REMAINING SITES VERIFICATION PACKAGE FOR THE 600-305, SUSPECT ASBESTOS CONTAINING MATERIAL SITES; 600-308, GARNET SAND; 600-309, BURN SITE #3; 600-310, BURN SITE #4; 600-311, BURN SITE #5; 600-312, BURN SITE #6; 600-313, BURNED AREA AND OIL STAINED SOIL; 600-314, TELECOMMUNICATIONS COMPONENTS; 600-317, BATTERY AND BURN AREA; 600-319, MISCELLANEOUS DEBRIS; AND 600-324, BURNT DEBRIS AREA

Attachment to Waste Site Reclassification Forms 2012-040, 2012-041, 2012-042, 2012-043, 2012-044, 2012-045, 2012-046, 2012-048, 2012-060, 2012-070, and 2012-071

October 2012

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-305, SUSPECT ASBESTOS CONTAINING MATERIAL SITES; 600-308, GARNET SAND; 600-309, BURN SITE #3, 600-310; BURN SITE #4; 600-311, BURN SITE #5; 600-312, BURN SITE #6; 600-313 BURNED AREA AND OIL STAINED SOIL; 600-314 TELECOMMUNICATIONS COMPONENTS; 600-317, BATTERY AND BURN AREA; 600-319, MISCELLANEOUS DEBRIS; AND 600-324, BURNT DEBRIS AREA

EXECUTIVE SUMMARY

This remaining sites verification package combines the reporting of the evaluations, remediation, and subsequent cleanup verification of several miscellaneous waste sites in the 100-IU-2 and 100-IU-6 Operable Units. Based on observations during the field walkdowns to support remedial action, it was determined that these waste sites required remediation.

The 600-305, 600-308, 600-309, 600-310, 600-311, and 600-312 waste sites (and subsites) are part of the 100-IU-2 Operable Unit. Descriptions of each waste site are as follows:

- **600-305:** Five subsites in the Central Shops Area of White Bluffs with scattered suspect asbestos debris.
- **600-308:** A 6-m by 6-m (20-ft by 20-ft) area with scattered garnet sand approximately 112 m (367 ft) east of the 105 Warehouse.
- **600-309:** One burned area located approximately 254 m (833 ft) west of the 600-158, White Bluffs Ground Storage Tank and Booster Pump Station.
- **600-310:** One burned area located approximately 12 m (39 ft) northeast of a former White Bluffs Office that was within site 600-171.
- **600-311:** One burned area with associated burned debris, nails, tar-like roofing material, and the underlying soil located approximately 126 m (413 ft) southeast of site 600-200.
- **600-312:** One area of concentrated burned debris and the underlying soil located approximately 138 m (452 ft) southeast of site 600-200.

The 600-313, 600-314, 600-317, 600-319, and 600-324 waste sites (and subsites) are part of the 100-IU-6 Operable Unit.

- **600-313:** One oil-stained or burned area north and west of the intersection of F Avenue and Route 2 North.

- **600-314:** Five subsites where telecommunications components were removed per the verification work instruction (WCH 2011L) ; no stained soil or anomalous materials were found.

- **600-317:** Area of scattered surface debris including a white granular substance, located south and west of the intersection of F Avenue and Route 2 North.

- **600-319:** Three subsites with surface debris, stained soil, and dried paint believed to have supported Army Tent Camp 230.

- **600-324:** One area with a concrete pad, miscellaneous pipe, auto parts, burnt wood, and debris located 100 m (328 ft) east of site 600-239, 615 Hot Mix Plant Debris.

Remediation of the combined 100-IU-2/6 waste sites occurred between August 10, 2011 and May 29, 2012, resulting in approximately 523 bank cubic meters (BCM) (682 bank cubic yards [BCY]) of soil and debris being removed and disposed at the Environmental Restoration Disposal Facility (ERDF). Site-specific remediation details are provided in the "REMEDIAL ACTION SUMMARY" section of this RSVP.

No overburden soil was stockpiled to be used as backfill at any of the waste sites. Following remediation, verification sampling was conducted for the 600-305:1 and 600-305:2 subsites on April 5, 2012; for the 600-308, 600-309, 600-310, 600-313, and 600-317 waste sites on May 30, 2012; for the 600-311 and 600-312 waste sites on May 17, 2012; for the 600-319:1, 600-319:2, and 600-319:3 subsites on May 30, 2012, May 15, 2012, and December 6, 2011; and for the 600-324 waste site on May 1, 2012. These results indicated that residual contaminant concentrations met the remedial action objectives (RAOs) and remedial action goals (RAGs) for the 600-305:1, 600-305:2, 600-305:3, 600-305:4, 600-305:5, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319:1, 600-319:2, 600-319:3, and 600-324 subsites and waste sites.

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 sites in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011b).

In accordance with this evaluation, the verification sampling results support a reclassification of these combined 100-IU-2/6 waste sites to Interim Closed Out. The current site conditions achieve the RAOs and the corresponding RAGs established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (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 contaminant levels remaining in the soil are protective of groundwater and the

Columbia River. The 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-314, 600-317, 600-319, and 600-324 waste sites contamination does not extend into the deep zone; 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 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-17, 600-319, and 600-324 site contaminants of concern, contaminants of potential concern, and other constituents. Those constituents exceeding the ecological screening level in *Washington Administrative Code* 173-340 were boron, copper, selenium, vanadium, and zinc. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for antimony, copper, lead, manganese, selenium, vanadium, and zinc. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because the detected levels of antimony, manganese, and vanadium 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.

Table ES-1. Summary of Remedial Action Goals for the Combined 100-IU-2/6 Waste Sites: 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-319, 600-324. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain 15 mrem/yr dose rate above background over 1,000 years.	Radionuclides were not COPCs for the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 combined 100-IU-2/6 waste sites.	NA
Direct Exposure – Nonradionuclides	Attain individual COPC RAGs.	All individual COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	The hazard quotients for individual nonradionuclide COPCs are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient for all sampling areas (6.7×10^{-2}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	No carcinogenic constituents met the criteria for evaluation; therefore, no calculations of excess carcinogenic risk were performed.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	No carcinogenic constituents met the criteria for evaluation; therefore, no calculations of excess carcinogenic risk were performed.	

Table ES-1. Summary of Remedial Action Goals for the Combined 100-IU-2/6 Waste Sites: 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-319, 600-324. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Radionuclides	Attain single COC groundwater and river RAGs.	Radionuclides were not COPCs for the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 combined 100-IU-2/6 waste sites.	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].		
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and Columbia River cleanup requirements.	Residual concentrations of chromium (total), copper, lead, selenium, and zinc exceeded soil RAGs for the protection of groundwater and/or the Columbia River at one or more of the combined 100-IU-2/6 waste sites. However, RESRAD modeling and evaluation of dilution-attenuation in the saturated zone predicts that these constituents will not migrate to groundwater and/or the Columbia River within 1,000 years. Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia 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), and the evaluation of dilution-attenuation in the saturated zone using the formulas from the EPA *Soil Screening Guidance: User's Guide* (EPA 1996), residual concentrations of chromium (total), copper, lead, selenium, and zinc are predicted to be protective of groundwater and Columbia River at the combined 100-IU-2/6 waste sites for 1,000 years. Site-specific discussions of comparisons of residual contaminant concentrations to remedial action goals are presented in Tables 10 through 20.

COC = contaminant of concern
COPC = contaminant of potential concern
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 for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)

REMAINING SITES VERIFICATION PACKAGE FOR THE 600-305, SUSPECT ASBESTOS CONTAINING MATERIAL SITES; 600-308, GARNET SAND; 600-309, BURN SITE #3, 600-310; BURN SITE #4; 600-311, BURN SITE #5; 600-312, BURN SITE #6; 600-313 BURNED AREA AND OIL STAINED SOIL; 600-314 TELECOMMUNICATIONS COMPONENTS; 600-317, BATTERY AND BURN AREA; 600-319, MISCELLANEOUS DEBRIS; AND 600-324, BURNT DEBRIS AREA

STATEMENT OF PROTECTIVENESS

The purpose of this remaining sites verification package is to provide verification sampling data, site evaluations, and supporting documentation to demonstrate that the following combined 100-IU-2/6 waste sites meet the remedial action objectives (RAOs) and remedial action goals (RAGs) established in the *Remedial Design Report/Remedial Action Work Plan for the 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):

- 600-305, Suspect Asbestos Containing Material Sites
- 600-308, Garnet Sand
- 600-309, Burn Site #3
- 600-310, Burn Site #4
- 600-311, Burn Site #5
- 600-312, Burn Site #6
- 600-313, Burned Area and Oil Stained Soil
- 600-314, Telecommunications Components
- 600-317, Battery and Burn Area
- 600-319, Miscellaneous Debris
- 600-324, Burnt Debris Area.

The results of these evaluations 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 from the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-314, 600-319, and 600-324 waste sites and subsites does not extend into the deep zone; 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 600-305, 600-308,

600-309, 600-310, 600-311, 600-312, 600-313, 600-17, 600-319, and 600-324 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 were boron, copper, selenium, vanadium, and zinc. The U.S. Environmental Protection Agency (EPA) ecological soil screening levels were exceeded for antimony, copper, lead, manganese, selenium, vanadium, and zinc. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. Because the detected levels of antimony, manganese, and vanadium 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 600-308, 600-309, 600-310, 600-311, and 600-312 waste sites are part of the 100-IU-2 Operable Unit. Based on observations during the field walkdowns to support remedial action, it was determined that these waste sites required remediation.

The 600-305 waste site consists of five areas in the Central Shops Area of White Bluffs, classified as five subsites, with scattered suspect asbestos debris from apparently randomly distributed construction materials. The Washington State Plane (WSP) coordinates for these five subsites are as follows (Figure 1):

- 600-305:1 at N 147948.6, E 577632.8
- 600-305:2 at N 147936.5, E 577696.8
- 600-305:3 at N 147168.3, E 578195.7
- 600-305:4 at N 147397.8, E 578293.8
- 600-305:5 at N 147948.4, E 578926.0.

The 600-308 waste site consists of a 6-m by 6-m (20-ft by 20-ft) area with scattered garnet sand and the underlying soil located between two rail spurs approximately 112 m (367 ft) east of the 105 Warehouse at WSP coordinates N 148649.9, E 577594.7 (Figure 2).

The 600-309 waste site consists of one burned area located approximately 254 m (833 ft) west of the 600-158, White Bluffs Ground Storage Tank and Booster Pump Station at WSP coordinates N 148347.9, E 578145.0 (Figure 3).

The 600-310 waste site consists of one burned area located approximately 12 m (39 ft) northeast of a former White Bluffs Office that was within site 600-171, White Bluffs Townsite at WSP coordinates N 148209.9, E 578208.2 (Figure 3).

The 600-311 waste site consists of one burned area with associated burned debris, nails, tar-like roofing material, and the underlying soil located approximately 126 m (413 ft) southeast of site 600-200, Priest Rapids Ice House Septic Tank, on the south side of a former White Bluffs Office at WSP coordinates N 147673.4, E 578215.5 (Figure 3).

Figure 1. The 600-305 Waste Subsites Location Map.

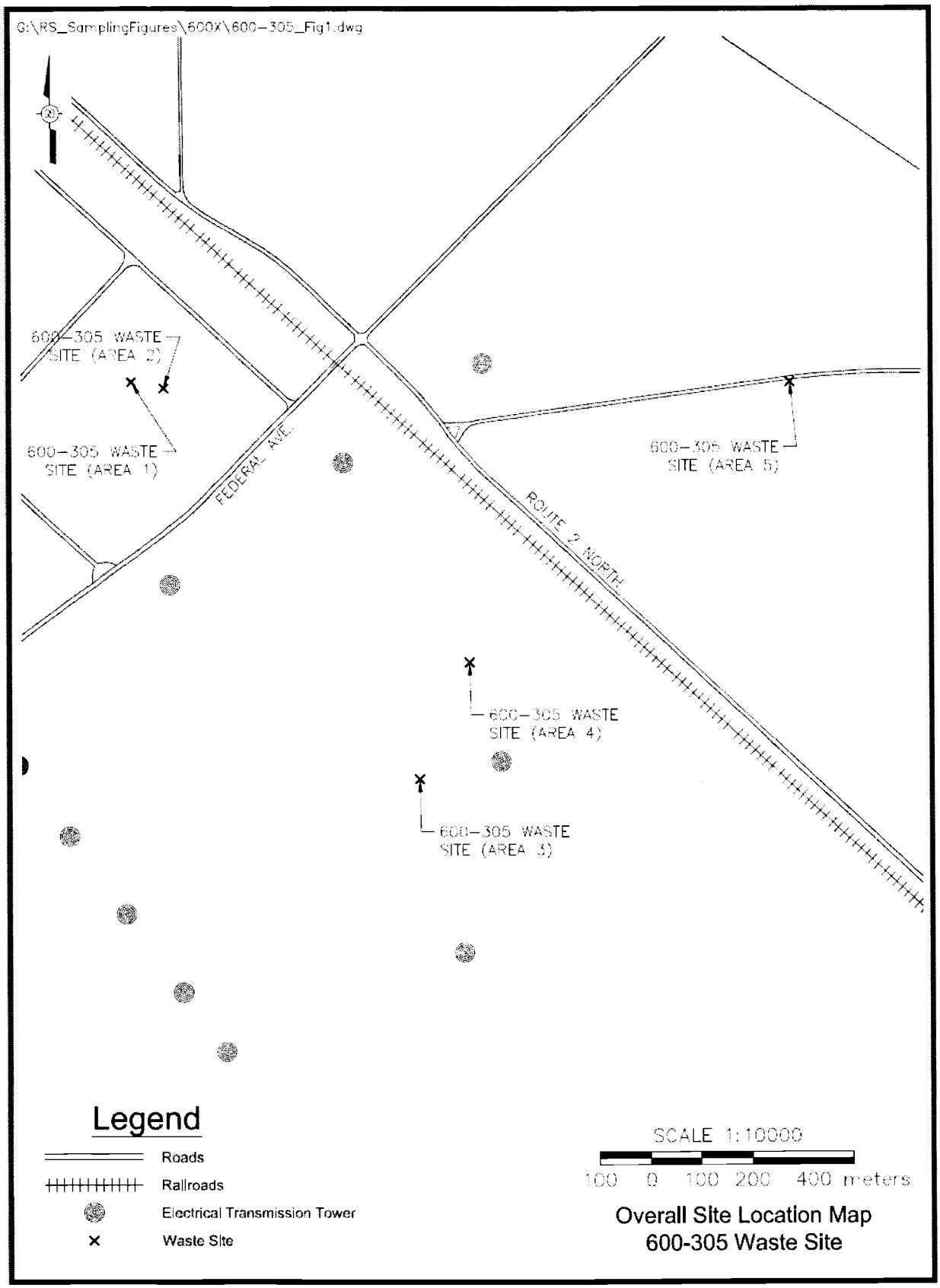


Figure 2. The 600-308 Waste Site Location Map.

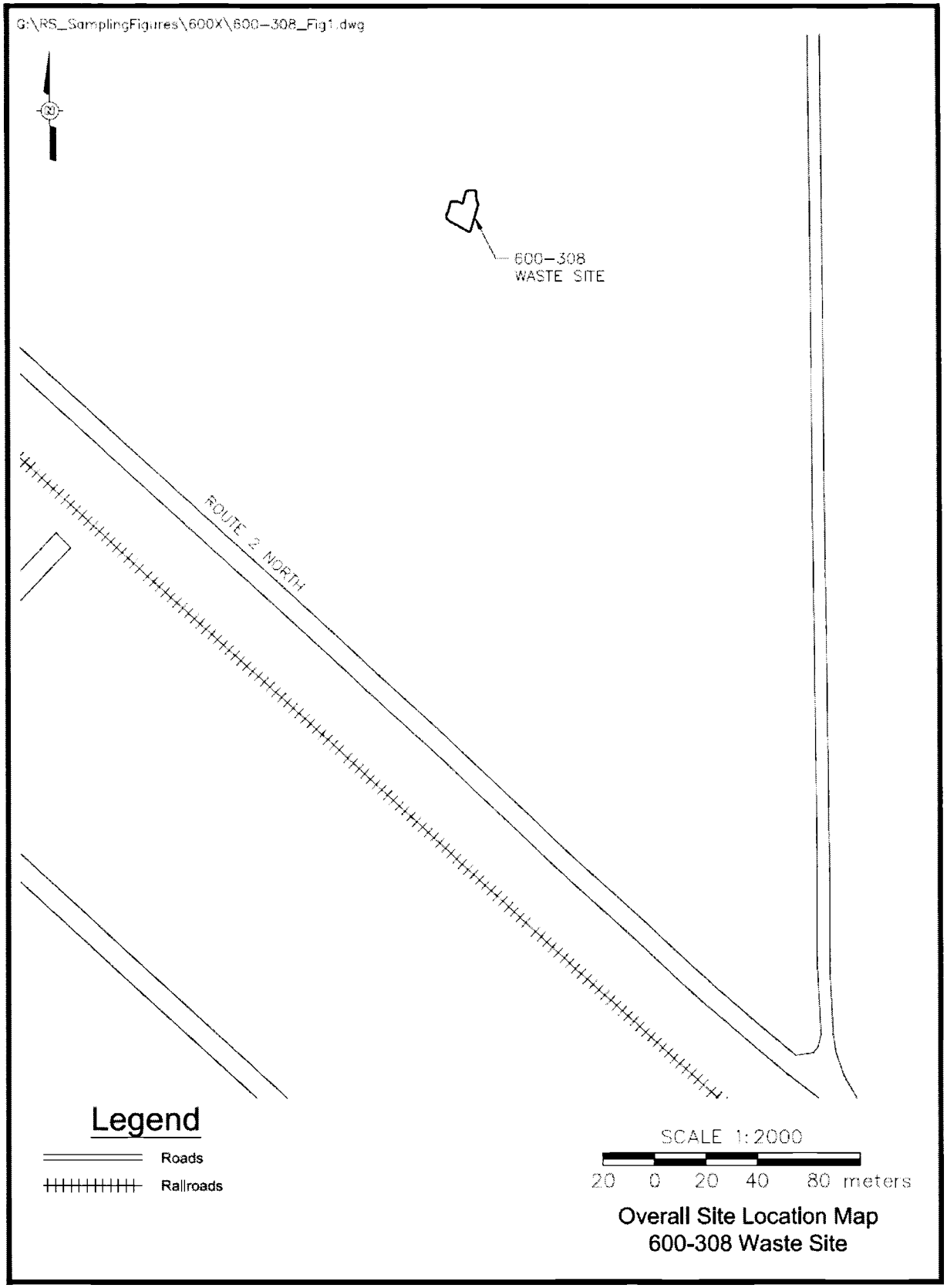
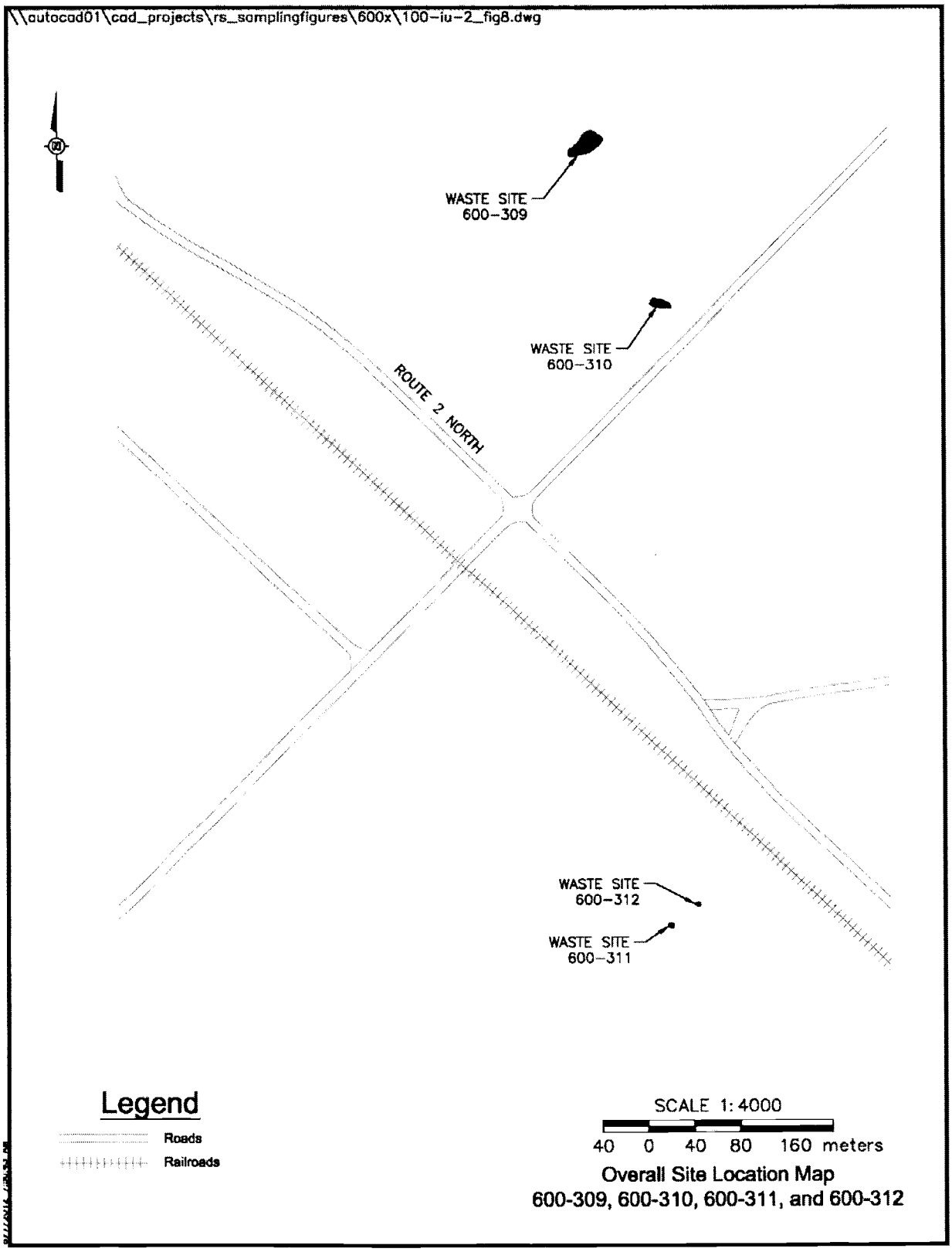


Figure 3. The 600-309, 600-310, 600-311, and 600-312 Waste Site Location Map.



The 600-312 waste site consists of one area of concentrated burned debris and the underlying soil located approximately 138 m (452 ft) southeast of site 600-200, Priest Rapids Ice House Septic Tank, on the north side of a former White Bluffs Office at WSP coordinates N 147691.2, E 578238.9 (Figure 3).

The 600-313, 600-314, 600-317, 600-319, and 600-324 waste sites are part of the 100-IU-6 Operable Unit. Based on observations during the field walkdowns to support remedial action, it was determined that these waste sites required remediation or removal of surface debris.

The 600-313 waste site consists of one potentially contaminated soil area that is either an oil stain or burned area located approximately 0.53 km (0.33 mi) north and 0.29 km (0.18 mi) west of the intersection of F Avenue and Route 2 North at WSP coordinates N 145430.7, E 580355.8 (Figure 4).

The 600-314 waste site is part of the 100-IU-6 Operable Unit (Figure 5). The 600-314 waste site consists of five areas, classified as subsites, where telecommunications components were on the ground surface. The WSP coordinates for these five subsites are as follows:

- 600-314:1, N 145210.4, E 580364.1
- 600-314:2, N 144976.8, E 580620.6
- 600-314:3, N 143485.8, E 581229.8
- 600-314:4, N 143389.9, E 581233.1
- 600-314:5, N 140100.2, E 582771.6.

The site components had hardened black liquid resembling tar on the outside surface. Only component removal occurred at this waste site per the verification work instruction (WCH 2011L) since only telecommunications components were present and no stained or anomalous materials were found during site remediation (WCH 2012e).

The 600-317 waste site consists of one area of scattered surface debris including wet cell battery plates, burned material, and a white granular substance located approximately 0.34 km (0.21 mi) south and 0.46 km (0.26 mi) west of the intersection of F Avenue and Route 2 North at WSP coordinates N 144555.3, E 580184.9 (Figure 4).

The 600-319 waste site is part of the 100-IU-6 Operable Unit (Figure 6). The 600-319 waste site consists of three areas of surface debris, classified as three subsites, consisting of ferrous metal, stained soil, and dried paint believed to have supported Army Tent Camp 230. The WSP coordinates for these three subsites are as follows:

- 600-319:1 at N 147948.6, E 577632.8
- 600-319:2 at N 147936.5, E 577696.8
- 600-319:3 at N 147168.3, E 578195.7.

Figure 4. The 600-313, 600-317, and 600-324 Waste Site Location Map.

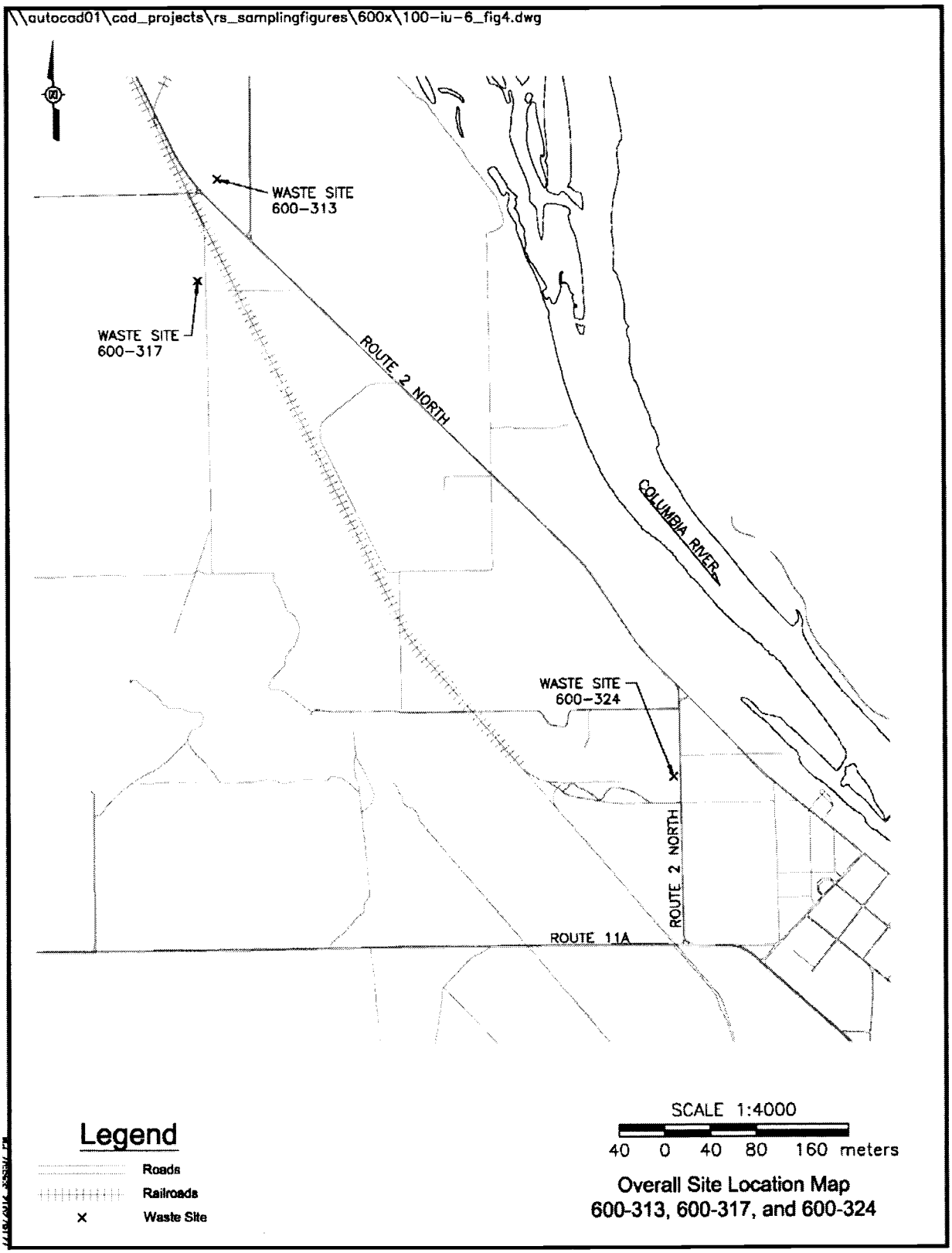


Figure 5. The 600-314 Waste Subsites Location Map.

