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

14-AMRP-0103

FEB 04 2014

Mr. D. A. Faulk, Program Manager
Office of Environmental Cleanup
Hanford Project Office
U.S. Environmental Protection Agency
309 Bradley Boulevard, Suite 115
Richland, Washington 99352

Dear Mr. Faulk:

TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM AND SUPPORTING DOCUMENTATION FOR THE 600-301, WHITE BLUFFS SANITARY SEWER PIPELINES WASTE SITE, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2013-129, and supporting, "Remaining Sites Verification Package for the 600-301, White Bluffs Sanitary Sewer Pipelines Waste Site," Rev. 0. If you have questions, please contact me or your staff may contact Ellwood Glossbrenner, of my staff, at (509) 376-5828.

Sincerely,

Mark S. French, Federal Project Director
for the River Corridor Closure Project

AMRC:ETG

Attachment

cc w/attach:
C. J. Guzzetti, EPA
Administrative Record, H6-08

cc w/o attach:
S. L. Feaster, WCH
T. Q. Howell, WCH
D. L. Plung, WCH
C. P. Strand, WCH

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-IU-2 **Control No.:** 2013-129

Waste Site Code(s)/Subsite Code(s):

600-301, White Bluffs Sanitary Sewer Pipelines

Reclassification Category: Interim ☒ Final ☐

Reclassification Status: Closed Out ☒ No Action ☐ Rejected ☐

RCRA Postclosure ☐ Consolidated ☐ None ☐

Approvals Needed: DOE ☒ Ecology ☐ EPA ☒

Description of current waste site condition:

The 600-301, White Bluffs Sanitary Sewer Pipelines waste site is located in the 100-IU-2 Operable Unit of the Hanford Site and consisted of the sanitary sewer system that served the White Bluffs shop area. The shop area consisted of warehouses and construction shops. The 600-301 waste site was identified as a candidate site for confirmatory sampling in the *Explanation of Significant Difference for the 100 Area Remaining Sites Interim Action Record of Decision, Hanford Site, Benton County, Washington* (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 2009), and 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), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 1999). Confirmatory sampling of the site was conducted in October and November 2010. Based on the results of confirmatory sampling, part of the 600-301 waste site was identified for remove, treat, and dispose (RTD).

Remediation of the 600-301 waste site occurred between April 22 and June 20, 2013. Approximately 963 bank cubic meters (1,260 bank cubic yards) of rock, gravel, and pipe were removed from the 600-301 waste site and disposed at the Environmental Restoration Disposal Facility (ERDF).

Cleanup verification sampling was performed on September 5, 2013, to determine if the waste site meets remedial action objectives (RAOs) and remedial action goals (RAGs) established by the Remaining Sites ROD (EPA 1999) and 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, Washington (DOE-RL 2009b). 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 at the 200 Area of the Hanford Site, (3) demonstrating through verification sampling that cleanup goals have been achieved, and (4) proposing the site for reclassification as Interim Closed Out.

Basis for reclassification:

Cleanup verification sampling results were evaluated in comparison to the RAGs. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-301 waste site to Interim Closed Out. The current site conditions achieve the RAOs and RAGs established by the Remaining Sites ROD (EPA 1999) and the 100 Area RDR/RAWP (DOE-RL 2009b). The results of verification sampling 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 analytical results and rationale presented in the attached remaining sites verification package also demonstrate that residual contaminant concentrations meet direct exposure cleanup criteria and are protective of groundwater and the Columbia River. Contamination above direct exposure levels was not observed in the shallow zone soils and is concluded to not exist in deep zone soils (i.e., below 4.6 m [15 ft] deep). 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 600-301, White Bluffs Sanitary Sewer Pipelines Waste Site* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-IU-2 **Control No.:** 2013-129

Waste Site Code(s)/Subsite Code(s):

600-301, White Bluffs Sanitary Sewer Pipelines

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		1/14/14
DOE Federal Project Director (printed)	Signature	Date
N/A		
Ecology Project Manager (printed)	Signature	Date
C. Guzzetti		1/16/14
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-301, WHITE BLUFFS SANITARY SEWER PIPELINES WASTE SITE

Attachment to Waste Site Reclassification Form 2013-129

January 2014

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-301, WHITE BLUFFS SANITARY SEWER PIPELINES WASTE SITE

EXECUTIVE SUMMARY

The 600-301 waste site is part of the 100-IU-2 Operable Unit. The 600-301 waste site consisted of the sanitary sewer pipeline system that served the White Bluffs shop area, underlying soils, and several suspected related features. The shop area included warehouses and construction shops.

The 600-301 waste site was added to the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999) as a candidate site for confirmatory sampling in accordance with the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington* (100 Area ESD) (EPA 2009).

Following confirmatory sampling, part of the 600-301 waste site was recommended for remove, treat, and dispose (RTD) due to the presence of residual contamination that required remediation (WCH 2011). The remainder of the 600-301 waste site will be interim closed without further remedial action and based on the confirmatory sampling.

Remediation of the 600-301 waste site occurred between April 22 and June 20, 2013. Approximately 963 bank cubic meters (1,260 bank cubic yards) of rock, gravel, and pipe were removed and disposed at the Environmental Restoration Disposal Facility (ERDF).

Following remediation, verification sampling for the remediated portion of 600-301 waste site was conducted on September 5, 2013. The results of verification sampling indicated that residual contaminant concentrations met the remedial action objectives (RAOs) and remedial action goals (RAGs) for the 600-301 waste site. Verification sampling results support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999). The results indicate that the waste removal action has achieved compliance with the RAOs and RAGs for the 600-301 waste site.

A summary of the 600-301 waste site based on the passing confirmatory data and the verification data collected from the remediated area compared to the applicable cleanup criteria is presented in Table ES-1. The results of the verification sampling are used to make reclassification decisions for the waste site in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011).

Table ES-1. Summary of Remedial Action Goals for the 600-301 Waste Site. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain dose rate of <15-mrem/yr above background over 1,000 years.	Radionuclides were not COPCs for the 600-301 waste site.	NA
Direct Exposure – Nonradionuclides	Attain individual COPC RAGs.	All individual COPC concentrations are below the direct exposure RAGs.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	The hazard quotients for individual nonradionuclide COPCs from confirmatory and verification sampling are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient from confirmatory sampling (7.7×10^{-2}) and verification sampling area (1.8×10^{-2}) are <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	For the confirmatory sampling results all individual carcinogenic risk values are $<1 \times 10^{-6}$. None of the contaminants detected in the verification data have carcinogenic RAGs. Therefore, individual excess cancer risks were not calculated for the verification data..	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	For the confirmatory sampling results the cumulative excess cancer risk (9.1×10^{-8}) is $<1 \times 10^{-5}$. None of the contaminants detected in the verification data have carcinogenic RAGs. Therefore, cumulative excess cancer risks were not calculated for the verification data..	
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not COPCs for the 600-301 waste site.	NA
	Attain National Primary Drinking Water Regulations: 4 mrem/yr (beta/gamma) dose standard to target receptor/organ [a].		
	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 21.2 pCi/L [c].		

Table ES-1. Summary of Remedial Action Goals for the 600-301 Waste Site. (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, nickel, zinc, 4-4'-DDE, and 4-4'-DDT were detected at concentrations exceeding soil RAGs for groundwater and/or Columbia River protection. However, an evaluation based upon RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b) shows that residual concentrations of these constituents are predicted to be protective of groundwater and the river [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), the residual concentrations of lead, nickel, zinc, 4-4'-DDE, and 4-4'-DDT are not expected to migrate vertically more than 1.8 m (5.9 ft) in 1,000 years based on the lowest distribution coefficient (30 mL/g) for lead and zinc. There are approximately 8 m (26.2 ft) of unsaturated soils above groundwater (vadose zone) at the 600-301 waste site. Therefore, residual concentrations of lead, nickel, and zinc are protective of groundwater and the river.

COPC = contaminant of potential concern
DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
DOE = U.S. Department of Energy
MCL = maximum contaminant level
NA = not applicable
RAG = remedial action goal
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity (dose model)

In accordance with this evaluation, the verification sampling results support a reclassification of the 600-301 waste site to interim closed out. The current site conditions achieve the RAOs and the corresponding RAGs established in the 100 Area RDR/RAWP (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 results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]), and contaminant levels remaining in the soil are protective of groundwater and the Columbia River.

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 waste site contaminants of concern, contaminants of potential concern, and other constituents. Those constituents exceeding the ecological screening level in *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act - Cleanup," are boron and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, lead, manganese, and zinc. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because the detected levels of antimony, manganese, vanadium, and zinc are below Hanford Site background levels, 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 ecological effects as a part of the final closeout decision for the Columbia River corridor portion of the Hanford Site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-301, WHITE BLUFFS SANITARY SEWER PIPELINES WASTE SITE

STATEMENT OF PROTECTIVENESS

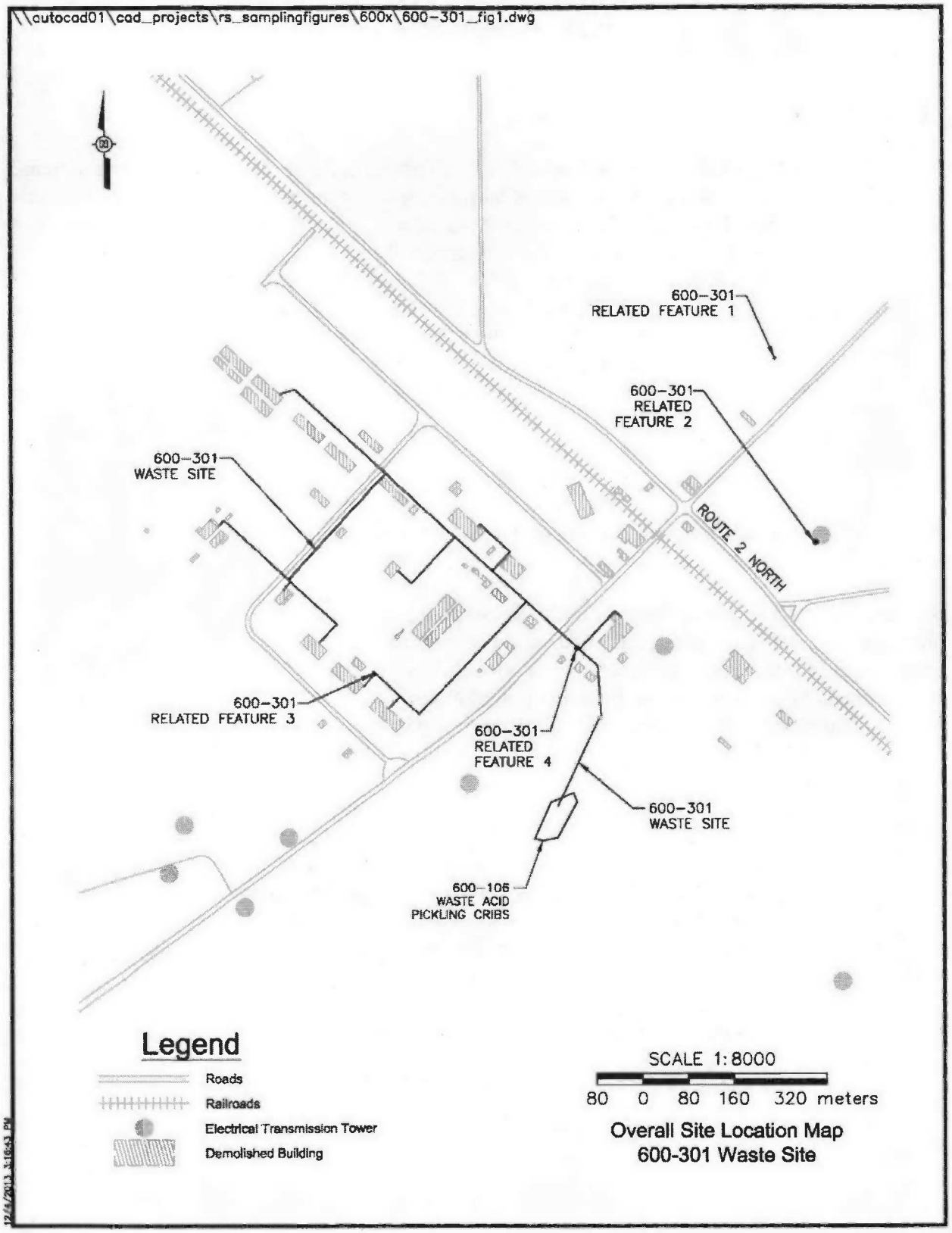
The 600-301, White Bluffs Sanitary Sewer Pipeline verification sampling data, site evaluations, and supporting documentation demonstrate that this waste site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Contamination above direct exposure levels from the 600-301waste site was not observed in the shallow zone soils and is concluded to not exist in the deep zone soils. Therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the site 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 waste site contaminants of concern, contaminants of potential concern (COPCs), and other constituents. Those constituents exceeding the ecological screening level in *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act - Cleanup," are boron and vanadium. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for antimony, lead, manganese, and zinc. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because the detected levels of antimony, manganese, vanadium, and zinc are below Hanford Site background levels, 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 ecological effects as a part of the final closeout decision for the Columbia River corridor portion of the Hanford Site.

GENERAL SITE INFORMATION AND BACKGROUND

The 600-301 waste site is located within the 100-IU-2 Operable Unit and consisted of the sanitary sewer pipelines associated with the White Bluffs shops area (Figure 1). The Waste Information Data System (WIDS) describes the 600-301 waste site as approximately 2,500 m (1.85 mi) of sanitary sewer pipelines, the soils underlying these pipelines, as well as several suspected related features.

Figure 1. The 600-301 Waste Site Location Map.



Relative locations of features related to the 600-301 waste site are indicated in Figure 1. The first related feature consisted of two square holes approximately 1 by 1 m (3 by 3 ft) and 0.5 m (1.5 ft) deep with a vertical pipe protruding upward in each hole and the pipe openings just below surface grade. The holes were located approximately 2 m (6 ft) apart. Confirmatory sampling test pit 1 was excavated at this location. The second related feature was a concrete-lined manhole approximately 1 m (3 ft) in diameter with a carbon steel lid. A below-grade 15-cm (6-in.)-diameter horizontal pipe exited the west side of the manhole. Confirmatory sampling test pit 2 was excavated at this location. The third related feature was a 1 by 1 m (3 by 3 ft) concrete foundation. Confirmatory sampling test pit 3 was excavated at this location. The fourth related feature was a concrete manhole approximately 1.5 m (5 ft) in diameter and 23 cm (9 in.) deep, which was partially filled with dirt and vegetation. Confirmatory sampling test pit 4 was excavated at this location.

The 600-301 waste site extends throughout the White Bluffs shop area of the Hanford Site in Washington State (Figure 1). Coordinates associated with the pipelines and related features are provided in the confirmatory sampling summary within the RTD report (WCH 2011).

REMEDIAL ACTION SUMMARY

Two areas of the 600-301 waste site were recommended for remediation based on the results of confirmatory sampling. Confirmatory sampling data is presented in Appendix A. Elevated levels of arsenic and nitrate at test pits 1 and 2, as well as elevated concentrations of cadmium and TPH at test pit 7 (WCH 2011) were identified in the confirmatory data. The extent of the remedial action for these areas was established in conference with the EPA.

Remedial Action

Between April 22 and June 20, 2013, approximately 963 bank cubic meters (1,260 bank cubic yards) of rock, gravel, and pipe were removed from the areas associated with test pits 1, 2, and a segment of pipeline associated with test pit 7. These materials were disposed at the Environmental Restoration Disposal Facility (ERDF). The maximum depth of the excavation is approximately 2.1 m (7.0 ft) below ground surface.

A post-excavation photograph of the 600-301 main excavation associated with test pit 7 is provided in Figure 2. All material removed from the waste site was direct loaded for disposal at ERDF, and no soil staging pile areas or overburden areas were utilized.

VERIFICATION SAMPLING ACTIVITIES

Verification sampling was performed at the 600-301 waste site on September 5, 2013. 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).

Figure 2. Post-Excavation Photograph of the 600-301 Waste Site.

The verification sample results are provided in Appendix A and indicate that the waste removal action achieved compliance with the remedial action objectives (RAOs) and remedial action goals (RAGs) for the 600-301 waste site. The following subsections provide additional discussion of the information used to develop the verification sampling design. Discrete samples were collected at the prescribed statistical and focused sample locations. A more detailed discussion of the verification sampling can be found in the *Work Instruction for Verification Sampling of the 600-301, White Bluffs Sanitary Sewer Pipelines* (WCH 2013b).

Contaminants of Potential Concern

The COPCs for verification sampling of the 600-301 waste site are based on the analytical results obtained from confirmatory sampling. The RAGs were exceeded in the confirmatory data for the following contaminants: total petroleum hydrocarbons in the diesel range (TPH-Dx), arsenic, barium, cadmium, chromium (total), cobalt, copper, lead, manganese, mercury, molybdenum, nickel, selenium, silver, zinc, nitrate, dichlorodiphenyldichloroethylene (DDE), and dichlorodiphenyltrichloroethane (DDT). These analytes were retained as COPCs for verification sampling. The analytical methods associated with these analytes are presented in Table 1.

Table 1. Laboratory Analytical Methods.

Analytical Method	Contaminants of Potential Concern
ICP metals [a] – EPA Method 6010	Arsenic, barium, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, zinc
Nitrate/nitrite – EPA Method 353.2	Nitrate
Mercury – EPA Method 7471	Mercury
Pesticides – EPA Method 8081	DDE, DDT
TPH – NWTPH-Dx [b]	Total petroleum hydrocarbons- diesel range

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

[b] NWTPH-Dx analyzes for both diesel and heavy oil range organics.

DDE = dichlorodiphenyldichloroethylene
DDT = dichlorodiphenyltrichloroethane
EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
NWTPH-Dx = Northwest total petroleum hydrocarbons – diesel range organics
TPH = total petroleum hydrocarbons

Verification Sample Design

This section describes the basis for selection of an appropriate sample design and determination of the number of verification samples that were collected. All sampling was performed in accordance with the *100 Area Remedial Action Sampling and Analysis Plan* (100 Area SAP) (DOE-RL 2009a).

The verification sample design included a statistical approach for the main excavation (Figures 3 and 4) associated with verification sampling test pit 7 and two focused samples for the suspect-related features 1 and 2 associated with verification sampling test pits 1 and 3. (Figure 5). A summary of the verification samples collected and laboratory analyses performed is provided in Table 2. All sampling was performed in accordance with ENV-1, *Environmental Monitoring & Management*, to fulfill the requirements of the 100 Area SAP (DOE-RL 2009a). Additional information related to verification sampling can be found in the verification sampling design (WCH 2013b) and the field sampling logbook (WCH 2013a).

Figure 3. 600-301 Main Excavation and Test Pits.

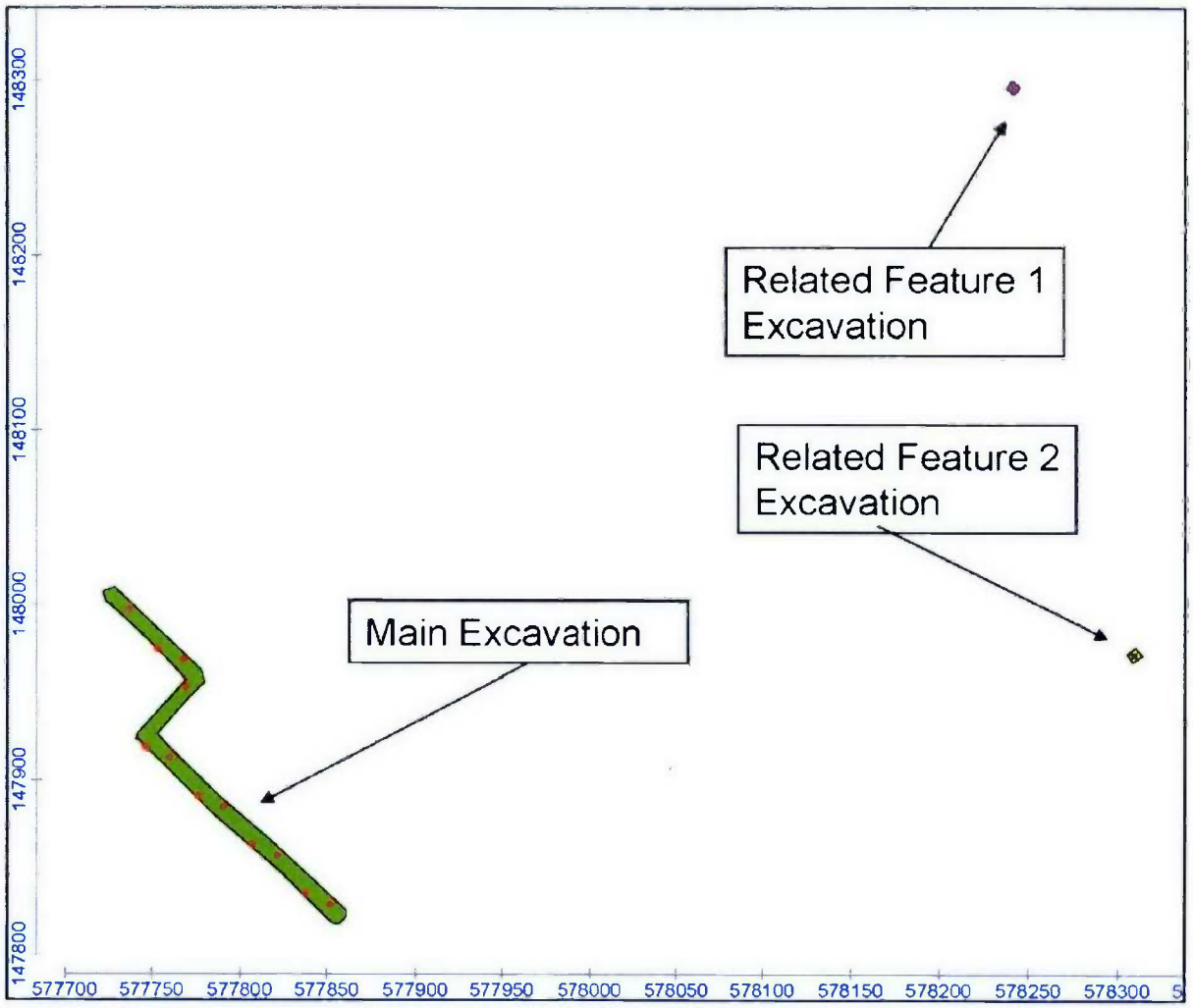


Figure 4. Statistical Samples at the 600-301 Main Excavation.

