WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-HR-1 **Control No.:** 2014-118

Waste Site Code(s)/Subsite Code(s): 100-H-28:4

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-H-28, 100-H Water Treatment Facilities Underground Pipelines waste site, part of the 100-HR-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). Subsequently, the 100-H-28 waste site was divided into eight subsites and the 100-H-28:4, 1607-H1 Sanitary Sewer Pipelines subsite was recommended for remedial action.

The 100-H-28:4 subsite consisted of a 15.2-cm (6-in.) vitrified clay sanitary sewer pipeline. It was designed to receive waste from the 105-H Reactor Building, the 151-H Electrical Substation, and the 190-H Pumphouse. The waste was discharged to the 1607-H1 Septic System.

Remedial action at the 100-H-28:4 subsite was performed between November 14, 2013, and March 25, 2014. The remediation depth ranged from approximately 0.9 to 3.7 m (3 to 12 ft) below ground surface, resulting in approximately 1,630 bank cubic meters (2,132 bank cubic yards) of soil and debris being removed for disposal at the Environmental Restoration Disposal Facility (ERDF). The debris consisted primarily of 15-cm (6-in.) and 20-cm (8-in.)-diameter vitrified clay pipe encased in concrete. The waste material was staged prior to loadout and will be addressed in the 100-H-28:2/100-H-42 closure document. Overburden material was removed from above the pipeline and stockpiled for use as clean backfill. The overburden material was stockpiled along with overburden from the 100-H-28:2, 100-H-28:3, and 100-H-28:5 pipeline subsites and will be addressed in the 100-H-28:3/100-H-28:5 closure document. No stained soil or anomalous materials were encountered during the remediation.

To maintain safe access to the 100-H-28:4 waste site during ongoing field remediation, backfilling of portions of the waste site at road crossing areas were necessary before the completion of field remediation. Focused verification soil samples were collected on November 18, 2013, and on March 25, 2014 from within the excavation after the segment of pipeline was removed at the road crossing area. The road crossing areas were backfilled following sample collection. Additionally, two focused verification soil samples were collected on March 25, 2014, from below a segment of pipeline located in close proximity to a power pole support guy wire. The pipeline segment in close proximity to the power pole support guy wire remains in place and will not be remediated.

Verification sampling continued on September 2, 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.

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-HR-1 **Control No.:** 2014-118

Waste Site Code(s)/Subsite Code(s): 100-H-28:4

Basis for reclassification:

The verification sampling and modeling results for the 100-H-28:4 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-H-28:4, 1607-H1 Sanitary Sewer Pipelines* (attached).

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	JP Neath	3/2/15
DOE Federal Project Director (printed)	Signature	Date
N. Menard	Nina M. Menard	3/5/15
Ecology Project Manager (printed)	Signature	Date
NA		
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-28:4, 1607-H1 SANITARY SEWER PIPELINES

Attachment to Waste Site Reclassification Form 2014-118

March 2015

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-H-28:4, 1607-H1 SANITARY SEWER PIPELINES

EXECUTIVE SUMMARY

The 100-H-28:4, 1607-H1 Sanitary Sewer Pipelines subsite, part of the 100-HR-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, 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). Subsequently, the 100-H-28 waste site was divided into eight subsites. The 100-H-28:4 subsite was identified for remediation based on confirmatory sampling results (WCH 2008a).

Remedial action at the 100-H-28:4 pipeline subsite was performed between November 14, 2013, and March 25, 2014. The depth of the remediation ranged from approximately 0.9 to 3.7 m (3 to 12 ft) below ground surface resulting in approximately 1,630 bank cubic meters (2,132 bank cubic yards) of soil and debris removed for disposal at the Environmental Restoration Disposal Facility. The debris consisted primarily of 15-cm (6-in.) and 20-cm (8-in.)-diameter vitrified clay pipe encased in concrete. The waste material was staged in a combined staging pile area (SPA), and has since been loaded out and disposed at the Environmental Restoration Disposal Facility. The waste SPA footprint was included in the 100-H-28:2/100-H-42 verification work instruction and will be addressed in the 100-H-28:2/100-H-42 closure document. Overburden material was removed from above the pipeline and stockpiled along with overburden material from the 100-H-28:2, 100-H-28:3, and 100-H-28:5 subsites for use as clean backfill. The overburden material was included in the 100-H-28:3/100-H-28:5/100-H-44 verification work instruction, and will be addressed in the 100-H-28:3/100-H-28:5/100-H-44 closure document. No stained soil or anomalous materials were encountered during the remediation.

To maintain safe access to the 100-H-28:4 waste site during ongoing field remediation, backfilling of portions of the waste site at road crossing areas were necessary before the completion of field remediation. Focused verification soil samples were collected on November 18, 2013, and on March 25, 2014 from within the excavation after the segment of pipeline was removed at the road crossing area. The road crossing areas were backfilled following sample collection. Additionally, two focused verification soil samples were collected on March 25, 2014, from below a segment of pipeline located in close proximity to a power pole support guy wire. All results were below the direct exposure remedial action goals (RAGs). All results were below the groundwater and river protection RAGs with the exception of lead, aroclor-1260, and 4-4'-DDT. However, based on RESRAD modeling, it is predicted that the residual concentrations of these contaminants will not reach groundwater and thus the Columbia River within 1,000 years. The pipeline segment in close proximity to the power pole support guy wire remains in place and will not be remediated.

Verification sampling continued on September 2, 2014. A summary of the cleanup evaluation for the soil sampling results against the applicable remedial action goals is presented in Table ES-1.

Table ES-1. Summary of Remedial Action Goals for the 100-H-28:4 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-H-28:4 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-H-28:4 subsite (1.1×10^{-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 (7.8×10^{-7}) is $<1 \times 10^{-5}$.	
Groundwater/River Protection Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not COPCs for the 100-H-28:4 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-H-28:4 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.	Lead, aroclor-1260, and 4-4'-DDT exceeded soil RAGs for groundwater and/or river protection. However, based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), it is predicted that the residual concentrations of these contaminants will not reach groundwater (and thus the Columbia River) within 1,000 years[d].	Yes

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).
[b] *Radiation Protection of the Public and 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 lead, aroclor-1260, and 4-4'-DDT are not predicted to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years (based on the lowest K_d of these contaminants [lead with a K_d of 30 mL/g]). The vadose zone underlying the soil beneath the excavation is approximately 6 m (20 ft) thick. 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
DOE = U.S. Department of Energy
K_d = soil partitioning coefficient
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-H-28:4 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 remedial action goals 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-H-28:4 subsite contaminants of potential concern and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for arsenic, boron, selenium, and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, lead, 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, 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-H-28:4, 1607-H1 SANITARY SEWER PIPELINES

STATEMENT OF PROTECTIVENESS

The 100-H-28:4 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), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (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.

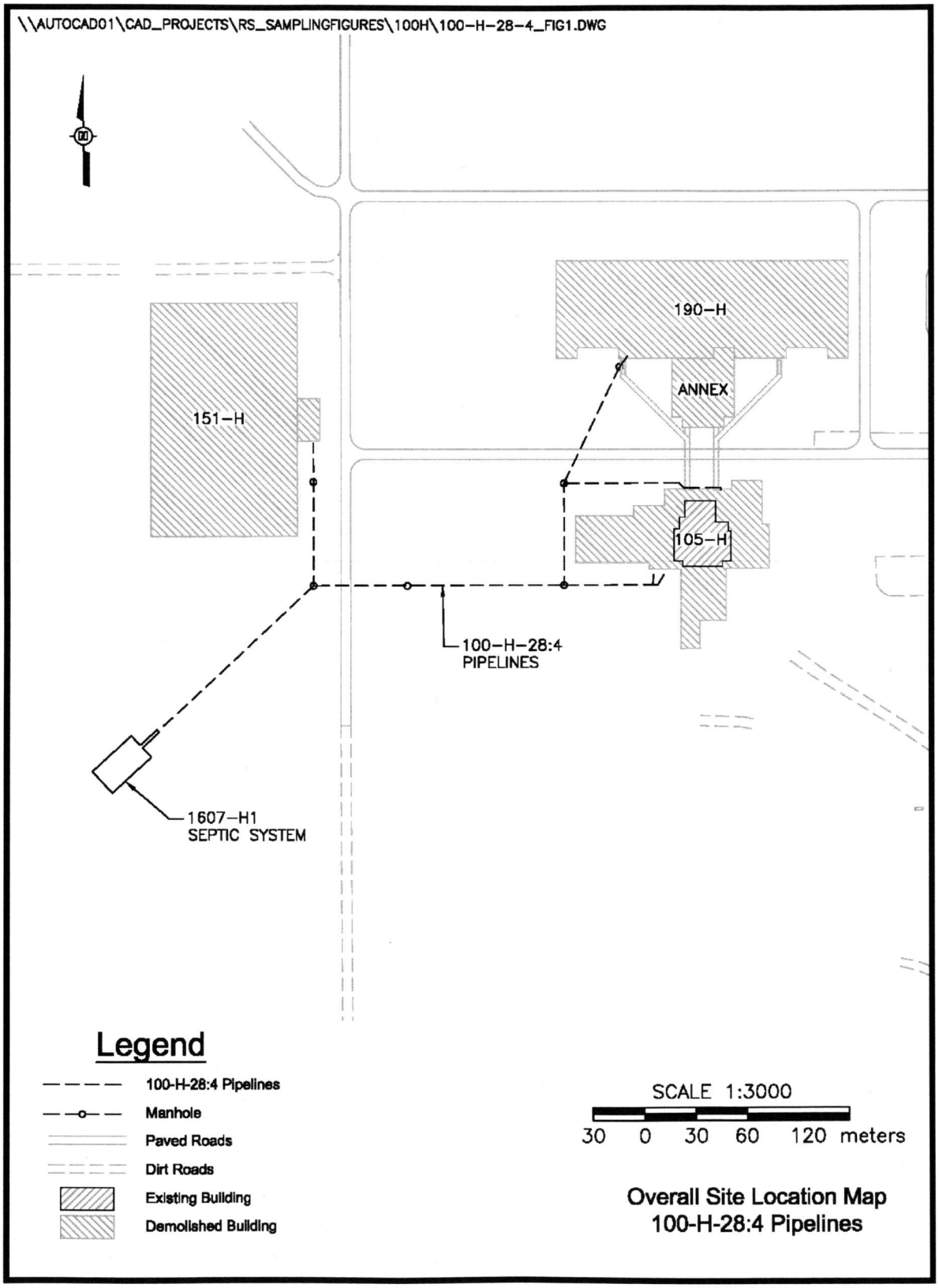
Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999) based in part on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the 100-H-28:4 subsite contaminants of potential concern (COPC) and other constituents (Appendix A). Ecological screening levels from the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup," were exceeded for arsenic, boron, selenium, and vanadium. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for antimony, lead, 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, 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-H-28:4 subsite consisted of a 15.2-cm (6-in.) vitrified clay sanitary sewer pipeline. It was designed to receive waste from the 105-H Reactor Building, the 151-H Electrical Substation, and the 190-H Pumphouse. The waste was discharged to the 1607-H1 Septic System.

The overall site location map is provided in Figure 1.

Figure 1. 100-H-28:4 Overall Site Location Map.



CONFIRMATORY SAMPLING

Contaminants of Potential Concern for Confirmatory Sampling

The COPCs identified for confirmatory sampling included inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, gamma energy analysis, gross alpha, gross beta, polychlorinated biphenyls (PCBs), semivolatile organic analysis, and pesticides. Kinetic phosphorescence analysis was performed to evaluate the presence of total uranium in the sewers.

Field screening did not detect volatile organic compounds and oily soil, oily sediment, or evidence of burning was not observed during field activities; therefore, volatile organic compound analysis was not requested. Suspect asbestos-containing material was not identified during field activities; therefore, asbestos analysis was not requested. No debris or other anomalous media unrelated to the 100-H-28:4 subsite was discovered during sampling activities.

Confirmatory Sampling Design

Confirmatory sampling of the 100-H-28:4 subsite was developed using a phased approach. Phase I consisted of the collection of a representative sample of accessible sediments within a selected manhole structure. The purpose of Phase I was to make an initial determination if residual pipeline contents fail remedial action goals (RAGs) and if the pipelines should be recommended for remedial action. Since the Phase I results indicate site remediation was needed, the Phase II portion of the confirmatory sampling design was not conducted.

Confirmatory Sampling Activities

Confirmatory sampling of the 100-H-28:4 subsite was performed in accordance with the *Work Instruction for Confirmatory Sampling of the 100-H-28:4 1607-H1 Sanitary Sewer Pipelines* (WCH 2006). Confirmatory sampling was performed at the site on June 3, 2008, as described in the *Miscellaneous Sampling* logbook (WCH 2008b). Sampling activities consisted of collecting a sample of the contents near the invert of the manhole located at the position indicated in Figure 2. A photograph taken in March 2006 shows the interior of the manhole (Figure 3). Information provided on the photograph indicates the depth to the bottom of the manhole is approximately 1.8 m (6 ft); however, after confirmatory sampling the depth was estimated at approximately 1.5 m (5 ft) below ground surface. A summary of confirmatory samples taken is provided in Table 1. The sample was collected of the brown, crumbly material within the flow channels at the bottom of the manhole.

Figure 2. 100-H-28:4 Confirmatory Sample Location.

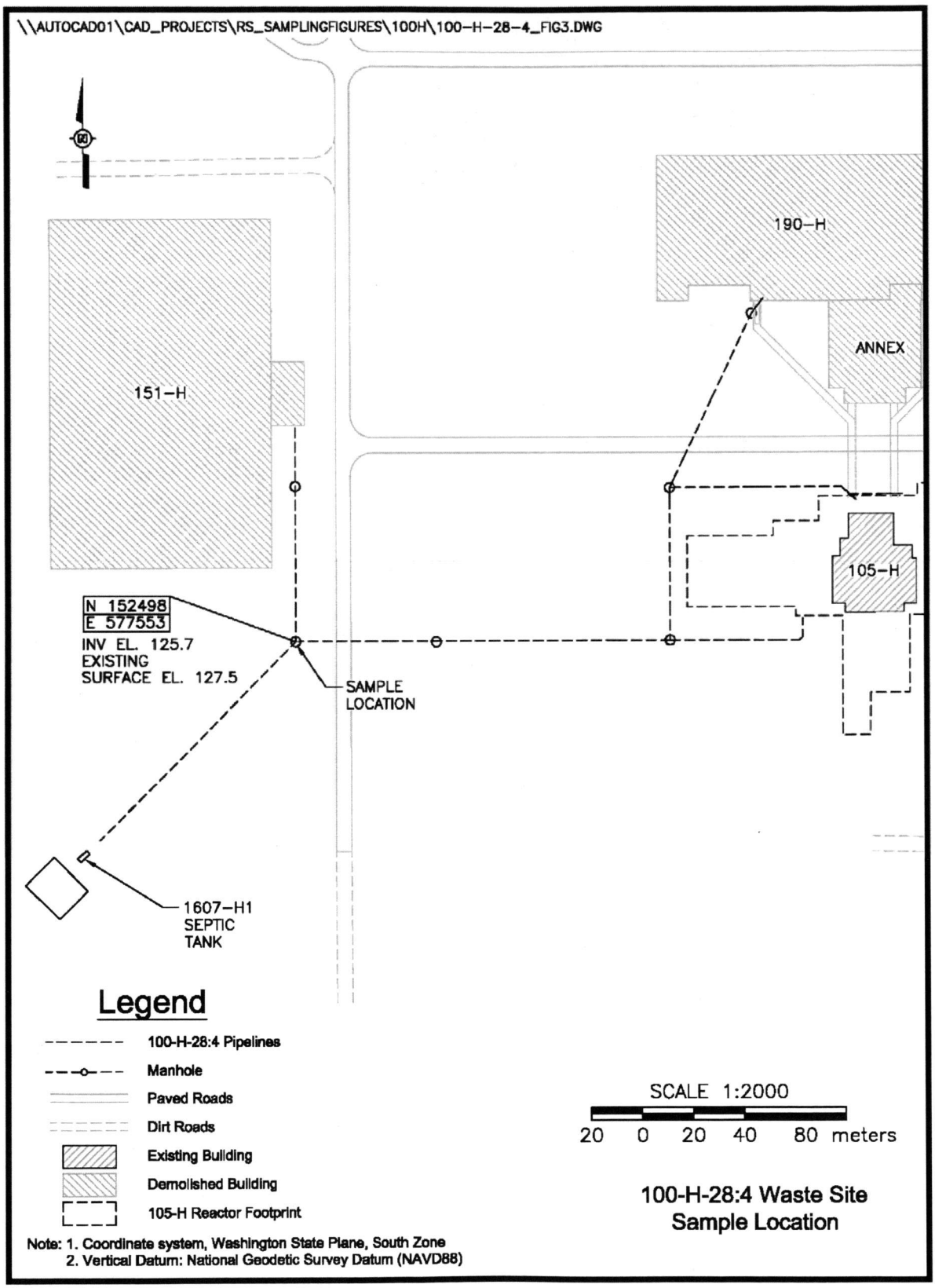


Figure 3. Manhole at Sample Location for the 100-H-28:4 Waste Site, March 2006.

Table 1. 100-H-28:4 Confirmatory Sampling Summary.

Sample Location	HEIS Sample Number	Sample Description	WSP Coordinates		Depth	Sample Analysis
			Northing (m)	Easting (m)		
Unlabeled manhole northeast of 1607-H1	J16VF8	Manhole contents	152498	577553	~1.5 m (5 ft)	ICP metals [a], mercury, GEA, gross alpha, gross beta, KPA, PCB, SVOA, and pesticides
	J16VJ0					Hexavalent chromium

[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.

GEA = gamma energy analysis
HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
KPA = kinetic phosphorescence analysis
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
WSP = Washington State Plane

Confirmatory Sample Results

Analytical results from confirmatory sampling indicated that the 100-H-28:4 site exceeded the groundwater and/or river protection RAGs for antimony, barium, cadmium, chromium (total), copper, lead, mercury, molybdenum, selenium, silver, zinc, dichlorodiphenyldichloroethylene (DDE), dichlorodiphenyltrichloroethane (DDT), dieldrin, endosulfan (sulfate), heptachlor, aroclor-1254, and aroclor-1260. The confirmatory results are provided in Appendix B. Endosulfan (sulfate) has a soil-partitioning coefficient (K_d) value of 2.04, such that protectiveness could not be demonstrated using vertical migration modeling. In discussion with the Washington Department of Ecology (Ecology) and the U.S. Department of Energy, Richland Operations Office (DOE-RL), it was determined that this subsite would be recommended for remedial action (WCH 2008a).

REMEDIAL ACTION SUMMARY

Remedial action at the 100-H-28:4 pipeline subsite was performed between November 14, 2013, and March 25, 2014. The depth of the remediation ranged from approximately 0.9 to 3.7 m (3 to 12 ft) below ground surface, resulting in approximately 1,630 bank cubic meters (2,132 bank cubic yards) of soil and debris removed for disposal at the Environmental Restoration Disposal Facility (ERDF). The debris consisted primarily of 15-cm (6-in.) and 20-cm (8-in.)-diameter vitrified clay pipe encased in concrete. The waste material was staged in a combined staging pile area (SPA), and has since been loaded out and disposed at the ERDF. The waste SPA footprint was included in the 100-H-28:2/100-H-42 verification work instruction and will be addressed in the 100-H-28:2/100-H-42 closure document. Overburden material was removed from above the pipeline and stockpiled along with overburden material from the 100-H-28:2, 100-H-28:3, and 100-H-28:5 subsites for use as clean backfill. The overburden material was included in the 100-H-28:3/100-H-28:5/100-H-44 verification work instruction and will be addressed in the 100-H-28:3/100-H-28:5/100-H-44 closure document. No stained soil or anomalous materials were encountered during the remediation.

In-process soil samples were collected of the waste material inside of the pipeline trenches awaiting loadout to ERDF. The sample results are provided in Appendix B.

