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

14-AMRP-0101

FEB 03 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 600-293, WHITE BLUFFS SERVICE STATION #1 WASTE SITE, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2013-120, and supporting, "Remaining Sites Verification Package for the 600-293, White Bluffs Service Station #1 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.:** 2013-120

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

600-293, White Bluffs Service Station #1

Reclassification Category: Interim ☒ Final ☐

Reclassification Status: Closed Out ☒ No Action ☐ Rejected ☐

RCRA Postclosure ☐ Consolidated ☐ None ☐

Approvals Needed: DOE ☒ Ecology ☐ EPA ☒

Description of current waste site condition:

The 600-293, White Bluffs Service Station #1 waste site was identified as a candidate site for confirmatory sampling in the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision, Hanford Site, Benton County, Washington,* U.S. Environmental Protection Agency, Region 10, Seattle, Washington (100 Area ESD) (EPA 2009). The 600-293 waste site consisted of several suspect features that appeared to be part of a gas station infrastructure.

Confirmatory sampling was performed at the 600-293 waste site on October 18, 2010. Confirmatory sampling results indicated the presence of several contaminants above cleanup levels, including lead, total petroleum hydrocarbons, and aroclor-1260. Based on the confirmatory sampling results, this waste site was subsequently recommended for remove, treat, and dispose.

Remediation of the 600-293 waste site was performed on March 25, June 24, and October 23, 2013. The remediation resulted in approximately 462 bank cubic meters (604 bank cubic yards) of material being removed and disposed at the Environmental Restoration Disposal Facility (ERDF). Cleanup verification sampling was performed on August 26 and October 24, 2013, to determine if the waste site meets remedial action objectives (RAOs) and remedial action goals (RAGs) established by the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington,* U.S. Environmental Protection Agency, Region 10, Seattle, Washington (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 600-293 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 600-293, White Bluffs Service Station #1 Waste Site* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-IU-2 **Control No.:** 2013-120

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

600-293, White Bluffs Service Station #1

Regulator comments:

Waste Site Controls:

Engineered Controls:	☐ Yes ☒ No	Institutional Controls:	☐ Yes ☒ No	O&M Requirements:	☐ Yes ☒ No

If any of the Waste Site Controls are checked Yes, specify control requirements including reference to the Record of Decision, TSD Closure Letter, or other relevant documents:

J. P. Neath DOE Federal Project Director (printed)	Signature	1/14/14 Date
N/A Ecology Project Manager (printed)	Signature	Date
C. Guzzetti EPA Project Manager (printed)	Signature	4/16/14 Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-293, WHITE BLUFFS SERVICE STATION #1 WASTE SITE

Attachment to Waste Site Reclassification Form 2013-120

January 2014

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-293, WHITE BLUFFS SERVICE STATION #1 WASTE SITE

EXECUTIVE SUMMARY

The 600-293, White Bluffs Service Station #1 waste site is part of the 100-IU-2 Operable Unit. The 600-293 waste site consisted of several suspect surface features that appeared to be part of a gas station infrastructure. The 600-293 waste site was included in the *Explanation of Significant Differences for the 100 Area Remaining Sites Interim Remedial Action Record of Decision* (EPA 2009) as a candidate site for confirmatory sampling.

Confirmatory sampling was performed at the 600-293 waste site on October 18, 2010. Confirmatory sampling results indicated the presence of several contaminants above cleanup levels, including lead, total petroleum hydrocarbons, and aroclor-1260. This waste site was subsequently recommended for remove, treat, and dispose based on the confirmatory sampling results (WCH 2011).

Remediation of the 600-293 waste site was performed on March 25and June 24, 2013. The floor of the 600-293 waste site excavation varied from approximately 2.4 to 3 m (8 to 10 ft) below ground surface. No overburden soil was stockpiled to be used as backfill.

Following remediation, verification sampling was conducted at the 600-293 waste site on August 26, 2013. Verification sampling results indicated one sample location (Comp-2) exceeded direct exposure remedial action goals (RAGs) for polychlorinated biphenyls (PCBs). Additional remediation was performed on October 23, 2013, to remove an additional 0.5 m (1.5 ft) of contaminated soils at sample location Comp-2. Verification resampling at this location followed on October 24, 2013. A total of approximately 462 bank cubic meters (604 bank cubic yards) of materials were excavated and direct loaded for disposal at the Environmental Restoration Disposal Facility.

The results of verification sampling, including the resampling data, indicated that residual contaminant concentrations met the remedial action objectives (RAOs) and RAGs for the 600-293 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 *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites ROD) (EPA 1999). The results indicated that the waste removal action achieved compliance with the RAOs and RAGs for the 600-293 waste site.

A summary of the cleanup evaluation for the soil results 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 600-293 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 600-293 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 are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient for all sampling areas (6.2×10^{-2}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk values for individual nonradionuclide COPCs are all $<1 \times 10^{-6}$.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The cumulative excess cancer risk (7.0×10^{-7}), is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COPC groundwater and river RAGs.	Radionuclides were not COPCs for the 600-293 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 600-293 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, aroclor-1254, and aroclor-1260 are present 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, aroclor-1254, and aroclor-1260 are not expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years (based on the contaminant with the lowest distribution coefficient, lead, with a K_d of 30 mL/g). The vadose zone underlying the soil below the site is approximately 11 m (36 ft). Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and the Columbia River.

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

In accordance with this evaluation, the verification sampling results support a reclassification of this site to interim closed out. The current site conditions achieve the 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. Residual contamination above direct exposure levels was not observed in the shallow zone soils and is concluded not to exist in 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 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," were boron and vanadium. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for lead, manganese,

vanadium, and zinc. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because the detected levels of 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 600-293, WHITE BLUFFS SERVICE STATION #1 WASTE SITE

STATEMENT OF PROTECTIVENESS

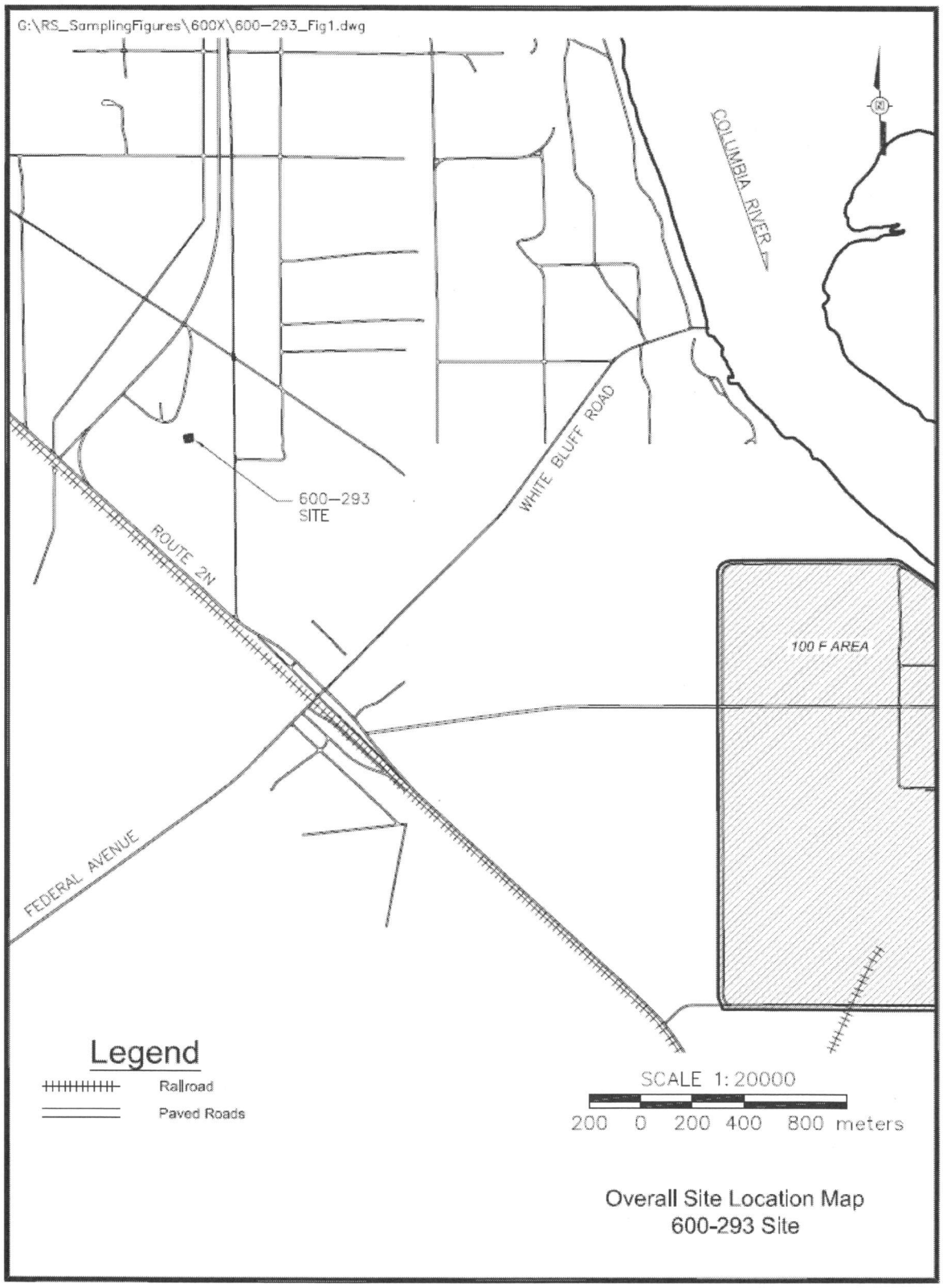
The 600-293, White Bluffs Service Station #1 verification sampling data, site evaluations, and supporting documentation demonstrate that this waste site meets the objectives established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE-RL 2009b) and the *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 600-293 waste 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 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," were boron and vanadium. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for lead, manganese, vanadium, and zinc. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because the detected levels of 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 600-293 waste site is located within the 100-IU-2 Operable Unit, northeast of the former Finished Metals warehouse and south of Sand Bar Road, approximately 1,000 m (3,281 ft) northwest of the intersection of Route 2 North and Federal Avenue (Figure 1). The center of the 600-293 waste site is located at Washington State Plane (WSP) coordinates N 149015, E 577534. The dimensions of the site were approximately 25 m (81 ft) long and 27 m (88 ft) wide.