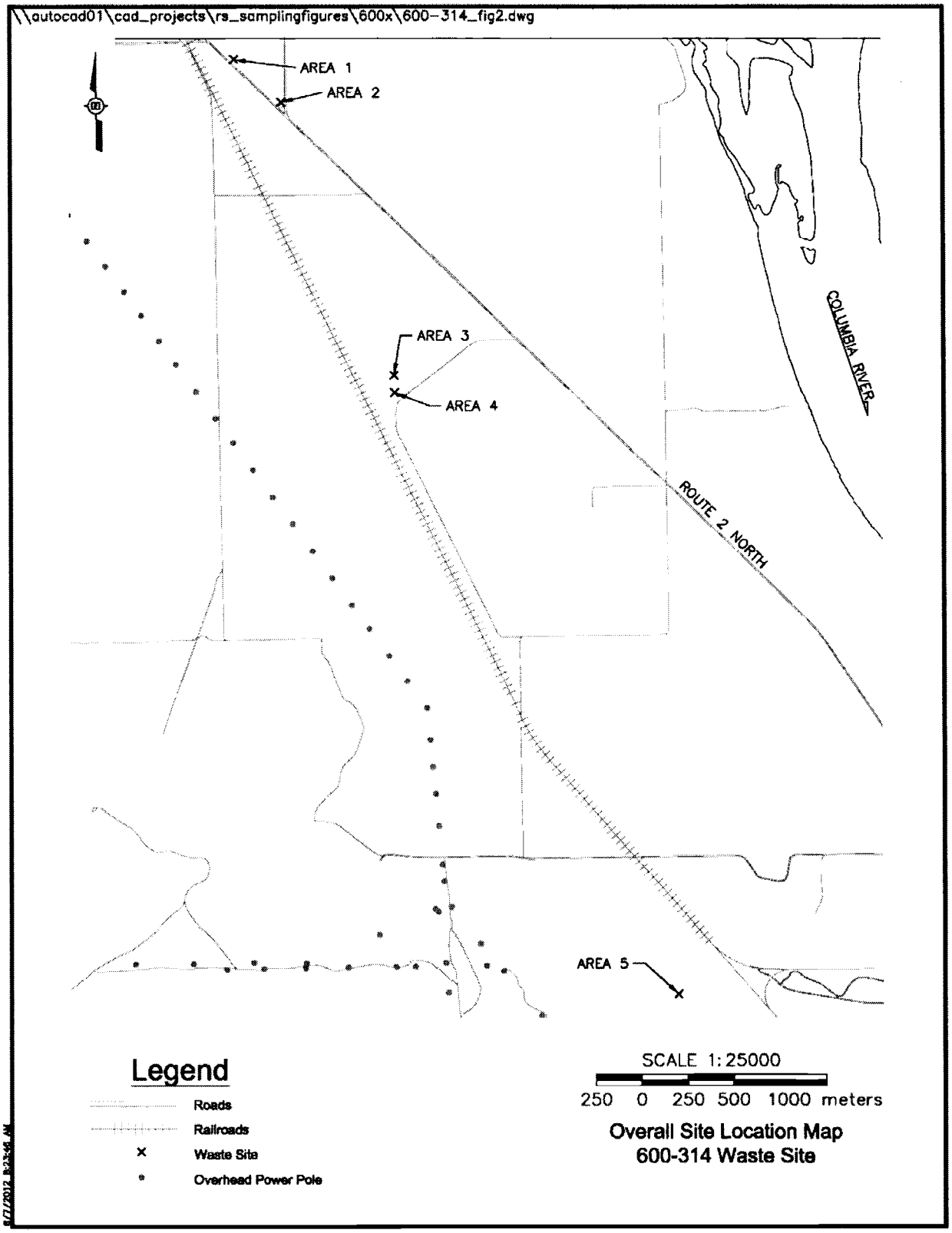
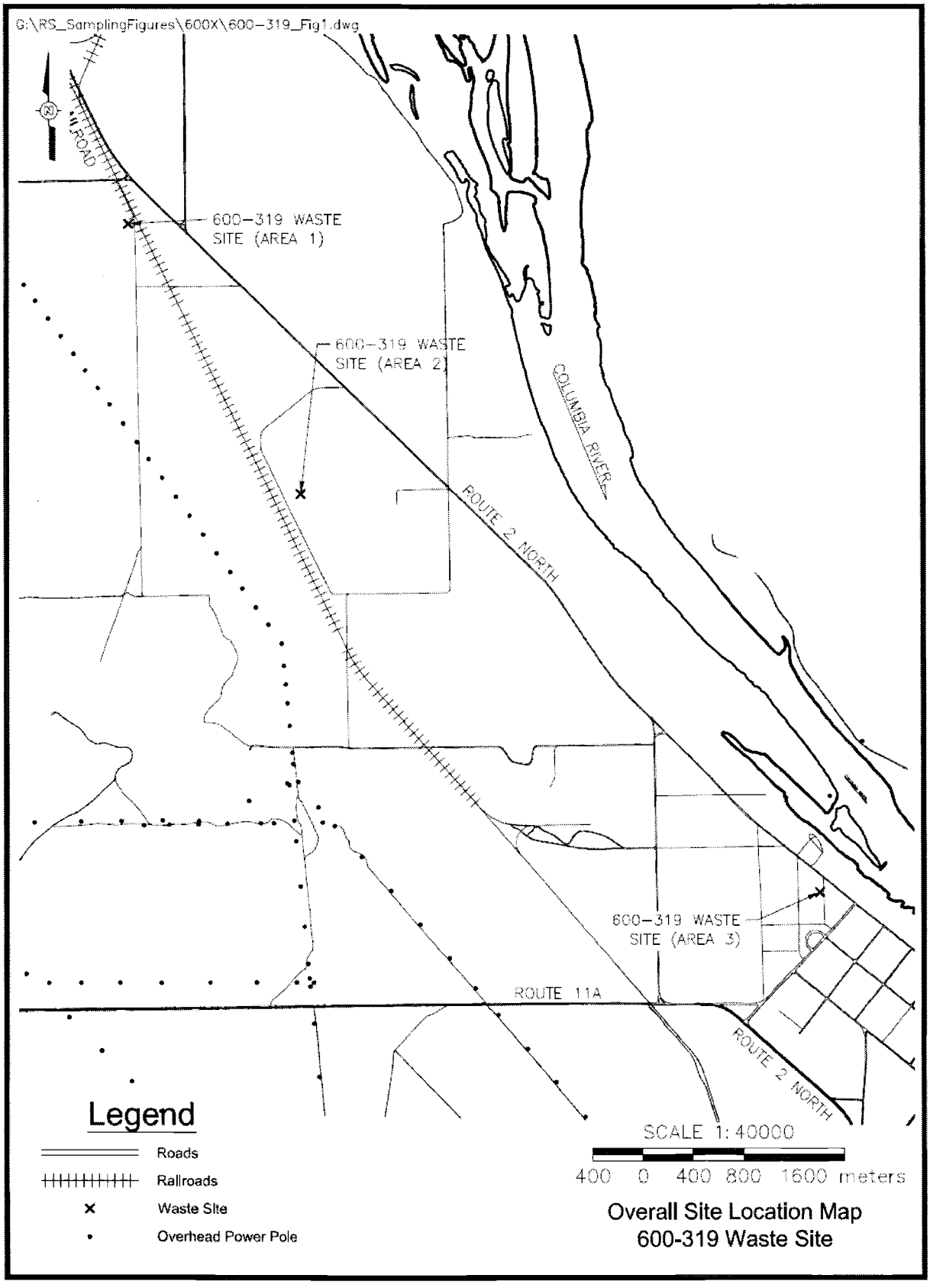


Figure 6. The 600-319 Waste Subsites Location Map.



The 600-324 waste site consists of consists of one area with a concrete pad with miscellaneous pipe, auto parts debris, burnt wood, metal debris, and underlying soil located approximately 1.5 km (0.93 mi) north of Route 11, 100 m (328 ft) west of Route 2 North, and 100 m (328 ft) east of site 600-239, 615 Hot Mix Plant Debris at WSP coordinates N 140285.7, E 584291.4 (Figure 4).

The 100-IU-2 and 100-IU-6 orphan sites evaluation that included the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-314, 600-319, and 600-324 waste sites was performed in 2006 and 2007 (WCH 2009). Various sizes and forms of hazardous substance (*Comprehensive Environmental Response, Compensation, and Liability Act of 1980* and WAC 173-340, "Model Toxics Control Act – Cleanup") surface debris waste materials were found. No process history exists for these waste sites; however, the types of debris and spill found in the area are believed to be the results of general Hanford townsite and White Bluffs activities.

Field walkdowns were performed for these waste sites in the spring and summer of 2011 for the purpose of locating and documenting suspect debris and waste materials. The walkdown was limited to field observations, and no sampling or waste removal was conducted.

In March and April 2011, waste characterization samples were taken at most of the sites addressed by this document. Table 1 provides the sample numbers and locations, and the results (with the exception of asbestos) are included in Appendix B of the verification work instruction (WCH 2011L).

Table 1. 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-314, 600-317, 600-319, and 600-324 Pre-Remediation Waste Characterization Soil Samples. (2 Pages)

Location	HEIS Sample Numbers	Sample Date	Requested Analyses
600-305	NA	NA	NA
600-308	J1H050	3/30/2011	ICP metals, TCLP, and PCBs
600-309	J1H0N2	4/4/2011	ICP metals, TCLP metals, IC anions, TPH, SVOA, PAH, PCBs, asbestos
	J1H0N1 [a]		
600-310	J1H134	4/4/2011	
	J1H0N3 [a]		
600-311	J1H136	4/4/2011	
	J1H135 [a]		
600-312	J1H138	4/4/2011	
	J1H137 [a]		
600-313	J1FHX7	3/8/2011	ICP metals, TPH, SVOA, PAH, PCBs, TCLP metals (leach and hold), asbestos
	J1FHX6 [a]		
600-314	NA	NA	NA
600-317	J1FJ01	3/9/2011	ICP metals, pH, TCLP metals (leach and hold)
600-319	J1FJL6	3/10/2011	ICP metals, TCLP metals (leach and hold), SVOA (location #2 only)

Table 1. 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-314, 600-317, 600-319, and 600-324 Pre-Remediation Waste Characterization Soil Samples. (2 Pages)

Location	HEIS Sample Numbers	Sample Date	Requested Analyses
600-324	NA	NA	NA

Source: Field logbook EL-1651 (WCH 2011a) and verification work instruction (WCH 2011L).

[a] This is the HEIS number for the asbestos sample.

HEIS = Hanford Environmental Information System
IC = ion chromatography
ICP = inductively coupled plasma
NA = not applicable; waste characterization samples were not taken at these sites
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
TCLP = toxicity characteristic leaching procedure
TPH = total petroleum hydrocarbons

Site Visit and Geophysical Survey

The project team conducted site visits at various times from June 2011 to December 2011. The objective of the visits was to perform a geophysical survey and determine the extent (if any) of buried debris associated with the waste site. Table 2 presents a summary of the results for each of the nine waste sites and their subsites addressed by this document. The geophysical interpretation maps are presented in Figures 7 through 27.

Table 2. Geophysical Survey Results for the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-314, 600-317, 600-319, and 600-324 Waste Sites. (2 Pages)

Location	Date	Summary of Results
600-305:1	October 2011	There appears to be no buried metallic features associated with the ACM (Figures 7 through 10) (WCH 2011b).
600-305:2		
600-305:3		
600-305:4		
600-305:5		No anomalous features were detected that have the characteristics of buried metallic debris (Figure 11) (WCH 2011b).
600-308	August 2011	There are no anomalous geophysical features associated with the garnet sand (Figure 12) (WCH 2011f).
600-309	August 2011	An anomalous zone was detected that includes the visible surface debris (Figure 13). The anomalous zone extends roughly 5 m to the east of visible debris. The eastern extension of the anomalous zone includes anomalies usually associated with buried metallic debris (WCH 2011g).
600-310	August 2011	There are no significant concentrations of metallic debris associated with the burn area (Figure 14). There are two small ~1- to 2-m-diameter anomalous zones that contain some shallow subsurface metal (WCH 2011h).

Table 2. Geophysical Survey Results for the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-314, 600-317, 600-319, and 600-324 Waste Sites. (2 Pages)

Location	Date	Summary of Results
600-311	August 2011	There are no significant concentrations of metallic debris associated with the burn area (Figure 15). A small concentration of anomalies, from apparent metallic debris, was located. The distinct, straight-edged anomaly along the northeastern side of the survey area is interpreted to be from a concrete slab (WCH 2011i).
600-312	August 2011	Only subtle EM anomalies, indicative of metallic debris, are observed in the geophysical data indicating minimal buried metallic debris (Figure 16). The distinct straight-edged anomaly along the southwestern side of the survey area is interpreted to be from a concrete slab (WCH 2011j).
600-313	November 2011	All the small anomalies that were detected are associated with scattered surface metallic debris (Figure 17). There appears to be no subsurface debris associated with the stained area (WCH 2011c).
600-314	November 2011	The only anomalous zone in the data is associated with surface debris for all five subsite areas (Figures 18 through 22) (WCH 2011d).
600-317	December 2011	The only anomalous feature detected correlates with surface debris (Figure 23) (WCH 2011e).
600-319:1	June 2011	All anomalous features appear to correlate with surface debris (Figure 24) (WCH 2012d).
600-319:2		Most of the anomalous features appear to correlate with surface debris. One area that may contain shallow subsurface debris is centered at E 584685, N 138950 (Figure 25) (WCH 2012d).
600-319:3		No anomalies are associated with dried paint observed at the surface. There are also no anomalies in the vicinity of the dried paint (Figure 26) (WCH 2012d).
600-324	June 2011	Several zones of anomalies do not correlate with the debris observed at the surface. These anomalous areas likely represent buried debris and/or remnants of old structures (Figure 27) (WCH 2011k).

ACM = asbestos-containing material
EM = electromagnetic

Figure 7. Geophysical Interpretation Map for the 600-305:1 Subsite.

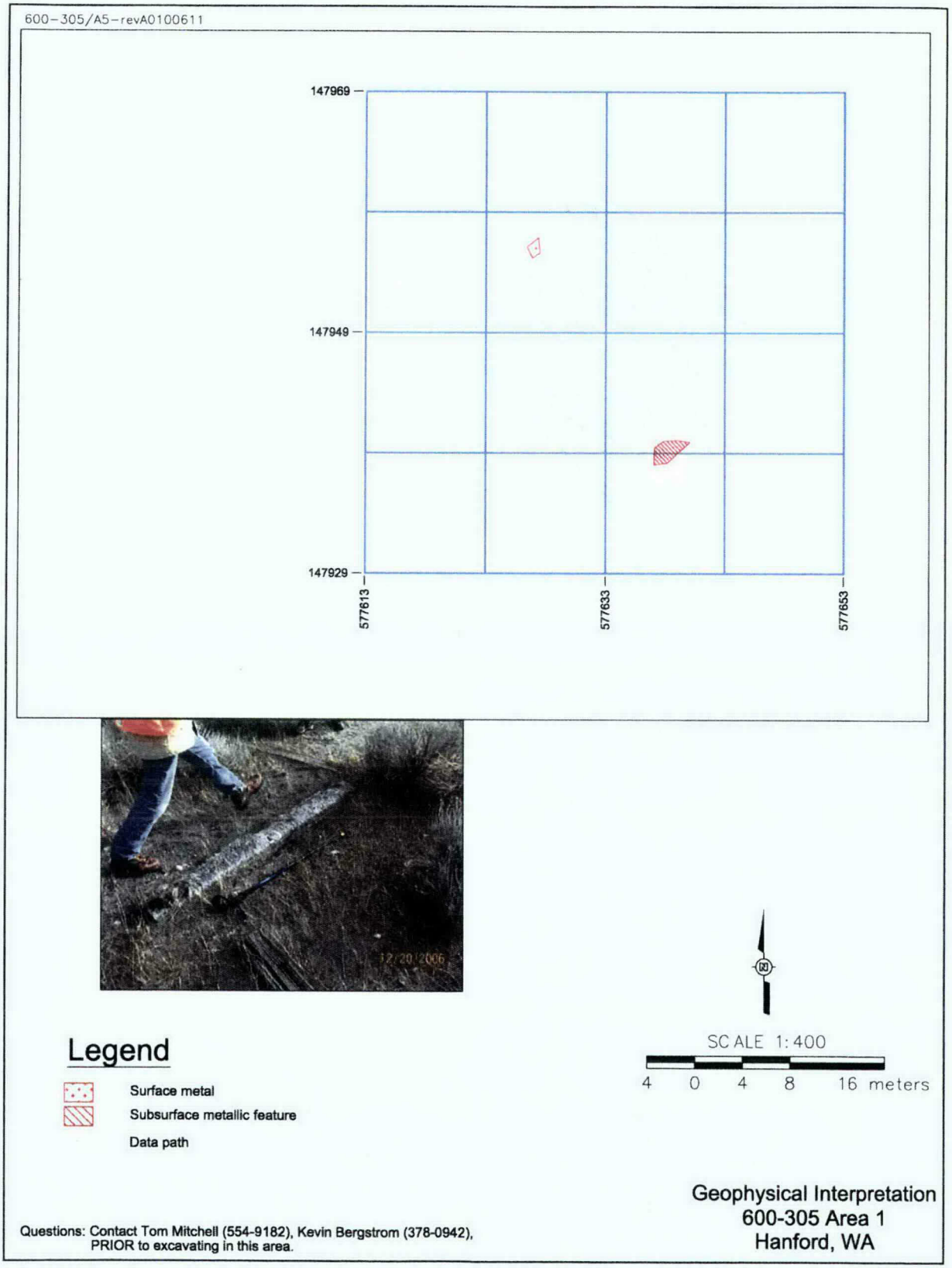


Figure 8. Geophysical Interpretation Map for the 600-305:2 Subsite.

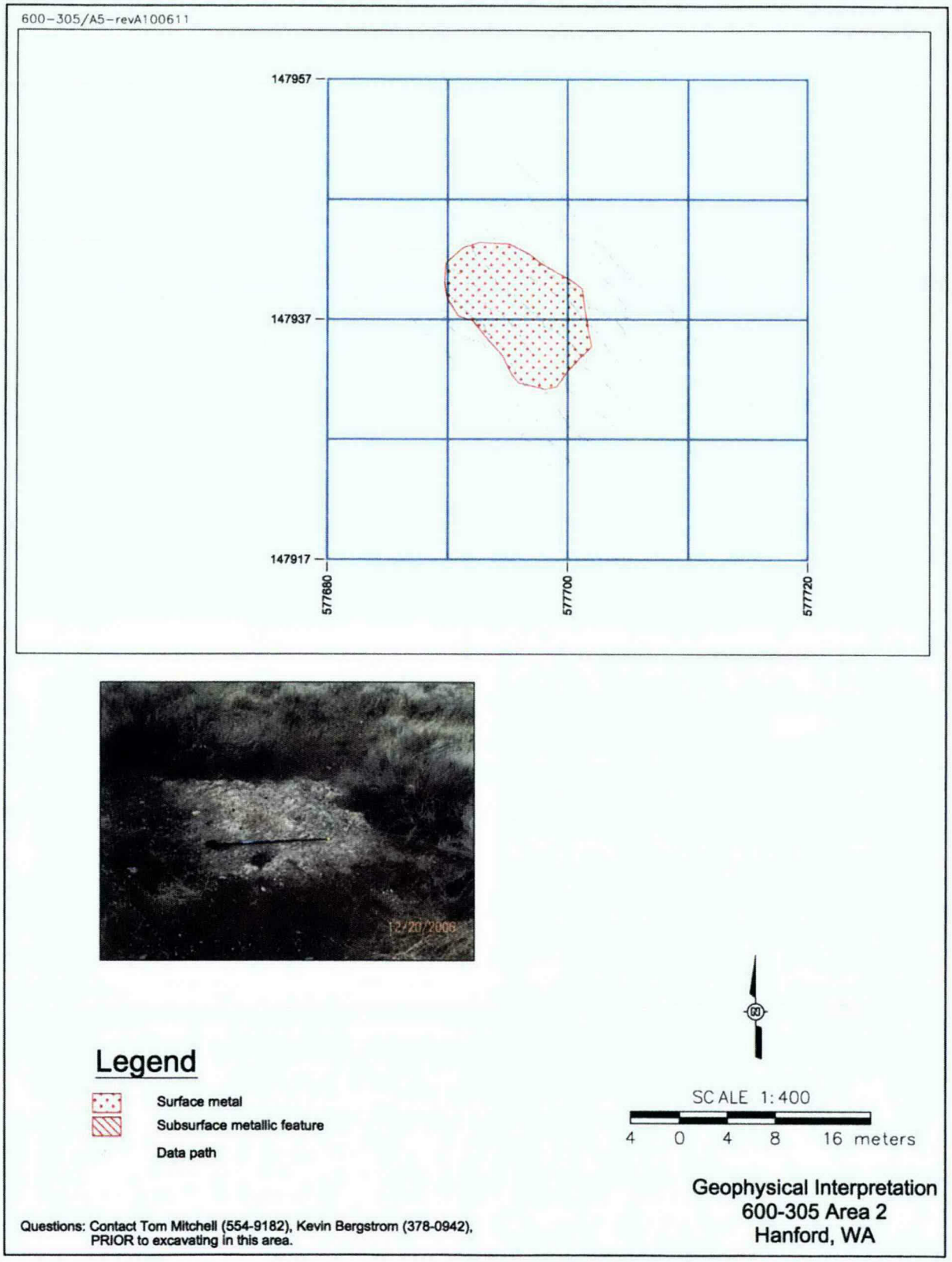


Figure 9. Geophysical Interpretation Map for the 600-305:3 Subsite.

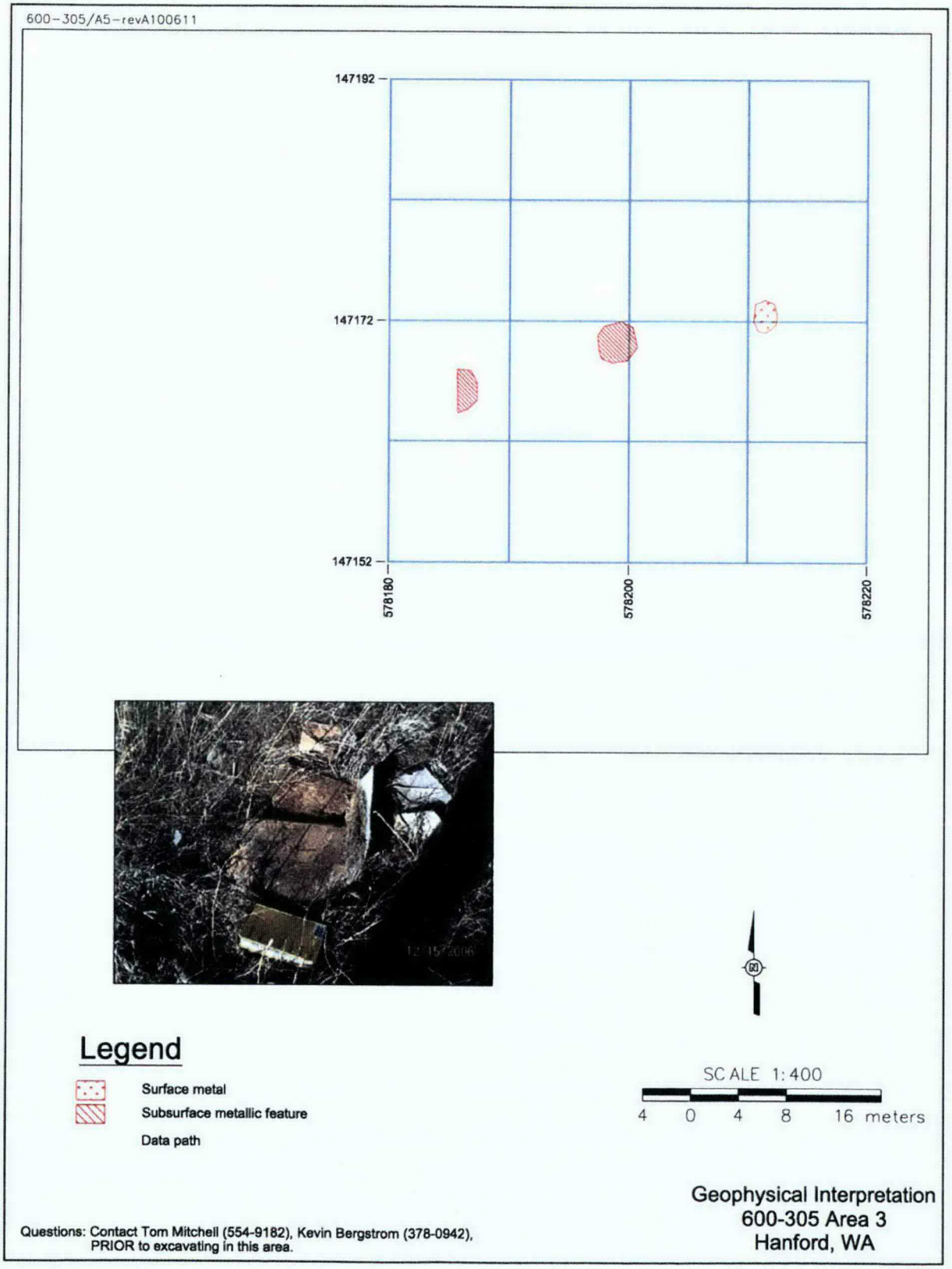


Figure 10. Geophysical Interpretation Map for the 600-305:4 Subsite.

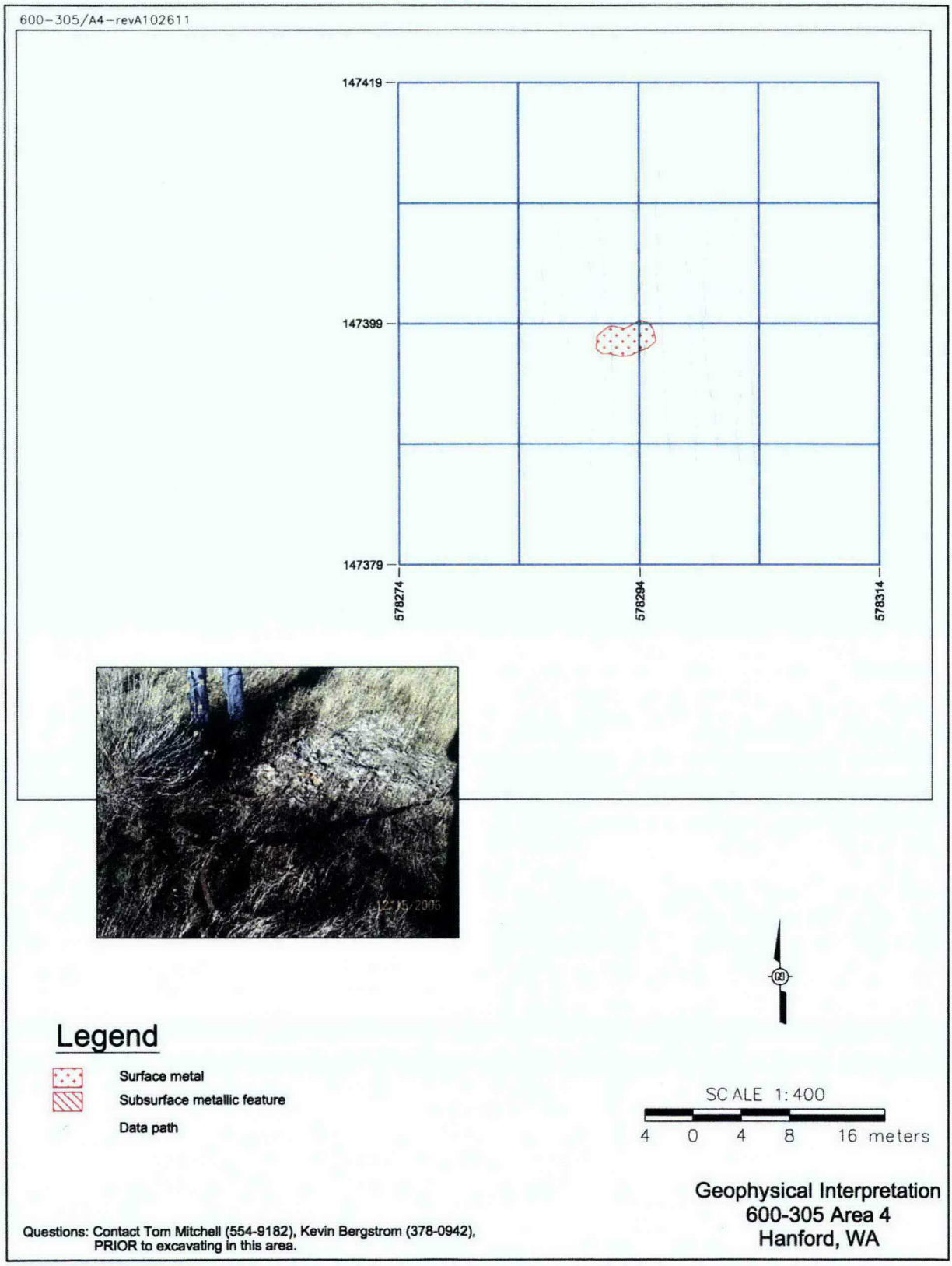


Figure 11. Geophysical Interpretation Map for the 600-305:5 Subsite.