To maintain safe access to the 100-H-28:4 waste site during ongoing field remediation, backfilling of portions of the waste site at road crossing areas were necessary before the completion of field remediation. Focused verification soil samples were collected on November 18, 2013, and March 25, 2014, from within the excavation after the segment of pipeline was removed at the road crossing area. The road crossing areas were backfilled following sample collection. Three small overburden stockpiles were used to backfill the road crossing areas; however, the material was used prior to being verification sampled. In agreement with DOE-RL and Ecology, the material used to backfill the road crossings are considered analogous to the remaining stockpiled overburden material awaiting verification sampling (WCH 2014a). The remaining overburden piles will be verification sampled per the *Work Instruction for Verification Sampling of the 100-H-28:3, 100-H-28:5, and 100-H-44 Waste Sites and the 100-H-28:2, 100-H-28:3, 100-H-28:4, and 100-H-28:5 Overburden Piles* (WCH 2014c) and will be addressed in the 100-H-28:3, 100-H-28:5, and 100-H-44 closure document.

The focused verification samples are further discussed in the Verification Sampling Activities section of this RSVP. The data are provided in Appendix C.

Additionally, two focused verification soil samples were collected on March 25, 2014, from below a segment of pipeline located in close proximity to a power pole support guy wire. The verification soil samples were collected to support leaving the pipeline segment in place without remediation. All sample results were below the direct exposure remedial action goals (RAGs). All results were below the groundwater and river protection RAGs with the exception of lead, aroclor-1260, and 4-4'-DDT. However, based on RESRAD modeling, it is predicted that the residual concentrations of these contaminants will not reach groundwater and thus the Columbia River within 1,000 years. Therefore, the pipeline segment remains in place and will not be remediated. The data are provided in Appendix C.

A post-excavation civil survey was conducted following remedial action activities and is provided in Figure 4.

An aerial photograph of the 100-H Area is shown in Figure 5. The photograph was annotated and cropped to show the pipeline excavation.

VERIFICATION SAMPLING ACTIVITIES

Focused verification soil samples were collected on November 18, 2013, and March 18 and 25, 2014, at locations where backfill was necessary to maintain safe access to the area. Two focused verification soil samples were collected from below a segment of pipeline in close proximity to a power pole support guy wire, and two focused verification soil samples were collected from road crossing areas.

Verification sampling continued on September 2, 2014, per the *Work Instruction for Verification Sampling of the 100-H-28:4, 1607-H1 Sanitary Sewer Pipelines* (WCH 2014d). Sampling was conducted to support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified in the 100 Area RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999).

The verification sample results are provided in Appendix C and indicate that the waste removal action achieved compliance with the remedial action objectives and RAGs for the 100-H-28:4 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.

Figure 4. 100-H-28:4 Post-Excavation Civil Survey.

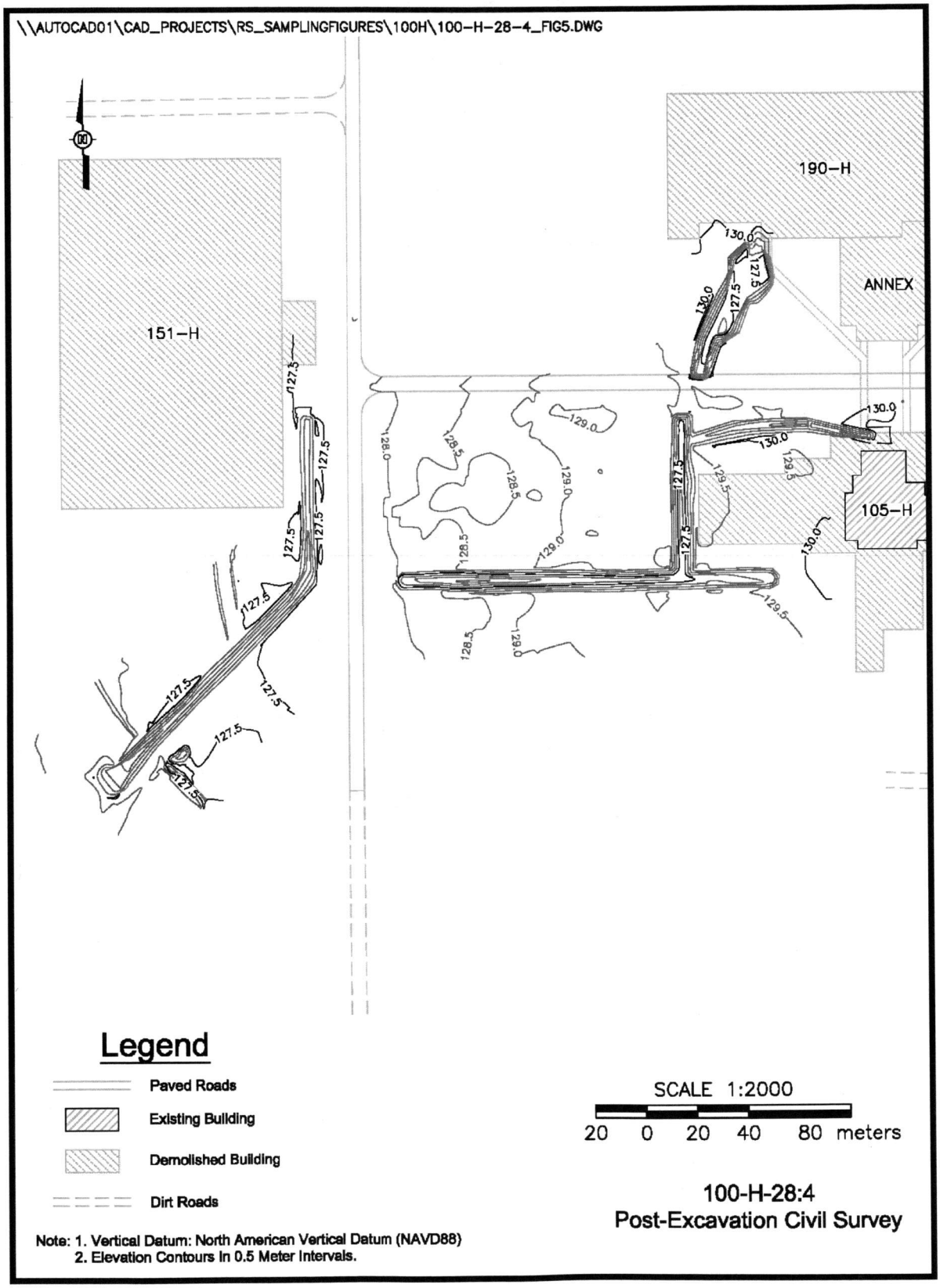


Figure 5. Aerial Photograph of the 100-H Area Identifying the 100-H-28:4 Excavation, Cropped, Dated April 14, 2014.

Contaminants of Potential Concern

The COPCs for verification sampling at the 100-H-28:4 subsite were determined based on the confirmatory sampling results (Appendix B). Antimony, barium, cadmium, chromium (total), copper, lead, mercury, molybdenum, selenium, silver, zinc, DDE, DDT, dieldrin, endosulfan (sulfate), heptachlor, aroclor-1254, and aroclor-1260 were detected above RAGs in the confirmatory samples; therefore, they were retained as site COPCs. Although hexavalent chromium was not detected above a RAG, it was retained as a COPC because of the use of sodium dichromate in the 190-H Building. While not considered site COPCs, arsenic, beryllium, boron, cobalt, manganese, nickel, and vanadium was included in the expanded list of ICP metals.

Three semivolatile organic compounds, di-n-butyl phthalate, bis(2-ethylhexyl)phthalate, and fluoranthene, were detected in the confirmatory samples. Because di-n-butyl phthalate and

bis(2-ethylhexyl)phthalate are common laboratory contaminants, they were excluded as site COPCs. Fluoranthene was detected at 0.150 mg/kg, which is well below the lowest RAG of 18 mg/kg; therefore, fluoranthene is excluded as a site COPC.

Four focused samples were collected prior to determining the site COPCs. In addition to the COPCs identified for the 100-H-28:4 subsite, the focused samples were also analyzed for semivolatile organic compounds.

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

Table 2. Laboratory Analytical Methods for the 100-H-28:4 Subsite.

Analytical Method	Contaminants of Potential Concern
ICP metals[a] – EPA Method 6010	Antimony, barium, cadmium, chromium, copper, lead, molybdenum, selenium, silver, zinc
Mercury – EPA Method 7471	Mercury
Hexavalent chromium – EPA Method 7196	Hexavalent chromium
PCB – EPA Method 8082	Aroclor-1254, aroclor-1260
Pesticides – EPA Method 8081	DDE, DDT, dieldrin, endosulfan (sulfate), heptachlor
SVOA – EPA Method 8270	Semivolatile organic compounds

[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.

DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis

Verification Sample Design

One decision unit was identified for the 100-H-28:4 subsite and consists of the excavation only. A combination statistical and focused sampling design was used to evaluate the waste site excavation. Twelve statistical verification soil samples plus one duplicate and one split were collected. Two focused samples were collected at separate locations where 100-H-28:4 pipeline segments crossed under established roadways. The pipelines were removed from the roadways and the areas were sampled, and the road crossing areas were backfilled. Two focused verification soil samples were collected from below a pipeline segment that could not be removed because of the proximity to a power pole support guy wire. A sample was collected of the soil below each end of the remaining segment of pipeline. The pipeline segment remains at this location. All samples were grab samples. Additionally, one equipment blank sample was collected.

All sampling was performed in accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2009a). Additional information related to verification sampling can be found in the field sampling logbook (WCH 2013, 2014a). The verification sample summary is provided in Table 3. Figure 6 shows the verification sample design boundary with the top of the excavation boundary overlaid. The verification sample locations are shown in Figure 7.

Table 3. 100-H-28:4 Subsite Verification Sample Summary Table.

Sample Location	HEIS Sample Number	WSP Northing (m)	WSP Easting (m)	Sample Analysis
EXC-1	J1TXL9	152461.7	577517.8	ICP metals [a], mercury, hexavalent chromium, PCB, pesticides
EXC-2	J1TXM0	152472.9	577530.7	
EXC-3	J1TXM1	152512.2	577553.2	
EXC-4	J1TXM2	152538.4	577553.2	
EXC-5	J1TXM3	152497.4	577611.5	
EXC-6	J1TXM4	152497.5	577656.8	
EXC-7	J1TXM5	152497.6	577702.1	
EXC-8	J1TXM6	152523.7	577702.1	
EXC-9	J1TXM7	152549.9	577702.0	
EXC-10	J1TXM8	152557.4	577740.8	
EXC-11	J1TXM9	152606.0	577721.3	
EXC-12	J1TXN0	152553.7	577766.7	
Duplicate of EXC-12	J1TXN1	152553.7	577766.7	
Split of EXC-12	J1TXW2	152553.7	577766.7	
FS-1 [b]	J1T5W5	152574.7	577707.5	ICP metals [a], mercury, hexavalent chromium, PCB, pesticides, SVOA [c]
FS-2 [b]	J1TH02	152560.2	577553.0	
FS-3 [b]	J1TH03	152578.6	577556.1	
FS-4 [b]	J1TH15	152498.0	577571.0	
Equipment blank	J1TXN2	NA	NA	ICP metals [a], mercury

[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] Focused samples FS-1 and FS-4 were collected at road crossing areas. The pipelines were removed, verification samples collected, and the areas were backfilled. Focused samples FS-2 and FS-3 were collected from locations in close proximity to a power pole support guy wire. The pipeline remains in place. The verification soil samples were collected from each end of the pipeline.

[c] The sample analyses identified for the focused samples conservatively requested SVOA as they were collected prior to determining the site COPCs.

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
WSP = Washington State Plane

Figure 6. 100-H-28:4 Sample Boundary Overlaid on Post-Excavation Boundary.

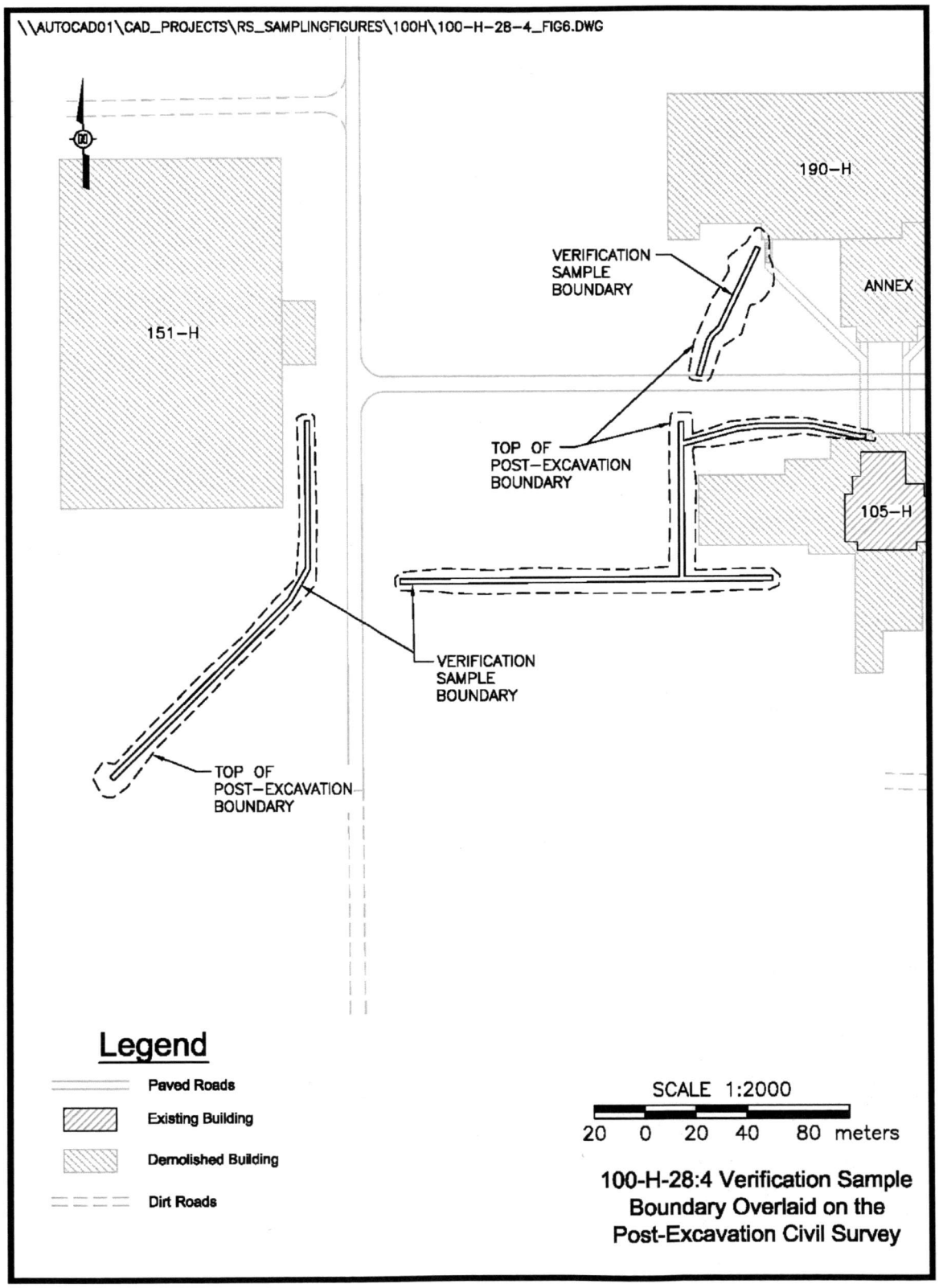
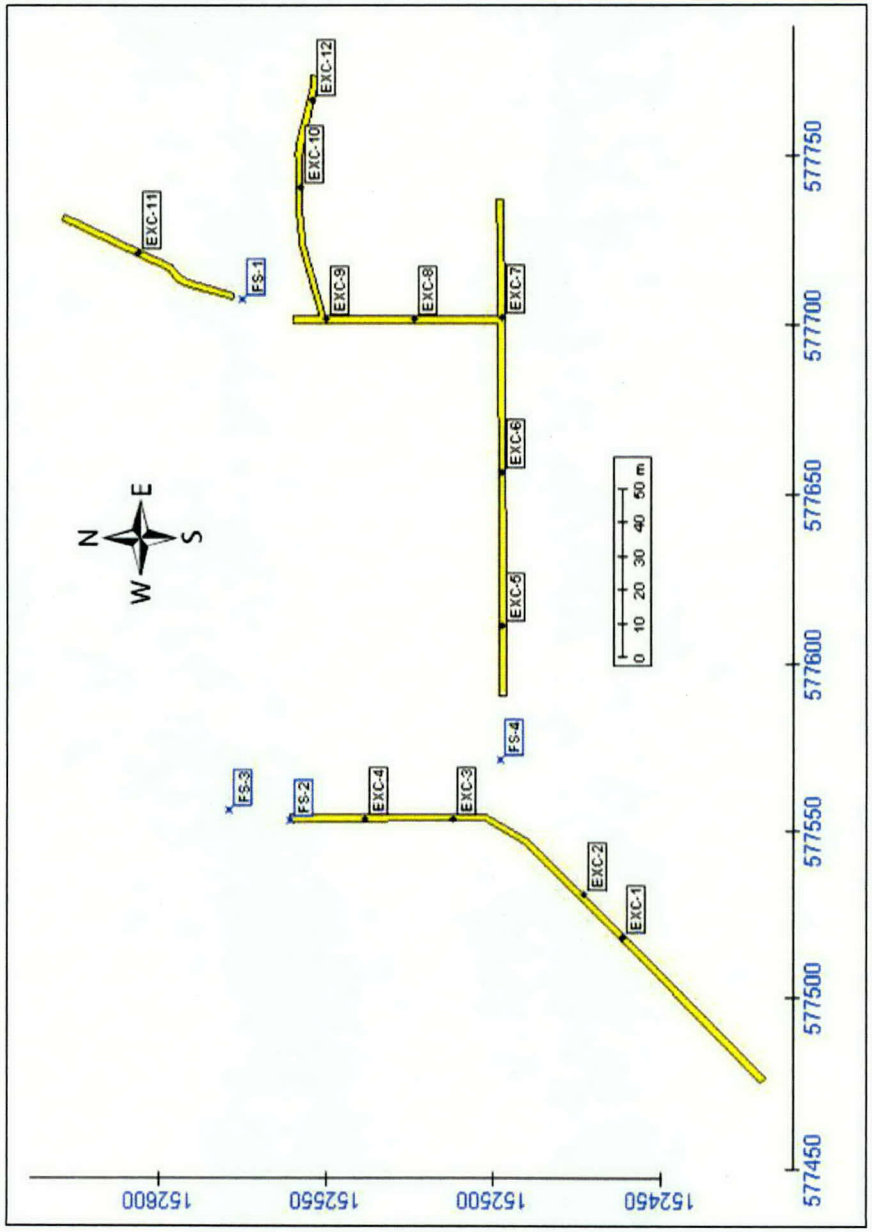


Figure 7. 100-H-28:4 Waste Site Verification Sample Locations.



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-H-28:4 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-H-28:4 decision unit as specified by the 100 Area RDR/RAWP (DOE-RL 2009b). The calculations are provided in Appendix C. 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-H-28:4 subsite against the RAGs are summarized in Tables 4 and 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 project-specific database prior to archival in the Hanford Environmental Information System and are presented in Attachment 1 of the 95% UCL calculations (Appendix C).

DATA EVALUATION

This section demonstrates that contaminant concentrations at the 100-H-28:4 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 4. Comparison of Contaminant Concentrations to Action Levels for the 100-H-28:4 Subsite Statistical Verification Samples.

