/15/14	0.17	2.8	52.4	0.18	0.43	9.4	6.5	12.1	0.254

	Antimony	Arsenic	Barium	Beryllium	Boron	Chromium	Cobalt	Copper	Hexavalent Chromium
95% UCL based on	Large data set (n ≥ 10), use MTCAStat normal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat normal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat normal distribution.
N	12	12	12	12	12	12	12	12	12
% < Detection limit	25%	0%	0%	0%	8%	0%	0%	0%	0%
Mean	0.44	2.9	62.4	0.19	1.2	8.4	8.3	13.3	0.313
Standard deviation	0.19	0.32	4.9	0.013	0.34	1.1	0.90	0.54	0.043
95% UCL on mean	0.54	3.1	64.7	0.20	1.4	9.0	8.7	13.6	0.335
Maximum value	0.71	3.5	68.0	0.21	1.8	10.6	9.1	13.9	0.379
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	5 GW & River Protection	20 DE, GW & River Protection	200 GW Protection	1.51 GW & River Protection	320 GW Protection	18.5 GW & River Protection	15.7 GW Protection	22.0 River Protection	2 River Protection
WAC 173-340 3-PART TEST									
95% UCL > Cleanup Limit?	NA	NA	NA	NA	NO	NA	NA	NA	NO
> 10% above Cleanup Limit?	NA	NA	NA	NA	NO	NA	NA	NA	NO
Any sample > 2X Cleanup Limit?	NA	NA	NA	NA	NO	NA	NA	NA	NO
WAC 173-340 Compliance?	Because all values are below background (5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (6.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (132 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (1.51 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (18.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (15.7 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (22.0 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

48 Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson
Project 100-D Field Remediation
Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations

Date 09/10/14
Job No. 14655

Calc. No. 0100D-CA-V0546
Checked I. B. Berezovsky

Rev. No. 0
Date 09/10/14
Sheet No. 7 of 17

1 100-D-84:2 Statistical Calculations
2 Verification Data - Excavation

3	Sample	Sample	Sample	Lead			Manganese			Mercury			Nickel			Vanadium			Zinc			Nitrogen in Nitrite and Nitrate			Pyrene		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL
5	EXC-2	J1TW22	7/14/14	4.1		0.24	297	X	0.090	0.0066	B	0.0050	10.5	X	0.11	52.3		0.065	41.7	X	0.36	0.36	U	0.36	32	J	12
6	Duplicate of J1TW22	J1TW33	7/14/14	4.7		0.25	314	X	0.093	0.0078	B	0.0050	12.2	X	0.11	50.0		0.067	43.3	X	0.37	0.47	B	0.36	22	J	12
7	EXC-1	J1TW21	7/14/14	4.5		0.26	295	X	0.097	0.010	B	0.0052	9.1	X	0.12	50.1		0.091	41.0	X	0.39	0.84		0.36	40	J	12
8	EXC-3	J1TW23	7/14/14	4.4		0.27	307	X	0.10	0.010	B	0.0055	11.2	X	0.12	55.1		0.094	51.8	X	0.40	1.8		0.36	12	U	12
9	EXC-4	J1TW24	7/14/14	4.2		0.25	312	X	0.092	0.0079	B	0.0049	10.0	X	0.11	58.0		0.087	43.5	X	0.37	0.36	U	0.36	12	U	12
10	EXC-5	J1TW25	7/14/14	3.8		0.25	303	X	0.094	0.0079	B	0.0053	8.6	X	0.12	55.3		0.088	42.1	X	0.37	0.36	U	0.36	11	U	11
11	EXC-6	J1TW26	7/14/14	4.2		0.25	323	X	0.091	0.009	B	0.0055	11.4	X	0.11	52.9		0.086	42.4	X	0.36	0.36	U	0.36	12	U	12
12	EXC-7	J1TW27	7/14/14	4.0		0.25	303	X	0.093	0.0096	B	0.0051	10.7	X	0.11	57.5		0.088	43.7	X	0.37	0.36	U	0.36	20	J	12
13	EXC-8	J1TW28	7/14/14	3.9		0.23	308	X	0.085	0.0083	B	0.0049	9.0	X	0.10	55.2		0.080	42.8	X	0.34	0.36	U	0.36	21	J	12
14	EXC-9	J1TW29	7/14/14	4.5		0.26	307	X	0.098	0.0089	B	0.0054	11.3	X	0.12	50.8		0.092	41.3	X	0.39	0.80		0.36	34	J	12
15	EXC-10	J1TW30	7/15/14	4.0		0.23	276	X	0.085	0.011	B	0.0052	9.4	X	0.10	41.3		0.080	35.8	X	0.34	0.52	B	0.36	11	U	11
16	EXC-11	J1TW31	7/15/14	4.0		0.23	273	X	0.087	0.0083	B	0.0055	11.5	X	0.11	33.6		0.081	34.6	X	0.34	0.62	B	0.36	52	J	12
17	EXC-12	J1TW32	7/15/14	3.4		0.24	261	X	0.088	0.0072	B	0.0049	9.7	X	0.11	36.0		0.082	34.1	X	0.35	0.36	U	0.36	12	U	12

18 Statistical Computation Input Data

19	Sample	Sample	Sample	Lead	Manganese	Mercury	Nickel	Vanadium	Zinc	Nitrogen in Nitrite and Nitrate	Pyrene
20	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	ug/kg
21	EXC-2	J1TW22/J1TW33	7/14/14	4.4	306	0.0082	11.4	51.2	42.5	0.33	27
22	EXC-1	J1TW21	7/14/14	4.5	295	0.0100	9.1	50.1	41.0	0.84	40
23	EXC-3	J1TW23	7/14/14	4.4	307	0.0100	11.2	55.1	51.8	1.8	6.0
24	EXC-4	J1TW24	7/14/14	4.2	312	0.0079	10.0	58.0	43.5	0.18	6.0
25	EXC-5	J1TW25	7/14/14	3.8	303	0.0079	8.6	55.3	42.1	0.18	5.5
26	EXC-6	J1TW26	7/14/14	4.2	323	0.0090	11.4	52.9	42.4	0.18	6.0
27	EXC-7	J1TW27	7/14/14	4.0	303	0.0096	10.7	57.5	43.7	0.18	20
28	EXC-8	J1TW28	7/14/14	3.9	308	0.0083	9.0	55.2	42.8	0.18	21
29	EXC-9	J1TW29	7/14/14	4.5	307	0.0089	11.3	50.8	41.3	0.80	34
30	EXC-10	J1TW30	7/15/14	4.0	276	0.0110	9.4	41.3	35.8	0.52	5.5
31	EXC-11	J1TW31	7/15/14	4.0	273	0.0083	11.5	33.6	34.6	0.62	52
32	EXC-12	J1TW32	7/15/14	3.4	261	0.0072	9.7	36.0	34.1	0.18	6.0

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34		Lead	Manganese	Mercury	Nickel	Vanadium	Zinc	Nitrogen in Nitrite and Nitrate	Pyrene
35	95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.
36	N	12	12	12	12	12	12	12	12
37	% < Detection limit	0%	0%	0%	0%	0%	0%	50%	50%
38	Mean	4.1	298	0.0089	10.3	49.9	41.3	0.50	19
39	Standard deviation	0.33	18.3	0.0011	1.1	8.0	4.8	0.48	16
40	95% UCL on mean	4.3	308	0.0094	10.9	53.7	43.6	0.73	27
41	Maximum value	4.7	323	0.011	12.2	58.0	51.8	1.8	52
42	Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	10.2 GW & River Protection	512 GW & River Protection	0.33 GW & River Protection	19.1 GW Protection	85.1 GW Protection	67.8 River Protection	1000 GW Protection	48000 ug/kg GW Protection
43	WAC 173-340 3-PART TEST								
44	95% UCL > Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NO
45	> 10% above Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NO
46	Any sample > 2X Cleanup Limit?	NA	NA	NA	NA	NA	NA	NA	NO
47	WAC 173-340 Compliance?	Because all values are below background (10.2 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (512 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (0.33 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (19.1 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (85.1 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (67.8 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (11.8 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

48 Acronyms and qualifiers are defined on sheet 3.

MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson

Project 100-D Field Remediation

Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations

Date 09/10/14

Job No. 14655

Calc. No. 0100D-CA-V0546

Checked I. B. Berezovskiy

Rev. No. 0

Date 09/10/14

Sheet No. 8 of 17

1 **100-D-84:2 Subsite Maximum Calculations**

2 **Verification Data - Excavation**

3				Cadmium			Molybdenum			Selenium			Benzo(a)anthracene			Benzo(b)fluoranthene			Chrysene			Fluoranthene			Phenanthrene		
4	Sample Area	Sample Number	Sample Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
5	EXC-2	J1TW22	7/14/14	0.037	U	0.037	0.55	B	0.23	0.88	B	0.78	20	J	19	25	JK	25	26	U	26	34	U	34	16	U	16
6	Duplicate of J1TW22	J1TW33	7/14/14	0.038	U	0.038	0.24	U	0.24	0.80	U	0.80	20	U	20	26	U	26	27	U	27	36	U	36	17	U	17
7	EXC-1	J1TW21	7/14/14	0.040	U	0.040	0.48	B	0.25	0.83	U	0.83	26	J	19	33	JK	25	30	J	26	37	J	35	16	U	16
8	EXC-3	J1TW23	7/14/14	0.041	U	0.041	0.26	U	0.26	0.86	U	0.86	20	U	20	26	U	26	27	U	27	36	U	36	17	U	17
9	EXC-4	J1TW24	7/14/14	0.038	U	0.038	0.24	U	0.24	0.80	U	0.80	19	U	19	25	U	25	26	U	26	35	U	35	16	U	16
10	EXC-5	J1TW25	7/14/14	0.039	U	0.039	0.24	U	0.24	0.81	U	0.81	19	U	19	24	U	24	25	U	25	34	U	34	16	U	16
11	EXC-6	J1TW26	7/14/14	0.037	U	0.037	0.24	U	0.24	0.78	U	0.78	20	U	20	26	U	26	27	U	27	36	U	36	17	U	17
12	EXC-7	J1TW27	7/14/14	0.038	U	0.038	0.24	U	0.24	0.80	U	0.80	20	U	20	26	U	26	27	U	27	36	U	36	17	U	17
13	EXC-8	J1TW28	7/14/14	0.035	U	0.035	0.22	U	0.22	0.73	U	0.73	20	U	20	26	U	26	26	U	26	35	U	35	17	U	17
14	EXC-9	J1TW29	7/14/14	0.040	U	0.040	0.25	U	0.25	0.84	U	0.84	20	J	19	25	U	25	26	U	26	35	J	35	17	U	17
15	EXC-10	J1TW30	7/15/14	0.035	U	0.035	0.22	U	0.22	0.73	U	0.73	19	U	19	25	U	25	26	U	26	34	U	34	16	U	16
16	EXC-11	J1TW31	7/15/14	0.048	B	0.035	0.23	U	0.23	0.74	U	0.74	27	J	19	31	JK	25	35	J	26	52	J	34	17	J	16
17	EXC-12	J1TW32	7/15/14	0.036	U	0.036	0.23	U	0.23	0.75	U	0.75	19	U	19	25	U	25	26	U	26	35	U	35	16	U	16

18 **Statistical Computations**

19		Cadmium		Molybdenum		Selenium		Benzo(a)anthracene		Benzo(b)fluoranthene		Chrysene		Fluoranthene		Phenanthrene	
20	% < Detection limit	92%		83%		92%		67%		75%		83%		75%		92%	
21	Maximum value	0.048		0.55		0.88		27		33		35		52		17	
22	Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg) unless otherwise noted	0.81	GW & River Protection	8	GW Protection	1	River Protection	15 ug/kg	GW & River Protection	15 ug/kg	GW & River Protection	100 ug/kg	River Protection	18000 ug/kg	River Protection	240000 ug/kg	GW Protection
23	3-PART TEST																
24	Maximum > Cleanup Limit?	NA		NO		NO		YES		YES		NO		NO		NO	
25	> 10% above Cleanup Limit?	NA		NO		NO		YES		YES		NO		NO		NO	
26	Any sample > 2X Cleanup Limit?	NA		NO		NO		NO		YES		NO		NO		NO	
27	3-Part Test Compliance?	Because all values are below background (0.81 mg/kg) the WAC 173-340 3-part test is not required.		The data set meets the 3-part test criteria when compared to the most stringent RAG.		The data set meets the 3-part test criteria when compared to the most stringent RAG.		A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.		A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.		The data set meets the 3-part test criteria when compared to the most stringent RAG.		The data set meets the 3-part test criteria when compared to the most stringent RAG.		The data set meets the 3-part test criteria when compared to the most stringent RAG.	

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29 **Acronyms and qualifiers are defined on sheet 3.**

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson RJN
Project 100-D Field Remediation
Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations

Date 09/09/14
Job No. 14655

Calc. No. 0100D-CA-V0546
Checked I. B. Berezovskiy

Rev. No. 0
Date 09/09/14
Sheet No. 9 of 17

1 **100-D-84:2 Statistical Calculations**

2 **Verification Data - SPA**

3 Sample	Sample	Sample	Arsenic			Barium			Beryllium			Boron			Chromium			Cobalt			Copper			Hexavalent Chromium		
4 Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
5 SPA-1	J1TW34	7/30/14	2.7		0.59	73.1	X	0.068	0.28		0.030	1.4	B	0.88	9.2	X	0.052	8.8	X	0.089	14.9	X	0.19	0.216		0.155
6 Duplicate of J1TW34	J1TW46	7/30/14	2.3		0.63	69.4	X	0.072	0.31		0.031	1.2	B	0.93	8.1	X	0.055	8.3	X	0.095	14.0	X	0.21	0.300		0.155
7 SPA-2	J1TW35	7/30/14	2.8		0.65	83.1	X	0.074	0.34		0.032	1.8	B	0.96	10.9	X	0.057	8.3	X	0.098	15.1	X	0.21	0.378		0.155
8 SPA-3	J1TW36	7/30/14	2.4		0.62	69.9	X	0.071	0.30		0.031	1.5	B	0.92	9.0	X	0.054	7.6	X	0.093	14.9	X	0.20	0.232		0.155
9 SPA-4	J1TW37	7/30/14	2.0		0.62	71.3	X	0.072	0.30		0.031	1.5	B	0.93	8.8	X	0.055	7.7	X	0.094	13.7	X	0.20	0.233		0.155
10 SPA-5	J1TW38	7/30/14	3.6		0.62	101	X	0.071	0.40		0.031	2.2		0.92	11.3	X	0.054	9.1	X	0.094	18.2	X	0.20	0.277		0.156
11 SPA-6	J1TW39	7/30/14	3.2		0.58	92.6	X	0.067	0.38		0.029	2.2		0.86	11.1	X	0.051	8.9	X	0.088	14.7	X	0.19	0.335		0.155
12 SPA-7	J1TW40	7/30/14	2.2		0.66	78.4	X	0.077	0.31		0.033	2.9		0.99	7.6	X	0.058	8.7	X	0.10	14.4	X	0.22	0.155	U	0.155
13 SPA-8	J1TW41	7/30/14	3.4		0.62	89.4	X	0.072	0.32		0.031	1.9		0.92	10.4	X	0.055	8.5	X	0.094	18.9	X	0.20	0.155	U	0.155
14 SPA-9	J1TW42	7/30/14	4.4		0.68	91.9	X	0.078	0.32		0.034	2.0		1.0	12.0	X	0.059	7.8	X	0.10	17.1	X	0.22	0.155	U	0.155
15 SPA-10	J1TW43	7/30/14	3.9		0.65	81.0	X	0.075	0.32		0.033	2.0		0.97	11.4	X	0.057	7.4	X	0.099	17.3	X	0.21	0.155	U	0.155
16 SPA-11	J1TW44	7/30/14	2.1		0.58	49.9	X	0.067	0.25		0.029	0.86	U	0.86	8.1	X	0.051	8.1	X	0.088	12.4	X	0.19	0.155	U	0.155
17 SPA-12	J1TW45	7/30/14	2.5		0.64	78.4	X	0.073	0.32		0.032	1.5	B	0.95	8.9	X	0.056	8.6	X	0.097	15.8	X	0.21	0.344		0.155

18

19 Sample	Sample	Sample	Arsenic	Barium	Beryllium	Boron	Chromium	Cobalt	Copper	Hexavalent Chromium
20 Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
21 SPA-1	J1TW34/J1tW46	7/30/14	2.5	71.3	0.30	1.3	8.7	8.6	14.5	0.258
22 SPA-2	J1TW35	7/30/14	2.8	83.1	0.34	1.8	10.9	8.3	15.1	0.378
23 SPA-3	J1TW36	7/30/14	2.4	69.9	0.30	1.5	9.0	7.6	14.9	0.232
24 SPA-4	J1TW37	7/30/14	2.0	71.3	0.30	1.5	8.8	7.7	13.7	0.233
25 SPA-5	J1TW38	7/30/14	3.6	101	0.40	2.2	11.3	9.1	18.2	0.277
26 SPA-6	J1TW39	7/30/14	3.2	92.6	0.38	2.2	11.1	8.9	14.7	0.335
27 SPA-7	J1TW40	7/30/14	2.2	78.4	0.31	2.9	7.6	8.7	14.4	0.078
28 SPA-8	J1TW41	7/30/14	3.4	89.4	0.32	1.9	10.4	8.5	18.9	0.078
29 SPA-9	J1TW42	7/30/14	4.4	91.9	0.32	2.0	12.0	7.8	17.1	0.078
30 SPA-10	J1TW43	7/30/14	3.9	81.0	0.32	2.0	11.4	7.4	17.3	0.078
31 SPA-11	J1TW44	7/30/14	2.1	49.9	0.25	0.43	8.1	8.1	12.4	0.078
32 SPA-12	J1TW45	7/30/14	2.5	78.4	0.32	1.5	8.9	8.6	15.8	0.344

33 **Statistical Computations**

34	Arsenic	Barium	Beryllium	Boron	Chromium	Cobalt	Copper	Hexavalent Chromium
35 95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat normal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat normal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.
36 N	12	12	12	12	12	12	12	12
37 % < Detection limit	0%	0%	0%	8%	0%	0%	0%	42%
38 Mean	2.9	79.8	0.32	1.8	9.8	8.3	15.6	0.204
39 Standard deviation	0.77	13.5	0.039	0.60	1.5	0.55	1.9	0.119
40 95% UCL on mean	3.4	86.8	0.34	2.1	10.7	8.6	16.7	0.260
41 Maximum value	4.4	101	0.40	2.9	12.0	9.1	18.9	0.378
42 Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	20 DE, GW & River Protection	200 GW Protection	1.51 GW & River Protection	320 GW Protection	18.5 GW & River Protection	15.7 GW Protection	22.0 River Protection	2 River Protection
43 WAC 173-340 3-PART TEST								
44 95% UCL > Cleanup Limit?	NA	NA	NA	NO	NA	NA	NA	NO
45 > 10% above Cleanup Limit?	NA	NA	NA	NO	NA	NA	NA	NO
46 Any sample > 2X Cleanup Limit?	NA	NA	NA	NO	NA	NA	NA	NO
47 WAC 173-340 Compliance?	Because all values are below background (8.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (132 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (1.51 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (18.5 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (15.7 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (22 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