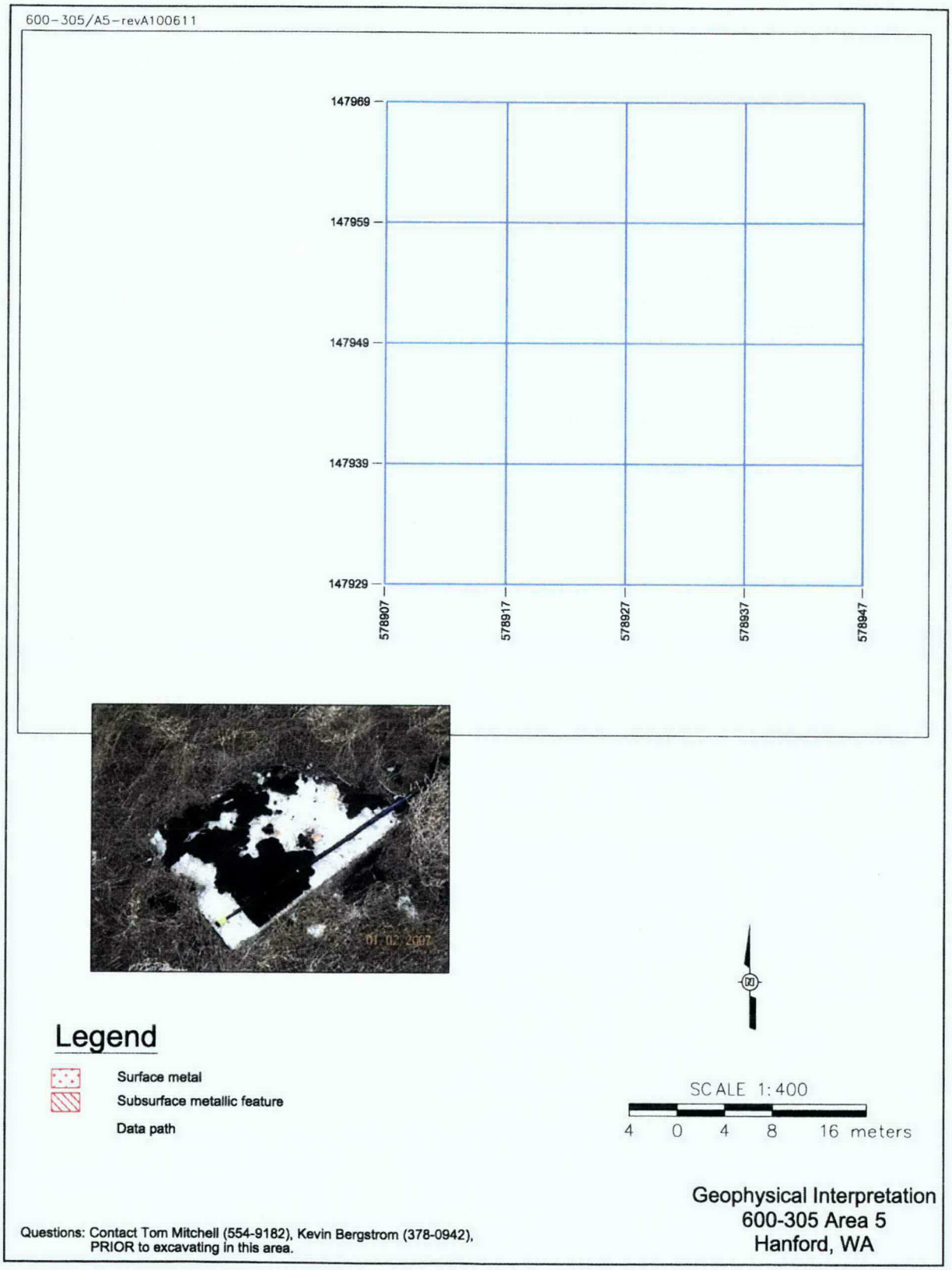


Figure 12. Geophysical Interpretation Map for the 600-308 Waste Site.

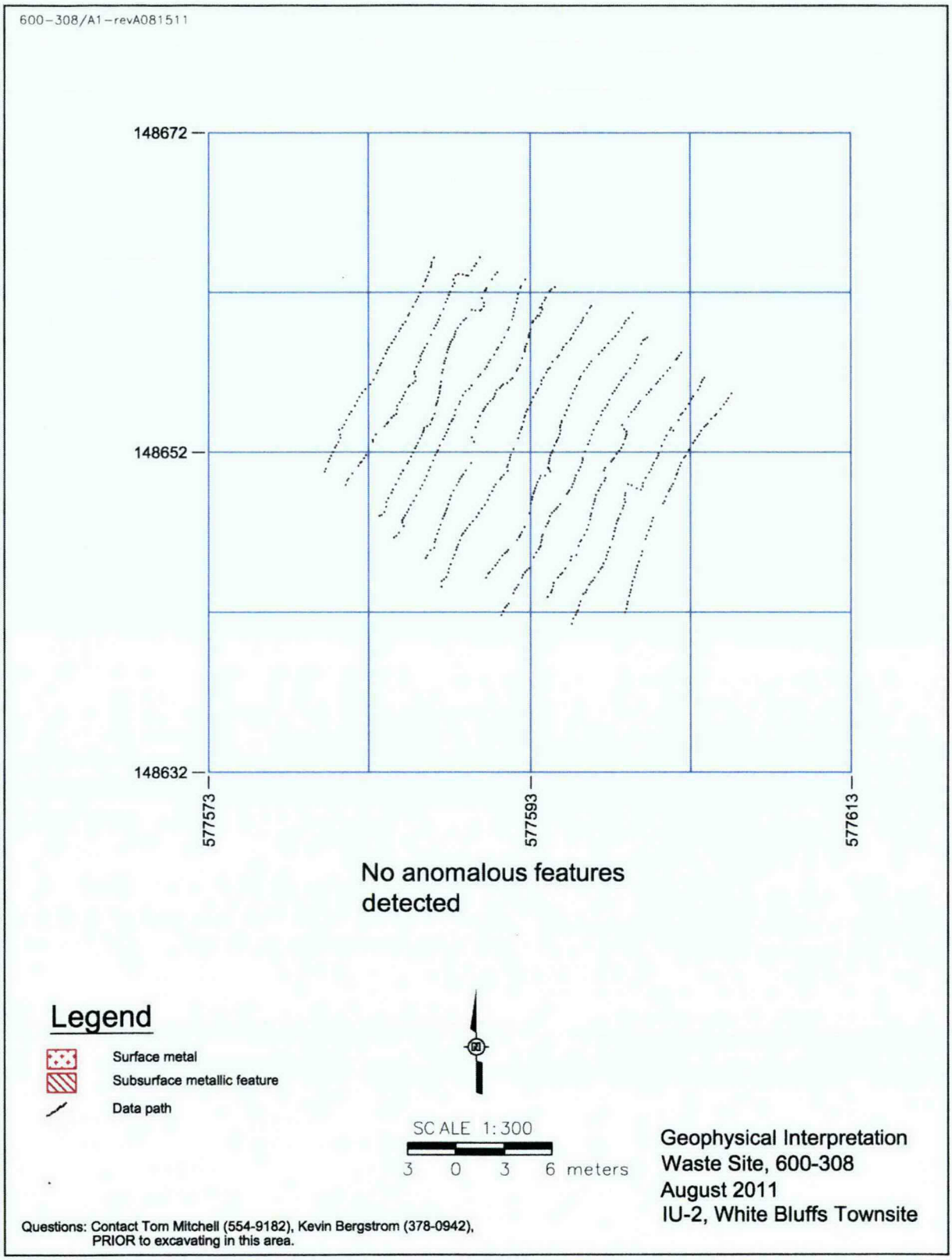


Figure 13. Geophysical Interpretation Map for the 600-309 Waste Site.

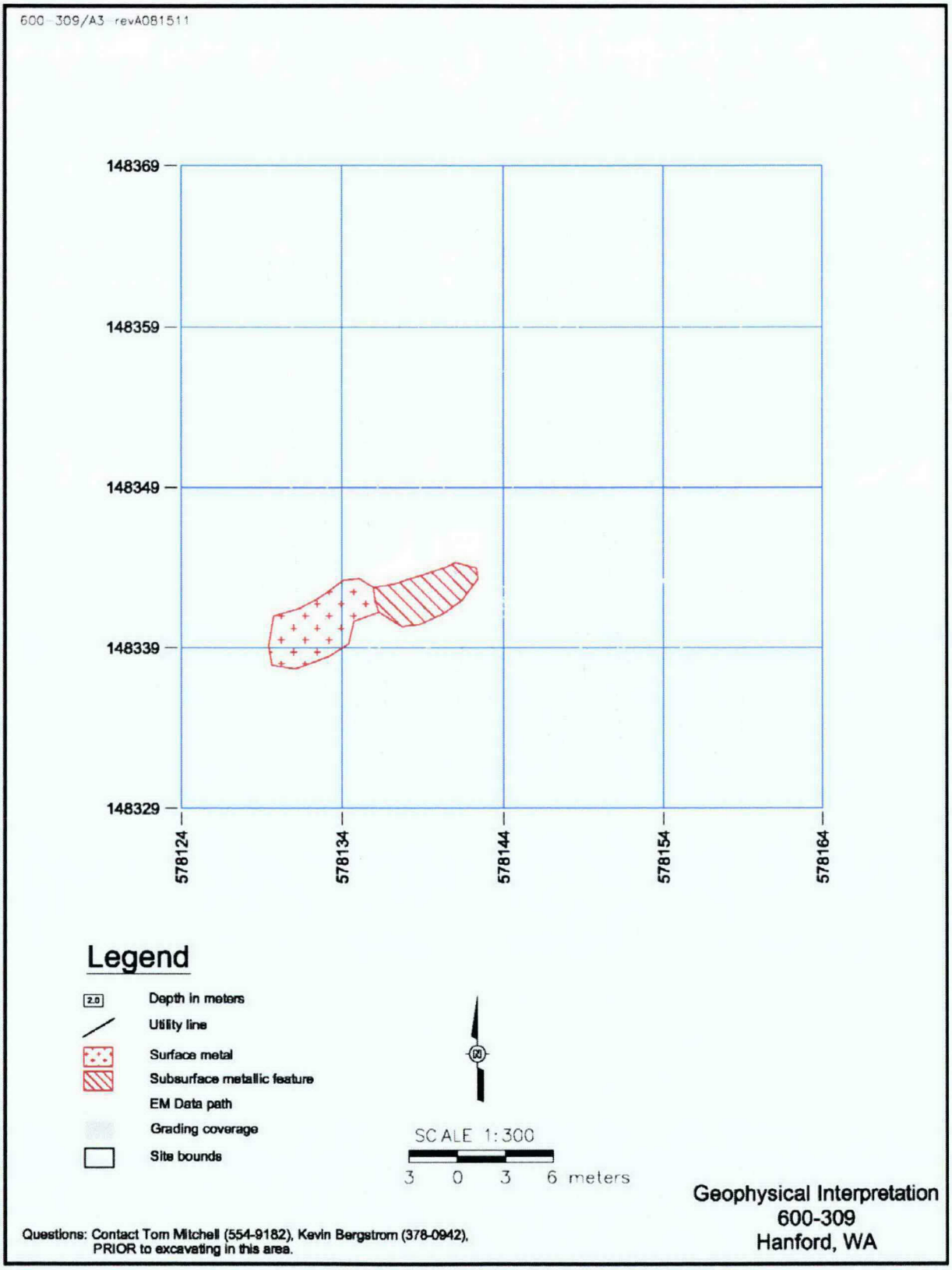


Figure 14. Geophysical Interpretation Map for the 600-310 Waste Site.

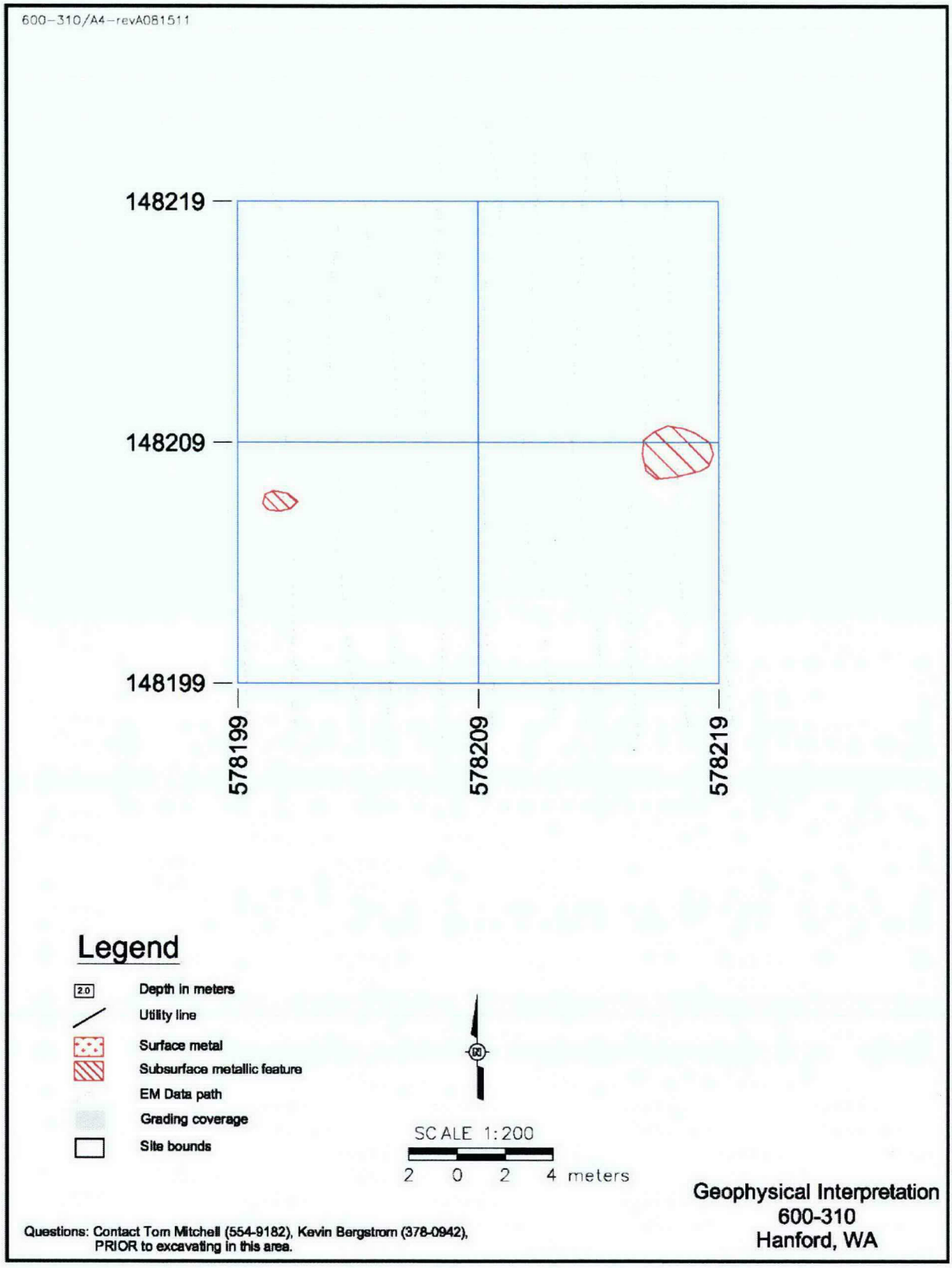


Figure 15. Geophysical Interpretation Map for the 600-311 Waste Site.

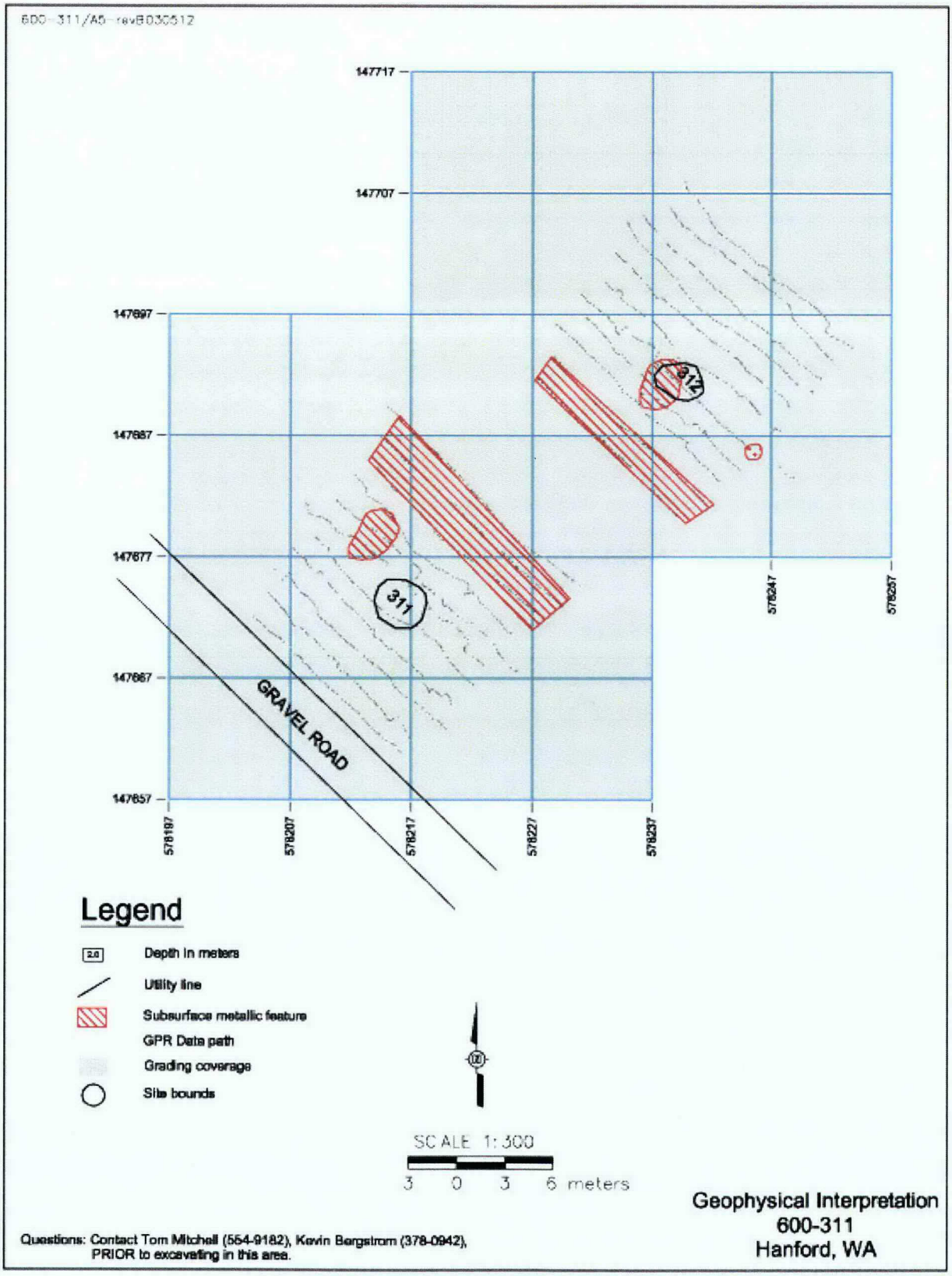


Figure 16. Geophysical Interpretation Map for the 600-312 Waste Site.

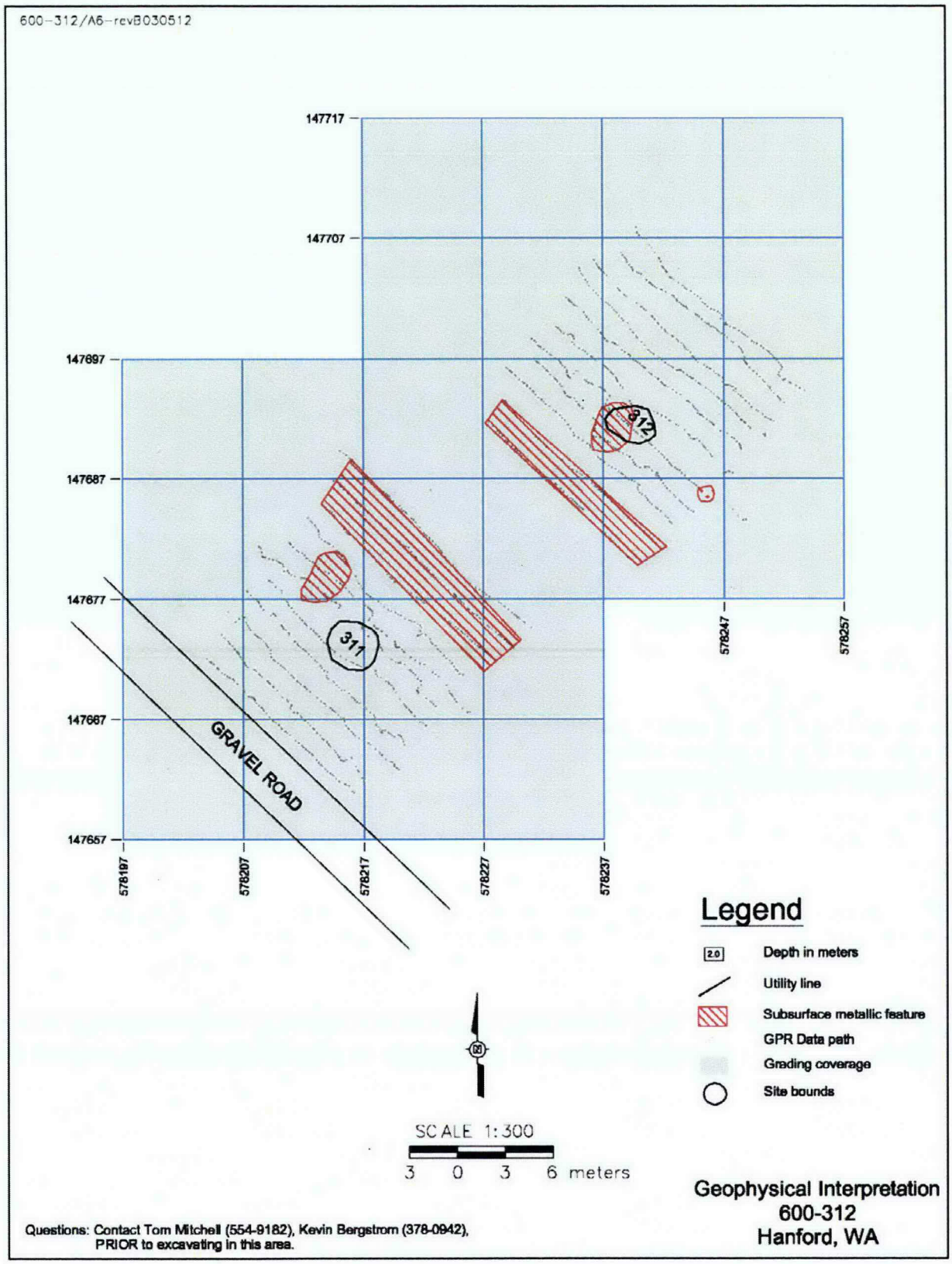


Figure 17. Geophysical Interpretation Map for the 600-313 Waste Site.

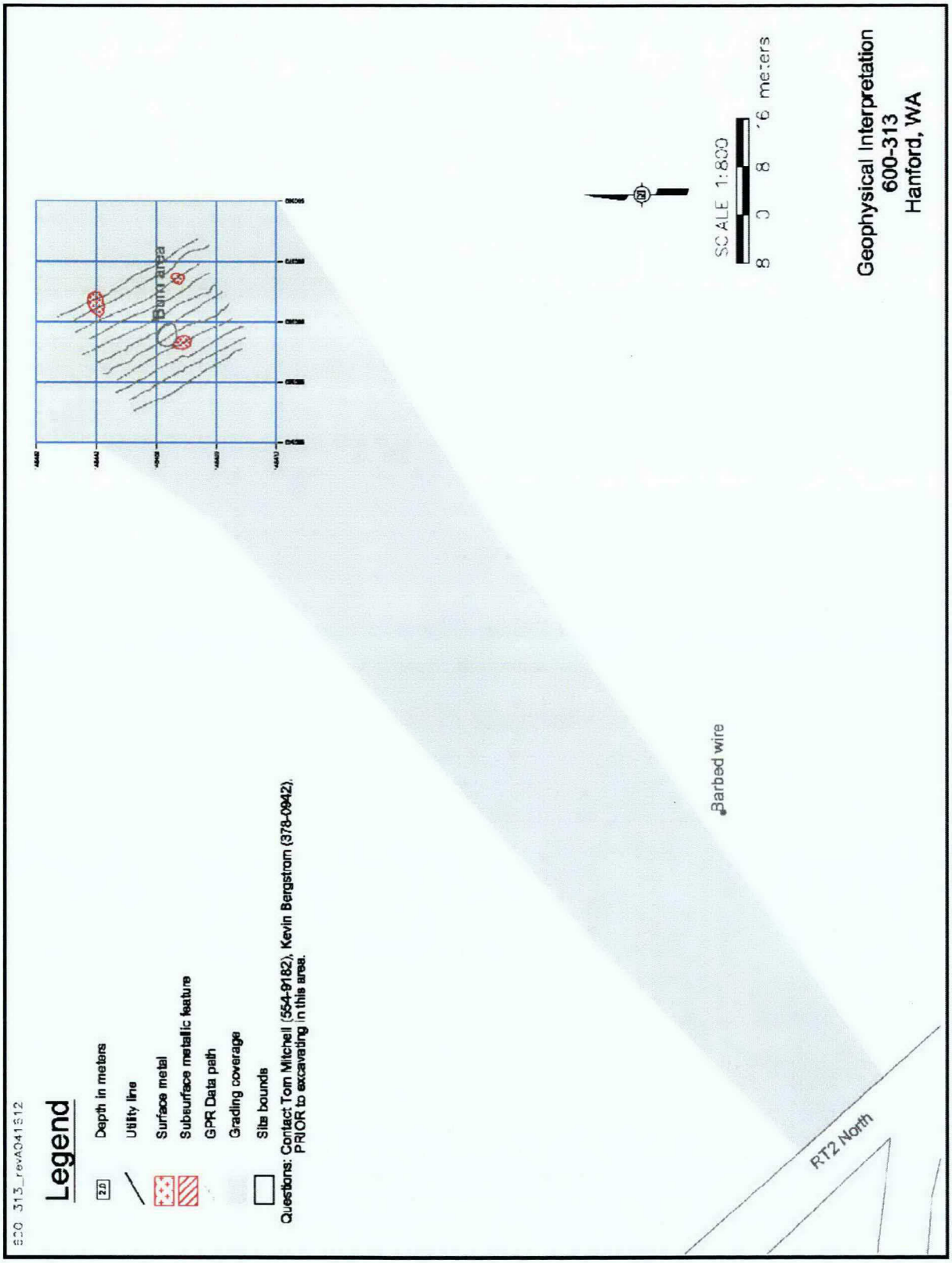


Figure 18. Geophysical Interpretation Map for the 600-314:1 Subsite.