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]	1.1 (<BG)	32	5 [d]	5 [d]	No	--
Arsenic	8.9	20 [d]	20 [d]	20 [d]	No	--
Barium	80.4 (<BG)	5,600	200	400	No	--
Beryllium	0.32 (<BG)	10.4 [e]	1.51 [d]	1.51 [d]	No	--
Boron [f]	2.4	7,200	320	-- [g]	No	--
Cadmium [c]	0.059 (<BG)	13.9 [e]	0.81 [d]	0.81 [d]	No	--
Chromium	11.4 (<BG)	80,000	18.5 [d]	18.5 [d]	No	--
Cobalt	6.8 (<BG)	24	15.7 [d]	-- [g]	No	--
Copper	14.7 (<BG)	2,960	59.2	22.0 [d]	No	--
Hexavalent chromium [f]	0.272	2.1 [e]	4.8	2	No	--
Lead	37.3	353	10.2 [d]	10.2 [d]	Yes	Yes [h]
Manganese	328 (<BG)	3,760	512 [d]	512 [d]	No	--
Mercury	0.012 (<BG)	24	0.33 [d]	0.33 [d]	No	--
Molybdenum [f]	0.36	400	8	-- [g]	No	--
Nickel	13.8 (<BG)	1,600	19.1 [d]	27.4	No	--
Selenium	0.87	400	5	1	No	--
Silver	0.23 (<BG)	400	8	0.73 [d]	No	--
Vanadium	46.9 (<BG)	560	85.1 [d]	-- [g]	No	--
Zinc	45.2 (<BG)	24,000	480	67.8 [d]	No	--
Aroclor-1254	0.0054	0.5	0.017 [i]	0.017 [i]	No	--
Aroclor-1260	0.061	0.5	0.017 [i]	0.017 [i]	Yes	Yes [h]
4-4'-DDE	0.0011	2.94	0.0257	0.0033 [i]	No	--
Dieldrin	0.00092	0.0625	0.0033 [i]	0.0033 [i]	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-H-28:4 Subsite Cleanup Verification 95% UCL Calculations* (Appendix C).

[c] Hanford Site-specific background value is not available. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

[d] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (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] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of lead and aroclor-1260 are not predicted to migrate more than 1.8 m (5.9 ft) vertically within 1,000 years (based on the lowest K_d of the contaminants [lead with a K_d of 30 mL/g]). The vadose zone beneath the 100-H-28:4 subsite is approximately 6 m (20 ft) thick. Therefore, the residual concentrations of the contaminants are predicted to be proactive of groundwater and the Columbia River.

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

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

Table 5. Comparison of Contaminant Concentrations to Action Levels for the 100-H-28:4 Subsite Focused Verification Samples.

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		
Antimony [c]	0.64 (<BG)	32	5 [d]	5 [d]	No	--
Arsenic	11.5	20 [d]	20 [d]	20 [d]	No	--
Barium	97.3 (<BG)	5,600	200	400	No	--
Beryllium	0.13 (<BG)	10.4 [e]	1.51 [d]	1.51 [d]	No	--
Boron [f]	6.8	7,200	320	-- [g]	No	--
Cadmium [c]	0.21 (<BG)	13.9 [e]	0.81 [d]	0.81 [d]	No	--
Chromium	12.4 (<BG)	80,000	18.5 [d]	18.5 [d]	No	--
Cobalt	6.7 (<BG)	24	15.7 [d]	-- [g]	No	--
Copper	15.5 (<BG)	2,960	59.2	22.0 [d]	No	--
Hexavalent chromium [f]	0.435	2.1 [e]	4.8	2	No	--
Lead	35.9	353	10.2 [d]	10.2 [d]	Yes	Yes [h]
Manganese	318 (<BG)	3,760	512 [d]	512 [d]	No	--
Mercury	0.047 (<BG)	24	0.33 [d]	0.33 [d]	No	--
Molybdenum [f]	0.30	400	8	-- [g]	No	--
Nickel	12.3 (<BG)	1,600	19.1 [d]	27.4	No	--
Vanadium	41.5 (<BG)	560	85.1 [d]	-- [g]	No	--
Zinc	44.1 (<BG)	24,000	480	67.8 [d]	No	--
Aroclor-1254	0.0071	0.5	0.017 [i]	0.017 [i]	No	--
Aroclor-1260	0.27	0.5	0.017 [i]	0.017 [i]	Yes	Yes [h]
4-4'-DDT	0.0046	2.94	0.0257	0.0033 [i]	Yes	Yes [h]
Methoxychlor	0.0011	400	4	1.67	No	--
Dimethyl phthalate	0.056	80,000	1,600	14,400	No	--
Pyrene	0.035	2,400	48	192	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] Maximum values as described in the *100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations* (Appendix C).
[c] Hanford Site-specific background value is not available. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[d] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (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] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of lead, aroclor-1260, and 4-4'-DDT are not predicted to migrate more than 1.8 m (5.9 ft) vertically within 1,000 years (based on the lowest K_d of the contaminants [lead with a K_d of 30 mL/g]). The vadose zone beneath the 100-H-28:4 subsite is approximately 6 m (20 ft) thick. Therefore, the residual concentrations of the contaminants are predicted to be proactive of groundwater and the Columbia River.
[i] Where cleanup levels are less than the RDLs, cleanup levels default to the RDLs per WAC 173-340-707(2) (Ecology 1996).

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

Attainment of Nonradionuclide RAGs

Tables 4 and 5 compare the cleanup verification sample values for the 100-H-28:4 subsite excavation 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 lead, aroclor-1260, and 4-4'-DDT. However, given the lowest K_d of these contaminants (lead with a K_d of 30), none would be expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years based on RESidual RADioactivity (RESRAD) modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). The vadose zone beneath the 100-H-28:4 subsite is approximately 60 m (20 ft) thick; therefore, residual concentrations of all contaminants are predicted 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)(c) 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-H-28:4 subsite is included in the *100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations* in Appendix C 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, with the exception of lead, which fails 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 concentrations of lead are not predicted to migrate more than 1.8 m (5.9 ft) vertically within 1,000 years (based on the K_d of 30 mL/g). The vadose zone beneath the 100-H-28:4 subsite is approximately 6 m (20 ft) thick; therefore, the residual concentrations of lead are predicted to be protective of groundwater and the Columbia River.

An additional application of the three-part test is included for the statistical data sets that default to the maximum value 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 aroclor-1260. However, given the K_d of 822 mL/g), it is not expected to migrate vertically within 1,000 years based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b). A contaminant with a K_d of 80 mL/g or greater is not predicted to migrate vertically through the soil; therefore, the residual concentration of aroclor-1260 is 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-H-28:4

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 1.1×10^{-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 7.8×10^{-7}, which is less than 1×10^{-5}. The 100-H-28:4 subsite meets the requirements for the direct contact hazard quotient and excess carcinogenic risk as identified in the 100 Area RDR/RAWP (DOE-RL 2009b).

Nonradionuclide Groundwater Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 100-H-28:4 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 K_d 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 6 m (20 ft) in thickness, a K_d of 12 mL/g or greater is required to show no predicted migration to groundwater in 1,000 years. All individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-H-28:4 subsite is 2.9×10^{-1}, which is less than 1.0. No carcinogenic constituents met the criteria for groundwater protection evaluation at the 100-H-28:4 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 2014d), the field logbook (WCH 2013, 2014b), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 100-H-28:4 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 Washington Closure Hanford project-specific database for data evaluation prior to archival in Hanford Environmental Information System and are summarized in Appendix C. The detailed DQA is presented in Appendix D.

SUMMARY FOR INTERIM CLOSURE

The 100-H-28:4 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 remedial action objectives for direct exposure, groundwater protection, and river protection.

In accordance with this evaluation, the verification sampling results support a reclassification of the 100-H-28:4 subsite to Interim Closed Out. Contamination above direct exposure levels was not observed in the shallow zone soils and is concluded to not exist in deep zone soils. Institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the sites are not required.

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APPENDIX A

ECOLOGICAL RISK COMPARISON TABLE

Table A-1. Maximum Contaminant Concentrations that Exceed Ecological Screening Levels for the 100-H-28:4 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	1.1 (<BG)
Arsenic III	6.5	NA	NA	7	18	NA	43	46	11.5
Arsenic V		10	60	132	NA	NA	NA	NA	
Boron	NA	0.5	NA	NA	NA	NA	NA	NA	6.8
Lead	10.2	50	500	118	120	1,700	11	56	37.3
Manganese	512	1,100[d]	NA	1,500	220	450	4,300	4,000	328 (<BG)
Selenium	0.78	1	70	0.3	0.52	4.1	1.2	0.63	0.87
Vanadium	85.1	2	NA	NA	NA	NA	7.8	280	46.9 (<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

CONFIRMATORY AND IN-PROCESS SAMPLE DATA

APPENDIX B

CONFIRMATORY SAMPLE DATA

Table B-1. 100-H-28:4 Confirmatory Sampling Results. (2 Pages)

Sample Number	Sample Date/Time	Northing	Easting	Aluminum			Antimony			Arsenic			Barium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J16VF8	6/3/2008 12:15	152498	577553	4770		10.1	6.9		0.76	7.3		1.3	262		0.25
J16VJ0	6/3/2008 12:15	152498	577553												

Sample Number	Sample Date/Time	Northing	Easting	Beryllium			Boron			Cadmium			Calcium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J16VF8	6/3/2008 12:15	152498	577553	0.13	U	0.13	2.7		1.3	1.9		0.13	2010	C	10.1
J16VJ0	6/3/2008 12:15	152498	577553												

Sample Number	Sample Date/Time	Northing	Easting	Chromium			Cobalt			Copper			Hexavalent Chromium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J16VF8	6/3/2008 12:15	152498	577553	45.6		0.5	2.5		0.5	329		0.5			
J16VJ0	6/3/2008 12:15	152498	577553										0.35	U	0.35

Sample Number	Sample Date/Time	Northing	Easting	Iron			Lead			Magnesium			Manganese		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J16VF8	6/3/2008 12:15	152498	577553	23400		11.3	126		76	879		6.3	66.9		0.1
J16VJ0	6/3/2008 12:15	152498	577553												

Sample Number	Sample Date/Time	Northing	Easting	Mercury			Molybdenum			Nickel			Potassium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J16VF8	6/3/2008 12:15	152498	577553	5.1		0.1	16.5		0.76	18.7		0.5	363		41.4
J16VJ0	6/3/2008 12:15	152498	577553												

Sample Number	Sample Date/Time	Northing	Easting	Selenium			Silicon			Silver			Sodium		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J16VF8	6/3/2008 12:15	152498	577553	5.2		1.5	384		10.1	1.4		0.25	65	C	1.7
J16VJ0	6/3/2008 12:15	152498	577553												

Sample Number	Sample Date/Time	Northing	Easting	Vanadium			Zinc		
				mg/kg	Q	PQL	mg/kg	Q	PQL
J16VF8	6/3/2008 12:15	152498	577553	22.9		0.35	322		1.5
J16VJ0	6/3/2008 12:15	152498	577553						

Sample Number	Sample Date/Time	Northing	Easting	Americium-241			Cesium-137			Cobalt-60			Europium-152		
				pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
J16VF8	6/3/2008 12:15	152498	577553	0.031	U	0.031	0.274		0.017	0.065	U	0.065	0.13	U	0.13

Sample Number	Sample Date/Time	Northing	Easting	Europium-154			Europium-155			Potassium-40			Radium-226		
				pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
J16VF8	6/3/2008 12:15	152498	577553	0.067	U	0.067	0.049	U	0.049	3.12		0.196	0.326		0.044

Sample Number	Sample Date/Time	Northing	Easting	Radium-228			Total Beta			Thorium-228			Thorium-232		
				pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
J16VF8	6/3/2008 12:15	152498	577553	0.24		0.104	0.163	U	0.237	0.241		0.025	0.24		0.104

Sample Number	Sample Date/Time	Northing	Easting	Uranium-235			Uranium-238			Gross alpha			Gross beta		
				pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
J16VF8	6/3/2008 12:15	152498	577553	0.142	U	0.142	2.72	U	2.72	21.6		3.23	35		5.35

Sample Number	Sample Date/Time	Northing	Easting	Uranium - KPA		
				ug/g	Q	MDA
J16VF8	6/3/2008 12:15	152498	577553	1.74		0.008

Table B-1. 100-H-28:4 Confirmatory Sampling Results. (2 Pages)

Sample Number	J16VF8			
Sample Location	N152498, E577553			
Sample Date	6/3/2008			
Constituent	Class	ug/kg	Q	PQL
Aroclor-1016	PCB	53	UD	53
Aroclor-1221	PCB	53	UD	53
Aroclor-1232	PCB	53	UD	53
Aroclor-1242	PCB	53	UD	53
Aroclor-1248	PCB	53	UD	53
Aroclor-1254	PCB	450	D	53
Aroclor-1260	PCB	220	D	53
Aldrin	PEST	1.3	UD	1.3
Alpha-BHC	PEST	1.3	UD	1.3
alpha-Chlordane	PEST	14	XD	1.3
beta-1,2,3,4,5,6-Hexachlorocyclohexane	PEST	1.3	UD	1.3
Delta-BHC	PEST	1.3	UD	1.3
Dichlorodiphenyldichloroethane	PEST	1.3	UD	1.3
Dichlorodiphenyldichloroethylene	PEST	26	XD	1.3
Dichlorodiphenyltrichloroethane	PEST	7.2	XD	1.3
Dieldrin	PEST	35	D	1.3
Endosulfan I	PEST	1.3	UD	1.3
Endosulfan II	PEST	1.3	UD	1.3
Endosulfan sulfate	PEST	13	D	1.3
Endrin	PEST	1.3	UD	1.3
Endrin aldehyde	PEST	3.6	JXD	1.3
Endrin ketone	PEST	3.3	JXD	1.3
Gamma-BHC (Lindane)	PEST	1.3	UD	1.3
gamma-Chlordane	PEST	1.3	UD	1.3
Heptachlor	PEST	4.3	JD	1.3
Heptachlor epoxide	PEST	1.3	UD	1.3
Methoxychlor	PEST	44	D	1.3
Toxaphene	PEST	13	UD	13
1,2,4-Trichlorobenzene	SVOA	2700	UD	2700
1,2-Dichlorobenzene	SVOA	2700	UD	2700
1,3-Dichlorobenzene	SVOA	2700	UD	2700
1,4-Dichlorobenzene	SVOA	2700	UD	2700
2,4,5-Trichlorophenol	SVOA	6700	UD	6700
2,4,6-Trichlorophenol	SVOA	2700	UD	2700
2,4-Dichlorophenol	SVOA	2700	UD	2700
2,4-Dimethylphenol	SVOA	2700	UD	2700
2,4-Dinitrophenol	SVOA	6700	UD	6700
2,4-Dinitrotoluene	SVOA	2700	UD	2700
2,6-Dinitrotoluene	SVOA	2700	UD	2700
2-Chloronaphthalene	SVOA	2700	UD	2700
2-Chlorophenol	SVOA	2700	UD	2700
2-Methylnaphthalene	SVOA	2700	UD	2700
2-Methylphenol (cresol, o-)	SVOA	2700	UD	2700
2-Nitroaniline	SVOA	6700	UD	6700
2-Nitrophenol	SVOA	2700	UD	2700
3,3'-Dichlorobenzidine	SVOA	2700	UD	2700

Sample Number	J16VF8			
Sample Location	N152498, E577553			
Sample Date	6/3/2008			
Constituent	Class	ug/kg	Q	PQL
3+4 Methylphenol (cresol, m+p)	SVOA	2700	UD	2700
3-Nitroaniline	SVOA	6700	UD	6700
4,6-Dinitro-2-methylphenol	SVOA	6700	UD	6700
4-Bromophenylphenyl ether	SVOA	2700	UD	2700
4-Chloro-3-methylphenol	SVOA	2700	UD	2700
4-Chloroaniline	SVOA	2700	UD	2700
4-Chlorophenylphenyl ether	SVOA	2700	UD	2700
4-Nitroaniline	SVOA	6700	UD	6700
4-Nitrophenol	SVOA	6700	UD	6700
Acenaphthene	SVOA	2700	UD	2700
Acenaphthylene	SVOA	2700	UD	2700
Anthracene	SVOA	2700	UD	2700
Benzo(a)anthracene	SVOA	2700	UD	2700
Benzo(a)pyrene	SVOA	2700	UD	2700
Benzo(b)fluoranthene	SVOA	2700	UD	2700
Benzo(ghi)perylene	SVOA	2700	UD	2700
Benzo(k)fluoranthene	SVOA	2700	UD	2700
Bis(2-chloro-1-methylethyl)ether	SVOA	2700	UD	2700
Bis(2-Chloroethoxy)methane	SVOA	2700	UD	2700
Bis(2-chloroethyl) ether	SVOA	2700	UD	2700
Bis(2-ethylhexyl) phthalate	SVOA	4500	BD	2700
Butylbenzylphthalate	SVOA	2700	UD	2700
Carbazole	SVOA	2700	UD	2700
Chrysene	SVOA	2700	UD	2700
Dibenz[a,h]anthracene	SVOA	2700	UD	2700
Dibenzofuran	SVOA	2700	UD	2700
Diethyl phthalate	SVOA	2700	UD	2700
Dimethyl phthalate	SVOA	2700	UD	2700
Di-n-butylphthalate	SVOA	470	JD	2700
Di-n-octylphthalate	SVOA	2700	UD	2700
Fluoranthene	SVOA	150	JD	2700
Fluorene	SVOA	2700	UD	2700
Hexachlorobenzene	SVOA	2700	UD	2700
Hexachlorobutadiene	SVOA	2700	UD	2700
Hexachlorocyclopentadiene	SVOA	2700	UD	2700
Hexachloroethane	SVOA	2700	UD	2700
Indeno(1,2,3-cd)pyrene	SVOA	2700	UD	2700
Isophorone	SVOA	2700	UD	2700
Naphthalene	SVOA	2700	UD	2700
Nitrobenzene	SVOA	2700	UD	2700
N-Nitroso-di-n-dipropylamine	SVOA	2700	UD	2700
N-Nitrosodiphenylamine	SVOA	2700	UD	2700
Pentachlorophenol	SVOA	6700	UD	6700
Phenanthrene	SVOA	2700	UD	2700
Phenol	SVOA	2700	UD	2700
Pyrene	SVOA	2700	UD	2700

Table B-2. 100-H-28:4 In-Process Sampling Results.