48 **Acronyms and qualifiers are defined on sheet 3.**

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson
Project 100-D Field Remediation
Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations

Date 09/09/14
Job No. 14655

Calc. No. 0100D-CA-V0546
Checked I. B. Berezovskiy

Rev. No. 0
Date 09/09/14
Sheet No. 10 of 17

1 **100-D-84:2 Statistical Calculations**

2 **Verification Data - SPA**

3	Sample	Sample	Sample	Lead			Manganese			Mercury			Nickel			Vanadium			Zinc			Nitrogen in Nitrite and Nitrate		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
5	SPA-1	J1TW34	7/30/14	3.6		0.24	307	X	0.089	0.0055	U	0.0055	10.9	X	0.11	59.0	X	0.084	42.2	X	0.36	0.98	N	0.37
6	Duplicate of J1TW34	J1TW46	7/30/14	3.8		0.26	285	X	0.095	0.0064	B	0.0051	10.7	X	0.12	52.6	X	0.089	38.3	X	0.38	2.4		0.37
7	SPA-2	J1TW35	7/30/14	4.4		0.26	319	X	0.098	0.0067	B	0.0055	11.7	X	0.12	50.8	X	0.092	41.2	X	0.39	5.8		0.36
8	SPA-3	J1TW36	7/30/14	3.5		0.25	282	X	0.083	0.0070	B	0.0050	11.1	X	0.11	48.8	X	0.088	37.6	X	0.37	3.2		0.37
9	SPA-4	J1TW37	7/30/14	3.6		0.25	294	X	0.094	0.0072	B	0.0060	10.0	X	0.12	49.5	X	0.089	38.6	X	0.38	2.6		0.37
10	SPA-5	J1TW38	7/30/14	5.4		0.25	346	X	0.094	0.0094	B	0.0058	12.8	X	0.12	50.8	X	0.088	43.7	X	0.37	11.2		0.37
11	SPA-6	J1TW39	7/30/14	5.0		0.24	342	X	0.088	0.0065	B	0.0050	12.0	X	0.11	54.0	X	0.083	41.2	X	0.35	17.2		0.36
12	SPA-7	J1TW40	7/30/14	4.3		0.27	298	X	0.10	0.011	B	0.006	10.4	X	0.12	58.9	X	0.095	43.2	X	0.40	11.7		0.37
13	SPA-8	J1TW41	7/30/14	4.0		0.25	319	X	0.094	0.011	B	0.0067	12.2	X	0.12	50.1	X	0.089	38.7	X	0.38	3.3		0.37
14	SPA-9	J1TW42	7/30/14	4.0		0.26	303	X	0.10	0.011	B	0.0060	11.8	X	0.13	47.8	X	0.096	37.4	X	0.41	3.3		0.37
15	SPA-10	J1TW43	7/30/14	3.8		0.27	293	X	0.099	0.011	B	0.0056	13.2	X	0.12	46.3	X	0.093	36.2	X	0.39	0.81	N	0.37
16	SPA-11	J1TW44	7/30/14	2.7		0.24	268	X	0.088	0.0073	B	0.0058	10.1	X	0.11	56.5	X	0.083	36.3	X	0.35	1.0		0.36
17	SPA-12	J1TW45	7/30/14	3.8		0.26	311	X	0.097	0.0069	B	0.0049	10.7	X	0.12	53.1	X	0.091	40.6	X	0.36	1.4		0.36

18 **Statistical Computation Input Data**

19	Sample	Sample	Sample	Lead	Manganese	Mercury	Nickel	Vanadium	Zinc	Nitrogen in Nitrite and Nitrate
20	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
21	SPA-1	J1TW34/J1TW46	7/30/14	3.7	296	0.0046	10.8	55.9	40.3	1.7
22	SPA-2	J1TW35	7/30/14	4.4	319	0.007	11.7	50.8	41.2	5.8
23	SPA-3	J1TW36	7/30/14	3.5	282	0.007	11.1	48.8	37.6	3.2
24	SPA-4	J1TW37	7/30/14	3.6	294	0.007	10.0	49.5	38.6	2.6
25	SPA-5	J1TW38	7/30/14	5.4	346	0.009	12.8	50.8	43.7	11.2
26	SPA-6	J1TW39	7/30/14	5.0	342	0.007	12.0	54.0	41.2	17.2
27	SPA-7	J1TW40	7/30/14	4.3	298	0.011	10.4	58.9	43.2	11.7
28	SPA-8	J1TW41	7/30/14	4.0	319	0.011	12.2	50.1	38.7	3.3
29	SPA-9	J1TW42	7/30/14	4.0	303	0.011	11.8	47.8	37.4	3.3
30	SPA-10	J1TW43	7/30/14	3.8	293	0.011	13.2	46.3	36.2	0.8
31	SPA-11	J1TW44	7/30/14	2.7	268	0.0073	10.1	56.5	36.3	1.0
32	SPA-12	J1TW45	7/30/14	3.8	311	0.007	10.7	53.1	40.6	1.4

33 **Statistical Computations**

34		Lead	Manganese	Mercury	Nickel	Vanadium	Zinc	Nitrogen in Nitrite and Nitrate
35	95% UCL based on	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.
36	N	12	12	12	12	12	12	12
37	% < Detection limit	0%	0%	0%	0%	0%	0%	0%
38	Mean	4.0	306	0.0083	11.4	51.9	39.6	5.3
39	Standard deviation	0.71	22.9	0.0023	1.0	3.8	2.5	5.3
40	95% UCL on mean	4.4	318	0.0090	12.0	53.9	40.9	13.1
41	Maximum value	5.4	346	0.011	13.2	59.0	43.7	17.2
42	Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	10.2 GW & River Protection	512 GW & River Protection	0.33 GW & River Protection	19.1 GW Protection	85.1 GW Protection	67.8 River Protection	1000 GW Protection
43	WAC 173-340 3-PART TEST							
44	95% UCL > Cleanup Limit?	NA	NA	NA	NA	NA	NA	NO
45	> 10% above Cleanup Limit?	NA	NA	NA	NA	NA	NA	NO
46	Any sample > 2X Cleanup Limit?	NA	NA	NA	NA	NA	NA	NO
47	WAC 173-340 Compliance?	Because all values are below background (10.2 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (512 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (0.33 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (19.1 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (85.1 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (67.8 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

48 **Acronyms and qualifiers are defined on sheet 3.**

MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson RN
Project 100-D Field Remediation
Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations

Date 09/09/14
Job No. 14655

Calc. No. 0100D-CA-V0546
Checked I. B. Berezovskiy

Rev. No. 0
Date 09/09/14
Sheet No. 11 of 17

1 **100-D-84:2 Subsite Maximum Calculations**

2 **Verification Data - SPA**

3	Sample	Sample	Sample	Antimony			Molybdenum			Benzo(a)anthracene			Fluoranthene			Pyrene		
4	Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
5	SPA-1	J1TW34	7/30/14	0.34	B	0.34	0.46	B	0.23	21	U	21	37	U	37	12	U	12
6	Duplicate of J1TW34	J1TW46	7/30/14	0.36	U	0.36	0.25	U	0.25	20	U	20	37	U	37	12	U	12
7	SPA-2	J1TW35	7/30/14	0.37	U	0.37	0.45	B	0.25	19	U	19	34	U	34	12	U	12
8	SPA-3	J1TW36	7/30/14	0.35	U	0.35	0.24	U	0.24	20	U	20	36	U	36	12	U	12
9	SPA-4	J1TW37	7/30/14	0.36	U	0.36	0.25	U	0.25	20	U	20	36	U	36	12	U	12
10	SPA-5	J1TW38	7/30/14	0.36	U	0.36	0.24	U	0.24	20	U	20	37	U	37	12	U	12
11	SPA-6	J1TW39	7/30/14	0.33	U	0.33	0.23	U	0.23	19	U	19	35	U	35	12	U	12
12	SPA-7	J1TW40	7/30/14	0.38	U	0.38	0.26	U	0.26	19	U	19	35	U	35	12	U	12
13	SPA-8	J1TW41	7/30/14	0.36	U	0.36	0.25	U	0.25	19	U	19	35	U	35	12	U	12
14	SPA-9	J1TW42	7/30/14	0.39	U	0.39	0.27	U	0.27	20	U	20	35	U	35	12	U	12
15	SPA-10	J1TW43	7/30/14	0.38	U	0.38	0.26	U	0.26	21	U	21	37	U	37	12	U	12
16	SPA-11	J1TW44	7/30/14	0.33	U	0.33	0.23	U	0.23	19	U	19	34	U	34	11	U	11
17	SPA-12	J1TW45	7/30/14	0.37	U	0.37	0.25	U	0.25	22	J	21	39	J	37	34	J	12

18 **Statistical Computations**

19		Antimony		Molybdenum		Benzo(a)anthracene		Fluoranthene		Pyrene	
20	% < Detection limit	92%		83%		92%		92%		92%	
21	Maximum value	0.34		0.46		22		39		34	
22	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg) unless otherwise noted**	5	GW & River Protection	8.00	GW Protection	15 ug/kg	GW & River Protection	18000 ug/kg	River Protection	48000 ug/kg	River Protection
23	**3-PART TEST**										
24	Maximum > Cleanup Limit?	NA		NO		YES		NO		NO	
25	> 10% above Cleanup Limit?	NA		NO		NO		NO		NO	
26	Any sample > 2X Cleanup Limit?	NA		NO		NO		NO		NO	
27	**3-Part Test Compliance?**	Because all values are below background (5 mg/kg) the WAC 173-340 3-part test is not required.		The data set meets the 3-part test criteria when compared to the most stringent RAG.		A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.		The data set meets the 3-part test criteria when compared to the most stringent RAG.		The data set meets the 3-part test criteria when compared to the most stringent RAG.	

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29 **Acronyms and qualifiers are defined on sheet 3.**

CALCULATION SHEET

Washington Closure Hanford
Originator R. J. Nielson
Project 100-D Field Remediation
Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations

Date 09/09/14
Job No. 14655

Calc. No. 0100D-CA-V0546
Checked I. B. Berezovskiy

Rev. No. 0
Date 09/09/14
Sheet No. 12 of 17

Ecology Software (MTCAStat) Results, 100-D-84:2 Subsite Excavation

Antimony 95% UCL Calculation

DATA	ID
0.58	J1TW22/J1TW33
0.46	J1TW21
0.52	J1TW23
0.36	J1TW24
0.50	J1TW25
0.60	J1TW26
0.71	J1TW27
0.48	J1TW28
0.59	J1TW29
0.16	J1TW30
0.17	J1TW31
0.17	J1TW32

Number of samples		Uncensored values	
Uncensorec	12	Mean	0.44
Censored		Lognormal me	0.46
Detection limit or PQL		Std. devn.	0.19
Method detection limit		Median	0.49
TOTAL	12	Min.	0.16
		Max.	0.71

Lognormal distribution? r-squared is: 0.807
Normal distribution? r-squared is: 0.901
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 0.54

Arsenic 95% UCL Calculation

DATA	ID
3.3	J1TW22/J1TW33
2.9	J1TW21
2.9	J1TW23
2.7	J1TW24
2.4	J1TW25
2.9	J1TW26
2.3	J1TW27
2.9	J1TW28
3.2	J1TW29
3.2	J1TW30
3.3	J1TW31
2.8	J1TW32

Number of samples		Uncensored values	
Uncensorec	12	Mean	2.9
Censored		Lognormal me	2.9
Detection limit or PQL		Std. devn.	0.32
Method detection limit		Median	2.9
TOTAL	12	Min.	2.3
		Max.	3.3

Lognormal distribution? r-squared is: 0.903
Normal distribution? r-squared is: 0.920
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 3.1

Barium 95% UCL Calculation

DATA	ID
65.3	J1TW22/J1TW33
66.3	J1TW21
64.2	J1TW23
65.4	J1TW24
58.4	J1TW25
65.4	J1TW26
65.1	J1TW27
62.2	J1TW28
68.0	J1TW29
61.8	J1TW30
54.1	J1TW31
52.4	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	62.4
Censored		Lognormal mean	62.4
Detection limit or PQL		Std. devn.	4.9
Method detection limit		Median	64.7
TOTAL	12	Min.	52.4
		Max.	68.0

Lognormal distribution? r-squared is: 0.837
Normal distribution? r-squared is: 0.855
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 64.7

Beryllim 95% UCL Calculation

DATA	ID
0.20	J1TW22/J1TW33
0.21	J1TW21
0.19	J1TW23
0.18	J1TW24
0.18	J1TW25
0.20	J1TW26
0.17	J1TW27
0.19	J1TW28
0.21	J1TW29
0.19	J1TW30
0.18	J1TW31
0.18	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	0.19
Censored		Lognormal mean	0.19
Detection limit or PQL		Std. devn.	0.013
Method detection limit		Median	0.19
TOTAL	12	Min.	0.17
		Max.	0.21

Lognormal distribution? r-squared is: 0.933
Normal distribution? r-squared is: 0.929
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.20

Boron 95% UCL Calculation

DATA	ID
1.4	J1TW22/J1TW33
1.4	J1TW21
1.4	J1TW23
1.0	J1TW24
0.93	J1TW25
1.4	J1TW26
1.2	J1TW27
1.1	J1TW28
1.2	J1TW29
1.1	J1TW30
1.8	J1TW31
0.43	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	1.2
Censored		Lognormal mean	1.2
Detection limit or PQL		Std. devn.	0.34
Method detection limit		Median	1.2
TOTAL	12	Min.	0.43
		Max.	1.8

Lognormal distribution? r-squared is: 0.776
Normal distribution? r-squared is: 0.904
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 1.4

Chromium 95% UCL Calculation

DATA	ID
9.2	J1TW22/J1TW33
8.1	J1TW21
8.1	J1TW23
8.0	J1TW24
6.9	J1TW25
8.1	J1TW26
7.0	J1TW27
7.2	J1TW28
9.4	J1TW29
9.2	J1TW30
10.3	J1TW31
9.4	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	8.4
Censored		Lognormal mean	8.4
Detection limit or PQL		Std. devn.	1.1
Method detection limit		Median	8.1
TOTAL	12	Min.	6.9
		Max.	10.3

Lognormal distribution? r-squared is: 0.939
Normal distribution? r-squared is: 0.938
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 9.0

Cobalt 95% UCL Calculation

DATA	ID
9.0	J1TW22/J1TW33
8.1	J1TW21
8.8	J1TW23
8.9	J1TW24
9.0	J1TW25
8.7	J1TW26
9.1	J1TW27
8.6	J1TW28
8.3	J1TW29
7.3	J1TW30
6.8	J1TW31
6.5	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	8.3
Censored		Lognormal mean	8.3
Detection limit or PQL		Std. devn.	0.90
Method detection limit		Median	8.7
TOTAL	12	Min.	6.5
		Max.	9.1

Lognormal distribution? r-squared is: 0.822
Normal distribution? r-squared is: 0.841
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 8.7

Copper 95% UCL Calculation

DATA	ID
13.7	J1TW22/J1TW33
13.8	J1TW21
13.7	J1TW23
13.4	J1TW24
13.6	J1TW25
13.0	J1TW26
13.7	J1TW27
13.5	J1TW28
13.9	J1TW29
13.0	J1TW30
12.7	J1TW31
12.1	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	13.3
Censored		Lognormal mean	13.3
Detection limit or PQL		Std. devn.	0.54
Method detection limit		Median	13.6
TOTAL	12	Min.	12.1
		Max.	13.9

Lognormal distribution? r-squared is: 0.849
Normal distribution? r-squared is: 0.859
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 13.6

Hexavalent Chromium 95% UCL Calculation

DATA	ID
0.357	J1TW22/J1TW33
0.338	J1TW21
0.336	J1TW23
0.276	J1TW24
0.337	J1TW25
0.317	J1TW26
0.379	J1TW27
0.315	J1TW28
0.254	J1TW29
0.336	J1TW30
0.253	J1TW31
0.254	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	0.313
Censored		Lognormal mean	0.313
Detection limit or PQL		Std. devn.	0.043
Method detection limit		Median	0.327
TOTAL	12	Min.	0.253
		Max.	0.379

Lognormal distribution? r-squared is: 0.891
Normal distribution? r-squared is: 0.907
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 0.335

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson
Project 100-D Field Remediation
Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations

Date 09/09/14
Job No. 14655

Calc. No. 0100D-CA-V0546
Checked I. B. Berezovskiy

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Date 09/09/14
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Ecology Software (MTCAStat) Results, 100-D-84:2 Subsite Excavation

Lead 95% UCL Calculation

DATA	ID
4.4	J1TW22/J1TW33
4.5	J1TW21
4.4	J1TW23
4.2	J1TW24
3.8	J1TW25
4.2	J1TW26
4.0	J1TW27
3.9	J1TW28
4.5	J1TW29
4.0	J1TW30
4.0	J1TW31
3.4	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	4.1
Censored		Lognormal mean	4.1
Detection limit or PQL		Std. devn.	0.33
Method detection limit		Median	4.1
TOTAL	12	Min.	3.4
		Max.	4.5

Lognormal distribution? r-squared is: 0.911
Normal distribution? r-squared is: 0.927
Recommendations:
Use lognormal distribution.

UCL (based on t-statistic) is 4.3

Manganese 95% UCL Calculation

DATA	ID
306	J1TW22/J1TW33
295	J1TW21
307	J1TW23
312	J1TW24
303	J1TW25
323	J1TW26
303	J1TW27
308	J1TW28
307	J1TW29
276	J1TW30
273	J1TW31
261	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	298
Censored		Lognormal mean	298
Detection limit or PQL		Std. devn.	18.3
Method detection limit		Median	304
TOTAL	12	Min.	261
		Max.	323

Lognormal distribution? r-squared is: 0.862
Normal distribution? r-squared is: 0.874
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 306

Mercury 95% UCL Calculation

DATA	ID
0.0082	J1TW22/J1TW33
0.010	J1TW21
0.010	J1TW23
0.0079	J1TW24
0.0079	J1TW25
0.0090	J1TW26
0.0096	J1TW27
0.0083	J1TW28
0.0089	J1TW29
0.011	J1TW30
0.0083	J1TW31
0.0072	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	0.0089
Censored		Lognormal mean	0.0089
Detection limit or PQL		Std. devn.	0.0011
Method detection limit		Median	0.0086
TOTAL	12	Min.	0.0072
		Max.	0.011

Lognormal distribution? r-squared is: 0.967
Normal distribution? r-squared is: 0.955
Recommendations:
Use lognormal distribution.