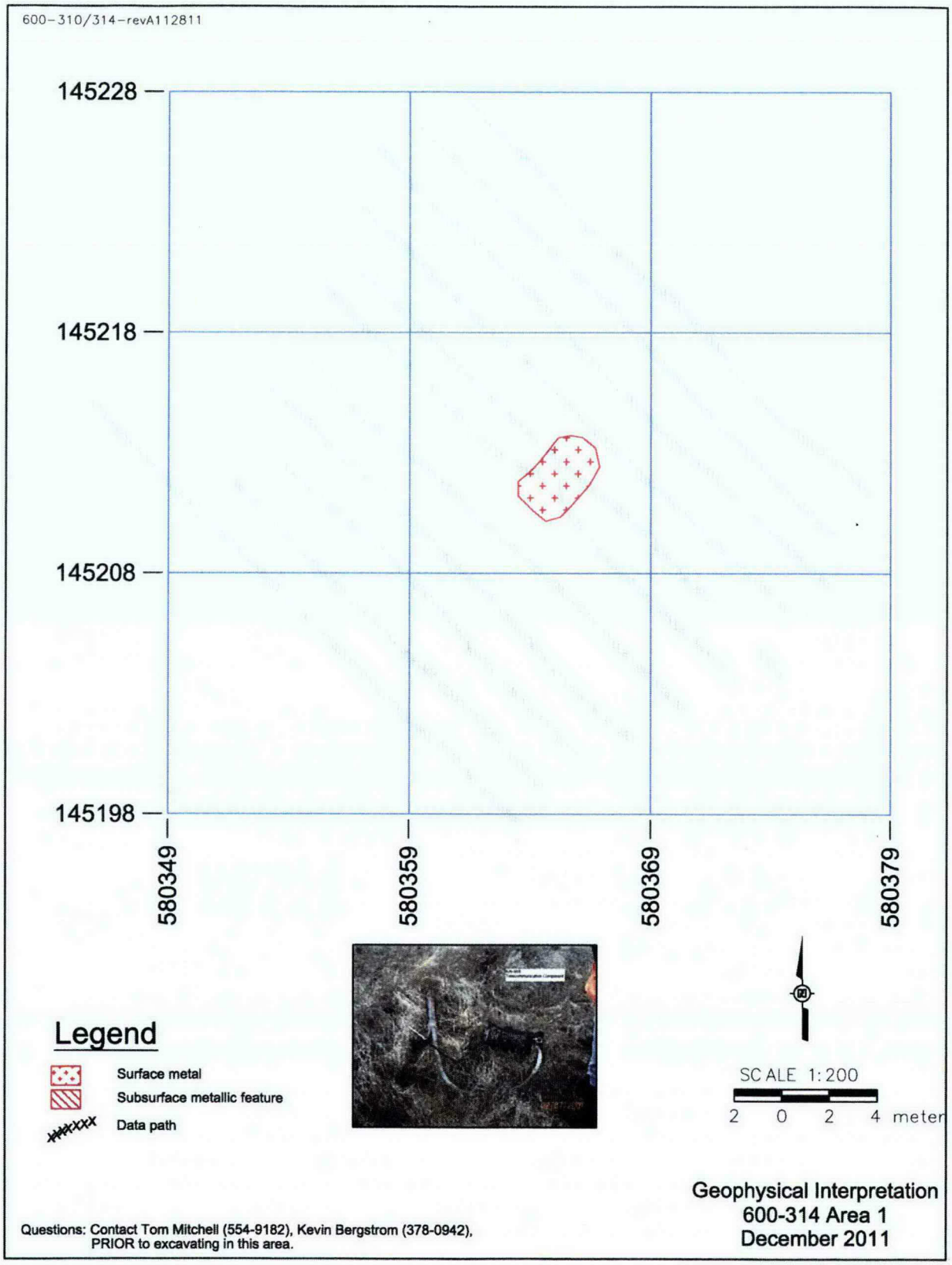


Figure 19. Geophysical Interpretation Map for the 600-314:2 Subsite.

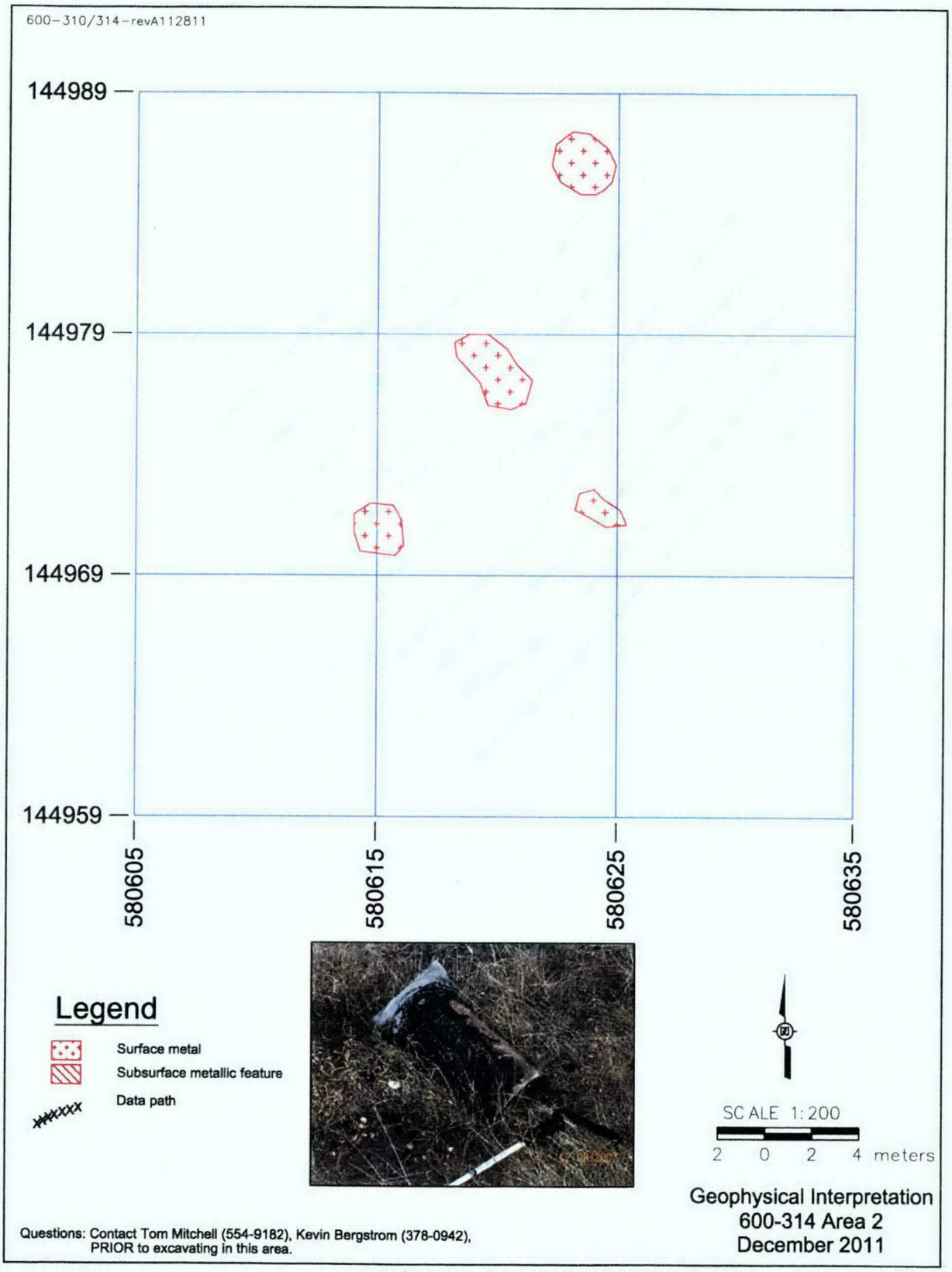


Figure 20. Geophysical Interpretation Map for the 600-314:3 Subsite.

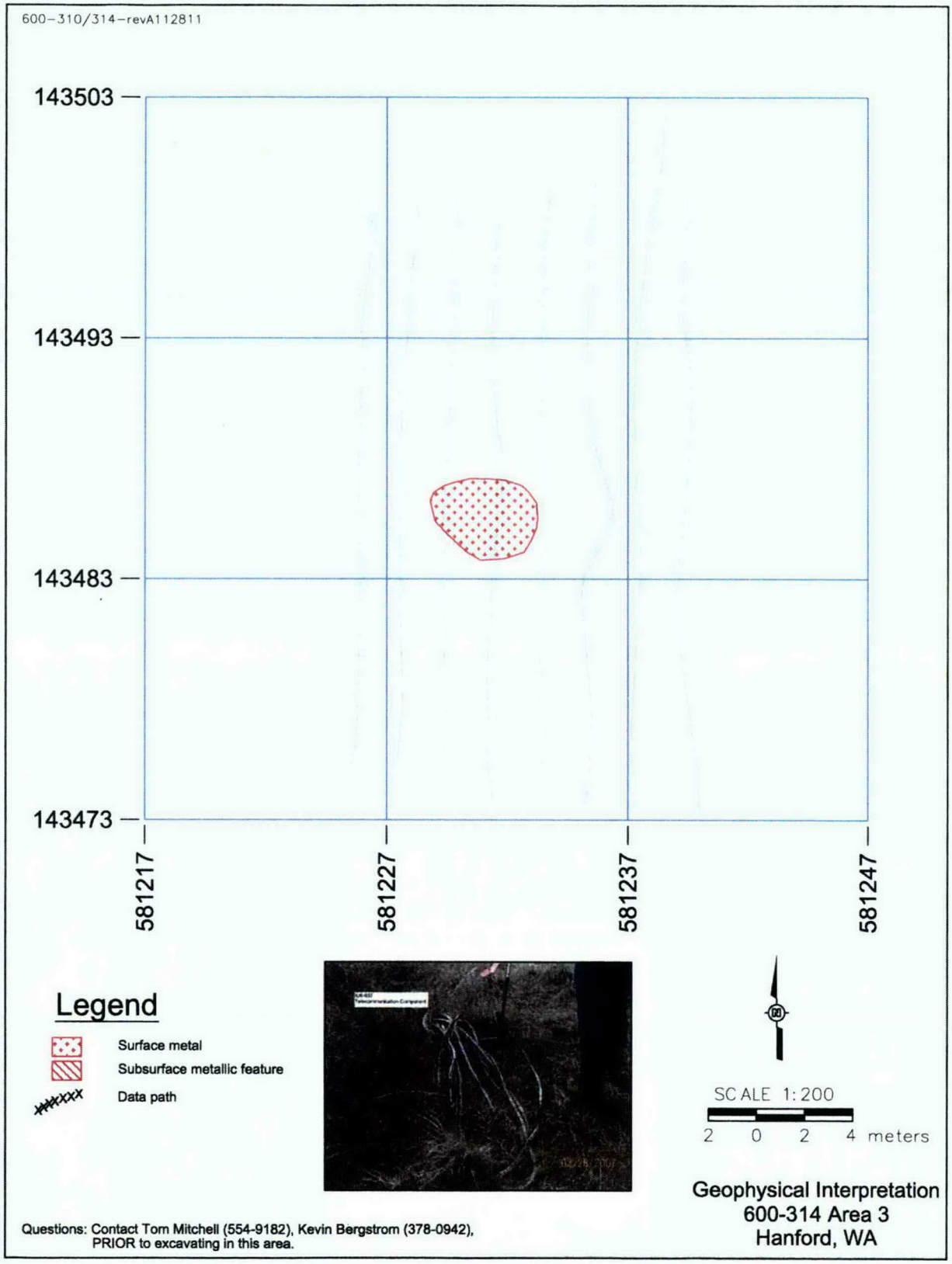


Figure 21. Geophysical Interpretation Map for the 600-314:4 Subsite.

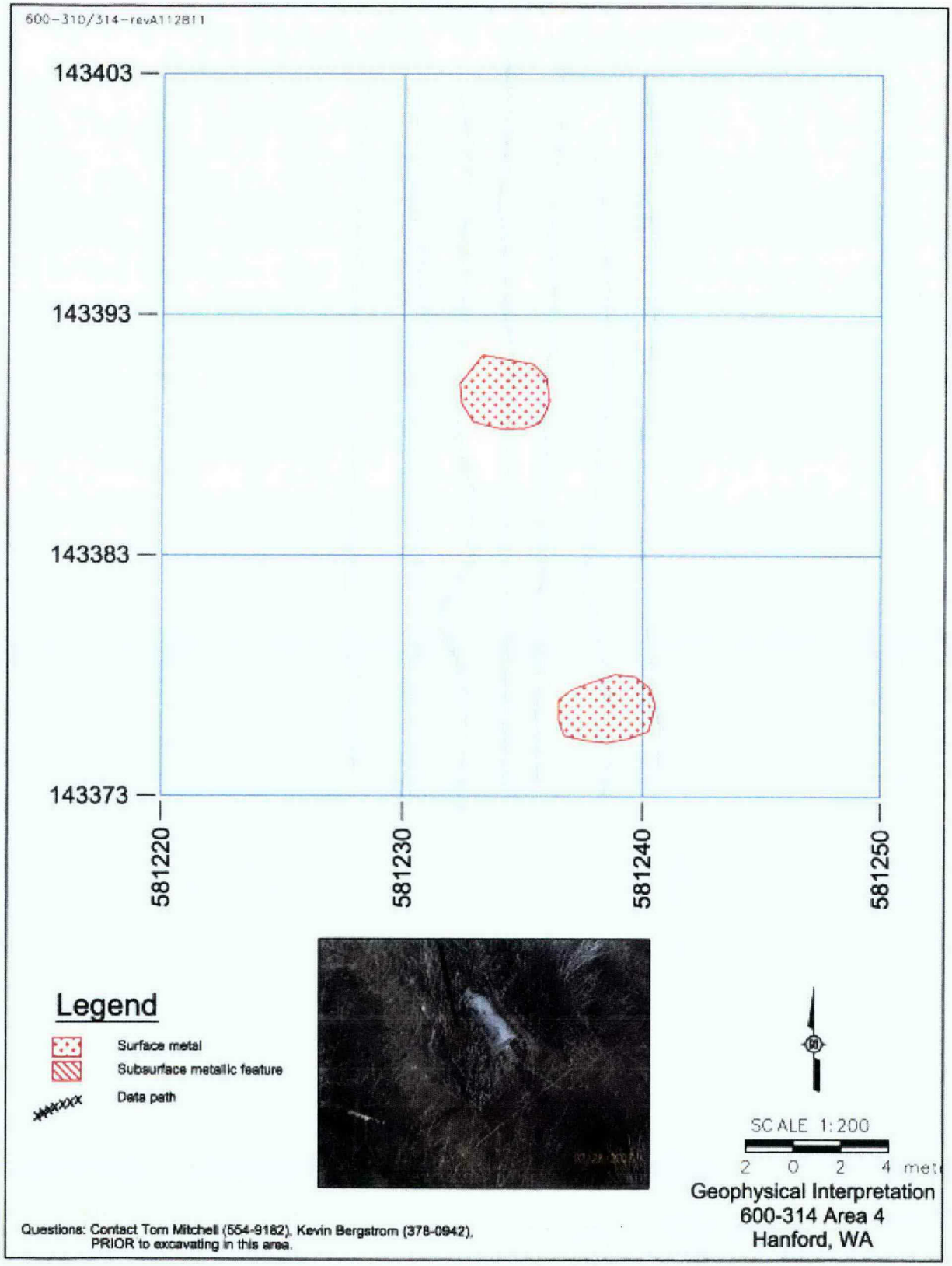


Figure 22. Geophysical Interpretation Map for the 600-314:5 Subsite.

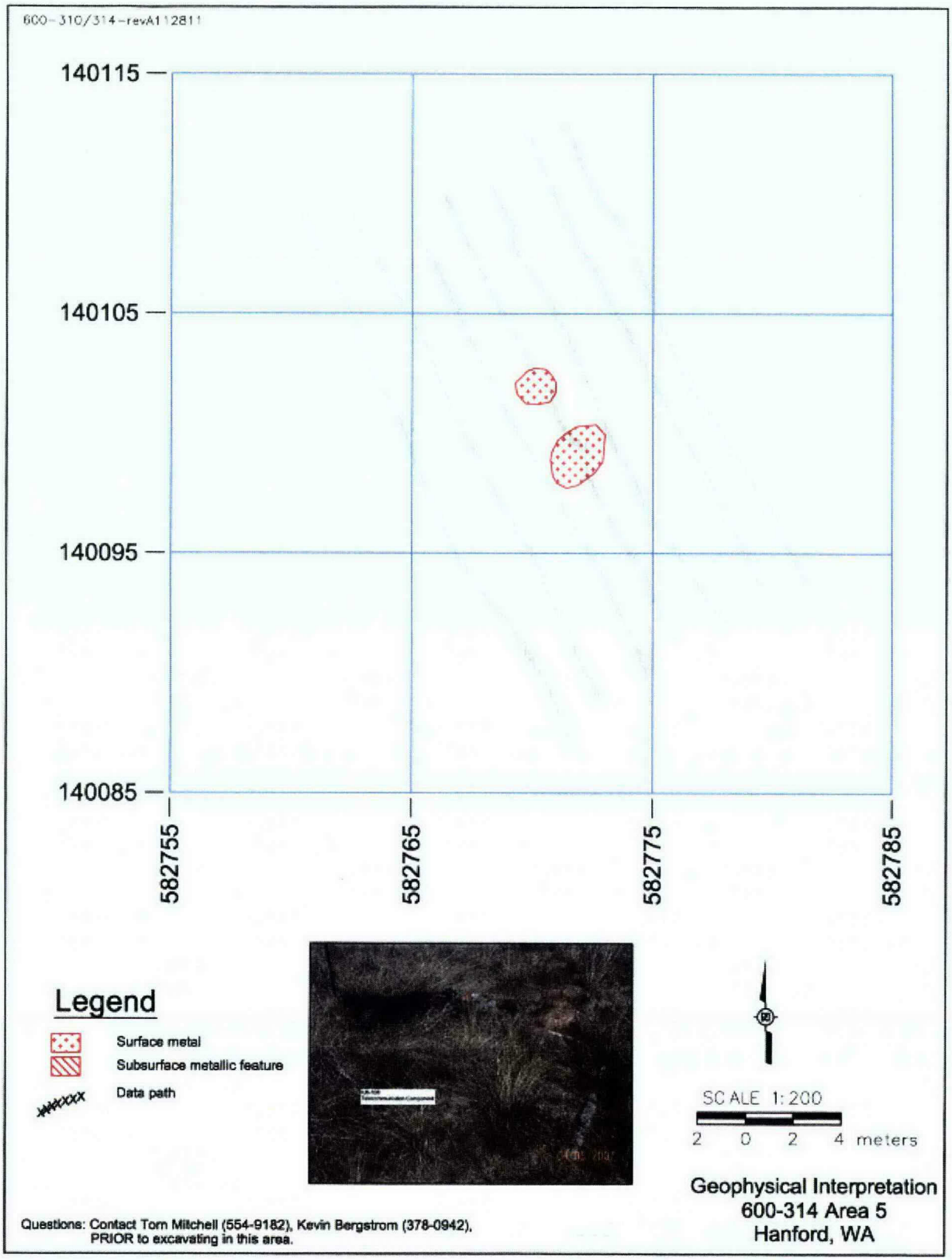


Figure 23. Geophysical Interpretation Map for the 600-317 Waste Site.

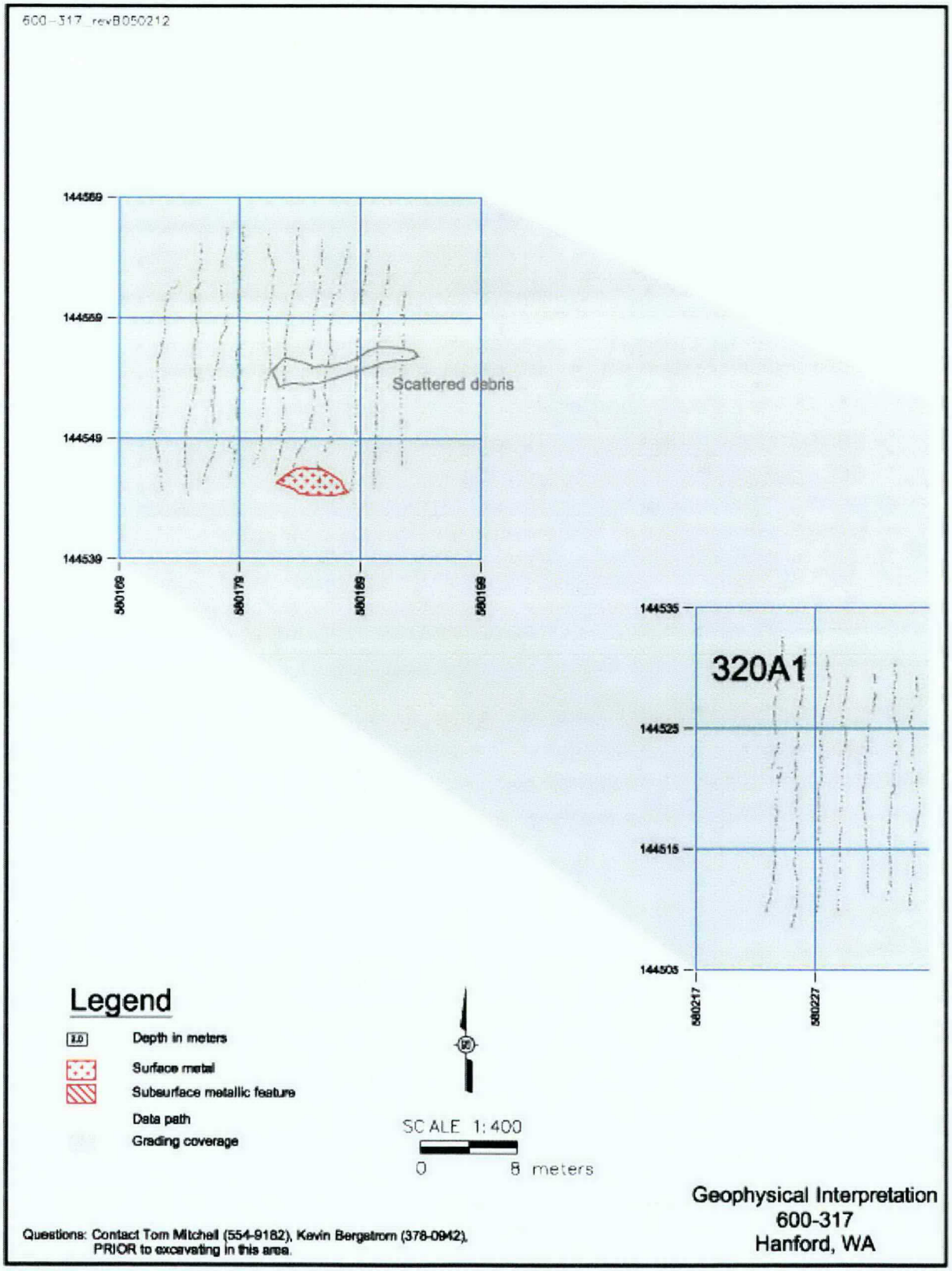


Figure 24. Geophysical Interpretation Map for the 600-319:1 Subsite.

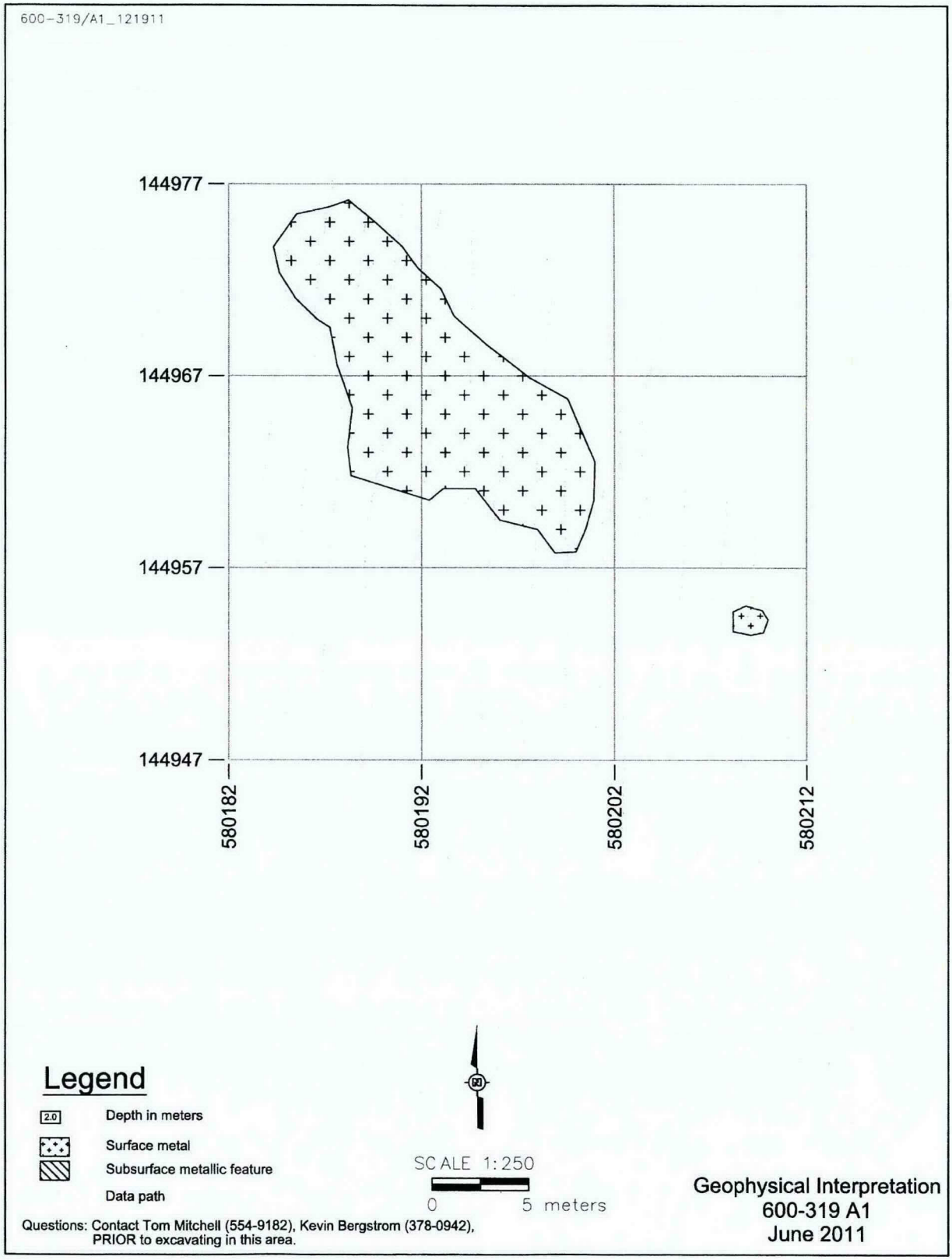


Figure 25. Geophysical Interpretation Map for the 600-319:2 Subsite.

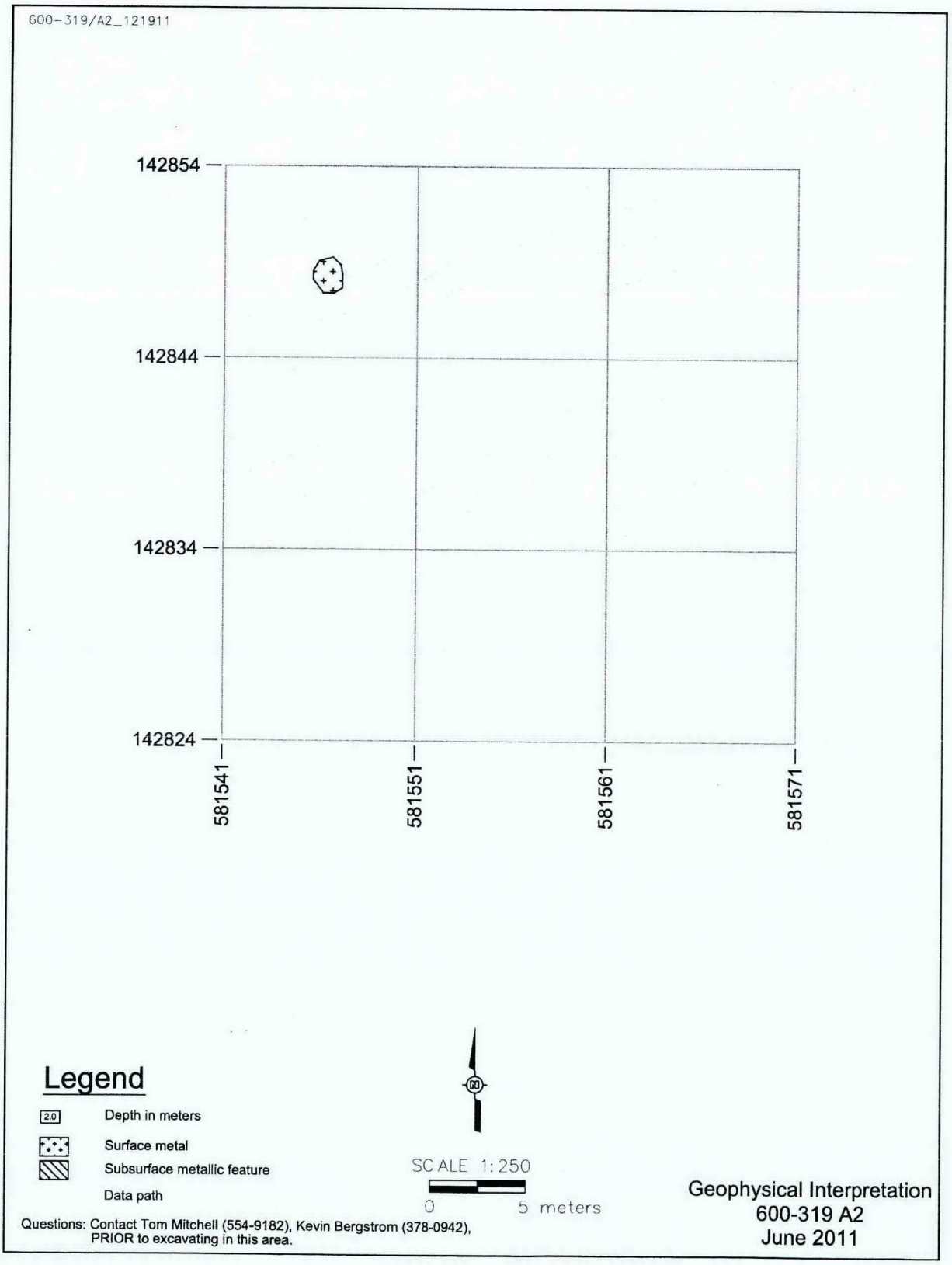


Figure 26. Geophysical Interpretation Map for the 600-319:3 Subsite.