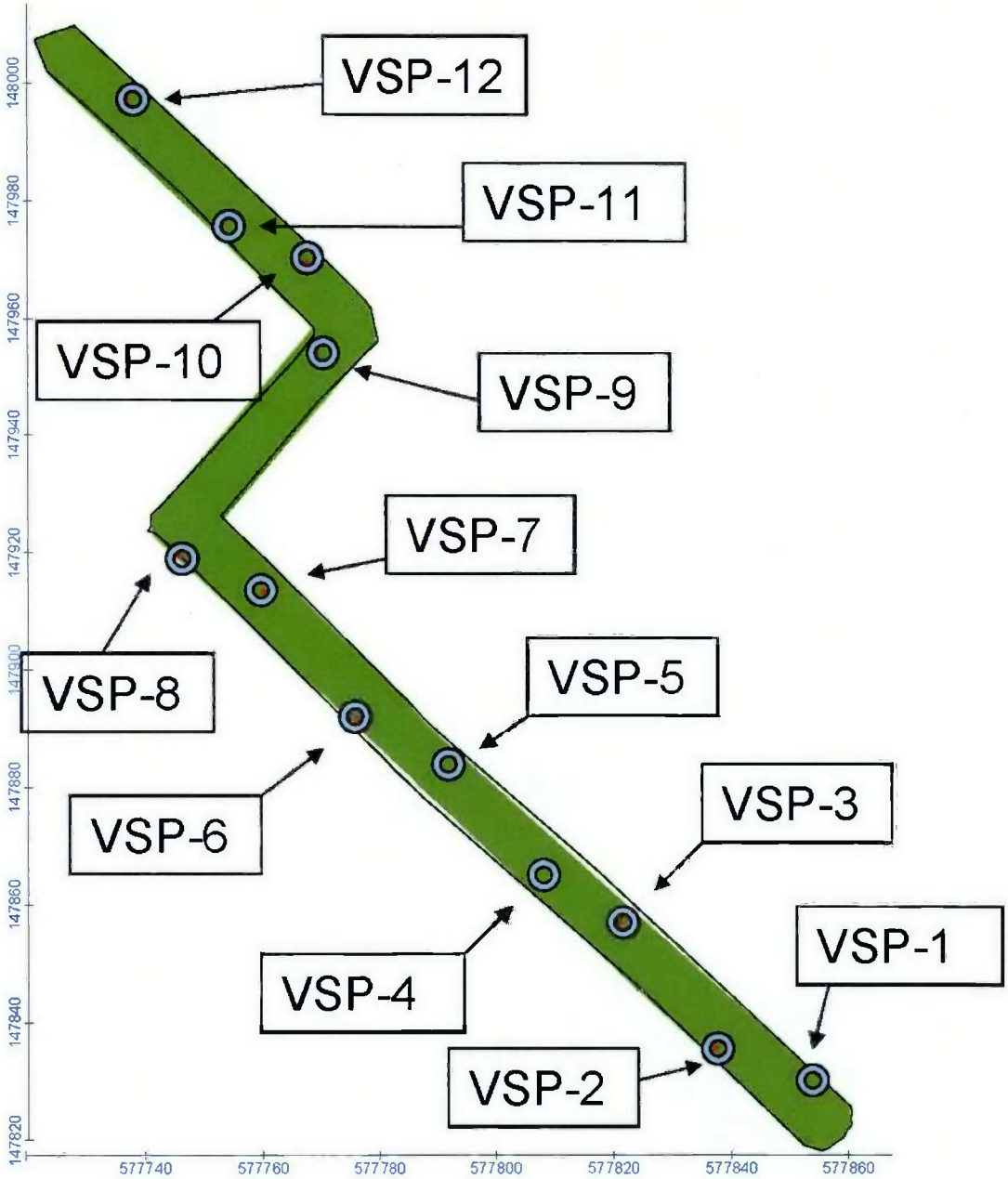


Figure 5. Focused Samples at the Excavations of Related Features 1 and 2.

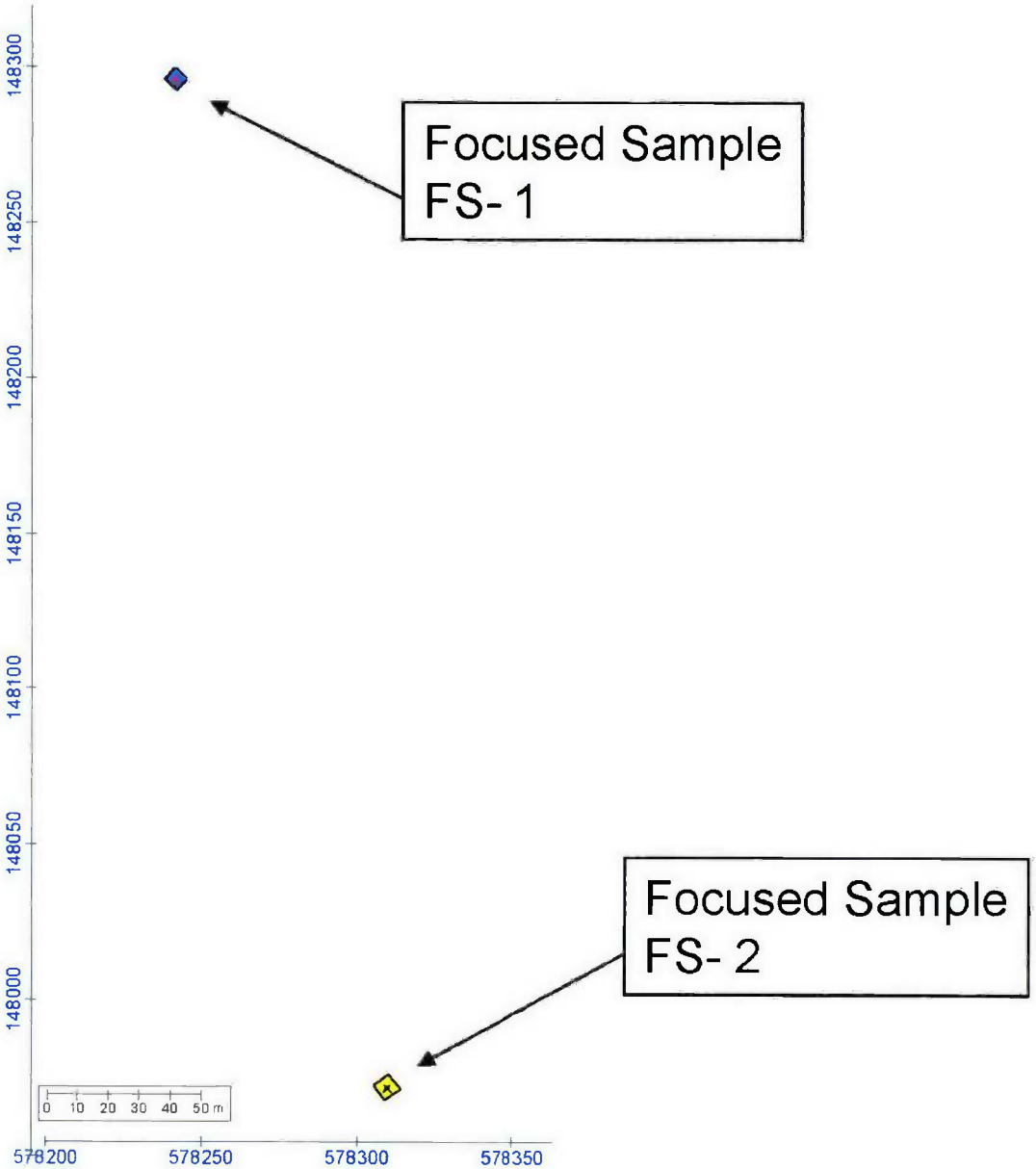


Table 2. 600-301 Verification Sample Summary.

Sample Location	HEIS Sample Number	Washington State Plane (m)		Sample analysis
		Easting	Northing	
VSP-1	J1RWR0	577851.7	147829.4	ICP metals [a], mercury, nitrate, pesticides, NWTPH-Dx [b]
VSP-2	J1RWR1	577837.3	147835.7	
VSP-3	J1RWR2	577821.2	147857.4	
VSP-4	J1RWR3	577806.8	147863.7	
VSP-5	J1RWR4	577790.7	147885.5	
VSP-6	J1RWR5	577776.3	147891.7	
VSP-7	J1RWR6	577760.2	147913.5	
VSP-8	J1RWR7	577745.8	147919.7	
VSP-9	J1RWR8	577769.2	147953.9	
VSP-10	J1RWR9	577767.4	147969.4	
VSP-11	J1RWT0	577753.1	147975.7	
VSP-12	J1RWT1	577737.0	147997.4	
FS-1	J1RWT2	578241.4	148295.8	
FS-2	J1RWT3	578309.6	147971.8	
Duplicate [c]	J1RWT4	577851.7	147829.4	
Equipment blank	J1RWT5	NA	NA	ICP metals [a], mercury

[a] Analyses were performed for the expanded list of ICP metals to include antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.
[b] NWTPH – Dx analyzes for both diesel and heavy oil range organics.
[c] The duplicate soil sample will be collected at a location selected at the project analytical lead's discretion.

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
NWTPH-Dx = Northwest total petroleum hydrocarbons – diesel range organics

Verification Sample Results

All verification samples were analyzed using analytical methods approved by EPA (DOE-RL 2009b). Evaluation of the verification data from the 600-301 waste site was performed by direct comparison of the statistical or maximum sample results for each COPC against cleanup criteria. If no detections for a given COPC were reported in the data set, then no maximum evaluation or calculations were performed for that COPC.

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 600-301 decision unit as specified by the 100 Area RDR/RAWP (DOE-RL 2009b). The calculations are provided in Appendix A. When a nonradionuclide COPC was detected in fewer than 50% of the verification samples collected for a decision unit, the maximum detected value was used for comparison to 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 verification sampling results for site COPCs against the RAGs for the 600-301 waste site are listed in Tables 3 and 4. Additionally, a comparison of the confirmatory data for the areas that did not require remedial action is presented in Table 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 2012) 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 (Part A)* (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 these tables.

The laboratory-reported data results for all constituents are stored in the Washington Closure Hanford (WCH) project-specific database prior to archival in the Hanford Environmental Information System. The verification data is presented in Attachment 1 of the 95% UCL calculation (Appendix A) and the confirmatory data is presented in Attachment 1 of the relative percent difference calculation (Appendix A).

Table 3. Comparison of Contaminant Concentrations to Remedial Action Goals for the 600-301 Waste Site Statistical Samples. (2 Pages)

COPC	Statistical or Maximum Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			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	0.353 (<BG)	32	5 [b]	5 [b]	No	--
Arsenic	4.88 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	63.3 (<BG)	5,600	200	400	No	--
Beryllium	0.576 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	1.51	7,200 [c]	320	-- [f]	No	--
Cadmium [g]	0.139 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium	12.8 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	7.19 (<BG)	24 [e]	15.7 [b]	-- [f]	No	--
Copper	15.7 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	5.91	353	10.2 [b]	10.2 [b]	No	--
Manganese	284 (<BG)	3,760 [c]	512 [b]	512 [b]	No	--
Molybdenum [d]	0.607	400	8	-- [f]	No	--
Nickel	26.3	1,600 [c]	19.1 [b]	27.4	Yes	Yes [h]
Vanadium	52.4 (<BG)	560 [e]	85.1 [b]	-- [f]	No	--
Zinc	50.9	24,000 [e]	480	67.8 [b]	No	--
Mercury	0.00922 (<BG)	24	0.33 [b]	0.33 [b]	No	--
Chloride	4.14	--	25,000	--	No	--
Fluoride	1.61	4,800	96	400	No	--
Nitrate (as N)	2.38	128,000	1,000	2,000	No	--
Nitrate/nitrite (as N)	3.97	128,000	1,000	2,000	No	--
Sulfate	21.1	--	25,000	--	No	--

Table 3. Comparison of Contaminant Concentrations to Remedial Action Goals for the 600-301 Waste Site Statistical Samples. (2 Pages)

COPC	Statistical or Maximum Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			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		
TPH-motor oil range	6.1	200	200	200	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (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).
[c] Carcinogenic cleanup level calculated based on the inhalation exposure pathway; WAC 173-340-750(3) (1996) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[d] No Hanford Site-specific or Washington State background value available.
[e] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), Method B (Ecology 1996).
[f] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2011) or other databases to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).
[g] Hanford Site-specific background value is not available; it was not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[h] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentration of nickel is expected to migrate vertically less than 1.0 m (3.3 ft) in 1,000 years based on the distribution coefficient (65 mL/g) for nickel. There are approximately 8 m (26.2 ft) of unsaturated soils above groundwater (vadose zone) at the 600-301 waste site. Therefore, residual concentrations of lead, nickel, and zinc are protective of groundwater and the river.

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Table 4. Comparison of Contaminant Concentrations to Remedial Action Goals for the 600-301 Waste Site Focused Samples. (2 Pages)

COPC	Statistical or Maximum Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			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		
Barium	79.0 (<BG)	5,600	200	400	No	--
Beryllium	0.572 (<BG)	10.4 [b]	1.51 [c]	1.51 [c]	No	--
Boron [d]	1.71	7,200 [e]	320	-- [f]	No	--
Cadmium [g]	0.149 (<BG)	13.9 [b]	0.81 [c]	0.81 [c]	No	--
Chromium	13.2 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	7.02 (<BG)	24 [e]	15.7 [c]	-- [f]	No	--
Copper	14.8 (<BG)	2,960	59.2	22.0 [c]	No	--
Lead	23.1	353	10.2 [c]	10.2 [c]	Yes	Yes [h]
Manganese	307 (<BG)	3,760 [e]	512 [c]	512 [c]	No	--
Molybdenum [d]	0.537	400	8	-- [f]	No	--
Nickel	11.2	1,600 [e]	19.1 [c]	27.4	No	--
Silver	0.167 (<BG)	400	8	0.73 [c]	No	--
Vanadium	48.3 (<BG)	560 [e]	85.1 [c]	-- [f]	No	--
Zinc	55.7	24,000 [e]	480	67.8 [c]	No	--

Table 4. Comparison of Contaminant Concentrations to Remedial Action Goals for the 600-301 Waste Site Focused Samples. (2 Pages)

COPC	Statistical or Maximum Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			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		
Mercury	0.0237 (<BG)	24	0.33 [c]	0.33 [c]	No	--
Chloride	4.03	--	25,000	--	No	--
Fluoride	1.25	4,800	96	400	No	--
Nitrate (as N)	28.1	128,000	1,000	2,000	No	--
Nitrate/nitrite (as N)	28.1	128,000	1,000	2,000	No	--
Sulfate	35.3	--	25,000	--	No	--
TPH-motor oil range	14	200	200	200	No	--
TPH diesel oil range	2.4	200	200	200	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] Carcinogenic cleanup level calculated based on the inhalation exposure pathway; WAC 173-340-750(3) (1996) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (1996). The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the 100 Area RDR/RAWP (DOE-RL 2009b).
[d] No Hanford Site-specific or Washington State background value available.
[e] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), Method B (Ecology 1996).
[f] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2011) or other databases to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).
[g] Hanford Site-specific background value is not available; it was not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).
[h] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentration of lead is not expected to migrate vertically more than 1.8 m (5.9 ft) in 1,000 years based on the distribution coefficient (30 mL/g) for lead. There are approximately 8 m (26.2 ft) of unsaturated soils above groundwater (vadose zone) at the 600-301 waste site. Therefore, residual concentrations of lead, nickel, and zinc are protective of groundwater and the river.

-- = not applicable
AWQC = ambient water quality criteria
BG = background
COPC = contaminant of potential concern
RAG = remedial action goal
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Table 5. Comparison of Contaminant Concentrations to Remedial Action Goals for the 600-301 Waste Site Confirmatory Samples. (2 Pages)

COPC	Statistical or Maximum Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	1.8 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	61.7(<BG)	5,600	200	400	No	--
Beryllium	0.18 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	1.3	7,200 [e]	320	-- [f]	No	--
Cadmium [g]	0.12 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium	14.4 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	5.5 (<BG)	24 [e]	15.7 [b]	-- [f]	No	--

Table 5. Comparison of Contaminant Concentrations to Remedial Action Goals for the 600-301 Waste Site Confirmatory Samples. (2 Pages)

COPC	Statistical or Maximum Result (mg/kg)	Remedial Action Goals [a] (mg/kg)			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		
Copper	18.8 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	15.4	353	10.2 [b]	10.2 [b]	Yes	Yes [h]
Manganese	254 (<BG)	3,760 [e]	512 [b]	512 [b]	No	--
Molybdenum [d]	0.26	400	8	-- [f]	No	--
Nickel	13.7	1,600 [e]	19.1 [b]	27.4	No	--
Vanadium	26.0 (<BG)	560 [e]	85.1 [b]	-- [f]	No	--
Zinc	1460	24,000 [e]	480	67.8 [b]	Yes	Yes [h]
Mercury	0.0091 (<BG)	24	0.33 [b]	0.33 [b]	No	--
Fluoride	1.2	4,800	96	400	No	--
Nitrate (as N)	7.9	128,000	1,000	2,000	No	--
Nitrate/nitrite (as N)	9.0	128,000	1,000	2,000	No	--
Sulfate	121	--	25,000	--	No	--
TPH-motor oil range	13	200	200	200	No	--
TPH diesel oil range	19	200	200	200	No	--
4-4'DDE	0.0065	2.94	0.0257	0.0033	Yes	Yes [h]
4-4'-DDT	0.0077	2.94	0.0257	0.0033	Yes	Yes [h]
Endrin aldehyde	0.00036	24	0.2	0.003	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).

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

[c] Carcinogenic cleanup level calculated based on the inhalation exposure pathway; WAC 173-340-750(3) (1996) using an airborne particulate mass-loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

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

[e] Noncarcinogenic cleanup level calculated from WAC 173-340-740(3), Method B (Ecology 1996).

[f] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2011) or other databases to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).

[g] Hanford Site-specific background value is not available; it was not evaluated during background study. Value used is from *Natural Background Soil Metals Concentrations in Washington State* (Ecology 1994).

[h] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of lead, zinc, 4-4'-DDE, and 4-4'-DDT are not expected to migrate vertically more than 1.8 m (5.9 ft) in 1,000 years based on the lowest distribution coefficient (30 mL/g) for lead and zinc. There are approximately 8 m (26.2 ft) of unsaturated soils above groundwater (vadose zone) at the 600-301 waste site. Therefore, residual concentrations of lead, nickel, and zinc are protective of groundwater and the river.

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

SAMPLE DATA EVALUATION

This section demonstrates that contaminant concentrations at the 600-301 waste site achieves the applicable RAGs developed to support unrestricted land use at the 100 Area as established in the Remaining Sites ROD (EPA 1999) and documented in the 100 Area RDR/RAWP (DOE-RL 2009b).

Direct Comparison to RAGs

Evaluation of all of the data representing the final state of the 600-301 waste site (Tables 3, 4, 5) shows that all direct exposure RAGs are met.

Lead and nickel were identified at concentrations exceeding cleanup criteria for protection of groundwater. Lead, nickel, zinc, 4-4'-DDE, and 4-4'-DDT were identified at concentrations exceeding cleanup criteria for protection of the Columbia River. Based on the RESidual RADioactivity modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), residual concentrations of these constituents are not expected to migrate vertically more than 1.8 m (5.9 ft) in 1,000 years based on the lowest distribution coefficient (30 mL/g) for lead and zinc. There are approximately 8 m (26.2 ft) of unsaturated soils above groundwater (vadose zone) at the 600-301 waste site. Therefore, residual concentrations of lead, nickel, and zinc are protective of groundwater and the river.