UCL (based on t-statistic) is 0.0094

Nickel 95% UCL Calculation

DATA	ID
11.4	J1TW22/J1TW33
9.1	J1TW21
11.2	J1TW23
10.0	J1TW24
8.6	J1TW25
11.4	J1TW26
10.7	J1TW27
9.0	J1TW28
11.3	J1TW29
9.4	J1TW30
11.5	J1TW31
9.7	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	10.3
Censored		Lognormal mean	10.3
Detection limit or PQL		Std. devn.	1.1
Method detection limit		Median	10.4
TOTAL	12	Min.	8.6
		Max.	11.5

Lognormal distribution? r-squared is: 0.902
Normal distribution? r-squared is: 0.902
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 10.9

Vanadium 95% UCL Calculation

DATA	ID
51.2	J1TW22/J1TW33
50.1	J1TW21
55.1	J1TW23
58.0	J1TW24
55.3	J1TW25
52.9	J1TW26
57.5	J1TW27
55.2	J1TW28
50.8	J1TW29
41.3	J1TW30
33.6	J1TW31
38.0	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	49.9
Censored		Lognormal mean	50.0
Detection limit or PQL		Std. devn.	8.0
Method detection limit		Median	52.0
TOTAL	12	Min.	33.6
		Max.	58.0

Lognormal distribution? r-squared is: 0.822
Normal distribution? r-squared is: 0.857
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 53.7

Zinc 95% UCL Calculation

DATA	ID
42.5	J1TW22/J1TW33
41.0	J1TW21
51.8	J1TW23
43.5	J1TW24
42.1	J1TW25
42.4	J1TW26
43.7	J1TW27
42.8	J1TW28
41.3	J1TW29
35.8	J1TW30
34.6	J1TW31
34.1	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	41.3
Censored		Lognormal mean	41.3
Detection limit or PQL		Std. devn.	4.8
Method detection limit		Median	42.3
TOTAL	12	Min.	34.1
		Max.	51.8

Lognormal distribution? r-squared is: 0.873
Normal distribution? r-squared is: 0.866
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 43.6

Nitrogen in Nitrite and Nitrate 95% UCL Calculation

DATA	ID
0.33	J1TW22/J1TW33
0.84	J1TW21
1.8	J1TW23
0.18	J1TW24
0.18	J1TW25
0.18	J1TW26
0.18	J1TW27
0.18	J1TW28
0.80	J1TW29
0.52	J1TW30
0.62	J1TW31
0.18	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	0.50
Censored		Lognormal mean	0.50
Detection limit or PQL		Std. devn.	0.48
Method detection limit		Median	0.25
TOTAL	12	Min.	0.18
		Max.	1.8

Lognormal distribution? r-squared is: 0.830
Normal distribution? r-squared is: 0.710
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.73

Pyrene 95% UCL Calculation

DATA	ID
27	J1TW22/J1TW33
40	J1TW21
6.0	J1TW23
6.0	J1TW24
5.5	J1TW25
6.0	J1TW26
20	J1TW27
21	J1TW28
34	J1TW29
5.5	J1TW30
52	J1TW31
6.0	J1TW32

Number of samples		Uncensored values	
Uncensored	12	Mean	19
Censored		Lognormal mean	20
Detection limit or PQL		Std. devn.	16
Method detection limit		Median	13
TOTAL	12	Min.	5.5
		Max.	52

Lognormal distribution? r-squared is: 0.835
Normal distribution? r-squared is: 0.839
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 27

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson

Project 100-D Field Remediation

Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations

Date 09/09/14

Job No. 14655

Calc. No. 0100D-CA-V0546

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Ecology Software (MTCAStat) Results, 100-D-84:2 Subsite Staging Pile Area

Arsenic 95% UCL Calculation

DATA	ID
2.5	J1TW34/J1TW46
2.8	J1TW35
2.4	J1TW36
2.0	J1TW37
3.6	J1TW38
3.2	J1TW39
2.2	J1TW40
3.4	J1TW41
4.4	J1TW42
3.9	J1TW43
2.1	J1TW44
2.5	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	2.9
Censored		Lognormal mean	2.9
Detection limit or PQL		Std. devn.	0.77
Method detection limit		Median	2.7
TOTAL	12	Min.	2.0
		Max.	4.4

Lognormal distribution? r-squared is: 0.963

Normal distribution? r-squared is: 0.940

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 3.4

Barium 95% UCL Calculation

DATA	ID
71.3	J1TW34/J1TW46
83.1	J1TW35
69.9	J1TW36
71.3	J1TW37
101	J1TW38
92.6	J1TW39
78.4	J1TW40
89.4	J1TW41
91.9	J1TW42
81.0	J1TW43
49.9	J1TW44
78.4	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	79.8
Censored		Lognormal mean	80.0
Detection limit or PQL		Std. devn.	13.5
Method detection limit		Median	79.7
TOTAL	12	Min.	49.9
		Max.	101

Lognormal distribution? r-squared is: 0.887

Normal distribution? r-squared is: 0.943

Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 86.8

Beryllium 95% UCL Calculation

DATA	ID
0.30	J1TW34/J1TW46
0.34	J1TW35
0.30	J1TW36
0.30	J1TW37
0.40	J1TW38
0.38	J1TW39
0.31	J1TW40
0.32	J1TW41
0.32	J1TW42
0.32	J1TW43
0.25	J1TW44
0.32	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	0.32
Censored		Lognormal mean	0.32
Detection limit or PQL		Std. devn.	0.039
Method detection limit		Median	0.32
TOTAL	12	Min.	0.25
		Max.	0.40

Lognormal distribution? r-squared is: 0.904

Normal distribution? r-squared is: 0.895

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.34

Boron 95% UCL Calculation

DATA	ID
1.3	J1TW34/J1TW46
1.8	J1TW35
1.5	J1TW36
1.5	J1TW37
2.2	J1TW38
2.2	J1TW39
2.9	J1TW40
1.9	J1TW41
2.0	J1TW42
2.0	J1TW43
0.43	J1TW44
1.5	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	1.8
Censored		Lognormal mean	1.8
Detection limit or PQL		Std. devn.	0.60
Method detection limit		Median	1.9
TOTAL	12	Min.	0.43
		Max.	2.9

Lognormal distribution? r-squared is: 0.742

Normal distribution? r-squared is: 0.919

Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 2.1

Chromium 95% UCL Calculation

DATA	ID
8.7	J1TW34/J1TW46
10.9	J1TW35
9.0	J1TW36
8.8	J1TW37
11.3	J1TW38
11.1	J1TW39
7.6	J1TW40
10.4	J1TW41
12.0	J1TW42
11.4	J1TW43
8.1	J1TW44
8.9	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	9.8
Censored		Lognormal mean	9.9
Detection limit or PQL		Std. devn.	1.5
Method detection limit		Median	9.7
TOTAL	12	Min.	7.6
		Max.	12.0

Lognormal distribution? r-squared is: 0.930

Normal distribution? r-squared is: 0.931

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 10.7

Cobalt 95% UCL Calculation

DATA	ID
8.6	J1TW34/J1TW46
8.3	J1TW35
7.6	J1TW36
7.7	J1TW37
9.1	J1TW38
8.9	J1TW39
8.7	J1TW40
8.5	J1TW41
7.8	J1TW42
7.4	J1TW43
8.1	J1TW44
8.6	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	8.3
Censored		Lognormal mean	8.3
Detection limit or PQL		Std. devn.	0.55
Method detection limit		Median	8.4
TOTAL	12	Min.	7.4
		Max.	9.1

Lognormal distribution? r-squared is: 0.964

Normal distribution? r-squared is: 0.968

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 8.6

Copper 95% UCL Calculation

DATA	ID
14.5	J1TW34/J1TW46
15.1	J1TW35
14.9	J1TW36
13.7	J1TW37
18.2	J1TW38
14.7	J1TW39
14.4	J1TW40
18.9	J1TW41
17.1	J1TW42
17.3	J1TW43
12.4	J1TW44
15.8	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	15.6
Censored		Lognormal mean	15.6
Detection limit or PQL		Std. devn.	1.9
Method detection limit		Median	15.0
TOTAL	12	Min.	12.4
		Max.	18.9

Lognormal distribution? r-squared is: 0.967

Normal distribution? r-squared is: 0.961

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 16.7

Hexavalent Chromium 95% UCL Calculation

DATA	ID
0.258	J1TW34/J1TW46
0.378	J1TW35
0.232	J1TW36
0.233	J1TW37
0.277	J1TW38
0.335	J1TW39
0.076	J1TW40
0.078	J1TW41
0.078	J1TW42
0.078	J1TW43
0.078	J1TW44
0.344	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	0.204
Censored		Lognormal mean	0.212
Detection limit or PQL		Std. devn.	0.119
Method detection limit		Median	0.233
TOTAL	12	Min.	0.078
		Max.	0.378

Lognormal distribution? r-squared is: 0.802

Normal distribution? r-squared is: 0.862

Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.260

Lead 95% UCL Calculation

DATA	ID
3.7	J1TW34/J1TW46
4.4	J1TW35
3.5	J1TW36
3.6	J1TW37
5.4	J1TW38
5.0	J1TW39
4.3	J1TW40
4.0	J1TW41
4.0	J1TW42
3.8	J1TW43
2.7	J1TW44
3.8	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	4.0
Censored		Lognormal mean	4.0
Detection limit or PQL		Std. devn.	0.71
Method detection limit		Median	3.9
TOTAL	12	Min.	2.7
		Max.	5.4

Lognormal distribution? r-squared is: 0.935

Normal distribution? r-squared is: 0.939

Recommendations:
Use lognormal distribution.

UCL (Land's method) is 4.4

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson
Project 100-D Field Remediation
Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations

Date 09/09/14
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Ecology Software (MTCAStat) Results, 100-D-84:2 Subsite Staging Pile Area

Manganese 95% UCL Calculation

DATA	ID
296	J1TW34/J1TW46
319	J1TW35
282	J1TW36
294	J1TW37
346	J1TW38
342	J1TW39
296	J1TW40
319	J1TW41
303	J1TW42
293	J1TW43
268	J1TW44
311	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	306
Censored		Lognormal mean	306
Detection limit or PQL		Std. devn.	22.9
Method detection limit		Median	301
TOTAL	12	Min.	268
		Max.	346

Lognormal distribution? r-squared is: 0.965
Normal distribution? r-squared is: 0.958
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 318

Mercury 95% UCL Calculation

DATA	ID
0.0046	J1TW34/J1TW46
0.0067	J1TW35
0.0070	J1TW36
0.0072	J1TW37
0.0094	J1TW38
0.0065	J1TW39
0.011	J1TW40
0.011	J1TW41
0.011	J1TW42
0.011	J1TW43
0.0073	J1TW44
0.0069	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	0.0063
Censored		Lognormal mean	0.0063
Detection limit or PQL		Std. devn.	0.0023
Method detection limit		Median	0.0073
TOTAL	12	Min.	0.0046
		Max.	0.011

Lognormal distribution? r-squared is: 0.877
Normal distribution? r-squared is: 0.867
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 0.0090

Nickel 95% UCL Calculation

DATA	ID
10.8	J1TW34/J1TW46
11.7	J1TW35
11.1	J1TW36
10.0	J1TW37
12.8	J1TW38
12.0	J1TW39
10.4	J1TW40
12.2	J1TW41
11.8	J1TW42
13.2	J1TW43
10.1	J1TW44
10.7	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	11.4
Censored		Lognormal mean	11.4
Detection limit or PQL		Std. devn.	1.05
Method detection limit		Median	11.4
TOTAL	12	Min.	10.0
		Max.	13.2

Lognormal distribution? r-squared is: 0.973
Normal distribution? r-squared is: 0.970
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 12.0

Vanadium 95% UCL Calculation

DATA	ID
55.9	J1TW34/J1TW46
50.8	J1TW35
48.8	J1TW36
49.5	J1TW37
50.8	J1TW38
54.0	J1TW39
58.9	J1TW40
50.1	J1TW41
47.8	J1TW42
46.3	J1TW43
56.5	J1TW44
53.1	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	51.9
Censored		Lognormal mean	51.9
Detection limit or PQL		Std. devn.	3.8
Method detection limit		Median	50.8
TOTAL	12	Min.	46.3
		Max.	58.9

Lognormal distribution? r-squared is: 0.976
Normal distribution? r-squared is: 0.969
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 53.9

Zinc 95% UCL Calculation

DATA	ID
40.3	J1TW34/J1TW46
41.2	J1TW35
37.6	J1TW36
38.6	J1TW37
43.7	J1TW38
41.2	J1TW39
43.2	J1TW40
38.7	J1TW41
37.4	J1TW42
36.2	J1TW43
36.3	J1TW44
40.6	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	39.6
Censored		Lognormal mean	39.6
Detection limit or PQL		Std. devn.	2.5
Method detection limit		Median	39.5
TOTAL	12	Min.	36.2
		Max.	43.7

Lognormal distribution? r-squared is: 0.964
Normal distribution? r-squared is: 0.962
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 40.9

Nirogen in Nitrite and Nitrate 95% UCL Calculation

DATA	ID
1.7	J1TW34/J1TW46
5.8	J1TW35
3.2	J1TW36
2.6	J1TW37
11.2	J1TW38
17.2	J1TW39
11.7	J1TW40
3.3	J1TW41
3.3	J1TW42
0.81	J1TW43
1.0	J1TW44
1.4	J1TW45

Number of samples		Uncensored values	
Uncensored	12	Mean	5.3
Censored		Lognormal mean	5.5
Detection limit or PQL		Std. devn.	5.3
Method detection limit		Median	3.3
TOTAL	12	Min.	0.81
		Max.	17.2

Lognormal distribution? r-squared is: 0.963
Normal distribution? r-squared is: 0.796
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 13.1

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson RN
Project 100-D Field Remediation
Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations

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1 **Duplicate Analysis - 100-D-84:2 Subsite - Excavation**

2 Sampling	Sample	Sample	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron			Calcium			Chromium		
3 Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
4 EXC-2	J1TW22	7/14/14	6710	X	1.4	0.52	J	0.34	3.0		0.60	63.0	X	0.069	0.19		0.030	1.5	B	0.88	6710	X	12.7	7.8	X	0.052
5 Duplicate of J1TW22	J1TW33	7/14/14	7200	X	1.4	0.64		0.35	3.5		0.61	67.6	X	0.071	0.21		0.031	1.3	B	0.91	6690	X	13.1	10.6	X	0.054

6 **Analysis:**

7 TDL		5	0.6	10	2	0.2	2	100	1
8 Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
9	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
10	RPD	7.0%			7.0%			0.3%	30.4%
11	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable

12

13 **Duplicate Analysis - 100-D-84:2 Subsite - Excavation**

14 Sampling	Sample	Sample	Cobalt			Copper			Hexavalent Chromium			Iron			Lead			Magnesium			Manganese			Mercury		
15 Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
16 EXC-2	J1TW22	7/14/14	9.0	X	0.090	13.5		0.20	0.356		0.155	22200	X	3.4	4.1		0.24	4490	X	3.3	297	X	0.090	0.0086	B	0.0050
17 Duplicate of J1TW22	J1TW33	7/14/14	8.9	X	0.093	13.9		0.20	0.358		0.155	22300	X	3.5	4.7		0.25	4760	X	3.4	314	X	0.093	0.0078	B	0.0050

18 **Analysis:**

19 TDL		2	1	0.5	5	5	75	5	0.2
20 Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
21	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
22	RPD		2.9%		0.4%		5.8%	5.6%	
23	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable

24

25 **Duplicate Analysis - 100-D-84:2 Subsite - Excavation**

26 Sampling	Sample	Sample	Nickel			Potassium			Silicon			Sodium			Vanadium			Zinc		
27 Area	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
28 EXC-2	J1TW22	7/14/14	10.5	X	0.11	1200		37.0	204		5.1	307		53.2	52.3		0.085	41.7	X	0.36
29 Duplicate of J1TW22	J1TW33	7/14/14	12.2	X	0.11	1360		38.1	150		5.3	272		54.8	50.0		0.087	43.3	X	0.37

30 **Analysis:**

31 TDL		4	400	2	50	2.5	1
32 Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
33	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
34	RPD			30.5%	12.1%	4.5%	3.8%
35	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	Not applicable	Not applicable	Not applicable

36

37 **Acronyms and qualifiers are defined on sheet 3.**

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CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson **Date** 09/09/14 **Calc. No.** 0100D-CA-V0546 **Rev. No.** 0
Project 100-D Field Remediation **Job No.** 14855 **Checked** I. B. Berezovskiy **Date** 09/09/14
Subject 100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations **Sheet No.** 17 of 17

Duplicate Analysis - 100-D-84:2 Subsite - SPA

Sampling Area	Sample Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Boron			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SPA-1	J1TW34	7/30/14	6340	X	1.4	2.7		0.59	73.1	X	0.068	0.28		0.030	1.4	B	0.88	7720	X	12.6	9.2	X	0.052	8.8	X	0.089
Duplicate of J1TW34	J1TW46	7/30/14	6100	X	1.5	2.3		0.63	69.4	X	0.072	0.31		0.031	1.2	B	0.93	7590	X	13.4	8.1	X	0.055	8.3	X	0.095

Analysis:

TDL		5	10	2	0.2	2	100	1	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	3.9%		5.2%			1.7%	12.7%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable

Duplicate Analysis - 100-D-84:2 Subsite - Overburden

Sampling Area	Sample Number	Sample Date	Copper			Hexavalent Chromium			Iron			Lead			Magnesium			Manganese			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SPA-1	J1TW34	7/30/14	14.9	X	0.19	0.216		0.155	22100	X	3.4	3.6		0.24	4730	X	3.3	307	X	0.089	10.9	X	0.11	857		36.7
Duplicate of J1TW34	J1TW46	7/30/14	14.0	X	0.21	0.300		0.155	20700	X	3.6	3.8		0.26	4640	X	3.5	285	X	0.095	10.7	X	0.12	855		38.9

Analysis:

TDL		1	0.5	5	5	75	5	4	400
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	6.2%		6.5%		1.9%	7.4%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable

Duplicate Analysis - 100-D-84:2 Subsite - Overburden

Sampling Area	Sample Number	Sample Date	Silicon			Sodium			Vanadium			Zinc			Nitrogen in Nitrite and Nitrate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
SPA-1	J1TW34	7/30/14	428	N	5.1	387		52.8	59.0	X	0.084	42.2	X	0.36	0.96	N	0.37
Duplicate of J1TW34	J1TW46	7/30/14	422		5.4	313		56.0	52.8	X	0.089	38.3	X	0.38	2.4		0.37

Analysis:

TDL		2	50	2.5	1	0.75
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	1.4%	21.1%	11.1%	9.7%	
	Difference > 2 TDL?	Not applicable	Not applicable	Not applicable	Not applicable	No - acceptable

Acronyms and qualifiers are defined on sheet 3.