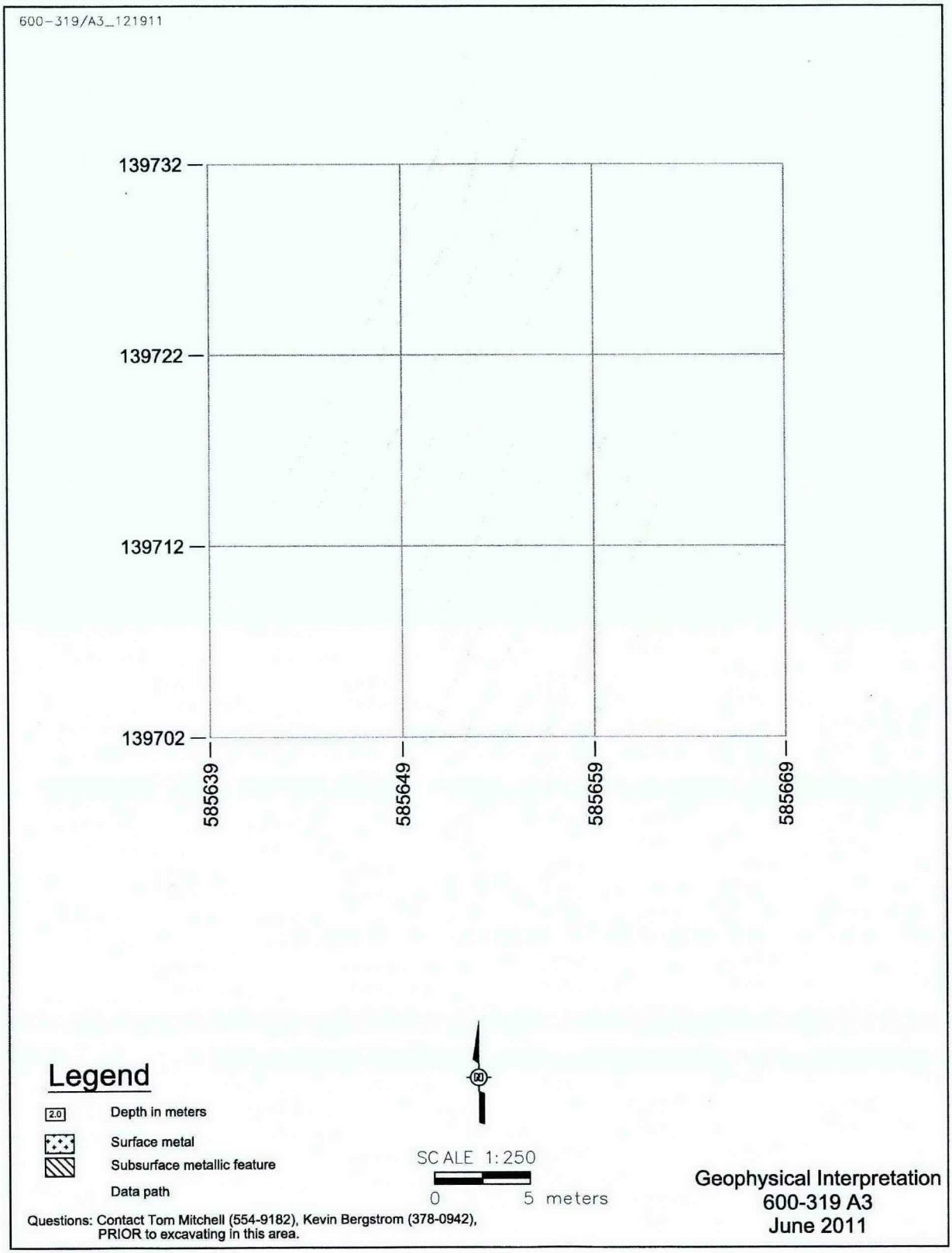
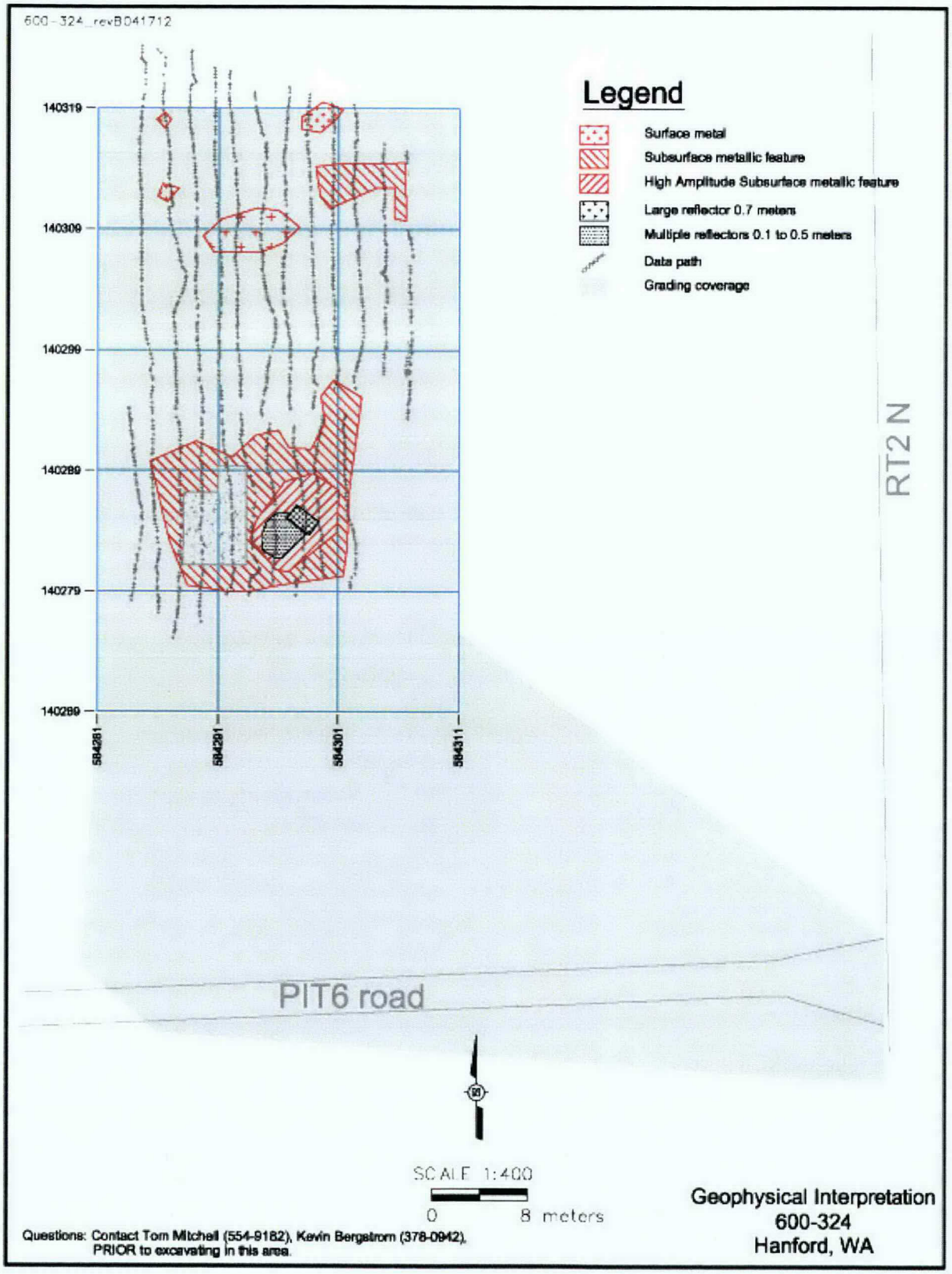


Figure 27. Geophysical Interpretation Map for the 600-324 Waste Site.



REMEDIAL ACTION SUMMARY

Based on observations during the field walkdowns to support remedial action, it was determined that the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-314, 600-317, 600-319, and 600-324 waste sites required remediation. The 600-314 subsites required removal of only telecommunication equipment on the ground surface with no excavation.

Remedial Action

Remedial action and verification sampling activities at the combined 100-IU-2/6 waste sites are summarized in Table 3. Site-specific details follow.

Table 3. Remedial Action and Verification Sampling Summary.

Waste Site	Remediation/ Removal Date	Remediation Quantity	Verification Sampling Date
600-305:1 & 2	April 4, 2012	9 BCM (12 BCY)	April 5, 2012
600-305:3	May 14, 2012	Single pipe removal	May 21, 2012
600-305:4	May 14, 2012	2 BCM (2.6 BCY)	May 21, 2012
600-305:5	May 15, 2012	20 BCM (26 BCY)	May 21, 2012
600-308	May 29, 2012	61.7 BCM (81 BCY)	May 30, 2012
600-309	May 23 - 24, 2012	99 BCM (129 BCY)	May 30, 2012
600-310	May 22 - 23, 2012	89.7 BCM (117 BCY)	May 30, 2012
600-311	May 14, 2012	8.2 BCM (11 BCY)	May 17, 2012
600-312	May 14, 2012,	13.4 BCM (18 BCY)	May 17, 2012
600-313	May 16, 2012	22.1 BCM (30 BCY)	May 30, 2012
600-314 subsites	May 1, 4, 14, 2012	Telecommunication component removal	NA
600-317	May 21 - 22, 2012	80.3 BCM (105 BCY)	May 30, 2012
600-319:1	May 23, 2012	62 BCM (81 BCY)	May 30, 2012
600-319:2	May 4, 2012	7 BCM (9 BCY)	May 15, 2012
600-319:3	August 10, 2011	7 BCM (9 BCY)	August 6, 2011
600-324	April 26 - 30, 2012	39 BCM (51 BCY)	May 1, 2012
Summary	August 10, 2011 to May 29, 2012	523 BCM (682 BCY)	December 6, 2011 to May 30, 2012

BCY = bank cubic yard
BCM= bank cubic meter
NA = not applicable

Remediation of the 600-305:1 and 600-305:2 subsites occurred on April 4, 2012 (Figures 28 and 29). The soil within these subsites was excavated to a depth of approximately 0.3 m (1 ft) below ground surface (bgs) and resulted in the removal of 9 bank cubic meters (BCM) (12 bank cubic yards [BCY]) of soil and debris, which were disposed at the Environmental Restoration Disposal Facility (ERDF). No excavation occurred at the 600-305:3 waste site since "surface removal of a pipe was the only pick up in the scope" (Figure 30) (WCH 2012g). The remediation of the 600-305:4 subsite occurred on May 14, 2012 (Figure 31). The soil within this subsite was excavated to a depth of approximately 0.3 m (1 ft) bgs and resulted in the removal of 2 BCM (2.6 BCY) of soil and debris, which were disposed at ERDF.

Figure 28. Post-Remediation Photograph of the 600-305:1 Subsite.

Figure 29. Post-Remediation Photograph of the 600-305:2 Subsite.

Figure 30. Post-Remediation Photograph of the 600-305:3 Subsite.

Figure 31. Post-Remediation Photograph of the 600-305:4 Subsite.

The remediation of the 600-305:5 subsite occurred on May 15, 2012 (Figure 32). The soil within this subsite was excavated to a depth of approximately 0.3 m (1ft) bgs and resulted in the removal of 20 BCM (26 BCY) of soil and debris, which were disposed at ERDF (WCH 2012g).

The remediation of the 600-308 waste site occurred on May 29, 2012 (Figure 33). The soil within this waste site was excavated to a depth of approximately 0.6 m (2 ft) bgs and resulted in the removal of 61.7 BCM (81 BCY) of soil and debris, which were disposed at ERDF (WCH 2012g).

The remediation of the 600-309 waste site occurred on May 23 and 24, 2012 (Figure 34). The soil within this waste site was excavated to a depth of approximately 1 m (3 ft) bgs and resulted in the removal of 99 BCM (129 BCY) of soil and debris, which were disposed at ERDF.

The remediation of the 600-310 waste site occurred on May 22 and 23, 2012 (Figure 35). The soil within this waste site was excavated to a depth of approximately 1 m (3 ft) bgs and resulted in the removal of 89.7 BCM (117 BCY) of soil and debris, which were disposed at ERDF.

The remediation of the 600-311 waste site occurred on May 14, 2012 (Figure 36). The soil within this waste site was excavated to a depth of approximately 1 m (3 ft) bgs and resulted in the removal of 8.2 BCM (11 BCY) of soil and debris, which were disposed at ERDF (WCH 2012f).

The remediation of the 600-312 waste site occurred on May 14, 2012 (Figure 37). The soil within this waste site was excavated to a depth of approximately 1 m (3 ft) bgs and resulted in the removal of 13.4 BCM (18 BCY) of soil and debris, which were disposed at ERDF.

The remediation of the 600-313 waste site occurred on May 16, 2012 (Figure 38). The soil within this waste site was excavated to a depth of approximately 1 m (3 ft) bgs and resulted in the removal of 22.1 BCM (30 BCY) of soil and debris, which were disposed at ERDF (WCH 2012f).

For the five 600-314 subsites, only component removal occurred per the verification work instruction (WCH 2011L) since only telecommunications components were present on the ground surface and no stained or anomalous materials were found during site component removal (WCH 2012e) (Figures 39 through 43). Component removal at the 600-314 subsites occurred on May 1, 4, and 14, 2012, and the components were disposed of at ERDF (WCH 2012e).

The remediation of the 600-317 waste site occurred on May 21 and 22, 2012 (Figure 44). The soil within this waste site was excavated to a depth of approximately 1 m (3 ft) bgs and resulted in the removal of 80.3 BCM (105 BCY) of soil and debris, which were disposed at ERDF (WCH 2012f).

Figure 32. Post-Remediation Photograph of the 600-305:5 Subsite.

Figure 33. Post-Remediation Photograph of the 600-308 Waste Site.

Figure 34. Post-Remediation Photograph of the 600-309 Waste Site.

Figure 35. Post-Remediation Photograph of the 600-310 Waste Site.

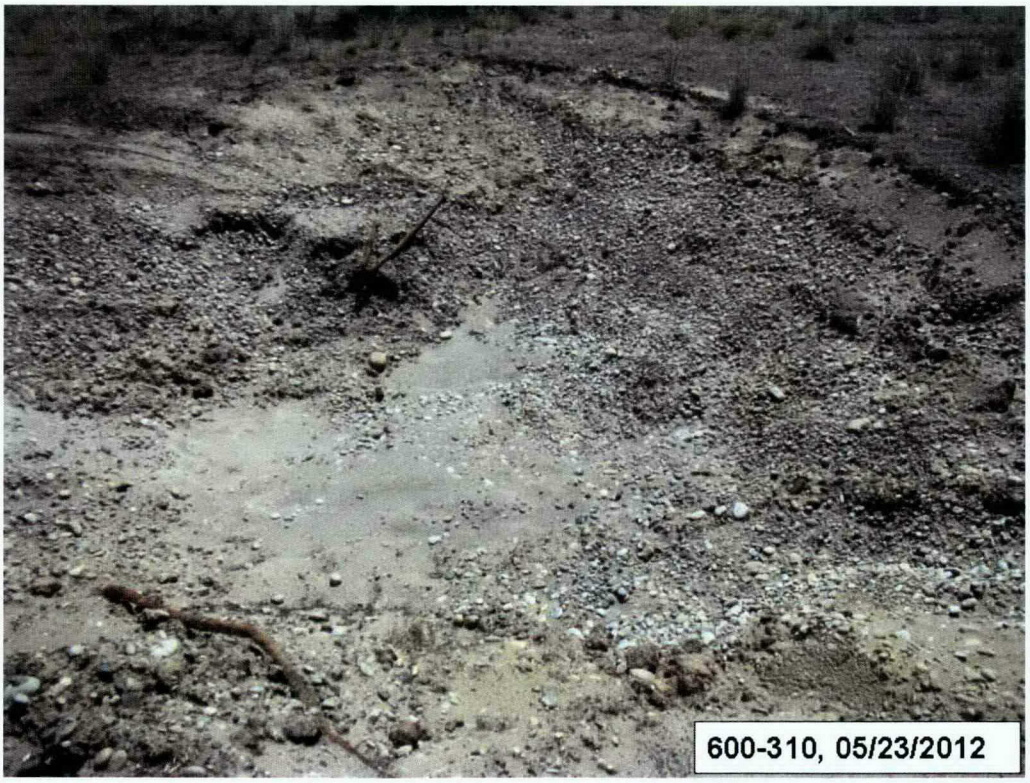


Figure 36. Post-Remediation Photograph of the 600-311 Waste Site.

Figure 37. Post-Remediation Photograph of the 600-312 Waste Site.

Figure 38. Post-Remediation Photograph of the 600-313 Waste Site.

Figure 39. Post-Remediation Photograph of the 600-314:1 Subsite.

Figure 40. Post-Remediation Photograph of the 600-314:2 Subsite.

Figure 41. Post-Remediation Photograph of the 600-314:3 Subsite.

Figure 42. Post-Remediation Photograph of the 600-314:4 Subsite.

Figure 43. Post-Remediation Photograph of the 600-314:5 Subsite.

Figure 44. Post-Remediation Photograph of the 600-317 Waste Site.

The remediation of the 600-319:1 subsite occurred on May 23, 2012 (Figure 45). The soil within this waste site was excavated to a depth of approximately 1 m (3 ft) bgs and resulted in the removal of 62 BCM (81 BCY) of soil and debris, which were disposed at ERDF. The remediation of the 600-319:2 subsite occurred on May 4, 2012 (Figure 46). The soil within this waste site was excavated to a depth of approximately 1 m (3 ft) bgs and resulted in the removal of 7 BCM (9 BCY) of soil and debris, which were disposed at ERDF. The remediation of the 600-319:3 subsite occurred on August 10, 2011 (Figure 47). The soil within this waste site was excavated to a depth of approximately 1 m (3 ft) bgs and resulted in the removal of 7 BCM (9 BCY) of soil and debris, which were disposed at ERDF (WCH 2012g).

The remediation of the 600-324 waste site occurred between April 26 and 30, 2012 (Figure 48). The soil within this waste site was excavated to a depth of approximately 1 m (3 ft) bgs and resulted in the removal of 39 BCM (51 BCY) of soil and debris, which were disposed at ERDF (WCH 2012f).

A post-excavation global positioning survey (GPS) walk-around for the excavated waste sites was performed following excavation. The GPS boundaries are included for the 600-305:1, 600-305:2, 600-305:4, 600-305:5, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319:1, 600-319:2, 600-319:3, and 600-324 subsites and waste sites in Figures 49 through 62. Excavated material from all subsites and waste sites was direct loaded for disposal to ERDF, and no soil staging pile area or overburden areas were utilized.

Figure 45. Post-Remediation Photograph of the 600-319:1 Subsite.

Figure 46. Post-Remediation Photograph of the 600-319:2 Subsite.

Figure 47. Post-Remediation Photograph of the 600-319:3 Subsite.

Figure 48. Post-Remediation Photograph of the 600-324 Waste Site.

Figure 49. The 600-305:1 and 600-305:2 Post-Excavation GPS Walk-Around (May 2012).

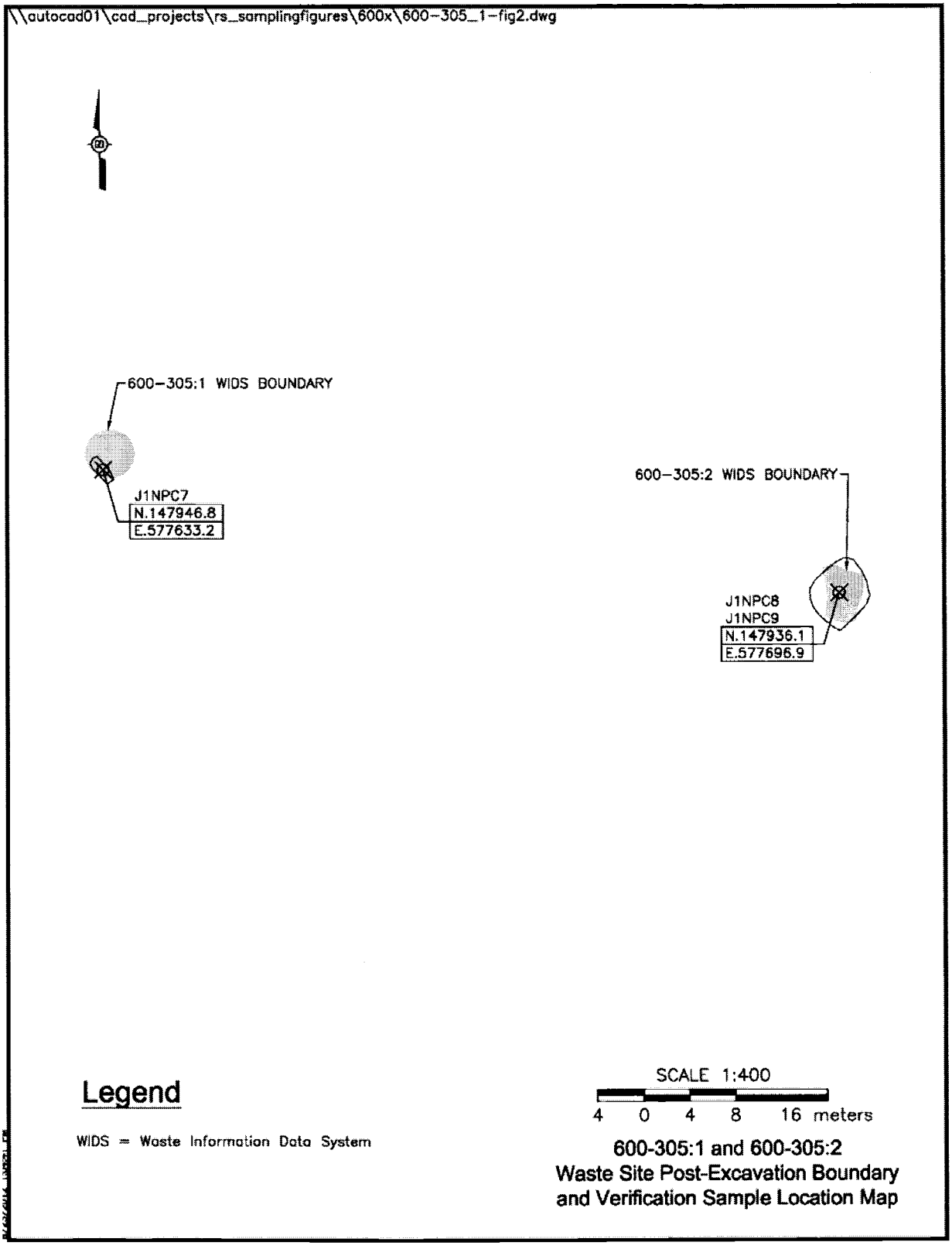


Figure 50. The 600-305:4 Post-Excavation GPS Walk-Around (May 2012).

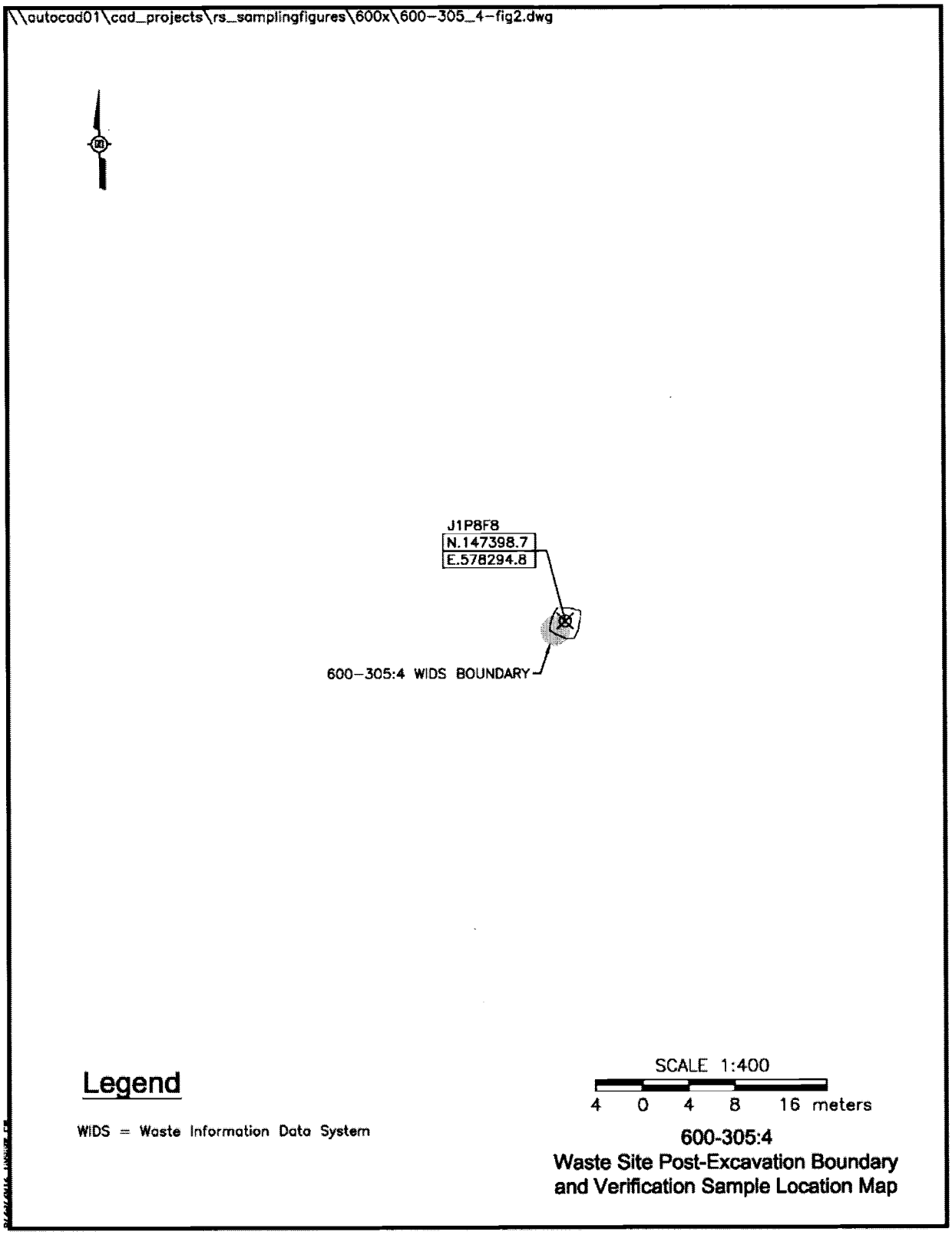


Figure 51. The 600-305:5 Post-Excavation GPS Walk-Around (May 2012).