Direct Contact Noncarcinogenic Hazard Quotient Remedial Action Goal

Assessment of the risk requirements for the 600-301 waste site was determined by calculation of the hazard quotient and excess carcinogenic risk. The 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 excess carcinogenic risk of less than 1×10^{-5}. Hazard quotient and excess carcinogenic risk calculations for direct contact were conservatively performed for the 600-301 waste site in Appendix A using the highest of the focused values from all decision units. Risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. All individual hazard quotients are below 1.0. The direct contact cumulative hazard quotient for the 600-301 waste site is 7.7×10^{-2}, which is less than 1.0. All individual carcinogenic risk values are below 1×10^{-6}. The direct contact cumulative excess cancer risk for the 600-301 waste site is 9.1×10^{-8}, which is less than 1×10^{-5}. Therefore, the nonradionuclide risk requirements are met.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach (WCH 2013b), the field logbook (WCH 2013a), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 600-301 waste site established that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The cleanup verification sample analytical data are stored in a WCH project-specific database prior to archival in the Hanford Environmental Information System and are summarized in an attachment to the relative percent difference calculation in Appendix A. The detailed DQA is presented in Appendix B.

SUMMARY FOR INTERIM CLOSURE

The 600-301 waste site 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 meet the RAOs for direct exposure, groundwater protection, and river protection. The 600-301 waste site contamination did not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling into the deep zone (below 4.6 m [15 ft]) are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-301 waste site to Interim Closed Out.

REFERENCES

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EPA, 2009, *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.

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

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WCH, 2013b, *Work Instruction for Verification Sampling of the 600-301, White Bluffs Sanitary Sewer Pipelines*, 0600X-WI-G0079, Rev. 0, Washington Closure Hanford, Richland, Washington.

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APPENDIX A

CALCULATIONS

APPENDIX A

CALCULATIONS

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

600-301 Waste Site Cleanup Verification 95% UCL Calculation, 0600X-CA-V0152, Rev. 0, Washington Closure Hanford, Richland, Washington.

600-301 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations, 0600X-CA-V0153, Rev. 0, Washington Closure Hanford, Richland Washington.

600-301 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations, 0600X-CA-V0163, Rev. 0, Washington Closure Hanford, Richland Washington.

DISCLAIMER FOR CALCULATIONS

The calculations 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.

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-IU-2/6 Field Remediation **Job No. 14655**

Area: 600 Area

Discipline: Environmental *Calculation No: 0600X-CA-C0152

Subject: 600-301 Waste Site Cleanup Verification 95% UCL Calculation

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 9 Attm. 1 = 6 Total = 16	J. D. Skoglie	N. K. Schiffern	I. B. Berezovskiy	D. F. Obenauer	12/16/13

SUMMARY OF REVISION

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

Washington Closure Hanford

CALCULATION SHEET

Originator	J. D. Skoglie	Date	10/24/13	Calc. No. 0600X-CA-C0152	Rev. No. 0
Project	100-IU-2/6 Remediation	Job No.	14655	Checked N. K. Schiffern	Date 10/24/13
Subject	600-301 Waste Site Cleanup Verification 95% UCL Calculation				Sheet No. 1 of 9

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 3 - Calculation Sheet Summary
Sheets 4 to 5 - Calculation Sheet Verification Data - 600-301 Excavation
Sheets 6 to 8 - Ecology Software (MTCAStat) Results
Sheet 9 - Calculation Sheet Duplicate Analysis
Attachment 1 - 600-301, Verification Sampling Results (6 sheets)

Given/References:

1) Sample Results (Attachment 1).
2) Background values and remedial action goals (RAGs) are taken from DOE-RL (2009b), DOE-RL (2001), and Ecology (1996).
3) DOE-RL, 2001, *Hanford Site Background: Part 1, Soil Background for Nonradioactive Analytes*, DOE/RL-92-24, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) 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.
5) 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.
6) Ecology, 1992, *Statistical Guidance for Ecology Site Managers*, Publication #92-54, Washington Department of Ecology, Olympia, Washington.
7) 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.
8) Ecology, 1996, *Model Toxic Control Act Cleanup Levels and Risk Calculations (CLARC II)*, Publication #94-145, Washington State Department of Ecology, Olympia, Washington.
9) Ecology, 2011, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.
10) 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.
11) 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 and focused data from verification samples (Attachment 1) from the 600-301 waste site. The data were entered into an EXCEL 2003 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 600-301 waste site underwent statistical verification sampling at one decision unit (excavation) and two focused samples. Analytical results for all sampling locations are summarized in the tables provided on sheet 3. 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 J. D. Skoglie	**Date** 10/24/13	**Calc. No.** 0600X-CA-C0152	**Rev. No.** 0
Project 100-IU-2/6 Remediation	**Job No.** 14655	**Checked** N. K. Schiffern	**Date** 10/24/13
Subject 600-301 Waste Site Cleanup Verification 95% UCL Calculation			**Sheet No.** 2 of 9

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 (which includes primary and duplicate samples) 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 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 either the duplicate or split value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed in Table 2-1 of the SAP (DOE-RL 2009a) for certain constituents. All other constituents will have their own pre-determined TDL's based on the laboratory and method used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

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

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

For quality assurance/quality control (QA/QC) 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/split 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/split result 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 J. D. Skoglie Date 10/24/13 Calc. No. 0600X-CA-C0152 Rev. No. 0
Project 100-IU-2/6 Remediation Job No. 14655 Checked N. K. Schiffern Date 10/24/13
Subject 600-301 Waste Site Cleanup Verification 95% UCL Calculation Sheet No. 3 of 9

Summary (continued)

Results:
The results presented in the tables that follow include the summary of the results of the 95% UCL and maximum calculations for the 600-301 excavation, focused samples, 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.

600-301 Statistical Sampling Results Summary [a]

Analyte	600-301		Focused Samples	Units
	95% UCL	Maximum	Maximum	
Antimony	--	0.353	--	mg/kg
Arsenic	--	4.88	4.13	mg/kg
Barium	63.3	--	79.0	mg/kg
Beryllium	0.576	--	0.572	mg/kg
Boron	1.51	--	1.71	mg/kg
Cadmium	0.139	--	0.149	mg/kg
Chromium	12.8	--	13.2	mg/kg
Cobalt	7.19	--	7.02	mg/kg
Copper	15.7	--	14.8	mg/kg
Lead	5.91	--	23.1	mg/kg
Manganese	284	--	**307**	mg/kg
Mercury	--	0.00922	**0.0237**	mg/kg
Molybdenum	**0.607**	--	**0.537**	mg/kg
Nickel	**26.3**	--	**11.2**	mg/kg
Silver	--	--	**0.167**	mg/kg
Vanadium	52.4	--	**48.3**	mg/kg
Zinc	50.9	--	**55.7**	mg/kg
Chloride	**4.14**	--	**4.03**	mg/kg
Fluoride	1.61	--	**1.25**	mg/kg
Nitrogen in nitrate	**2.38**	--	**28.1**	mg/kg
Nitrogen in nitrate and Nitrite	3.97	--	**28.1**	mg/kg
Sulfate	21.1	--	**35.3**	mg/kg
TPH - Motor Oil (high boiling)	6.1	--	**14**	mg/kg
TPH - Diesel Range	--	--	**2.4**	mg/kg

3-Part Test Evaluation:	**600-301**
95% UCL or maximum[a] > Cleanup Limit?	YES
> 10% above Cleanup Limit?	NO
Any sample > 2x Cleanup Limit?	YES

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

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

Analyte	Duplicate Analysis
	600-301
Aluminum	2.9%
Barium	1.0%
Calcium	15.8%
Chromium	0.3%
Copper	1.8%
Iron	1.3%
Magnesium	1.1%
Manganese	0.5%
Silicon	6.9%
Sodium	1.0%
Vanadium	3.0%
Zinc	2.1%
Sulfate	25.6%

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

-- = not applicable
* = duplicate analysis not within control limits.
B = the analyte was detected in both the associated QC blank and in the sample.
D = dilution
DE = direct exposure
EXC = excavation
GW = groundwater
J = estimate
MTCA = *Model Toxics Control Act*
N = spike sample recovery outside control limits
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
TPH = total petroleum hydrocarbons
U = undetected
UCL = upper confidence limit
VSP = visual sample plan
WAC = Washington Administrative Code

CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie
Project 100-IU-2/6 Remediation
Subject 600-301 Waste Site Cleanup Verification 95% UCL Calculation

Date 10/24/13
Job No. 14655

Calc. No. 0600X-CA-C0152
Checked N. K. Schiffern

Rev. No. 0
Date 10/24/13
Sheet No. 4 of 9

600-301 Statistical Calculations

Verification Data - 600-301 Waste Site Excavation

Sample Area	Sample Number	Sample Date	Barium			Beryllium			Boron			Cadmium			Chromium			Cobalt			Copper			Lead			Manganese			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	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
VSP-1	J1RWR0	9/5/13	48.3		0.0982	0.441	B	0.0982	2.09	B	0.982	0.107	B	0.0982	9.24		0.147	4.86		0.147	11.5		0.295	4.33		0.324	208		0.196	0.407	B	0.196
Duplicate of J1RWR0	J1RWT4	9/5/13	47.8		0.0992	0.430	B	0.0992	1.97	B	0.992	0.0992	U	0.0992	9.27		0.149	4.55		0.149	11.3		0.298	3.70		0.327	207		0.198	0.323	B	0.198
VSP-2	J1RWR1	9/5/13	36.6		0.0973	0.359	B	0.0973	0.973	U	0.973	0.0973	U	0.0973	7.05		0.146	4.29		0.146	11.0		0.292	2.73		0.321	169		0.195	0.264	B	0.195
VSP-3	J1RWR2	9/5/13	51.2		0.0983	0.502		0.0983	2.03	B	0.983	0.146	B	0.0983	9.64		0.147	5.71	D	0.737	10.8		0.295	4.82	BD	1.62	227		0.197	0.426	B	0.197
VSP-4	J1RWR3	9/5/13	59.0		0.101	0.537		0.101	1.53	B	1.01	0.107	B	0.101	10.7		0.151	6.76	D	0.756	11.5		0.302	4.89	BD	1.66	268		0.202	0.405	B	0.202
VSP-5	J1RWR4	9/5/13	44.8		0.0929	0.474		0.0929	1.85	B	0.929	0.0929	U	0.0929	9.33		0.139	5.86	D	0.697	11.4		0.279	3.62	BD	1.53	219		0.186	0.335	B	0.186
VSP-6	J1RWR5	9/5/13	44.8		0.0999	0.522		0.0999	1.27	B	0.999	0.162	B	0.0999	11.3		0.150	7.12	D	0.749	13.2		0.300	5.37	D	1.65	223		0.200	1.21		0.200
VSP-7	J1RWR6	9/5/13	75.3		0.0976	0.475	B	0.0976	1.24	B	0.976	0.0976	U	0.0976	16.7		0.146	6.90		0.146	21.6		0.293	5.69		0.322	306		0.195	0.378	B	0.195
VSP-8	J1RWR7	9/5/13	78.3		0.0971	0.708		0.0971	1.48	B	0.971	0.134	B	0.0971	12.8		0.146	8.55	D	0.728	14.5		0.291	7.41	D	1.60	340		0.194	0.500	B	0.194
VSP-9	J1RWR8	9/5/13	74.5		0.0978	0.530		0.0978	1.33	B	0.978	0.148	B	0.0978	14.7		0.147	7.31	D	0.734	20.4		0.293	4.97	D	1.61	292		0.196	0.577	B	0.196
VSP-10	J1RWR9	9/5/13	44.2		0.0947	0.602		0.0947	0.947	U	0.947	0.169	B	0.0947	9.05		0.142	6.88	D	0.710	14.1		0.284	3.99	BD	1.56	245		0.189	0.497	B	0.189
VSP-11	J1RWT0	9/5/13	43.4		0.0950	0.437	B	0.0950	0.950	U	0.950	0.0950	B	0.0950	11.2		0.142	4.81		0.142	11.5		0.285	4.06		0.313	239		0.190	0.446	B	0.190
VSP-12	J1RWT1	9/5/13	73.0		0.0940	0.648		0.0940	0.940	U	0.940	0.180	B	0.0940	12.7		0.141	7.46	D	0.705	15.7		0.282	7.88	D	1.55	311		0.188	0.508	B	0.188

Statistical Computation Input Data

Sample Area	Sample Number	Sample Date	Barium mg/kg	Beryllium mg/kg	Boron mg/kg	Cadmium mg/kg	Chromium mg/kg	Cobalt mg/kg	Copper mg/kg	Lead mg/kg	Manganese mg/kg	Molybdenum mg/kg
VSP-1	J1RWR0/ J1RWT4	9/5/13	48.1	0.436	2.03	0.0783	9.26	4.71	11.4	4.02	208	0.365
VSP-2	J1RWR1	9/5/13	36.6	0.359	0.487	0.0487	7.05	4.29	11.0	2.73	169	0.264
VSP-3	J1RWR2	9/5/13	51.2	0.502	2.03	0.146	9.64	5.71	10.8	4.82	227	0.426
VSP-4	J1RWR3	9/5/13	59.0	0.537	1.53	0.107	10.7	6.76	11.5	4.89	268	0.405
VSP-5	J1RWR4	9/5/13	44.8	0.474	1.85	0.0465	9.33	5.86	11.4	3.62	219	0.335
VSP-6	J1RWR5	9/5/13	44.8	0.522	1.27	0.162	11.3	7.12	13.2	5.37	223	1.21
VSP-7	J1RWR6	9/5/13	75.3	0.475	1.24	0.0488	16.7	6.90	21.6	5.69	306	0.378
VSP-8	J1RWR7	9/5/13	78.3	0.708	1.48	0.134	12.8	8.55	14.5	7.41	340	0.500
VSP-9	J1RWR8	9/5/13	74.5	0.530	1.33	0.148	14.7	7.31	20.4	4.97	292	0.577
VSP-10	J1RWR9	9/5/13	44.2	0.602	0.474	0.169	9.05	6.88	14.1	3.99	245	0.497
VSP-11	J1RWT0	9/5/13	43.4	0.437	0.475	0.0950	11.2	4.81	11.5	4.06	239	0.446
VSP-12	J1RWT1	9/5/13	73.0	0.648	0.470	0.180	12.7	7.46	15.7	7.88	311	0.508

Statistical Computations

	Barium	Beryllium	Boron	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Molybdenum
95% UCL based on	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), use MTCAStat normal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), use MTCAStat lognormal distribution.	Large data set (n ≥ 10), lognormal and normal distribution rejected, use z-statistic.
N	12	12	12	12	12	12	12	12	12	12
% < Detection limit	0%	0%	33%	25%	0%	0%	0%	0%	0%	0%
Mean	56.1	0.519	1.22	0.114	11.2	6.36	13.9	4.95	254	0.493
Standard deviation	15.1	0.0969	0.611	0.0496	2.68	1.29	3.66	1.50	50.1	0.242
95% UCL on mean	63.3	0.576	1.51	0.139	12.8	7.19	15.7	5.91	284	0.607
Maximum value	78.3	0.708	2.09	0.180	16.7	8.55	21.6	7.88	340	1.21
Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg)	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	22.0 River Protection	10.2 GW & River Protection	512 GW & River Protection	8 GW Protection
WAC 173-340 3-PART TEST										
95% UCL > Cleanup Limit?	NO	NA	NO	NA	NA	NA	NA	NA	NA	NO
> 10% above Cleanup Limit?	NO	NA	NO	NA	NA	NA	NA	NA	NA	NO
Any sample > 2X Cleanup Limit?	NO	NA	NO	NA	NA	NA	NA	NA	NA	NO
WAC 173-340 Compliance?	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.	Because all values are below background (22.0 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (10.2 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (512 mg/kg) the WAC 173-340 3-part test is not required.	The data set meets the 3-part test criteria when compared to the most stringent RAG.

CALCULATION SHEET

Washington Closure Hanford

Originator J. D. Skoglie
Project 100-IU-2/6 Remediation
Subject 600-301 Waste Site Cleanup Verification 95% UCL Calculation

Date 10/24/13
Job No. 14655

Calc. No. 0600X-CA-C0152
Checked N. K. Schiffern

Rev. No. 0
Date 10/24/13
Sheet No. 5 of 9

1 **600-301 Statistical Calculations**

2 **Verification Data - 600-301 Waste Site Excavation**

3	Sample	Sample	Sample	Nickel			Vanadium			Zinc			Chloride			Fluoride			Nitrogen in Nitrate			Nitrogen in Nitrate and Nitrite			Sulfate			TPH - motor oil (high boiling)		
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	ug/kg	Q	PQL
5	VSP-1	J1RWR0	9/5/13	8.94		0.147	36.9		0.0982	32.7		0.393	7.32		0.672	2.40		0.331	3.04	J	0.331	2.06		0.172	40.2		1.33	6340	J	2170
6	Duplicate of J1RWR0	J1RWT4	9/5/13	8.57		0.149	35.8		0.0992	33.4		0.397	7.84		0.661	1.99		0.326	2.85	J	0.326	1.89		0.170	52.0		1.31	6870		2160
7	VSP-2	J1RWR1	9/5/13	8.28		0.146	30.8		0.0973	23.2		0.389	1.15	B	0.675	0.756	B	0.333	1.05	J	0.333	0.549		0.167	5.36		1.34	3640	J	2170
8	VSP-3	J1RWR2	9/5/13	10.8		0.147	43.7	D	0.492	93.7	D	1.97	1.81	B	0.673	1.57		0.332	2.60	J	0.332	1.78		0.170	8.10		1.34	7340		2170
9	VSP-4	J1RWR3	9/5/13	9.67		0.151	48.2	D	0.504	51.9	D	2.02	2.01	B	0.690	0.966	B	0.340	2.07	J	0.340	1.44		0.172	6.62		1.37	7100		2210
10	VSP-5	J1RWR4	9/5/13	9.19		0.139	45.4	D	0.465	33.4	D	1.86	1.35	B	0.674	1.73		0.332	1.20	J	0.332	0.676		0.171	4.34		1.34	4360	J	2180
11	VSP-6	J1RWR5	9/5/13	81.3		0.150	48.1	D	0.499	35.6	D	2.00	1.13	B	0.674	1.80		0.332	0.775	JB	0.332	0.465	B	0.171	4.35		1.34	3690	J	2180
12	VSP-7	J1RWR6	9/5/13	14.5		0.146	43.5		0.0976	39.1		0.390	2.23		0.673	1.28		0.332	0.566	JB	0.332	0.167	B	0.160	25.0		1.34	2920	J	2170
13	VSP-8	J1RWR7	9/5/13	12.0		0.146	60.5	D	0.485	45.0	D	1.94	2.95		0.663	1.00		0.327	3.15	J	0.327	2.44		0.162	7.38		1.32	6990		2180
14	VSP-9	J1RWR8	9/5/13	13.2		0.147	51.1	D	0.489	41.9	D	1.96	5.14		0.674	1.24		0.332	0.751	JB	0.332	0.330	B	0.171	10.9		1.34	4180	J	2170
15	VSP-10	J1RWR9	9/5/13	9.79		0.142	59.0	D	0.474	38.7	D	1.89	3.36		0.661	0.686	B	0.326	0.453	JB	0.326	0.156	U	0.156	2.75	B	1.31	3120	J	2170
16	VSP-11	J1RWT0	9/5/13	9.55		0.142	36.7		0.0950	31.1		0.380	0.922	B	0.672	0.859	B	0.331	0.565	JB	0.331	0.166	U	0.166	1.98	B	1.33	2840	J	2170
17	VSP-12	J1RWT1	9/5/13	11.3		0.141	56.0	D	0.470	42.8	D	1.88	0.970	B	0.674	1.35		0.332	0.616	JB	0.332	0.168	U	0.168	5.13		1.34	5480	J	2170

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19 **Statistical Computation Input Data**

20	Sample	Sample	Sample	Nickel	Vanadium	Zinc	Chloride	Fluoride	Nitrogen in Nitrate	Nitrogen in Nitrate and Nitrite	Sulfate	TPH - motor oil (high boiling)
21	Area	Number	Date	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	ug/kg
22	VSP-1	J1RWR0/ J1RWT4	9/5/13	8.76	36.4	33.1	7.58	2.20	2.95	1.98	46.1	6605
23	VSP-2	J1RWR1	9/5/13	8.28	30.8	23.2	1.15	0.756	1.05	0.549	5.36	3640
24	VSP-3	J1RWR2	9/5/13	10.8	43.7	93.7	1.81	1.57	2.60	1.78	8.10	7340
25	VSP-4	J1RWR3	9/5/13	9.67	48.2	51.9	2.01	0.966	2.07	1.44	6.62	7100
26	VSP-5	J1RWR4	9/5/13	9.19	45.4	33.4	1.35	1.73	1.20	0.676	4.34	4360
27	VSP-6	J1RWR5	9/5/13	81.3	48.1	35.6	1.13	1.80	0.775	0.465	4.35	3690
28	VSP-7	J1RWR6	9/5/13	14.5	43.5	39.1	2.23	1.28	0.566	0.167	25.0	2920
29	VSP-8	J1RWR7	9/5/13	12.0	60.5	45.0	2.95	1.00	3.15	2.44	7.38	6990
30	VSP-9	J1RWR8	9/5/13	13.2	51.1	41.9	5.14	1.24	0.751	0.330	10.9	4180
31	VSP-10	J1RWR9	9/5/13	9.79	59.0	38.7	3.36	0.686	0.453	0.0780	2.75	3120
32	VSP-11	J1RWT0	9/5/13	9.55	36.7	31.1	0.922	0.859	0.565	0.0830	1.98	2840
33	VSP-12	J1RWT1	9/5/13	11.3	56.0	42.8	0.970	1.35	0.616	0.0840	5.13	5480

34 **Statistical Computations**

35		Nickel	Vanadium	Zinc	Chloride	Fluoride	Nitrogen in Nitrate	Nitrogen in Nitrate and Nitrite	Sulfate	TPH - motor oil (high boiling)
36	95% UCL based on	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), 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.
37	N	12	12	12	12	12	12	12	12	12
38	% < Detection limit	0%	0%	0%	0%	0%	0%	25%	0%	0%
39	Mean	16.5	46.6	42.5	2.55	1.29	1.40	0.839	10.7	4855
40	Standard deviation	20.5	9.21	17.7	2.01	0.465	1.01	0.841	12.7	1747
41	95% UCL on mean	26.3	52.4	50.9	4.14	1.61	2.38	3.97	21.1	6071
42	Maximum value	81.3	60.5	93.7	7.84	2.40	3.15	2.44	52.0	7340
43	**Most Stringent Cleanup Limit for nonradionuclide and RAG type (mg/kg) unless noted otherwise**	19.1 GW Protection	85.1 GW Protection	67.8 River Protection	25000 GW Protection	96 GW Protection	1000 GW Protection	1000 GW Protection	25000 GW Protection	200000 ug/kg DE, GW & River Protection
44	**WAC 173-340 3-PART TEST**									
45	95% UCL > Cleanup Limit?	YES	NA	NO	NA	NA	NA	NA	NA	NO
46	> 10% above Cleanup Limit?	NO	NA	NO	NA	NA	NA	NA	NA	NO
47	Any sample > 2X Cleanup Limit?	YES	NA	NO	NA	NA	NA	NA	NA	NO
48	**WAC 173-340 Compliance?**	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 (85.1 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 (100 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (2.81 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (11.8 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (11.8 mg/kg) the WAC 173-340 3-part test is not required.	Because all values are below background (237 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.