Attachment 1. 100-D-84:2 Subsite Verificiation Sample Results (Metals).

Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-2	J1TW22	7/14/14	6710	X	1.4	0.52	J	0.34	3.0		0.60	63.0	X	0.069	0.19		0.030	1.5	B	0.88
Duplicate of J1TW22	J1TW33	7/14/14	7200	X	1.4	0.64	J	0.35	3.5		0.61	67.6	X	0.071	0.21		0.031	1.3	B	0.91
EXC-1	J1TW21	7/14/14	7190	X	1.5	0.46	J	0.37	2.9		0.64	66.3	X	0.074	0.21		0.032	1.4	B	0.95
EXC-3	J1TW23	7/14/14	6990	X	1.5	0.52	J	0.38	2.9		0.66	64.2	X	0.076	0.19	B	0.033	1.4	B	0.98
EXC-4	J1TW24	7/14/14	6780	X	1.4	0.36	J	0.35	2.7		0.61	65.4	X	0.070	0.18		0.031	1.0	B	0.91
EXC-5	J1TW25	7/14/14	6540	X	1.5	0.50	J	0.36	2.4		0.62	58.4	X	0.071	0.18	B	0.031	0.93	B	0.92
EXC-6	J1TW26	7/14/14	6830	X	1.4	0.60	J	0.35	2.9		0.60	65.4	X	0.069	0.20		0.030	1.4	B	0.89
EXC-7	J1TW27	7/14/14	6630	X	1.4	0.71	J	0.35	2.3		0.62	65.1	X	0.071	0.17	B	0.031	1.2	B	0.91
EXC-8	J1TW28	7/14/14	6420	X	1.3	0.48	J	0.32	2.9		0.56	62.2	X	0.064	0.19		0.028	1.1	B	0.83
EXC-9	J1TW29	7/14/14	7120	X	1.5	0.59	J	0.37	3.2		0.65	68.0	X	0.074	0.21		0.032	1.2	B	0.96
EXC-10	J1TW30	7/15/14	6460	X	1.3	0.32	J	0.32	3.2		0.56	61.8	X	0.065	0.19		0.028	1.1	B	0.84
EXC-11	J1TW31	7/15/14	6390	X	1.3	0.33	J	0.33	3.3		0.57	54.1	X	0.066	0.18		0.029	1.8		0.85
EXC-12	J1TW32	7/15/14	6330	X	1.4	0.33	J	0.33	2.8		0.58	52.4	X	0.067	0.18		0.029	0.86	U	0.86
SPA-1	J1TW34	7/30/14	6340	X	1.4	0.34	B	0.34	2.7		0.59	73.1	X	0.068	0.28		0.030	1.4	B	0.88
Duplicate of J1TW34	J1TW46	7/30/14	6100	X	1.5	0.36	U	0.36	2.3		0.63	69.4	X	0.072	0.31		0.031	1.2	B	0.93
SPA-2	J1TW35	7/30/14	8120	X	1.5	0.37	U	0.37	2.8		0.65	83.1	X	0.074	0.34		0.032	1.8	B	0.96
SPA-3	J1TW36	7/30/14	6430	X	1.4	0.35	U	0.35	2.4		0.62	69.9	X	0.071	0.30		0.031	1.5	B	0.92
SPA-4	J1TW37	7/30/14	6560	X	1.5	0.36	U	0.36	2.0		0.62	71.3	X	0.072	0.30		0.031	1.5	B	0.93
SPA-5	J1TW38	7/30/14	9040	X	1.5	0.36	U	0.36	3.6		0.62	101	X	0.071	0.40		0.031	2.2		0.92
SPA-6	J1TW39	7/30/14	8520	X	1.4	0.33	U	0.33	3.2		0.58	92.6	X	0.067	0.38		0.029	2.2		0.86
SPA-7	J1TW40	7/30/14	6420	X	1.6	0.38	U	0.38	2.2		0.66	78.4	X	0.077	0.31		0.033	2.9		0.99
SPA-8	J1TW41	7/30/14	7330	X	1.5	0.36	U	0.36	3.4		0.62	89.4	X	0.072	0.32		0.031	1.9		0.92
SPA-9	J1TW42	7/30/14	7610	X	1.6	0.39	U	0.39	4.4		0.68	91.9	X	0.078	0.32		0.034	2.0		1.0
SPA-10	J1TW43	7/30/14	7370	X	1.5	0.38	U	0.38	3.9		0.65	81.0	X	0.075	0.32		0.033	2.0		0.97
SPA-11	J1TW44	7/30/14	4770	X	1.4	0.33	U	0.33	2.1		0.58	49.9	X	0.067	0.25		0.029	0.86	U	0.86
SPA-12	J1TW45	7/30/14	6820	X	1.5	0.37	U	0.37	2.5		0.64	78.4	X	0.073	0.32		0.032	1.5	B	0.95
100-D-84:2, Area 4	J1THH2	4/7/14	6750		1.5	0.37	U	0.37	2.9		0.64	146		0.073	0.43		0.032	10.4		0.95
Equipment blank	J1TW47	7/30/14	184	X	1.6	0.38	U	0.38	0.66	U	0.66	2.1	X	0.076	0.064	B	0.033	0.98	U	0.98

Gray cells indicate not applicable.
B = estimated result. Result isless than the RL, but greater than the MDL.
EXC = excavation
HEIS = Hanford Environmental Information System
J = estimate
K = benzo(b&k)fluoranthene are unresolved due to matrix, result is reported as benzo(b)fluoranthene
N = recovery outside control limits
PQL = practical quantitation limit
Q = qualifier
T = recovery outside control limits
SPA = staging pile area
U = undetected
X = serial dilution in the analytical batch indicates that physical and chemical interferences are present

Attachment	1	Sheet No.	1 of 16
Originator	R. J. Nielson	Date	9/18/14
Checked	I. B. Berezovskiy	Date	9/18/14
Calc. No.	0100D-CA-V0546	Rev. No.	0

Attachment 1. 100-D-84:2 Subsite Verificiation Sample Results (Metals and Hexavalent Chromium).

Location	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper			Hexavalent Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-2	J1TW22	7/14/14	0.037	U	0.037	6710	X	12.7	7.8	X	0.052	9.0	X	0.090	13.5		0.20	0.356		0.155
Duplicate of J1TW22	J1TW33	7/14/14	0.038	U	0.038	6690	X	13.1	10.6	X	0.054	8.9	X	0.093	13.9		0.20	0.358		0.155
EXC-1	J1TW21	7/14/14	0.040	U	0.040	7170	X	13.6	8.1	X	0.056	8.1	X	0.097	13.8		0.21	0.338		0.155
EXC-3	J1TW23	7/14/14	0.041	U	0.041	6020	X	14.1	8.1	X	0.058	8.8	X	0.100	13.7		0.22	0.336		0.155
EXC-4	J1TW24	7/14/14	0.038	U	0.038	6200	X	13.0	8.0	X	0.054	8.9	X	0.092	13.4		0.20	0.276		0.155
EXC-5	J1TW25	7/14/14	0.039	U	0.039	6060	X	13.3	6.9	X	0.055	9.0	X	0.094	13.6		0.20	0.337		0.155
EXC-6	J1TW26	7/14/14	0.037	U	0.037	5640	X	12.8	8.1	X	0.053	8.7	X	0.091	13.0		0.20	0.317		0.155
EXC-7	J1TW27	7/14/14	0.038	U	0.038	6250	X	13.2	7.0	X	0.054	9.1	X	0.093	13.7		0.20	0.379		0.155
EXC-8	J1TW28	7/14/14	0.035	U	0.035	6230	X	11.9	7.2	X	0.049	8.6	X	0.085	13.5		0.18	0.315		0.155
EXC-9	J1TW29	7/14/14	0.040	U	0.040	7900	X	13.8	9.4	X	0.057	8.3	X	0.098	13.9		0.21	0.254		0.155
EXC-10	J1TW30	7/15/14	0.035	U	0.035	6830	X	12.0	9.2	X	0.049	7.3	X	0.085	13.0		0.19	0.336		0.155
EXC-11	J1TW31	7/15/14	0.048	B	0.035	8040	X	12.2	10.3	X	0.050	6.8	X	0.087	12.7		0.19	0.253		0.155
EXC-12	J1TW32	7/15/14	0.036	U	0.036	7500	X	12.3	9.4	X	0.051	6.5	X	0.088	12.1		0.19	0.254		0.155
SPA-1	J1TW34	7/30/14	0.037	U	0.037	7720	X	12.6	9.2	X	0.052	8.8	X	0.089	14.9	X	0.19	0.216		0.155
Duplicate of J1TW34	J1TW46	7/30/14	0.039	U	0.039	7590	X	13.4	8.1	X	0.055	8.3	X	0.095	14.0	X	0.21	0.300		0.155
SPA-2	J1TW35	7/30/14	0.040	U	0.040	4070	X	13.8	10.9	X	0.057	8.3	X	0.098	15.1	X	0.21	0.378		0.155
SPA-3	J1TW36	7/30/14	0.038	U	0.038	8680	X	13.2	9.0	X	0.054	7.6	X	0.093	14.9	X	0.20	0.232		0.155
SPA-4	J1TW37	7/30/14	0.039	U	0.039	5320	X	13.3	8.8	X	0.055	7.7	X	0.094	13.7	X	0.20	0.233		0.155
SPA-5	J1TW38	7/30/14	0.038	U	0.038	8530	X	13.2	11.3	X	0.054	9.1	X	0.094	18.2	X	0.20	0.277		0.155
SPA-6	J1TW39	7/30/14	0.036	U	0.036	4240	X	12.4	11.1	X	0.051	8.9	X	0.088	14.7	X	0.19	0.335		0.155
SPA-7	J1TW40	7/30/14	0.041	U	0.041	6410	X	14.2	7.6	X	0.058	8.7	X	0.10	14.4	X	0.22	0.155	U	0.155
SPA-8	J1TW41	7/30/14	0.039	U	0.039	13700	X	13.3	10.4	X	0.055	8.5	X	0.094	18.9	X	0.20	0.155	U	0.155
SPA-9	J1TW42	7/30/14	0.042	U	0.042	18500	X	14.4	12.0	X	0.059	7.8	X	0.10	17.1	X	0.22	0.155	U	0.155
SPA-10	J1TW43	7/30/14	0.041	U	0.041	17100	X	13.9	11.4	X	0.057	7.4	X	0.099	17.3	X	0.21	0.155	U	0.155
SPA-11	J1TW44	7/30/14	0.036	U	0.036	6610	X	12.4	8.1	X	0.051	8.1	X	0.088	12.4	X	0.19	0.155	U	0.155
SPA-12	J1TW45	7/30/14	0.040	U	0.040	5860	X	13.6	8.9	X	0.056	8.6	X	0.097	15.8	X	0.21	0.344		0.155
100-D-84:2, Area 4	J1THH2	4/7/14	0.040	U	0.040	9170		13.6	8.4		0.056	7.4	X	0.096	13.0		0.20	0.155	U	0.155
Equipment blank	J1TW47	7/30/14	0.041	U	0.041	42.0	BX	14.1	0.13	BX	0.058	0.13	BX	0.10	0.36	BX	0.22			

Attachment	1	Sheet No.	2 of 16
Originator	R. J. Nielson	Date	9/18/14
Checked	I. B. Berezovskiy	Date	9/18/14
Calc. No.	0100D-CA-V0546	Rev. No.	0

Attachment 1. 100-D-84:2 Subsite Verificiation Sample Results (Metals and Mercury).

Location	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese			Mercury			Molybdenum		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-2	J1TW22	7/14/14	22200	X	3.4	4.1		0.24	4490	X	3.3	297	X	0.090	0.0086	B	0.0050	0.55	B	0.23
Duplicate of J1TW22	J1TW33	7/14/14	22300	X	3.5	4.7		0.25	4760	X	3.4	314	X	0.093	0.0078	B	0.0050	0.24	U	0.24
EXC-1	J1TW21	7/14/14	21300	X	3.7	4.5		0.26	4270	X	3.6	295	X	0.097	0.010	B	0.0052	0.48	B	0.25
EXC-3	J1TW23	7/14/14	22900	X	3.8	4.4		0.27	4620	X	3.7	307	X	0.10	0.010	B	0.0055	0.26	U	0.26
EXC-4	J1TW24	7/14/14	23500	X	3.5	4.2		0.25	4560	X	3.4	312	X	0.092	0.0079	B	0.0049	0.24	U	0.24
EXC-5	J1TW25	7/14/14	23200	X	3.6	3.8		0.25	4310	X	3.5	303	X	0.094	0.0079	B	0.0053	0.24	U	0.24
EXC-6	J1TW26	7/14/14	22300	X	3.5	4.2		0.25	4540	X	3.4	323	X	0.091	0.0090	B	0.0055	0.24	U	0.24
EXC-7	J1TW27	7/14/14	24100	X	3.5	4.0		0.25	4640	X	3.5	303	X	0.093	0.0096	B	0.0051	0.24	U	0.24
EXC-8	J1TW28	7/14/14	23200	X	3.2	3.9		0.23	4330	X	3.1	308	X	0.085	0.0083	B	0.0049	0.22	U	0.22
EXC-9	J1TW29	7/14/14	21400	X	3.7	4.5		0.26	4720	X	3.6	307	X	0.098	0.0089	B	0.0054	0.25	U	0.25
EXC-10	J1TW30	7/15/14	18500	X	3.2	4.0		0.23	4280	X	3.2	276	X	0.085	0.011	B	0.0052	0.22	U	0.22
EXC-11	J1TW31	7/15/14	17000	X	3.3	4.0		0.23	4810	X	3.2	273	X	0.087	0.0083	B	0.0055	0.23	U	0.23
EXC-12	J1TW32	7/15/14	17400	X	3.3	3.4		0.24	4420	X	3.2	261	X	0.088	0.0072	B	0.0049	0.23	U	0.23
SPA-1	J1TW34	7/30/14	22100	X	3.4	3.6		0.24	4730	X	3.3	307	X	0.089	0.0055	U	0.0055	0.46	B	0.23
Duplicate of J1TW34	J1TW46	7/30/14	20700	X	3.6	3.8		0.26	4640	X	3.5	285	X	0.095	0.0064	B	0.0051	0.25	U	0.25
SPA-2	J1TW35	7/30/14	21300	X	3.7	4.4		0.26	4950	X	3.6	319	X	0.098	0.0067	B	0.0055	0.45	B	0.25
SPA-3	J1TW36	7/30/14	19700	X	3.5	3.5		0.25	4800	X	3.5	282	X	0.093	0.0070	B	0.0050	0.24	U	0.24
SPA-4	J1TW37	7/30/14	20400	X	3.6	3.6		0.25	4490	X	3.5	294	X	0.094	0.0072	B	0.0060	0.25	U	0.25
SPA-5	J1TW38	7/30/14	23000	X	3.6	5.4		0.25	5480	X	3.5	346	X	0.094	0.0094	B	0.0058	0.24	U	0.24
SPA-6	J1TW39	7/30/14	22600	X	3.3	5.0		0.24	4810	X	3.3	342	X	0.088	0.0065	B	0.0050	0.23	U	0.23
SPA-7	J1TW40	7/30/14	22200	X	3.8	4.3		0.27	4360	X	3.7	298	X	0.10	0.011	B	0.0060	0.26	U	0.26
SPA-8	J1TW41	7/30/14	20900	X	3.6	4.0		0.25	5070	X	3.5	319	X	0.094	0.011	B	0.0067	0.25	U	0.25
SPA-9	J1TW42	7/30/14	19200	X	3.9	4.0		0.28	4860	X	3.8	303	X	0.10	0.011	B	0.0060	0.27	U	0.27
SPA-10	J1TW43	7/30/14	18800	X	3.8	3.8		0.27	4870	X	3.7	293	X	0.099	0.011	B	0.0056	0.26	U	0.26
SPA-11	J1TW44	7/30/14	21600	X	3.3	2.7		0.24	4350	X	3.3	268	X	0.088	0.0073	B	0.0058	0.23	U	0.23
SPA-12	J1TW45	7/30/14	21600	X	3.7	3.8		0.26	4630	X	3.6	311	X	0.097	0.0069	B	0.0049	0.25	U	0.25
100-D-84:2, Area 4	J1THH2	4/7/14	19100		3.7	4.2		0.26	4740		3.6	285		0.096	0.0061	UN	0.0061	0.38	B	0.25
Equipment blank	J1TW47	7/30/14	404	X	3.8	0.42	B	0.27	23.4	X	3.7	5.3	X	0.10	0.0051	U	0.0051	0.26	U	0.26

Attachment	1	Sheet No.	3 of 16
Originator	R. J. Nielson	Date	9/16/14
Checked	I. B. Berezovskiy	Date	9/16/14
Calc. No.	0100D-CA-V0546	Rev. No.	0

Attachment 1. 100-D-84:2 Subsite Verificiation Sample Results (Metals).