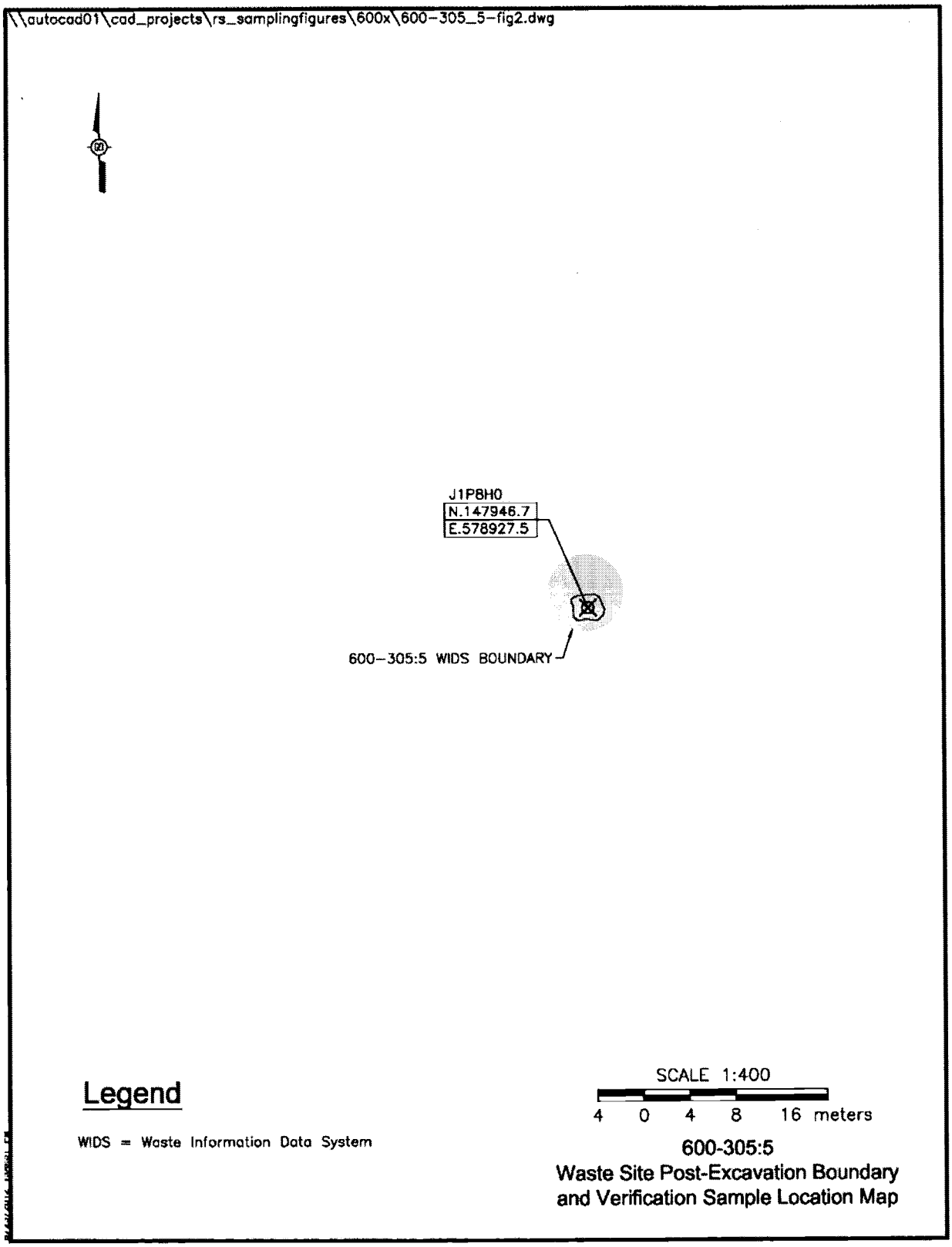


Figure 52. The 600-308 Post-Excavation GPS Walk-Around (May 2012).

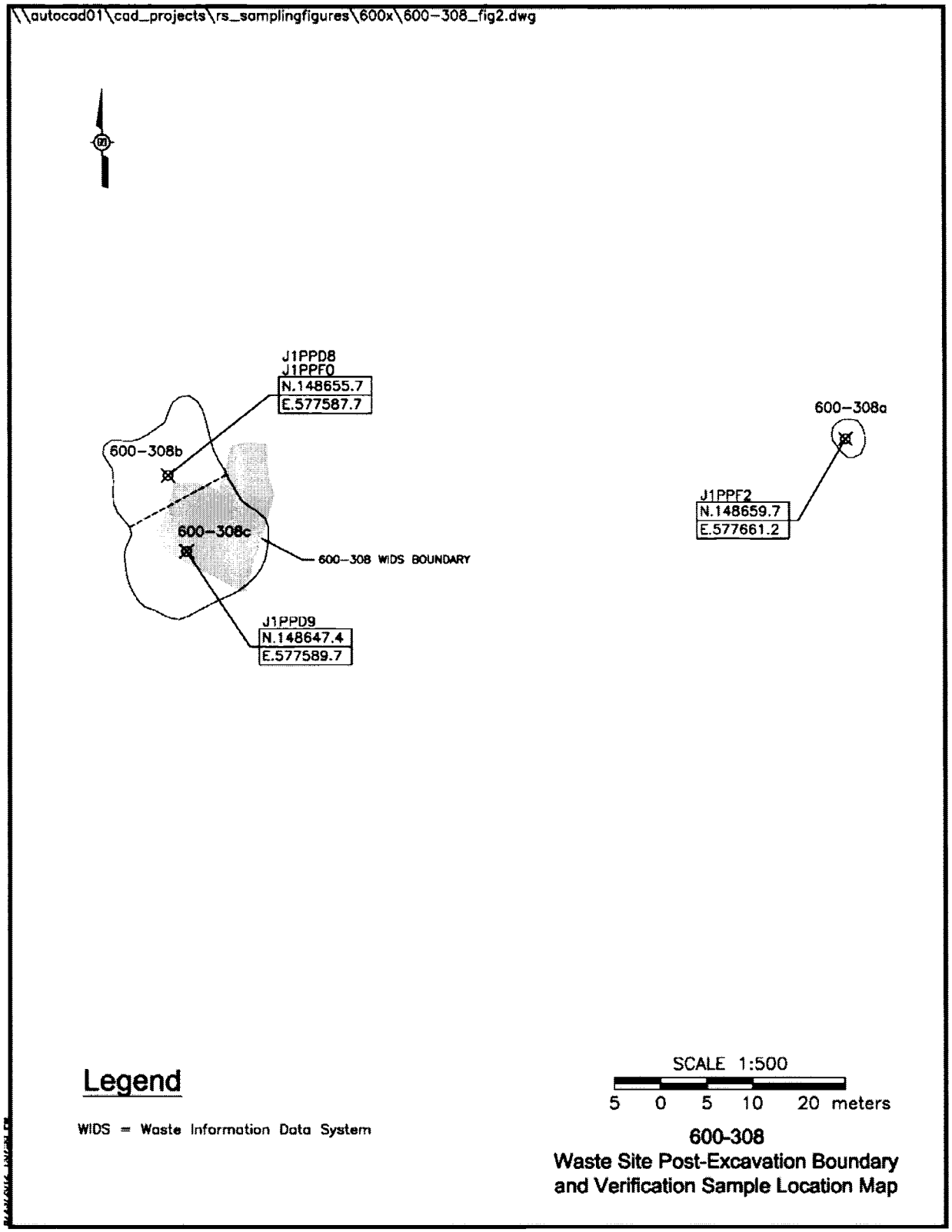


Figure 53. The 600-309 Post-Excavation GPS Walk-Around (May 2012).

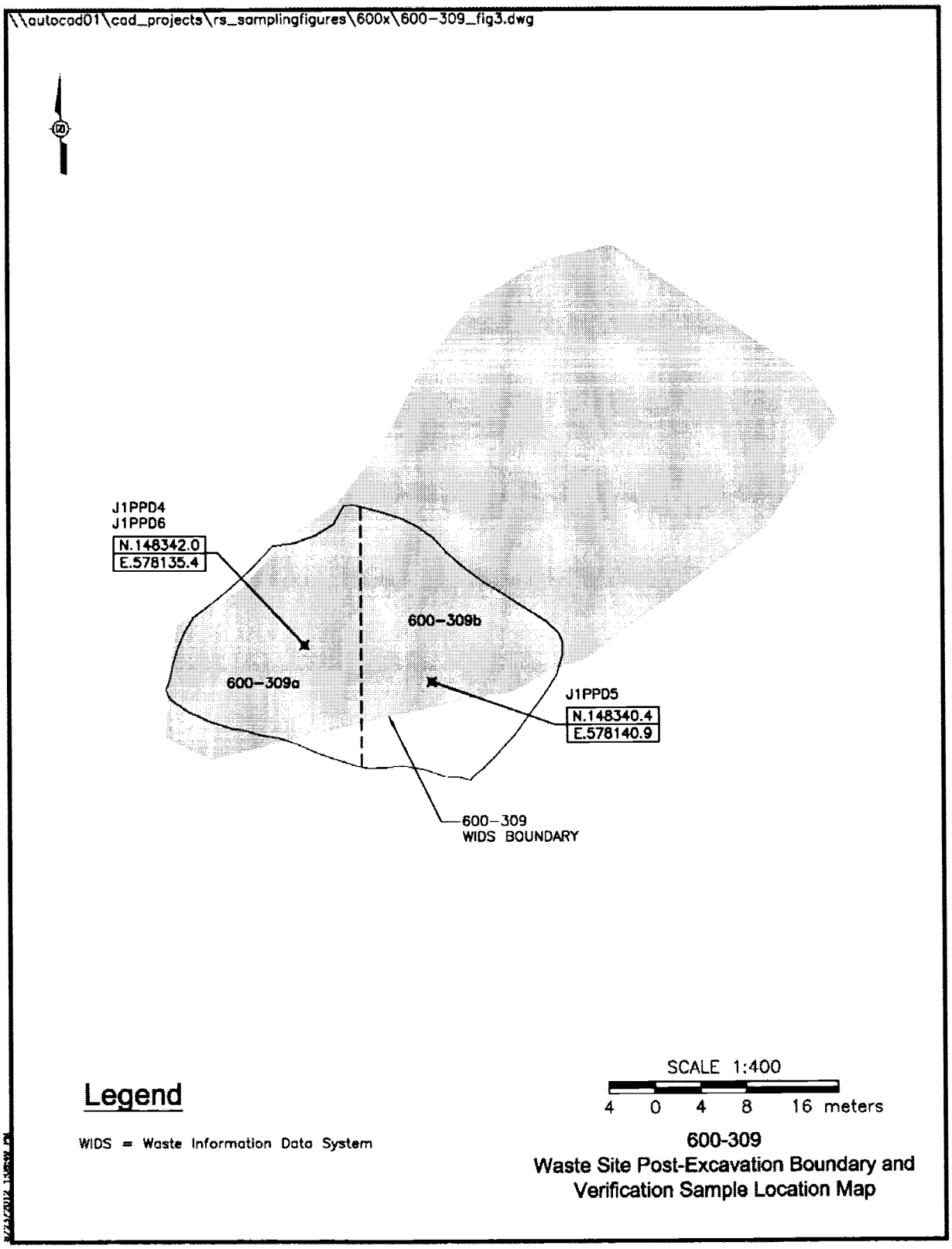


Figure 54. The 600-310 Post-Excavation GPS Walk-Around (May 2012).

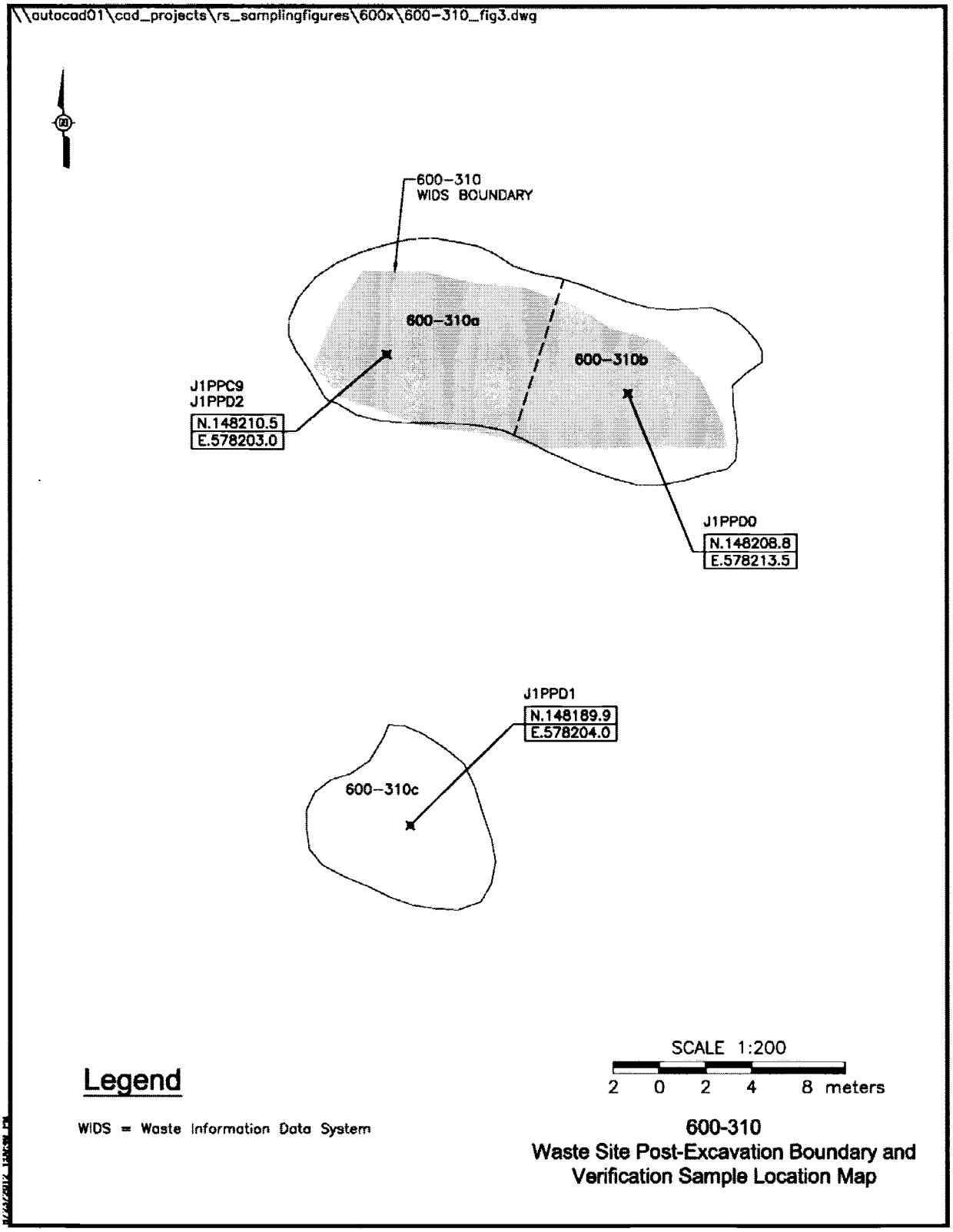


Figure 55. The 600-311 Post-Excavation GPS Walk-Around (May 2012).

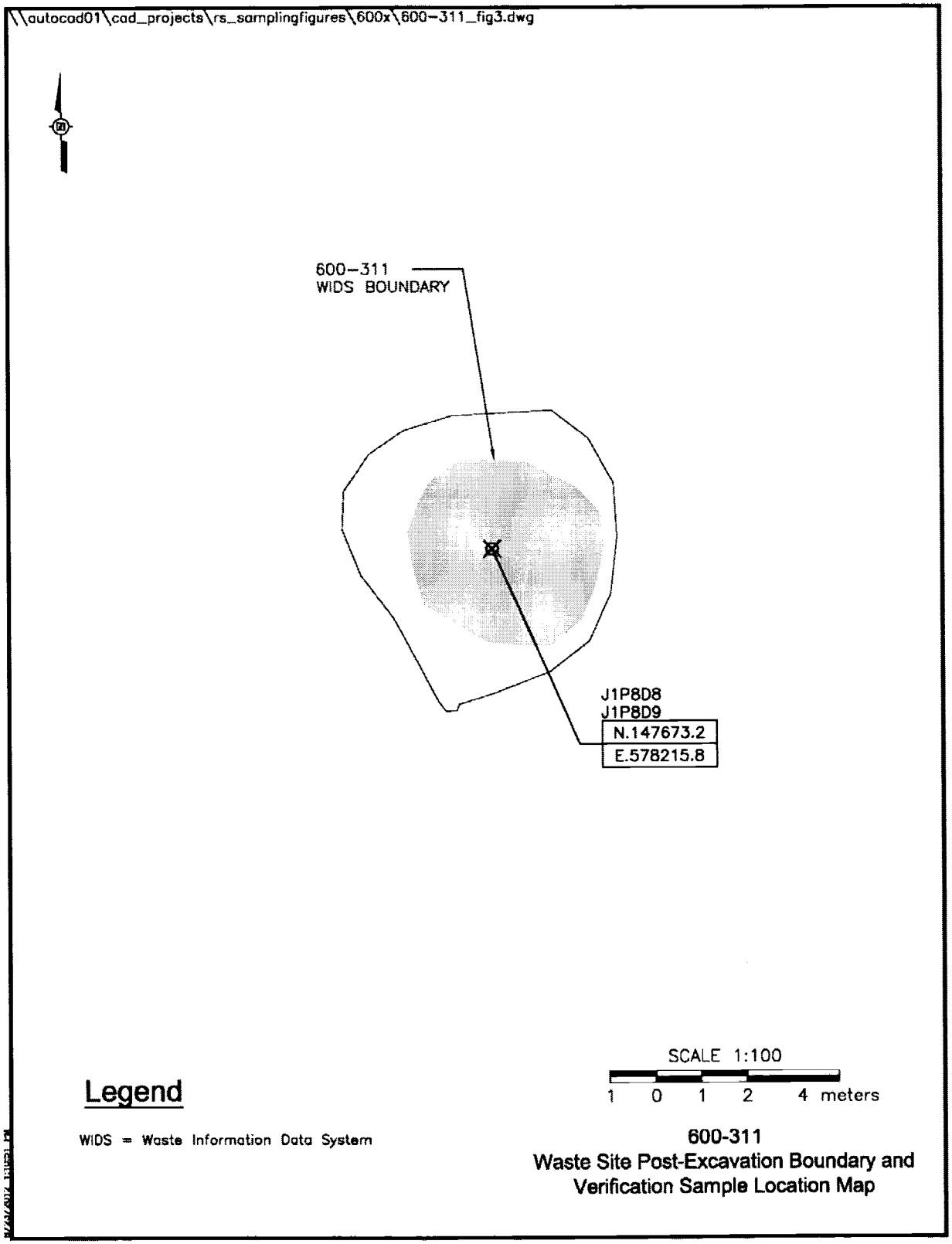


Figure 56. The 600-312 Post-Excavation GPS Walk-Around (May 2012).

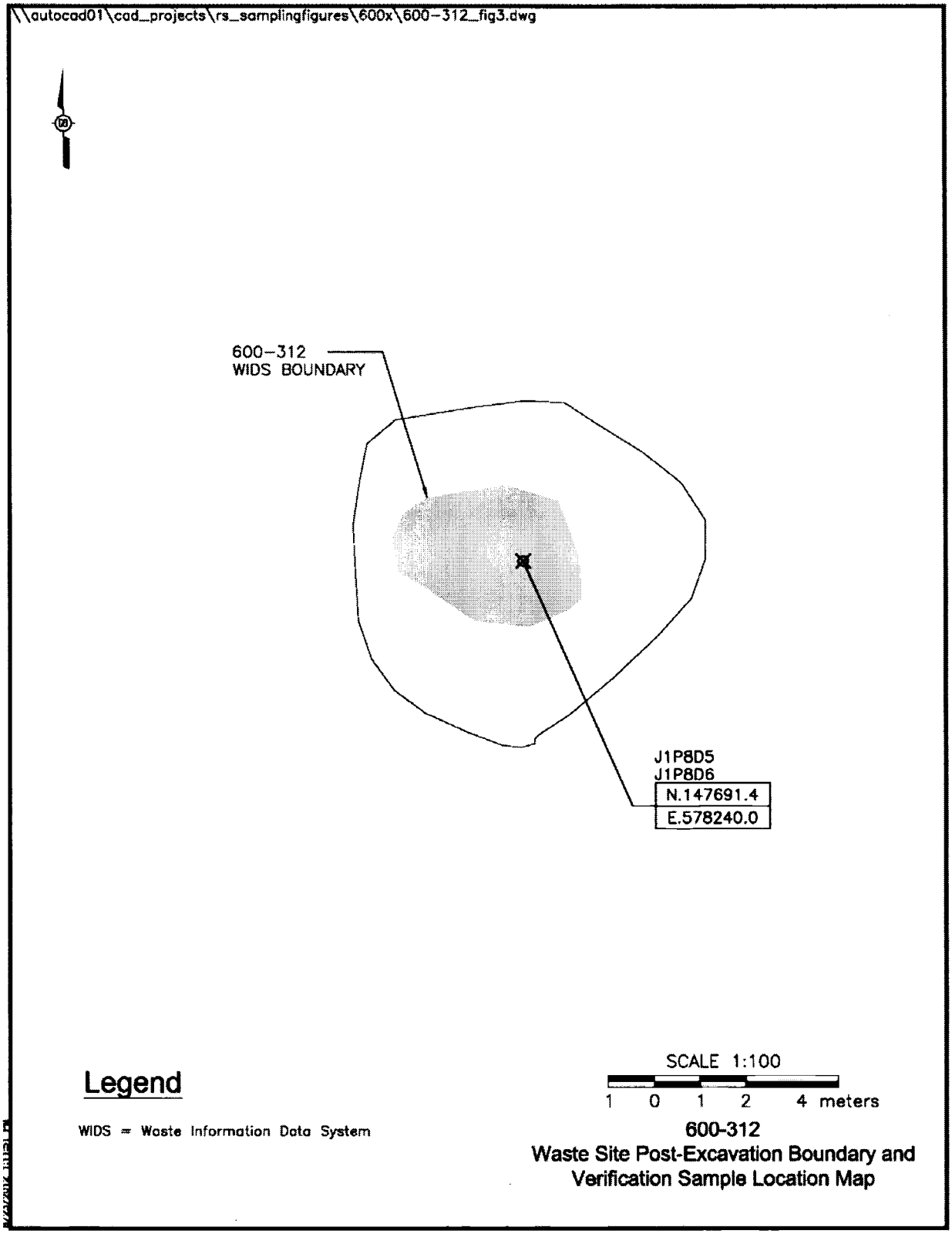


Figure 57. The 600-313 Post-Excavation GPS Walk-Around (May 2012).

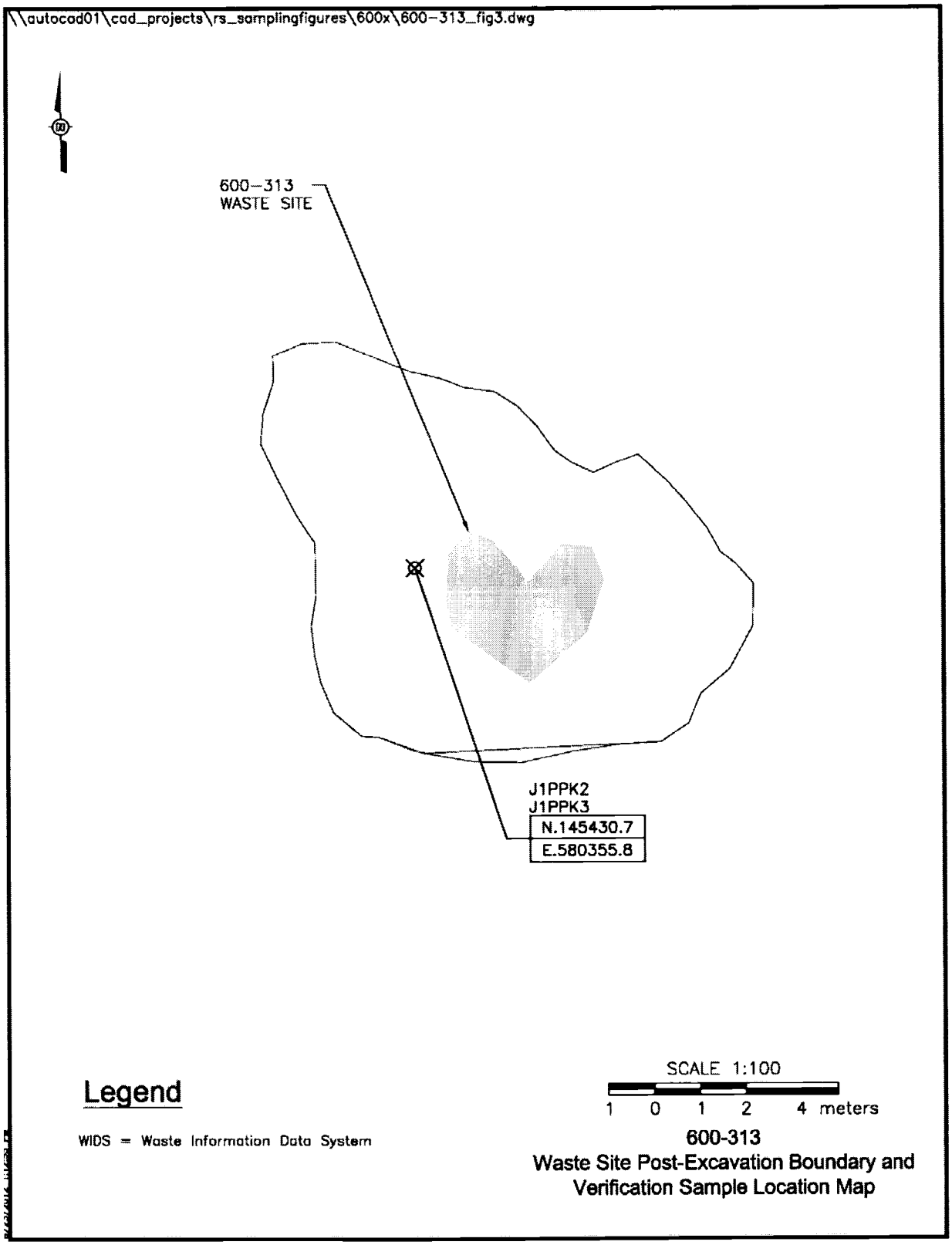


Figure 58. The 600-317 Post-Excavation GPS Walk-Around (May 2012).

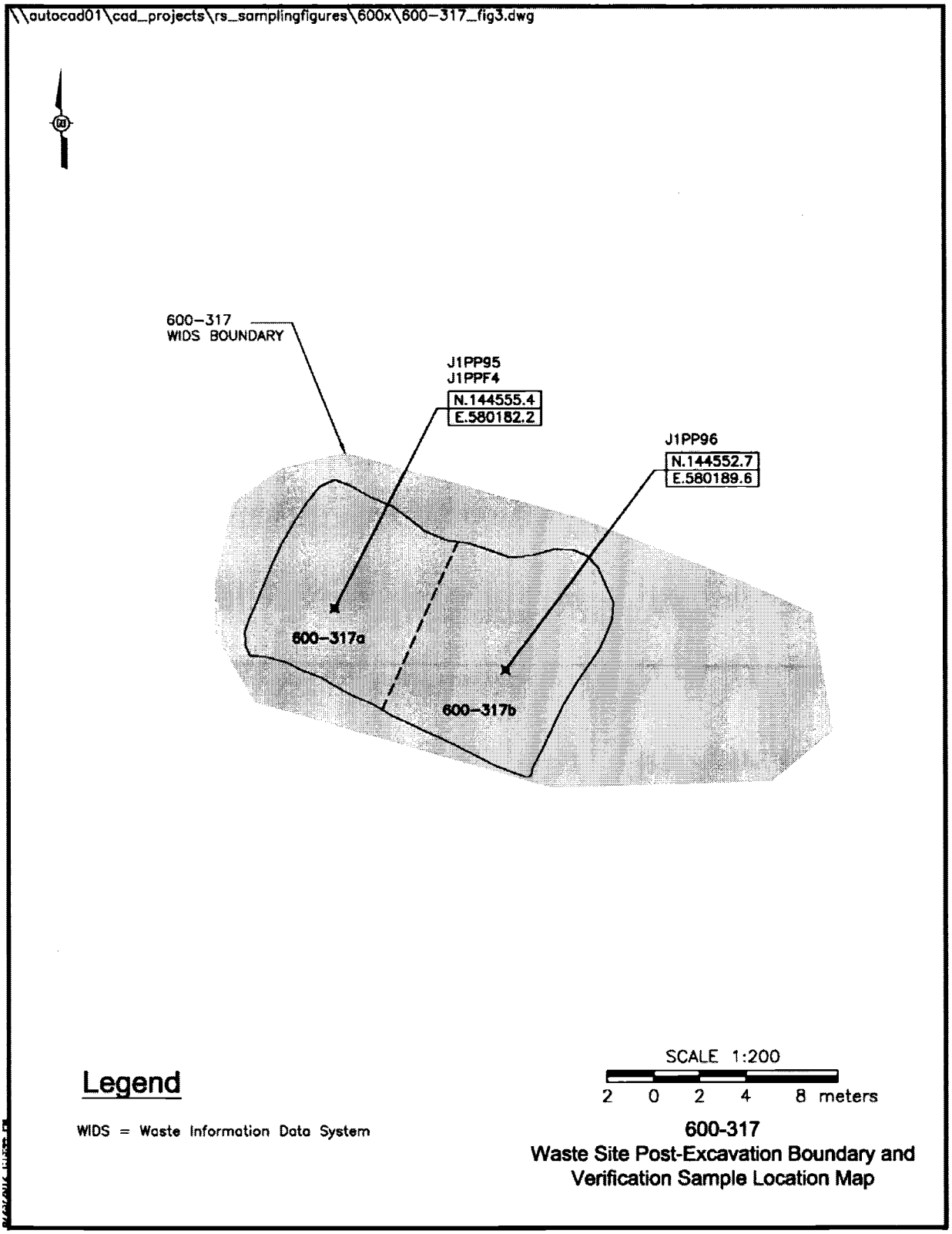


Figure 59. The 600-319:1 Post-Excavation GPS Walk-Around (May 2012).