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Washington Closure Hanford

Originator J. D. Skoglie
Project 100-IU-2/6 Remediation
Subject 600-301 Waste Site Cleanup Verification 95% UCL Calculation

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Job No. 14655

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Ecology Software (MTCAStat) Results, 600-301 Waste Site

Barium 95% UCL Calculation

DATA	ID
48.1	J1RWR0/ J1RWT4
36.6	J1RWR1
51.2	J1RWR2
59.0	J1RWR3
44.8	J1RWR4
44.8	J1RWR5
75.3	J1RWR6
78.3	J1RWR7
74.5	J1RWR8
44.2	J1RWR9
43.4	J1RWT0
73.0	J1RWT1

Number of samples		Uncensored values	
Uncensored	12	Mean	56.1
Censored		Lognormal mean	56.2
Detection limit or PQL		Std. devn.	15.1
Method detection limit		Median	49.6
TOTAL	12	Min.	36.6
		Max.	78.3

Lognormal distribution? r-squared is: 0.899
Normal distribution? r-squared is: 0.875
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 63.3

Beryllium 95% UCL Calculation

DATA	ID
0.436	J1RWR0/ J1RWT4
0.359	J1RWR1
0.502	J1RWR2
0.537	J1RWR3
0.474	J1RWR4
0.522	J1RWR5
0.475	J1RWR6
0.708	J1RWR7
0.530	J1RWR8
0.602	J1RWR9
0.437	J1RWT0
0.648	J1RWT1

Number of samples		Uncensored values	
Uncensored	12	Mean	0.519
Censored		Lognormal mean	0.520
Detection limit or PQL		Std. devn.	0.0969
Method detection limit		Median	0.512
TOTAL	12	Min.	0.359
		Max.	0.708

Lognormal distribution? r-squared is: 0.975
Normal distribution? r-squared is: 0.963
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 0.576

Boron 95% UCL Calculation

DATA	ID
2.03	J1RWR0/ J1RWT4
0.487	J1RWR1
2.03	J1RWR2
1.53	J1RWR3
1.85	J1RWR4
1.27	J1RWR5
1.24	J1RWR6
1.48	J1RWR7
1.33	J1RWR8
0.474	J1RWR9
0.475	J1RWT0
0.470	J1RWT1

Number of samples		Uncensored values	
Uncensored	12	Mean	1.22
Censored		Lognormal mean	1.27
Detection limit or PQL		Std. devn.	0.611
Method detection limit		Median	1.30
TOTAL	12	Min.	0.470
		Max.	2.03

Lognormal distribution? r-squared is: 0.827
Normal distribution? r-squared is: 0.893
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 1.51

Cadmium 95% UCL Calculation

DATA	ID
0.0783	J1RWR0/ J1RWT4
0.0487	J1RWR1
0.146	J1RWR2
0.107	J1RWR3
0.0465	J1RWR4
0.162	J1RWR5
0.0488	J1RWR6
0.134	J1RWR7
0.148	J1RWR8
0.169	J1RWR9
0.0950	J1RWT0
0.180	J1RWT1

Number of samples		Uncensored values	
Uncensored	12	Mean	0.114
Censored		Lognormal mean	0.116
Detection limit or PQL		Std. devn.	0.0496
Method detection limit		Median	0.121
TOTAL	12	Min.	0.0465
		Max.	0.180

Lognormal distribution? r-squared is: 0.885
Normal distribution? r-squared is: 0.930
Recommendations:
Use normal distribution.

UCL (based on t-statistic) is 0.139

Chromium 95% UCL Calculation

DATA	ID
9.26	J1RWR0/ J1RWT4
7.05	J1RWR1
9.64	J1RWR2
10.7	J1RWR3
9.33	J1RWR4
11.3	J1RWR5
16.7	J1RWR6
12.8	J1RWR7
14.7	J1RWR8
9.05	J1RWR9
11.2	J1RWT0
12.7	J1RWT1

Number of samples		Uncensored values	
Uncensored	12	Mean	11.2
Censored		Lognormal mean	11.2
Detection limit or PQL		Std. devn.	2.68
Method detection limit		Median	11.0
TOTAL	12	Min.	7.05
		Max.	16.7

Lognormal distribution? r-squared is: 0.972
Normal distribution? r-squared is: 0.951
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 12.8

Cobalt 95% UCL Calculation

DATA	ID
4.71	J1RWR0/ J1RWT4
4.29	J1RWR1
5.71	J1RWR2
6.76	J1RWR3
5.86	J1RWR4
7.12	J1RWR5
6.90	J1RWR6
8.55	J1RWR7
7.31	J1RWR8
6.88	J1RWR9
4.81	J1RWT0
7.46	J1RWT1

Number of samples		Uncensored values	
Uncensored	12	Mean	6.36
Censored		Lognormal mean	6.38
Detection limit or PQL		Std. devn.	1.29
Method detection limit		Median	6.82
TOTAL	12	Min.	4.29
		Max.	8.55

Lognormal distribution? r-squared is: 0.932
Normal distribution? r-squared is: 0.950
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 7.19

Copper 95% UCL Calculation

DATA	ID
11.4	J1RWR0/ J1RWT4
11.0	J1RWR1
10.8	J1RWR2
11.5	J1RWR3
11.4	J1RWR4
13.2	J1RWR5
21.6	J1RWR6
14.5	J1RWR7
20.4	J1RWR8
14.1	J1RWR9
11.5	J1RWT0
15.7	J1RWT1

Number of samples		Uncensored values	
Uncensored	12	Mean	13.9
Censored		Lognormal mean	13.9
Detection limit or PQL		Std. devn.	3.66
Method detection limit		Median	12.4
TOTAL	12	Min.	10.8
		Max.	21.6

Lognormal distribution? r-squared is: 0.848
Normal distribution? r-squared is: 0.801
Recommendations:
Reject BOTH lognormal and normal distributions.

UCL (based on Z-statistic) is 15.7

Lead 95% UCL Calculation

DATA	ID
4.02	J1RWR0/ J1RWT4
2.73	J1RWR1
4.82	J1RWR2
4.89	J1RWR3
3.62	J1RWR4
5.37	J1RWR5
5.69	J1RWR6
7.41	J1RWR7
4.97	J1RWR8
3.99	J1RWR9
4.06	J1RWT0
7.88	J1RWT1

Number of samples		Uncensored values	
Uncensored	12	Mean	4.95
Censored		Lognormal mean	4.97
Detection limit or PQL		Std. devn.	1.50
Method detection limit		Median	4.86
TOTAL	12	Min.	2.73
		Max.	7.88

Lognormal distribution? r-squared is: 0.962
Normal distribution? r-squared is: 0.925
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 5.91

Manganese 95% UCL Calculation

DATA	ID
208	J1RWR0/ J1RWT4
169	J1RWR1
227	J1RWR2
268	J1RWR3
219	J1RWR4
223	J1RWR5
306	J1RWR6
340	J1RWR7
292	J1RWR8
245	J1RWR9
239	J1RWT0
311	J1RWT1

Number of samples		Uncensored values	
Uncensored	12	Mean	254
Censored		Lognormal mean	254
Detection limit or PQL		Std. devn.	50.1
Method detection limit		Median	242
TOTAL	12	Min.	169
		Max.	340

Lognormal distribution? r-squared is: 0.969
Normal distribution? r-squared is: 0.970
Recommendations:
Use lognormal distribution.

UCL (Land's method) is 284

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	DATA	ID	Molybdenum 95% UCL Calculation			
1		J1RWR0/				
2	0.365	J1RWT4				
3	0.264	J1RWR1				
4	0.426	J1RWR2	Number of samples		Uncensored values	
5	0.405	J1RWR3	Uncensored	12	Mean	0.493
6	0.335	J1RWR4	Censored		Lognormal mean	0.490
7	1.21	J1RWR5	Detection limit or PQL		Std. devn.	0.242
8	0.378	J1RWR6	Method detection limit		Median	0.436
9	0.500	J1RWR7	TOTAL	12	Min.	0.264
10	0.577	J1RWR8			Max.	1.21
11	0.497	J1RWR9				
12	0.446	J1RWT0				
13	0.508	J1RWT1				
14			Lognormal distribution?		Normal distribution?	
15			r-squared is: 0.845		r-squared is: 0.647	
16			Recommendations:			
17			Reject BOTH lognormal and normal distributions.			
18						
19			UCL (based on Z-statistic) is		0.607	
20						

	DATA	ID	Nickel 95% UCL Calculation			
		J1RWR0/				
	8.76	J1RWT4				
	8.28	J1RWR1				
	10.8	J1RWR2	Number of samples		Uncensored values	
	9.67	J1RWR3	Uncensored	12	Mean	16.5
	9.19	J1RWR4	Censored		Lognormal mean	15.0
	81.3	J1RWR5	Detection limit or PQL		Std. devn.	20.5
	14.5	J1RWR6	Method detection limit		Median	10.3
	12.0	J1RWR7	TOTAL	12	Min.	8.28
	13.2	J1RWR8			Max.	81.3
	9.79	J1RWR9				
	9.55	J1RWT0				
	11.3	J1RWT1				
			Lognormal distribution?		Normal distribution?	
			r-squared is: 0.554		r-squared is: 0.376	
			Recommendations:			
			Reject BOTH lognormal and normal distributions.			
			UCL (based on Z-statistic) is		26.3	

	DATA	ID	Vanadium 95% UCL Calculation			
		J1RWR0/				
	36.4	J1RWT4				
	30.8	J1RWR1				
	43.7	J1RWR2	Number of samples		Uncensored values	
	48.2	J1RWR3	Uncensored	12	Mean	46.6
	45.4	J1RWR4	Censored		Lognormal mean	46.7
	48.1	J1RWR5	Detection limit or PQL		Std. devn.	9.21
	43.5	J1RWR6	Method detection limit		Median	46.8
	60.5	J1RWR7	TOTAL	12	Min.	30.8
	51.1	J1RWR8			Max.	60.5
	59.0	J1RWR9				
	36.7	J1RWT0				
	56.0	J1RWT1				
			Lognormal distribution?		Normal distribution?	
			r-squared is: 0.964		r-squared is: 0.977	
			Recommendations:			
			Use lognormal distribution.			
			UCL (Land's method) is		52.4	

	DATA	ID	Zinc 95% UCL Calculation			
21		J1RWR0/				
22	33.1	J1RWT4				
23	23.2	J1RWR1				
24	93.7	J1RWR2	Number of samples		Uncensored values	
25	51.9	J1RWR3	Uncensored	12	Mean	42.5
26	33.4	J1RWR4	Censored		Lognormal mean	42.4
27	35.6	J1RWR5	Detection limit or PQL		Std. devn.	17.7
28	39.1	J1RWR6	Method detection limit		Median	38.9
29	45.0	J1RWR7	TOTAL	12	Min.	23.2
30	41.9	J1RWR8			Max.	93.7
31	38.7	J1RWR9				
32	31.1	J1RWT0				
33	42.8	J1RWT1				
34			Lognormal distribution?		Normal distribution?	
35			r-squared is: 0.868		r-squared is: 0.702	
36			Recommendations:			
37			Reject BOTH lognormal and normal distributions.			
38						
39			UCL (based on Z-statistic) is		50.9	
40						

	DATA	ID	Chloride 95% UCL Calculation			
		J1RWR0/				
	7.58	J1RWT4				
	1.15	J1RWR1				
	1.81	J1RWR2	Number of samples		Uncensored values	
	2.01	J1RWR3	Uncensored	12	Mean	2.55
	1.35	J1RWR4	Censored		Lognormal mean	2.55
	1.13	J1RWR5	Detection limit or PQL		Std. devn.	2.01
	2.23	J1RWR6	Method detection limit		Median	1.91
	2.95	J1RWR7	TOTAL	12	Min.	0.922
	5.14	J1RWR8			Max.	7.58
	3.36	J1RWR9				
	0.922	J1RWT0				
	0.970	J1RWT1				
			Lognormal distribution?		Normal distribution?	
			r-squared is: 0.944		r-squared is: 0.787	
			Recommendations:			
			Use lognormal distribution.			
			UCL (Land's method) is		4.14	

	DATA	ID	Flouride 95% UCL Calculation			
		J1RWR0/				
	2.20	J1RWT4				
	0.756	J1RWR1				
	1.57	J1RWR2	Number of samples		Uncensored values	
	0.966	J1RWR3	Uncensored	12	Mean	1.29
	1.73	J1RWR4	Censored		Lognormal mean	1.29
	1.80	J1RWR5	Detection limit or PQL		Std. devn.	0.465
	1.28	J1RWR6	Method detection limit		Median	1.26
	1.00	J1RWR7	TOTAL	12	Min.	0.686
	1.24	J1RWR8			Max.	2.20
	0.686	J1RWR9				
	0.859	J1RWT0				
	1.35	J1RWT1				
			Lognormal distribution?		Normal distribution?	
			r-squared is: 0.983		r-squared is: 0.962	
			Recommendations:			
			Use lognormal distribution.			
			UCL (Land's method) is		1.61	

	DATA	ID	Nitrogen in Nitrate 95% UCL Calculation			
41		J1RWR0/				
42	2.95	J1RWT4				
43	1.05	J1RWR1				
44	2.60	J1RWR2	Number of samples		Uncensored values	
45	2.07	J1RWR3	Uncensored	12	Mean	1.40
46	1.20	J1RWR4	Censored		Lognormal mean	1.42
47	0.775	J1RWR5	Detection limit or PQL		Std. devn.	1.01
48	0.566	J1RWR6	Method detection limit		Median	0.913
49	3.15	J1RWR7	TOTAL	12	Min.	0.453
50	0.751	J1RWR8			Max.	3.15
51	0.453	J1RWR9				
52	0.565	J1RWT0				
53	0.616	J1RWT1				
54			Lognormal distribution?		Normal distribution?	
55			r-squared is: 0.913		r-squared is: 0.836	
56			Recommendations:			
57			Use lognormal distribution.			
58						
59			UCL (Land's method) is		2.38	
60						

	DATA	ID	Nitrogen in ntirate and nitrite 95% UCL Calculation			
		J1RWR0/				
	1.98	J1RWT4				
	0.549	J1RWR1				
	1.78	J1RWR2	Number of samples		Uncensored values	
	1.44	J1RWR3	Uncensored	12	Mean	0.839
	0.676	J1RWR4	Censored		Lognormal mean	1.03
	0.465	J1RWR5	Detection limit or PQL		Std. devn.	0.841
	0.167	J1RWR6	Method detection limit		Median	0.507
	2.44	J1RWR7	TOTAL	12	Min.	0.0780
	0.330	J1RWR8			Max.	2.44
	0.0780	J1RWR9				
	0.0830	J1RWT0				
	0.0840	J1RWT1				
			Lognormal distribution?		Normal distribution?	
			r-squared is: 0.931		r-squared is: 0.856	
			Recommendations:			
			Use lognormal distribution.			
			UCL (Land's method) is		3.97	

	DATA	ID	Sulfate 95% UCL Calculation			
		J1RWR0/				
	46.1	J1RWT4				
	5.36	J1RWR1				
	8.10	J1RWR2	Number of samples		Uncensored values	
	6.62	J1RWR3	Uncensored	12	Mean	10.7
	4.34	J1RWR4	Censored		Lognormal mean	10.3
	4.35	J1RWR5	Detection limit or PQL		Std. devn.	12.7
	25.0	J1RWR6	Method detection limit		Median	5.99
	7.38	J1RWR7	TOTAL	12	Min.	1.98
	10.9	J1RWR8			Max.	46.1
	2.75	J1RWR9				
	1.98	J1RWT0				
	5.13	J1RWT1				
			Lognormal distribution?		Normal distribution?	
			r-squared is: 0.925		r-squared is: 0.630	
			Recommendations:			
			Reject BOTH lognormal and normal distributions.			
			UCL (based on Z-statistic) is		21.1	

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Ecology Software (MTCAStat) Results, 600-301 Waste Site

1	**DATA**	**ID**	**TPH - Motor Oil (high boiling) 95% UCL Calculation**			
2	6605	J1RWR0/ J1RWT4				
3	3640	J1RWR1				
4	7340	J1RWR2	Number of samples		Uncensored values	
5	7100	J1RWR3	Uncensored	12	Mean	4855
6	4360	J1RWR4	Censored		Lognormal mean	4884
7	3690	J1RWR5	Detection limit or PQL		Std. devn.	1747
8	2920	J1RWR6	Method detection limit		Median	4270
9	6990	J1RWR7	TOTAL	12	Min.	2840
10	4180	J1RWR8			Max.	7340
11	3120	J1RWR9				
12	2840	J1RWT0				
13	5480	J1RWT1				
14			Lognormal distribution?		Normal distribution?	
15			r-squared is: 0.921		r-squared is: 0.897	
16			Recommendations:			
17			Use lognormal distribution.			
18						
19			UCL (Land's method) is		6071	
20						

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Originator J. D. Skoglie **Date** 10/24/13 **Calc. No.** 0600X-CA-C0152 **Rev. No.** 0

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Duplicate Analysis - 600-301

Sampling Area	Sample Number	Sample Date	Aluminum			Barium			Beryllium			Boron			Calcium			Chromium			Cobalt			Copper			Iron		
			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	mg/kg	Q	PQL
VSP-1	J1RWR0	9/5/13	4810		6.68	48.3		0.0982	0.441	B	0.0982	2.09	B	0.982	4720	*	7.86	9.24		0.147	4.86		0.147	11.5		0.295	15000		7.86
Duplicate of J1RWR0	J1RWT4	9/5/13	4950		6.75	47.8		0.0992	0.430	B	0.0992	1.97	B	0.992	4030	*	7.94	9.27		0.149	4.55		0.149	11.3		0.298	14800		7.94

Analysis:

	TDL	5	2	0.2	2	100	1	2	1	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	2.9%	1.0%			15.8%	0.3%		1.8%	1.3%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable

Duplicate Analysis - 600-301

Sampling Area	HEIS Number	Sample Date	Lead			Magnesium			Manganese			Molybdenum			Nickel			Potassium			Silicon			Sodium			Vanadium		
			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	mg/kg	Q	PQL
VSP-1	J1RWR0	9/5/13	4.33		0.324	3670		8.35	208		0.196	0.407	B	0.196	8.94		0.147	970		6.28	279	JN	1.47	297		6.87	36.9		0.0982
Duplicate of J1RWR0	J1RWT4	9/5/13	3.70		0.327	3710		8.43	207		0.198	0.323	B	0.198	8.57		0.149	1030		6.35	299	JN	1.49	300		6.94	35.8		0.0992