Figure 1. The 600-293 Waste Site Location Map.



The 600-293 waste site was documented in 2008, during the orphan sites evaluation of this area (WCH 2009). The 600-293 waste site consisted of several suspect surface features that appeared to be part of a gas station infrastructure. One linear depression was observed at the site (Figure 2). The terrain of the 600-293 waste site was generally flat with a north-south-oriented mound approximately 1 m (3 ft) high that ran down the middle of the site (Figure 3). There was a very flat area relative to the surrounding terrain located at this waste site, which is often a characteristic of the remnants of a building foundation (Figure 4). The service station supported the White Bluffs Central Shops and was used for dispensing automotive fuel.

Figure 2. Linear Depression at the 600-293 Waste Site (January 22, 2010).

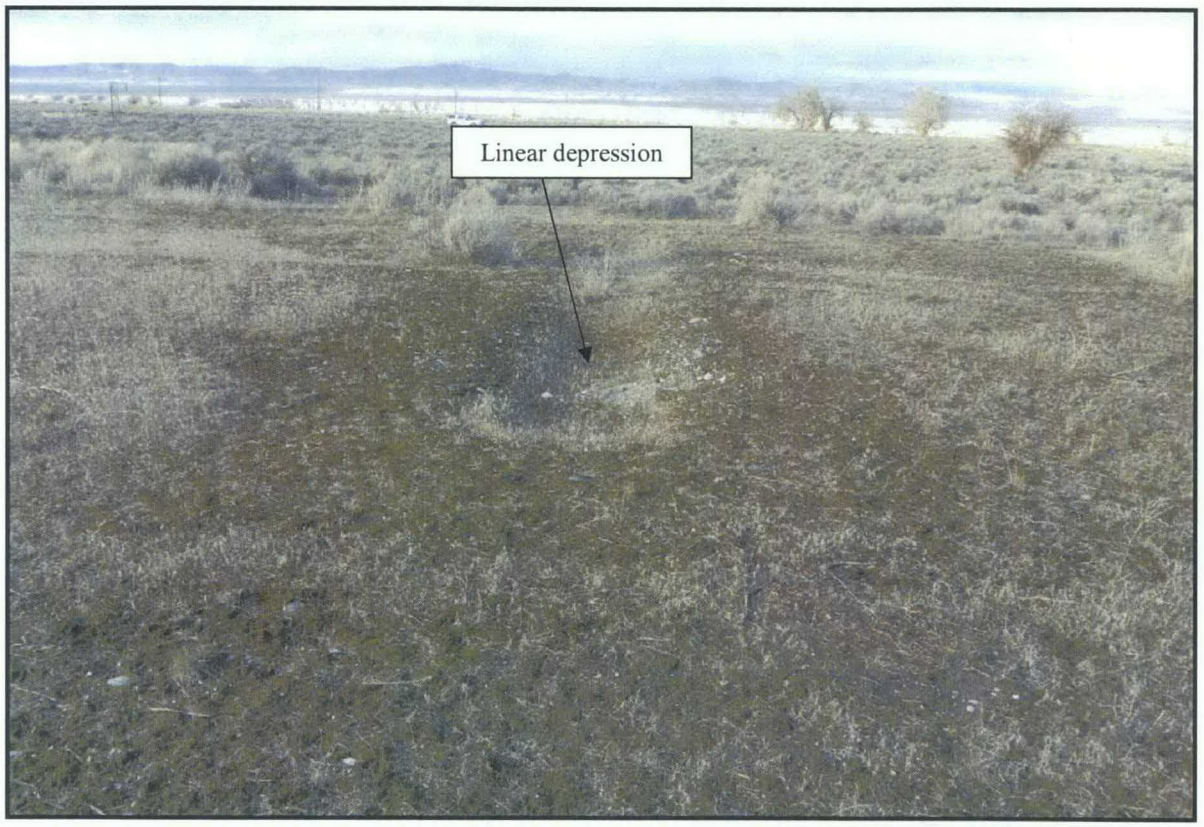


Figure 3. Mound at the 600-293 Waste Site (January 22, 2010).

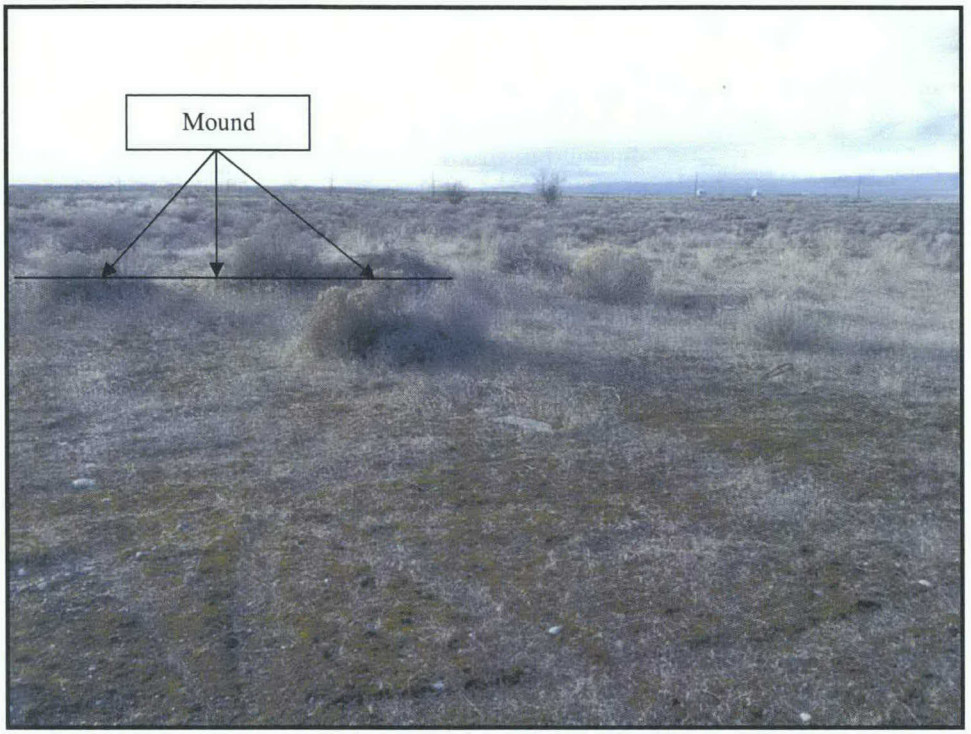


Figure 4. Possible Building Remnant (Flat Area) at the 600-293 Waste Site (January 22, 2010).

The White Bluffs Township contained construction support facilities that were used during the 1940s for the Hanford Works Project. In the early 1970s, a Hanford Site safety and housekeeping evaluation focused on decontamination, decommissioning, and cleanup of farm remnants and deteriorating production facilities. As part of this program, the pre-Manhattan Project gas station facilities at White Bluffs were demolished and buried in place in 1975. Any underground storage tanks at the gas station site potentially remained in place (Wahlen 1991). The White Bluffs 100-IU-2 Operable Unit Technical Baseline Report (Carpenter 1995) also states that the service station was demolished in 1975, but no documentation was found related to removal of underground fuel storage tanks or septic systems.