Location	HEIS Number	Sample Date	Nickel			Potassium			Selenium			Silicon			Silver			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
EXC-2	J1TW22	7/14/14	10.5	X	0.11	1200		37.0	0.88	B	0.78	204	J	5.1	0.14	U	0.14	307		53.2
Duplicate of J1TW22	J1TW33	7/14/14	12.2	X	0.11	1360		38.1	0.80	U	0.80	150	J	5.3	0.15	U	0.15	272		54.8
EXC-1	J1TW21	7/14/14	9.1	X	0.12	1290		39.7	0.83	U	0.83	270	NJ	5.5	0.15	U	0.15	336		57.1
EXC-3	J1TW23	7/14/14	11.2	X	0.12	1290		40.9	0.86	U	0.86	220	J	5.7	0.16	U	0.16	285		58.9
EXC-4	J1TW24	7/14/14	10.0	X	0.11	1250		37.9	0.80	U	0.80	224	J	5.2	0.15	U	0.15	276		54.6
EXC-5	J1TW25	7/14/14	8.6	X	0.12	1160		38.6	0.81	U	0.81	148	J	5.3	0.15	U	0.15	288		55.5
EXC-6	J1TW26	7/14/14	11.4	X	0.11	1330		37.3	0.78	U	0.78	161	J	5.2	0.15	U	0.15	265		53.7
EXC-7	J1TW27	7/14/14	10.7	X	0.11	1160		38.2	0.80	U	0.80	185	J	5.3	0.15	U	0.15	317		55.0
EXC-8	J1TW28	7/14/14	9.0	X	0.10	1140		34.7	0.73	U	0.73	180	J	4.8	0.14	U	0.14	288		49.9
EXC-9	J1TW29	7/14/14	11.3	X	0.12	1230		40.1	0.84	U	0.84	217	J	5.5	0.16	U	0.16	298		57.7
EXC-10	J1TW30	7/15/14	9.4	X	0.10	1080		35.0	0.73	U	0.73	173	J	4.8	0.14	U	0.14	255		50.3
EXC-11	J1TW31	7/15/14	11.5	X	0.11	1080		35.5	0.74	U	0.74	171	J	4.9	0.14	U	0.14	219		51.1
EXC-12	J1TW32	7/15/14	9.7	X	0.11	1050		35.9	0.75	U	0.75	141	J	5.0	0.14	U	0.14	230		51.6
SPA-1	J1TW34	7/30/14	10.9	X	0.11	857		36.7	0.77	U	0.77	428	N	5.1	0.14	U	0.14	387		52.8
Duplicate of J1TW34	J1TW46	7/30/14	10.7	X	0.12	855		38.9	0.82	U	0.82	422		5.4	0.15	U	0.15	313		56.0
SPA-2	J1TW35	7/30/14	11.7	X	0.12	1480		40.2	0.84	U	0.84	473		5.5	0.16	U	0.16	234		57.8
SPA-3	J1TW36	7/30/14	11.1	X	0.11	889		38.3	0.80	U	0.80	452		5.3	0.15	U	0.15	277		55.1
SPA-4	J1TW37	7/30/14	10.0	X	0.12	858		38.7	0.81	U	0.81	383		5.3	0.15	U	0.15	350		55.7
SPA-5	J1TW38	7/30/14	12.8	X	0.12	1300		38.4	0.81	U	0.81	628		5.3	0.15	U	0.15	273		55.3
SPA-6	J1TW39	7/30/14	12.0	X	0.11	1490		36.0	0.76	U	0.76	558		5.0	0.14	U	0.14	236		51.8
SPA-7	J1TW40	7/30/14	10.4	X	0.12	1250		41.3	0.87	U	0.87	291		5.7	0.16	U	0.16	286		59.4
SPA-8	J1TW41	7/30/14	12.2	X	0.12	1060		38.7	0.81	U	0.81	359		5.3	0.15	U	0.15	250		55.7
SPA-9	J1TW42	7/30/14	11.8	X	0.13	1050		42.0	0.88	U	0.88	324		5.8	0.16	U	0.16	212		60.4
SPA-10	J1TW43	7/30/14	13.2	X	0.12	1050		40.5	0.85	U	0.85	308		5.6	0.16	U	0.16	214		58.3
SPA-11	J1TW44	7/30/14	10.1	X	0.11	594		36.1	0.76	U	0.76	158		5.0	0.14	U	0.14	210		51.9
SPA-12	J1TW45	7/30/14	10.7	X	0.12	1160		39.6	0.83	U	0.83	339		5.5	0.15	U	0.15	249		57.0
100-D-84:2, Area 4	J1THH2	4/7/14	9.9		0.12	1070		39.6	0.83	U	0.83	263		5.5	0.15	U	0.15	298		56.9
Equipment blank	J1TW47	7/30/14	0.19	BX	0.12	44.3	B	41.0	0.86	U	0.86	111		5.7	0.16	U	0.16	59.0	U	59.0

Attachment	1	Sheet No.	4 of 16
Originator	R. J. Nielson	Date	9/16/14
Checked	I. B. Berezovskiy	Date	9/16/14
Calc. No.	0100D-CA-V0546	Rev. No.	0

Attachment 1. 100-D-84:2 Subsite Verificiation Sample Results (Metals, Nitrate/Nitrite, TPH, and Physical).

Location	HEIS Number	Sample Date	Vanadium			Zinc			Nitrogen in Nitrite and Nitrate			TPH - Diesel Extended			TPH - Diesel			Percent Moisture (wet sample)		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	%	Q	PQL
EXC-2	J1TW22	7/14/14	52.3		0.085	41.7	X	0.36	0.36	U	0.36							0.99		0.10
Duplicate of J1TW22	J1TW33	7/14/14	50.0		0.087	43.3	X	0.37	0.47	B	0.36							1.2		0.10
EXC-1	J1TW21	7/14/14	50.1		0.091	41.0	X	0.39	0.84		0.36							0.67		0.10
EXC-3	J1TW23	7/14/14	55.1		0.094	51.8	X	0.40	1.8		0.36							0.83		0.10
EXC-4	J1TW24	7/14/14	58.0		0.087	43.5	X	0.37	0.36	U	0.36							0.80		0.10
EXC-5	J1TW25	7/14/14	55.3		0.088	42.1	X	0.37	0.36	U	0.36							0.64		0.10
EXC-6	J1TW26	7/14/14	52.9		0.086	42.4	X	0.36	0.36	U	0.36							1.1		0.10
EXC-7	J1TW27	7/14/14	57.5		0.088	43.7	X	0.37	0.36	U	0.36							0.73		0.10
EXC-8	J1TW28	7/14/14	55.2		0.080	42.8	X	0.34	0.36	U	0.36							0.64		0.10
EXC-9	J1TW29	7/14/14	50.8		0.092	41.3	X	0.39	0.80		0.36							0.70		0.10
EXC-10	J1TW30	7/15/14	41.3		0.08	35.8	X	0.34	0.52	B	0.36							0.65		0.10
EXC-11	J1TW31	7/15/14	33.6		0.081	34.6	X	0.34	0.62	B	0.36							0.39		0.10
EXC-12	J1TW32	7/15/14	38.0		0.082	34.1	X	0.35	0.36	U	0.36							0.62		0.10
SPA-1	J1TW34	7/30/14	59.0	X	0.084	42.2	X	0.36	0.96	N	0.37							4.4		0.10
Duplicate of J1TW34	J1TW46	7/30/14	52.8	X	0.089	38.3	X	0.38	2.4		0.37							4.2		0.10
SPA-2	J1TW35	7/30/14	50.8	X	0.092	41.2	X	0.39	5.8		0.36							1.9		0.10
SPA-3	J1TW36	7/30/14	48.8	X	0.088	37.6	X	0.37	3.2		0.37							2.7		0.10
SPA-4	J1TW37	7/30/14	49.5	X	0.089	38.6	X	0.38	2.6		0.37							2.8		0.10
SPA-5	J1TW38	7/30/14	50.8	X	0.088	43.7	X	0.37	11.2		0.37							3.8		0.10
SPA-6	J1TW39	7/30/14	54.0	X	0.083	41.2	X	0.35	17.2		0.36							1.9		0.10
SPA-7	J1TW40	7/30/14	58.9	X	0.095	43.2	X	0.40	11.7		0.37							3.6		0.10
SPA-8	J1TW41	7/30/14	50.1	X	0.089	38.7	X	0.38	3.3		0.37							2.8		0.10
SPA-9	J1TW42	7/30/14	47.8	X	0.096	37.4	X	0.41	3.3		0.37							4.2		0.10
SPA-10	J1TW43	7/30/14	46.3	X	0.093	36.2	X	0.39	0.81	N	0.37							3.6		0.10
SPA-11	J1TW44	7/30/14	56.5	X	0.083	36.3	X	0.35	1.0		0.36							0.26		0.10
SPA-12	J1TW45	7/30/14	53.1	X	0.091	40.6	X	0.38	1.4		0.38							5.1		0.10
100-D-84:2, Area 4	J1THH2	4/7/14	51.0		0.091	41.7	X	0.38	3.3		0.37	12000		980	5500		670	4.0		0.10
Equipment blank	J1TW47	7/30/14	0.47	BX	0.094	1.4	X	0.40										0.10	U	0.10

Attachment	1	Sheet No.	5 of 16
Originator	R. J. Nielson	Date	9/16/14
Checked	I. B. Berezovskiy	Date	9/16/14
Calc. No.	0100D-CA-V0546	Rev. No.	0

Attachment 1. 100-D-84:2 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TW22			J1TW33			J1TW21			J1TW23			J1TW24			J1TW25		
		EXC-2			Duplicate of J1TW22			EXC-1			EXC-3			EXC-4			EXC-5		
		7/14/14			7/14/14			7/14/14			7/14/14			7/14/14			7/14/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Aroclor-1016	PCB	2.7	U	2.7	2.7	U	2.7	2.7	U	2.7	2.6	U	2.6	2.6	U	2.6	2.6	U	2.6
Aroclor-1221	PCB	7.7	U	7.7	7.8	U	7.8	7.7	U	7.7	7.5	U	7.5	7.6	U	7.6	7.7	U	7.7
Aroclor-1232	PCB	1.9	U	1.9	2	U	2	1.9	U	1.9	1.9	U	1.9	1.9	U	1.9	1.9	U	1.9
Aroclor-1242	PCB	4.5	U	4.5	4.5	U	4.5	4.5	U	4.5	4.3	U	4.3	4.4	U	4.4	4.5	U	4.5
Aroclor-1248	PCB	4.5	U	4.5	4.5	U	4.5	4.5	U	4.5	4.3	U	4.3	4.4	U	4.4	4.5	U	4.5
Aroclor-1254	PCB	2.5	U	2.5	2.5	U	2.5	2.5	U	2.5	2.4	U	2.4	2.5	U	2.5	2.5	U	2.5
Aroclor-1260	PCB	2.5	UJ	2.5	2.5	UJ	2.5	2.5	UJ	2.5	2.4	UJ	2.4	2.5	UJ	2.5	2.5	UNJ	2.5
1,2,4-Trichlorobenzene	SVOA	27	U	27	28	U	28	27	U	27	28	U	28	27	U	27	26	U	26
1,2-Dichlorobenzene	SVOA	21	U	21	22	U	22	21	U	21	22	U	22	21	U	21	21	U	21
1,3-Dichlorobenzene	SVOA	11	U	11	12	U	12	12	U	12	12	U	12	12	U	12	11	U	11
1,4-Dichlorobenzene	SVOA	13	U	13	13	U	13	13	U	13	14	U	14	13	U	13	13	U	13
2,4,5-Trichlorophenol	SVOA	9.6	U	9.6	9.9	U	9.9	9.6	U	9.6	10	U	10	9.7	U	9.7	9.3	U	9.3
2,4,6-Trichlorophenol	SVOA	9.6	U	9.6	9.9	U	9.9	9.6	U	9.6	10	U	10	9.7	U	9.7	9.3	U	9.3
2,4-Dichlorophenol	SVOA	9.6	U	9.6	9.9	U	9.9	9.6	U	9.6	10	U	10	9.7	U	9.7	9.3	U	9.3
2,4-Dimethylphenol	SVOA	63	U	63	65	U	65	63	U	63	66	U	66	64	U	64	62	U	62
2,4-Dinitrophenol	SVOA	320	UTJ	320	330	UJ	330	320	UJ	320	330	UJ	330	320	UJ	320	310	UJ	310
2,4-Dinitrotoluene	SVOA	63	U	63	65	U	65	63	U	63	66	U	66	64	U	64	62	U	62
2,6-Dinitrotoluene	SVOA	27	U	27	28	U	28	27	U	27	28	U	28	27	U	27	26	U	26
2-Chloronaphthalene	SVOA	9.6	U	9.6	9.9	U	9.9	9.6	U	9.6	10	U	10	9.7	U	9.7	9.3	U	9.3
2-Chlorophenol	SVOA	20	U	20	21	U	21	20	U	20	21	U	21	20	U	20	20	U	20
2-Methylnaphthalene	SVOA	18	U	18	19	U	19	18	U	18	19	U	19	18	U	18	18	U	18
2-Methylphenol (cresol, o-)	SVOA	12	U	12	13	U	13	12	U	12	13	U	13	13	U	13	12	U	12
2-Nitroaniline	SVOA	48	U	48	50	U	50	48	U	48	50	U	50	48	U	48	47	U	47
2-Nitrophenol	SVOA	9.6	U	9.6	9.9	U	9.9	9.6	U	9.6	10	U	10	9.7	U	9.7	9.3	U	9.3
3,3'-Dichlorobenzidine	SVOA	86	UJ	86	89	UJ	89	86	UJ	86	90	UJ	90	87	UJ	87	84	UJ	84
3+4 Methylphenol (cresol, m+p)	SVOA	32	U	32	33	U	33	32	U	32	33	U	33	32	U	32	31	U	31
3-Nitroaniline	SVOA	70	U	70	72	U	72	70	U	70	73	U	73	71	U	71	68	U	68
4,6-Dinitro-2-methylphenol	SVOA	320	U	320	330	U	330	320	U	320	330	U	330	320	U	320	310	U	310
4-Bromophenylphenyl ether	SVOA	18	U	18	19	U	19	18	U	18	19	U	19	18	U	18	18	U	18
4-Chloro-3-methylphenol	SVOA	63	U	63	65	U	65	63	U	63	66	U	66	64	U	64	62	U	62
4-Chloroaniline	SVOA	78	U	78	81	U	81	79	U	79	81	U	81	79	U	79	76	U	76
4-Chlorophenylphenyl ether	SVOA	20	U	20	21	U	21	20	U	20	21	U	21	20	U	20	20	U	20
4-Nitroaniline	SVOA	69	U	69	72	U	72	70	U	70	72	U	72	70	U	70	68	U	68
4-Nitrophenol	SVOA	93	U	93	96	U	96	93	U	93	97	U	97	94	U	94	90	U	90
Acenaphthene	SVOA	9.8	U	9.8	10	U	10	9.9	U	9.9	10	U	10	10	U	10	9.6	U	9.6
Acenaphthylene	SVOA	16	U	16	17	U	17	16	U	16	17	U	17	16	U	16	16	U	16
Anthracene	SVOA	16	U	16	17	U	17	16	U	16	17	U	17	16	U	16	16	U	16

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Checked	I. B. Berezovskiy	Date	9/16/14
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Attachment 1. 100-D-84:2 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TW22			J1TW33			J1TW21			J1TW23			J1TW24			J1TW25		
		EXC-2			Duplicate of J1TW22			EXC-1			EXC-3			EXC-4			EXC-5		
		7/14/14			7/14/14			7/14/14			7/14/14			7/14/14			7/14/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Benzo(a)anthracene	SVOA	20	J	19	20	U	20	26	J	19	20	U	20	19	U	19	19	U	19
Benzo(a)pyrene	SVOA	19	U	19	20	U	20	19	U	19	20	U	20	19	U	19	19	U	19
Benzo(b)fluoranthene	SVOA	25	JK	25	26	U	26	33	JK	25	26	U	26	25	U	25	24	U	24
Benzo(ghi)perylene	SVOA	15	U	15	16	U	16	15	U	15	16	U	16	16	U	16	15	U	15
Benzo(k)fluoranthene	SVOA	38	UK	38	40	U	40	38	UK	38	40	U	40	39	U	39	37	U	37
Bis(2-chloro-1-methylethyl)ether	SVOA	22	U	22	23	U	23	22	U	22	23	U	23	22	U	22	21	U	21
Bis(2-Chloroethoxy)methane	SVOA	22	U	22	23	U	23	22	U	22	23	U	23	22	U	22	21	U	21
Bis(2-chloroethyl) ether	SVOA	16	U	16	16	U	16	16	U	16	17	U	17	16	U	16	15	U	15
Bis(2-ethylhexyl) phthalate	SVOA	44	U	44	46	U	46	44	U	44	46	U	46	45	U	45	43	U	43
Butylbenzylphthalate	SVOA	41	U	41	43	U	43	41	U	41	43	U	43	42	U	42	40	U	40
Carbazole	SVOA	34	U	34	36	U	36	35	U	35	36	U	36	35	U	35	34	U	34
Chrysene	SVOA	26	U	26	27	U	27	30	J	26	27	U	27	26	U	26	25	U	25
Dibenz[a,h]anthracene	SVOA	18	U	18	19	U	19	18	U	18	19	U	19	18	U	18	18	U	18
Dibenzofuran	SVOA	19	U	19	20	U	20	19	U	19	20	U	20	19	U	19	19	U	19
Diethyl phthalate	SVOA	25	U	25	26	U	26	25	U	25	26	U	26	25	U	25	24	U	24
Dimethyl phthalate	SVOA	22	U	22	23	U	23	22	U	22	23	U	23	22	U	22	21	U	21
Di-n-butylphthalate	SVOA	28	U	28	29	U	29	28	U	28	29	U	29	28	U	28	27	U	27
Di-n-octylphthalate	SVOA	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14	13	U	13
Fluoranthene	SVOA	34	U	34	36	U	36	37	J	35	36	U	36	35	U	35	34	U	34
Fluorene	SVOA	17	U	17	18	U	18	17	U	17	18	U	18	17	U	17	17	U	17
Hexachlorobenzene	SVOA	28	U	28	29	U	29	28	U	28	29	U	29	28	U	28	27	U	27
Hexachlorobutadiene	SVOA	9.6	U	9.6	9.9	U	9.9	9.6	U	9.6	10	U	10	9.7	U	9.7	9.3	U	9.3
Hexachlorocyclopentadiene	SVOA	48	U	48	50	U	50	48	U	48	50	U	50	48	U	48	47	U	47
Hexachloroethane	SVOA	20	U	20	21	U	21	20	U	20	21	U	21	21	U	21	20	U	20
Indeno(1,2,3-cd)pyrene	SVOA	21	U	21	22	U	22	21	U	21	22	U	22	21	U	21	21	U	21
Isophorone	SVOA	16	U	16	17	U	17	16	U	16	17	U	17	16	U	16	16	U	16
Naphthalene	SVOA	30	U	30	31	U	31	30	U	30	31	U	31	30	U	30	29	U	29
Nitrobenzene	SVOA	21	U	21	22	U	22	21	U	21	22	U	22	21	U	21	21	U	21
N-Nitroso-di-n-dipropylamine	SVOA	30	U	30	31	U	31	30	U	30	31	U	31	30	U	30	29	U	29
N-Nitrosodiphenylamine	SVOA	20	U	20	21	U	21	20	U	20	21	U	21	20	U	20	20	U	20
Pentachlorophenol	SVOA	320	U	320	330	U	330	320	U	320	330	U	330	320	U	320	310	U	310
Phenanthrene	SVOA	16	U	16	17	U	17	16	U	16	17	U	17	16	U	16	16	U	16
Phenol	SVOA	17	U	17	18	U	18	17	U	17	18	U	18	17	U	17	17	U	17
Pyrene	SVOA	32	J	12	22	J	12	40	J	12	12	U	12	12	U	12	11	U	11