Sample Number	Sample Date/Time	Northing	Easting	Arsenic			Beryllium			Cadmium			Chromium		
				QT METAL			QT METAL			QT METAL			QT METAL		
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1MWW6	11/28/11 10:00	NA	NA	4.51		4.25	0.341		0.118	0.159	U	1.73	13		0.985
J1MWW7	11/28/11 10:05	NA	NA	2.21	U	4.16	0.299		0.115	0.178	U	1.69	12.3		0.962
J1MWW8	11/28/11 10:10	NA	NA	2.23	U	4.19	0.316		0.117	0.143	U	1.71	12.5		0.971
J1MWW9	11/28/11 10:12	NA	NA	2.16	U	4.35	0.284		0.121	0.143	U	1.77	13.5		1.01
J1MWX0	11/28/11 10:15	NA	NA	2.43	U	4.34	0.29		0.12	0.123	U	1.77	11.3		1
J1MWX1	11/28/11 10:21	NA	NA	2.06	U	4.26	0.31		0.118	0.133	U	1.73	12.1		0.985
J1MWX2	11/28/11 10:25	NA	NA	2	U	4.3	0.364		0.119	0.172	U	1.75	15.6		0.995
J1MWX3	11/28/11 10:29	NA	NA	1.94	U	4.36	0.338		0.121	0.153	U	1.78	13.5		1.01
J1MWX4	11/28/11 10:33	NA	NA	2.01	U	4.35	0.293		0.121	0.127	U	1.77	11.9		1.01
J1MWX5	11/28/11 10:37	NA	NA	4.76		4.29	0.315		0.119	0.163	U	1.75	12.4		0.993

Sample Number	Sample Date/Time	Northing	Easting	Lead			Selenium			Silver			Hexavalent Chromium		
				QT METAL			QT METAL			QT METAL					
				mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
J1MWW6	11/28/11 10:00	NA	NA	14.3		3.43	-0.111	U	8.23	-0.0543	U	1.08	0.155	U	0.155
J1MWW7	11/28/11 10:05	NA	NA	4.68		3.35	-0.0023	U	8.04	-0.0424	U	1.06	0.189		0.155
J1MWW8	11/28/11 10:10	NA	NA	4.48		3.38	-0.536	U	8.12	-0.0446	U	1.07	0.155	U	0.155
J1MWW9	11/28/11 10:12	NA	NA	3.69		3.5	0.223	U	8.42	-0.0139	U	1.11	0.155	U	0.155
J1MWX0	11/28/11 10:15	NA	NA	3.22	U	3.49	0.233	U	8.39	-0.0644	U	1.1	0.155	U	0.155
J1MWX1	11/28/11 10:21	NA	NA	11.9		3.43	0.288	U	8.23	-0.0434	U	1.08	0.155	U	0.155
J1MWX2	11/28/11 10:25	NA	NA	5.51		3.46	0.547	U	8.32	-0.0076	U	1.09	0.155	U	0.155
J1MWX3	11/28/11 10:29	NA	NA	3.88		3.51	0.673	U	8.44	-0.0749	U	1.11	0.155	U	0.155
J1MWX4	11/28/11 10:33	NA	NA	3.87		3.51	0.17	U	8.42	-0.0136	U	1.11	0.155	U	0.155
J1MWX5	11/28/11 10:37	NA	NA	8.58		3.46	-0.103	U	8.3	-0.0597	U	1.09	0.155	U	0.155

Sample Number	Sample Date/Time	Northing	Easting	Arsenic			Barium			Cadmium			Chromium		
				TCLP			TCLP			TCLP			TCLP		
				mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL
J1RWF5	8/14/2013 12:52	NA	NA	0.022	U	0.022	0.4	B	0.002	0.002	U	0.002	0.003	U	0.003

Sample Number	Sample Date/Time	Northing	Easting	Lead			Mercury			Selenium			Silver		
				TCLP			TCLP			TCLP			TCLP		
				mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL
J1RWF5	8/14/2013 12:52	NA	NA	0.013	B	0.013	0.00003	U	3E-05	0.024	U	0.024	0.004	U	0.004

APPENDIX C

CALCULATIONS

APPENDIX C

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:

100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations, 0100H-CA-V0214, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-H-28:4 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations, 0100H-CA-V0215, Rev. 0, Washington Closure Hanford, Richland, Washington.

100-H-28:4 Subsite Hazard Quotient and Carcinogenic Risk Calculations for Protection of Groundwater, 0100H-CA-V0216, 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.

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CALCULATION COVER SHEET

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

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0214

Subject: 100-H-28:4 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 = 11 Attm. 1 = 8 Total = 20	R. J. Nielson	I. B. Berezovsky	J. D. Skoglie	S. G. Wilkinson	2/17/15

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**	11/13/14	**Calc. No.**	0100H-CA-V0214	**Rev. No.**	0
Project	100-H Area Closure Operations	**Job No.**	14655	**Checked**	I. B. Berezovskiy	**Date**	11/13/14
Subject	100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations					**Sheet No.**	1 of 11

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 8 - Calculation Sheet Verification Data Results - Excavation
Sheets 9 to 10 - Ecology Software (MTCAStat) Results
Sheet 11 - Calculation Sheet Duplicate Analysis - Excavation
Attachment 1 - 100-H-28:4, Verification Sampling Results (8 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-H-28:4 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-H-28:4 subsite underwent statistical verification sampling at the excavation area decision unit. Four focused samples were also collected.

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** 11/13/14	**Calc. No.** 0100H-CA-V0214		**Rev. No.**	0
Project 100-H Area Closure Operations	**Job No.** 14655	**Checked** I. B. Berezovskiy		**Date**	11/13/14
Subject 100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations				**Sheet No.**	2 of 11

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 RJN	**Date** 11/13/14	**Calc. No.** 0100H-CA-V0214	**Rev. No.** 0		
Project 100-H Area Closure Operations	**Job No.** 14655	**Checked** I. B. Berezovskiy	**Date** 11/13/14		
Subject 100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations			**Sheet No.** 3 of 11		

Summary (continued)

QUALIFIER LIST

* = duplicate analysis not within control limits
B = estimated result. Result isless than the RL, but greater than the MDL
C = the analyte was detected in both the sample and the associated QC blank, and the sample concentrations was </= 5X the blank concentration
D = reported value is from a dilution
J = Result is les than the RL but greather than or equal to the MDL and the concentration is an approximate value (organics)
M = sample duplicate precision not met
N = recovery exceeds upper or lower control limits (metals)
N = MS, MSD recovery exceeds upper or lower control limits (organics)
U = undetected
X = serial dilution in the analytical batch indicates that physical and chemical interferences are present (metals)
X = More than 40% difference between columns, lower result reported (organics)

ACRONYM LIST

-- = not applicable
DE = direct exposure
EXC = excavation
GW = groundwater
HEIS = Hanford Environmental Information System
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
TDL = target detection limit
UCL = upper confidence limit
WAC = Washington Administrative Code

Washington Closure Hanford **CALCULATION SHEET**

Originator R. J. Nielson **Date** 11/13/14 **Calc. No.** 0100H-CA-V0214 **Rev. No.** 0
Project 100-H Area Closure Operations **Job No.** 14655 **Checked** I. B. Berezovskiy **Date** 11/13/14
Subject 100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations **Sheet No.** 4 of 11

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, 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		Focused	Units
	95% UCL Result	Maximum Result	Maximum Result	
Antimony	1.1	--	0.64	mg/kg
Arsenic	8.9	--	11.5	mg/kg
Barium	80.4	--	97.3	mg/kg
Beryllium	0.32	--	0.13	mg/kg
Boron	2.4	--	6.8	mg/kg
Cadmium	0.059	--	0.21	mg/kg
Chromium	11.4	--	12.4	mg/kg
Cobalt	6.8	--	6.7	mg/kg
Copper	14.7	--	15.5	mg/kg
Hexavalent chromium	--	0.272	0.435	mg/kg
Lead	37.3	--	35.9	mg/kg
Manganese	328	--	318	mg/kg
Mercury	0.012	--	0.047	mg/kg
Molybdenum	--	0.36	0.30	mg/kg
Nickel	13.8	--	12.3	mg/kg
Selenium	--	0.87	--	mg/kg
Silver	0.23	--	--	mg/kg
Vanadium	46.9	--	41.5	mg/kg
Zinc	45.2	--	44.1	mg/kg
Aroclor-1254	--	0.0054	0.0071	mg/kg
Aroclor-1260	--	0.061	0.27	mg/kg
4-4'-DDE	--	0.0011	--	mg/kg
4-4'-DDT	--	--	0.0046	mg/kg
Dieldrin	--	0.00092	--	mg/kg
Methoxychlor	--	--	0.0011	mg/kg
Dimethyl phthalate	--	--	0.056	mg/kg
Pyrene	--	--	0.035	mg/kg

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

WAC 173-340 3-Part Test for most stringent RAG:	EXCAVATION	
95% UCL or maximum> Cleanup Limit?	YES	YES
> 10% above Cleanup Limit?	YES	YES
Any sample > 2x Cleanup Limit?	YES	YES

[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 RN **Date** 11/13/14 **Calc. No.** 0100H-CA-V0214 **Rev. No.** 0
Project 100-H Area Closure Operations **Job No.** 14655 **Checked** I. B. Berezovskiy **Date** 11/13/14
Subject 100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations **Sheet No.** 5 of 11

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, 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	Excavation	
	Duplicate	Split
Aluminum	4.2%	14.7%
Barium	6.7%	14.7%
Calcium	4.0%	4.2%
Chromium	9.8%	1.5%
Copper	0.8%	22.8%
Iron	1.0%	15.2%
Magnesium	1.8%	3.4%
Manganese	8.7%	11.8%
Silicon	4.6%	**86.7%**
Sodium	9.6%	--
Vanadium	2.9%	25.2%
Zinc	2.1%	27.8%

[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% (35% for split data), is addressed in the data quality assessment section of the RSVP.

CALCULATION SHEET

Washington Closure Hanford

Originator R.J. Nielson
Project 100-H Area Closure Operations
Subject 100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations

Date 11/13/14
Job No. 14655

Calc. No. 0100H-CA-V0214
Checked I.B. Berezovsky

Rev. No. 0
Date 11/13/14
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1 **100-H-28:4 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	Boron mg/kg	Q	POL	Cadmium mg/kg	Q	POL	Chromium mg/kg	Q	POL	Cobalt mg/kg	Q	POL
3																											
4																											
5	EXC-12	J1TXN0	9/2/14	1.1	J	0.38	2.5		0.65	58.9		0.075	0.19	B	0.033	0.97	U	0.97	0.041	U	0.041	7.6		0.057	7.8	X	0.099
6	Duplicate of J1TXN0	J1TXN1	9/2/14	1.1	J	0.37	2.6		0.64	56.0	X	0.073	0.2		0.032	0.95	U	0.95	0.040	U	0.040	6.8		0.056	7.1	X	0.097
7	EXC-1	J1TXL9	9/2/14	1.5	MJ	0.35	3.5		0.60	73.9		0.069	0.32		0.030	2.0		0.89	0.065	B	0.037	10.4		0.053	6.3	X	0.091
8	EXC-2	J1TXM0	9/2/14	0.93	J	0.34	3.8		0.59	73.2		0.068	0.32		0.030	1.7	B	0.86	0.037	U	0.037	11.4		0.052	6.4	X	0.090
9	EXC-3	J1TXM1	9/2/14	1.1	J	0.35	3.9		0.60	91.2		0.069	0.34		0.030	2.0		0.89	0.061	B	0.037	12.1		0.053	7.5	X	0.091
10	EXC-4	J1TXM2	9/2/14	1.0	J	0.34	4.1		0.59	94.5		0.068	0.38		0.030	2.7		0.88	0.039	B	0.037	12.3		0.052	7.3	X	0.090
11	EXC-5	J1TXM3	9/2/14	1.0	J	0.38	22.3		0.66	71.4		0.076	0.32		0.033	1.4	B	0.98	0.061	B	0.041	10.3		0.058	6.5	X	0.10
12	EXC-6	J1TXM4	9/2/14	0.78	J	0.38	9.1		0.65	59.6		0.075	0.26		0.033	1.5	B	0.97	0.053	B	0.041	9.3		0.058	5.2	X	0.099
13	EXC-7	J1TXM5	9/2/14	0.96	J	0.36	5.0		0.62	58.4		0.072	0.24		0.031	1.8	B	0.93	0.046	B	0.039	9.5		0.055	6.0	X	0.095
14	EXC-8	J1TXM6	9/2/14	0.97	J	0.37	3.1		0.64	54.1		0.074	0.2		0.032	0.95	U	0.95	0.040	U	0.040	6.9		0.056	6.6	X	0.097
15	EXC-9	J1TXM7	9/2/14	0.76	J	0.35	6.2		0.60	77.8		0.069	0.3		0.030	3.4		0.89	0.061	B	0.037	12.5		0.053	6.1	X	0.091
16	EXC-10	J1TXM8	9/2/14	1.1	J	0.35	8.3		0.62	89.8		0.071	0.27		0.031	3.3		0.91	0.066	B	0.038	11.7		0.054	5.7	X	0.093
17	EXC-11	J1TXM9	9/2/14	1.0	J	0.34	3.7		0.59	65.0		0.068	0.21		0.029	2.7		0.86	0.062	B	0.037	7.5		0.052	5.9	X	0.089

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	Cadmium mg/kg	Chromium mg/kg	Cobalt mg/kg
19											
20											
21	EXC-12	J1TXN0/J1TXN1	9/2/14	1.1	2.6	58.0	0.20	0.5	0.020	7.2	7.5
22	EXC-1	J1TXL9	9/2/14	1.5	3.5	73.9	0.32	2.0	0.065	10.4	6.3
23	EXC-2	J1TXM0	9/2/14	0.93	3.8	73.2	0.32	1.7	0.019	11.4	6.4
24	EXC-3	J1TXM1	9/2/14	1.1	3.9	91.2	0.34	2.0	0.061	12.1	7.5
25	EXC-4	J1TXM2	9/2/14	1.0	4.1	94.5	0.38	2.7	0.039	12.3	7.3
26	EXC-5	J1TXM3	9/2/14	1.0	22.3	71.4	0.32	1.4	0.061	10.3	6.5
27	EXC-6	J1TXM4	9/2/14	0.78	9.1	59.6	0.26	1.5	0.053	9.3	5.2
28	EXC-7	J1TXM5	9/2/14	1.0	5.0	58.4	0.24	1.8	0.046	9.5	6.0
29	EXC-8	J1TXM6	9/2/14	1.0	3.1	54.1	0.20	0.5	0.020	6.9	6.6
30	EXC-9	J1TXM7	9/2/14	0.76	6.2	77.8	0.30	3.4	0.061	12.5	6.1
31	EXC-10	J1TXM8	9/2/14	1.1	8.3	89.8	0.27	3.3	0.066	11.7	5.7
32	EXC-11	J1TXM9	9/2/14	1.0	3.7	65.0	0.21	2.7	0.062	7.5	5.9
33											

		Antimony	Arsenic	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt
34									
35	95% UCL based on	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 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 normal 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	12
37	% < Detection limit	0%	0%	0%	0%	17%	25%	0%	0%
38	Mean	1.0	6.3	72.2	0.28	2.0	0.049	10.1	6.4
39	Standard deviation	0.19	5.4	13.8	0.060	0.95	0.021	2.0	0.71
40	95% UCL on mean	1.1	8.9	80.4	0.32	2.4	0.059	11.4	6.8
41	Maximum value	1.5	22.3	94.5	0.38	3.4	0.066	12.5	7.8
42	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	0.81 GW & River Protection	18.5 GW & River Protection	15.7 GW Protection
43	WAC 173-340 3-PART TEST								
44	95% UCL > Cleanup Limit?	NA	NO	NA	NA	NO	NA	NA	NA
45	> 10% above Cleanup Limit?	NA	NO	NA	NA	NO	NA	NA	NA
46	Any sample > 2X Cleanup Limit?	NA	NO	NA	NA	NO	NA	NA	NA
47	WAC 173-340 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.	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 (0.81 mg/kg) the WAC 173-340 3-part test is not required.	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.

48 Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson — Date 11/13/14 — Calc. No. 0100H-CA-V0214 — Rev. No. 0
Project 100-H Area Closure Operations — Job No. 14655 — Checked I. B. Berezovskiy — Date 11/13/14
Subject 100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations — Sheet No. 7 of 11

1 **100-H-28:4 Statistical Calculations**

2 **Verification Data - Excavation**

3	Sample	Sample	Sample	Copper			Lead			Manganese			Mercury			Nickel			Silver			Vanadium			Zinc		
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	EXC-12	J1TXN0	9/2/14	12.8	X	0.21	3.3		0.27	324		0.099	0.0067	B	0.0050	13.8	X	0.12	0.16	U	0.16	58.9		0.093	44.3		0.39
6	Duplicate of J1TXN0	J1TXN1	9/2/14	12.7	X	0.21	3.4		0.26	297		0.097	0.0083	B	0.0060	12.2	X	0.12	0.21		0.15	57.2		0.091	43.4		0.38
7	EXC-1	J1TXL9	9/2/14	13.9	X	0.20	5.9		0.25	319		0.091	0.011	BM	0.0055	11.0	X	0.11	0.15	U	0.15	42.2		0.086	46.3		0.36
8	EXC-2	J1TXM0	9/2/14	13.9	X	0.20	6.1		0.24	340		0.090	0.012	B	0.0048	11.9	X	0.11	0.17	B	0.14	42.7		0.085	46.6		0.36
9	EXC-3	J1TXM1	9/2/14	14.6	X	0.20	8.5		0.25	378		0.091	0.0095	B	0.0054	20.8	X	0.11	0.27		0.15	42.6		0.086	45.2		0.38
10	EXC-4	J1TXM2	9/2/14	16.0	X	0.19	8.0		0.24	358		0.090	0.014	B	0.0049	12.9	X	0.11	0.24		0.14	42.6		0.084	47.5		0.36
11	EXC-5	J1TXM3	9/2/14	14.4	X	0.22	84.3		0.27	318		0.10	0.0095	B	0.0055	11.7	X	0.12	0.16	U	0.16	42.6		0.094	41.9		0.40
12	EXC-6	J1TXM4	9/2/14	12.8	X	0.22	22.5		0.27	272		0.099	0.0066	B	0.0048	10.4	X	0.12	0.16	B	0.15	38.3		0.093	37.4		0.39
13	EXC-7	J1TXM5	9/2/14	13.6	X	0.21	13.0		0.26	274		0.095	0.014	B	0.0052	11.0	X	0.12	0.15	B	0.15	46.7		0.089	40.3		0.38
14	EXC-8	J1TXM6	9/2/14	14.1	X	0.21	3.3		0.26	288		0.097	0.0075	B	0.0049	10.2	X	0.12	0.19		0.15	49.9		0.091	39.4		0.39
15	EXC-9	J1TXM7	9/2/14	14.9	X	0.20	19.5		0.25	295		0.091	0.0082	B	0.0047	13.1	X	0.11	0.28		0.15	39.4		0.086	43.0		0.36
16	EXC-10	J1TXM8	9/2/14	15.7	X	0.20	26.5		0.25	285		0.093	0.012	B	0.0053	12.8	X	0.11	0.15	U	0.15	38.4		0.088	47.6		0.37
17	EXC-11	J1TXM9	9/2/14	13.0	X	0.19	6.7		0.24	280		0.089	0.0092	B	0.0050	10.7	X	0.11	0.14	U	0.14	48.2		0.084	36.4		0.36

18 **Statistical Computation Input Data**

19	Sample	Sample	Sample	Copper	Lead	Manganese	Mercury	Nickel	Silver	Vanadium	Zinc
20	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
21	EXC-12	J1TXN0/J1TXN1	9/2/14	12.8	3.4	311	0.0065	13.0	0.15	58.1	43.9
22	EXC-1	J1TXL9	9/2/14	5.9	5.9	319	0.011	11.0	0.075	42.2	46.3
23	EXC-2	J1TXM0	9/2/14	13.9	6.1	340	0.012	11.9	0.17	42.7	46.6
24	EXC-3	J1TXM1	9/2/14	14.6	8.5	378	0.0095	20.8	0.27	42.6	45.2
25	EXC-4	J1TXM2	9/2/14	16.0	8.0	358	0.014	12.9	0.24	42.6	47.5
26	EXC-5	J1TXM3	9/2/14	14.4	84.3	318	0.0095	11.7	0.080	42.6	41.9
27	EXC-6	J1TXM4	9/2/14	12.8	22.5	272	0.0066	10.4	0.16	38.3	37.4
28	EXC-7	J1TXM5	9/2/14	13.6	13.0	274	0.014	11.0	0.15	46.7	40.3
29	EXC-8	J1TXM6	9/2/14	14.1	3.3	288	0.0075	10.2	0.19	49.9	39.4
30	EXC-9	J1TXM7	9/2/14	14.9	19.5	295	0.0082	13.1	0.28	39.4	43.0
31	EXC-10	J1TXM8	9/2/14	15.7	26.5	285	0.012	12.8	0.075	38.4	47.6
32	EXC-11	J1TXM9	9/2/14	13.0	6.7	280	0.0092	10.7	0.070	48.2	36.4

33

34		Copper	Lead	Manganese	Mercury	Nickel	Silver	Vanadium	Zinc
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), 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), 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%	33%	0%	0%
38	Mean	14.1	17.3	306	0.010	12.6	0.16	44.2	43.0
39	Standard deviation	1.1	22.5	36.3	0.0026	2.8	0.076	5.6	3.9
40	95% UCL on mean	14.7	37.3	328	0.012	13.8	0.23	48.9	45.2
41	Maximum value	16.0	84.3	378	0.014	20.8	0.28	58.9	47.6
42	Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	22.0 River Protection	10.2 GW & River Protection	512 GW & River Protection	0.33 GW & River Protection	19.1 GW Protection	0.73 River Protection	85.1 GW Protection	67.8 River Protection
43	WAC 173-340 3-PART TEST								
44	95% UCL > Cleanup Limit?	NA	YES	NA	NA	NO	NA	NA	NA
45	> 10% above Cleanup Limit?	NA	YES	NA	NA	NO	NA	NA	NA
46	Any sample > 2X Cleanup Limit?	NA	YES	NA	NA	NO	NA	NA	NA
47	WAC 173-340 Compliance?	Because all values are below background (22.0 mg/kg) the WAC 173-340 3-part test is not required.	A detailed assessment will be performed. The data set meets the 3-part test criteria when compared to the direct exposure RAG.	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.	The data set meets the 3-part test criteria when compared to the most stringent RAG.	Because all values are below background (0.73 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.