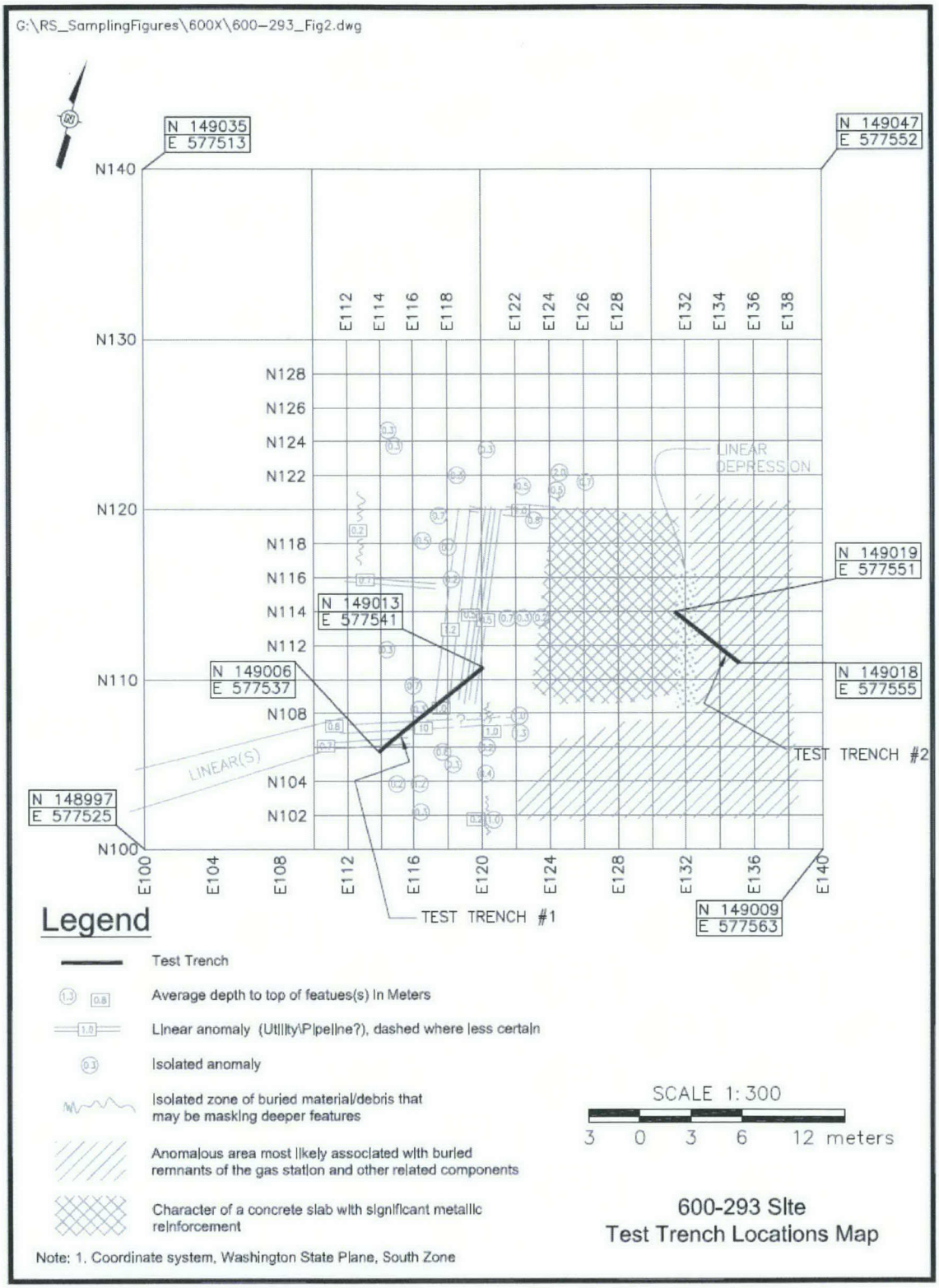
Geophysical Survey

A geophysical site investigation of the 600-293 White Bluffs Service Station #1 was conducted in April 2007 (WCH 2007) using ground-penetrating radar techniques. The purpose of the geophysical survey was to determine whether the underground storage tank(s) (UST) was removed during demolition of the service station. The investigation identified several suspect features that appear to be part of the gas station underground infrastructure. They included concrete slabs, pipelines, utilities, possible pits, and UST(s). Some of the linear features that were identified could have been related to a UST. Several suspect linear features were mapped trending into and buried beneath the mound pictured in Figure 2. Most appear to be utility/pipelines of an unknown origin/purpose. A distinct feature that had the characteristics of a reinforced concrete slab was identified (N115/E128). Numerous other anomalous features coincided with the flat area located in the southeastern corner of the waste site (Figure 5).

CONFIRMATORY SAMPLING

Confirmatory sampling was conducted at the 600-293 waste site on October 18, 2010, per *Work Instruction for Confirmatory Sampling of the 600-293, White Bluffs Service Station #1* (WCH 2010). The excavation of test trench 1 (Figure 5) uncovered a 2.54-cm (1-in.)-diameter steel pipeline at approximately 1 m (3 ft) below ground surface (bgs) and a 5.08-cm (2-in.)-diameter steel pipeline on the east end of the trench. During a partial removal of the pipeline, a small amount of black-brown liquid was discharged from the pipe. A sample was collected of this liquid with soil (J1C2C2). Three more 2.54-cm (1-in.)-diameter pipelines were encountered at 1.4 m (4 ft) bgs; one of the pipelines was observed to be leaking a small amount of oil. Native soil was encountered directly below these three pipelines. The second sample and a duplicate were collected under the three pipelines at approximately 1.5 m (5 ft) bgs (J1C2B8 and J1C2B9).

Figure 5. 600-293 Geophysical Investigation Results and Confirmatory Test Trench Locations.



During the excavation of test trench 2, a concrete trench measuring approximately 0.6 to 0.8 m (2 to 2.5 ft) wide was uncovered containing metal and wood debris. It appeared to be a trench for servicing vehicles in which a person could stand under the vehicle. No staining, pipes, or USTs were discovered at this test trench location. A soil sample was collected from beneath the concrete trench at approximately 2.4 m (8 ft) bgs (J1C2C0). During confirmatory sampling activities, the team discovered a vertical pipe that was thought to potentially lead to a UST, however, no UST was found. The WSP coordinates for the observed vertical pipe are N 149023, E 577538. The results for confirmatory sampling are provided in Appendix A.

REMEDIAL ACTION SUMMARY

The 600-293 waste site was recommended for remediation based on confirmatory sampling results (WCH 2011).

Remediation of the 600-293, White Bluffs Service Station #1 was performed on March 25 and June 24, 2013. Approximately 432 bank cubic meters (BCM) (659 bank cubic yards [BCY]) of materials were excavated and direct loaded for disposal at the Environmental Restoration Disposal Facility (ERDF). The floor of the 600-293 waste site excavation varies from approximately 2.4 to 3 m (8 to 10 ft) bgs (Figure 6).

During the 600-293 waste site remedial activities, no UST was found. A number of pipeline segments associated with the service station were excavated from the 600-293 waste site for disposal at ERDF. Various forms of waste and debris were observed during remediation, including the concrete slab that covered most of the waste site and approximately 0.6 m (2 ft) of bedding sand below the slab where more pipelines were observed and excavated.

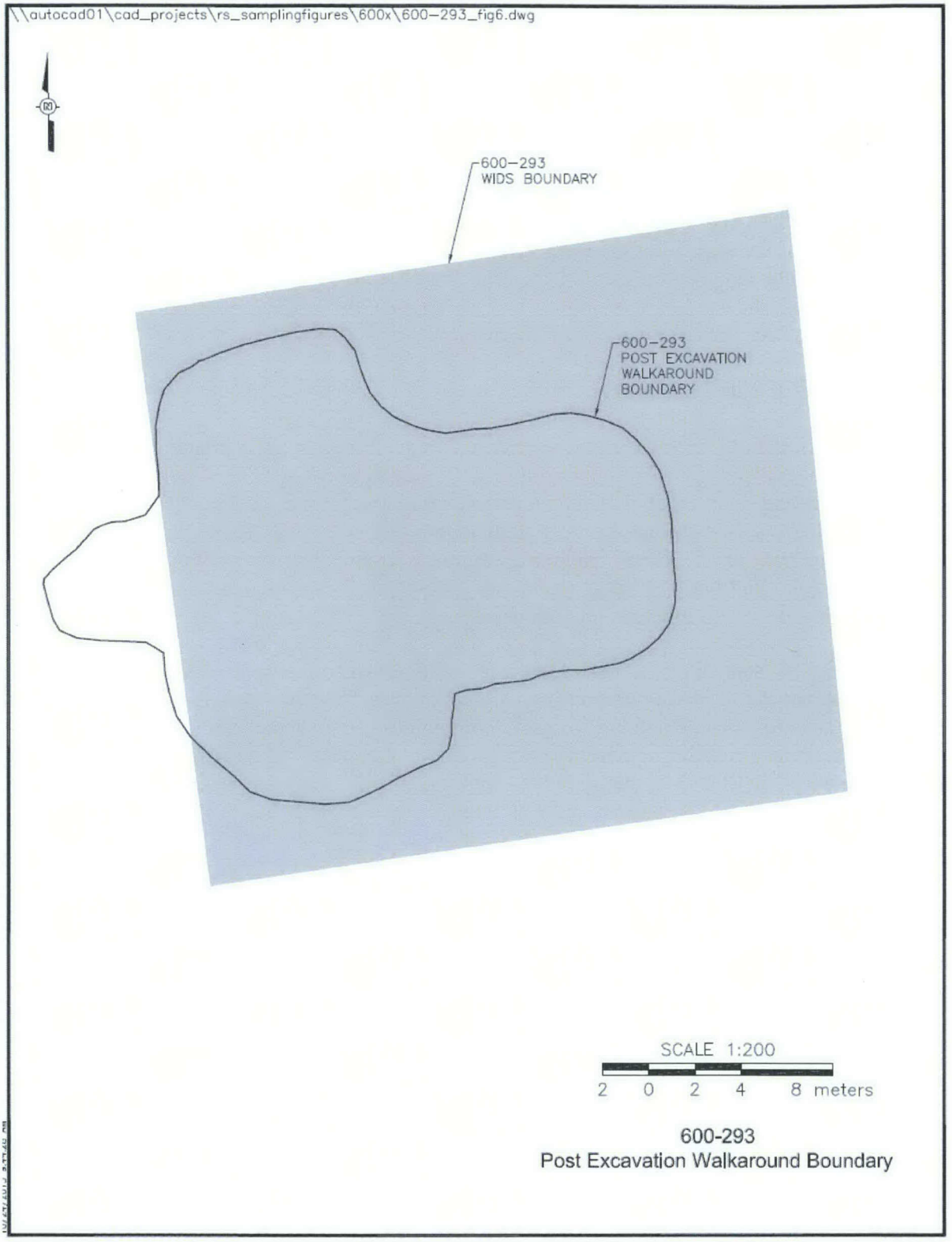
Verification sampling at the 600-293 waste site excavation was performed on August 26, 2013. Verification sampling results indicated that sample location Comp-2 exceeded direct exposure remedial action goals (RAGs) for total polychlorinated biphenyls (PCBs). Per the regulatory agreement "Regulator Concurrence for 600-293 Additional Remediation and Sampling," (WCH 2013b) additional remediation was performed on October 23, 2013, to remove an additional 0.5 m (1.5 ft) of contaminated soils at sample location Comp-2. Approximately 30 BCM (39 BCY) of contaminated soil was excavated from the Comp-2 quadrant of the excavation and direct located for disposal at ERDF (Figure 7). Verification resampling at this location followed on October 24, 2013.

A total volume of 462 BCM (604 BCY) of contaminated soil was excavated from the 600-293 waste site and disposed at ERDF. No overburden materials were salvaged from the 600-293 waste site excavation; therefore, there is no overburden pile associated with the 600-293 waste site. A walk-around boundary of the 600-293 waste site excavation is provided in Figure 8.

Figure 6. Photograph of the 600-293 Waste Site Excavation (July 3, 2013).

Figure 7. Photograph of the 600-293 Waste Site Excavation – Following Additional Remediation (October 23, 2013).

Figure 8. The 600-293 Waste Site Post-Excavation Boundary.



VERIFICATION SAMPLING ACTIVITIES

Verification sampling was performed at the 600-293 waste site on August 26 and October 24, 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).

The verification sample results are provided in Appendix B and indicate that the waste removal action achieved compliance with the remedial action objectives (RAOs) and RAGs for the 600-293 waste site. The following subsections provide additional discussion of the information used to develop the verification sampling design. The maximum results of verification sampling are summarized to support interim closure of the site. A more detailed discussion of the verification sampling can be found in the *Work Instruction for Verification Sampling of the 600-293, White Bluffs Service Station #1 Waste Site* (WCH 2013c).