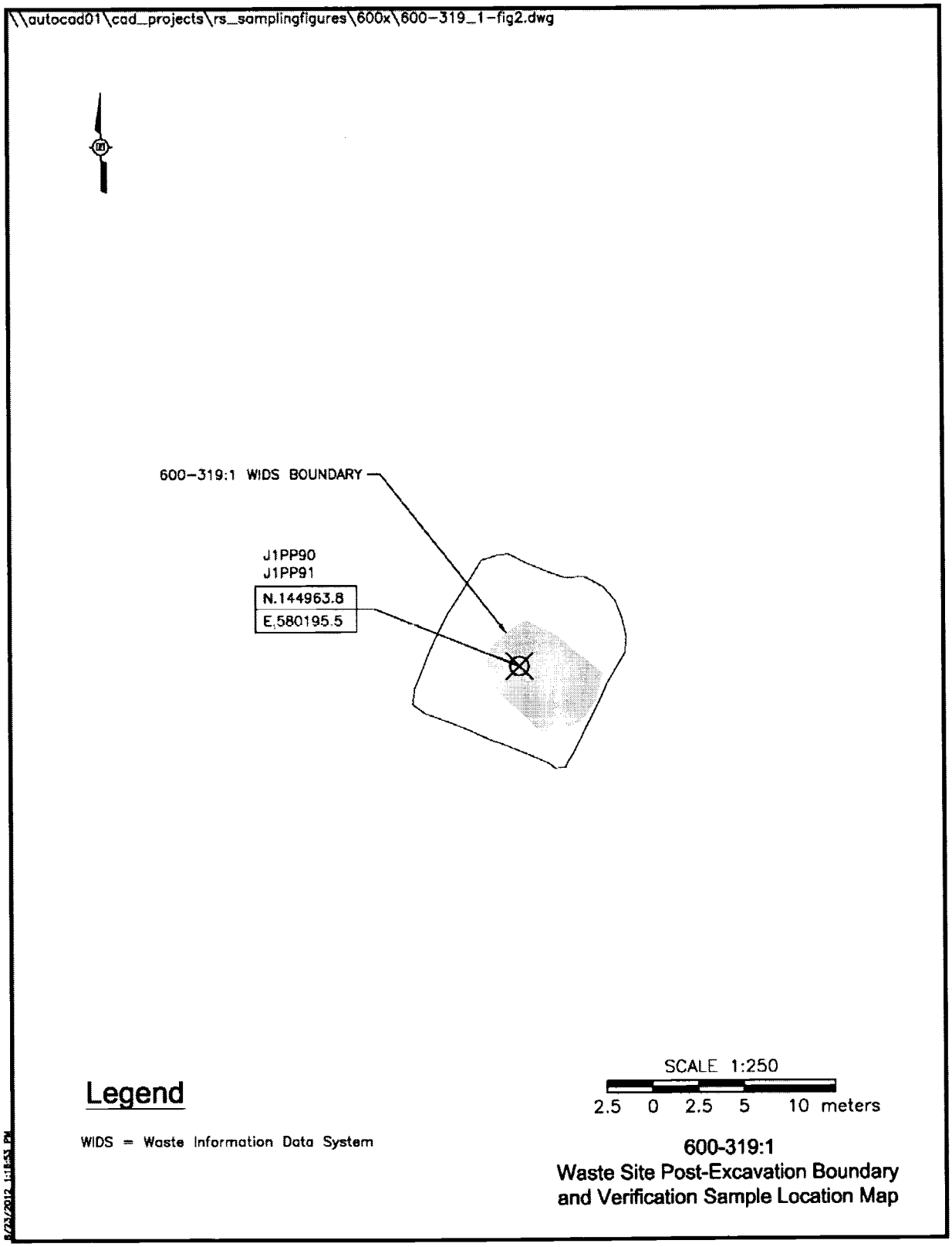


Figure 60. The 600-319:2 Post-Excavation GPS Walk-Around (May 2012).

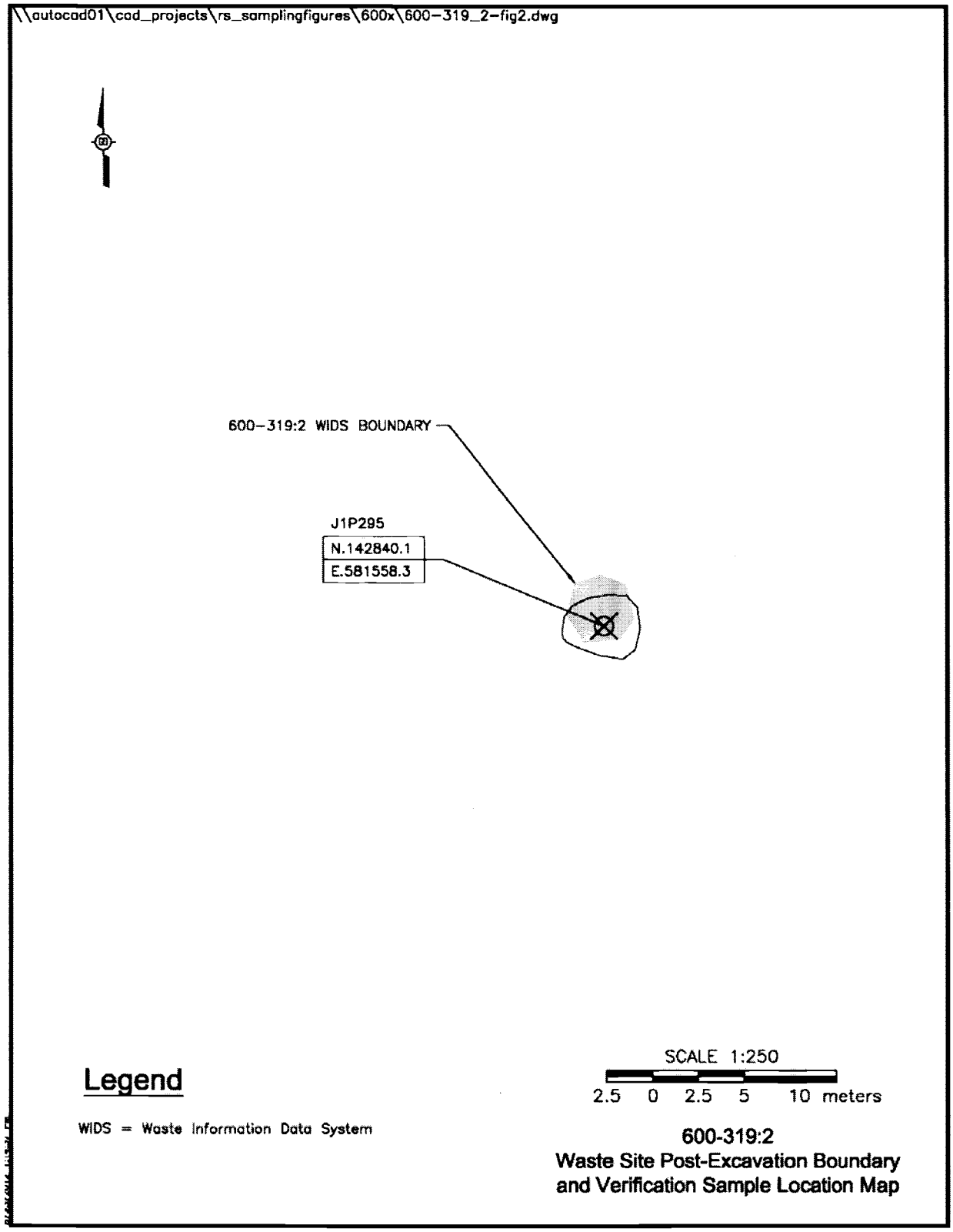


Figure 61. The 600-319:3 Post-Excavation GPS Walk-Around (May 2012).

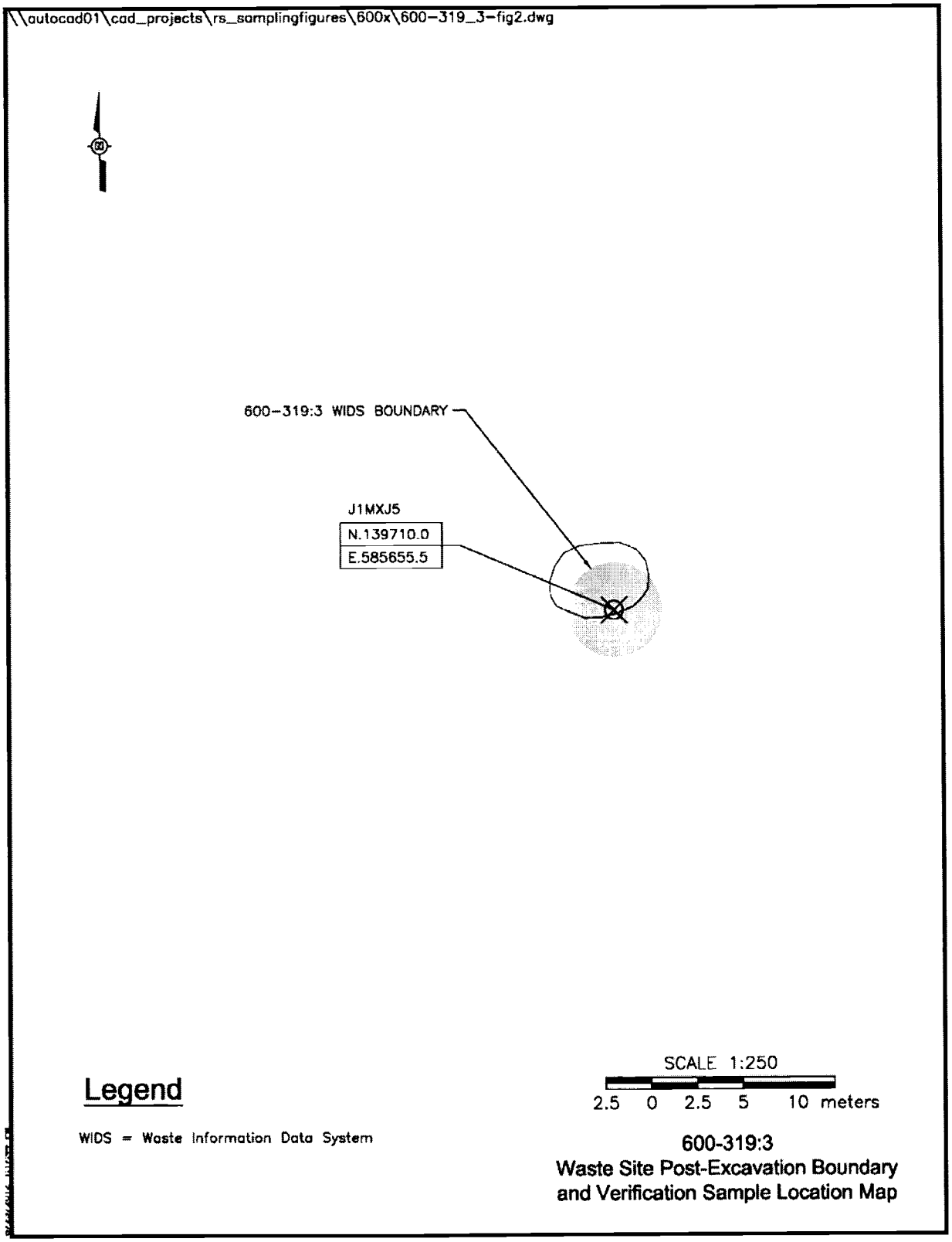
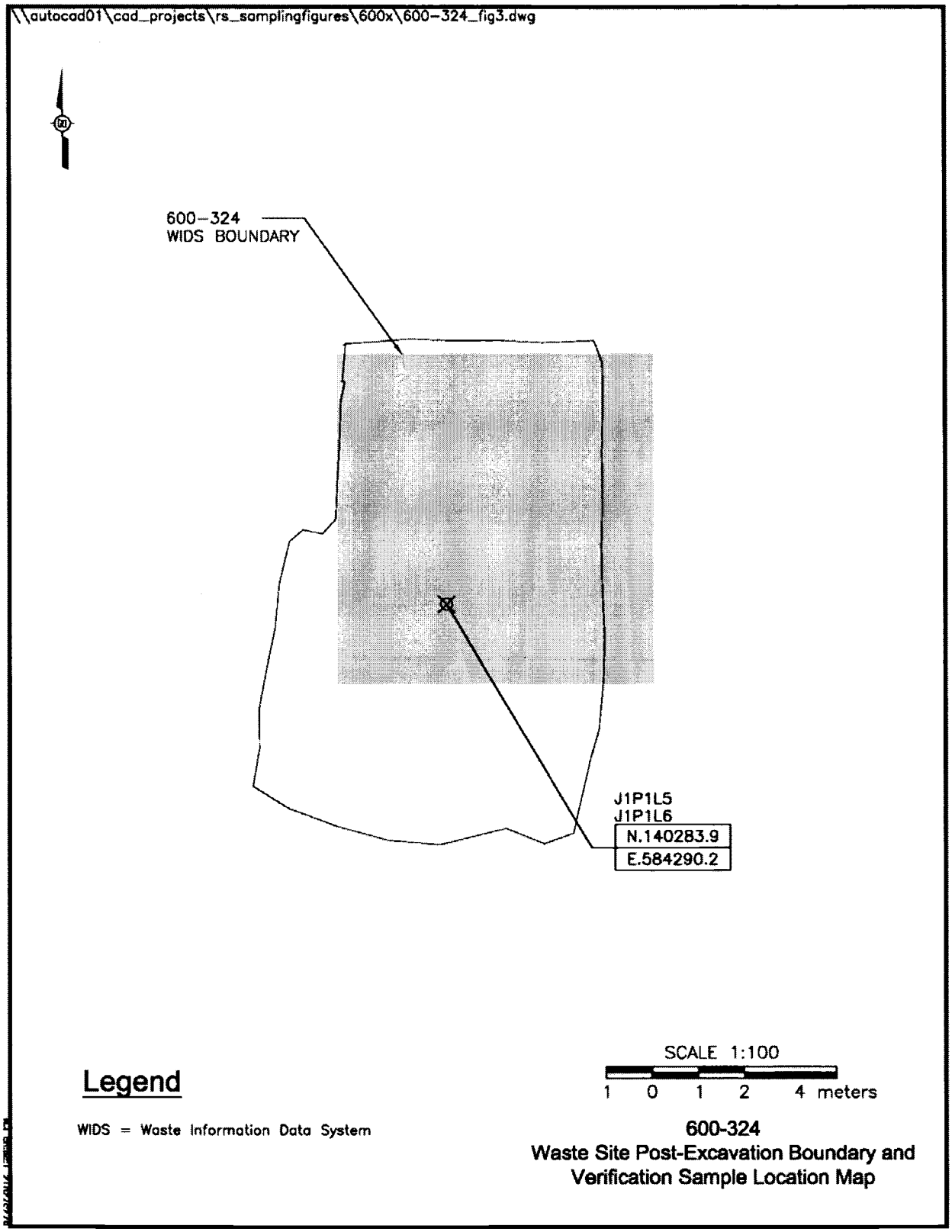


Figure 62. The 600-324 Post-Excavation GPS Walk-Around (May 2012).



For many of these waste sites the excavation boundary is smaller than the WIDS boundary. This discrepancy occurs with smaller, miscellaneous sites that are given large WIDS boundaries during the orphan sites evaluation process. During the design and excavation phase, these sites are given a much more detailed examination and the excavation is adjusted accordingly. The extent of the excavations at these waste sites or subsites removed all staining and debris present.

VERIFICATION SAMPLING ACTIVITIES

Verification sampling was conducted at the waste sites and subsites listed in Table 4 where dates are provided. Verification sampling was not conducted at the five 600-324 subsites. Sampling was conducted to support a determination that residual contaminant concentrations in the soil meet cleanup criteria specified in the RDR/RAWP (DOE-RL 2009b) and the Remaining Sites ROD (EPA 1999).

Table 4. Verification Sampling Dates.

Site Code	Verification Sampling Date
600-305:1, 600-305:2	April 5, 2012
600-305:3, 600-305:4, 600-305:5	May 21, 2012
600-308, 600-309, 600-310	May 30, 2012
600-311, 600-312	May 17, 2012
600-313	May 30, 2012
600-314:1, 600-314:2, 600-314:3, 600-314:4, 600-314:5	Verification sampling was not conducted at these subsites.
600-317	May 30, 2012
600-319:1	May 30, 2012
600-319:2	May 15, 2012
600-319:3	December 6, 2011
600-324	May 1, 2012

The verification sample results are provided in Appendix A and indicate that the waste removal actions achieved compliance with the RAOs and RAGs for the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites (and subsites). The following subsections provide additional discussion of the information used to develop the verification sampling design. The maximum results of verification sampling are also 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 Combined 100-IU-2/6 Waste Sites, 600-298, 600-299, 600-300, 600-303, 600-305, 600-306, 600-307, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-314, 600-316, 600-317, 600-318, 600-319, 600-320, 600-321, 600-324, 600-325, 600-326, 600-328* (WCH 2011L).

Contaminants of Potential Concern

The COPCs for the individual waste sites were based on site descriptions, the results of waste characterization sampling, and professional judgment. The technical basis for the COPC determination at each waste site is detailed in Table 5. Analytes that were detected near or above RAGs during waste characterization sampling (WCH 2011L) were included as COPCs for verification sampling.

Table 5. Verification Sampling Contaminants of Potential Concern.

Waste Site	WIDS Name	Area	Operable Unit	Analytes from Waste Characterization Sampling	COPCs in WIDS/SIS	COPCs for Verification Sampling
600-305	Suspect Asbestos Containing Material Sites	305:1 305:2 305:3 305:4 305:5	100-IU-2		Asbestos	Asbestos
600-308	Garnet Sand	None	100-IU-2		Lead	ICP metals
600-309	Burn Site #3	None	100-IU-2	ICP metals, TPH (asbestos not detected)	Asbestos	ICP metals, TPH
600-310	Burn Site #4	None	100-IU-2	ICP metals, TPH (PAH and PCBs detected below RAGs)		ICP metals, TPH
600-311	Burn Site #5	None	100-IU-2	ICP metals, TPH (TPH detected just below RAG at 190 mg/kg) (all SVOCs undetected)		ICP metals, TPH
600-312	Burn Site #6	None	100-IU-2	ICP metals, TPH (all SVOCs undetected)		ICP metals, TPH
600-313	Burned Area and Oil Stained Soil	None	100-IU-2	SVOCs (all TPH, PAH, PCBs, and metals detected below RAGs)	TPH, PAH, PCBs, and ICP metals	SVOCs
600-314	Telecommunication Components	Five unnamed subsites	100-IU-6		PCBs, asbestos, lead	
600-317	Battery and Burn Area	None	100-IU-6	ICP metals, pH, anions, (organics and TPH not sampled)	Lead, sulfuric acid	ICP metals, pH, anions, nitrate/nitrite, PAH, TPH
600-319	Miscellaneous Debris	319:1 319:2 319:3	100-IU-6	ICP metals (organics and TPH not sampled)		ICP metals, PAH, PCBs, TPH
600-324	Burnt Debris Area	None	100-IU-6			TPH, PAH

Source: Verification work instruction (WCH 2011L).

COPC = contaminant of potential concern
ICP = inductively coupled plasma
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
RAG = remedial action goal
SIS = Stewardship Information System
SVOC = semivolatile organic compound
TPH = total petroleum hydrocarbons
WIDS = Waste Information Data System

The area history at these waste sites does not indicate the presence of hexavalent chromium; therefore, it was excluded as a COPC for all waste sites.

The COPCs for verification sampling and the laboratory analytical methods are identified in Table 6.

Table 6. 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Laboratory Analytical Methods.

Analytical Method	Contaminant of Potential Concern
ICP metals [a] – EPA Method 6010	Metals [a]
Bulk asbestos – NIOSH Method 7400	Asbestos
Mercury – EPA Method 7471	Mercury
IC anions – EPA Method 300.0	Inorganic anions
Nitrate/nitrite – EPA Method 353.2	Nitrate/nitrite
SVOA – EPA Method 8270	Semivolatile organic compounds
TPH – NWTPH-Dx	TPH
PAH – EPA Method 8310	PAH

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

EPA = U.S. Environmental Protection Agency
IC = ion chromatography
ICP = inductively coupled plasma
PAH = polycyclic aromatic hydrocarbons
SVOA = semivolatile organic analysis
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). Composite sampling occurred based on the size of each waste site or waste site area in accordance with Table 7. The dimensions and numbers of sample per site were determined based on previously approved waste site designs in the 100-IU-2 and 100-IU-6 Operable Units (WCH 2011L).

Table 7. Verification Sampling Design Based on Waste Site Surface Area (WCH 2011L).

Surface Area	Sample Design
<100 m^2	One composite sample
100 – 500 m^2	Two composite samples (halves)
500 – 1000 m^2	Four composite samples (quadrants)
>1,000 m^2	Statistical design using Visual Sample Plan

Table 8 includes information from the verification sampling instructions (WCH 2011L) that estimated the dimensions of each waste site and correlated the number of samples to be collected to the estimated waste site size based on the information in Table 7.

Table 8. Waste Site Dimension Information.

Waste Site or Subsite	WSP Easting (m)	WSP Northing (m)	Estimated Remediation Dimensions [a] L x W x D (m)	Estimated Surface Area [a] (m^2)	Initial Sample Design [a]	Actual Surface Area [b] (m^2)	Actual Sample Design [c]
600-305, Suspect Asbestos Containing Material Sites							
600-305:1	577632.8	147948.6	2 x 1 x 1	2	One composite	2	One composite
600-305:2	577696.8	147936.5	4 x 4 x 1	16	One composite	22	One composite
600-305:3	578195.6	147168.3	3 x 5 x 1	15	One composite	NA	One composite
600-305:4	578293.8	147397.8	2 x 2 x 1	4	One composite	5.5	One composite
600-305:5	578926	147948.4	2 x 2 x 1	4	One composite	6	One composite
600-309, Burn Site #3	578145	148347.9	20 x 30 x 1	600	Four composites	133	Two composites
600-308, Garnet Sand	577594.7	148649.9	10 x 8 x 1	80	One composite	284	Three composites
600-310, Burn Site #4							
600-310 (Area 1)	578208.2	148209.9	4 x 10 x 1	40	One composite	71	One composite
600-310 (Area 2)	578208.2	148209.9	4 x 10 x 1	40	One composite	71	One composite
600-310 (Area 3)	578208.2	148209.9	4 x 5 x 1	20	One composite	46	One composite
600-311, Burn Site #5	578215.5	147673.4	4 x 4 x 1	16	One composite	28	One composite
600-312, Burn Site #6	578238.9	147691.2	5 x 5 x 1	25	One composite	44	One composite
600-313, Burned Area and Oil Stained Soil	580355.8	145430.7	2 x 5 x 1	10	One composite	66	One composite
600-317, Battery and Burn Area	580184.9	144555.3	15 x 7 x 1	105	Two composites	120	Two composites
600-319, Miscellaneous Debris							
600-319:1	580195.5	144963.8	7 x 7 x 1	49	One composite	89	One composite
600-319:2	581558.7	142840.5	2 x 2 x 2	4	One composite	12	One composite
600-319:3	585655.5	139710	2 x 4 x 1	8	One composite	20	One composite
600-324, Burnt Debris Area	584291.4	140285.7	7 x 9 x 1	63	One composite	70	One composite

[a] These are the estimated dimensions, surface area, and initial sample design from the verification work instruction (WCH 2011L).
[b] The actual waste site surface areas were determined after remediation activities.
[c] Duplicate samples are not in listed count. See field logbooks EL-1651-02 and EL-1651-03 (WCH 2012a, 2012b).
WSP = Washington State Plane coordinates

The original design for the 600-309 waste site indicated that this site was expected to have four composite samples collected based on the estimated remediation dimensions (Table 8). However, the design excavation for this site included several gravel piles with limited debris and an adjacent burn area. After removal of surface debris in the gravel piles and recontouring, no additional debris or staining was visible and only the burn area was excavated. Concurrence to

take two composite samples from the burn area by dividing it into halves was requested as the new sample design, and EPA agreed to this new verification sample design (WCH 2012c).

The Hanford Environmental Information System (HEIS) numbers for each sample are provided in Table 9. Figures 49 through 62 show the waste site excavation footprints and the sampling locations. 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 logbooks (WCH 2012a, 2012b).

Table 9. Verification Sample Summary Table for 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites. (2 Pages)

Sample Location	HEIS Number	Sample Date	Coordinate Locations (WSP)	Sample Analysis
600-305:1	J1NPC7	4/5/2012	N 147946.8 E 577633.2	Asbestos
600-305:2	J1NPC8		N 147936.1 E 577696.9	
Duplicate of J1NPC8	J1NPC9		N 147936.1 E 577696.9	
600-305:3	J1P8F9	5/21/2012	N 147168.3 E 578197.7	Asbestos
600-305:4	J1P8F8		N 147398.7 E 578294.8	
600-305:5	J1P8H0		N 147946.7 E 578927.5	
600-308a	J1PPF2	5/30/2012	N 148659.7 E 577661.2	Asbestos
600-308b	J1PPD8		N 148655.7 E 577587.7	ICP metals [a], mercury
Duplicate of J1PPD8	J1PPF0		N 148655.7 E 577587.7	
600-308c	J1PPD9		N 148647.4 E 577589.7	
600-309a	J1PPD4	5/30/2012	N 148342.0 E 578135.4	ICP metals [a], mercury, TPH
Duplicate of J1PPD4	J1PPD6			
600-309b	J1PPD5		N 148340.4 E 578140.9	
600-310a	J1PPC9	5/30/2012	N 1482203.0 E 578140.9	ICP metals [a], mercury, TPH
Duplicate of J1PPC9	J1PPD2			
600-310b	J1PPD0		N 148208.8 E 578213.5	
600-310c	J1PPD1		N 148189.9 E 578204.0	
600-311	J1P8D8	5/17/2012	N 147673.2 E 578215.8	ICP metals [a], mercury, TPH
Duplicate of J1P8D8	J1P8D9			
600-312	J1P8D5	5/17/2012	N 147691.4 E 578240.0	
Duplicate of J1P8D5	J1P8D6			

Table 9. Verification Sample Summary Table for 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites. (2 Pages)

Sample Location	HEIS Number	Sample Date	Coordinate Locations (WSP)	Sample Analysis
600-313	J1PPK2	5/30/2012	N 145430.7 E 580355.8	SVOA
Duplicate of J1PPK2	J1PPK3			
600-317a	J1PP95	5/30/2012	N 144555.4 E 580182.2	ICP metals [a], mercury, TPH, IC anions, nitrate/nitrite, PAH, pH
Duplicate of J1PP95	J1PPF4			
600-317b	J1PP96		N 144552.7 E 580189.6	
600-319:1	J1PP90	5/30/2012	N 144963.8 E 580195.5	ICP metals [a], mercury, TPH, PAH, PCB
Duplicate of J1PP90	J1PP91		N 144963.8 E 580195.5	
600-319:2	J1P295	5/15/2012	N 142840.1 E 581558.3	
600-319:3	J1MXJ5	12/6/2011	N 139710.0 E 585655.5	ICP metals [a], mercury, TPH, PAH, PCB
600-324	J1P1L5	5/1/2012	N 140283.9 E 584290.2	TPH, PAH
Duplicate of J1P1L5	J1P1L6			
Equipment blank (600-308)	J1PPF1	5/30/2012	NA	ICP metals [a], mercury
Equipment blank (600-309)	J1PPD7	5/30/2012		
Equipment blank (600-310)	J1PPD3	5/30/2012		
Equipment blank (600-311)	J1P8F0	5/17/2012		
Equipment blank (600-312)	J1P8D7	5/17/2012		
Equipment blank (600-313)	J1PPK4	5/30/2012		
Equipment blank (600-317)	J1PPF5	5/30/2012		
Equipment blank (600-319)	J1PP92	5/30/2012		
Equipment blank (600-324)	J1P1L7	5/1/2012		TPH, PAH

Source: Field logbooks EL-1651-02 (WCH 2012a) and EL-1651-03 (WCH 2012b).

[a] Analysis 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 in the analytical results package.

HEIS = Hanford Environmental Information System
IC = ion chromatography
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbons
WSP = Washington State Plane, meters

Verification Sample Results

Verification samples were analyzed using EPA-approved analytical methods. The maximum detected values for each analyte were compared to the RAGs for each waste site as specified by the RDR/RAWP (DOE-RL 2009b). If no detections for a given COPC were reported in the data set, then no maximum evaluation or calculations were performed for that COPC.

Comparisons of the results for each COPC from the 600-308, 600-309, 600-310, and 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 excavation areas against site RAGs are summarized in Tables 10 through 20. Contaminants that were not detected by laboratory analysis are excluded from these tables. Note that asbestos was not detected in 600-308 or in any of the 600-305 subsites; therefore, there is not a comparison table for the five 600-305 subsites. Also note that sampling was not conducted at the five 600-314 subsites as discussed in the Remedial Action section of this document.