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

MAXIMUM VALUE 3-PART TEST CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson **Date** 11/13/14 **Calc. No.** 0100H-CA-V0214 **Rev. No.** 0
Project 100-H Area Closure Operations **Job No.** 14655 **Checked** I. B. Berezovsky **Date** 11/13/14
Subject 100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations **Sheet No.** 8 of 11

1 **100-H-28:4 Subsite Maximum Calculations**

2 **Verification Data - Excavation**

3	Sample	Sample	Sample	Hexavalent Chromium			Molybdenum			Selenium			Aroclor-1254			Aroclor-1260			4-4'-DDE			Dieldrin		
4	Area	Number	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
5	EXC-12	J1TXN0	9/2/14	0.272		0.155	0.26	U	0.26	0.85	U	0.85	2.6	U	2.6	2.6	U	2.6	0.24	U	0.24	0.21	U	0.21
6	Duplicate of J1TXN0	J1TXN1	9/2/14	0.250		0.155	0.25	U	0.25	0.87	B	0.83	2.6	U	2.6	3.1	J	2.6	0.23	U	0.23	0.20	U	0.20
7	EXC-1	J1TXL9	9/2/14	0.155	U	0.155	0.24	U	0.24	0.78	U	0.78	5.3	J	2.6	2.6	U	2.6	0.24	U	0.24	0.79	J	0.21
8	EXC-2	J1TXM0	9/2/14	0.155	U	0.155	0.23	U	0.23	0.78	U	0.78	5.4	J	2.5	2.5	U	2.5	0.24	U	0.24	0.21	U	0.21
9	EXC-3	J1TXM1	9/2/14	0.155	U	0.155	0.24	U	0.24	0.78	U	0.78	2.6	U	2.6	9.1	J	2.6	0.88	J	0.24	0.21	U	0.21
10	EXC-4	J1TXM2	9/2/14	0.155	U	0.155	0.36	B	0.23	0.77	U	0.77	2.5	U	2.5	61		2.5	1.1	J	0.24	0.92	JX	0.21
11	EXC-5	J1TXM3	9/2/14	0.155	U	0.155	0.26	U	0.26	0.86	U	0.86	2.6	U	2.6	2.6	U	2.6	0.23	U	0.23	0.21	U	0.21
12	EXC-6	J1TXM4	9/2/14	0.155	U	0.155	0.26	U	0.26	0.85	U	0.85	2.6	U	2.6	2.6	U	2.6	0.23	U	0.23	0.21	U	0.21
13	EXC-7	J1TXM5	9/2/14	0.155	U	0.155	0.25	U	0.25	0.81	U	0.81	2.6	U	2.6	20		2.6	0.23	U	0.23	0.20	U	0.20
14	EXC-8	J1TXM6	9/2/14	0.184		0.155	0.25	U	0.25	0.83	U	0.83	2.5	U	2.5	2.5	U	2.5	0.24	U	0.24	0.21	U	0.21
15	EXC-9	J1TXM7	9/2/14	0.155	U	0.155	0.24	U	0.24	0.78	U	0.78	2.5	U	2.5	2.5	U	2.5	0.23	U	0.23	0.20	U	0.20
16	EXC-10	J1TXM8	9/2/14	0.155	U	0.155	0.24	U	0.24	0.80	U	0.80	2.4	U	2.4	3.9	J	2.4	0.23	U	0.23	0.20	U	0.20
17	EXC-11	J1TXM9	9/2/14	0.155	U	0.155	0.23	U	0.23	0.77	U	0.77	2.5	U	2.5	2.5	U	2.5	0.23	U	0.23	0.20	U	0.20

18 **Statistical Computations**

19		Hexavalent Chromium		Molybdenum		Selenium		Aroclor-1254		Aroclor-1260		4-4'-DDE		Dieldrin	
20	% < Detection limit	83%		92%		92%		83%		58%		83%		83%	
21	Maximum value	0.272		0.36		0.87		5.4		61		1.1		0.92	
22	Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg) unless otherwise noted	2	River Protection	8	GW Protection	1	River Protection	17 ug/kg	GW & River Protection	17 ug/kg	GW & River Protection	3.3 ug/kg	River Protection	3.3 ug/kg	GW & River Protection
23	3-PART TEST														
24	Maximum > Cleanup Limit?	NO		NO		NO		NO		YES		NO		NO	
25	> 10% above Cleanup Limit?	NO		NO		NO		NO		YES		NO		NO	
26	Any sample > 2X Cleanup Limit?	NO		NO		NO		NO		YES		NO		NO	
27	3-Part Test Compliance?	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.		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-H Area Closure Operations
Subject 100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations

Date 11/13/14
Job No. 14655

Calc. No. 0100H-CA-V0214
Checked B. Berezovsky

Rev. No. 0
Date 11/13/14
Sheet No. 9 of 11

Ecology Software (MTCAStat) Results, 100-H-28:4 Subsite Excavation

Antimony 95% UCL Calculation

DATA	ID
1.1	J1TXN0/J1TXN1
1.5	J1TXL9
0.93	J1TXM0
1.1	J1TXM1
1.0	J1TXM2
1.0	J1TXM3
0.78	J1TXM4
0.96	J1TXM5
0.87	J1TXM6
0.76	J1TXM7
1.1	J1TXM8
1.0	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	1.02
Censored		Lognormal mean	1.02
Detection limit or PQL		Std. devn.	0.19
Method detection limit		Median	1.0
TOTAL	12	Min.	0.76
		Max.	1.5

Lognormal distribution? Normal distribution?
r-squared is: 0.880 r-squared is 0.828
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 1.1

Arsenic 95% UCL Calculation

DATA	ID
2.8	J1TXN0/J1TXN1
3.5	J1TXL9
3.8	J1TXM0
3.9	J1TXM1
4.1	J1TXM2
22.3	J1TXM3
9.1	J1TXM4
5.0	J1TXM5
3.1	J1TXM6
6.2	J1TXM7
8.3	J1TXM8
3.7	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	6.3
Censored		Lognormal mean	6.1
Detection limit or PQL		Std. devn.	5.4
Method detection limit		Median	4.0
TOTAL	12	Min.	2.8
		Max.	22.3

Lognormal distribution? Normal distribution?
r-squared is: 0.858 r-squared is: 0.617
Recommendations:
Reject BOTH lognormal and normal distributions

UCL (based on Z-statistic) is 8.9

Barium 95% UCL Calculation

DATA	ID
58.0	J1TXN0/J1TXN1
73.9	J1TXL9
73.2	J1TXM0
91.2	J1TXM1
94.5	J1TXM2
71.4	J1TXM3
59.6	J1TXM4
58.4	J1TXM5
54.1	J1TXM6
77.8	J1TXM7
89.8	J1TXM8
65.0	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	72.2
Censored		Lognormal mean	72.3
Detection limit or PQL		Std. devn.	13.9
Method detection limit		Median	72.3
TOTAL	12	Min.	54.1
		Max.	94.5

Lognormal distribution? Normal distribution?
r-squared is: 0.951 r-squared is: 0.939
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 80.4

Beryllium 95% UCL Calculation

DATA	ID
0.20	J1TXN0/J1TXN1
0.32	J1TXL9
0.32	J1TXM0
0.34	J1TXM1
0.38	J1TXM2
0.32	J1TXM3
0.26	J1TXM4
0.24	J1TXM5
0.20	J1TXM6
0.30	J1TXM7
0.27	J1TXM8
0.21	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	0.28
Censored		Lognormal mean	0.28
Detection limit or PQL		Std. devn.	0.080
Method detection limit		Median	0.29
TOTAL	12	Min.	0.20
		Max.	0.38

Lognormal distribution? Normal distribution?
r-squared is: 0.945 r-squared is 0.867
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.32

Boron 95% UCL Calculation

DATA	ID
0.48	J1TXN0/J1TXN1
2.0	J1TXL9
1.7	J1TXM0
2.0	J1TXM1
2.7	J1TXM2
1.4	J1TXM3
1.5	J1TXM4
1.8	J1TXM5
0.48	J1TXM6
3.4	J1TXM7
3.3	J1TXM8
2.7	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	2.0
Censored		Lognormal mean	2.07
Detection limit or PQL		Std. devn.	0.95
Method detection limit		Median	1.9
TOTAL	12	Min.	0.48
		Max.	3.4

Lognormal distribution? Normal distribution?
r-squared is: 0.849 r-squared is: 0.957
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 2.4

Cadmium 95% UCL Calculation

DATA	ID
0.020	J1TXN0/J1TXN1
0.065	J1TXL9
0.019	J1TXM0
0.051	J1TXM1
0.039	J1TXM2
0.061	J1TXM3
0.053	J1TXM4
0.046	J1TXM5
0.020	J1TXM6
0.061	J1TXM7
0.066	J1TXM8
0.062	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	0.049
Censored		Lognormal mean	0.050
Detection limit or PQL		Std. devn.	0.021
Method detection limit		Median	0.052
TOTAL	12	Min.	0.019
		Max.	0.066

Lognormal distribution? Normal distribution?
r-squared is: 0.865 r-squared is: 0.931
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 0.059

Chromium 95% UCL Calculation

DATA	ID
7.15	J1TXN0/J1TXN1
10.4	J1TXL9
11.4	J1TXM0
12.1	J1TXM1
12.3	J1TXM2
10.3	J1TXM3
9.3	J1TXM4
9.5	J1TXM5
6.9	J1TXM6
12.5	J1TXM7
11.7	J1TXM8
7.5	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	10.1
Censored		Lognormal mean	10.1
Detection limit or PQL		Std. devn.	2.0
Method detection limit		Median	10.4
TOTAL	12	Min.	6.9
		Max.	12.5

Lognormal distribution? Normal distribution?
r-squared is: 0.901 r-squared is 0.925
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 11.4

Cobalt 95% UCL Calculation

DATA	ID
7.5	J1TXN0/J1TXN1
6.3	J1TXL9
6.4	J1TXM0
7.5	J1TXM1
7.3	J1TXM2
6.5	J1TXM3
5.2	J1TXM4
6.0	J1TXM5
6.6	J1TXM6
6.1	J1TXM7
5.7	J1TXM8
5.9	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	6.4
Censored		Lognormal mean	6.4
Detection limit or PQL		Std. devn.	0.71
Method detection limit		Median	6.4
TOTAL	12	Min.	5.2
		Max.	7.5

Lognormal distribution? Normal distribution?
r-squared is: 0.962 r-squared is: 0.956
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 6.8

Copper 95% UCL Calculation

DATA	ID
12.8	J1TXN0/J1TXN1
13.9	J1TXL9
13.9	J1TXM0
14.6	J1TXM1
16.0	J1TXM2
14.4	J1TXM3
12.8	J1TXM4
13.6	J1TXM5
14.1	J1TXM6
14.9	J1TXM7
15.7	J1TXM8
13.0	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	14.1
Censored		Lognormal mean	14.1
Detection limit or PQL		Std. devn.	1.1
Method detection limit		Median	14.0
TOTAL	12	Min.	12.8
		Max.	16.0

Lognormal distribution? Normal distribution?
r-squared is: 0.968 r-squared is: 0.983
Recommendations
Use lognormal distribution.

UCL (Land's method) is 14.7

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford
Originator R. J. Nielson
Project 100-H Area Closure Operations
Subject 100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations

Date 11/13/14
Job No. 14655

Calc. No. 0100H-CA-V0214
Checked I. B. Berezovsky

Rev. No. 0
Date 11/13/14
Sheet No. 10 of 11

Ecology Software (MTCAStat) Results, 100-H-28:4 Subsite Excavation

Lead 95% UCL Calculation

DATA	ID
3.4	J1TXN0/J1TXN1
5.9	J1TXL9
6.1	J1TXM0
8.5	J1TXM1
8.0	J1TXM2
84.3	J1TXM3
22.5	J1TXM4
13.0	J1TXM5
3.3	J1TXM6
19.5	J1TXM7
26.5	J1TXM8
6.7	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	17.3
Censored		Lognormal mean	16.7
Detection limit or PQL		Std. devn.	22.5
Method detection limit		Median	6.25
TOTAL	12	Min.	3.3
		Max.	84.3

Lognormal distribution? r-squared is: 0.933
Normal distribution? r-squared is 0.595
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 37.3

Manganese 95% UCL Calculation

DATA	ID
311	J1TXN0/J1TXN1
319	J1TXL9
340	J1TXM0
378	J1TXM1
358	J1TXM2
316	J1TXM3
272	J1TXM4
274	J1TXM5
288	J1TXM6
295	J1TXM7
285	J1TXM8
260	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	306
Censored		Lognormal mean	306
Detection limit or PQL		Std. devn.	36.3
Method detection limit		Median	303
TOTAL	12	Min.	260
		Max.	378

Lognormal distribution? r-squared is: 0.972
Normal distribution? r-squared is: 0.957
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 328

Mercury 95% UCL Calculation

DATA	ID
0.0065	J1TXN0/J1TXN1
0.011	J1TXL9
0.012	J1TXM0
0.0095	J1TXM1
0.014	J1TXM2
0.0095	J1TXM3
0.0066	J1TXM4
0.014	J1TXM5
0.0075	J1TXM6
0.0082	J1TXM7
0.012	J1TXM8
0.0092	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	0.010
Censored		Lognormal mean	0.010
Detection limit or PQL		Std. devn.	0.0026
Method detection limit		Median	0.0095
TOTAL	12	Min.	0.0065
		Max.	0.014

Lognormal distribution? r-squared is: 0.961
Normal distribution? r-squared is: 0.955
Recommendations:
Use lognormal distribution

UCL (based on t-statistic) is 0.012

Nickel 95% UCL Calculation

DATA	ID
13.0	J1TXN0/J1TXN1
11.0	J1TXL9
11.9	J1TXM0
20.8	J1TXM1
12.9	J1TXM2
11.7	J1TXM3
10.4	J1TXM4
11.0	J1TXM5
10.2	J1TXM6
13.1	J1TXM7
12.8	J1TXM8
10.7	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	12.5
Censored		Lognormal mean	12.5
Detection limit or PQL		Std. devn.	2.8
Method detection limit		Median	11.8
TOTAL	12	Min.	10.2
		Max.	20.8

Lognormal distribution? r-squared is: 0.745
Normal distribution? r-squared is 0.649
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 13.8

Silver 95% UCL Calculation

DATA	ID
0.15	J1TXN0/J1TXN1
0.075	J1TXL9
0.17	J1TXM0
0.27	J1TXM1
0.24	J1TXM2
0.08	J1TXM3
0.16	J1TXM4
0.15	J1TXM5
0.19	J1TXM6
0.28	J1TXM7
0.075	J1TXM8
0.070	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	0.16
Censored		Lognormal mean	0.16
Detection limit or PQL		Std. devn.	0.076
Method detection limit		Median	0.16
TOTAL	12	Min	0.07
		Max.	0.28

Lognormal distribution? r-squared is: 0.912
Normal distribution? r-squared is: 0.924
Recommendations
Use lognormal distribution.

UCL (Land's method) is 0.23

Vanadium 95% UCL Calculation

DATA	ID
58.1	J1TXN0/J1TXN1
42.2	J1TXL9
42.7	J1TXM0
42.6	J1TXM1
42.6	J1TXM2
42.6	J1TXM3
38.3	J1TXM4
45.7	J1TXM5
49.9	J1TXM6
39.4	J1TXM7
38.4	J1TXM8
48.2	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	44.2
Censored		Lognormal mean	44.2
Detection limit or PQL		Std. devn.	5.6
Method detection limit		Median	42.6
TOTAL	12	Min.	38.3
		Max.	58.1

Lognormal distribution? r-squared is: 0.884
Normal distribution? r-squared is: 0.848
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 46.9

Zinc 95% UCL Calculation

DATA	ID
43.9	J1TXN0/J1TXN1
46.3	J1TXL9
48.6	J1TXM0
45.2	J1TXM1
47.5	J1TXM2
41.9	J1TXM3
37.4	J1TXM4
40.3	J1TXM5
39.4	J1TXM6
43.0	J1TXM7
47.6	J1TXM8
36.4	J1TXM9

Number of samples		Uncensored values	
Uncensored	12	Mean	43.0
Censored		Lognormal mean	43.0
Detection limit or PQL		Std. devn.	3.9
Method detection limit		Median	43.4
TOTAL	12	Min.	36.4
		Max.	47.6

Lognormal distribution? r-squared is: 0.943
Normal distribution? r-squared is 0.950
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 45.2

Acronyms and qualifiers are defined on sheet 3.

CALCULATION SHEET

Washington Closure Hanford

Originator R. J. Nielson **Date** 11/13/14 **Calc. No.** 0100H-CA-V0214 **Rev. No.** 0
Project 100-H Area Closure Operations **Job No.** 14655 **Checked** I. B. Berezovskiy **Date** 11/13/14
Subject 100-H-28:4 Subsite Cleanup Verification 95% UCL Calculations **Sheet No.** 11 of 11

Duplicate Analysis - 100-H-28:4 Subsite - Excavation

Sampling Area	Sample Number	Sample Date	Aluminum mg/kg	Q	PQL	Antimony mg/kg	Q	PQL	Arsenic mg/kg	Q	PQL	Barium mg/kg	Q	PQL	Beryllium mg/kg	Q	PQL	Calcium mg/kg	Q	PQL	Chromium mg/kg	Q	PQL	Cobalt mg/kg	Q	PQL
EXC-12	J1TXN0	9/2/14	5340		1.5	1.1		0.38	2.5		0.65	59.9		0.075	0.19	B	0.033	5850		13.9	7.5		0.057	7.8	X	0.099
Duplicate of J1TXN0	J1TXN1	9/2/14	5570		1.5	1.1		0.37	2.6		0.64	56.0		0.073	0.20		0.032	6090		13.6	6.8		0.056	7.1	X	0.097
Split of J1TXN0	J1TXW2	9/2/14	4610		6.76	1.64	DU	1.64	4.28	C	0.497	51.7		0.0994	0.793		0.0994	5610		7.96	7.39		0.149	13.4		0.149

Analysis:

		Aluminum	Antimony	Arsenic	Barium	Beryllium	Calcium	Chromium	Cobalt
TDL		5	0.6	10	2	0.2	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)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	4.2%			6.7%		4.0%	9.8%	
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable
Split Analysis	Both > PQL?	Yes (continue)	No-Stop (acceptable)	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)
	RPD	14.7%			14.7%		4.2%	1.5%	
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable	Yes - assess further	Not applicable	Not applicable	Yes - assess further

Duplicate Analysis - 100-H-28:4 Subsite - Excavation

Sampling Area	Sample Number	Sample Date	Copper mg/kg	Q	PQL	Hexavalent Chromium mg/kg	Q	PQL	Iron mg/kg	Q	PQL	Lead mg/kg	Q	PQL	Magnesium mg/kg	Q	PQL	Manganese mg/kg	Q	PQL	Mercury mg/kg	Q	PQL	Nickel mg/kg	Q	PQL
EXC-12	J1TXN0	9/2/14	12.8	X	0.21	0.272		0.155	20000		3.8	3.3		0.27	5020		3.7	324		0.099	0.0067	B	0.0050	13.8	X	0.12
Duplicate of J1TXN0	J1TXN1	9/2/14	12.7	X	0.21	0.250		0.155	19600		3.7	3.4		0.26	5110		3.6	297		0.097	0.0063	B	0.0060	12.2	X	0.12
Split of J1TXN0	J1TXW2	9/2/14	16.1	*	0.298	0.115	U	0.115	23300		7.96	3.14	BD	1.64	4850		8.45	288		0.199	0.0040	U	0.0040	11.9		0.149

Analysis:

		Copper	Hexavalent Chromium	Iron	Lead	Magnesium	Manganese	Mercury	Nickel
TDL		1	0.5	5	5	75	5	0.2	4
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	0.8%		1.0%		1.8%	8.7%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable
Split Analysis	Both > PQL?	Yes (continue)	No-Stop (acceptable)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)		Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)		No-Stop (acceptable)
	RPD	27.8%		15.2%		3.4%	11.8%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable

Duplicate Analysis - 100-H-28:4 Subsite - Excavation

Sampling Area	Sample Number	Sample Date	Potassium mg/kg	Q	PQL	Silicon mg/kg	Q	PQL	Sodium mg/kg	Q	PQL	Vanadium mg/kg	Q	PQL	Zinc mg/kg	Q	PQL	Aroclor-1260 ug/kg	Q	PQL
EXC-12	J1TXN0	9/2/14	782		40.5	232	N	5.6	299		58.3	58.9		0.093	44.3		0.39	2.6	U	2.6
Duplicate of J1TXN0	J1TXN1	9/2/14	817		39.6	243	N	5.5	329		57.0	57.2		0.091	43.4		0.38	3.1	J	2.6
Split of J1TXN0	J1TXW2	9/2/14	713		6.36	587		1.49	192		6.96	75.9		0.0994	33.5		0.398	3.59		1.12

Analysis:

		Potassium	Silicon	Sodium	Vanadium	Zinc	Aroclor-1260
TDL		400	2	50	2.5	1	20
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)	
	RPD		4.6%	8.6%	2.9%	2.1%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	Not applicable	Not applicable	No - acceptable
Split Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	No-Stop (acceptable)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	
	RPD		86.7%		25.2%	27.8%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Yes - assess further	Not applicable	Not applicable	No - acceptable

Acronyms and qualifiers are defined on sheet 3.