Contaminants of Potential Concern

The COPCs for the 600-293 waste site were based on the results of the available confirmatory sampling data, existing historical information, and process knowledge. The COPCs identified for the verification sampling included total petroleum hydrocarbons, aroclor-1260, lead, mercury, and hexavalent chromium. Although not considered COPCs, the expanded list of inductively coupled plasma metals including antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc was requested for analysis.

Radiological field screening was performed with handheld instruments during and immediately following remediation. No radiological contamination was detected within the 600-293 excavation area. No volatile organic compounds were detected within the 600-293 excavation area during confirmatory sampling; therefore, volatile organic analysis was not performed. The COPCs for verification sampling and the laboratory analytical methods are identified in Table 1.

Table 1. 600-293 Laboratory Analytical Methods and Contaminants of Potential Concern.

Analysis	Analytical Method	Contaminant of Potential Concern
ICP metals [a]	EPA Method 6010	Lead
Mercury	EPA Method 7471	Mercury
Hexavalent chromium	EPA Method 7196	Hexavalent chromium
TPH	NWTPH-Dx	Total petroleum hydrocarbons
PCBs	EPA Method 8082	Aroclor-1260

[a] Analysis was 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.

EPA = U.S. Environmental Protection Agency
ICP = inductively coupled plasma
NWTPH-Dx = Northwest total petroleum hydrocarbons-diesel range organics
PCB = polychlorinated biphenyl
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 number of samples required for verification sampling was determined based on the remediated site dimensions, as done for previously approved waste site designs (WCH 2013d) in the 100-IU-2 Operable Unit.

Based on the estimated excavation dimensions of 500 m^2 (5,382 ft^2), four composite samples were collected from the waste site. The excavation was divided into four approximately equal quadrants for verification sampling purposes (Figure 9). One composite sample composed of 25 aliquots of soil was collected from across the surface of each of the excavation quadrants. A summary of the verification samples collected and laboratory analyses performed is provided in Table 2.

Figure 9. 600-293 Waste Site Verification Sample Locations.

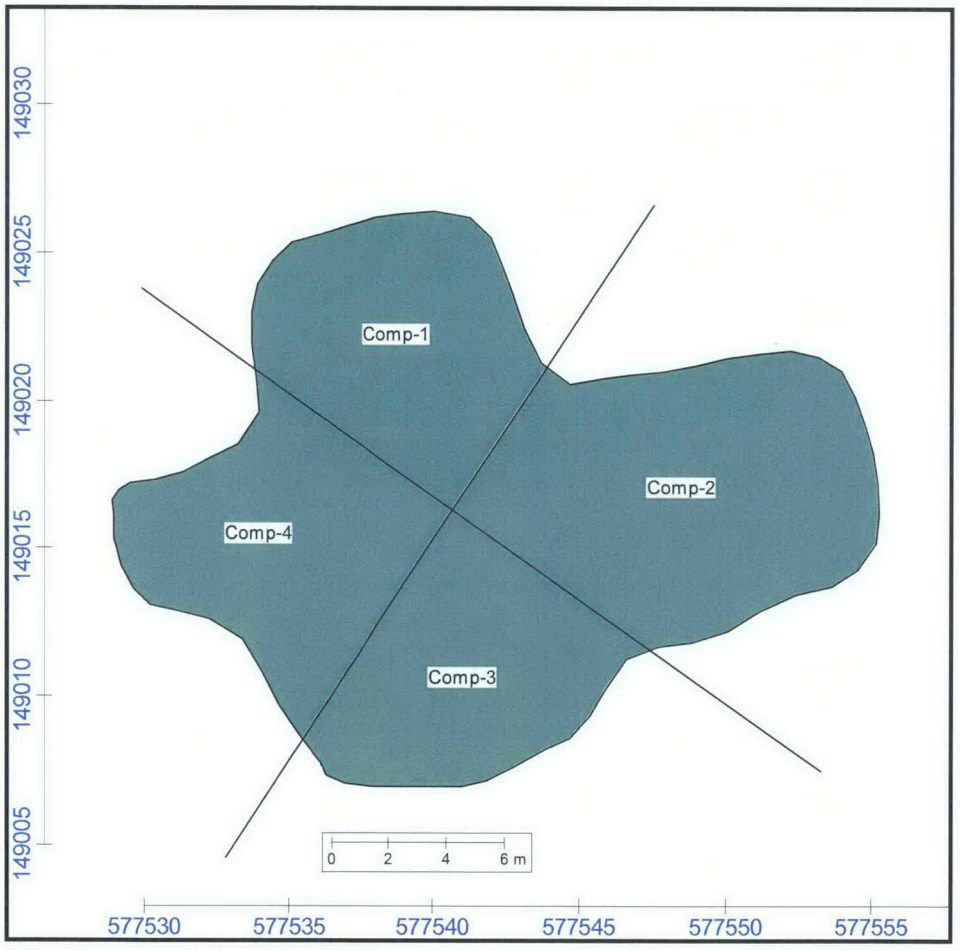


Table 2. 600-293 Verification Sample Summary.

Sample Location	HEIS Sample Number	Washington State Plane Coordinates (Center of Quadrant)		Sample Analysis
		Northing (m)	Easting (m)	
Comp-1	J1RWL1	149021.5	577539.2	ICP metals [a], mercury, hexavalent chromium, PCBs, TPH
Comp-2	J1RWL2	149017.1	577548.8	
Comp-3	J1RWL3	149011.2	577541.2	
Comp-4	J1RWL4	149015.5	577535.4	
Duplicate of J1RWL1	J1RWL5	149021.5	577539.2	
Equipment blank	J1RWL6	NA	NA	ICP metals [a], mercury

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

HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbons

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 field sampling logbook (WCH 2013a).

Verification Sample Results

All verification samples were analyzed using analytical methods approved by EPA (DOE-RL 2009b). Evaluation of the verification data from the 600-293 waste site was performed by direct comparison of the maximum detected value for each COPC against cleanup criteria.

Comparisons of the samples analytical results for site COPCs against the RAGs for the 600-293 waste site are listed in Table 3. 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 2013) 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) Restoration project-specific database prior to archival in the Hanford Environmental Information System, and are provided in Appendix B.

Table 3. Comparison of Contaminant Concentrations to Action Levels for the 600-293 Excavation Verification Samples.

COPC	Maximum Result [b] (mg/kg)	Remedial Action Goals (mg/kg) [a]			Does the Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	2.44 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	60.0 (<BG)	5,600	200	400	No	--
Beryllium	0.605 (<BG)	10.4 [d]	1.51 [c]	1.51 [c]	No	--
Boron [e]	1.46	7,200	320	-- [f]	No	--
Cadmium	0.340 (<BG)	13.9 [d]	0.81 [c]	0.81 [c]	No	--
Chromium	12.0 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	7.47 (<BG)	24	15.7 [c]	-- [f]	No	--
Copper	14.1 (<BG)	2,960	59.2	22.0 [c]	No	--
Lead	14.3	353	10.2 [c]	10.2 [c]	Yes	Yes [g]
Manganese	278 (<BG)	3,760	512 [c]	-- [f]	No	--
Molybdenum [e]	0.493	400	8	-- [f]	No	--
Nickel	10.9 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	54.1 (<BG)	560	85.1 [c]	-- [f]	No	--
Zinc	54.2 (<BG)	24,000	480	67.8 [c]	No	--
TPH – diesel range + motor oil	86	200	200	200	No	--
Aroclor-1242	0.00442	0.5	0.017 [h]	0.017 [h]	No	--
Aroclor-1254	0.0970	0.5	0.017 [h]	0.017 [h]	Yes	Yes [g]
Aroclor-1260	0.247	0.5	0.017 [h]	0.017 [h]	Yes	Yes [g]
Total PCBs	0.348	0.5	0.017 [h]	0.017 [h]	Yes	Yes [g]

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

[b] Maximum value as described in the *600-293 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations* (Appendix B).

[c] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (Ecology 1996). The arsenic cleanup level 20 mg/kg has been agreed to by the Tri-Party Agreement project managers as discussed in Section 2.1.2.1 of the 100 Area RDR/RAWP (DOE-RL 2009b).

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

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

[f] No parameters (bioconcentration factors or ambient water quality criteria values) are available from the Washington State Department of Ecology Cleanup Levels and Risk Calculations database (Ecology 2013) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], Ecology 1996 [Method B for surface waters]).

[g] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), the residual concentrations of lead, aroclor-1254, and aroclor-1260 are not expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years (based on the contaminant with the lowest distribution coefficient, lead, with a K_d of 30 mL/g). The vadose zone underlying the soil below the site is approximately 11 m (36 ft). Therefore, residual concentrations of these constituents are predicted to be protective of groundwater and the Columbia River.

[h] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per WAC 173-340-707(2) (Ecology 1996). The cited RDLs are based on EPA-approved analytical methods that may not be available for rapid-turnaround analyses.

-- = not applicable
BG = background
COPC = contaminant of potential concern
EPA = U.S. Environmental Protection Agency
K_d = distribution coefficient
PCB = polychlorinated biphenyl
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = Remedial Design Report/Remedial Action Work
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

VERIFICATION SAMPLE DATA EVALUATION

This section demonstrates that contaminant concentrations at the 600-293 waste site achieve the applicable RAGs developed to support unrestricted land use at the 100 Area as established in the Remaining Sites ROD (EPA 1999) and documented in the 100 Area RDR/RAWP (DOE-RL 2009b). Table 3 compares the verification sample values to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River.

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 600-293 waste site was determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix B). Nonradionuclide risk requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative carcinogenic risk of less than 1×10^{-5}. For the 600-293 waste site, these risk values were not calculated for constituents that were either not detected or were detected at concentrations below Hanford Site or Washington State background levels. The calculations indicate that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 600-293 waste site is 6.2×10^{-2}. All individual cumulative carcinogenic risk values are less than 1×10^{-6}. The cumulative carcinogenic risk value is 7.0×10^{-7}. Therefore, nonradionuclide risk requirements are met.