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Attachment 1. 100-D-84:2 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TW26			J1TW27			J1TW28			J1TW29			J1TW30			J1TW31		
		EXC-6			EXC-7			EXC-8			EXC-9			EXC-10			EXC-11		
		07/14/14			07/14/14			07/14/14			07/14/14			07/15/14			07/15/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Aroclor-1016	PCB	2.7	U	2.7	2.7	U	2.7	2.5	U	2.5	2.6	U	2.6	2.7	U	2.7	2.8	U	2.8
Aroclor-1221	PCB	7.7	U	7.7	7.7	U	7.7	7.4	U	7.4	7.6	U	7.6	7.8	U	7.8	8.0	U	8.0
Aroclor-1232	PCB	1.9	U	1.9	1.9	U	1.9	1.8	U	1.8	1.9	U	1.9	1.9	U	1.9	2.0	U	2.0
Aroclor-1242	PCB	4.5	U	4.5	4.5	U	4.5	4.3	U	4.3	4.4	U	4.4	4.5	U	4.5	4.6	U	4.6
Aroclor-1248	PCB	4.5	U	4.5	4.5	U	4.5	4.3	U	4.3	4.4	U	4.4	4.5	U	4.5	4.6	U	4.6
Aroclor-1254	PCB	2.5	U	2.5	2.5	U	2.5	2.4	U	2.4	2.5	U	2.5	2.5	U	2.5	2.6	U	2.6
Aroclor-1260	PCB	2.5	UJ	2.5	2.5	UJ	2.5	2.4	UJ	2.4	2.5	UJ	2.5	2.5	UJ	2.5	2.6	UJ	2.6
1,2,4-Trichlorobenzene	SVOA	28	U	28	28	U	28	27	U	27	27	U	27	27	U	27	27	U	27
1,2-Dichlorobenzene	SVOA	22	U	22	22	U	22	21	U	21	21	U	21	21	U	21	21	U	21
1,3-Dichlorobenzene	SVOA	12	U	12	12	U	12	12	U	12	12	U	12	11	U	11	11	U	11
1,4-Dichlorobenzene	SVOA	13	U	13	14	U	14	13	U	13	13	U	13	13	U	13	13	U	13
2,4,5-Trichlorophenol	SVOA	9.9	U	9.9	10	U	10	9.8	U	9.8	9.7	U	9.7	9.5	U	9.5	9.5	U	9.5
2,4,6-Trichlorophenol	SVOA	9.9	U	9.9	10	U	10	9.8	U	9.8	9.7	U	9.7	9.5	U	9.5	9.5	U	9.5
2,4-Dichlorophenol	SVOA	9.9	U	9.9	10	U	10	9.8	U	9.8	9.7	U	9.7	9.5	U	9.5	9.5	U	9.5
2,4-Dimethylphenol	SVOA	65	U	65	66	U	66	64	U	64	64	U	64	62	U	62	63	U	63
2,4-Dinitrophenol	SVOA	330	UJ	330	330	UJ	330	330	UJ	330	320	UJ	320	320	UJ	320	320	UJ	320
2,4-Dinitrotoluene	SVOA	65	U	65	66	U	66	64	U	64	64	U	64	62	U	62	63	U	63
2,6-Dinitrotoluene	SVOA	28	U	28	28	U	28	27	U	27	27	U	27	27	U	27	27	U	27
2-Chloronaphthalene	SVOA	9.9	U	9.9	10	U	10	9.8	U	9.8	9.7	U	9.7	9.5	U	9.5	9.5	U	9.5
2-Chlorophenol	SVOA	21	U	21	21	U	21	21	U	21	20	U	20	20	U	20	20	U	20
2-Methylnaphthalene	SVOA	19	U	19	19	U	19	19	U	19	18	U	18	18	U	18	18	U	18
2-Methylphenol (cresol, o-)	SVOA	13	U	13	13	U	13	13	U	13	13	U	13	12	U	12	12	U	12
2-Nitroaniline	SVOA	50	U	50	50	U	50	49	U	49	49	U	49	47	U	47	48	U	48
2-Nitrophenol	SVOA	9.9	U	9.9	10	U	10	9.8	U	9.8	9.7	U	9.7	9.5	U	9.5	9.5	U	9.5
3,3'-Dichlorobenzidine	SVOA	89	UJ	89	90	UJ	90	88	UJ	88	87	UJ	87	85	UJ	85	86	UJ	86
3+4 Methylphenol (cresol, m+p)	SVOA	33	U	33	33	U	33	32	U	32	32	U	32	31	U	31	31	U	31
3-Nitroaniline	SVOA	72	U	72	73	U	73	71	U	71	71	U	71	69	U	69	70	U	70
4,6-Dinitro-2-methylphenol	SVOA	330	U	330	330	U	330	320	U	320	320	U	320	310	U	310	310	U	310
4-Bromophenylphenyl ether	SVOA	19	U	19	19	U	19	19	U	19	18	U	18	18	U	18	18	U	18
4-Chloro-3-methylphenol	SVOA	65	U	65	66	U	66	64	U	64	64	U	64	62	U	62	63	U	63
4-Chloroaniline	SVOA	81	U	81	82	U	82	80	U	80	80	U	80	78	U	78	78	U	78
4-Chlorophenylphenyl ether	SVOA	21	U	21	21	U	21	21	U	21	20	U	20	20	U	20	20	U	20
4-Nitroaniline	SVOA	72	U	72	73	U	73	71	U	71	70	U	70	69	U	69	69	U	69
4-Nitrophenol	SVOA	96	U	96	97	U	97	95	U	95	94	U	94	92	U	92	92	U	92
Acenaphthene	SVOA	10	U	10	10	U	10	10	U	10	10	U	10	9.7	U	9.7	9.8	U	9.8
Acenaphthylene	SVOA	17	U	17	17	U	17	17	U	17	17	U	17	16	U	16	16	U	16
Anthracene	SVOA	17	U	17	17	U	17	17	U	17	17	U	17	16	U	16	16	U	16

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Attachment 1. 100-D-84:2 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TW26			J1TW27			J1TW28			J1TW29			J1TW30			J1TW31		
		EXC-6			EXC-7			EXC-8			EXC-9			EXC-10			EXC-11		
		7/14/14			7/14/14			7/14/14			7/14/14			7/15/14			7/15/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Benzo(a)anthracene	SVOA	20	U	20	20	U	20	20	U	20	20	J	19	19	U	19	27	J	19
Benzo(a)pyrene	SVOA	20	U	20	20	U	20	20	U	20	19	U	19	19	U	19	19	U	19
Benzo(b)fluoranthene	SVOA	26	U	26	26	U	26	26	U	26	25	U	25	25	U	25	31	JK	25
Benzo(ghi)perylene	SVOA	16	U	16	16	U	16	16	U	16	16	U	16	15	U	15	15	U	15
Benzo(k)fluoranthene	SVOA	40	U	40	40	U	40	39	U	39	39	U	39	38	U	38	38	UK	38
Bis(2-chloro-1-methylethyl)ether	SVOA	23	U	23	23	U	23	22	U	22	22	U	22	22	U	22	22	U	22
Bis(2-Chloroethoxy)methane	SVOA	23	U	23	23	U	23	22	U	22	22	U	22	22	U	22	22	U	22
Bis(2-chloroethyl) ether	SVOA	16	U	16	17	U	17	16	U	16	16	U	16	16	U	16	16	U	16
Bis(2-ethylhexyl) phthalate	SVOA	46	U	46	46	U	46	45	U	45	45	U	45	44	U	44	44	U	44
Butylbenzylphthalate	SVOA	43	U	43	43	U	43	42	U	42	42	U	42	41	U	41	41	U	41
Carbazole	SVOA	36	U	36	36	U	36	35	U	35	35	U	35	34	U	34	34	U	34
Chrysene	SVOA	27	U	27	27	U	27	26	U	26	26	U	26	26	U	26	35	J	26
Dibenz[a,h]anthracene	SVOA	19	U	19	19	U	19	19	U	19	18	U	18	18	U	18	18	U	18
Dibenzofuran	SVOA	20	U	20	20	U	20	20	U	20	19	U	19	19	U	19	19	U	19
Diethyl phthalate	SVOA	26	U	26	26	U	26	25	U	25	25	U	25	25	U	25	25	U	25
Dimethyl phthalate	SVOA	23	U	23	23	U	23	22	U	22	22	U	22	22	U	22	22	U	22
Di-n-butylphthalate	SVOA	29	U	29	29	U	29	28	U	28	28	U	28	27	U	27	28	U	28
Di-n-octylphthalate	SVOA	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14	14	U	14
Fluoranthene	SVOA	36	U	36	36	U	36	35	U	35	35	J	35	34	U	34	52	J	34
Fluorene	SVOA	18	U	18	18	U	18	18	U	18	17	U	17	17	U	17	17	U	17
Hexachlorobenzene	SVOA	29	U	29	29	U	29	28	U	28	28	U	28	27	U	27	28	U	28
Hexachlorobutadiene	SVOA	9.9	U	9.9	10	U	10	9.8	U	9.8	9.7	U	9.7	9.5	U	9.5	9.5	U	9.5
Hexachlorocyclopentadiene	SVOA	50	U	50	50	U	50	49	U	49	49	U	49	47	U	47	48	U	48
Hexachloroethane	SVOA	21	U	21	21	U	21	21	U	21	21	U	21	20	U	20	20	U	20
Indeno(1,2,3-cd)pyrene	SVOA	22	U	22	22	U	22	21	U	21	21	U	21	21	U	21	21	U	21
Isophorone	SVOA	17	U	17	17	U	17	17	U	17	17	U	17	16	U	16	16	U	16
Naphthalene	SVOA	31	U	31	31	U	31	30	U	30	30	U	30	29	U	29	30	U	30
Nitrobenzene	SVOA	22	U	22	22	U	22	21	U	21	21	U	21	21	U	21	21	U	21
N-Nitroso-di-n-dipropylamine	SVOA	31	U	31	31	U	31	30	U	30	30	U	30	29	U	29	30	U	30
N-Nitrosodiphenylamine	SVOA	21	U	21	21	U	21	21	U	21	20	U	20	20	U	20	20	U	20
Pentachlorophenol	SVOA	330	U	330	330	U	330	320	U	320	320	U	320	310	U	310	310	U	310
Phenanthrene	SVOA	17	U	17	17	U	17	17	U	17	17	U	17	16	U	16	17	J	16
Phenol	SVOA	18	U	18	18	U	18	18	U	18	17	U	17	17	U	17	17	U	17
Pyrene	SVOA	12	U	12	20	J	12	21	J	12	34	J	12	11	U	11	52	J	12

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CONSTITUENT	CLASS	J1TW32			J1TW34			J1TW35			J1TW36			J1TW37			J1TW38		
		EXC-12			SPA-1			SPA-2			SPA-3			SPA-4			SPA-5		
		07/15/14			07/30/14			07/30/14			07/30/14			07/30/14			07/30/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Aroclor-1016	PCB	2.7	U	2.7	2.7	U	2.7	2.7	U	2.7	2.8	U	2.8	2.7	U	2.7	2.8	U	2.8
Aroclor-1221	PCB	7.9	U	7.9	7.8	U	7.8	7.8	U	7.8	8.1	U	8.1	7.7	U	7.7	8	U	8
Aroclor-1232	PCB	2.0	U	2.0	2.0	U	2.0	1.9	U	1.9	2.0	U	2.0	1.9	U	1.9	2.0	U	2.0
Aroclor-1242	PCB	4.6	U	4.6	4.6	U	4.6	4.5	U	4.5	4.7	U	4.7	4.5	U	4.5	4.7	U	4.7
Aroclor-1248	PCB	4.6	U	4.6	4.6	U	4.6	4.5	U	4.5	4.7	U	4.7	4.5	U	4.5	4.7	U	4.7
Aroclor-1254	PCB	2.6	U	2.6	2.5	U	2.5	2.5	U	2.5	2.6	U	2.6	2.5	U	2.5	2.6	U	2.6
Aroclor-1260	PCB	2.6	UJ	2.6	2.5	U	2.5	2.5	U	2.5	2.6	U	2.6	2.5	U	2.5	2.6	U	2.6
1,2,4-Trichlorobenzene	SVOA	27	U	27	29	U	29	27	U	27	28	U	28	28	U	28	29	U	29
1,2-Dichlorobenzene	SVOA	21	U	21	23	U	23	21	U	21	22	U	22	22	U	22	22	U	22
1,3-Dichlorobenzene	SVOA	12	U	12	12	U	12	11	U	11	12	U	12	12	U	12	12	U	12
1,4-Dichlorobenzene	SVOA	13	U	13	14	U	14	13	U	13	13	U	13	14	U	14	14	U	14
2,4,5-Trichlorophenol	SVOA	9.6	U	9.6	10	U	10	9.5	U	9.5	9.9	U	9.9	10	U	10	10	U	10
2,4,6-Trichlorophenol	SVOA	9.6	U	9.6	10	U	10	9.5	U	9.5	9.9	U	9.9	10	U	10	10	U	10
2,4-Dichlorophenol	SVOA	9.6	U	9.6	10	U	10	9.5	U	9.5	9.9	U	9.9	10	U	10	10	U	10
2,4-Dimethylphenol	SVOA	64	U	64	68	U	68	63	U	63	65	U	65	67	U	67	67	U	67
2,4-Dinitrophenol	SVOA	320	UJ	320	340	UT	340	320	U	320	330	U	330	340	U	340	340	U	340
2,4-Dinitrotoluene	SVOA	64	U	64	68	U	68	63	U	63	65	U	65	67	U	67	67	U	67
2,6-Dinitrotoluene	SVOA	27	U	27	29	U	29	27	U	27	28	U	28	28	U	28	29	U	29
2-Chloronaphthalene	SVOA	9.6	U	9.6	10	U	10	9.5	U	9.5	9.9	U	9.9	10	U	10	10	U	10
2-Chlorophenol	SVOA	20	U	20	22	U	22	20	U	20	21	U	21	21	U	21	21	U	21
2-Methylnaphthalene	SVOA	18	U	18	20	U	20	18	U	18	19	U	19	19	U	19	19	U	19
2-Methylphenol (cresol, o-)	SVOA	13	U	13	13	U	13	12	U	12	13	U	13	13	U	13	13	U	13
2-Nitroaniline	SVOA	48	U	48	52	U	52	48	U	48	50	U	50	50	U	50	51	U	51
2-Nitrophenol	SVOA	9.6	U	9.6	10	U	10	9.5	U	9.5	9.9	U	9.9	10	U	10	10	U	10
3,3'-Dichlorobenzidine	SVOA	87	UJ	87	93	U	93	86	U	86	89	U	89	91	U	91	92	U	92
3+4 Methylphenol (cresol, m+p)	SVOA	32	U	32	34	U	34	31	U	31	33	U	33	33	U	33	34	U	34
3-Nitroaniline	SVOA	70	U	70	75	U	75	70	U	70	72	U	72	74	U	74	74	U	74
4,6-Dinitro-2-methylphenol	SVOA	320	U	320	340	U	340	310	U	310	330	U	330	330	U	330	340	U	340
4-Bromophenylphenyl ether	SVOA	18	U	18	20	U	20	18	U	18	19	U	19	19	U	19	19	U	19
4-Chloro-3-methylphenol	SVOA	64	U	64	68	U	68	63	U	63	65	U	65	67	U	67	67	U	67
4-Chloroaniline	SVOA	79	U	79	85	U	85	78	U	78	81	U	81	83	U	83	83	U	83
4-Chlorophenylphenyl ether	SVOA	20	U	20	22	U	22	20	U	20	21	U	21	21	U	21	21	U	21
4-Nitroaniline	SVOA	70	U	70	75	U	75	69	U	69	72	U	72	73	U	73	74	U	74
4-Nitrophenol	SVOA	94	U	94	100	U	100	92	U	92	96	U	96	98	U	98	99	U	99
Acenaphthene	SVOA	9.9	U	9.9	11	U	11	9.8	U	9.8	10	U	10	10	U	10	11	U	11
Acenaphthylene	SVOA	16	U	16	18	U	18	16	U	16	17	U	17	17	U	17	17	U	17
Anthracene	SVOA	16	U	16	18	U	18	16	U	16	17	U	17	17	U	17	17	U	17

Attachment	1	Sheet No.	10 of 16
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Checked	I. B. Berezovskiy	Date	9/16/14
Calc. No.	0100D-CA-V0546	Rev. No.	0