Analysis:

	TDL	5	75	5	2	4	400	2	50	2.5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	Yes (calc RPD)
	RPD		1.1%	0.5%				6.9%	1.0%	3.0%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable	No - acceptable	Not applicable	Not applicable	Not applicable

Duplicate Analysis - 600-301

Sampling Area	HEIS Number	Sample Date	Zinc			Chloride			Fluoride			Nitrogen in Nitrate			Nitrogen in Nitrate and Nitrite			Phosphorous in Phosphate			Sulfate			TPH - motor oil (high boiling)		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL
VSP-1	J1RWR0	9/5/13	32.7		0.393	7.32		0.672	2.40		0.331	3.04	J	0.331	2.06		0.172	0.815	JB	0.672	40.2		1.33	6340	J	2170
Duplicate of J1RWR0	J1RWT4	9/5/13	33.4		0.397	7.84		0.661	1.99		0.326	2.85	J	0.326	1.89		0.170	1.01	JB	0.661	52.0		1.31	6870		2160

Analysis:

	TDL	1	2	5	0.75	0.75	10	5	5000
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)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	2.1%						25.6%	
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable

Attachment 1. 600-301 Waste Site Verification Sample Results (Metals)

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
VSP-1	J1RWR0	9/5/13	4810		6.68	1.62	DU	1.62	2.89	UJBC	0.491	48.3		0.0982	0.441	B	0.0982
Duplicate of J1RWR0	J1RWT4	9/5/13	4950		6.75	0.327	U	0.327	2.44	UJBC	0.496	47.8		0.0992	0.430	B	0.0992
VSP-2	J1RWR1	9/5/13	4310		6.61	0.353	B	0.321	2.28	UJBC	0.486	36.6		0.0973	0.359	B	0.0973
VSP-3	J1RWR2	9/5/13	5020		6.68	1.62	DU	1.62	2.90	UJBC	0.492	51.2		0.0983	0.502		0.0983
VSP-4	J1RWR3	9/5/13	5690		6.86	1.66	DU	1.66	2.65	UJBC	0.504	59.0		0.101	0.537		0.101
VSP-5	J1RWR4	9/5/13	4970		6.32	1.53	DU	1.53	2.95	UJC	0.465	44.8		0.0929	0.474		0.0929
VSP-6	J1RWR5	9/5/13	5250		6.79	1.65	DU	1.65	3.56	UJC	0.499	44.8		0.0999	0.522		0.0999
VSP-7	J1RWR6	9/5/13	7450		6.63	0.322	U	0.322	4.88		0.488	75.3		0.0976	0.475	B	0.0976
VSP-8	J1RWR7	9/5/13	7190		6.60	1.60	DU	1.60	3.26	UJC	0.485	78.3		0.0971	0.708		0.0971
VSP-9	J1RWR8	9/5/13	6740		6.65	1.61	DU	1.61	4.12		0.489	74.5		0.0978	0.530		0.0978
VSP-10	J1RWR9	9/5/13	4550		6.44	1.56	DU	1.56	2.44	UJBC	0.474	44.2		0.0947	0.602		0.0947
VSP-11	J1RWT0	9/5/13	5340		6.46	0.313	U	0.313	2.85	UJC	0.475	43.4		0.0950	0.437	B	0.0950
VSP-12	J1RWT1	9/5/13	7030		6.39	1.55	DU	1.55	3.18	UJC	0.470	73.0		0.0940	0.648		0.0940
FS-1	J1RWT2	9/5/13	6460		6.78	1.65	DU	1.65	2.67	UJBC	0.499	69.5		0.0997	0.538		0.0997
FS-2	J1RWT3	9/5/13	7150		6.76	1.64	DU	1.64	4.13		0.497	79.0		0.0994	0.572		0.0994
Equipment Blank	J1RWT5	9/5/13	115		6.17	0.299	U	0.299	0.491	UJBC	0.454	1.6		0.0907	0.0907	U	0.0907

Sample Location	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
VSP-1	J1RWR0	9/5/13	2.09	B	0.982	0.107	B	0.0982	4720	*	7.86	9.24		0.147	4.86		0.147
Duplicate of J1RWR0	J1RWT4	9/5/13	1.97	B	0.992	0.0992	U	0.0992	4030	*	7.94	9.27		0.149	4.55		0.149
VSP-2	J1RWR1	9/5/13	0.973	U	0.973	0.0973	U	0.0973	2970	*	7.78	7.05		0.146	4.29		0.146
VSP-3	J1RWR2	9/5/13	2.03	B	0.983	0.146	B	0.0983	3840	*	7.86	9.64		0.147	5.71	D	0.737
VSP-4	J1RWR3	9/5/13	1.53	B	1.01	0.107	B	0.101	3360	*	8.07	10.7		0.151	6.76	D	0.756
VSP-5	J1RWR4	9/5/13	1.85	B	0.929	0.0929	U	0.0929	4780	*	7.43	9.33		0.139	5.86	D	0.697
VSP-6	J1RWR5	9/5/13	1.27	B	0.999	0.162	B	0.0999	4270	*	7.99	11.3		0.150	7.12	D	0.749
VSP-7	J1RWR6	9/5/13	1.24	B	0.976	0.0976	U	0.0976	11600	*	7.80	16.7		0.146	6.90		0.146
VSP-8	J1RWR7	9/5/13	1.48	B	0.971	0.134	B	0.0971	3570	*	7.77	12.8		0.146	8.55	D	0.728
VSP-9	J1RWR8	9/5/13	1.33	B	0.978	0.148	B	0.0978	8290	*	7.82	14.7		0.147	7.31	D	0.734
VSP-10	J1RWR9	9/5/13	0.947	U	0.947	0.169	B	0.0947	4220	*	7.58	9.05		0.142	6.88	D	0.710
VSP-11	J1RWT0	9/5/13	0.950	U	0.950	0.0950	B	0.0950	4820	*	7.60	11.2		0.142	4.81		0.142
VSP-12	J1RWT1	9/5/13	0.940	U	0.940	0.180	B	0.0940	3720	*	7.52	12.7		0.141	7.46	D	0.705
FS-1	J1RWT2	9/5/13	1.37	B	0.997	0.137	B	0.0997	3510	*	7.98	10.9		0.150	6.37	D	0.748
FS-2	J1RWT3	9/5/13	1.71	B	0.994	0.149	B	0.0994	4110	*	7.95	13.2		0.149	7.02	D	0.745
Equipment Blank	J1RWT5	9/5/13	0.907	U	0.907	0.0907	U	0.0907	32.6	*	7.26	0.136	U	0.136	0.136	U	0.136

Note: 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 = analyte was detected inboth the sample and associated QC blank, and the sample concentration was ≤ 5x the blank concentration.

D = reported from a dilution

FS = focused sample

HEIS = Hanford Environmental Information System

HERB = herbicides

J = estimate

N = recovery is outside control limits.

PEST = pesticides

PQL = practical quantitation limit

Q = qualifier

R = rejected

TPH = total petroleum hydrocarbon

U = undetected

VSP = visual sample plan

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

Attachment	1	Sheet No.	1 of 6
Originator	J. D. Skoglie	Date	10/24/13
Checked	N. K. Schiffern	Date	10/24/13
Calc. No.	0600X-CA-C0152	Rev. No.	0

Attachment 1. 600-301 Waste Site Verification Sample Results (Metals)

Sample Location	HEIS Number	Sample Date	Copper			Iron			Lead			Magnesium			Manganese		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
VSP-1	J1RWR0	9/5/13	11.5		0.295	15000		7.86	4.33		0.324	3670		8.35	208		0.196
Duplicate of J1RWR0	J1RWT4	9/5/13	11.3		0.298	14800		7.94	3.70		0.327	3710		8.43	207		0.198
VSP-2	J1RWR1	9/5/13	11.0		0.292	12600		7.78	2.73		0.321	3030		8.27	169		0.195
VSP-3	J1RWR2	9/5/13	10.8		0.295	16300		7.86	4.82	BD	1.62	4000		8.36	227		0.197
VSP-4	J1RWR3	9/5/13	11.5		0.302	18200		8.07	4.89	BD	1.66	3760		8.57	268		0.202
VSP-5	J1RWR4	9/5/13	11.4		0.279	16900		7.43	3.62	BD	1.53	4170		7.90	219		0.186
VSP-6	J1RWR5	9/5/13	13.2		0.300	18700		7.99	5.37	D	1.65	4370		8.49	223		0.200
VSP-7	J1RWR6	9/5/13	21.6		0.293	18900		7.80	5.69		0.322	6390		8.29	306		0.195
VSP-8	J1RWR7	9/5/13	14.5		0.291	23100		7.77	7.41	D	1.60	4520		8.25	340		0.194
VSP-9	J1RWR8	9/5/13	20.4		0.293	19100		7.82	4.97	D	1.61	5300		8.31	292		0.196
VSP-10	J1RWR9	9/5/13	14.1		0.284	20700		7.58	3.99	BD	1.56	4120		8.05	245		0.189
VSP-11	J1RWT0	9/5/13	11.5		0.285	16000		7.60	4.06		0.313	4040		8.07	239		0.190
VSP-12	J1RWT1	9/5/13	15.7		0.282	20900		7.52	7.88	D	1.55	4230		7.99	311		0.188
FS-1	J1RWT2	9/5/13	12.0		0.299	17800		7.98	11.4	D	1.65	3650		8.48	282		0.199
FS-2	J1RWT3	9/5/13	14.8		0.298	19600		7.95	23.1	D	1.64	4380		8.45	307		0.199
Equipment Blank	J1RWT5	9/5/13	0.272	U	0.272	259		7.26	0.513	B	0.299	19.6	B	7.71	5.52		0.181

Sample Location	HEIS Number	Sample Date	Mercury			Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
VSP-1	J1RWR0	9/5/13	0.00681	B	0.00400	0.407	B	0.196	8.94		0.147	970		6.28	0.322	DU	0.322
Duplicate of J1RWR0	J1RWT4	9/5/13	0.00404	U	0.00404	0.323	B	0.198	8.57		0.149	1030		6.35	0.289	DU	0.289
VSP-2	J1RWR1	9/5/13	0.00386	U	0.00386	0.264	B	0.195	8.28		0.146	927		6.22	0.302	DU	0.302
VSP-3	J1RWR2	9/5/13	0.00391	U	0.00391	0.426	B	0.197	10.8		0.147	1150		6.29	0.328	DU	0.328
VSP-4	J1RWR3	9/5/13	0.00395	U	0.00395	0.405	B	0.202	9.67		0.151	1540		6.45	0.333	DU	0.333
VSP-5	J1RWR4	9/5/13	0.00368	U	0.00368	0.335	B	0.186	9.19		0.139	1180		5.95	0.311	DU	0.311
VSP-6	J1RWR5	9/5/13	0.00388	U	0.00388	1.21		0.200	81.3		0.150	989		6.39	0.330	DU	0.330
VSP-7	J1RWR6	9/5/13	0.00922	B	0.00396	0.378	B	0.195	14.5		0.146	759		6.24	0.313	DU	0.313
VSP-8	J1RWR7	9/5/13	0.00352	U	0.00352	0.500	B	0.194	12.0		0.146	1560		6.21	0.324	DU	0.324
VSP-9	J1RWR8	9/5/13	0.00461	B	0.00396	0.577	B	0.196	13.2		0.147	940		6.26	0.297	DU	0.297
VSP-10	J1RWR9	9/5/13	0.00396	U	0.00396	0.497	B	0.189	9.79		0.142	670		6.06	0.313	DU	0.313
VSP-11	J1RWT0	9/5/13	0.00383	U	0.00383	0.446	B	0.190	9.55		0.142	864		6.08	0.313	DU	0.313
VSP-12	J1RWT1	9/5/13	0.00392	U	0.00392	0.508	B	0.188	11.3		0.141	1360		6.01	0.312	DU	0.312
FS-1	J1RWT2	9/5/13	0.00842	B	0.00392	0.537	B	0.199	9.32		0.150	1600		6.38	0.304	DU	0.304
FS-2	J1RWT3	9/5/13	0.0237		0.00380	0.518	B	0.199	11.2		0.149	1700		6.36	0.325	DU	0.325
Equipment Blank	J1RWT5	9/5/13	0.00377	U	0.00377	0.181	U	0.181	0.153	B	0.136	37.5		5.81	0.296	DU	0.296

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
VSP-1	J1RWR0	9/5/13	279	JN	1.47	0.0982	U	0.0982	297		6.87	36.9		0.0982	32.7		0.393
Duplicate of J1RWR0	J1RWT4	9/5/13	299	JN	1.49	0.0992	U	0.0992	300		6.94	35.8		0.0992	33.4		0.397
VSP-2	J1RWR1	9/5/13	275	JN	1.46	0.0973	U	0.0973	178		6.81	30.8		0.0973	23.2		0.389
VSP-3	J1RWR2	9/5/13	275	JN	1.47	0.0983	U	0.0983	109		6.88	43.7	D	0.492	93.7	D	1.97
VSP-4	J1RWR3	9/5/13	278	JN	1.51	0.101	U	0.101	97.5		7.06	48.2	D	0.504	51.9	D	2.02
VSP-5	J1RWR4	9/5/13	242	JN	1.39	0.0929	U	0.0929	150		6.50	45.4	D	0.465	33.4	D	1.86
VSP-6	J1RWR5	9/5/13	279	JN	1.50	0.0999	U	0.0999	130		6.99	48.1	D	0.499	35.6	D	2.00
VSP-7	J1RWR6	9/5/13	274	JN	1.46	0.0976	U	0.0976	365		6.83	43.5		0.0976	39.1		0.390
VSP-8	J1RWR7	9/5/13	294	JN	1.46	0.0971	U	0.0971	115		6.80	60.5	D	0.485	45.0	D	1.94
VSP-9	J1RWR8	9/5/13	280	JN	1.47	0.0978	U	0.0978	194		6.85	51.1	D	0.489	41.9	D	1.96
VSP-10	J1RWR9	9/5/13	279	JN	1.42	0.0947	U	0.0947	119		6.63	59.0	D	0.474	38.7	D	1.89
VSP-11	J1RWT0	9/5/13	271	JN	1.42	0.0950	U	0.0950	78.3		6.65	36.7		0.0950	31.1		0.380
VSP-12	J1RWT1	9/5/13	262	JN	1.41	0.0940	U	0.0940	115		6.58	56.0	D	0.470	42.8	D	1.88
FS-1	J1RWT2	9/5/13	317	JN	1.50	0.0997	U	0.0997	106		6.98	45.3	D	0.499	49.4	D	1.99
FS-2	J1RWT3	9/5/13	323	JN	1.49	0.167	B	0.0994	139		6.96	48.3	D	0.497	55.7	D	1.99
Equipment Blank	J1RWT5	9/5/13	139	JN	1.36	0.0907	U	0.0907	6.35	U	6.35	0.226	B	0.0907	0.807	B	0.363

Attachment	1	Sheet No.	2 of 6
Originator	J. D. Skoglie	Date	10/24/13
Checked	N. K. Schiffern	Date	10/24/13
Calc. No.	0600X-CA-C0152	Rev. No.	0

Attachment 1. 600-301 Waste Site Verification Sample Results (Anions, TPH, and Physical)

Sample Location	HEIS Number	Sample Date	Bromide			Chloride			Fluoride			Nitrogen in Nitrate			Nitrogen in Nitrate and Nitrite			Nitrogen in Nitrite		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
VSP-1	J1RWR0	9/5/13	0.672	U	0.672	7.32		0.672	2.40		0.331	3.04	J	0.331	2.06		0.172	0.331	UR	0.331
Duplicate of J1RWR0	J1RWT4	9/5/13	0.661	U	0.661	7.84		0.661	1.99		0.326	2.85	J	0.326	1.89		0.170	0.326	UR	0.326
VSP-2	J1RWR1	9/5/13	0.675	U	0.675	1.15	B	0.675	0.756	B	0.333	1.05	J	0.333	0.549		0.167	0.333	UR	0.333
VSP-3	J1RWR2	9/5/13	0.673	U	0.673	1.81	B	0.673	1.57		0.332	2.60	J	0.332	1.78		0.170	0.332	UR	0.332
VSP-4	J1RWR3	9/5/13	0.690	U	0.690	2.01	B	0.690	0.966	B	0.340	2.07	J	0.340	1.44		0.172	0.340	UR	0.340
VSP-5	J1RWR4	9/5/13	0.674	U	0.674	1.35	B	0.674	1.73		0.332	1.20	J	0.332	0.676		0.171	0.332	UR	0.332
VSP-6	J1RWR5	9/5/13	0.674	U	0.674	1.13	B	0.674	1.80		0.332	0.775	JB	0.332	0.465	B	0.171	0.332	UR	0.332
VSP-7	J1RWR6	9/5/13	0.673	U	0.673	2.23		0.673	1.28		0.332	0.566	JB	0.332	0.167	B	0.160	0.332	UR	0.332
VSP-8	J1RWR7	9/5/13	0.663	U	0.663	2.95		0.663	1.00		0.327	3.15	J	0.327	2.44		0.162	0.327	UR	0.327
VSP-9	J1RWR8	9/5/13	0.674	U	0.674	5.14		0.674	1.24		0.332	0.751	JB	0.332	0.330	B	0.171	0.332	UR	0.332
VSP-10	J1RWR9	9/5/13	0.661	U	0.661	3.36		0.661	0.686	B	0.326	0.453	JB	0.326	0.156	U	0.156	0.326	UR	0.326
VSP-11	J1RWT0	9/5/13	0.672	U	0.672	0.922	B	0.672	0.859	B	0.331	0.565	JB	0.331	0.166	U	0.166	0.331	UR	0.331
VSP-12	J1RWT1	9/5/13	0.674	U	0.674	0.970	B	0.674	1.35		0.332	0.616	JB	0.332	0.168	U	0.168	0.332	UR	0.332
FS-1	J1RWT2	9/5/13	0.668	U	0.668	4.03		0.668	1.15		0.329	28.1	J	0.329	28.1	D	0.852	0.329	UR	0.329
FS-2	J1RWT3	9/5/13	0.691	U	0.691	1.67	B	0.691	1.25		0.340	3.68	J	0.340	3.08		0.175	0.340	UR	0.340

Sample Location	HEIS Number	Sample Date	Phosphorous in Phosphate			Sulfate			TPH - motor oil (high boiling)			TPH - Diesel Range			pH Measurement		
			mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	pH	Q	PQL
VSP-1	J1RWR0	9/5/13	0.815	JB	0.672	40.2		1.33	6340	J	2170	2170	U	2170	9.36	JX	0.010
Duplicate of J1RWR0	J1RWT4	9/5/13	1.01	JB	0.661	52.0		1.31	6870		2160	2160	U	2160	9.16	JX	0.010
VSP-2	J1RWR1	9/5/13	0.675	UR	0.675	5.36		1.34	3640	J	2170	2170	U	2170	9.14	JX	0.010
VSP-3	J1RWR2	9/5/13	1.06	JB	0.673	8.10		1.34	7340		2170	2170	U	2170	8.89	JX	0.010
VSP-4	J1RWR3	9/5/13	1.73	JB	0.690	6.62		1.37	7100		2210	2210	U	2210	8.94	JX	0.010
VSP-5	J1RWR4	9/5/13	0.674	UR	0.674	4.34		1.34	4360	J	2180	2180	U	2180	9.08	JX	0.010
VSP-6	J1RWR5	9/5/13	0.674	UR	0.674	4.35		1.34	3690	J	2180	2180	U	2180	8.86	JX	0.010
VSP-7	J1RWR6	9/5/13	0.673	UR	0.673	25.0		1.34	2920	J	2170	2170	U	2170	9.32	JX	0.010
VSP-8	J1RWR7	9/5/13	1.46	JB	0.663	7.38		1.32	6990		2180	2180	U	2180	8.36	JX	0.010
VSP-9	J1RWR8	9/5/13	0.674	UR	0.674	10.9		1.34	4180	J	2170	2170	U	2170	8.79	JX	0.010
VSP-10	J1RWR9	9/5/13	0.681	JB	0.661	2.75	B	1.31	3120	J	2170	2170	U	2170	9.08	JX	0.010
VSP-11	J1RWT0	9/5/13	1.06	JB	0.672	1.98	B	1.33	2840	J	2170	2170	UJ	2170	8.82	JX	0.010
VSP-12	J1RWT1	9/5/13	1.16	JB	0.674	5.13		1.34	5480	J	2170	2170	U	2170	8.63	JX	0.010
FS-1	J1RWT2	9/5/13	5.38	J	0.668	35.3		1.33	14000		2180	2410	J	2180	6.74	JX	0.010
FS-2	J1RWT3	9/5/13	3.93	J	0.691	9.68		1.37	9910		2230	2230	U	2230	8.54	JX	0.010

Attachment	1	Sheet No.	3 of 6
Originator	J. D. Skoglie	Date	10/24/13
Checked	N. K. Schiffern	Date	10/24/13
Calc. No.	0600X-CA-C0152	Rev. No.	0