Residual concentrations of lead, aroclor-1254, aroclor-1260, and total PCBs exceeded soil RAGs for the protection of groundwater and/or the Columbia River at the 600-293 waste site. However, RESidual RADioactivity modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b) indicates that residual concentrations of contaminants are not predicted to migrate more than 1.8 m (5.9 ft) vertically within 1,000 years based on the contaminant with the lowest distribution coefficient of lead (30 mg/kg). The vadose zone underlying the 600-293 waste site is at least 11 m (36 ft) thick. Therefore, residual concentrations of these contaminants are not predicted to migrate through the soil column to groundwater (and thus the Columbia River) within 1,000 years. All other verification sample results are less than the applicable RAGs.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach (WCH 2013b, c), 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 600-293 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 B. The detailed DQA is presented in Appendix C.

SUMMARY FOR INTERIM CLOSURE

The 600-293 waste site was 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. Contamination above direct exposure levels originating from Hanford Site or Manhattan Project activities was not observed in the shallow zone and is concluded to not exist in the deep zone soils. 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 600-293 waste site to Interim Closed Out.

REFERENCES

40 CFR 141, "National Primary Drinking Water Regulations," *Code of Federal Regulations*, as amended.

BHI, 2001, *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

Carpenter, R. W., 1995, *White Bluffs, 100-IU-2 Operable Unit Technical Baseline Report*, BHI-00448, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* as amended, U.S. Department of Energy, Washington, D.C.

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.

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.

DOE-RL, 2011, *Tri-Party Agreement Handbook Management Procedures,* RL-TPA-90-0001, Rev. 2, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, 1996, "Model Toxics Control Act – Cleanup," *Washington Administrative Code* (WAC) 173-340, Washington State Department of Ecology, Olympia, Washington.

Ecology, 2013, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, <https://fortress.wa.gov/ecy/clarc/CLARCHome.aspx>.

ENV-1, *Environmental Monitoring & Management*, Washington Closure Hanford, Richland, Washington.

EPA, 1989, *Risk Assessment Guidance for Superfund, Volume I1: Human Health Evaluation Manual (Part A), Interim Final*, EPA/540/1-89/002, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1999, *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*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

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.

Wahlen, R. K., 1991, *Summary* of *the Hanford Site Decontamination, Decommissioning, and Cleanup FY 1974 through FY 1990,* WHC-EP-0478, Westinghouse Hanford Company, Richland, Washington.

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

WCH, 2007, *Geophysical Site Investigation Summary, White Bluffs Town Site Between Federal Avenue and the Entrance Road to 100 H*, GI#0578533 Washington Closure Hanford, Richland, Washington.

WCH, 2009, *100-IU-2 and 100-IU-6 Areas Orphan Sites Evaluation Report*, OSR-2008-001 (Doc# 848412), Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH, 2010, *Work Instruction for Confirmatory Sampling of the 600-293, White Bluffs Service Station #1*, 0600X-WI-G0019, Rev. 0, Washington Closure Hanford, Richland Washington.

WCH, 2011, "600-293, White Bluffs Service Station #1 for Remedial Action," CCN 155684 to S. W. Callison, from M. L. Proctor, Washington Closure Hanford, Richland Washington, January 6.

WCH, 2013a, *100-K and IU-2/6 Miscellaneous Restoration and Failed Remaining Sites Sampling*, Logbook EL-1666-01, pp. 12-14, Washington Closure Hanford, Richland, Washington.

WCH, 2013b, "Regulator Concurrence for 600-293 Additional Remediation and Sampling," CCN 173760 to C. Guzzetti, U.S. Environmental Protection Agency, and H. Carman, Washington Closure Hanford, from E. Glossbrenner, U.S. Department of Energy, Richland Operations Office, Richland, Washington, September 25.

WCH, 2013c, *Work Instruction for Verification Sampling of the 600-293, White Bluffs Service Station #1 Waste Site,* 0600X-WI-G0075, Rev. 0, Washington Closure Hanford, Richland Washington.

WCH, 2013d, *Work Instruction for Verification Sampling of the Combined 600 Area Waste Sites, 600-368, 600-369, 600-370, 600-371, 600-372, 600-373, 600-374, 600-375, 600-376, 600-377, 600-379,* 0600X-WI-G0074, Rev. 0, Washington Closure Hanford, Richland, Washington.

WDOH, 1997, *Hanford Guidance for Radiological Cleanup,* WDOH/320-015, Rev. 1, Washington State Department of Health, Olympia, Washington.

APPENDIX A

CONFIRMATORY SAMPLING RESULTS

Table A-1. 600-293 Confirmatory Sample Results (5 pages).

Metals																				
	HEIS	Sample	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron		
Sample location	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
2" Steel Pipe Contents with soil	J1C2C2	10/18/2010	7870		1.9	0.46	U	0.46	3.1	M	0.8	63.4		0.092	0.12	B	0.04	1.5	B	1.2
Soil beneath pipes (5 ft bgs)	J1C2B8	10/18/2010	7020		1.4	0.34	U	0.34	2.4		0.59	63		0.068	0.088	B	0.03	1.3	B	0.88
Duplicate of J1C2B8	J1C2B9	10/18/2010	7170		1.6	0.4	U	0.4	2.8		0.7	57.8		0.08	0.13	B	0.035	1.3	B	1.0
Soil beneath concrete trench (8 ft bgs)	J1C2C0	10/18/2010	7540		1.6	0.39	U	0.39	2.2		0.67	76.7		0.077	0.12	B	0.034	1.3	B	1.0
Equipment blank	J1C2B7	10/18/2010	176		1.4	0.34	U	0.34	0.66	B	0.59	1.8		0.068	0.036	B	0.029	0.88	U	0.88

	HEIS	Sample	Cadmium			Calcium			Chromium			Cobalt			Copper			Hexavalent Chromium		
Sample location	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
2" Steel Pipe Contents with soil	J1C2C2	10/18/2010	0.15	B	0.05	4300		17.2	12.5		0.071	6.1		0.12	14.1		0.26	0.141	U	0.141
Soil beneath pipes (5 ft bgs)	J1C2B8	10/18/2010	0.083	B	0.037	6100		12.6	11.8		0.052	6.2		0.089	14.3		0.19	0.154	U	0.154
Duplicate of J1C2B8	J1C2B9	10/18/2010	0.06	B	0.043	6240		14.9	12.0		0.061	6.4		0.11	13.9		0.23	0.251		0.153
Soil beneath concrete trench (8 ft bgs)	J1C2C0	10/18/2010	0.45		0.042	5220		14.4	13.9		0.059	6.4		0.10	20.2		0.22	0.153	U	0.153
Equipment blank	J1C2B7	10/18/2010	0.037	U	0.037	44.9		12.6	0.12	B	0.052	0.092	B	0.089	0.21	B	0.19			

	HEIS	Sample	Iron			Lead			Magnesium			Manganese			Mercury			Molybdenum		
Sample location	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
2" Steel Pipe Contents with soil	J1C2C2	10/18/2010	26700		4.6	12.5		0.33	4150		4.5	306		0.12	0.016	B	0.0071	0.32	U	0.32
Soil beneath pipes (5 ft bgs)	J1C2B8	10/18/2010	18600		3.4	4.1		0.24	4430		3.3	263		0.089	0.0062	B	0.0053	0.23	U	0.23
Duplicate of J1C2B8	J1C2B9	10/18/2010	18900		4.0	5.0		0.29	4730		3.9	267		0.11	0.0074	B	0.0055	0.28	U	0.28
Soil beneath concrete trench (8 ft bgs)	J1C2C0	10/18/2010	19400		3.9	33.7		0.27	4480		3.8	287		0.10	0.0072	B	0.0055	0.26	U	0.26
Equipment blank	J1C2B7	10/18/2010	234		3.4	0.32	B	0.24	25.1		3.3	4.9		0.089	0.0051	U	0.0051	0.23	U	0.23

	HEIS	Sample	Nickel			Potassium			Selenium			Silicon			Silver			Sodium		
Sample location	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
2" Steel Pipe Contents with soil	J1C2C2	10/18/2010	11.3		0.15	1350		49.9	1.0	U	1.0	346	N	2.6	0.19	U	0.19	263	N	71.8
Soil beneath pipes (5 ft bgs)	J1C2B8	10/18/2010	11.1		0.11	1230		36.7	0.77	U	0.77	217		1.9	0.14	U	0.14	254		52.8
Duplicate of J1C2B8	J1C2B9	10/18/2010	12.8		0.13	1190		43.4	0.91	U	0.91	201		2.2	0.17	U	0.17	238		62.5
Soil beneath concrete trench (8 ft bgs)	J1C2C0	10/18/2010	11.3		0.13	1380		41.8	0.88	U	0.88	278		2.1	0.16	U	0.16	266		60.1
Equipment blank	J1C2B7	10/18/2010	0.14	B	0.11	51.4	B	36.6	0.9		0.77	90.4		1.9	0.14	U	0.14	52.7	U	52.7

	HEIS	Sample	Vanadium			Zinc		
Sample location	Number	Date	mg/kg	Q	PQL	mg/kg	Q	PQL
2" Steel Pipe Contents with soil	J1C2C2	10/18/2010	42.0		0.11	44.0	JL	0.48
Soil beneath pipes (5 ft bgs)	J1C2B8	10/18/2010	46.2		0.084	44.9	JL	0.36
Duplicate of J1C2B8	J1C2B9	10/18/2010	44.0		0.1	53.7	JL	0.42
Soil beneath concrete trench (8 ft bgs)	J1C2C0	10/18/2010	41.3		0.096	46.9	JL	0.41
Equipment blank	J1C2B7	10/18/2010	0.28	B	0.084	1.0	JCL	0.36

Table A-1. 600-293 Confirmatory Sample Results. (5 Pages)

Total Petroleum Hydrocarbons (TPH)								
Sample Location	HEIS Number	Sample Date	TPH - diesel range			TPH - diesel range - extended		
			ug/kg	Q	PQL	ug/kg	Q	PQL
2" Steel Pipe Contents with soil	J1C2C2	10/18/2010	7600		890	22000		1300
Soil beneath pipes (5 ft bgs)	J1C2B8	10/18/2010	7400		680	18000		1000
Duplicate of J1C2B8	J1C2B9	10/18/2010	17000		700	30000		1000
Soil beneath concrete trench (8 ft bgs)	J1C2C0	10/18/2010	84000	N	720	220000	N	1100
Equipment blank	J1C2B7	10/18/2010						

Table A-1. 600-293 Confirmatory Sample Results (5 pages).