Attachment 1. 100-H-28:4 Subsite Verification 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-12	J1TXN0	9/2/14	5340		1.5	1.1	J	0.38	2.5		0.65	59.9		0.075	0.19	B	0.033	0.97	U	0.97
Duplicate of J1TXN0	J1TXN1	9/2/14	5570		1.5	1.1	J	0.37	2.6		0.64	56.0		0.073	0.20		0.032	0.95	U	0.95
EXC-1	J1TXL9	9/2/14	8810		1.4	1.5	MJ	0.35	3.5		0.60	73.9		0.069	0.32		0.030	2.0		0.89
EXC-2	J1TXM0	9/2/14	8850		1.4	0.93	J	0.34	3.8		0.59	73.2		0.068	0.32		0.030	1.7	B	0.88
EXC-3	J1TXM1	9/2/14	9200		1.4	1.1	J	0.35	3.9		0.60	91.2		0.069	0.34		0.030	2.0		0.89
EXC-4	J1TXM2	9/2/14	10600		1.4	1.0	J	0.34	4.1		0.59	94.5		0.068	0.38		0.030	2.7		0.88
EXC-5	J1TXM3	9/2/14	8720		1.5	1.0	J	0.38	22.3		0.66	71.4		0.076	0.32		0.033	1.4	B	0.98
EXC-6	J1TXM4	9/2/14	7030		1.5	0.78	J	0.38	9.1		0.65	59.6		0.075	0.26		0.033	1.5	B	0.97
EXC-7	J1TXM5	9/2/14	6460		1.5	0.96	J	0.36	5.0		0.62	58.4		0.072	0.24		0.031	1.8	B	0.93
EXC-8	J1TXM6	9/2/14	5550		1.5	0.97	J	0.37	3.1		0.64	54.1		0.074	0.20		0.032	0.95	U	0.95
EXC-9	J1TXM7	9/2/14	8400		1.4	0.76	J	0.35	6.2		0.60	77.8		0.069	0.30		0.030	3.4		0.89
EXC-10	J1TXM8	9/2/14	7850		1.4	1.1	J	0.35	8.3		0.62	89.8		0.071	0.27		0.031	3.3		0.91
EXC-11	J1TXM9	9/2/14	5670		1.4	1.0	J	0.34	3.7		0.59	65.0		0.068	0.21		0.029	2.7		0.88
Split of J1TXN0	J1TXW2	9/2/14	4610		6.76	1.64	DU	1.64	4.28	C	0.497	51.7		0.0994	0.793		0.0994	1.71	B	0.994
FS-1	J1T5W5	11/18/13	7200		1.4	0.35	U	0.35	11.5		0.61	97.3		0.070	0.11	B	0.030	6.8		0.90
FS-2	J1TH02	3/25/14	8620		1.7	0.64	B	0.42	8.5		0.73	79.3		0.084	0.11	B	0.036	1.8	B	1.1
FS-3	J1TH03	3/25/14	5650		1.5	0.44	B	0.37	7.0		0.65	41.1		0.075	0.033	U	0.033	0.97	U	0.97
FS-4	J1TH15	3/18/14	7630		1.5	0.38	U	0.38	3.5		0.66	60.0		0.075	0.13	B	0.033	1.3	B	0.97
Equipment blank	J1TXN2	9/2/14	166		1.3	0.33	UJ	0.33	0.57	U	0.57	1.6		0.066	0.061	B	0.028	0.84	U	0.84

Gray cells indicate not applicable.
* = duplicate analysis not within control limits
B = estimated result. Result is less than the RL, but greater than the MDL
C = the analyte was detected in both the sample and the associated QC blank, and the sample concentrations was <= 5X the blank concentration
D = reported value is from a dilution
EXC = excavation
FS = focused sample
HEIS = Hanford Environmental Information System
J = Result is les than the RL but greater than or equal to the MDL and the concentration is an approximate value (organics)
M = sample duplicate precision not met
N = recovery exceeds upper or lower control limits (metals)
N = MS, MSD recovery exceeds upper or lower control limits (organics)
PCB = polychlorinated biphenyls
PEST = pesticides
PQL = practical quantitation limit
Q = qualifier
SVOA = semivolatile organic compounds
U = undetected
X = serial dilution in the analytical batch indicates that physical and chemical interferences are present (metals)
X = More than 40% difference between columns, lower result reported (organics)

Attachment	1	Sheet No.	1 of 8
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0214	Rev. No.	0

Attachment 1. 100-H-28:4 Subsite Verification 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-12	J1TXN0	9/2/14	0.041	U	0.041	5850		13.9	7.5		0.057	7.8	X	0.099	12.8	X	0.21	0.272		0.155
Duplicate of J1TXN0	J1TXN1	9/2/14	0.040	U	0.040	6090		13.6	6.8		0.056	7.1	X	0.097	12.7	X	0.21	0.250		0.155
EXC-1	J1TXL9	9/2/14	0.065	B	0.037	4920		12.8	10.4		0.053	6.3	X	0.091	13.9	X	0.20	0.155	U	0.155
EXC-2	J1TXM0	9/2/14	0.037	U	0.037	4930		12.7	11.4		0.052	6.4	X	0.09	13.9	X	0.20	0.155	U	0.155
EXC-3	J1TXM1	9/2/14	0.051	B	0.037	4300		12.8	12.1		0.053	7.5	X	0.091	14.6	X	0.20	0.155	U	0.155
EXC-4	J1TXM2	9/2/14	0.039	B	0.037	5370		12.6	12.3		0.052	7.3	X	0.09	16.0	X	0.19	0.155	U	0.155
EXC-5	J1TXM3	9/2/14	0.061	B	0.041	5090		14.1	10.3		0.058	6.5	X	0.10	14.4	X	0.22	0.155	U	0.155
EXC-6	J1TXM4	9/2/14	0.053	B	0.041	5690		14.0	9.3		0.058	5.2	X	0.099	12.8	X	0.22	0.155	U	0.155
EXC-7	J1TXM5	9/2/14	0.046	B	0.039	6530		13.3	9.5		0.055	6.0	X	0.095	13.6	X	0.21	0.155	U	0.155
EXC-8	J1TXM6	9/2/14	0.040	U	0.040	5680		13.6	6.9		0.056	6.6	X	0.097	14.1	X	0.21	0.184		0.155
EXC-9	J1TXM7	9/2/14	0.061	B	0.037	6350		12.8	12.5		0.053	6.1	X	0.091	14.9	X	0.20	0.155	U	0.155
EXC-10	J1TXM8	9/2/14	0.086	B	0.038	6420		13.1	11.7		0.054	5.7	X	0.093	15.7	X	0.20	0.155	U	0.155
EXC-11	J1TXM9	9/2/14	0.062	B	0.037	5210		12.6	7.5		0.052	5.9	X	0.089	13.0	X	0.19	0.155	U	0.155
Split of J1TXN0	J1TXW2	9/2/14	0.545		0.0994	5610		7.96	7.39		0.149	13.4		0.149	16.1	*	0.298	0.115	U	0.115
FS-1	J1T5W5	11/18/13	0.16	B	0.038	5760		13.0	10.9		0.053	6.3		0.092	14.7		0.20	0.155	U	0.155
FS-2	J1TH02	3/25/14	0.21	B	0.045	4110		15.5	10.5		0.064	6.7	X	0.11	15.5		0.24	0.435		0.155
FS-3	J1TH03	3/25/14	0.16	B	0.040	5200		13.9	9.8		0.057	5.1	X	0.099	12.7		0.21	0.155	U	0.155
FS-4	J1TH15	3/18/14	0.18	B	0.041	6180		14.0	12.4		0.058	6.5		0.099	14.4		0.22	0.269		0.155
Equipment blank	J1TXN2	9/2/14	0.035	U	0.035	37.3	BCUJ	12.2	0.21		0.050	0.14	BX	0.086	0.75	BXCUJ	0.19			

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-12	J1TXN0	9/2/14	20000		3.8	3.3		0.27	5020		3.7	324		0.099	0.0067	B	0.0050	0.26	U	0.26
Duplicate of J1TXN0	J1TXN1	9/2/14	19800		3.7	3.4		0.26	5110		3.6	297		0.097	0.0063	B	0.0060	0.25	U	0.25
EXC-1	J1TXL9	9/2/14	16800		3.5	5.9		0.25	4510		3.4	319		0.091	0.011	BM	0.0055	0.24	U	0.24
EXC-2	J1TXM0	9/2/14	16900		3.4	6.1		0.24	4660		3.3	340		0.090	0.012	B	0.0048	0.23	U	0.23
EXC-3	J1TXM1	9/2/14	17800		3.5	8.5		0.25	5870		3.4	378		0.091	0.0095	B	0.0054	0.24	U	0.24
EXC-4	J1TXM2	9/2/14	18500		3.4	8.0		0.24	5250		3.3	358		0.090	0.014	B	0.0049	0.36	B	0.23
EXC-5	J1TXM3	9/2/14	16500		3.8	84.3		0.27	4610		3.7	318		0.10	0.0095	B	0.0055	0.26	U	0.26
EXC-6	J1TXM4	9/2/14	14200		3.8	22.5		0.27	4120		3.7	272		0.099	0.0066	B	0.0048	0.26	U	0.26
EXC-7	J1TXM5	9/2/14	16200		3.6	13.0		0.26	4530		3.5	274		0.095	0.014	B	0.0062	0.25	U	0.25
EXC-8	J1TXM6	9/2/14	18300		3.7	3.3		0.26	4630		3.6	288		0.097	0.0075	B	0.0049	0.25	U	0.25
EXC-9	J1TXM7	9/2/14	15500		3.5	19.5		0.25	5050		3.4	295		0.091	0.0082	B	0.0047	0.24	U	0.24
EXC-10	J1TXM8	9/2/14	14600		3.5	26.5		0.25	4950		3.4	285		0.093	0.012	B	0.0063	0.24	U	0.24
EXC-11	J1TXM9	9/2/14	15700		3.4	6.7		0.24	4290		3.3	260		0.089	0.0092	B	0.0060	0.23	U	0.23
Split of J1TXN0	J1TXW2	9/2/14	23300		7.96	3.14	BD	1.64	4850		8.45	288		0.199	0.0040	U	0.0040	0.199	U	0.199
FS-1	J1T5W5	11/18/13	16000		3.5	35.9		0.25	4410		3.4	262		0.092	0.0067	U	0.0067	0.24	U	0.24
FS-2	J1TH02	3/25/14	16100		4.2	33.2		0.30	4380		4.1	318		0.11	0.047	M	0.0078	0.30	B	0.29
FS-3	J1TH03	3/25/14	13400		3.7	26.7		0.27	4000		3.6	229		0.099	0.0059	U	0.0059	0.26	U	0.26
FS-4	J1TH15	3/18/14	18200		3.8	6.1		0.27	4470		3.7	292		0.099	0.0061	U	0.0061	0.26	U	0.26
Equipment blank	J1TXN2	9/2/14	729		3.3	0.23	U	0.23	37.0		3.2	4.2		0.086	0.0050	U	0.0050	0.22	U	0.22

Attachment	1	Sheet No.	2 of 8
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0214	Rev. No.	0

Attachment 1. 100-H-28:4 Subsite Verification 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-12	J1TXN0	9/2/14	13.8	X	0.12	782		40.5	0.85	U	0.85	232	NJ	5.6	0.16	U	0.16	299		58.3
Duplicate of J1TXN0	J1TXN1	9/2/14	12.2	X	0.12	817		39.6	0.87	B	0.83	243	NJ	5.5	0.21		0.15	329		57.0
EXC-1	J1TXL9	9/2/14	11.0	X	0.11	1680		37.4	0.78	U	0.78	375	NJ	5.2	0.15	U	0.15	279		53.8
EXC-2	J1TXM0	9/2/14	11.9	X	0.11	1620		36.9	0.78	U	0.78	354	NJ	5.1	0.17	B	0.14	267		53.2
EXC-3	J1TXM1	9/2/14	20.8	X	0.11	1900		37.3	0.78	U	0.78	359	NJ	5.2	0.27		0.15	259		53.7
EXC-4	J1TXM2	9/2/14	12.9	X	0.11	2760		36.8	0.77	U	0.77	332	NJ	5.1	0.24		0.14	249		52.9
EXC-5	J1TXM3	9/2/14	11.7	X	0.12	1540		40.9	0.86	U	0.86	301	NJ	5.7	0.16	U	0.16	248		58.9
EXC-6	J1TXM4	9/2/14	10.4	X	0.12	1560		40.7	0.85	U	0.85	295	NJ	5.6	0.16	B	0.16	218		58.5
EXC-7	J1TXM5	9/2/14	11.0	X	0.12	1200		38.7	0.81	U	0.81	261	NJ	5.3	0.15	B	0.15	291		55.8
EXC-8	J1TXM6	9/2/14	10.2	X	0.12	854		39.7	0.83	U	0.83	228	NJ	5.5	0.19		0.15	318		57.1
EXC-9	J1TXM7	9/2/14	13.1	X	0.11	1290		37.3	0.78	U	0.78	284	NJ	5.2	0.28		0.15	271		53.7
EXC-10	J1TXM8	9/2/14	12.8	X	0.11	1230		38.2	0.80	U	0.80	297	NJ	5.3	0.15	U	0.15	276		55.0
EXC-11	J1TXM9	9/2/14	10.7	X	0.11	654		36.6	0.77	U	0.77	186	NJ	5.1	0.14	U	0.14	236		52.7
Split of J1TXN0	J1TXW2	9/2/14	11.9		0.149	713		6.36	0.329	DU	0.329	587		1.49	0.256	B	0.0994	192		6.96
FS-1	J1T5W5	11/18/13	11.3		0.11	1120		37.7	0.79	U	0.79	209	N	5.2	0.15	U	0.15	250		54.3
FS-2	J1TH02	3/25/14	11.5		0.14	1760		45.1	0.95	U	0.95	536	N	6.2	0.18	U	0.18	209		64.9
FS-3	J1TH03	3/25/14	10.5		0.12	785		40.4	0.85	U	0.85	188		5.6	0.16	U	0.16	251		58.1
FS-4	J1TH15	3/18/14	12.3		0.12	1270		40.7	0.85	U	0.85	305		5.6	0.16	U	0.16	220		58.6
Equipment blank	J1TXN2	9/2/14	0.56	BX	0.11	67.2	B	35.3	0.74	U	0.74	103	NJ	4.9	0.14	U	0.14	50.9	U	50.9

Location	HEIS Number	Sample Date	Vanadium			Zinc			Percent Moisture		
			mg/kg	Q	PQL	mg/kg	Q	PQL	%	Q	PQL
EXC-12	J1TXN0	9/2/14	58.9		0.093	44.3		0.39	1.8		0.10
Duplicate of J1TXN0	J1TXN1	9/2/14	57.2		0.091	43.4		0.38	1.5		0.10
EXC-1	J1TXL9	9/2/14	42.2		0.086	46.3		0.36	1.1		0.10
EXC-2	J1TXM0	9/2/14	42.7		0.085	46.6		0.36	0.92		0.10
EXC-3	J1TXM1	9/2/14	42.6		0.086	45.2		0.36	1.0		0.10
EXC-4	J1TXM2	9/2/14	42.6		0.084	47.5		0.36	1.3		0.10
EXC-5	J1TXM3	9/2/14	42.6		0.094	41.9		0.4	0.85		0.10
EXC-6	J1TXM4	9/2/14	38.3		0.093	37.4		0.39	1.2		0.10
EXC-7	J1TXM5	9/2/14	45.7		0.089	40.3		0.38	1.1		0.10
EXC-8	J1TXM6	9/2/14	49.9		0.091	39.4		0.39	0.65		0.10
EXC-9	J1TXM7	9/2/14	39.4		0.086	43.0		0.36	1.1		0.10
EXC-10	J1TXM8	9/2/14	38.4		0.088	47.6		0.37	0.67		0.10
EXC-11	J1TXM9	9/2/14	48.2		0.084	36.4		0.36	0.95		0.10
Split of J1TXN0	J1TXW2	9/2/14	75.9		0.0994	33.5		0.398			0.10
FS-1	J1T5W5	11/18/13	36.6		0.086	44.1	X	0.37	2.9		0.10
FS-2	J1TH02	3/25/14	33.9		0.10	39.9	X	0.44	16.6		0.10
FS-3	J1TH03	3/25/14	35.5		0.093	30.4	X	0.39	1.5		0.10
FS-4	J1TH15	3/18/14	41.5		0.093	37.9	X	0.40	8.4		0.10
Equipment blank	J1TXN2	9/2/14	0.66	B	0.081	1.2		0.34	0.10	U	0.10

Attachment	1	Sheet No.	3 of 8
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0214	Rev. No.	0