Attachment 1. 100-D-84:2 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TW32			J1TW34			J1TW35			J1TW36			J1TW37			J1TW38		
		EXC-12			SPA-1			SPA-2			SPA-3			SPA-4			SPA-5		
		7/15/14			7/30/14			7/30/14			7/30/14			7/30/14			7/30/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Benzo(a)anthracene	SVOA	19	U	19	21	U	21	19	U	19	20	U	20	20	U	20	20	U	20
Benzo(a)pyrene	SVOA	19	U	19	21	U	21	19	U	19	20	U	20	20	U	20	20	U	20
Benzo(b)fluoranthene	SVOA	25	U	25	27	U	27	25	U	25	26	U	26	26	U	26	27	U	27
Benzo(ghi)perylene	SVOA	15	U	15	17	U	17	15	U	15	16	U	16	16	U	16	16	U	16
Benzo(k)fluoranthene	SVOA	39	U	39	41	U	41	38	U	38	40	U	40	40	U	40	41	U	41
Bis(2-chloro-1-methylethyl)ether	SVOA	22	U	22	24	U	24	22	U	22	23	U	23	23	U	23	23	U	23
Bis(2-Chloroethoxy)methane	SVOA	22	U	22	24	U	24	22	U	22	23	U	23	23	U	23	23	U	23
Bis(2-chloroethyl) ether	SVOA	16	U	16	17	U	17	16	U	16	16	U	16	17	U	17	17	U	17
Bis(2-ethylhexyl) phthalate	SVOA	44	U	44	47	U	47	44	U	44	46	U	46	46	U	46	47	U	47
Butylbenzylphthalate	SVOA	41	U	41	44	U	44	41	U	41	43	U	43	43	U	43	44	U	44
Carbazole	SVOA	35	U	35	37	U	37	34	U	34	36	U	36	36	U	36	37	U	37
Chrysene	SVOA	26	U	26	28	U	28	26	U	26	27	U	27	27	U	27	28	U	28
Dibenz[a,h]anthracene	SVOA	18	U	18	20	U	20	18	U	18	19	U	19	19	U	19	19	U	19
Dibenzofuran	SVOA	19	U	19	21	U	21	19	U	19	20	U	20	20	U	20	20	U	20
Diethyl phthalate	SVOA	25	U	25	27	U	27	25	U	25	26	U	26	26	U	26	27	U	27
Dimethyl phthalate	SVOA	22	U	22	24	U	24	22	U	22	23	U	23	23	U	23	23	U	23
Di-n-butylphthalate	SVOA	28	U	28	30	U	30	28	U	28	29	U	29	29	U	29	30	U	30
Di-n-octylphthalate	SVOA	14	U	14	15	U	15	14	U	14	14	U	14	15	U	15	15	U	15
Fluoranthene	SVOA	35	U	35	37	U	37	34	U	34	36	U	36	36	U	36	37	U	37
Fluorene	SVOA	17	U	17	19	U	19	17	U	17	18	U	18	18	U	18	18	U	18
Hexachlorobenzene	SVOA	28	U	28	30	U	30	28	U	28	29	U	29	29	U	29	30	U	30
Hexachlorobutadiene	SVOA	9.6	U	9.6	10	U	10	9.5	U	9.5	9.9	U	9.9	10	U	10	10	U	10
Hexachlorocyclopentadiene	SVOA	48	U	48	52	UT	52	48	UT	48	50	UT	50	50	UT	50	51	UT	51
Hexachloroethane	SVOA	21	U	21	22	U	22	20	U	20	21	U	21	21	U	21	22	U	22
Indeno(1,2,3-cd)pyrene	SVOA	21	U	21	23	U	23	21	U	21	22	U	22	22	U	22	22	U	22
Isophorone	SVOA	16	U	16	18	U	18	16	U	16	17	U	17	17	U	17	17	U	17
Naphthalene	SVOA	30	U	30	32	U	32	30	U	30	31	U	31	31	U	31	32	U	32
Nitrobenzene	SVOA	21	U	21	23	U	23	21	U	21	22	U	22	22	U	22	22	U	22
N-Nitroso-di-n-dipropylamine	SVOA	30	U	30	32	U	32	30	U	30	31	U	31	31	U	31	32	U	32
N-Nitrosodiphenylamine	SVOA	20	U	20	22	U	22	20	U	20	21	U	21	21	U	21	21	U	21
Pentachlorophenol	SVOA	320	U	320	340	UT	340	310	UT	310	330	UT	330	330	UT	330	340	UT	340
Phenanthrene	SVOA	16	U	16	18	U	18	16	U	16	17	U	17	17	U	17	17	U	17
Phenol	SVOA	17	U	17	19	U	19	17	U	17	18	U	18	18	U	18	18	U	18
Pyrene	SVOA	12	U	12	12	U	12	12	U	12	12	U	12	12	U	12	12	U	12

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Checked	I. B. Berezovskiy	Date	9/16/14
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Attachment 1. 100-D-84:2 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TW39			J1TW40			J1TW41			J1TW42			J1TW43			J1TW44		
		SPA-6			SPA-7			SPA-8			SPA-9			SPA-10			SPA-11		
		07/30/14			07/30/14			07/30/14			07/30/14			07/30/14			07/30/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Aroclor-1016	PCB	2.7	U	2.7	2.8	U	2.8	2.7	U	2.7	2.6	U	2.6	2.8	U	2.8	2.6	U	2.6
Aroclor-1221	PCB	7.9	U	7.9	8.2	U	8.2	7.8	U	7.8	7.7	U	7.7	8.2	U	8.2	7.4	U	7.4
Aroclor-1232	PCB	2.0	U	2.0	2.0	U	2.0	2.0	U	2.0	1.9	U	1.9	2.0	U	2.0	1.9	U	1.9
Aroclor-1242	PCB	4.6	U	4.6	4.8	U	4.8	4.5	U	4.5	4.5	U	4.5	4.8	U	4.8	4.3	U	4.3
Aroclor-1248	PCB	4.6	U	4.6	4.8	U	4.8	4.5	U	4.5	4.5	U	4.5	4.8	U	4.8	4.3	U	4.3
Aroclor-1254	PCB	2.6	U	2.6	2.7	U	2.7	2.5	U	2.5	2.5	U	2.5	2.7	U	2.7	2.4	U	2.4
Aroclor-1260	PCB	2.6	U	2.6	2.7	U	2.7	2.5	U	2.5	2.5	U	2.5	2.7	U	2.7	2.4	U	2.4
1,2,4-Trichlorobenzene	SVOA	27	U	27	27	U	27	27	U	27	27	U	27	29	U	29	26	U	26
1,2-Dichlorobenzene	SVOA	21	U	21	21	U	21	21	U	21	21	U	21	23	U	23	20	U	20
1,3-Dichlorobenzene	SVOA	12	U	12	12	U	12	12	U	12	12	U	12	12	U	12	11	U	11
1,4-Dichlorobenzene	SVOA	13	U	13	13	U	13	13	U	13	13	U	13	14	U	14	13	U	13
2,4,5-Trichlorophenol	SVOA	9.6	U	9.6	9.6	U	9.6	9.7	U	9.7	9.8	U	9.8	10	U	10	9.3	U	9.3
2,4,6-Trichlorophenol	SVOA	9.6	U	9.6	9.6	U	9.6	9.7	U	9.7	9.8	U	9.8	10	U	10	9.3	U	9.3
2,4-Dichlorophenol	SVOA	9.6	U	9.6	9.6	U	9.6	9.7	U	9.7	9.8	U	9.8	10	U	10	9.3	U	9.3
2,4-Dimethylphenol	SVOA	63	U	63	64	U	64	64	U	64	64	U	64	68	U	68	61	U	61
2,4-Dinitrophenol	SVOA	320	U	320	320	U	320	320	U	320	320	U	320	340	U	340	310	U	310
2,4-Dinitrotoluene	SVOA	63	U	63	64	U	64	64	U	64	64	U	64	68	U	68	61	U	61
2,6-Dinitrotoluene	SVOA	27	U	27	27	U	27	27	U	27	27	U	27	29	U	29	26	U	26
2-Chloronaphthalene	SVOA	9.6	U	9.6	9.6	U	9.6	9.7	U	9.7	9.8	U	9.8	10	U	10	9.3	U	9.3
2-Chlorophenol	SVOA	20	U	20	20	U	20	20	U	20	20	U	20	22	U	22	20	U	20
2-Methylnaphthalene	SVOA	18	U	18	18	U	18	18	U	18	19	U	19	20	U	20	18	U	18
2-Methylphenol (cresol, o-)	SVOA	12	U	12	13	U	13	13	U	13	13	U	13	13	U	13	12	U	12
2-Nitroaniline	SVOA	48	U	48	48	U	48	48	U	48	49	U	49	51	U	51	47	U	47
2-Nitrophenol	SVOA	9.6	U	9.6	9.6	U	9.6	9.7	U	9.7	9.8	U	9.8	10	U	10	9.3	U	9.3
3,3'-Dichlorobenzidine	SVOA	87	U	87	87	U	87	87	U	87	88	U	88	92	U	92	84	U	84
3+4 Methylphenol (cresol, m+p)	SVOA	32	U	32	32	U	32	32	U	32	32	U	32	34	U	34	31	U	31
3-Nitroaniline	SVOA	70	U	70	70	U	70	71	U	71	71	U	71	75	U	75	68	U	68
4,6-Dinitro-2-methylphenol	SVOA	320	U	320	320	U	320	320	U	320	320	U	320	340	U	340	310	U	310
4-Bromophenylphenyl ether	SVOA	18	U	18	18	U	18	18	U	18	19	U	19	20	U	20	18	U	18
4-Chloro-3-methylphenol	SVOA	63	U	63	64	U	64	64	U	64	64	U	64	68	U	68	61	U	61
4-Chloroaniline	SVOA	79	U	79	79	U	79	79	U	79	80	U	80	84	U	84	76	U	76
4-Chlorophenylphenyl ether	SVOA	20	U	20	20	U	20	20	U	20	20	U	20	22	U	22	20	U	20
4-Nitroaniline	SVOA	70	U	70	70	U	70	70	U	70	71	U	71	74	U	74	68	U	68
4-Nitrophenol	SVOA	93	U	93	93	U	93	94	U	94	95	U	95	100	U	100	90	U	90
Acenaphthene	SVOA	9.9	U	9.9	9.9	U	9.9	10	U	10	10	U	10	11	U	11	9.6	U	9.6
Acenaphthylene	SVOA	16	U	16	16	U	16	16	U	16	17	U	17	17	U	17	16	U	16
Anthracene	SVOA	16	U	16	16	U	16	16	U	16	17	U	17	17	U	17	16	U	16

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Checked	I. B. Berezovskiy	Date	9/16/14
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Attachment 1. 100-D-84:2 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TW39			J1TW40			J1TW41			J1TW42			J1TW43			J1TW44		
		SPA-6			SPA-7			SPA-8			SPA-9			SPA-10			SPA-11		
		7/30/14			7/30/14			7/30/14			7/30/14			7/30/14			7/30/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Benzo(a)anthracene	SVOA	19	U	19	19	U	19	19	U	19	20	U	20	21	U	21	19	U	19
Benzo(a)pyrene	SVOA	19	U	19	19	U	19	19	U	19	20	U	20	21	U	21	19	U	19
Benzo(b)fluoranthene	SVOA	25	U	25	25	U	25	25	U	25	26	U	26	27	U	27	24	U	24
Benzo(ghi)perylene	SVOA	15	U	15	15	U	15	15	U	15	16	U	16	16	U	16	15	U	15
Benzo(k)fluoranthene	SVOA	38	U	38	39	U	39	39	U	39	39	U	39	41	U	41	37	U	37
Bis(2-chloro-1-methylethyl)ether	SVOA	22	U	22	22	U	22	22	U	22	22	U	22	24	U	24	21	U	21
Bis(2-Chloroethoxy)methane	SVOA	22	U	22	22	U	22	22	U	22	22	U	22	24	U	24	21	U	21
Bis(2-chloroethyl) ether	SVOA	16	U	16	16	U	16	16	U	16	16	U	16	17	U	17	15	U	15
Bis(2-ethylhexyl) phthalate	SVOA	44	U	44	44	U	44	44	U	44	45	U	45	47	U	47	43	U	43
Butylbenzylphthalate	SVOA	41	U	41	41	U	41	42	U	42	42	U	42	44	U	44	40	U	40
Carbazole	SVOA	35	U	35	35	U	35	35	U	35	35	U	35	37	U	37	34	U	34
Chrysene	SVOA	26	U	26	26	U	26	26	U	26	26	U	26	28	U	28	25	U	25
Dibenz[a,h]anthracene	SVOA	18	U	18	18	U	18	18	U	18	19	U	19	20	U	20	18	U	18
Dibenzofuran	SVOA	19	U	19	19	U	19	19	U	19	20	U	20	21	U	21	19	U	19
Diethyl phthalate	SVOA	25	U	25	25	U	25	25	U	25	25	U	25	27	U	27	24	U	24
Dimethyl phthalate	SVOA	22	U	22	22	U	22	22	U	22	22	U	22	24	U	24	21	U	21
Di-n-butylphthalate	SVOA	28	U	28	28	U	28	28	U	28	28	U	28	30	U	30	27	U	27
Di-n-octylphthalate	SVOA	14	U	14	14	U	14	14	U	14	14	U	14	15	U	15	13	U	13
Fluoranthene	SVOA	35	U	35	35	U	35	35	U	35	35	U	35	37	U	37	34	U	34
Fluorene	SVOA	17	U	17	17	U	17	17	U	17	18	U	18	18	U	18	17	U	17
Hexachlorobenzene	SVOA	28	U	28	28	U	28	28	U	28	28	U	28	30	U	30	27	U	27
Hexachlorobutadiene	SVOA	9.6	U	9.6	9.6	U	9.6	9.7	U	9.7	9.8	U	9.8	10	U	10	9.3	U	9.3
Hexachlorocyclopentadiene	SVOA	48	UT	48	48	UT	48	48	UT	48	49	UT	49	51	UT	51	47	UT	47
Hexachloroethane	SVOA	20	U	20	21	U	21	21	U	21	21	U	21	22	U	22	20	U	20
Indeno(1,2,3-cd)pyrene	SVOA	21	U	21	21	U	21	21	U	21	21	U	21	23	U	23	20	U	20
Isophorone	SVOA	16	U	16	16	U	16	16	U	16	17	U	17	17	U	17	16	U	16
Naphthalene	SVOA	30	U	30	30	U	30	30	U	30	30	U	30	32	U	32	29	U	29
Nitrobenzene	SVOA	21	U	21	21	U	21	21	U	21	21	U	21	23	U	23	20	U	20
N-Nitroso-di-n-dipropylamine	SVOA	30	U	30	30	U	30	30	U	30	30	U	30	32	U	32	29	U	29
N-Nitrosodiphenylamine	SVOA	20	U	20	20	U	20	20	U	20	20	U	20	22	U	22	20	U	20
Pentachlorophenol	SVOA	320	UT	320	320	UT	320	320	UT	320	320	UT	320	340	UT	340	310	UT	310
Phenanthrene	SVOA	16	U	16	16	U	16	16	U	16	17	U	17	17	U	17	16	U	16
Phenol	SVOA	17	U	17	17	U	17	17	U	17	18	U	18	18	U	18	17	U	17
Pyrene	SVOA	12	U	12	12	U	12	12	U	12	12	U	12	12	U	12	11	U	11

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Checked	I. B. Berezovskiy	Date	9/16/14
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Attachment 1. 100-D-84:2 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TW45			J1TW46			J1TW47			J1THH2		
		SPA-12			Duplicate of J1TW34			Equipment blank			100-D-84:2, Area 4		
		07/30/14			07/30/14			07/30/14			04/07/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Aroclor-1016	PCB	2.7	U	2.7	2.7	U	2.7				2.9	U	2.9
Aroclor-1221	PCB	7.8	U	7.8	7.9	U	7.9				8.3	U	8.3
Aroclor-1232	PCB	1.9	U	1.9	2.0	U	2.0				2.1	U	2.1
Aroclor-1242	PCB	4.5	U	4.5	4.6	U	4.6				4.8	U	4.8
Aroclor-1248	PCB	4.5	U	4.5	4.6	U	4.6				4.8	U	4.8
Aroclor-1254	PCB	2.5	U	2.5	2.6	U	2.6				2.7	U	2.7
Aroclor-1260	PCB	2.5	U	2.5	2.6	U	2.6				2.7	U	2.7
1,2,4-Trichlorobenzene	SVOA	29	U	29	29	U	29	27	U	27	28	U	28
1,2-Dichlorobenzene	SVOA	23	U	23	23	U	23	21	U	21	22	U	22
1,3-Dichlorobenzene	SVOA	12	U	12	12	U	12	11	U	11	12	U	12
1,4-Dichlorobenzene	SVOA	14	U	14	14	U	14	13	U	13	14	U	14
2,4,5-Trichlorophenol	SVOA	10	U	10	10	U	10	9.5	U	9.5	10	U	10
2,4,6-Trichlorophenol	SVOA	10	U	10	10	U	10	9.5	U	9.5	10	U	10
2,4-Dichlorophenol	SVOA	10	U	10	10	U	10	9.5	U	9.5	10	U	10
2,4-Dimethylphenol	SVOA	68	U	68	68	U	68	63	U	63	67	U	67
2,4-Dinitrophenol	SVOA	340	U	340	340	U	340	320	U	320	340	U	340
2,4-Dinitrotoluene	SVOA	68	U	68	68	U	68	63	U	63	67	U	67
2,6-Dinitrotoluene	SVOA	29	U	29	29	U	29	27	U	27	28	U	28
2-Chloronaphthalene	SVOA	10	U	10	10	U	10	9.5	U	9.5	10	U	10
2-Chlorophenol	SVOA	22	U	22	21	U	21	20	U	20	21	U	21
2-Methylnaphthalene	SVOA	20	U	20	19	U	19	18	U	18	19	U	19
2-Methylphenol (cresol, o-)	SVOA	13	U	13	13	U	13	12	U	12	13	U	13
2-Nitroaniline	SVOA	52	U	52	51	U	51	48	U	48	51	U	51
2-Nitrophenol	SVOA	10	U	10	10	U	10	9.5	U	9.5	10	U	10
3,3'-Dichlorobenzidine	SVOA	93	U	93	92	U	92	86	U	86	91	U	91
3+4 Methylphenol (cresol, m+p)	SVOA	34	U	34	34	U	34	31	U	31	33	U	33
3-Nitroaniline	SVOA	75	U	75	75	U	75	70	U	70	74	U	74
4,6-Dinitro-2-methylphenol	SVOA	340	U	340	340	U	340	310	U	310	330	U	330
4-Bromophenylphenyl ether	SVOA	20	U	20	19	U	19	18	U	18	19	U	19
4-Chloro-3-methylphenol	SVOA	68	U	68	68	U	68	63	U	63	67	U	67
4-Chloroaniline	SVOA	85	U	85	84	U	84	78	U	78	83	U	83
4-Chlorophenylphenyl ether	SVOA	22	U	22	21	U	21	20	U	20	21	U	21
4-Nitroaniline	SVOA	75	U	75	74	U	74	69	U	69	74	U	74
4-Nitrophenol	SVOA	100	U	100	99	U	99	92	U	92	98	U	98
Acenaphthene	SVOA	11	U	11	11	U	11	9.8	U	9.8	10	U	10
Acenaphthylene	SVOA	18	U	18	17	U	17	16	U	16	17	U	17
Anthracene	SVOA	18	U	18	17	U	17	16	U	16	17	U	17

Attachment	1	Sheet No.	14 of 16
Originator	R. J. Nielson	Date	9/16/14
Checked	I. B. Berezovskiy	Date	9/16/14
Calc. No.	0100D-CA-V0546	Rev. No.	0