CONSTITUENT	J1C2C2			J1C2B8			J1C2B9			J1C2C0			J1C2B7		
	10/18/2010			10/18/2010			10/18/2010			10/18/2010			10/18/2010		
	2" Steel Pipe Contents			Soil beneath pipes (5 ft bgs)			Duplicate of J1C2B8			Soil beneath concrete			Equipment blank		
	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Semivolatile Organics (SVOAs)															
1,2,4-Trichlorobenzene	37	U	37	29	U	29	28	U	28	30	U	30			
1,2-Dichlorobenzene	29	U	29	23	U	23	22	U	22	24	U	24			
1,3-Dichlorobenzene	16	U	16	12	U	12	12	U	12	13	U	13			
1,4-Dichlorobenzene	18	U	18	14	U	14	14	U	14	15	U	15			
2,4,5-Trichlorophenol	13	U	13	10	U	10	10	U	10	11	U	11			
2,4,6-Trichlorophenol	13	U	13	10	U	10	10	U	10	11	U	11			
2,4-Dichlorophenol	13	U	13	10	U	10	10	U	10	11	U	11			
2,4-Dimethylphenol	86	U	86	68	U	68	66	U	66	71	U	71			
2,4-Dinitrophenol	440	U	440	340	U	340	330	U	330	360	U	360			
2,4-Dinitrotoluene	86	U	86	68	U	68	66	U	66	71	U	71			
2,6-Dinitrotoluene	37	U	37	29	U	29	28	U	28	30	U	30			
2-Chloronaphthalene	13	U	13	10	U	10	10	U	10	11	U	11			
2-Chlorophenol	27	U	27	22	U	22	21	U	21	23	U	23			
2-Methylnaphthalene	25	U	25	20	U	20	19	U	19	20	U	20			
2-Methylphenol (cresol, o-)	17	U	17	13	U	13	13	U	13	14	U	14			
2-Nitroaniline	65	U	65	52	U	52	50	U	50	54	U	54			
2-Nitrophenol	13	U	13	10	U	10	10	U	10	11	U	11			
3+4 Methylphenol (cresol, m+p)	43	U	43	34	U	34	33	U	33	35	U	35			
3,3'-Dichlorobenzidine	120	U	120	93	U	93	90	U	90	97	U	97			
3-Nitroaniline	95	U	95	76	U	76	73	U	73	78	U	78			
4,6-Dinitro-2-methylphenol	430	U	430	340	U	340	330	U	330	350	U	350			
4-Bromophenylphenyl ether	25	U	25	20	U	20	19	U	19	20	U	20			
4-Chloro-3-methylphenol	86	U	86	68	U	68	66	U	66	71	U	71			
4-Chloroaniline	110	U	110	85	U	85	82	U	82	88	U	88			
4-Chlorophenylphenyl ether	27	U	27	22	U	22	21	U	21	23	U	23			
4-Nitroaniline	95	U	95	75	U	75	73	U	73	78	U	78			
4-Nitrophenol	130	U	130	100	U	100	97	U	97	100	U	100			
Acenaphthene	13	U	13	11	U	11	10	U	10	11	U	11			
Acenaphthylene	22	U	22	18	U	18	17	U	17	18	U	18			
Anthracene	22	U	22	18	U	18	17	U	17	18	U	18			

Table A-1. 600-293 Confirmatory Sample Results (5 pages).

CONSTITUENT	J1C2C2			J1C2B8			J1C2B9			J1C2C0			J1C2B7		
	10/18/2010			10/18/2010			10/18/2010			10/18/2010			10/18/2010		
	2" Steel Pipe Contents			Soil beneath pipes (5 ft bgs)			Duplicate of J1C2B8			Soil beneath concrete			Equipment blank		
	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
SVOAs (continued)															
Benzo(a)anthracene	26	U	26	21	U	21	20	U	20	21	U	21			
Benzo(a)pyrene	26	U	26	21	U	21	20	U	20	21	U	21			
Benzo(b)fluoranthene	34	U	34	27	U	27	26	U	26	28	U	28			
Benzo(ghi)perylene	21	U	21	17	U	17	16	U	16	17	U	17			
Benzo(k)fluoranthene	52	U	52	41	U	41	40	U	40	43	U	43			
Bis(2-chloro-1-methylethyl)ether	30	U	30	24	U	24	23	U	23	25	U	25			
Bis(2-Chloroethoxy)methane	30	U	30	24	U	24	23	U	23	25	U	25			
Bis(2-chloroethyl) ether	22	U	22	17	U	17	17	U	17	18	U	18			
Bis(2-ethylhexyl) phthalate	60	U	60	48	U	48	46	U	46	49	U	49			
Butylbenzylphthalate	56	U	56	45	U	45	43	U	43	46	U	46			
Carbazole	47	U	47	37	U	37	36	U	36	39	U	39			
Chrysene	35	U	35	28	U	28	27	U	27	29	U	29			
Di-n-butylphthalate	38	U	25	30	U	20	29	U	19	31	U	20			
Di-n-octylphthalate	19	U	26	15	U	21	14	U	20	15	U	21			
Dibenz[a,h]anthracene	25	U	34	20	U	27	19	U	26	20	U	28			
Dibenzofuran	26	U	30	21	U	24	20	U	23	21	U	25			
Diethyl phthalate	34	U	38	27	U	30	26	U	29	28	U	31			
Dimethyl phthalate	30	U	19	24	U	15	23	U	14	25	U	15			
Fluoranthene	47	U	47	37	U	37	36	U	36	39	U	39			
Fluorene	24	U	24	19	U	19	18	U	18	19	U	19			
Hexachlorobenzene	38	U	38	30	U	30	29	U	29	31	U	31			
Hexachlorobutadiene	13	U	13	10	U	10	10	U	10	11	U	11			
Hexachlorocyclopentadiene	65	U	65	52	U	52	50	U	50	54	U	54			
Hexachloroethane	28	U	28	22	U	22	21	U	21	23	U	23			
Indeno(1,2,3-cd)pyrene	29	U	29	23	U	23	22	U	22	24	U	24			
Isophorone	22	U	22	18	U	18	17	U	17	18	U	18			
N-Nitroso-di-n-dipropylamine	41	U	41	32	U	32	31	U	31	33	U	33			
N-Nitrosodiphenylamine	27	U	29	22	U	23	21	U	22	23	U	24			
Naphthalene	41	U	41	32	U	32	31	U	31	33	U	33			
Nitrobenzene	29	U	27	23	U	22	22	U	21	24	U	23			

Table A-1. 600-293 Confirmatory Sample Results (5 pages).

CONSTITUENT	J1C2C2			J1C2B8			J1C2B9			J1C2C0			J1C2B7		
	10/18/2010			10/18/2010			10/18/2010			10/18/2010			10/18/2010		
	2" Steel Pipe Contents			Soil beneath pipes (5 ft bgs)			Duplicate of J1C2B8			Soil beneath concrete			Equipment blank		
	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
SVOAs (continued)															
Pentachlorophenol	430	U	430	340	U	340	330	U	330	350	U	350			
Phenanthrene	22	U	22	18	U	18	17	U	17	18	U	18			
Phenol	24	J	24	19	U	19	18	U	18	19	U	19			
Pyrene	16	U	16	13	U	13	12	U	12	13	U	13			
Polychlorinated Byphenyls (PCBs)															
Aroclor-1016	3.6	U	3.6	2.9	U	2.9	2.9	U	2.9	58	UD	58			
Aroclor-1221	10	U	10	8.3	U	8.3	8.5	U	8.5	170	UD	170			
Aroclor-1232	2.6	U	2.6	2.1	U	2.1	2.1	U	2.1	42	UD	42			
Aroclor-1242	6.0	U	6.0	4.8	U	4.8	4.9	U	4.9	97	UD	97			
Aroclor-1248	6.0	U	6.0	4.8	U	4.8	4.9	U	4.9	97	UD	97			
Aroclor-1254	3.3	U	3.3	2.7	U	2.7	2.8	U	2.8	54	UD	54			
Aroclor-1260	52		3.3	2.7	U	2.7	3.2	J	2.8	1300	D	54			
Polycyclic Aromatic Hydrocarbons (PAHs)															
Acenaphthene	13	U	13	10	U	10	10	U	10	10	U	10			
Acenaphthylene	11	U	11	9.4	U	9.4	9.0	U	9.0	9.4	U	9.4			
Anthracene	3.8	U	3.8	3.2	U	3.2	3.1	U	3.1	3.2	U	3.2			
Benzo(a)anthracene	4.0	U	4.0	3.3	U	3.3	3.2	U	3.2	3.3	U	3.3			
Benzo(a)pyrene	8.1	U	8.1	6.7	U	6.7	6.4	U	6.4	6.7	U	6.7			
Benzo(b)fluoranthene	5.3	U	5.3	4.4	U	4.4	4.2	U	4.2	4.4	U	4.4			
Benzo(ghi)perylene	9.1	U	9.1	7.5	U	7.5	7.2	U	7.2	7.5	U	7.5			
Benzo(k)fluoranthene	5.0	U	5.0	4.1	U	4.1	3.9	U	3.9	4.1	U	4.1			
Chrysene	6.1	U	6.1	5.0	U	5.0	4.8	U	4.8	5.1	U	5.1			
Dibenz[a,h]anthracene	14	U	14	11	U	11	11	U	11	12	U	12			
Fluoranthene	16	U	16	14	U	14	13	U	13	14	U	14			
Fluorene	6.6	U	6.6	5.5	U	5.5	5.3	U	5.3	5.5	U	5.5			
Indeno(1,2,3-cd)pyrene	15	U	15	13	U	13	12	U	12	13	U	13			
Naphthalene	15	U	15	13	U	13	12	U	12	13	U	13			
Phenanthrene	15	U	15	13	U	13	12	U	12	13	U	13			
Pyrene	15	U	15	13	U	13	12	U	12	13	U	13			

APPENDIX B

CALCULATIONS

APPENDIX B

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:

600-293 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation, 0600X-CA-V0156, 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: 600 Field Remediation **Job No. 14655**

Area: 600 Area

Discipline: Environmental Calculation No: 0600X-CA-V0156

Subject: 600-293 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 = 3 Total = 10	I. B. Berezovskiy	J. D. Skoglie	H. M. Sulloway	D. F. Obenauer	12/17/13

SUMMARY OF REVISION

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

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	11/13/2013	Calc. No.:	0600X-CA-V0156	Rev.:	0
Project:	600 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	11/13/2013
Subject:	600-293 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 600-293 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 the 600-293 waste site verification sampling, as necessary.