Attachment 1. 100-H-28:4 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TXN0			J1TXN1			J1TXW2			J1TXL9			J1TXM0			J1TXM1		
		EXC-12			Duplicate of J1TXN0			Split of J1TXN0			EXC-1			EXC-2			EXC-3		
		9/2/14			9/2/14			9/2/14			9/2/14			9/2/14			9/2/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q		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	1.12	U	1.12	2.8	U	2.8	2.7	U	2.7	2.8	U	2.8
Aroclor-1221	PCB	7.9	U	7.9	8.1	U	8.1	1.12	U	1.12	8.1	U	8.1	7.8	U	7.8	8.0	U	8.0
Aroclor-1232	PCB	2.0	U	2.0	2.0	U	2.0	1.12	U	1.12	2.0	U	2.0	1.9	U	1.9	2.0	U	2.0
Aroclor-1242	PCB	4.6	U	4.6	4.7	U	4.7	1.12	U	1.12	4.7	U	4.7	4.5	U	4.5	4.6	U	4.6
Aroclor-1248	PCB	4.6	U	4.6	4.7	U	4.7	1.12	U	1.12	4.7	U	4.7	4.5	U	4.5	4.6	U	4.6
Aroclor-1254	PCB	2.6	U	2.6	2.6	U	2.6	1.12	U	1.12	5.3	J	2.6	5.4	J	2.5	2.6	U	2.6
Aroclor-1260	PCB	2.6	U	2.6	3.1	J	2.6	3.59		1.12	2.6	U	2.6	2.5	U	2.5	9.1	J	2.6
Aroclor-1262	PCB							1.12	U	1.12									
Aroclor-1268	PCB							1.12	U	1.12									
Aldrin	PEST	0.25	U	0.25	0.24	U	0.24	0.169	U	0.169	0.25	U	0.25	0.25	U	0.25	0.25	U	0.25
Alpha-BHC	PEST	0.22	U	0.22	0.20	U	0.20	0.169	U	0.169	0.22	U	0.22	0.22	U	0.22	0.21	U	0.21
alpha-Chlordane	PEST	0.33	U	0.33	0.31	U	0.31	0.169	U	0.169	0.32	U	0.32	0.32	U	0.32	0.32	U	0.32
Beta-BHC	PEST	0.67	U	0.67	0.63	U	0.63	0.169	U	0.169	0.67	U	0.67	0.67	U	0.67	0.66	U	0.66
Delta-BHC	PEST	0.41	U	0.41	0.38	U	0.38	0.169	U	0.169	0.40	U	0.40	0.40	U	0.40	0.40	U	0.40
4-4'-DDD	PEST	0.55	U	0.55	0.52	U	0.52	0.337	U	0.337	0.55	U	0.55	0.55	U	0.55	0.54	U	0.54
4-4'-DDE	PEST	0.24	U	0.24	0.23	U	0.23	0.337	U	0.337	0.24	U	0.24	0.24	U	0.24	0.88	J	0.24
4-4'-DDT	PEST	0.60	U	0.60	0.56	U	0.56	0.337	U	0.337	0.59	U	0.59	0.59	U	0.59	0.58	U	0.58
Dieldrin	PEST	0.21	U	0.21	0.20	U	0.20	0.337	U	0.337	0.79	J	0.21	0.21	U	0.21	0.21	U	0.21
Endosulfan I	PEST	0.18	U	0.18	0.17	U	0.17	0.169	U	0.169	0.18	U	0.18	0.18	U	0.18	0.17	U	0.17
Endosulfan II	PEST	0.29	U	0.29	0.27	U	0.27	0.337	U	0.337	0.29	U	0.29	0.29	U	0.29	0.28	U	0.28
Endosulfan sulfate	PEST	0.28	U	0.28	0.26	U	0.26	0.337	U	0.337	0.28	U	0.28	0.28	U	0.28	0.27	U	0.27
Endrin	PEST	0.31	U	0.31	0.29	U	0.29	0.337	U	0.337	0.31	U	0.31	0.31	U	0.31	0.30	U	0.30
Endrin aldehyde	PEST	0.17	U	0.17	0.16	U	0.16	0.337	U	0.337	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17
Endrin ketone	PEST	0.49	U	0.49	0.47	U	0.47	0.337	U	0.337	0.49	U	0.49	0.49	U	0.49	0.48	U	0.48
Gamma-BHC (Lindane)	PEST	0.47	U	0.47	0.44	U	0.44	0.169	U	0.169	0.47	U	0.47	0.47	U	0.47	0.46	U	0.46
gamma-Chlordane	PEST	0.27	U	0.27	0.25	U	0.25	0.169	U	0.169	0.27	U	0.27	0.27	U	0.27	0.26	U	0.26
Heptachlor	PEST	0.22	U	0.22	0.20	U	0.20	0.169	U	0.169	0.22	U	0.22	0.22	U	0.22	0.21	U	0.21
Heptachlor epoxide	PEST	0.43	U	0.43	0.41	U	0.41	0.169	U	0.169	0.43	U	0.43	0.43	U	0.43	0.42	U	0.42
Methoxychlor	PEST	0.46	U	0.46	0.43	U	0.43	1.69	U	1.69	0.45	U	0.45	0.45	U	0.45	0.44	U	0.44
Toxaphene	PEST	16	UJ	16	15	UJ	15	5.61	UJ	5.61	16	UJ	16	16	UJ	16	16	UJ	16

Attachment	1	Sheet No.	4 of 8
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0214	Rev. No.	0

Attachment 1. 100-H-28:4 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TXM2			J1TXM3			J1TXM4			J1TXM5			J1TXM6			J1TXM7		
		EXC-4			EXC-5			EXC-6			EXC-7			EXC-8			EXC-9		
		9/2/14			9/2/14			9/2/14			9/2/14			9/2/14			9/2/14		
		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	2.6	U	2.6	2.8	U	2.8	2.8	U	2.8	2.8	U	2.8	2.7	U	2.7	2.7	U	2.7
Aroclor-1221	PCB	7.6	U	7.6	8.1	U	8.1	8.1	U	8.1	8.0	U	8.0	7.7	U	7.7	7.7	U	7.7
Aroclor-1232	PCB	1.9	U	1.9	2.0	U	2.0	2.0	U	2.0	2.0	U	2.0	1.9	U	1.9	1.9	U	1.9
Aroclor-1242	PCB	4.4	U	4.4	4.7	U	4.7	4.7	U	4.7	4.7	U	4.7	4.5	U	4.5	4.5	U	4.5
Aroclor-1248	PCB	4.4	U	4.4	4.7	U	4.7	4.7	U	4.7	4.7	U	4.7	4.5	U	4.5	4.5	U	4.5
Aroclor-1254	PCB	2.5	U	2.5	2.6	U	2.6	2.6	U	2.6	2.6	U	2.6	2.5	U	2.5	2.5	U	2.5
Aroclor-1260	PCB	61		2.5	2.6	U	2.6	2.6	U	2.6	20		2.6	2.5	U	2.5	2.5	U	2.5
Aroclor-1262	PCB																		
Aroclor-1268	PCB																		
Aldrin	PEST	0.25	U	0.25	0.25	U	0.25	0.25	U	0.25	0.24	U	0.24	0.25	U	0.25	0.24	U	0.24
Alpha-BHC	PEST	0.22	U	0.22	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21
alpha-Chlordane	PEST	0.33	U	0.33	0.32	U	0.32	0.32	U	0.32	0.31	U	0.31	0.32	U	0.32	0.31	U	0.31
Beta-BHC	PEST	0.67	U	0.67	0.65	U	0.65	0.65	U	0.65	0.65	U	0.65	0.66	U	0.66	0.64	U	0.64
Delta-BHC	PEST	0.40	U	0.40	0.39	U	0.39	0.39	U	0.39	0.39	U	0.39	0.40	U	0.40	0.39	U	0.39
4-4'-DDD	PEST	0.55	U	0.55	0.54	U	0.54	0.53	U	0.53	0.53	U	0.53	0.54	U	0.54	0.53	U	0.53
4-4'-DDE	PEST	1.1	J	0.24	0.23	U	0.23	0.23	U	0.23	0.23	U	0.23	0.24	U	0.24	0.23	U	0.23
4-4'-DDT	PEST	3.0	UD	3.0	0.58	U	0.58	0.58	U	0.58	0.57	U	0.57	0.59	U	0.59	0.57	U	0.57
Dieldrin	PEST	0.92	JX	0.21	0.21	U	0.21	0.21	U	0.21	0.20	U	0.20	0.21	U	0.21	0.20	U	0.20
Endosulfan I	PEST	0.18	U	0.18	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17	0.18	U	0.18	0.17	U	0.17
Endosulfan II	PEST	0.29	U	0.29	0.28	U	0.28	0.28	U	0.28	0.28	U	0.28	0.29	U	0.29	0.28	U	0.28
Endosulfan sulfate	PEST	0.28	U	0.28	0.27	U	0.27	0.27	U	0.27	0.27	U	0.27	0.28	U	0.28	0.27	U	0.27
Endrin	PEST	0.31	U	0.31	0.30	U	0.30	0.30	U	0.30	0.30	U	0.30	0.30	U	0.30	0.29	U	0.29
Endrin aldehyde	PEST	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17	0.16	U	0.16
Endrin ketone	PEST	0.49	U	0.49	0.48	U	0.48	0.48	U	0.48	0.48	U	0.48	0.49	U	0.49	0.47	U	0.47
Gamma-BHC (Lindane)	PEST	0.47	U	0.47	0.46	U	0.46	0.45	U	0.45	0.45	U	0.45	0.46	U	0.46	0.45	U	0.45
gamma-Chlordane	PEST	0.27	U	0.27	0.26	U	0.26	0.26	U	0.26	0.26	U	0.26	0.27	U	0.27	0.26	U	0.26
Heptachlor	PEST	0.22	U	0.22	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21	0.21	U	0.21
Heptachlor epoxide	PEST	0.43	U	0.43	0.42	U	0.42	0.42	U	0.42	0.41	U	0.41	0.42	U	0.42	0.41	U	0.41
Methoxychlor	PEST	2.3	UD	2.3	0.44	U	0.44	0.44	U	0.44	0.44	U	0.44	0.45	U	0.45	0.43	U	0.43
Toxaphene	PEST	16	UJ	16	16	UJ	16	15	UJ	15	15	UJ	15	16	UJ	16	15	UJ	15

Attachment	1	Sheet No.	5 of 8
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0214	Rev. No.	0

Attachment 1. 100-H-28:4 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1TXM8			J1TXM9			J1T5W5			J1TH02			J1TH03			J1TH15		
		EXC-10			EXC-11			FS-1			FS-2			FS-3			FS-4		
		9/2/14			9/2/14			11/18/13			3/25/14			3/25/14			3/18/14		
		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	2.6	U	2.6	2.6	U	2.6	2.8	U	2.8	6.5	UD	6.5	2.7	U	2.7	3.0	U	3.0
Aroclor-1221	PCB	7.5	U	7.5	7.6	U	7.6	8.0	U	8.0	19	UD	19	7.9	U	7.9	8.6	U	8.6
Aroclor-1232	PCB	1.9	U	1.9	1.9	U	1.9	2.0	U	2.0	4.7	UD	4.7	2.0	U	2.0	2.2	U	2.2
Aroclor-1242	PCB	4.4	U	4.4	4.4	U	4.4	4.7	U	4.7	11	UD	11	4.6	U	4.6	5.0	U	5.0
Aroclor-1248	PCB	4.4	U	4.4	4.4	U	4.4	4.7	U	4.7	11	UD	11	4.6	U	4.6	5.0	U	5.0
Aroclor-1254	PCB	2.4	U	2.4	2.5	U	2.5	2.6	U	2.6	6.1	UD	6.1	2.5	U	2.5	7.1	J	2.8
Aroclor-1260	PCB	3.9	J	2.4	2.5	U	2.5	2.6	U	2.6	270	DN	6.1	2.5	U	2.5	2.8	U	2.8
Aroclor-1262	PCB																		
Aroclor-1268	PCB																		
Aldrin	PEST	0.24	U	0.24	0.24	U	0.24	0.25	U	0.25	0.30	U	0.30	0.25	U	0.25	0.27	U	0.27
Alpha-BHC	PEST	0.21	U	0.21	0.20	U	0.20	0.21	U	0.21	0.25	U	0.25	0.21	U	0.21	0.23	U	0.23
alpha-Chlordane	PEST	0.31	U	0.31	0.31	U	0.31	0.32	U	0.32	0.38	U	0.38	0.32	U	0.32	0.34	U	0.34
Beta-BHC	PEST	0.64	U	0.64	0.63	U	0.63	0.66	UN	0.66	0.79	U	0.79	0.66	U	0.66	0.71	U	0.71
Delta-BHC	PEST	0.39	U	0.39	0.38	U	0.38	0.40	U	0.40	0.48	U	0.48	0.40	U	0.40	0.43	U	0.43
4-4'-DDD	PEST	0.53	U	0.53	0.52	U	0.52	0.54	U	0.54	0.65	U	0.65	0.54	U	0.54	0.58	U	0.58
4-4'-DDE	PEST	0.23	U	0.23	0.23	U	0.23	0.24	U	0.24	0.28	U	0.28	0.24	U	0.24	0.25	U	0.25
4-4'-DDT	PEST	0.57	U	0.57	0.56	U	0.56	0.59	U	0.59	4.6	X	0.70	0.58	U	0.58	0.63	U	0.63
Dieldrin	PEST	0.20	U	0.20	0.20	U	0.20	0.21	U	0.21	0.25	U	0.25	0.21	U	0.21	0.22	U	0.22
Endosulfan I	PEST	0.17	U	0.17	0.17	U	0.17	0.17	U	0.17	0.21	U	0.21	0.17	U	0.17	0.19	U	0.19
Endosulfan II	PEST	0.28	U	0.28	0.27	U	0.27	0.29	UN	0.29	0.34	U	0.34	0.28	U	0.28	0.31	U	0.31
Endosulfan sulfate	PEST	0.27	U	0.27	0.26	U	0.26	0.27	UN	0.27	0.33	U	0.33	0.27	U	0.27	0.29	U	0.29
Endrin	PEST	0.30	U	0.30	0.29	U	0.29	0.30	U	0.30	0.36	U	0.36	0.30	U	0.30	0.33	U	0.33
Endrin aldehyde	PEST	0.17	U	0.17	0.16	U	0.16	0.17	UN	0.17	0.20	U	0.20	0.17	U	0.17	0.18	U	0.18
Endrin ketone	PEST	0.47	U	0.47	0.47	U	0.47	0.49	UN	0.49	0.58	U	0.58	0.48	U	0.48	0.52	U	0.52
Gamma-BHC (Lindane)	PEST	0.45	U	0.45	0.44	U	0.44	0.46	U	0.46	0.55	U	0.55	0.46	U	0.46	0.49	U	0.49
gamma-Chlordane	PEST	0.26	U	0.26	0.25	U	0.25	0.26	U	0.26	0.32	U	0.32	0.26	U	0.26	0.28	U	0.28
Heptachlor	PEST	0.21	U	0.21	0.20	U	0.20	0.21	U	0.21	0.25	U	0.25	0.21	U	0.21	0.23	U	0.23
Heptachlor epoxide	PEST	0.41	U	0.41	0.41	U	0.41	0.42	U	0.42	0.51	U	0.51	0.42	U	0.42	0.45	U	0.45
Methoxychlor	PEST	0.44	U	0.44	0.43	U	0.43	0.45	UN	0.45	1.1	JX	0.53	0.44	U	0.44	0.48	U	0.48
Toxaphene	PEST	15	UJ	15	15	UJ	15	16	U	16	19	U	19	16	U	16	17	U	17

Attachment	1	Sheet No.	6 of 8
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0214	Rev. No.	0

Attachment 1. 100-H-28:4 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1T5W5			J1TH02			J1TH03			J1TH15		
		FS-1			FS-2			FS-3			FS-4		
		11/18/13			3/25/14			3/25/14			3/18/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	28	U	28	33	U	33	27	U	27	30	U	30
1,2-Dichlorobenzene	SVOA	22	U	22	26	U	26	21	U	21	23	U	23
1,3-Dichlorobenzene	SVOA	12	U	12	14	U	14	12	U	12	13	U	13
1,4-Dichlorobenzene	SVOA	14	U	14	16	U	16	13	U	13	14	U	14
2,4,5-Trichlorophenol	SVOA	10	U	10	12	U	12	9.8	U	9.8	11	U	11
2,4,6-Trichlorophenol	SVOA	10	U	10	12	U	12	9.8	U	9.8	11	U	11
2,4-Dichlorophenol	SVOA	10	U	10	12	U	12	9.8	U	9.8	11	U	11
2,4-Dimethylphenol	SVOA	67	U	67	77	U	77	64	U	64	70	U	70
2,4-Dinitrophenol	SVOA	340	U	340	390	U	390	320	UX	320	350	UX	350
2,4-Dinitrotoluene	SVOA	67	U	67	77	U	77	64	U	64	70	U	70
2,6-Dinitrotoluene	SVOA	28	U	28	33	U	33	27	U	27	30	U	30
2-Chloronaphthalene	SVOA	10	U	10	12	U	12	9.8	U	9.8	11	U	11
2-Chlorophenol	SVOA	21	U	21	25	U	25	20	U	20	22	U	22
2-Methylnaphthalene	SVOA	19	U	19	22	U	22	19	U	19	20	U	20
2-Methylphenol (cresol, o-)	SVOA	13	U	13	15	U	15	13	U	13	14	U	14
2-Nitroaniline	SVOA	51	U	51	59	U	59	49	U	49	53	U	53
2-Nitrophenol	SVOA	10	U	10	12	U	12	9.8	U	9.8	11	U	11
3,3'-Dichlorobenzidine	SVOA	91	U	91	110	U	110	88	U	88	96	U	96
3+4 Methylphenol (cresol, m+p)	SVOA	34	U	34	39	U	39	32	U	32	35	U	35
3-Nitroaniline	SVOA	74	U	74	86	U	86	71	U	71	78	U	78
4,6-Dinitro-2-methylphenol	SVOA	340	U	340	390	U	390	320	U	320	350	UX	350
4-Bromophenylphenyl ether	SVOA	19	U	19	22	U	22	19	U	19	20	U	20
4-Chloro-3-methylphenol	SVOA	67	U	67	77	U	77	64	U	64	70	U	70
4-Chloroaniline	SVOA	83	U	83	96	U	96	80	U	80	87	U	87
4-Chlorophenylphenyl ether	SVOA	21	U	21	25	U	25	20	U	20	22	U	22
4-Nitroaniline	SVOA	74	U	74	85	U	85	71	U	71	77	U	77
4-Nitrophenol	SVOA	99	U	99	110	U	110	95	U	95	100	U	100
Acenaphthene	SVOA	10	U	10	12	U	12	10	U	10	11	U	11
Acenaphthylene	SVOA	17	U	17	20	U	20	17	U	17	18	U	18
Anthracene	SVOA	17	U	17	20	U	20	17	U	17	18	U	18

Attachment	1	Sheet No.	7 of 8
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0214	Rev. No.	0

Attachment 1. 100-H-28:4 Subsite Verification Sample Results (Organics).