Attachment 1. 600-301 Waste Site Verification Sample Results (Organics)

CONSTITUENT	CLASS	VSP-1 - J1RWR0			Duplicate of J1RWR0 - J1RWT4			VSP-2 - J1RWR1			VSP-3 - J1RWR2			VSP-4 - J1RWR3		
		9/5/13			9/5/13			9/5/13			9/5/13			9/5/13		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
2-(2,4,5-Trichlorophenoxy)propionic acid	HERB	1.67	U	1.67	1.66	U	1.66	1.67	U	1.67	1.66	U	1.66	1.71	U	1.71
2-(2-methyl-4-chlorophenoxy) propionic acid	HERB	201	U	201	201	U	201	201	U	201	201	U	201	206	U	206
2,4,5-Trichlorophenoxyacetic acid	HERB	1.67	U	1.67	1.66	U	1.66	1.67	U	1.67	1.66	U	1.66	1.71	U	1.71
2,4-Dichlorophenoxyacetic acid	HERB	1.67	U	1.67	1.66	U	1.66	1.67	U	1.67	1.66	U	1.66	1.71	U	1.71
2-Methyl-4 chlorophenoxyacetic acid	HERB	231	U	231	231	U	231	232	U	232	231	U	231	237	U	237
2-secButyl-4,6-dinitrophenol(DNBP)	HERB	1.67	U	1.67	1.66	U	1.66	1.67	U	1.67	1.66	U	1.66	1.71	U	1.71
4-(2,4-Dichlorophenoxy)butanoic acid	HERB	1.67	U	1.67	1.66	U	1.66	1.67	U	1.67	1.66	U	1.66	1.71	U	1.71
Dalapon	HERB	35.1	UJ	35.1	35.1	UJ	35.1	35.2	UJ	35.2	35.1	UJ	35.1	36.0	UJ	36.0
Dicamba	HERB	2.01	U	2.01	2.01	U	2.01	2.01	U	2.01	2.01	U	2.01	2.06	U	2.06
Dichloroprop	HERB	2.27	U	2.27	2.27	U	2.27	2.27	U	2.27	2.27	U	2.27	2.33	U	2.33
Aldrin	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.171	U	0.171
Alpha-BHC	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.171	U	0.171
alpha-Chlordane	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.171	U	0.171
Beta-BHC	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.171	U	0.171
Delta-BHC	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.171	U	0.171
4-4'-DDD	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.342	U	0.342
4-4'-DDE	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.342	U	0.342
4-4'-DDT	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.342	U	0.342
Dieldrin	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.342	U	0.342
Endosulfan I	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.171	U	0.171
Endosulfan II	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.342	U	0.342
Endosulfan sulfate	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.342	U	0.342
Endrin	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.342	U	0.342
Endrin aldehyde	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.342	U	0.342
Endrin ketone	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.342	U	0.342
Gamma-BHC (Lindane)	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.171	U	0.171
gamma-Chlordane	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.171	U	0.171
Heptachlor	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.171	U	0.171
Heptachlor epoxide	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.171	U	0.171
Methoxychlor	PEST	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.71	U	1.71
Toxaphene	PEST	5.55	UJ	5.55	5.55	UJ	5.55	5.58	UJ	5.58	5.56	UJ	5.56	5.70	UJ	5.70

Attachment	1	Sheet No.	4 of 6
Originator	J. D. Skoglie	Date	10/24/13
Checked	N. K. Schiffern	Date	10/24/13
Calc. No.	0600X-CA-C0152	Rev. No.	0

Attachment 1. 600-301 Waste Site Verification Sample Results (Organics)

CONSTITUENT	CLASS	VSP-5 - J1RWR4			VSP-6 - J1RWR5			VSP-7 - J1RWR6			VSP-8 - J1RWR7			VSP-9 - J1RWR8		
		9/5/13			9/5/13			9/5/13			9/5/13			9/5/13		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
2-(2,4,5-Trichlorophenoxy)propionic acid	HERB	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67
2-(2-methyl-4-chlorophenoxy) propionic acid	HERB	201	U	201	201	U	201	201	U	201	202	U	202	201	U	201
2,4,5-Trichlorophenoxyacetic acid	HERB	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67
2,4-Dichlorophenoxyacetic acid	HERB	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67
2-Methyl-4 chlorophenoxyacetic acid	HERB	231	U	231	232	U	232	231	U	231	232	U	232	231	U	231
2-secButyl-4,6-dinitrophenol(DNBP)	HERB	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67
4-(2,4-Dichlorophenoxy)butanoic acid	HERB	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67
Dalapon	HERB	35.1	UJ	35.1	35.2	UJ	35.2	35.1	UJ	35.1	35.3	UJ	35.3	35.2	UJ	35.2
Dicamba	HERB	2.01	U	2.01	2.01	U	2.01	2.01	U	2.01	2.02	U	2.02	2.01	U	2.01
Dichloroprop	HERB	2.27	U	2.27	2.27	U	2.27	2.27	U	2.27	2.28	U	2.28	2.27	U	2.27
Aldrin	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.168	U	0.168	0.168	U	0.168
Alpha-BHC	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.168	U	0.168	0.168	U	0.168
alpha-Chlordane	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.168	U	0.168	0.168	U	0.168
Beta-BHC	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.168	U	0.168	0.168	U	0.168
Delta-BHC	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.168	U	0.168	0.168	U	0.168
4-4'-DDD	PEST	0.334	U	0.334	0.334	U	0.334	0.334	U	0.334	0.336	U	0.336	0.335	U	0.335
4-4'-DDE	PEST	0.334	U	0.334	0.334	U	0.334	0.334	U	0.334	0.336	U	0.336	0.335	U	0.335
4-4'-DDT	PEST	0.334	U	0.334	0.334	U	0.334	0.334	U	0.334	0.336	U	0.336	0.335	U	0.335
Dieldrin	PEST	0.334	U	0.334	0.334	U	0.334	0.334	U	0.334	0.336	U	0.336	0.335	U	0.335
Endosulfan I	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.168	U	0.168	0.168	U	0.168
Endosulfan II	PEST	0.334	U	0.334	0.334	U	0.334	0.334	U	0.334	0.336	U	0.336	0.335	U	0.335
Endosulfan sulfate	PEST	0.334	U	0.334	0.334	U	0.334	0.334	U	0.334	0.336	U	0.336	0.335	U	0.335
Endrin	PEST	0.334	U	0.334	0.334	U	0.334	0.334	U	0.334	0.336	U	0.336	0.335	U	0.335
Endrin aldehyde	PEST	0.334	U	0.334	0.334	U	0.334	0.334	U	0.334	0.336	U	0.336	0.335	U	0.335
Endrin ketone	PEST	0.334	U	0.334	0.334	U	0.334	0.334	U	0.334	0.336	U	0.336	0.335	U	0.335
Gamma-BHC (Lindane)	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.168	U	0.168	0.168	U	0.168
gamma-Chlordane	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.168	U	0.168	0.168	U	0.168
Heptachlor	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.168	U	0.168	0.168	U	0.168
Heptachlor epoxide	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.168	U	0.168	0.168	U	0.168
Methoxychlor	PEST	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.68	U	1.68	1.68	U	1.68
Toxaphene	PEST	5.56	UJ	5.56	5.57	UJ	5.57	5.57	UJ	5.57	5.59	UJ	5.59	5.58	UJ	5.58

Attachment	1	Sheet No.	5 of 6
Originator	J. D. Skoglie	Date	10/24/13
Checked	N. K. Schiffern	Date	10/24/13
Calc. No.	0600X-CA-C0152	Rev. No.	0

Attachment 1. 600-301 Waste Site Verification Sample Results (Organics)

CONSTITUENT	CLASS	VSP-10 - J1RWR9			VSP-11 - J1RWT0			VSP-12 - J1RWT1			FS-1 - J1RWT2			FS-2 - J1RWT3		
		9/5/13			9/5/13			9/5/13			9/5/13			9/5/13		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
2-(2,4,5-Trichlorophenoxy)propionic acid	HERB	1.66	U	1.66	1.66	U	1.66	1.67	U	1.67	1.67	U	1.67	1.71	U	1.71
2-(2-methyl-4-chlorophenoxy) propionic acid	HERB	201	U	201	201	U	201	201	U	201	201	U	201	206	U	206
2,4,5-Trichlorophenoxyacetic acid	HERB	1.66	U	1.66	1.66	U	1.66	1.67	U	1.67	1.67	U	1.67	1.71	U	1.71
2,4-Dichlorophenoxyacetic acid	HERB	1.66	U	1.66	1.66	U	1.66	1.67	U	1.67	1.67	U	1.67	1.71	U	1.71
2-Methyl-4 chlorophenoxyacetic acid	HERB	231	U	231	231	U	231	231	U	231	231	U	231	237	U	237
2-secButyl-4,6-dinitrophenol(DNBP)	HERB	1.66	U	1.66	1.66	U	1.66	1.67	U	1.67	1.67	U	1.67	1.71	U	1.71
4-(2,4-Dichlorophenoxy)butanoic acid	HERB	1.66	U	1.66	1.66	U	1.66	1.67	U	1.67	1.67	U	1.67	1.71	U	1.71
Dalapon	HERB	35.1	UJ	35.1	35.1	UJ	35.1	35.2	UJ	35.2	35.2	UJ	35.2	36.1	UJ	36.1
Dicamba	HERB	2.01	U	2.01	2.01	U	2.01	2.01	U	2.01	2.01	U	2.01	2.06	U	2.06
Dichloroprop	HERB	2.27	U	2.27	2.27	U	2.27	2.27	U	2.27	2.27	U	2.27	2.33	U	2.33
Aldrin	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.172	U	0.172
Alpha-BHC	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.172	U	0.172
alpha-Chlordane	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.172	U	0.172
Beta-BHC	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.172	U	0.172
Delta-BHC	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.172	U	0.172
4-4'-DDD	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.344	U	0.344
4-4'-DDE	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.344	U	0.344
4-4'-DDT	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.344	U	0.344
Dieldrin	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.344	U	0.344
Endosulfan I	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.172	U	0.172
Endosulfan II	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.344	U	0.344
Endosulfan sulfate	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.344	U	0.344
Endrin	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.344	U	0.344
Endrin aldehyde	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.344	U	0.344
Endrin ketone	PEST	0.334	U	0.334	0.333	U	0.333	0.335	U	0.335	0.334	U	0.334	0.344	U	0.344
Gamma-BHC (Lindane)	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.172	U	0.172
gamma-Chlordane	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.172	U	0.172
Heptachlor	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.172	U	0.172
Heptachlor epoxide	PEST	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.167	U	0.167	0.172	U	0.172
Methoxychlor	PEST	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.67	U	1.67	1.72	U	1.72
Toxaphene	PEST	5.57	UJ	5.57	5.55	UJ	5.55	5.57	UJ	5.57	5.56	UJ	5.56	5.72	UJ	5.72

Attachment	1	Sheet No.	6 of 6
Originator	J. D. Skoglie	Date	10/24/13
Checked	N. K. Schiffern	Date	10/24/13
Calc. No.	0600X-CA-C0152	Rev. No.	0

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-IU-2/6 Field Remediation **Job No. 14655**

Area: 600

Discipline: Environmental Calculation No: 0600X-CA-V0153

Subject: 600-301 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 3 Total = 4	J. D. Skoglie	C. H. Dobie	I. B. Berezovskiy	D. F. Obenauer	12/16/13

SUMMARY OF REVISION

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

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	10/29/2013	Calc. No.:	0600X-CA-V0153	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	C. H. Dobie	Date:	10/29/2013
Subject:	600-301 Waste Site 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 600-301 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009b), the following criteria must be met:

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

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 Area,* 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, 2013, *Remaining Sites Verification Package for the 600-301, White Bluffs Sanitary Sewer Pipelines Waste Site*, Attachment to Waste Site Reclassification Form 2013-129, Washington Closure Hanford, Inc., 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, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	10/29/2013	Calc. No.:	0600X-CA-V0153	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	C. H. Dobie	Date:	10/29/2013
Subject:	600-301 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 3	

METHODOLOGY:

The 600-301 waste site is comprised of one statistical decision unit (excavation) and two focused samples for verification sampling. The direct contact hazard quotient and carcinogenic risk calculations for the 600-301 waste site were conservatively calculated for the entire waste site using the greater of the statistical and focused verification soil sample results (WCH 2013). Of the contaminants of potential concern (COPCs) for this site, boron and molybdenum require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Nickel and nitrogen in nitrate and nitrite require HQ and risk calculations because these analytes were detected above a Washington State or Hanford Site background value. Lead is not included in the calculation based on modeling of child blood levels, which is fundamentally different from the oral-reference dose and cancer slope factors used to calculate typical cleanup levels and associated HQs and cancer risks. Although total petroleum hydrocarbons (Diesel Range + Motor Oil) was detected and no background value is available, the risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 1.71 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 2.4×10^{-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 1.8×10^{-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}. There were not any detected analytes with a carcinogenic RAG, therefore, comparing all individual values, to the requirement of $<1 \times 10^{-6}$, this criterion is met. The sum of the excess cancer risk value is zero, which also meets the criterion of $<1 \times 10^{-5}$.

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 hazard quotient and excess cancer risk calculations.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoghe	Date:	10/29/2013	Calc. No.:	0600X-CA-V0153	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	C. H. Dobie	Date:	10/29/2013
Subject:	600-301 Waste Site 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 600-301 Waste Site.

Contaminants of Potential Concern	Maximum or Statistical Value [a] (mg/kg)	Noncarcinogen RAG [b] (mg/kg)	Hazard Quotient	Carcinogen RAG [b] (mg/kg)	Carcinogen Risk
Metals					
Boron	1.71	7,200	2.4E-04	--	--
Lead [c]	23.1	353	--	--	--
Molybdenum	0.607	400	1.5E-03	--	--
Nickel	26.3	1,600	1.6E-02	--	--
Anions					
Nitrogen in nitrate and nitrite	28.1	128,000	2.2E-04	--	--
Total Petroleum Hydrocarbons					
TPH - Diesel Range + Motor Oil [d]	16.4	200	--	--	--
Totals					
Cumulative Hazard Quotient:			**1.8E-02**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:

[a] = From WCH (2013).

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

[c] = 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.

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

-- = not applicable

RAG = remedial action goal

CONCLUSION:

The calculations in Table 1 demonstrate that the 600-301 waste site meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk, respectively, as identified in the RDR/RAWP (DOE-RL 2009b) and SAP (DOE-RL 2009a). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this site.

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-IU-2/6 Field Remediation **Job No. 14655**

Area: 600 Area

Discipline: Environmental *Calculation No: 0600X-CA-V0163

Subject: 600-301 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☐ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 6 Attachment = 8 Total = 15	J. D. Skoglie John Skoglie	N. K. Schiffern N K. Schiffern	I. B. Berezovsky I B Berezovsky	D. F. Obenauer D F Obenauer	12/16/13

SUMMARY OF REVISION

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/10/2013	Calc. No.:	0600X-CA-V0163	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	12/10/2013
Subject:	600-301 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 6	

PURPOSE:

Using sample data from Attachment 1 provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 600-301 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009b), the following criteria must be met:

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

Also, calculate the relative percent difference (RPD) for primary-duplicate sample pairs from 600-301 waste site confirmatory sampling, as necessary.

GIVEN/REFERENCES:

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

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

3) EPA, 1994, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, EPA 540/R-94/013, U.S. Environmental Protection Agency, Washington, D.C.

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

5) WCH, 2013, *Remaining Sites Verification Package for the 600-301, White Bluffs Sanitary Sewer Pipelines Waste Site*, Attachment to Waste Site Reclassification Form 2013-129, Washington Closure Hanford, Inc., 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).

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/12/2013	Calc. No.:	0600X-CA-V0163	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	12/12/2013
Subject:	600-301 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 6	

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

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

METHODOLOGY:

The 600-301 waste site underwent confirmatory sampling at six test pits (TP-1, 2, 3, 4, 5, and 7) consisting of 10 focused samples and one duplicate sample. Of these, only TP-3, TP-4, and TP-5 will be used in the following RPD-HQ calculations. The remaining test pits are for information only and are discussed in the RSVP (WCH 2013). The direct contact hazard quotient and carcinogenic risk calculations for the 600-301 waste site were conservatively calculated using the maximum results from Attachment 1. Of the contaminants of potential concern (COPCs) and other analytes for this site, boron, molybdenum, and the detected pesticides require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Cadmium and zinc require HQ and risk calculations because these analytes were detected above Washington State or Hanford Site background value. Although total petroleum hydrocarbons (Diesel Range EXT) were detected and no background value is available, the risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation. 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. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 1.3 mg/kg, divided by the noncarcinogenic RAG value of 7,200 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 1.8×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation. The sum of the HQ values for COPCs is 7.7×10^{-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 cadmium is 1.2 mg/kg, divided by 13.9 mg/kg, and multiplied as indicated, is 8.6×10^{-8}. Comparing this value, and all other individual values, to the requirement of $<1 \times 10^{-6}$, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual cancer risk values prior to rounding are used for this calculation. The sum of the excess cancer risk values for COPCs is 9.1×10^{-8}. Comparing these values to the requirement of $<1 \times 10^{-5}$, this criterion is met.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/10/2013	Calc. No.:	0600X-CA-V0163	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	12/10/2013
Subject:	600-301 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 6	

5) The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed for certain analytes in Table II-1 of the SAP (DOE-RL 2009a). Other analytes will have their own pre-determined constituents and will have their own TDLs based on the laboratory and method used. Where direct evaluation of the attached sample data showed that a given analyte was not detected in the primary and/or duplicate sample, further evaluation of the RPD value was not performed. The RPD calculations use the following formula:

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

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

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

For quality assurance/quality control (QA/QC) duplicate RPD calculations, a value less than 30% indicates the data compare favorably. For regulatory splits, a threshold of 35% is used (EPA 1994). If the RPD is greater than 30% (or 35% for regulatory split data), further investigation regarding the usability of the data is performed. No split samples were collected for the confirmatory sampling at the subject site. Additional discussion is provided in the data quality assessment section of the applicable RSVP (WCH 2013), as necessary.

RESULTS:

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

Table 1 shows the results of the hazard quotient and excess cancer risk calculations for the 600-301 waste site.

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

Table 2 shows the results of the RPD calculations for the 600-301 waste site.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/12/2013	Calc. No.:	0600X-CA-V0163	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	12/12/2013
Subject:	600-301 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 4 of 6	

Table 1. Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 600-301 Waste Site.

Contaminants of Potential Concern	Maximum Value [a] (mg/kg)	Noncarcinogen RAG [b] (mg/kg)	Hazard Quotient	Carcinogen RAG [b] (mg/kg)	Carcinogen Risk
Metals					
Boron	1.3	7,200	1.8E-04	--	--
Cadmium	1.2	80	1.5E-02	13.9	8.6E-08
Lead [c]	15.4	353	--	--	--
Molybdenum	0.26	400	6.5E-04	--	--
Zinc	1460	24,000	6.1E-02	--	--
Pesticides					
DDE, 4,4'-	0.0065	--	--	2.94	2.2E-09
DDT, 4,4'-	0.0077	40	1.9E-04	2.94	2.6E-09
Endrin (and ketone, aldehyde)	0.00036	24	1.5E-05	--	--
Total Petroleum Hydrocarbons					
TPH - Diesel Range EXT [d]	19	200	--	--	--
Totals					
Cumulative Hazard Quotient:			**7.7E-02**		
Cumulative Excess Cancer Risk:					**9.1E-08**

Notes:

[a] = From Attachment 1.

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

[c] = 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.

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

-- = not applicable

RAG = remedial action goal

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/10/2013	Calc. No.:	0600X-CA-V0163	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	12/10/2013
Subject:	600-301 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 5 of 6	

Table 2. Relative Percent Difference Calculations for the 600-301 Waste Site (2 Pages).