GIVEN/REFERENCES:

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

2) DOE-RL, 2009b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area,* 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 600-293, White Bluffs Service Station #1 Waste Site,* Attachment to Waste Site Reclassification Form 2013-120, 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:	I. B. Berezovskiy	Date:	11/13/2013	Calc. No.:	0600X-CA-V0156	Rev.:	0
Project:	600 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	11/13/2013
Subject:	600-293 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 600-293 waste site was comprised of four composite focused sample locations including one duplicate sample for verification sampling. The direct contact hazard quotient and carcinogenic risk calculations for the 600-293 waste site were conservatively calculated using the maximum results from the sample results from Attachment 1. Of the contaminants of potential concern (COPCs) and other analytes for these sites, boron, molybdenum and the detected polychlorinated biphenyls require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Although total petroleum hydrocarbons (diesel range and motor oil) 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 1.46 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 2.0×10^{-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 6.2×10^{-2}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value, then multiplied by 1.0×10^{-6}. For example, the maximum value for aroclor-1242 is 0.00442 mg/kg, divided by 0.5 mg/kg, and multiplied as indicated, is 8.8×10^{-9}. 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 7.0×10^{-7}. Comparing these values to the requirement of $<1 \times 10^{-5}$, this criterion is met.

5) The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed for certain analytes

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	11/13/2013	Calc. No.:	0600X-CA-V0156	Rev.:	0
Project:	600 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	11/13/2013
Subject:	600-293 Waste Site Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 6	

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 cleanup verification of the subject sites. 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 600-293 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 600-293 waste site.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	11/13/2013	Calc. No.:	0600X-CA-V0156	Rev.:	0
Project:	600 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	11/13/2013
Subject:	600-293 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 600-293 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	1.46	7,200	2.0E-04	--	--
Lead [c]	14.3	353	--	--	--
Molybdenum	0.493	400	1.2E-03	--	--
Polychlorinated Biphenyls					
Aroclor-1242	0.00442	--	--	0.5	8.8E-09
Aroclor-1254	0.0970	1.6	6.1E-02	0.5	1.9E-07
Aroclor-1260	0.247	--	--	0.5	4.9E-07
Total Petroleum Hydrocarbon					
TPH-diesel range plus motor oil [d]	86	200	--	--	--
Totals					
Cumulative Hazard Quotient:			**6.2E-02**		
Cumulative Excess Cancer Risk:					**7.0E-07**

Notes:

[a] = From Attachment 1.

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

[c] = Value for the 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					
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Project:	600 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	11/13/2013
Subject:	600-293 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 600-293 Waste Site (2 Pages).

Duplicate Analysis - 600-293 Waste Site

Sampling Area	Sample Number	Sample Date	Aluminum mg/kg	Q	PQL	Arsenic mg/kg	Q	PQL	Barium mg/kg	Q	PQL	Beryllium mg/kg	Q	PQL
Comp-1	J1RWL1	8/26/13	6090		6.66	2.31	B	0.490	60.0		0.098	0.575		0.098
Duplicate of J1RWL1	J1RWL5	8/26/13	6090		6.86	2.44	B	0.504	59.9		0.101	0.605		0.101

Analysis:

TDL		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			0.2%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable

Duplicate Analysis - 600-293 Waste Site

Sampling Area	Sample Number	Sample Date	Boron mg/kg	Q	PQL	Cadmium mg/kg	Q	PQL	Calcium mg/kg	Q	PQL	Chromium mg/kg	Q	PQL
Comp-1	J1RWL1	8/26/13	1.35	B	0.98	0.246	B	0.098	3380		7.84	11.2		0.147
Duplicate of J1RWL1	J1RWL5	8/26/13	1.46	B	1.01	0.268	B	0.101	3420		8.07	10.9		0.151

Analysis:

TDL		2	0.2	100	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD			1.2%	2.7%
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	Not applicable

Duplicate Analysis - 600-293 Waste Site

Sampling Area	Sample Number	Sample Date	Cobalt mg/kg	Q	PQL	Copper mg/kg	Q	PQL	Iron mg/kg	Q	PQL	Lead mg/kg	Q	PQL
Comp-1	J1RWL1	8/26/13	7.07	D	0.735	13.1		0.294	19000		7.84	7.84	D	1.62
Duplicate of J1RWL1	J1RWL5	8/26/13	7.38	D	0.756	13.2		0.303	19100		8.07	8.35	D	1.66

Analysis:

TDL		2	1	5	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%	0.5%	
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable

Duplicate Analysis - 600-293 Waste Site

Sampling Area	HEIS Number	Sample Date	Magnesium mg/kg	Q	PQL	Manganese mg/kg	Q	PQL	Molybdenum mg/kg	Q	PQL	Nickel mg/kg	Q	PQL
Comp-1	J1RWL1	8/26/13	4280		8.33	274		0.196	0.461	B	0.196	10.8		0.147
Duplicate of J1RWL1	J1RWL5	8/26/13	4210		8.57	278		0.202	0.459	B	0.202	10.4		0.151

Analysis:

TDL		75	5	2	4
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	1.6%	1.4%		
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable

Duplicate Analysis - 600-293 Waste Site

Sampling Area	HEIS Number	Sample Date	Potassium mg/kg	Q	PQL	Silicon mg/kg	Q	PQL	Sodium mg/kg	Q	PQL	Vanadium mg/kg	Q	PQL
Comp-1	J1RWL1	8/26/13	1300		6.27	302	MNJ	1.47	157		6.86	51.5	D	0.490
Duplicate of J1RWL1	J1RWL5	8/26/13	1320		6.45	384	MNJ	1.51	160		7.06	54.1	D	0.504

Analysis:

TDL		400	2	50	2.5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		23.9%		4.9%
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable

Washington Closure Hanford, Inc.		CALCULATION SHEET					
Originator:	I. B. Berezovskiy	Date:	11/13/2013	Calc. No.:	0600X-CA-V0156	Rev.:	0
Project:	600 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	11/13/2013
Subject:	600-293 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 600-293 Waste Site (2 Pages).

Duplicate Analysis - 600-293 Waste Site

Sampling	HEIS	Sample	Zinc			Aroclor-1242			Aroclor-1254			Aroclor-1260		
Area	Number	Date	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Comp-1	J1RWL1	8/26/13	46.2	D	1.96	4.42	P	1.13	10.9		1.13	26.4		1.13
Duplicate of J1RWL1	J1RWL5	8/26/13	49.0	D	2.02	3.59	J	1.14	10.6	J	1.14	26.9	J	1.14

Analysis:

TDL		1	20	20	20
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	5.9%			
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable	No - acceptable

CONCLUSION:

The calculations in Tables 1 and 2 demonstrate that the 600-293 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 these sites.

Attachment 1. 600-293 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
Comp-1	J1RWL1	8/26/13	6090		6.66	1.62	DU	1.62	2.31	B	0.490	60.0		0.098	0.575		0.098
Duplicate of J1RWL1	J1RWL5	8/26/13	6090		6.86	1.66	DU	1.66	2.44	B	0.504	59.9		0.101	0.605		0.101
Comp-2	J1RWL2	8/26/13	6100		6.40	1.55	DU	1.55	2.25	B	0.470	58.3		0.0941	0.557		0.0941
Comp-3	J1RWL3	8/26/13	5510		6.34	1.54	DU	1.54	2.14	B	0.466	59.3		0.0932	0.540		0.0932
Comp-4	J1RWL4	8/26/13	5620		6.45	1.56	DU	1.56	1.80	B	0.474	54.8		0.0948	0.533		0.0948
Equipment Blank	J1RWL6	8/26/13	165		6.32	0.307	U	0.307	0.465	U	0.465	1.98		0.093	0.0969	B	0.093

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
Comp-1	J1RWL1	8/26/13	1.35	B	0.980	0.246	B	0.098	3380		7.84	11.2		0.147	7.07	D	0.735
Duplicate of J1RWL1	J1RWL5	8/26/13	1.46	B	1.01	0.268	B	0.101	3420		8.07	10.9		0.151	7.38	D	0.756
Comp-2	J1RWL2	8/26/13	1.13	B	0.941	0.340	B	0.0941	3940		7.53	12.0		0.141	7.33	D	0.706
Comp-3	J1RWL3	8/26/13	0.932	U	0.932	0.258	B	0.0932	3970		7.46	11.4		0.140	7.47	D	0.699
Comp-4	J1RWL4	8/26/13	1.12	B	0.948	0.277	B	0.0948	4140		7.58	10.3		0.142	7.10	D	0.711
Equipment Blank	J1RWL6	8/26/13	0.930	U	0.930	0.093	U	0.093	37.4		7.44	0.241	B	0.139	0.200	B	0.139

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

Gray cells indicate not applicable.

[a] Sample J1RWL2 from the 600-293 waste site was near the direct exposure RAG for PCB, therefore this location underwent additional remediation and resampling.

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

B = blank contamination (organic constituents) = estimated (inorganic)

C = Sample was </= 5X the blank concentration

Comp = composite

D = results are reported from a diluted aliquot of sample.

HEIS = Hanford Environmental Information System

J = estimated

M = sample duplicate precision not met.

N = recovery is outside the control limits.

P = aroclor target analyte with greater than 25% difference between column analyses.

PQL = practical quantitation limit

TPH = total petroleum hydrocarbons

Q = qualifier

U = undetected

X = serial dilution indicates that physical and chemical interferences are present.

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Attachment 1. 600-293 Waste Site Verification Sample Results (Metals).