CONSTITUENT	CLASS	J1T5W5			J1TH02			J1TH03			J1TH15		
		FS-1			FS-2			FS-3			FS-4		
		11/18/13			3/25/14			3/25/14			3/18/14		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Benzo(a)anthracene	SVOA	20	U	20	23	U	23	20	U	20	21	U	21
Benzo(a)pyrene	SVOA	20	U	20	23	U	23	20	U	20	21	U	21
Benzo(b)fluoranthene	SVOA	27	U	27	31	U	31	26	U	26	28	U	28
Benzo(ghi)perylene	SVOA	16	U	16	19	U	19	16	U	16	17	U	17
Benzo(k)fluoranthene	SVOA	41	U	41	47	U	47	39	U	39	43	U	43
Bis(2-chloro-1-methylethyl)ether	SVOA	23	U	23	27	U	27	22	U	22	24	U	24
Bis(2-Chloroethoxy)methane	SVOA	23	U	23	27	U	27	22	U	22	24	U	24
Bis(2-chloroethyl) ether	SVOA	17	U	17	19	U	19	16	U	16	18	U	18
Bis(2-ethylhexyl) phthalate	SVOA	47	U	47	54	U	54	45	U	45	49	U	49
Butylbenzylphthalate	SVOA	44	U	44	50	U	50	42	U	42	46	U	46
Carbazole	SVOA	37	U	37	42	U	42	35	U	35	38	U	38
Chrysene	SVOA	27	U	27	32	U	32	26	U	26	29	U	29
Dibenz[a,h]anthracene	SVOA	19	U	19	22	U	22	19	U	19	20	U	20
Dibenzofuran	SVOA	20	U	20	23	U	23	20	U	20	21	U	21
Diethyl phthalate	SVOA	26	U	26	30	U	30	25	U	25	28	U	28
Dimethyl phthalate	SVOA	56	JB	23	27	U	27	22	U	22	24	U	24
Di-n-butylphthalate	SVOA	29	U	29	34	U	34	28	U	28	31	U	31
Di-n-octylphthalate	SVOA	15	U	15	17	U	17	14	U	14	15	U	15
Fluoranthene	SVOA	37	U	37	42	U	42	35	U	35	38	U	38
Fluorene	SVOA	18	U	18	21	U	21	18	U	18	19	U	19
Hexachlorobenzene	SVOA	29	U	29	34	U	34	28	U	28	31	U	31
Hexachlorobutadiene	SVOA	10	U	10	12	U	12	9.8	U	9.8	11	U	11
Hexachlorocyclopentadiene	SVOA	51	U	51	59	U	59	49	U	49	53	UX	53
Hexachloroethane	SVOA	22	U	22	25	U	25	21	U	21	23	U	23
Indeno(1,2,3-cd)pyrene	SVOA	22	U	22	26	U	26	21	U	21	23	U	23
Isophorone	SVOA	17	U	17	20	U	20	17	U	17	18	U	18
Naphthalene	SVOA	32	U	32	36	U	36	30	U	30	33	U	33
Nitrobenzene	SVOA	22	U	22	26	U	26	21	U	21	23	U	23
N-Nitroso-di-n-dipropylamine	SVOA	32	U	32	36	U	36	30	U	30	33	U	33
N-Nitrosodiphenylamine	SVOA	21	U	21	25	U	25	20	U	20	22	U	22
Pentachlorophenol	SVOA	340	U	340	390	U	390	320	U	320	350	U	350
Phenanthrene	SVOA	17	U	17	20	U	20	17	U	17	18	U	18
Phenol	SVOA	18	U	18	21	U	21	18	U	18	19	U	19
Pyrene	SVOA	20	J	12	35	J	14	12	U	12	13	U	13

Attachment	1	Sheet No.	8 of 8
Originator	R. J. Nielson	Date	11/3/14
Checked	I. B. Berezovskiy	Date	11/3/14
Calc. No.	0100H-CA-V0214	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0215

Subject: 100-H-28:4 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 = 3 Total = 4	R. J. Nielson	I. B. Berezovskiy	J. D. Skoglie	S. G. Wilkinson	2/17/15

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:	11/17/14	Calc. No.:	0100H-CA-V0215	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/17/14
Subject:	100-H-28:4 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	1 of 3

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 100-H-28:4 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-H-28:4 Subsite Cleanup Verification 95% UCL Calculations*, 0100H-CA-V0216 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:	11/17/14	Calc. No.:	0100H-CA-V0215	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/17/14
Subject:	100-H-28:4 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	2 of 3

METHODOLOGY:

The 100-H-28:4 subsite is comprised of one decision unit for verification sampling, consisting of the excavation area. Additionally, four focused samples were collected. The direct contact hazard quotient and carcinogenic risk calculations for the 100-H-28:4 subsite were conservatively calculated for the entire subsite using the greater of the statistical or maximum value for each analyte in the excavation decision unit and focused samples from WCH (2014). Of the contaminants of potential concern (COPCs) for this site, boron, hexavalent chromium, molybdenum, aroclor-1254, aroclor-1260, DDE, DDT, dieldrin, methoxychlor, dimethyl phthalate, and pyrene require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Selenium was included because it was detected above the Hanford Site background value. Lead was detected above background; however, lead does not have a reference dose for calculation of a hazard quotient because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake. Additionally, arsenic was detected bove background; however, the arsenic standard is not toxicity based. All other site nonradionuclide COPCs were either undetected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 6.8 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 9.4×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation. The sum of the HQ values is 1.1×10^{-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 maximum value for hexavalent chromium is 0.435 mg/kg; divided by 2.1 mg/kg, and multiplied as indicated, is 2.1×10^{-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 7.8×10^{-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 RJN	Date:	11/17/14	Calc. No.:	0100H-CA-V0215	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy IBB	Date:	11/17/14
Subject:	100-H-28:4 Subsite Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	3 of 3

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 100-H-28:4 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					
Arsenic[c]	11.5	20	--	--	--
Boron	6.8	7,200	9.4E-04	--	--
Chromium, hexavalent[d]	0.435	240	1.8E-03	2.1	2.1E-07
Lead[e]	37.3	353	--	--	--
Molybdenum	0.36	400	9.0E-04	--	--
Selenium	0.87	400	2.2E-03	--	--
Semivolatiles					
Dimethylphthalate	0.056	80,000	7.0E-07	--	--
Pyrene	0.035	2,400	1.5E-05	--	--
Pesticides					
DDE, 4,4'-	0.0011	--	--	2.94	3.7E-10
DDT, 4,4'-	0.0046	40	1.2E-04	2.94	1.6E-09
Dieldrin	0.00092	4	2.3E-04	0.0625	1.5E-08
Methoxychlor	0.0011	400	2.8E-06	--	--
Polychlorinated Biphenyls					
Aroclor-1254	0.0071	1.6	4.4E-03	0.5	1.4E-08
Aroclor-1260	0.270	--	--	0.5	5.4E-07
Totals					
Cumulative Hazard Quotient:			**1.1E-02**		
Cumulative Excess Cancer Risk:					**7.8E-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] = The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009a).

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

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

-- = not applicable

RAG = remedial action goal

CONCLUSION:

The calculations in Table 1 demonstrate that the 100-H-28:4 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-H Area Closure Operations **Job No. 14655**

Area: 100-H

Discipline: Environmental *Calculation No: 0100H-CA-V0216

Subject: 100-H-28:4 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. Berezovskiy	J. D. Skoglie	S. G. Wilkinson	2/17/15

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 RJN	Date:	11/13/2014	Calc. No.:	0100H-CA-V0216	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/13/2014
Subject:	100-H-28:4 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-H-28:4 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-H-28:4 Subsite Cleanup Verification 95% UCL Calculations*, 0100H-CA-V0214, 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 RJN	Date:	11/13/2014	Calc. No.:	0100H-CA-V0216	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy IBB	Date:	11/13/2014
Subject:	100-H-28:4 Subsite Hazard Quotient and Carcinogenic Risk Calculation for Protection of Groundwater					Sheet No. 2 of 3	

METHODOLOGY:

The 100-H-28:4 subsite consists of one decision unit for the purpose of verification sampling; specifically, the excavation area. Additionally, four focused samples were collected. The hazard quotient and carcinogenic risk calculations for potential impact to groundwater at the 100-H-28:4 subsite were conservatively calculated for the entire subsite using the greater of the statistical or maximum value for each analyte in the excavation area decision unit and focused sample from the 95% UCL calculation (WCH 2014). Of the contaminants of potential concern (COPCs) for this site, boron, hexavalent chromium, selenium, and dimethyl phthalate 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). Arsenic was detected above background; however, the arsenic standard is not toxicity based. Based on this model and a vadose zone of approximately 6 m (20 ft) thickness, a K_d of 12 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 12. An example of the HQ and risk calculations for soil constituents with a potential impact to groundwater is presented below:

1) The hazard quotient is defined as the ratio of the dose of a substance obtained over a specified time (mg/kg/day) to a reference dose for the same substance derived over the same specified time (mg/kg/day). The hazard quotient can also be calculated as the ratio of the concentration in soil (maximum or statistical value) (mg/kg) to the soil RAG (mg/kg) for protection of groundwater, where the RAG is the groundwater cleanup level (mg/L) (calculated with, and related to the hazard quotient through, WAC 173-340-720(3)(a)(ii)(A), 1996) x 100 x 1 mg/1000 mg (conversion factor). This is based on the "100 times rule" of WAC 173-340-740(3)(a)(ii)(A) (1996). For example, the maximum value for boron of 6.8 mg/kg, divided by the noncarcinogenic RAG value of 320 mg/kg is 2.1×10^{-2}. Comparing this value to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The cumulative HQ for the 100-H-28:4 subsite is 2.9×10^{-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-H-28:4 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	Date:	11/13/2014	Calc. No.:	0100H-CA-V0216	Rev.:	0
Project:	100-H Area Closure Operations	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/13/2014
Subject:	100-H-28:4 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-H-28:4 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					
Arsenic	11.5	20[c]	--	--	--
Boron	6.8	320	2.1E-02	--	--
Chromium, hexavalent	0.435	4.8	9.1E-02	--	--
Selenium	0.87	5	1.7E-01	--	--
Semivolatiles					
Dimethylphthalate	0.056	1,600	3.5E-05	--	--
Totals					
Cumulative Hazard Quotient:			**2.9E-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.

[c] = The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project Managers as discussed in Section 2.1.2.1 of the RDR/RAWP (DOE-RL 2009). The arsenic standard is not toxicity based, therefore, will not have a hazard quotient calculated.

-- = not applicable

RAG = remedial action goal

CONCLUSION:

This calculation demonstrates that the 100-H-28:4 subsite meets the requirements for the hazard quotient and excess carcinogenic risk for protection of groundwater as identified in the RDR/RAWP (DOE-RL 2009).

APPENDIX D

DATA QUALITY ASSESSMENT

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DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2014b). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP) (DOE-RL 2009).

A review of the sample design (WCH 2014b), the field logbooks (WCH 2013, 2014a), and applicable analytical data packages has been performed as part of this DQA. To ensure quality data, the 100 Area SAP (DOE-RL 2009) 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 sample data collected at the 100-H-28:4 subsite were provided by the laboratory in five sample delivery groups (SDGs): SDG JP0856, SDG XP0125, SDG J02122, SDG J02114, and SDG JP0661. The SDG JP0856 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 100-H-28:4 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 JP0856

This SDG comprises 12 statistical soil samples (J1TXL9, J1TXM0 through J1TXM9, and J1TXN0) from the 100-H-28:4 subsite excavation area. This SDG includes one field duplicate pair (J1TXN0/J1TXN1). These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, polychlorinated biphenyls (PCBs), and pesticides. In addition, one field equipment blank (J1TXN2) was collected and analyzed for ICP metals and mercury. SDG JP0856 was submitted for third-party validation. Minor deficiencies are as follows.

In the ICP metals analysis, the matrix spike (MS) recoveries are out of project acceptance criteria for five analytes (aluminum [1,800%], antimony [39%], iron [2,157%], manganese [193%], and silicon [5%]). 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. All antimony and silicon results for SDG JP0856 were qualified as estimated with "J" flags by third-party validation. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory control sample (LCS) recovery for silicon was below the project recovery limit at 9%. All silicon results in SDG JP0856 were qualified as estimated with "J" flags by third-party validation. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, calcium and copper were detected in the method blank (MB). Third-party validation qualified all detected calcium and cadmium results in sample J1TXN2 as undetected with "UJ" flags. Data are usable for decision-making purposes.

In the pesticides analysis, all of the toxaphene data in SDG JP0856 was qualified by third-party validation as estimated with "J" flags due to lack of an MS, matrix spike duplicate (MSD), and LCS analysis. Estimated or "J"-flagged data are acceptable for decision-making purposes.

SDG XP0125

This SDG comprises one statistical soil sample (J1TXW2) from the excavation decision unit. Field sample J1TXW2 is a split sample associated with J1TXN0. This sample was analyzed for ICP metals, mercury, hexavalent chromium, PCBs, and pesticides. Minor deficiencies are as follows.

In the ICP metals analysis, the laboratory duplicate relative percent difference (RPD) for lead (42.1%) and silver (49.1%) are above the acceptance criteria of 30%. Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. Although not qualified for the RPD above the quality control (QC) limits, all lead and silver data results in SDG XP0125 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, zinc was detected in the MB at very low levels, less than 1/20th of the associated field sample result. Although not qualified for the MB contamination, zinc data for SDG XP0125 may be considered estimated. Estimated data are usable for decision-making purposes.

In the pesticides analysis, due to lack of an MS, MSD, and LCS analysis, all of the toxaphene data in SDG XP0125 may be considered estimated. Estimated data are acceptable for decision-making purposes.

SDG J02122

This SDG comprises two focused soil samples (J1TH02 and J1TH03) from the 100-H-28:4 subsite power pole support guy wire area (FS-3 and FS-4). These samples were analyzed for

ICP metals, mercury, hexavalent chromium, PCBs, pesticides, and semivolatile organic compounds (SVOCs). Minor deficiencies are as follows.

In the SVOC analysis, the LCS recovery for 4-chloroanaline is below the project recovery limit at 46%. All 4-chloroanaline data in SDG J02122 may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the MS and MSD recoveries for 4-chloroanililne (48%, 48%) and 2,4-dinitrophenol (44%, 48%) are below the project recovery limits. LCS recovery for 2,4 dinitrophenol is within the acceptable project control limits. Although not qualified for the MS and MSD recoveries outside the QC limits, all 4-chloroanililne and 2,4-dinitrophenol data for SDG J02122 may be considered estimated. Estimated data are usable for decision-making purposes.

In the pesticides analysis, due to lack of an MS, MSD, and LCS analysis, all of the toxaphene data in SDG J02122 may be considered estimated. Estimated data are acceptable for decision-making purposes.

In the ICP metals analysis, zinc was detected in the MB at very low levels, less than 1/20th of the associated field sample result. Although not qualified for the MB contamination, all zinc data for SDG J02122 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon was below the project recovery limit at 16%. Silicon is not a contaminant of potential concern (COPC) for the 100-H-28:4 subsite nor is it a regulated compound under the *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup." Although not qualified for LCS recovery outside the QC limits, all silicon results in SDG J02122 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for five analytes (aluminum [1,361%], antimony [54%], iron [1,802%], manganese [170%], and silicon [12%]). For aluminum, manganese, and iron analytes 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 concentrations 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 results outside the QC limits, all antimony and silicon results for SDG J02122 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J02114

This SDG comprises one focused soil sample (J1TH15) from the 100-H-28:4 subsite road crossing area (FS-4). This sample was analyzed for ICP metals, mercury, hexavalent chromium, PCBs, pesticides, and SVOCs. Minor deficiencies are as follows.

In the SVOC analysis, the LCS recovery for 3,3'-dichlorobenzidine is below the project recovery limit at 48%. The MS and MSD recoveries for 3,3'-dichlorobenzidine are within the acceptable project recovery limits. Although not qualified for LCS recoveries outside the QC limits, all 3,3'-dichlorobenzidine data in SDG J02114 may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the MS and MSD recoveries were below the project acceptance criteria for the following analytes: 4-chloroanililne (46%, 48%), 4,6-dinitro-2-methylphenol (44%, 43%), 2,4-dinitrophenol (31%, 32%), and hexachlorocyclopentadiene (46%, 44%). Laboratory control sample recoveries for the listed analytes are within the acceptable project control limits. Although not qualified for MS and MSD recoveries outside the QC limits, all 4-chloroanililne, 4,6-dinitro-2-methylphenol, 2,4-dinitrophenol, and hexachlorocyclopentadiene results in SDG J02114 may be considered estimated. Estimated data are usable for decision-making purposes.

In the pesticides analysis, due to lack of an MS, MSD, and LCS analysis, all of the toxaphene data in SDG J02114 may be considered estimated. Estimated data are acceptable for decision-making purposes.

In the ICP metals analysis, zinc was detected in the MB at very low levels, less than 1/20th of the associated field sample result. Although not qualified for the MB contamination, all zinc data for SDG J02114 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon was below the project recovery limit at 25%. Silicon is not a COPC for the 100-H-28:4 subsite nor is it a regulated compound under the WAC 173-340. Although not qualified for LCS recovery outside the QC limits, all silicon results in SDG J02114 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for four analytes (aluminum [905%], antimony [64%], iron [259%], and silicon [32%]). For aluminum and iron analytes, 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 concentrations 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 results outside the QC limits, all antimony and silicon results for SDG J02114 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG JP0661

This SDG comprises one focused soil sample (J1T5W5) from the 100-H-28:4 subsite road crossing area (FS-1). This sample was analyzed for ICP metals, mercury, hexavalent chromium, PCBs, pesticides, and SVOCs. Minor deficiencies are as follows.

In the SVOC analysis, dimethyl phthalate was detected in the MB at low levels, less than 1/25th of the most stringent cleanup limit. Although not qualified for MB contamination, all dimethyl phthalate results for SDG JP0661 may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOC analysis, the MS recoveries were below the project acceptance criteria for the following analytes: 4-chloroanililne (47%) and 2,4-dinitrophenol (47%). LCS recoveries for the listed analytes are within the acceptable project control limits. Although not qualified for MS recoveries outside the QC limits, all 4-chloroanililne and 2,4-dinitrophenol results in SDG JP0661 may be considered estimated. Estimated data are usable for decision-making purposes.

In the pesticides analysis, due to lack of an MS, MSD, and LCS analysis, all of the toxaphene data in SDG JP0661 may be considered estimated. Estimated data are acceptable for decision-making purposes.

In the pesticides analysis, the MS and MSD duplicate RPD for endosulfan I (59%), endosulfan II (79%), endrin aldehyde (43%), endrin ketone (43%), and methoxychlor (62%) are above the acceptance criteria of 30%. Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. Although not qualified for the RPD above the QC limits, all endosulfan I, endosulfan II, endrin aldehyde, endrin ketone, and methoxychlor data results in SDG JP0661 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, barium, iron, manganese, and zinc were detected in the MB at very low levels, less than 1/20th of the associated field sample result. Although not qualified for the MB contamination, all barium, iron, manganese, and zinc data for SDG JP0661 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon was below the project recovery limit at 7%. Silicon is not a COPC for the 100-H-28:4 subsite nor is it a regulated compound under the WAC 173-340. Although not qualified for LCS recovery outside the QC limits, all silicon results in SDG JP0661 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for five analytes (aluminum [1,605%], antimony [53%], iron [1,691%], manganese [193%], and silicon [15%]). For aluminum, manganese, and iron analytes, 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 concentrations 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 results outside the QC limits, all antimony and silicon results for SDG JP0661 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 logbooks (WCH 2013a, 2014), are shown in Table D-1. The main and QA/QC sample results are presented in Appendix C.

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

Sample Area	Main Sample	Duplicate Sample	Split Sample
Excavation area	J1TXN0	J1TXN1	J1TXW2

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 COPC. Relative percent differences are not calculated for analytes that are not detected in both the main and duplicate sample at more than five times the target detection limit. Relative percent differences of analytes detected at low concentrations (less than five times the detection limit) are not considered to be indicative of the analytical system performance. The calculation brief in Appendix C provides details on duplicate pair evaluation and RPD calculation.

Field split samples are used to determine systematic differences (bias) between laboratories. A statistical determination of systematic differences would require larger data sets than are presented here. Such a determination is complicated by variability introduced by the natural heterogeneities inherent in field soil samples and the analytical variability that each individual laboratory experiences. Therefore, when evaluating limited field split data relatively large RPDs are expected. No major deficiencies in the RPD calculations were found for the split sample. Minor deficiencies for the field duplicates and split samples are as follows.

None of the duplicate RPDs calculated for 100-H-28:4 data set are above the duplicate acceptance criteria of 30%. In the split evaluation, the RPD calculated for silicon (86.7%) is above the field split acceptance criteria (less than 35%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneity in the sample matrix. The data are usable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than five times the target detection limit. In these cases, a control limit of ±2 times the target detection limit is used (Appendix C) to indicate that a visual check of the data is required by the reviewer. In the duplicate analysis, aluminum, antimony,

barium, calcium, iron, magnesium, manganese, silicon, sodium, strontium, vanadium, and zinc required this check. In the split analysis, aluminum, antimony, barium, beryllium, calcium, chromium, cobalt, iron, magnesium, manganese, silicon, sodium, strontium, vanadium, zinc, and zirconium required this check. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are usable for decision-making purposes.

Summary

Limited, random, or sample matrix-specific influenced batch QC issues, such as those discussed above, are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-H-28:4 subsite verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for 100-H-28:4 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 Environmental Restoration project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification sample analytical data are also summarized in Appendix C.

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