600-301 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP-3 - Soil Inside/on Top of Concrete Structure	J1C2D7	10/21/10	5990	X	1.4	1.8		0.62	58.0		0.071	0.11	B	0.031
Duplicate of J1C2D7	J1C2D8	10/21/10	6210	X	1.5	1.8		0.65	60.0		0.075	0.12	B	0.033

Analysis:

TDL		Aluminum	Arsenic	Barium	Beryllium
		5	10	2	0.2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	3.6%		3.4%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable

600-301 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP-3 - Soil Inside/on Top of Concrete Structure	J1C2D7	10/21/10	0.18	B	0.038	3560	X	13.2	8.5		0.054	5.1		0.093
Duplicate of J1C2D7	J1C2D8	10/21/10	0.19	B	0.041	3530	X	14.0	14.4		0.058	5.3		0.099

Analysis:

TDL		Cadmium	Calcium	Chromium	Cobalt
		0.2	100	1	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD		0.8%	51.5%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable

600-301 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Copper			Iron			Lead			Magnesium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP-3 - Soil Inside/on Top of Concrete Structure	J1C2D7	10/21/10	18.8		0.20	13800	X	3.6	15.2		0.25	3770	X	3.5
Duplicate of J1C2D7	J1C2D8	10/21/10	14.5		0.22	14200	X	3.8	13.2		0.27	3810	X	3.7

Analysis:

TDL		Copper	Iron	Lead	Magnesium
		1	5	5	75
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	25.8%	2.9%		1.1%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Not applicable

600-301 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Manganese			Nickel			Potassium			Silicon		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP-3 - Soil Inside/on Top of Concrete Structure	J1C2D7	10/21/10	240	X	0.093	10.3		0.11	1110		38.3	222		2.2
Duplicate of J1C2D7	J1C2D8	10/21/10	248	X	0.099	13.7		0.12	1110		40.7	182		2.1

Analysis:

TDL		Manganese	Nickel	Potassium	Silicon
		5	4	400	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	3.3%			19.8%
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	Not applicable

600-301 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Sodium			Vanadium			Zinc			Fluoride		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP-3 - Soil Inside/on Top of Concrete Structure	J1C2D7	10/21/10	124		55.2	25.8		0.088	35.9		0.37	1.2	B	0.86
Duplicate of J1C2D7	J1C2D8	10/21/10	129		58.5	26.0		0.093	36.0		0.39	0.96	B	0.80

Analysis:

TDL		Sodium	Vanadium	Zinc	Fluoride
		50	2.5	1	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD		0.8%	0.3%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable

600-301 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Nitrogen in Nitrate			Nitrogen in Nitrite and Nitrate			Phosphorous in phosphate			4-4'-DDE		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL
TP-3 - Soil Inside/on Top of Concrete Structure	J1C2D7	10/21/10	0.61	B	0.33	0.52	B	0.38	1.7	B	1.3	6.3		0.25
Duplicate of J1C2D7	J1C2D8	10/21/10	0.66	B	0.31	0.49	B	0.37	1.6	B	1.2	6.5		0.24

Analysis:

TDL		Nitrogen in Nitrate	Nitrogen in Nitrite and Nitrate	Phosphorous in phosphate	4-4'-DDE
		0.75	0.75	5	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD				
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	No - acceptable

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	J. D. Skoglie	Date:	12/12/2013	Calc. No.:	0600X-CA-V0163	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	N. K. Schiffern	Date:	12/12/2013
Subject:	600-301 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 6 of 6	

Table 2. Relative Percent Difference Calculations for the 600-301 Waste Site (2 Pages).

600-301 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	4-4'-DDT		
			ug/kg	Q	PQL
TP-3 - Soil Inside/on Top of Concrete Structure	J1C2D7	10/21/10	7.7		0.63
Duplicate of J1C2D7	J1C2D8	10/21/10	7.7		0.60

Analysis:

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

CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 600-301 waste site meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the RDR/RAWP (DOE-RL 2009b) and SAP (DOE-RL 2009a). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this site.

Attachment 1. 600-301 Waste Site Confirmatory Sample Results (Metals).

Sample 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
TP-3 - Soil Inside/on Top of Concrete Structure [a]	J1C2D7	10/21/10	5990	X	1.4	0.36	U	0.36	1.8		0.62	58.0		0.071	0.11	B	0.031	0.98	B	0.92
Duplicate of J1C2D7 [a]	J1C2D8	10/21/10	6210	X	1.5	0.38	U	0.38	1.8		0.65	60.0		0.075	0.12	B	0.033	0.97	U	0.97
TP-1 - West Vertical Pipe Contents (soil)	J1CMP8	11/3/10	7480		1.3	0.32	U	0.32	2.2		0.56	64.3	X	0.065	0.12	B	0.028	1.8		0.83
TP-2 - Tank Contents (soil)	J1C2D9	10/25/10	7550		1.5	0.51	B	0.37	3.3		0.65	85.6		0.075	0.18	B	0.032	3.2		0.96
TP-2 - East Vertical Pipe Contents (soil)	J1C2F0	10/25/10	7550		1.4	0.34	U	0.34	3.2		0.58	85.8		0.067	0.19		0.029	2.5		0.87
TP-2 - Soil Under Tank	J1C2F1	10/25/10	6700		1.6	0.39	U	0.39	33.2		0.67	62.9		0.078	0.13	B	0.034	1.4	B	1.0
TP-4 - Surface Soil Inside Manhole [a]	J1C2F2	10/25/10	6370		1.4	0.35	U	0.35	1.8		0.62	61.7		0.071	0.13	B	0.031	1.3	B	0.91
TP-5 - Red Stained Soil [a]	J1CN45	11/8/10	4680		1.5	0.36	U	0.36	1.5		0.62	43.0	X	0.072	0.18	B	0.031	0.92	U	0.92
TP-7 - Cast Iron Pipe Contents (Soil)	J1C2F3	10/26/10	6020		1.5	1.0	M	0.37	22.8	NM	0.65	247		0.075	0.082	BM	0.032	6.5	M	0.96
TP-7 - Soil Underlying Pipe	J1C2F4	10/26/10	7690		1.6	0.40	U	0.40	2.4		0.70	76.2		0.080	0.14	B	0.035	1.1	B	1.0
TP-7 - Ash Layer	J1C2H9	10/26/10	8550		1.6	0.40	U	0.40	4.0		0.70	222		0.081	0.10	B	0.035	6.3		1.0
Equipment Blank	J1C2D6	10/21/10	174	XN	1.3	0.33	U	0.33	0.62	B	0.57	2.2		0.066	0.029	U	0.029	0.85	U	0.85
Equipment Blank	J1CNN4	11/8/10	135		1.3	0.32	U	0.32	0.56	U	0.56	2.2	X	0.065	0.028	U	0.028	0.84	U	0.84

Sample 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
TP-3 - Soil Inside/on Top of Concrete Structure [a]	J1C2D7	10/21/10	0.18	B	0.038	3560	X	13.2	8.5		0.054	5.1		0.093	18.8		0.20			
Duplicate of J1C2D7 [a]	J1C2D8	10/21/10	0.19	B	0.041	3530	X	14.0	14.4		0.058	5.3		0.099	14.5		0.22			
TP-1 - West Vertical Pipe Contents (soil)	J1CMP8	11/3/10	0.11	B	0.035	3080	X	12.0	10.4		0.049	5.6	X	0.085	12.6	X	0.18			
TP-2 - Tank Contents (soil)	J1C2D9	10/25/10	0.17	B	0.040	7530	X	13.9	9.7		0.057	6.2		0.098	13.9		0.21			
TP-2 - East Vertical Pipe Contents (soil)	J1C2F0	10/25/10	0.17	B	0.036	4230	X	12.5	9.9		0.051	6.0		0.088	13.8		0.19			
TP-2 - Soil Under Tank	J1C2F1	10/25/10	0.10	B	0.042	3990	X	14.4	16.2		0.059	14.0		0.10	23.3		0.22			
TP-4 - Surface Soil Inside Manhole [a]	J1C2F2	10/25/10	0.11	B	0.038	3240	X	13.2	10.4		0.054	5.5		0.093	12.8		0.20			
TP-5 - Red Stained Soil [a]	J1CN45	11/8/10	1.2	M	0.039	3010		13.3	9.7	X	0.058	4.4		0.094	12.8	X	0.20	0.154	U	0.154
TP-7 - Cast Iron Pipe Contents (Soil)	J1C2F3	10/26/10	1.5		0.040	25300	X	13.8	108		0.057	24.3	NM	0.098	225	M	0.21			
TP-7 - Soil Underlying Pipe	J1C2F4	10/26/10	0.089	B	0.043	4370	X	14.9	8.8		0.061	5.9		0.11	11.2		0.23			
TP-7 - Ash Layer	J1C2H9	10/26/10	18.3	M	0.044	45700	X	15.0	48.2	N	0.062	9.0		0.11	110	M	0.23			
Equipment Blank	J1C2D6	10/21/10	0.036	U	0.036	79.5	CX	12.3	0.12	B	0.050	0.13	B	0.087	0.37	B	0.19			
Equipment Blank	J1CNN4	11/8/10	0.035	U	0.035	53.4		12.1	8.7	X	0.056	0.086	U	0.086	0.21	BXC	0.19			

[a] = Test pits 3, 4, and 5 will only be included in these calculations. Test pits 1, 2, and 7 are for information only. This is discussed further in the RSVP.

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

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

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

B = blank contamination (inorganic constituents)

C = detected in both sample and associated QC blank, sample concentration <=5X blank concentration.

D = reported from a diluted aliquot of sample.

HEIS = Hanford Environmental Information System

J = estimate

M = sample duplicate precision not met.

N = recovery exceeds upper or lower control limit.

PQL = practical quantitation limit

Q = qualifier

RAG = remedial action goal

TP = test pit

TPH = total petroleum hydrocarbons

U = not detected.

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

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

Y = More than 40% difference between the primary and confirmation detector results. The higher of the two results is reported.

Attachment	1	Sheet No.	1 of 8
Originator	J. D. Skoglie	Date	12/12/2013
Checked	N. K. Schiffern	Date	12/12/2013
Calc. No.	0600X-CA-V0163	Rev. No.	0

Attachment 1. 600-301 Waste Site Confirmatory Sample Results (Metals).

Sample 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
TP-3 - Soil Inside/on Top of Concrete Structure *	J1C2D7	10/21/10	13800	X	3.6	15.2		0.25	3770	X	3.5	240	X	0.093	0.0057	U	0.0057	0.24	U	0.24
Duplicate of J1C2D7 *	J1C2D8	10/21/10	14200	X	3.8	13.2		0.27	3810	X	3.7	248	X	0.099	0.0055	U	0.0055	0.26	U	0.26
TP-1 - West Vertical Pipe Contents (soil)	J1CMP8	11/3/10	16400		3.2	7.3		0.23	3510	XY	3.1	271		0.085	0.0062	BM	0.0051	0.31	B	0.22
TP-2 - Tank Contents (soil)	J1C2D9	10/25/10	14800		3.7	38.3	X	0.27	5090		3.6	303		0.098	0.048		0.0057	0.72	BM	0.26
TP-2 - East Vertical Pipe Contents (soil)	J1C2F0	10/25/10	14600		3.4	40.9	X	0.24	4090		3.3	305		0.088	0.050		0.0055	0.41	B	0.23
TP-2 - Soil Under Tank	J1C2F1	10/25/10	65600		3.9	11.1	X	0.28	3850		3.8	544		0.10	0.014	B	0.0051	0.80	B	0.27
TP-4 - Surface Soil Inside Manhole *	J1C2F2	10/25/10	13100		3.5	6.9	X	0.25	3740		3.5	254		0.093	0.0085	B	0.0057	0.24	U	0.24
TP-5 - Red Stained Soil *	J1CN45	11/8/10	12900		3.6	15.4		0.25	3410		3.5	179	X	0.094	0.0091	B	0.0056	0.26	B	0.25
TP-7 - Cast Iron Pipe Contents (Soil)	J1C2F3	10/26/10	199000	X	7.9	224	XM	0.27	3920	NM	3.6	1100		0.098	0.49		0.0059	18.4	M	0.26
TP-7 - Soil Underlying Pipe	J1C2F4	10/26/10	18800	X	3.6	7.6	X	0.29	3360		3.9	260		0.11	0.0064	B	0.0054	0.27	U	0.27
TP-7 - Ash Layer	J1C2H9	10/26/10	18300		4.0	62.9	X	0.29	5060	XM	3.9	298		0.11	0.24	MN	0.0061	4.7		0.28
Equipment Blank	J1C2D6	10/21/10	261	XN	3.3	0.52		0.23	28.9	X	3.2	6.0	X	0.087	0.0054	U	0.0054	0.23	U	0.23
Equipment Blank	J1CNN4	11/8/10	201		3.2	0.43		0.23	23.1		3.2	4.7	X	0.086	0.0054	U	0.0054	0.22	B	0.22

Sample 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
TP-3 - Soil Inside/on Top of Concrete Structure *	J1C2D7	10/21/10	10.3		0.11	1110		38.3	0.80	U	0.80	222		2.2	0.15	U	0.15	124		55.2
Duplicate of J1C2D7 *	J1C2D8	10/21/10	13.7		0.12	1110		40.7	0.85	U	0.85	182		2.1	0.16	U	0.16	129		58.5
TP-1 - West Vertical Pipe Contents (soil)	J1CMP8	11/3/10	9.5	X	0.10	1790		34.9	0.73	U	0.73	312		1.8	0.14	U	0.14	152		50.2
TP-2 - Tank Contents (soil)	J1C2D9	10/25/10	9.6		0.12	2440		40.3	0.82	U	0.82	502	N	2.0	0.17	B	0.16	351		58.1
TP-2 - East Vertical Pipe Contents (soil)	J1C2F0	10/25/10	10.2		0.11	2070		36.3	0.81	U	0.81	423		2.0	0.15	B	0.14	156		52.2
TP-2 - Soil Under Tank	J1C2F1	10/25/10	32.6		0.13	1310		41.8	0.85	U	0.85	381		2.1	0.32		0.16	386		60.2
TP-4 - Surface Soil Inside Manhole *	J1C2F2	10/25/10	10.8		0.11	1660		38.2	0.77	U	0.77	387		1.9	0.15	U	0.15	149		55.0
TP-5 - Red Stained Soil *	J1CN45	11/8/10	8.7	X	0.12	702		38.6	0.81	U	0.81	245		2.1	0.15	U	0.15	139		55.6
TP-7 - Cast Iron Pipe Contents (Soil)	J1C2F3	10/26/10	104	NM	0.12	1160		40.3	1.8	U	1.8	369		2.2	1.2	M	0.16	179	NM	57.9
TP-7 - Soil Underlying Pipe	J1C2F4	10/26/10	8.7		0.13	1310		41.3	0.82	U	0.82	422		2.0	0.17	U	0.17	145		62.3
TP-7 - Ash Layer	J1C2H9	10/26/10	38		0.13	1440		43.6	1.9	M	0.91	220	N	2.2	0.34		0.17	245		62.8
Equipment Blank	J1C2D6	10/21/10	0.13	B	0.11	53.8	B	35.7	0.75	U	0.75	63.1	N	1.8	0.14	U	0.14	51.3	U	51.3
Equipment Blank	J1CNN4	11/8/10	0.11	U	0.11	62.6	B	35.1	0.74	U	0.74	201		2.0	0.14	U	0.14	50.5	U	50.5

Attachment	1	Sheet No.	2 of 8
Originator	J. D. Skoglie	Date	12/12/2013
Checked	N. K. Schiffern	Date	12/12/2013
Calc. No.	0600X-CA-V0163	Rev. No.	0

Attachment 1. 600-301 Waste Site Confirmatory Sample Results (Metals).

Sample Location	HEIS Number	Sample Date	Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL
TP-3 - Soil Inside/on Top of Concrete Structure [a]	J1C2D7	10/21/10	25.8		0.088	35.9		0.37
Duplicate of J1C2D7 [a]	J1C2D8	10/21/10	26.0		0.093	36.0		0.39
TP-1 - West Vertical Pipe Contents (soil)	J1CMP8	11/3/10	38.0		0.080	38.6		0.34
TP-2 - Tank Contents (soil)	J1C2D9	10/25/10	27.3		0.092	57.8		0.39
TP-2 - East Vertical Pipe Contents (soil)	J1C2F0	10/25/10	26.6		0.083	56.5		0.35
TP-2 - Soil Under Tank	J1C2F1	10/25/10	28.0		0.096	35.1		0.41
TP-4 - Surface Soil Inside Manhole [a]	J1C2F2	10/25/10	25.6		0.088	35.3		0.37
TP-5 - Red Stained Soil [a]	J1CN45	11/8/10	21.8		0.089	1460	M	0.40
TP-7 - Cast Iron Pipe Contents (Soil)	J1C2F3	10/26/10	34.8		0.092	436	X	0.39
TP-7 - Soil Underlying Pipe	J1C2F4	10/26/10	28.5		0.099	36.1	X	0.42
TP-7 - Ash Layer	J1C2H9	10/26/10	47.0		0.10	381	XM	0.42
Equipment Blank	J1C2D6	10/21/10	0.26	B	0.082	1.2		0.35
Equipment Blank	J1CNN4	11/8/10	0.23	B	0.080	771		0.38

Attachment	1	Sheet No.	3 of 8
Originator	J. D. Skoglie	Date	12/12/2013
Checked	N. K. Schiffern	Date	12/12/2013
Calc. No.	0600X-CA-V0163	Rev. No.	0

Attachment 1. 600-301 Waste Site Confirmatory Sample Results (Anions, TPH, and Physical).

Sample Location	HEIS Number	Sample Date	Bromide			Chloride			Fluoride			Nitrogen in Nitrate			Nitrogen in Nitrite and Nitrate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP-3 - Soil Inside/on Top of Concrete Structure *	J1C2D7	10/21/10	0.41	U	0.41	2.1	U	2.1	1.2	B	0.86	0.61	B	0.33	0.52	B	0.38
Duplicate of J1C2D7 *	J1C2D8	10/21/10	0.38	U	0.38	1.9	U	1.9	0.96	B	0.80	0.66	B	0.31	0.49	B	0.37
TP-1 - West Vertical Pipe Contents (soil)	J1CMP8	11/3/10	0.39	U	0.39	2.0	U	2.0	0.88	B	0.83	6.3		0.32	6.7	N	0.36
TP-2 - Tank Contents (soil)	J1C2D9	10/25/10	2.0	UD	2.0	170		2.0	1.6	B	0.84	2830	D	16	3250	ND	15.1
TP-2 - East Vertical Pipe Contents (soil)	J1C2F0	10/25/10	0.38	U	0.38	14.7		1.9	1.1	B	0.80	80.9		0.30	89.8		0.36
TP-2 - Soil Under Tank	J1C2F1	10/25/10	0.40	U	0.40	9.5		2.0	2.3	B	0.84	26.5		0.32	25		0.37
TP-4 - Surface Soil Inside Manhole*	J1C2F2	10/25/10	0.39	U	0.39	2.0	U	2.0	1.2	B	0.83	7.9		0.32	9.0		0.37
TP-5 - Red Stained Soil *	J1CN45	11/8/10	0.40	U	0.40	2.1	U	2.1	0.89	B	0.86	0.65	B	0.33	0.50	B	0.37
TP-7 - Cast Iron Pipe Contents (Soil)	J1C2F3	10/26/10	0.40	U	0.40	2.0	U	2.0	0.85	U	0.85	4.3		0.33	5.1		0.38
TP-7 - Soil Underlying Pipe	J1C2F4	10/26/10	0.41	U	0.41	2.1	U	2.1	0.95	B	0.88	0.66	B	0.33	0.39	U	0.39
TP-7 - Ash Layer	J1C2H9	10/26/10	0.43	U	0.43	2.2	U	2.2	1.5	B	0.91				1.6	N	0.40

Sample Location	HEIS Number	Sample Date	Nitrogen in Nitrite			Phosphorous in phosphate			Sulfate			TPH - Diesel Range EXT			TPH - Diesel Range		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
TP-3 - Soil Inside/on Top of Concrete Structure *	J1C2D7	10/21/10	0.35	U	0.35	1.7	B	1.3	1.8	U	1.8						
Duplicate of J1C2D7 *	J1C2D8	10/21/10	0.33	U	0.33	1.6	B	1.2	1.7	U	1.7						
TP-1 - West Vertical Pipe Contents (soil)	J1CMP8	11/3/10	0.34	U	0.34	5.4	XC	1.2	1.7	U	1.7	290000	N	920	170000	N	620
TP-2 - Tank Contents (soil)	J1C2D9	10/25/10	0.34	U	0.34	1.3	U	1.3	594	D	8.8						
TP-2 - East Vertical Pipe Contents (soil)	J1C2F0	10/25/10	0.33	U	0.33	6.6		1.2	52.7		1.7						
TP-2 - Soil Under Tank	J1C2F1	10/25/10	0.34	U	0.34	3.0	B	1.3	118		1.8						
TP-4 - Surface Soil Inside Manhole*	J1C2F2	10/25/10	0.34	U	0.34	4.2	B	1.2	2.2	B	1.7						
TP-5 - Red Stained Soil *	J1CN45	11/8/10	0.35	U	0.35	1.3	U	1.3	121		1.8	19000	B	1100	13000		730
TP-7 - Cast Iron Pipe Contents (Soil)	J1C2F3	10/26/10	0.35	U	0.35	2.0	B	1.3	7630	D	36						
TP-7 - Soil Underlying Pipe	J1C2F4	10/26/10	0.36	U	0.36	1.3	U	1.3	3160	D	18.5						
TP-7 - Ash Layer	J1C2H9	10/26/10							15000	D	95.7	2000000	N	11000	2E+06	N	7500

Sample Location	HEIS Number	Sample Date	Percent moisture (wet sample)			pH Measurement		
			%	Q	PQL	pH	Q	PQL
TP-3 - Soil Inside/on Top of Concrete Structure *	J1C2D7	10/21/10	6.2		0.10			
Duplicate of J1C2D7 *	J1C2D8	10/21/10	3.0		0.10			
TP-1 - West Vertical Pipe Contents (soil)	J1CMP8	11/3/10	0.39	M	0.10	8.79		0.0100
TP-2 - Tank Contents (soil)	J1C2D9	10/25/10	5.0		0.10			
TP-2 - East Vertical Pipe Contents (soil)	J1C2F0	10/25/10	0.79		0.10			
TP-2 - Soil Under Tank	J1C2F1	10/25/10	3.9		0.10			
TP-4 - Surface Soil Inside Manhole*	J1C2F2	10/25/10	3.4		0.10			
TP-5 - Red Stained Soil *	J1CN45	11/8/10	7.7		0.10	8.21		0.0100
TP-7 - Cast Iron Pipe Contents (Soil)	J1C2F3	10/26/10	5.7		0.10			
TP-7 - Soil Underlying Pipe	J1C2F4	10/26/10	8.1		0.10			
TP-7 - Ash Layer	J1C2H9	10/26/10	10.5		0.10	7.42		0.0100
Equipment Blank	J1C2D6	10/21/10	0.10	U	0.10			
Equipment Blank	J1CNN4	11/8/10	0.10	U	0.10			

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Attachment 1. 600-301 Waste Site Confirmatory Sample Results (Organics).