Sample Location	HEIS Number	Sample Date	Copper			Hexavalent chromium			Iron			Lead			Magnesium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Comp-1	J1RWL1	8/26/13	13.1		0.294	0.165	U	0.165	19000		7.84	7.84	D	1.62	4280		8.33
Duplicate of J1RWL1	J1RWL5	8/26/13	13.2		0.303	0.159	U	0.159	19100		8.07	8.35	D	1.66	4210		8.57
Comp-2	J1RWL2	8/26/13	14.1		0.282	0.163	U	0.163	18300		7.53	14.3	D	1.55	4280		8.00
Comp-3	J1RWL3	8/26/13	12.0		0.280	0.161	U	0.161	17700		7.46	5.56	D	1.54	3930		7.92
Comp-4	J1RWL4	8/26/13	12.9		0.284	0.162	U	0.162	17700		7.58	5.37	D	1.56	4140		8.06
Equipment Blank	J1RWL6	8/26/13	0.279	U	0.279				1050		7.44	0.598	BCUJ	0.307	39.4		7.90

Sample Location	HEIS Number	Sample Date	Manganese			Mercury			Molybdenum			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Comp-1	J1RWL1	8/26/13	274		0.196	0.00412	U	0.00412	0.461	B	0.196	10.8		0.147	1300		6.27
Duplicate of J1RWL1	J1RWL5	8/26/13	278		0.202	0.00395	U	0.00395	0.459	B	0.202	10.4		0.151	1320		6.45
Comp-2	J1RWL2	8/26/13	264		0.188	0.00385	U	0.00385	0.406	B	0.188	10.9		0.141	1320		6.02
Comp-3	J1RWL3	8/26/13	251		0.186	0.00382	U	0.00382	0.493	B	0.186	9.74		0.140	1150		5.97
Comp-4	J1RWL4	8/26/13	255		0.190	0.00398	U	0.00398	0.353	B	0.190	10.2		0.142	1200		6.07
Equipment Blank	J1RWL6	8/26/13	7.51		0.186	0.00393	U	0.00393	0.186	U	0.186	0.628		0.139	62.3		5.95

Sample Location	HEIS Number	Sample Date	Selenium			Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Comp-1	J1RWL1	8/26/13	0.316	DU	0.316	302	MNJ	1.47	0.098	U	0.098	157		6.86	51.5	D	0.490
Duplicate of J1RWL1	J1RWL5	8/26/13	0.334	DU	0.334	384	MNJ	1.51	0.101	U	0.101	160		7.06	54.1	D	0.504
Comp-2	J1RWL2	8/26/13	0.301	DU	0.301	355	MNJ	1.41	0.0941	U	0.0941	171		6.59	52.8	D	0.470
Comp-3	J1RWL3	8/26/13	0.312	DU	0.312	338	MNJ	1.40	0.0932	U	0.0932	150		6.53	52.7	D	0.466
Comp-4	J1RWL4	8/26/13	0.323	DU	0.323	349	MNJ	1.42	0.0948	U	0.0948	196		6.64	50.5	D	0.474
Equipment Blank	J1RWL6	8/26/13	0.290	DU	0.290	142	MNJ	1.39	0.093	U	0.093	6.51	U	6.51	1.26		0.093

Sample Location	HEIS Number	Sample Date	Zinc		
			mg/kg	Q	PQL
Comp-1	J1RWL1	8/26/13	46.2	D	1.96
Duplicate of J1RWL1	J1RWL5	8/26/13	49.0	D	2.02
Comp-2	J1RWL2	8/26/13	47.4	D	1.88
Comp-3	J1RWL3	8/26/13	54.2	D	1.86
Comp-4	J1RWL4	8/26/13	41.9	D	1.90
Equipment Blank	J1RWL6	8/26/13	1.82	CUJ	0.372

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Attachment 1. 600-293 Waste Site Verification Sample Results (PCBs and TPH).

CONSTITUENT	CLASS	Comp-1, J1RWL1			Duplicate of J1RWL1, J1RWL5			Comp-2, J1RWL2			Re-sample Comp-2, J1T232			Comp-3, J1RWL3			Comp-4, J1RWL4		
		08/26/13			08/26/13			08/26/13			10/24/13			08/26/13			08/26/13		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Aroclor-1016	PCB	1.13	U	1.13	1.14	UJ	1.14	22.8	DUJ	22.8	6.20	DU	6.20	1.14	UJ	1.14	1.13	UJ	1.13
Aroclor-1221	PCB	1.13	U	1.13	1.14	UJ	1.14	22.8	DUJ	22.8	6.20	DU	6.20	1.14	UJ	1.14	1.13	UJ	1.13
Aroclor-1232	PCB	1.13	U	1.13	1.14	UJ	1.14	22.8	DUJ	22.8	6.20	DU	6.20	1.14	UJ	1.14	1.13	UJ	1.13
Aroclor-1242	PCB	4.42	P	1.13	3.59	J	1.14	136	DJ	22.8	6.20	DU	6.20	2.41	J	1.14	2.27	J	1.13
Aroclor-1248	PCB	1.13	U	1.13	1.14	UJ	1.14	22.8	DUJ	22.8	6.20	DU	6.20	1.14	UJ	1.14	1.13	UJ	1.13
Aroclor-1254	PCB	10.9		1.13	10.6	J	1.14	198	DJ	22.8	97.0	D	6.20	8.20	J	1.14	5.40	J	1.13
Aroclor-1260	PCB	26.4		1.13	26.9	J	1.14	437	DJ	22.8	247	D	6.20	24.3	J	1.14	14.0	J	1.13

Sample Location	HEIS Number	Sample Date	TPH - diesel range			TPH - motor oil (high boiling)		
			ug/kg	Q	PQL	ug/kg	Q	PQL
Comp-1	J1RWL1	8/26/13	2340	JX	2230	14000	XUJ	2230
Duplicate of J1RWL1	J1RWL5	8/26/13	2220	UXJ	2220	16900	XUJ	2220
Comp-2	J1RWL2	8/26/13	5580	JX	2230	80200	XJ	2230
Comp-3	J1RWL3	8/26/13	4320	JX	2220	21900	XUJ	2220
Comp-4	J1RWL4	8/26/13	2200	UXJ	2200	23300	XUJ	2200
Equipment Blank	J1RWL6	8/26/13						

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APPENDIX C

DATA QUALITY ASSESSMENT

APPENDIX C

DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample designs (WCH 2013b, c). 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 designs (WCH 2013b, c), 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 designs. To ensure quality data, the 100 Area SAP (DOE-RL 2009) data assurance requirements and the data validation procedures for chemical analysis (BHI 2000) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2006).

Verification sample data collected at the 600-293 waste site were provided by the laboratories in two sample delivery groups (SDGs): SDG X0020 and SDG XP0024. SDG X0020 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed for the 600-293 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.

SDG X0020

This SDG comprises four focused composite soil samples (J1RWL1 through J1RWL4) from the 600-293 waste site. This SDG includes a field duplicate pair (J1RWL1/J1RWL5). These samples were analyzed for inductively coupled plasma (ICP) metals, mercury, hexavalent chromium, polychlorinated biphenyls (PCBs), and total petroleum hydrocarbons (TPH). In addition, one equipment blank (J1RWL6) was collected and analyzed for ICP metals and mercury. SDG X0020 was submitted for third-party validation. Minor deficiencies are as follows.

In the ICP metals analysis, the matrix spike (MS) recoveries are below the project acceptance criteria for silicon. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Silicon did not have mismatched spike and native concentrations in the MS. The MS recovery for silicon was 5.32%. All silicon results in SDG X0020 are qualified as estimates by third-party validation with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, lead and zinc were detected in the method blank. Due to method blank contamination, third-party validation qualified all lead and zinc results in sample J1RWL6 as undetected with "UJ" flags. The data are usable for decision-making purposes.

In the TPH analysis, the holding time for motor oil results was exceeded by less than twice the limit. All motor oil sampling results were qualified as estimates by third-party validation with "J" flags. Estimated data are usable for decision-making purposes.

In the TPH analysis, motor oil was detected in the MB. Third-party validation qualified all motor oil results for samples J1RWL1, J1RWL3, J1RWL4, and J1RWL5 as undetected with "U" flags. The data are usable for decision-making purposes.

In the TPH analysis, the MS and matrix spike duplicate (MSD) recoveries for motor oil were outside the quality control (QC) limits. All motor oil sampling results in SDG X0020 were qualified by third-party validation as estimates with "J" flags. Estimated data are usable for decision-making purposes.

In the PCB analysis, all PCB results in samples J1RWL2, J1RWL3, J1RWL4, and J1RWL5 were qualified as estimates by third-party validation with "J" flags due to a lack of an MS and MSD analysis. The data are usable for decision-making purposes.

SDG XP0024

This SDG comprises one composite-focused soil sample (J1T232) from the Comp-2 location of the 600-293 waste site excavation. This sample was analyzed for PCBs only. Minor deficiencies are as follows.

In the PCB analysis, all PCB results for SDG XP0024 may be considered estimated due to a lack of an MS and MSD analysis. The 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 the 600-293 primary and duplicate samples (J1RWL1/J1RWL5). The main and QA/QC sample results are presented in Appendix B.

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 relative percent difference (RPD) of the sample/duplicate pair(s) for each contaminant of

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

None of the RPD calculated for the field duplicate sample are above the acceptance criteria (30%). 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 TDL, including undetected analytes. In these cases, a control limit of ±2 times the TDL is used (Appendix B) to indicate that a visual check of the data is required by the reviewer. None of the data 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 600-293 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 600-293 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 the Washington Closure Hanford project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System database. The verification sample analytical data are also summarized in Appendix B.

REFERENCES

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

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

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

WCH, 2013a, *100-K and IU-2/6 Miscellaneous Restoration and Failed Remaining Sites Sampling*, Logbook EL-1666-01, pp. 12-14, Washington Closure Hanford, Richland, Washington.

WCH, 2013b, "Regulator Concurrence for 600-293 Additional Remediation and Sampling," CCN 173760 to C. Guzzetti, U.S. Environmental Protection Agency, and H. Carman, Washington Closure Hanford, from E. Glossbrenner, U.S. Department of Energy, Richland Operations Office, Richland, Washington, September 25.

WCH, 2013c, *Work Instruction for Verification Sampling of the 600-293, White Bluffs Service Station #1 Waste Site,* 0600X-WI-G0075, Rev. 0, Washington Closure Hanford, Richland Washington.