Attachment 1. 100-D-84:2 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TW45			J1TW46			J1TW47			J1THH2		
		SPA-12			Duplicate of J1TW34			Equipment blank			100-D-84:2, Area 4		
		7/30/14			7/30/14			7/30/14			04/07/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Benzo(a)anthracene	SVOA	22	J	21	20	U	20	19	U	19	20	U	20
Benzo(a)pyrene	SVOA	21	U	21	20	U	20	19	U	19	20	U	20
Benzo(b)fluoranthene	SVOA	27	U	27	27	U	27	25	U	25	27	U	27
Benzo(ghi)perylene	SVOA	17	U	17	16	U	16	15	U	15	16	U	16
Benzo(k)fluoranthene	SVOA	41	U	41	41	U	41	38	U	38	41	U	41
Bis(2-chloro-1-methylethyl)ether	SVOA	24	U	24	24	U	24	22	U	22	23	U	23
Bis(2-Chloroethoxy)methane	SVOA	24	U	24	24	U	24	22	U	22	23	U	23
Bis(2-chloroethyl) ether	SVOA	17	U	17	17	U	17	16	U	16	17	U	17
Bis(2-ethylhexyl) phthalate	SVOA	47	U	47	47	U	47	44	U	44	47	U	47
Butylbenzylphthalate	SVOA	44	U	44	44	U	44	41	U	41	44	U	44
Carbazole	SVOA	37	U	37	37	U	37	34	U	34	37	U	37
Chrysene	SVOA	28	U	28	28	U	28	26	U	26	27	U	27
Dibenz[a,h]anthracene	SVOA	20	U	20	19	U	19	18	U	18	19	U	19
Dibenzofuran	SVOA	21	U	21	20	U	20	19	U	19	20	U	20
Diethyl phthalate	SVOA	27	U	27	27	U	27	25	U	25	26	U	26
Dimethyl phthalate	SVOA	24	U	24	24	U	24	22	U	22	23	U	23
Di-n-butylphthalate	SVOA	30	U	30	30	U	30	28	U	28	29	U	29
Di-n-octylphthalate	SVOA	15	U	15	15	U	15	14	U	14	15	U	15
Fluoranthene	SVOA	39	J	37	37	U	37	34	U	34	37	U	37
Fluorene	SVOA	19	U	19	18	U	18	17	U	17	18	U	18
Hexachlorobenzene	SVOA	30	U	30	30	U	30	28	U	28	29	U	29
Hexachlorobutadiene	SVOA	10	U	10	10	U	10	9.5	U	9.5	10	U	10
Hexachlorocyclopentadiene	SVOA	52	UT	52	51	UT	51	48	UT	48	51	U	51
Hexachloroethane	SVOA	22	U	22	22	U	22	20	U	20	22	U	22
Indeno(1,2,3-cd)pyrene	SVOA	23	U	23	23	U	23	21	U	21	22	U	22
Isophorone	SVOA	18	U	18	17	U	17	16	U	16	17	U	17
Naphthalene	SVOA	32	U	32	32	U	32	30	U	30	31	U	31
Nitrobenzene	SVOA	23	U	23	23	U	23	21	U	21	22	U	22
N-Nitroso-di-n-dipropylamine	SVOA	32	U	32	32	U	32	30	U	30	31	U	31
N-Nitrosodiphenylamine	SVOA	22	U	22	21	U	21	20	U	20	21	U	21
Pentachlorophenol	SVOA	340	UT	340	340	UT	340	310	UT	310	330	U	330
Phenanthrene	SVOA	18	U	18	17	U	17	16	U	16	17	U	17
Phenol	SVOA	19	U	19	18	U	18	17	U	17	18	U	18
Pyrene	SVOA	34	J	12	12	U	12	12	U	12	26	J	12

Attachment	1	Sheet No.	15 of 16
Originator	R. J. Nielson	Date	9/16/14
Checked	I. B. Berezovskiy	Date	9/16/14
Calc. No.	0100D-CA-V0546	Rev. No.	0

Attachment 1. 100-D-84:2 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1THH2		
		100-D-84:2, Area 4		
		04/07/14		
		ug/kg	Q	PQL
Acenaphthene	PAH	9.7	U	9.7
Acenaphthylene	PAH	8.8	U	8.8
Anthracene	PAH	3.0	U	3.0
Benzo(a)anthracene	PAH	26		3.1
Benzo(a)pyrene	PAH	22		6.2
Benzo(b)fluoranthene	PAH	28		4.1
Benzo(ghi)perylene	PAH	19	J	7.0
Benzo(k)fluoranthene	PAH	7.6	J	3.8
Chrysene	PAH	25	J	4.7
Dibenz[a,h]anthracene	PAH	11	U	11
Fluoranthene	PAH	47		13
Fluorene	PAH	5.1	U	5.1
Indeno(1,2,3-cd)pyrene	PAH	15	J	12
Naphthalene	PAH	12	U	12
Phenanthrene	PAH	20	J	12
Pyrene	PAH	46		12
Aldrin	PEST	0.25	U	0.25
Alpha-BHC	PEST	0.21	U	0.21
alpha-Chlordane	PEST	0.32	U	0.32
beta-1,2,3,4,5,6-Hexachlorocyclohexane	PEST	0.66	U	0.66
Delta-BHC	PEST	0.40	U	0.40
Dichlorodiphenyldichloroethane	PEST	0.54	U	0.54
Dichlorodiphenyldichloroethylene	PEST	2.4		0.24
Dichlorodiphenyltrichloroethane	PEST	0.85	J	0.58
Dieldrin	PEST	0.21	U	0.21
Endosulfan I	PEST	0.17	U	0.17
Endosulfan II	PEST	0.28	U	0.28
Endosulfan sulfate	PEST	0.27	U	0.27
Endrin	PEST	0.30	U	0.30
Endrin aldehyde	PEST	0.17	U	0.17
Endrin ketone	PEST	0.48	U	0.48
Gamma-BHC (Lindane)	PEST	0.46	U	0.46
gamma-Chlordane	PEST	0.26	U	0.26
Heptachlor	PEST	0.21	U	0.21
Heptachlor epoxide	PEST	0.42	U	0.42
Methoxychlor	PEST	0.45	U	0.45
Toxaphene	PEST	16	U	16

Attachment	1	Sheet No.	16 of 16
Originator	R. J. Nielson	Date	9/18/14
Checked	I. B. Berezovskiy	Date	9/18/14
Calc. No.	0100D-CA-V0546	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-D Field Remediation **Job No. 14655**

Area: 100-D

Discipline: Environmental *Calculation No: 0100D-CA-V0547

Subject: 100-D-84:2 Subsite 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 = 4 Total = 5	R. J. Nielson	I. B. Berezovskiy	J. D. Skoglie	S. G. Wilkinson	1/6/15

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:	R. J. Nielson	Date:	09/18/14	Calc. No.:	0100D-CA-V0547	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	09/18/14
Subject:	100-D-84:2 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	1 of 4

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-D-84:2 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 $<1 \times 10^{-6}$ for individual carcinogens
4) A cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.

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

4) WCH, 2014, *100-D-84:2 Subsite Cleanup Verification 95% UCL Calculations*, 0100D-CA-V0546, Rev. 0, Washington Closure Hanford, Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 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:	R. J. Nielson	Date:	09/23/14	Calc. No.:	0100D-CA-V0547	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	09/23/14
Subject:	100-D-84:2 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	2 of 4

METHODOLOGY:

The 100-D-84:2 subsite is comprised of three decision units for verification sampling, consisting of the Area 3 excavation, Area 4, and the staging pile area. The direct contact hazard quotient and carcinogenic risk calculations for the 100-D-84:2 subsite were conservatively calculated for the entire subsite using the greater of the statistical or maximum value for each analyte in all decision units from WCH (2014). Of the contaminants of potential concern (COPCs) for this site, boron, hexavalent chromium, molybdenum, and detected semivolatile organic compounds and polycyclic aromatic hydrocarbons require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Barium, selenium, and nitrogen in nitrate and nitrite are included because they were quantitated at a concentration above the Washington State or Hanford Site background. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the statistical value for boron is 10.4 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 1.4×10^{-3}. 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 is 3.3×10^{-2}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, then multiplied by 1.0×10^{-6}. For example, the statistical value for hexavalent chromium is 0.335 mg/kg; divided by 2.1 mg/kg, and multiplied as indicated, is 1.6×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-6}$, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk is obtained by summing the individual values. The excess cancer risk for the carcinogenic constituents detected is 3.8×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

RESULTS:

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

Table 1 shows the results of the calculations.

Washington Closure Hanford CALCULATION SHEET

Originator:	R. J. Nielson	Date:	09/23/14	Calc. No.:	0100D-CA-V0547	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	09/23/14
Subject:	100-D-84:2 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	3 of 4

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-D-84:2 Subsite.

Contaminants of Potential Concern	Statistical or Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Barium	146	5,600	2.6E-02	--	--
Boron	10.4	7,200	1.4E-03	--	--
Chromium, hexavalent [c]	0.335	240	1.4E-03	2.1	1.6E-07
Molybdenum	0.55	400	1.4E-03	--	--
Selenium	0.88	400	2.2E-03	--	--
Anions					
Nitrogen in nitrite and nitrate	13.1	128,000	1.0E-04	--	--
Semivolatiles					
Benzo(a)anthracene	0.027	--	--	1.37	2.0E-08
Benzo(b)fluoranthene	0.033	--	--	1.37	2.4E-08
Chrysene	0.035	--	--	13.7	2.6E-09
Fluoranthene	0.052	3,200	1.6E-05	--	--
Phenanthrene [d]	0.020	24,000	8.3E-07	--	--
Pyrene	0.046	2,400	1.9E-05	--	--
Polycyclic Aromatic Hydrocarbons					
Benzo(a)pyrene	0.022	--	--	0.137	1.6E-07
Benzo(ghi)perylene[d]	0.019	2,400	7.9E-06	--	--
Benzo(k)fluoranthene	0.0076	--	--	1.37	5.5E-09
Indeno(1,2,3-cd)pyrene	0.015	--	--	1.37	1.1E-08
Pesticides					
DDE, 4,4'-	0.0024	--	--	2.94	8.2E-10
DDT, 4,4'-	0.00085	40	2.1E-05	2.94	2.9E-10
Total Petroleum Hydrocarbon					
TPH-diesel EXT [e]	12	200	--	--	--
Totals					
Cumulative Hazard Quotient:			**3.3E-02**		
Cumulative Excess Cancer Risk:					**3.8E-07**

Notes:

[a] = From WCH (2014).

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

[c] = Value for the carcinogen RAG calculated based on the inhalation exposure pathway (WAC) 173-340-750(3), 1996.

[d] = 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

[e] = 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:	R. J. Nielson	Date:	09/18/14	Calc. No.:	0100D-CA-V0547	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	09/18/14
Subject:	100-D-84:2 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	4 of 4

CONCLUSION:

The calculations in Table 1 demonstrate that the 100-D-84:2 subsite meets the requirements for the direct contact hazard quotient and carcinogenic (excess cancer) risk, respectively, as identified in the RDR/RAWP (DOE-RL 2009b) and SAP (DOE-RL 2009a). The direct contact hazard quotient and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this subsite.

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-D Area Field Remediation **Job No. 14655**

Area: 100-D

Discipline: Environmental *Calculation No: 0100D-CA-V0548

Subject: 100-D-84:2 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 Sheets = 3 Total = 4	R. J. Nielson	I. B. Berezovsky	J. D. Skoglie	S. G. Wilkinson	1/6/15

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:	R. J. Nielson	Date:	9/17/2014	Calc. No.:	0100D-CA-V0548	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	9/17/2014
Subject:	100-D-84:2 Subsite Hazard Quotient and Carcinogenic Risk Calculation 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-D-84:2 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 $<1 \times 10^{-6}$ for individual carcinogens
4) A cumulative excess cancer risk of $<1 \times 10^{-5}$ 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-D-84:2 Subsite Cleanup Verification 95% UCL Calculations*, 0100D-CA-V0546, Rev. 0, 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 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 of $<1 \times 10^{-5}$.

Washington Closure Hanford CALCULATION SHEET

Originator:	R. J. Nielson	Date:	9/23/2014	Calc. No.:	0100D-CA-V0548	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	9/23/2014
Subject:	100-D-84:2 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 2 of 3	

METHODOLOGY:

The 100-D-84:2 subsite was divided into three decision units for the purpose of verification sampling; the Area 3 excavation, Area 4, and the staging pile area. Hazard quotient and carcinogenic risk calculations for potential impact to groundwater at the 100-D-84:2 subsite were conservatively calculated for the entire subsite using the greater of the statistical or maximum value for each analyte in all decision units from the 95% UCL calculation (WCH 2014). Of the contaminants of potential concern (COPCs) for this site, boron, hexavalent chromium, and nitrogen in nitrate and nitrite are included because no Washington State or Hanford background value has been established or the detected value is greater than the background value and the distribution coefficients are 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 16 m (52 ft) thickness, a K_d of 4.6 or greater is required to show no predicted migration to groundwater in 1,000 years. All other site nonradionuclide COPCs were not detected, quantified below background levels, or have a K_d greater than or equal to 4.6. 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 statistical value for boron of 10.4 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg is 3.3×10^{-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-D-84:2 subsite is 1.1×10^{-1}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum or statistical value is divided by the carcinogenic RAG value, and then multiplied by 1×10^{-6}. The 100-D-84:2 subsite does not have any constituents with carcinogenic RAGs; therefore, the criterion for excess risk is met. Consequently, the criterion for cumulative excess cancer risk for carcinogens is also met.

4) 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 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.

Washington Closure Hanford CALCULATION SHEET

Originator:	R. J. Nielson RN	Date:	9/23/2014	Calc. No.:	0100D-CA-V0548	Rev.:	0
Project:	100-D Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	9/23/2014
Subject:	100-D-84:2 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 3 of 3	

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-D-84:2 Subsite.

Contaminants of Potential Concern[a]	Maximum or Statistical Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	10.4	320	3.3E-02	--	--
Chromium, hexavalent	0.335	4.8	7.0E-02	--	--
Anions					
Nitrogen in nitrate and nitrite	13.1	2,560	5.1E-03	--	--
Totals					
Cumulative Hazard Quotient:			**1.1E-01**		
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.
-- = not applicable
RAG = remedial action goal

CONCLUSION:

This calculation demonstrates that the 100-D-84:2 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 C

DATA QUALITY ASSESSMENT

APPENDIX C

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* (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, with minimal alterations, as warranted by field conditions.

To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical analysis (BHI 2000) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2006).

Verification data from samples collected at the 100-D-84:2 subsite were provided by the laboratories in three sample delivery groups (SDGs): SDG JP0832, SDG JP0843, and SDG JP0773. SDG JP0832 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 100-D-84:2 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 JP0832

This SDG comprises 12 statistical soil samples (J1TW21 through J1TW32) from the excavation area. This SDG includes one field duplicate pair (J1TW22/J1TW33). All samples were analyzed for inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, nitrate/nitrite, polychlorinated biphenyls (PCBs), and semivolatile organic compounds (SVOCs). SDG JP0832 was submitted for third-party validation. Minor deficiencies are as follows:

In the ICP metals analysis, the matrix spike (MS) recoveries were outside the project acceptance criteria for five analytes (aluminum [1,314%], antimony [50%], iron [2,607%], manganese [160%], and silicon [16%]). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native

concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have a mismatched spike and native concentrations in the MS. All antimony and silicon results for SDG JP0832 were qualified by third-party validation as estimates with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory control sample (LCS) recovery for silicon is below the project quality control (QC) limits, at 19%. All silicon results for SDG JP0832 were qualified by third-party validation as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the PCB analysis, the laboratory duplicate relative percent difference (RPD) for aroclor-1260 (144%) is above the project QC limit of 30%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. All silicon results for SDG JP0832 were qualified by third-party validation as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the LCS recovery for 3,3-dichlorobenzidine (47%) is below the project QC limits. All 3,3-dichlorobenzidine results for SDG JP0832 were qualified by third-party validation as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the MS and matrix spike duplicate (MSD) recoveries for 2,4-dinitrophenol are below the project QC limit. All 2,4-dinitrophenol results for SDG JP0832 were qualified by third-party validation as estimated with "J" flags. Estimated data are usable for decision-making purposes.

SDG JP0843

This SDG comprises 12 statistical soil samples (J1TW34 through J1TW45) from the excavation area. This SDG includes one field duplicate pair (J1TW34/J1TW46). All samples were analyzed for ICP metals, mercury, hexavalent chromium, nitrate/nitrite, PCBs, and SVOCs. In addition, one field equipment blank sample (J1TW47) was collected and analyzed for ICP metals, mercury, and SVOCs. Minor deficiencies are as follows:

In the SVOC analysis, the LCS recovery for hexachlorocyclopentadiene is below the project QC limit, at 44%. Although not qualified for recovery below LCS limit, all hexachlorocyclopentadiene results for SDG JP0843 may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the MSD recovery for 2,4-dinitrophenol (36%) is below the project QC limit. Although not qualified for low MSD recovery, all 2,4-dinitrophenol results may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the RPD recovery for 2,4-dinitrophenol was above the project QC limit of 30%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. Although not qualified for RPD recovery above QC limits,

all 2,4-dinitrophenol results for SDG JP0843 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP analysis, the LCS recovery for silicon is below the project QC limits, at 18%. Although not qualified for LCS recovery below the QC limit, all silicon results for SDG JP0843 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were outside the project acceptance criteria for five analytes (aluminum [1,330%], antimony [53%], iron [3,043%], manganese [199%], and silicon [4%]). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. Although not qualified for MS recoveries outside the QC limits, all antimony and silicon results for SDG JP0843 may be considered estimated. Estimated data are usable for decision-making purposes.

In the nitrate/nitrite analysis, the MS recoveries were above the project acceptance criteria at 141% and 134%. Although not qualified for MS recoveries above QC limit, all nitrate/nitrite results for SDG JP0843 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG JP0773

This SDG comprises one discrete focused soil sample (J1THH2) from Area 4. All samples were analyzed for ICP metals, mercury, hexavalent chromium, nitrate/nitrite, pesticides, PCBs, SVOCs, polycyclic aromatic hydrocarbons (PAH), and total petroleum hydrocarbons (TPH). Minor deficiencies are as follows:

In the TPH analysis, TPH-diesel range was detected in a method blank (MB) at low levels, less than half of the reporting limit. Although not qualified for MB contamination, all TPH results for sample J1THH2 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, zinc is detected in the MB at very low levels, less than 1/25th of the most stringent cleanup limit. Although not qualified for MB contamination, all zinc results in SDG JP0773 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP analysis, the LCS recovery for silicon is below the project QC limits, at 23%. Although not qualified for LCS recovery below the QC limit, all silicon results for SDG JP0773 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries were outside the project acceptance criteria for six analytes (aluminum [978%], antimony [58%], copper [66%], iron [1,565%], manganese [160%], and silicon [23%]). For aluminum, iron, and manganese, the spiking concentration was

insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony, copper, and silicon did not have mismatched spike and native concentrations in the MS. Although not qualified for MS recoveries outside the QC limits, all antimony, copper, and silicon results for SDG JP0773 may be considered estimated. 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 C-1. The main and QA/QC sample results are presented in Appendix B.

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

Sample Area	Main Sample	Duplicate Sample
Excavation Area	J1TW22	J1TW33
Staging Pile Area	J1TW34	J1TW46

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 B provides details on duplicate pair evaluation and RPD calculation.

The calculated RPD duplicate analysis for chromium (30.4%) and silicon (30.5%) for the excavation area decision unit are below the acceptance criteria of 30%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. There is no indication that the analytical system was operating out of control. 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 (TDL), including undetected analytes. In these cases, a control limit of ±2 times the TDL is used (Appendix B) to indicate that a visual check of the data is required by the reviewer. No sample 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-D-84:2 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-D-84:2 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 B.

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