CONSTITUENT	CLASS	TP-3 - Soil Inside/on Top of Concrete Structure - J1C2D7 [a]			Duplicate of J1C2D7 - J1C2D8 [a]			TP-1 - West Vertical Pipe Contents (soil) - J1CMP8			TP-2 - Tank Contents (soil) - J1C2D9		
		10/21/10			10/21/10			11/3/10			10/25/10		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH							9.3	U	9.3			
Acenaphthylene	PAH							8.4	U	8.4			
Anthracene	PAH							2.8	U	2.8			
Benzo(a)anthracene	PAH							3.0	U	3.0			
Benzo(a)pyrene	PAH							6.0	U	6.0			
Benzo(b)fluoranthene	PAH							3.9	U	3.9			
Benzo(ghi)perylene	PAH							6.7	U	6.7			
Benzo(k)fluoranthene	PAH							3.7	U	3.7			
Chrysene	PAH							4.5	U	4.5			
Dibenz[a,h]anthracene	PAH							10	U	10			
Fluoranthene	PAH							12	U	12			
Fluorene	PAH							4.9	U	4.9			
Indeno(1,2,3-cd)pyrene	PAH							11	U	11			
Naphthalene	PAH							11	U	11			
Phenanthrene	PAH							11	U	11			
Pyrene	PAH							11	U	11			
Aroclor-1016	PCB							2.7	U	2.7			
Aroclor-1221	PCB							7.9	U	7.9			
Aroclor-1232	PCB							2.0	U	2.0			
Aroclor-1242	PCB							4.6	U	4.6			
Aroclor-1248	PCB							4.6	U	4.6			
Aroclor-1254	PCB							2.6	U	2.6			
Aroclor-1260	PCB							2.6	U	2.6			
Aldrin	PEST	0.27	U	0.27	0.26	U	0.26				0.26	U	0.26
Alpha-BHC	PEST	0.23	U	0.23	0.22	U	0.22				0.22	U	0.22
alpha-Chlordane	PEST	0.34	U	0.34	0.33	U	0.33				0.34	U	0.34
beta-BHC	PEST	0.71	U	0.71	0.68	U	0.68				0.70	U	0.70
Delta-BHC	PEST	0.43	U	0.43	0.41	U	0.41				0.42	U	0.42
4-4'-DDD	PEST	0.58	U	0.58	0.56	U	0.56				0.57	U	0.57
4-4'-DDE	PEST	6.3		0.25	6.5		0.24				0.65	J	0.25
4-4'-DDT	PEST	7.7		0.63	7.7		0.6				0.62	U	0.62
Dieldrin	PEST	0.22	U	0.22	0.21	U	0.21				0.27	JB	0.22
Endosulfan I	PEST	0.19	U	0.19	0.18	U	0.18				0.38	J	0.18
Endosulfan II	PEST	0.30	U	0.30	0.29	U	0.29				0.30	U	0.30
Endosulfan sulfate	PEST	0.29	U	0.29	0.28	U	0.28				0.29	U	0.29
Endrin	PEST	0.33	U	0.33	0.31	U	0.31				0.32	U	0.32
Endrin aldehyde	PEST	0.18	U	0.18	0.17	U	0.17				0.18	U	0.18
Endrin ketone	PEST	0.52	U	0.52	0.50	U	0.50				0.51	U	0.51
Gamma-BHC (Lindane)	PEST	0.49	U	0.49	0.47	U	0.47				0.49	U	0.49
gamma-Chlordane	PEST	0.28	U	0.28	0.27	U	0.27				0.28	U	0.28
Heptachlor	PEST	0.23	U	0.23	0.22	U	0.22				0.22	U	0.22
Heptachlor epoxide	PEST	0.45	U	0.45	0.43	U	0.43				0.45	U	0.45
Methoxychlor	PEST	0.48	U	0.48	0.46	U	0.46				0.47	U	0.47
Toxaphene	PEST	17	U	17	16	U	16				17	U	17

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Attachment 1. 600-301 Waste Site Confirmatory Sample Results (Organics).

CONSTITUENT	CLASS	TP-2 - East Vertical Pipe Contents (soil) - J1C2F0			TP-2 - Soil Under Tank - J1C2F1			TP-4 - Surface Soil Inside Manhole - J1C2F2 [a]			TP-5 - Red Stained Soil - J1CN45 [a]		
		10/25/10			10/25/10			10/25/10			11/8/10		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH										11	U	11
Acenaphthylene	PAH										9.5	U	9.5
Anthracene	PAH										3.2	U	3.2
Benzo(a)anthracene	PAH										3.4	U	3.4
Benzo(a)pyrene	PAH										6.8	U	6.8
Benzo(b)fluoranthene	PAH										4.4	U	4.4
Benzo(ghi)perylene	PAH										7.6	U	7.6
Benzo(k)fluoranthene	PAH										4.2	U	4.2
Chrysene	PAH										5.1	U	5.1
Dibenz[a,h]anthracene	PAH										12	U	12
Fluoranthene	PAH										14	U	14
Fluorene	PAH										5.6	U	5.6
Indeno(1,2,3-cd)pyrene	PAH										13	U	13
Naphthalene	PAH										13	U	13
Phenanthrene	PAH										13	U	13
Pyrene	PAH										13	U	13
Aroclor-1016	PCB										2.9	U	2.9
Aroclor-1221	PCB										8.5	U	8.5
Aroclor-1232	PCB										2.1	U	2.1
Aroclor-1242	PCB										4.9	U	4.9
Aroclor-1248	PCB										4.9	U	4.9
Aroclor-1254	PCB										2.7	U	2.7
Aroclor-1260	PCB										2.7	U	2.7
Aldrin	PEST	0.25	U	0.25	0.26	U	0.26	0.25	U	0.25			
Alpha-BHC	PEST	0.21	U	0.21	0.22	U	0.22	0.21	U	0.21			
alpha-Chlordane	PEST	0.32	U	0.32	0.33	U	0.33	0.32	U	0.32			
beta-BHC	PEST	0.66	U	0.66	0.68	U	0.68	0.66	U	0.66			
Delta-BHC	PEST	0.40	U	0.40	0.41	U	0.41	0.40	U	0.40			
4-4'-DDD	PEST	0.55	U	0.55	0.56	U	0.56	0.54	U	0.54			
4-4'-DDE	PEST	0.37	J	0.24	0.24	U	0.24	0.24	U	0.24			
4-4'-DDT	PEST	0.59	U	0.59	0.60	U	0.60	0.58	U	0.58			
Dieldrin	PEST	0.25	JB	0.21	0.27	JXB	0.21	0.21	U	0.21			
Endosulfan I	PEST	0.38	J	0.18	0.18	U	0.18	0.17	U	0.17			
Endosulfan II	PEST	0.29	U	0.29	0.29	U	0.29	0.28	U	0.28			
Endosulfan sulfate	PEST	0.28	U	0.28	0.28	U	0.28	0.27	U	0.27			
Endrin	PEST	0.31	U	0.31	0.31	U	0.31	0.30	U	0.30			
Endrin aldehyde	PEST	0.17	U	0.17	0.17	U	0.17	0.36	JXB	0.17			
Endrin ketone	PEST	0.49	U	0.49	0.50	U	0.50	0.48	U	0.48			
Gamma-BHC (Lindane)	PEST	0.46	U	0.46	0.47	U	0.47	0.46	U	0.46			
gamma-Chlordane	PEST	0.27	U	0.27	0.27	U	0.27	0.26	U	0.26			
Heptachlor	PEST	0.21	U	0.21	0.22	U	0.22	0.21	U	0.21			
Heptachlor epoxide	PEST	0.43	U	0.43	0.43	U	0.43	0.42	U	0.42			
Methoxychlor	PEST	0.45	U	0.45	0.46	U	0.46	0.45	U	0.45			
Toxaphene	PEST	16	U	16	16	U	16	16	U	16			

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Attachment 1. 600-301 Waste Site Confirmatory Sample Results (Organics).

CONSTITUENT	CLASS	TP-7 - Cast Iron Pipe Contents (Soil) - J1C2F3			TP-7 - Soil Underlying Pipe - J1C2F4			TP-7 - Ash Layer - J1C2H9		
		10/26/10			10/26/10			10/26/10		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH							100	UD	100
Acenaphthylene	PAH							94	UD	94
Anthracene	PAH							32	UD	32
Benzo(a)anthracene	PAH							33	UD	33
Benzo(a)pyrene	PAH							67	UD	67
Benzo(b)fluoranthene	PAH							44	UD	44
Benzo(ghi)perylene	PAH							75	UD	75
Benzo(k)fluoranthene	PAH							41	UD	41
Chrysene	PAH							51	UD	51
Dibenz[a,h]anthracene	PAH							120	UD	120
Fluoranthene	PAH							140	UD	140
Fluorene	PAH							55	UD	55
Indeno(1,2,3-cd)pyrene	PAH							130	UD	130
Naphthalene	PAH							130	UD	130
Phenanthrene	PAH							130	UD	130
Pyrene	PAH							130	UD	130
Aroclor-1016	PCB							4.7	U	4.7
Aroclor-1221	PCB							14	U	14
Aroclor-1232	PCB							3.4	U	3.4
Aroclor-1242	PCB							7.9	U	7.9
Aroclor-1248	PCB							7.9	U	7.9
Aroclor-1254	PCB							4.4	U	4.4
Aroclor-1260	PCB							47		4.4
Aldrin	PEST	0.27	U	0.27	0.27	U	0.27	0.27	U	0.27
Alpha-BHC	PEST	0.23	U	0.23	0.23	U	0.23	0.23	U	0.23
alpha-Chlordane	PEST	0.34	U	0.34	0.34	U	0.34	0.35	U	0.35
beta-BHC	PEST	0.70	U	0.70	0.71	U	0.71	0.72	U	0.72
Delta-BHC	PEST	0.43	U	0.43	0.43	U	0.43	0.44	U	0.44
4-4'-DDD	PEST	0.58	U	0.58	0.58	U	0.58	5.9	UD	5.9
4-4'-DDE	PEST	7.7		0.25	0.25	U	0.25	5.7		0.26
4-4'-DDT	PEST	15	JD	6.3	0.63	U	0.63	29	D	6.4
Dieldrin	PEST	0.22	U	0.22	0.22	U	0.22	0.23	U	0.23
Endosulfan I	PEST	0.19	U	0.19	0.19	U	0.19	0.19	U	0.19
Endosulfan II	PEST	0.30	U	0.30	0.31	U	0.31	0.31	U	0.31
Endosulfan sulfate	PEST	0.29	U	0.29	0.29	U	0.29	0.30	U	0.30
Endrin	PEST	0.32	U	0.32	0.33	U	0.33	0.33	U	0.33
Endrin aldehyde	PEST	0.18	U	0.18	0.18	U	0.18	0.19	U	0.19
Endrin ketone	PEST	0.52	U	0.52	0.52	U	0.52	0.53	U	0.53
Gamma-BHC (Lindane)	PEST	0.49	U	0.49	0.49	U	0.49	0.50	U	0.50
gamma-Chlordane	PEST	2.2		0.28	0.28	U	0.28	2.5		0.29
Heptachlor	PEST	0.23	U	0.23	0.23	U	0.23	0.23	U	0.23
Heptachlor epoxide	PEST	0.45	U	0.45	0.45	U	0.45	0.46	U	0.46
Methoxychlor	PEST	0.48	U	0.48	0.48	U	0.48	0.49	U	0.49
Toxaphene	PEST	17	U	17	17	U	17	17	U	17

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Attachment 1. 600-301 Waste Site Confirmatory Sample Results (Organics).

CONSTITUENT	CLASS	TP-7 - Ash Layer - J1C2119		
		10/26/10		
		ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	6100	UD	6100
1,2-Dichlorobenzene	SVOA	4800	UD	4800
1,3-Dichlorobenzene	SVOA	2600	UD	2600
1,4-Dichlorobenzene	SVOA	3000	UD	3000
2,4,5-Trichlorophenol	SVOA	2200	UD	2200
2,4,6-Trichlorophenol	SVOA	2200	UD	2200
2,4-Dichlorophenol	SVOA	2200	UD	2200
2,4-Dimethylphenol	SVOA	14000	UD	14000
2,4-Dinitrophenol	SVOA	73000	UD	73000
2,4-Dinitrotoluene	SVOA	14000	UD	14000
2,6-Dinitrotoluene	SVOA	6100	UD	6100
2-Chloronaphthalene	SVOA	2200	UD	2200
2-Chlorophenol	SVOA	4600	UD	4600
2-Methylnaphthalene	SVOA	4200	UD	4200
2-Methylphenol (cresol, o-)	SVOA	2800	UD	2800
2-Nitroaniline	SVOA	11000	UD	11000
2-Nitrophenol	SVOA	2200	UD	2200
3,3'-Dichlorobenzidine	SVOA	20000	UD	20000
3+4 Methylphenol (cresol, m+p)	SVOA	7200	UD	7200
3-Nitroaniline	SVOA	16000	UD	16000
4,6-Dinitro-2-methylphenol	SVOA	72000	UD	72000
4-Bromophenylphenyl ether	SVOA	4200	UD	4200
4-Chloro-3-methylphenol	SVOA	14000	UD	14000
4-Chloroaniline	SVOA	18000	UD	18000
4-Chlorophenylphenyl ether	SVOA	4600	UD	4600
4-Nitroaniline	SVOA	16000	UD	16000
4-Nitrophenol	SVOA	21000	UD	21000
Acenaphthene	SVOA	2300	UD	2300
Acenaphthylene	SVOA	3700	UD	3700
Anthracene	SVOA	3700	UD	3700
Benzo(a)anthracene	SVOA	4400	UD	4400
Benzo(a)pyrene	SVOA	4400	UD	4400
Benzo(b)fluoranthene	SVOA	5700	UD	5700
Benzo(ghi)perylene	SVOA	3500	UD	3500
Benzo(k)fluoranthene	SVOA	8800	UD	8800
Bis(2-chloro-1-methylethyl)ether	SVOA	5000	UD	5000
Bis(2-Chloroethoxy)methane	SVOA	5000	UD	5000
Bis(2-chloroethyl) ether	SVOA	3600	UD	3600
Bis(2-ethylhexyl) phthalate	SVOA	10000	UD	10000
Butylbenzylphthalate	SVOA	9400	UD	9400
Carbazole	SVOA	7900	UD	7900
Chrysene	SVOA	5900	UD	5900
Dibenz[a,h]anthracene	SVOA	4200	UD	4200
Dibenzofuran	SVOA	4400	UD	4400
Diethyl phthalate	SVOA	5700	UD	5700
Dimethyl phthalate	SVOA	5000	UD	5000
Di-n-butylphthalate	SVOA	6400	UD	6400
Di-n-octylphthalate	SVOA	3200	UD	3200
Fluoranthene	SVOA	7900	UD	7900
Fluorene	SVOA	3900	UD	3900
Hexachlorobenzene	SVOA	6400	UD	6400
Hexachlorobutadiene	SVOA	2200	UD	2200
Hexachlorocyclopentadiene	SVOA	11000	UD	11000
Hexachloroethane	SVOA	4700	UD	4700
Indeno(1,2,3-cd)pyrene	SVOA	4800	UD	4800
Isophorone	SVOA	3700	UD	3700
Naphthalene	SVOA	6800	UD	6800
Nitrobenzene	SVOA	4800	UD	4800
N-Nitroso-di-n-dipropylamine	SVOA	6800	UD	6800
N-Nitrosodiphenylamine	SVOA	4600	UD	4600
Pentachlorophenol	SVOA	72000	UD	72000
Phenanthrene	SVOA	3700	UD	3700
Phenol	SVOA	3900	UD	3900
Pyrene	SVOA	2700	UD	2700

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APPENDIX B

DATA QUALITY ASSESSMENT

APPENDIX B

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 2013b). 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 2013b), the field logbook (WCH 2013a), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. To ensure quality data, the 100 Area SAP (DOE-RL 2009) data assurance requirements and the data validation procedures for chemical analysis and radiochemical 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 600-301 waste site was provided by the laboratories in sample delivery group (SDG) XP0010. SDG XP0010 was submitted for third-party validation. Major and minor deficiencies are discussed for the 600-301 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.

MAJOR DEFICIENCIES

In the ion chromatograph (IC) anions analysis, the holding times for nitrate, nitrite, and orthophosphate in method 300.0 were exceeded by more than twice the limit in SDG XP0010. All undetected nitrate, nitrite, and orthophosphate results in the SDG were qualified as rejected with "UR" flags. However, analysis for IC anions was inadvertently requested and was not required by the sample design (WCH 2013b). Nitrate was a waste site contaminant of potential concern (COPC) and was analyzed by method 353.2. Therefore the resulting data set is sufficient for decision-making purposes.

MINOR DEFICIENCIES

SDG XP0010

This SDG is comprised of 15 soil samples (J1RWR0 through J1RWR9 and J1RWT0 through J1RWT4) collected during verification sampling of the 600-301 waste site on September 5, 2013. This SDG includes a field duplicate pair (J1RWR0/J1RWT4). All samples were analyzed for inductively coupled plasma (ICP) metals, mercury, IC anions, nitrate/nitrite, herbicides, pesticides, and total petroleum hydrocarbons (TPH). Analyses for IC anions and herbicides were inadvertently requested and not required in the sample design (WCH 2013b). In addition, one equipment blank (J1RWT5) was analyzed for ICP metals and mercury. SDG XP0010 was submitted for third-party validation.

In the IC anions analysis, holding times were exceeded by more than twice the specified holding time for nitrate, nitrite, and orthophosphate. The nondetected results for these analytes are discussed above in the Major Deficiencies section. Third-party validation qualified all undetected nitrate, nitrite, and orthophosphate as rejected with "UR" flags. All detected nitrate, nitrite, and orthophosphate results were qualified as estimated and flagged with a "J" by third-party validation. Estimated data are usable for decision-making purposes.

In the TPH analysis, surrogate recovery in sample J1RWT0 was outside of quality control (QC) limits at 40.9%. Due to the surrogate recovery, the diesel range organic and motor oil results in sample J1RWT0 were qualified as estimated and flagged "J" by third-party validation. The data are usable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recovery was outside of QC limits for silicon (2.32%). Due to the MS recovery outside the QC limits, all silicon data were qualified estimated and flagged "J" by third-party validation. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, arsenic was detected in the method blank. Due to the MB contamination, the arsenic results in samples J1RWR0 through J1RWR5, J1RWR7, J1RWR9, J1RWT0 through J1RWT2, J1RWT4, and J1RWT5 were qualified as undetected and flagged "UJ" by third-party validation. The data are usable for decision-making purposes.

In the pesticide analysis, there was no MS, matrix spike duplicate (MSD), or laboratory control sample for toxaphene. The laboratory typically quantitates toxaphene but does not include toxaphene in QC samples. All toxaphene results were qualified as estimated and flagged with a "J" by third-party validation. Estimated data are usable for decision-making purposes.

In the herbicides analysis, the MS recovery for dalopon (41.7%) was outside of QC limits. The resulting MS/MSD relative percent difference (RPD) calculation for dalopon was above QC limits at 47.5%. All dalapon results were qualified as estimated and flagged with a "J" by third-party validation. Estimated data are usable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

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

Field quality assurance (QA)/QC measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbook (WCH 2013a), are shown in Table B-1. The main and QA/QC sample results are presented in Appendix A.

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

Sample Area	Main Sample	Duplicate Sample
VSP-1	J1RWR0	J1RWT4

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. The RPDs of analytes detected at low concentrations (less than five times the detection limit) are not considered to be indicative of the analytical system performance. The calculation brief in Appendix A provides details on duplicate pair evaluation and RPD calculation.

All calculated RPDs for the field QA/QC duplicate samples were within the acceptance criteria of 30%. The data are usable for decision-making purposes. A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than five times the target detection limit (TDL), including undetected analytes. In these cases, a control limit of ±2 times the TDL is used (Appendix A) to indicate that a visual check of the data is required by the reviewer. No sample results 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 600-301 waste site verification sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for the 600-301 waste site 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 a Washington Closure Hanford project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification sample analytical data are also summarized in Appendix A.

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