Table 10. Comparison of Maximum Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-308 Excavation Verification Sampling Data.

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony [b]	0.36 (<BG)	32	5 [c]	5 [c]	No	--
Arsenic	2.5 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	85.3 (<BG)	5,600	200	400	No	--
Beryllium	0.25 (<BG)	10.4 [d]	1.51 [c]	1.51 [c]	No	--
Boron [e]	1.9	7,200	320	-- [f]	No	--
Cadmium [b]	0.16 (<BG)	13.9 [d]	0.81 [c]	0.81 [c]	No	--
Chromium (total)	11.6 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	6.7 (<BG)	24	15.7 [c]	-- [f]	No	--
Copper	11.9 (<BG)	2,960	59.2	22.0 [c]	No	--
Lead	4.6 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	317 (<BG)	3,760	512 [c]	512 [c]	No	--
Mercury	0.0089 (<BG)	24	0.33 [b]	0.33 [b]	No	--
Molybdenum [e]	0.27	400	8	-- [f]	No	--
Nickel	11.4 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	44.4 (<BG)	560	85.1 [c]	-- [f]	No	--
Zinc	41.5 (<BG)	24,000	480	67.8 [c]	No	--

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

[b] 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).

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

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

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

-- = 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 for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
WAC = *Washington Administrative Code*

Table 11. Comparison of Maximum Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-309 Excavation Verification Sampling Data.

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	2.2 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	65.6 (<BG)	5,600	200	400	No	--
Beryllium	0.25 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	1.3	7,200	320	-- [e]	No	--
Cadmium [f]	0.10 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	9.4 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	5.3 (<BG)	24	15.7 [b]	-- [e]	No	--
Copper	11.9 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	5.6 (<BG)	353	10.2 [b]	10.2 [b]	No	--
Manganese	257 (<BG)	3,760	512 [b]	512 [b]	No	--
Mercury	0.014 (<BG)	24	0.33 [b]	0.33 [b]	No	--
Nickel	15.6 (<BG)	1,600	19.1 [b]	27.4	No	--
Vanadium	33.2 (<BG)	560	85.1 [b]	-- [e]	No	--
Zinc	33.0 (<BG)	24,000	480	67.8 [b]	No	--
TPH – diesel	37.0	200	200	200	No	--
TPH diesel extended	68.0	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 per WAC 173-340-750(3), 1996 (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

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

[e] 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]).

[f] 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).

-- = 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 for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Table 12. Comparison of Maximum Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-310 Excavation Verification Sampling Data.

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	2.7 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	83.2 (<BG)	5,600	200	400	No	--
Beryllium	0.20 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	2.8	7,200	320	-- [e]	No	--
Cadmium [f]	0.13 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	19.2	80,000	18.5 [b]	18.5 [b]	Yes	Yes [g]
Cobalt	6.2 (<BG)	24	15.7 [b]	-- [e]	No	--
Copper	169	2,960	59.2	22.0 [b]	Yes	Yes [g]
Lead	11.6	353	10.2 [b]	10.2 [b]	Yes	Yes [g]
Manganese	292 (<BG)	3,760	512 [b]	512 [b]	No	--
Mercury	0.012 (<BG)	24	0.33 [b]	0.33 [b]	No	--
Nickel	11.7 (<BG)	1,600	19.1 [b]	27.4	No	--
Selenium	1.4	400	5	1	Yes	Yes [h]
Vanadium	41.4 (<BG)	560	85.1 [b]	-- [e]	No	--
Zinc	75.1	24,000	480	67.8 [b]	Yes	Yes [g]
TPH – diesel	15.0	200	200	200	No	--
TPH diesel extended	30.0	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 per WAC 173-340-750(3), 1996 (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

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

[e] 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]).

[f] 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).

[g] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), residual concentrations are not expected to migrate more than 2.6 m (8.5 ft) vertically in 1,000 years (based on the lowest distribution coefficient [K_d] of the chromium, copper, lead, and zinc contaminants that exceeded the RAGs [copper with a K_d of 22 mL/g]). The vadose zone underlying the soil below the floor of the excavation is approximately 7 m (22 ft) thick based on an elevation at ground surface of 124 m (407 ft), a groundwater elevation of approximately 116 m (381 ft) (*Hanford Site Groundwater Monitoring Report for 2010* [DOE-RL 2011a]), and an excavation depth of 1 m (3 ft). Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia River.

[h] Based on RESRAD modeling discussed in Appendix C of the RDR/RAWP (DOE-RL 2009b) and the evaluation of dilution-attenuation in the saturated zone using the formulas from the U.S. Environmental Protection Agency's *Soil Screening Guidance: User's Guide* (EPA 1996), maximum residual concentrations of selenium are predicted to be protective of groundwater and the Columbia River for 1,000 years (Appendix B).

-- = 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 for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Table 13. Comparison of Maximum Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-311 Excavation Verification Sampling Data.

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	2.3 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	63.7 (<BG)	5,600	200	400	No	--
Beryllium	0.23 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	1.5	7,200	320	-- [e]	No	--
Cadmium [f]	0.13 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	10.5 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	5.8 (<BG)	24	15.7 [b]	-- [e]	No	--
Copper	10.8 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	3.8 (<BG)	353	10.2 [b]	10.2 [b]	No	--
Manganese	250 (<BG)	3,760	512 [b]	512 [b]	No	--
Nickel	10.1 (<BG)	1,600	19.1 [b]	27.4	No	--
Vanadium	46.9 (<BG)	560	85.1 [b]	-- [e]	No	--
Zinc	32.5 (<BG)	24,000	480	67.8 [b]	No	--
TPH – diesel	4.7	200	200	200	No	--
TPH diesel extended	8.2	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 per WAC 173-340-750(3), 1996 (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

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

[e] 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]).

[f] 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).

-- = 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 for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Table 14. Comparison of Maximum Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-312 Excavation Verification Sampling Data.

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony [b]	0.64 (<BG)	32	5 [c]	5 [c]	No	--
Arsenic	1.7 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	62.2 (<BG)	5,600	200	400	No	--
Beryllium	0.18 (<BG)	10.4 [d]	1.51 [c]	1.51 [c]	No	--
Boron [e]	1.4	7,200	320	-- [f]	No	--
Cadmium [b]	0.14 (<BG)	13.9 [d]	0.81 [c]	0.81 [c]	No	--
Chromium (total)	11.7 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	5.7 (<BG)	24	15.7 [c]	-- [f]	No	--
Copper	10.4 (<BG)	2,960	59.2	22.0 [c]	No	--
Lead	3.3 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	266 (<BG)	3,760	512 [c]	512 [c]	No	--
Molybdenum [e]	0.26	400	8	-- [f]	No	--
Nickel	10.2 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	44.0 (<BG)	560	85.1 [c]	-- [f]	No	--
Zinc	34.3 (<BG)	24,000	480	67.8 [c]	No	--
TPH – diesel	1.8	200	200	200	No	--
TPH diesel extended	3.9	200	200	200	No	--

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

[b] 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).

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

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

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

-- = 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 for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Table 15. Comparison of Maximum Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-313 Excavation Verification Sampling Data.

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Fluorene	0.025	3,200	64	260	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
-- = not applicable
COPC = contaminant of potential concern
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)

Table 16. Comparison of Maximum Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-317 Excavation Verification Sampling Data. (2 Pages)

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony [b]	0.50 (<BG)	32	5 [c]	5 [c]	No	--
Arsenic	2.2 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	96.4 (<BG)	5,600	200	400	No	--
Beryllium	0.18 (<BG)	10.4 [d]	1.51 [c]	1.51 [c]	No	--
Boron [e]	1.3	7,200	320	-- [f]	No	--
Cadmium [b]	0.15 (<BG)	13.9 [d]	0.81 [c]	0.81 [c]	No	--
Chromium (total)	13.8 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	6.2 (<BG)	24	15.7 [c]	-- [f]	No	--
Copper	14.1 (<BG)	2,960	59.2	22.0 [c]	No	--
Lead	15.0	353	10.2 [c]	10.2 [c]	Yes	Yes [g]
Manganese	275 (<BG)	3,760	512 [c]	512 [c]	No	--
Nickel	13.5 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	43.9 (<BG)	560	85.1 [c]	-- [f]	No	--
Zinc	132	24,000	480	67.8 [c]	Yes	Yes [g]
TPH – diesel	2.6	200	200	200	No	--
TPH diesel extended	4.8	200	200	200	No	--
Chloride	3.1 (<BG)	--	25,000	--	No	--
Fluoride	1.1 (<BG)	4,800	96	400	No	--
Nitrate (as nitrogen)	1.6 (<BG)	128,000	1,000	2,000	No	--

Table 16. Comparison of Maximum Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-317 Excavation Verification Sampling Data. (2 Pages)

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Sulfate	6.5 (<BG)	--	25,000	--	No	--

[a] RAGs obtained from the 100 Area RDR/RAWP (DOE-RL 2009b).
[b] 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).
[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] Carcinogenic cleanup level calculated based on the inhalation exposure pathway per WAC 173-340-750(3), 1996 (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).
[e] No Hanford Site-specific or Washington State background value available.
[f] No parameters (bioconcentration factors or AWQC values) are available from the Cleanup Levels and Risk Calculations Database (Ecology 2011) or other databases to calculate cleanup levels (WAC 173-340-730[3][a][iii], 1996 [Method B for surface waters]).
[g] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), residual concentrations of lead and zinc are not expected to migrate more than 1.8 m (5.9 ft) vertically in 1,000 years (based on the distribution coefficient of 30 mL/g for both lead and zinc). The vadose zone underlying the soil below the floor of the excavation is approximately 3 m (9.8 ft) thick based on an elevation at ground surface of 118 m (387 ft), a groundwater elevation of approximately 114 m (374 ft) (*Hanford Site Groundwater Monitoring Report for 2010* [DOE-RL 2011a]), and an excavation depth of 1 m (3 ft). Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia 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 for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Table 17. Comparison of Maximum Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-319:1 Excavation Verification Sampling Data. (2 Pages)

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	3.1 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	76.5 (<BG)	5,600	200	400	No	--
Beryllium	0.25 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	1.7	7,200	320	-- [e]	No	--
Cadmium [f]	0.12 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	9.7 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	9.3 (<BG)	24	15.7 [b]	-- [e]	No	--
Copper	41.9	2,960	59.2	22.0 [b]	Yes	Yes [g]
Lead	14.7	353	10.2 [b]	10.2 [b]	Yes	Yes [g]

Table 17. Comparison of Maximum Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-319:1 Excavation Verification Sampling Data. (2 Pages)

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Manganese	389 (<BG)	3,760	512 [b]	512 [b]	No	--
Mercury	0.015 (<BG)	24	0.33 [b]	0.33 [b]	No	--
Nickel	10.4 (<BG)	1,600	19.1 [b]	27.4	No	--
Selenium	0.85	400	5	1	No	--
Vanadium	69.1 (<BG)	560	85.1 [b]	-- [e]	No	--
Zinc	55.2 (<BG)	24,000	480	67.8 [b]	No	--
TPH – diesel	2.6	200	200	200	No	--
TPH diesel extended	5.6	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 per WAC 173-340-750(3), 1996 (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

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

[e] 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]).

[f] 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).

[g] Based on RESRAD modeling discussed in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), residual concentrations are not expected to migrate more than 2.6 m (8.5 ft) vertically in 1,000 years (based on the lowest distribution coefficient [K_d] of the copper and lead contaminants that exceeded the RAGs [copper with a K_d of 22 mL/g]). The vadose zone underlying the soil below the floor of the excavation is approximately 9 m (30 ft) thick based on an elevation at ground surface of 124 m (407 ft), a groundwater elevation of approximately 114 m (374 ft) (*Hanford Site Groundwater Monitoring Report for 2010* [DOE-RL 2011a]), and an excavation depth of 1 m (3 ft). Therefore, residual concentrations of these contaminants are predicted to be protective of groundwater and the Columbia 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 for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Table 18. Comparison of Maximum Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-319:2 Excavation Verification Sampling Data.

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Arsenic	4.2 (<BG)	20 [b]	20 [b]	20 [b]	No	--
Barium	77.2 (<BG)	5,600	200	400	No	--
Beryllium	0.39 (<BG)	10.4 [c]	1.51 [b]	1.51 [b]	No	--
Boron [d]	1.1	7,200	320	-- [e]	No	--
Cadmium [f]	0.067 (<BG)	13.9 [c]	0.81 [b]	0.81 [b]	No	--
Chromium (total)	9.8 (<BG)	80,000	18.5 [b]	18.5 [b]	No	--
Cobalt	7.3 (<BG)	24	15.7 [b]	-- [e]	No	--
Copper	14.2 (<BG)	2,960	59.2	22.0 [b]	No	--
Lead	8.1 (<BG)	353	10.2 [b]	10.2 [b]	No	--
Manganese	364 (<BG)	3,760	512 [b]	512 [b]	No	--
Nickel	9.4 (<BG)	1,600	19.1 [b]	27.4	No	--
Vanadium	58.6 (<BG)	560	85.1 [b]	-- [e]	No	--
Zinc	42.6 (<BG)	24,000	480	67.8 [b]	No	--
TPH – diesel	3.9	200	200	200	No	--
TPH diesel extended	8.5	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 per WAC 173-340-750(3), 1996 (Method B for air quality) and an airborne particulate mass loading rate of 0.0001 g/m^3 (*Hanford Guidance for Radiological Cleanup* [WDOH 1997]).

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

[e] 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]).

[f] 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).

-- = 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 for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Table 19. Comparison of Maximum Focused Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-319:3 Excavation Verification Sampling Data.

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony [b]	1.1 (<BG)	32	5 [c]	5 [c]	No	--
Arsenic	3.2 (<BG)	20 [c]	20 [c]	20 [c]	No	--
Barium	97.7 (<BG)	5,600	200	400	No	--
Boron [e]	2.1	7,200	320	-- [f]	No	--
Cadmium [b]	0.088 (<BG)	13.9 [d]	0.81 [c]	0.81 [c]	No	--
Chromium (total)	12.4 (<BG)	80,000	18.5 [c]	18.5 [c]	No	--
Cobalt	7.5 (<BG)	24	15.7 [c]	-- [f]	No	--
Copper	13.6 (<BG)	2,960	59.2	22.0 [c]	No	--
Lead	6.8 (<BG)	353	10.2 [c]	10.2 [c]	No	--
Manganese	360 (<BG)	3,760	512 [c]	512 [c]	No	--
Nickel	11.5 (<BG)	1,600	19.1 [c]	27.4	No	--
Vanadium	45.8 (<BG)	560	85.1 [c]	-- [f]	No	--
Zinc	44.7 (<BG)	24,000	480	67.8 [c]	No	--
TPH – diesel	0.87	200	200	200	No	--
TPH diesel extended	2.8	200	200	200	No	--

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

[b] 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).

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

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

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

-- = 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 for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Table 20. Comparison of Maximum Verification Sample Contaminant Concentrations to Remedial Action Goals for the 600-324 Excavation Verification Sampling Data.

COPC	Maximum Result	Remedial Action Goals [a]			Does the Maximum Result Exceed RAGs?	Do the Results Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
TPH – Diesel	9.4	200	200	200	No	--
TPH Diesel Extended	22.0	200	200	200	No	--

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

-- = not applicable
COPC = contaminant of potential concern
RAG = remedial action goal
RDR/RAWP = *Remedial Design Report/Remedial Action Work Plan for the 100 Area*
RESRAD = RESidual RADioactivity (dose model)
TPH = total petroleum hydrocarbons

Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2011) under WAC 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund* (EPA 1989) recommends that aluminum and iron not be considered in site-risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COPCs and are also not included in these tables.

The laboratory-reported data results for all constituents are stored in the Environmental Restoration (ENRE) project-specific database prior to archival in the Hanford Environmental Information System (HEIS) and are presented in Attachment 1 of the calculations (Appendix A).

VERIFICATION SAMPLE DATA EVALUATION

This section demonstrates that contaminant concentrations at the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites (and subsites) 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 RDR/RAWP (DOE-RL 2009b). Application of the WAC 173-340-740(7)(e) three-part test is not included in these evaluations because the three-part test is a statistical evaluation of the data that does not apply to the results of focused samples such as those taken at these 100-IU-2/6 combined waste sites.

Nonradionuclide Soil RAGs for Direct Exposure and Groundwater and River Protection Attained

Evaluation of the verification sampling results in Tables 10 through 20 shows that all direct exposure, groundwater protection, and Columbia River protection RAGs are met for the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites (and subsites).

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Assessment of the risk requirements for the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites (and subsites) was performed by calculating the hazard quotient and examining the excess carcinogenic risk values for direct contact (Appendix A).

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 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites (and subsites), 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.

All individual hazard quotients for noncarcinogenic constituents were less than 1.0. The cumulative hazard quotient for those noncarcinogenic constituents above background or detection levels is 6.7×10^{-2}. No carcinogenic constituents met the criteria for evaluation of direct exposure at the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites (and subsites); therefore, no calculations of excess carcinogenic risk were performed. Thus, the individual contaminant carcinogenic risk requirement of less than 1×10^{-6} is met and the cumulative carcinogenic risk of less than 1×10^{-5} is met. These waste sites meet the requirements for the direct contact hazard quotient and excess carcinogenic risk as identified in the RDR/RAWP (DOE-RL 2009b). Calculation of the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites (and subsites) direct contact hazard quotient and carcinogenic risk is presented in Appendix A.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach (WCH 2011L), the field logbooks (WCH 2012a, 2012b), and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications.

The DQA for the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites (and subsites) 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 the ENRE project-specific database for data evaluation prior to archival in the HEIS and are summarized in an attachment to the relative percent difference calculation in Appendix A. The detailed DQA is presented in Appendix C.

SUMMARY FOR INTERIM CLOSURE

The 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites (and subsites) have been evaluated in accordance with the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2009b). Remedial action was performed in August 2011 and April and May 2012, removing contaminated soil and debris from the sites. Verification sampling was performed in August 2011 and May 2012, and the analytical results indicate that the residual concentrations of COPCs meet the RAGs and associated RAOs for direct exposure, groundwater protection, and river protection.

In accordance with this evaluation, the verification sampling results support a reclassification of the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites (and subsites) to Interim Closed Out. The waste sites' contamination does not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the sites are not required.

For the five 600-314 subsites, only component removal occurred per the verification work instruction (WCH 2011L), since only telecommunications components were present and no stained or anomalous materials were found during site component removal. Component removal at the 600-314 subsites occurred in May 2012, and the components were disposed of at ERDF.

In accordance with this evaluation, the component removal results support a reclassification of the 600-314 subsites to Interim Closed Out. The subsites' contamination does not extend into the deep zone; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of the subsites are not required.

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APPENDIX A

RELATIVE PERCENT DIFFERENCE (RPD)

AND

DIRECT CONTACT HAZARD QUOTENT AND CARCINOGENIC RISK CALCULATION

APPENDIX A

RELATIVE PERCENT DIFFERENCE (RPD) AND DIRECT CONTACT HAZARD QUOTENT AND CARCINOGENIC RISK CALCULATION

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:

600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk Calculation, 0600X-CA-V0133, 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-V0133

Subject: 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites Relative Percent Difference (RPD) and Direct Contact Hazard Quotient and Carcinogenic Risk 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 Summary = 12 Attachment 1 = 9 Total = 22	N. K. Schiffern N. K. Schiffern	J. D. Skoglie J. D. Skoglie	I. B. Berezovskiy I. B. Berezovskiy	D. F. Obenauer D. F. Obenauer	10/22/12

SUMMARY OF REVISION

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

DE01-437.03

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	7/31/2012	Calc. No.:	0600X-CA-V0133	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	7/31/2012
Subject:	600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 12	

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009a), 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 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites verification sampling, as necessary.

GIVEN/REFERENCES:

1) DOE-RL, 2009a, *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.

2) DOE-RL, 2009b, *100 Area Remedial Action Sampling and Analysis Plan,* DOE/RL-96-22, Rev. 5, 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, 2012, *Remaining Sites Verification Package for the 600-305, Suspect Asbestos Containing Material Sites, 600-308, Garnet Sand, 600-309, Burn Site #3, 600-310, Burn Site #4, 600-311, Burn Site #5, 600-312, Burn Site #6, 600-313, Burned Area and Stained Soil, 600-314, Telecommunications Components, 600-317, Battery and Burn Area, 600-319, Miscellaneous Debris, 600-324, Burnt Debris Area,* Attachment to Waste Site Reclassification Forms 2012-070, 2012-060, 2012-040, 2012-041, 2012-042, 2012-043, 2012-044, 2012-045, 2012-046, 2012-071, 2012-048, Washington Closure Hanford, Inc., Richland, Washington.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	7/31/2012	Calc. No.:	0600X-CA-V0133	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	7/31/2012
Subject:	600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 12	

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 2009a).

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 2009a).

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 WCH (2012) to perform the RPD calculations for primary-duplicate sample pairs, as required.

METHODOLOGY:

The 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites underwent composite sampling. Five samples from the 600-305 waste site, two samples from the 600-308 waste site, two samples from the 600-309 waste site, three samples from the 600-310 waste site, one sample from 600-311 waste site, one sample from 600-312 waste site, one sample from 600-313 waste site, two samples from 600-317 waste site, three samples from the 600-319 waste site, and one sample from 600-324 waste site were taken. A total of twenty one composite samples (or fifteen if excluding asbestos samples) and ten duplicate samples (or nine if excluding asbestos samples) were collected at the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites. The direct contact hazard quotient and carcinogenic risk calculations for the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites were conservatively calculated using the greatest of the maximum soil sample results (WCH 2012). Of the contaminants of potential concern (COPCs) for this site, chromium, copper, selenium, and zinc require HQ and risk calculations because these analytes were detected above Washington State or Hanford background value. Boron, molybdenum, and fluorene require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Lead was quantitated at a concentration above Hanford Site background; however, 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 extended) were 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 2.8 mg/kg, divided by the noncarcinogenic RAG value of 7,200 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 3.9×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	7/31/2012	Calc. No.:	0600X-CA-V0133	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	7/31/2012
Subject:	600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 12	

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 6.7×10^{-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}. No carcinogenic constituents met the criteria for evaluation in direct exposure at the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites; therefore, no calculations of excess carcinogenic risk were performed. The requirement of $<1 \times 10^{-6}$ is met.

4) The cumulative excess cancer risk can be obtained by summing the individual values. The sum of the excess cancer risk values is zero. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

5) The RPD is calculated when both the primary value and the duplicate value for a given analyte are above detection limits and are greater than 5 times the target detection limit (TDL). The TDL is a laboratory detection limit pre-determined for each analytical method and is listed for certain analytes in Table II-1 of the SAP (DOE-RL 2009b). 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 verification sampling of the subject site. Additional discussion is provided in the data quality assessment section of the applicable RSVP (WCH 2012), as necessary.

RESULTS:

1) List individual noncarcinogens and corresponding HQs >1.0: None
2) List the cumulative noncarcinogenic HQ >1.0: None

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	7/31/2012	Calc. No.:	0600X-CA-V0133	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	7/31/2012
Subject:	600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 4 of 12	

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 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites.

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

Tables 2, 3, 4, 5, 6, 7, 8, and 9 show the results of the RPD calculations for the 600-308, 600-309, 600-310, 600-311, 600-312, 600-317, 600-319, and 600-324 waste sites.

Table 1. Direct Contact HQ and Excess Cancer Risk Results for the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites.

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	2.8	7,200	3.9E-04	--	--
Chromium, total	19.2	80,000	2.4E-04	--	--
Copper	169	2,960	5.7E-02	--	--
Lead[c]	15.0	353	--	--	--
Molybdenum	0.27	400	6.8E-04	--	--
Selenium	1.4	400	3.5E-03	--	--
Zinc	132	24,000	5.5E-03	--	--
Semivolatiles					
Fluorene	0.025	3,200	7.8E-06	--	--
Total Petroleum Hydrocarbon					
TPH-diesel range EXT[d]	68.0	200	--	--	--
Totals					
Cumulative Hazard Quotient:			**6.7E-02**		
Cumulative Excess Cancer Risk:					**0.0E+00**

Notes:
[a] = From WCH (2012).
[b] = Value obtained from the RDR/RAWP (DOE-RL 2009a) 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:	N. K. Schiffern	Date:	7/31/2012	Calc. No.:	0600X-CA-V0133	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	7/31/2012
Subject:	600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 5 of 12	

Table 2. Relative Percent Difference Calculations for the 600-308 Waste Site.

600-308 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-308 Comp-1	J1PPD8	5/30/2012	8540		1.5	2.5		0.62	75.2		0.071	0.25		0.031	1.9		0.92
Duplicate of J1PPD8	J1PPF0	5/30/2012	8860		1.6	1.9		0.68	85.3		0.078	0.25		0.034	1.7	B	1.0

Analysis:

TDL		5	10	2	0.2	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	3.7%		12.6%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable

600-308 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-308 Comp-1	J1PPD8	5/30/2012	0.12	B	0.038	3330		13.2	11.6		0.054	6.6	X	0.094	11.9		0.20
Duplicate of J1PPD8	J1PPF0	5/30/2012	0.16	B	0.042	3500		14.4	11.1		0.059	6.7	X	0.10	11.8		0.22

Analysis:

TDL		0.2	100	1	2	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		5.0%	4.4%		0.8%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable

600-308 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-308 Comp-1	J1PPD8	5/30/2012	18900		3.6	4.6		0.25	3740		3.5	314		0.094	0.0089	BM	0.0059
Duplicate of J1PPD8	J1PPF0	5/30/2012	19400		3.9	4.4		0.28	3800	.	3.8	317		0.10	0.0071	B	0.0069

Analysis:

TDL		5	5	75	5	0.2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	2.6%		1.6%	1.0%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable

600-308 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	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
600-308 Comp-1	J1PPD8	5/30/2012	11.1		0.12	1740		38.5	636	NXJ	5.3	202		55.4	43.7		0.088
Duplicate of J1PPD8	J1PPF0	5/30/2012	11.4		0.13	1750		42.0	735	XJ	5.8	205		60.4	44.4		0.096

Analysis:

TDL		4	400	2	50	2.5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD			14.4%		1.6%
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable

600-308 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Zinc		
			mg/kg	Q	PQL
600-308 Comp-1	J1PPD8	5/30/2012	40.00	X	0.37
Duplicate of J1PPD8	J1PPF0	5/30/2012	41.50	X	0.41

Analysis:

TDL		1.0
Duplicate Analysis	Both > PQL?	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)
	RPD	3.7%
	Difference > 2 TDL?	Not applicable

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	7/31/2012	Calc. No.:	0600X-CA-V0133	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	7/31/2012
Subject:	600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 6 of 12	

Table 3. Relative Percent Difference Calculations for the 600-309 Waste Site.

600-309 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-309a	J1PPD4	5/30/2012	6550		1.4	1.6	M	0.61	60.5		0.071	0.23		0.031	1.1	B	0.91
Duplicate of J1PPD4	J1PPD6	5/30/2012	6930		1.5	2.2		0.62	64.3		0.071	0.24		0.031	1.1	B	0.92

Analysis:

TDL		5	10	2	0.2	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	5.6%		6.1%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable

600-309 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-309a	J1PPD4	5/30/2012	0.10	B	0.038	5720		13.1	9.2		0.054	5.2		0.093	11.0		0.20
Duplicate of J1PPD4	J1PPD6	5/30/2012	0.091	B	0.038	6540		13.2	9.4		0.054	5.2		0.094	11.6		0.20

Analysis:

TDL		0.2	100	1	2	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		13.4%	2.2%		5.3%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable

600-309 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-309a	J1PPD4	5/30/2012	14400		3.5	5.6		0.25	3880		3.4	236		0.093	0.013	BC	0.0048
Duplicate of J1PPD4	J1PPD6	5/30/2012	15100		3.6	4.9		0.25	4110		3.5	246		0.094	0.012	BC	0.0058

Analysis:

TDL		5	5	75	5	0.2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	4.7%		5.8%	4.1%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable

600-309 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	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
600-309a	J1PPD4	5/30/2012	9.8		0.11	1200		38.1	357	N	5.3	174		54.9	32.4		0.087
Duplicate of J1PPD4	J1PPD6	5/30/2012	9.9		0.12	1270		38.4	387		5.3	181		55.3	33.2		0.088

Analysis:

TDL		4	400	2	50	2.5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD			8.1%		2.4%
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable

600-309 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Zinc			TPH Diesel			TPH Diesel Extended		
			mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
600-309a	J1PPD4	5/30/2012	30.9	X	0.37	17000		620	33000		920
Duplicate of J1PPD4	J1PPD6	5/30/2012	32.3	X	0.37	37000		650	68000		950

Analysis:

TDL		1.0	5000	5000
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD	4.4%		69.3%
	Difference > 2 TDL?	Not applicable	Yes - assess further	Not applicable

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern NS	Date:	7/31/2012	Calc. No.:	0600X-CA-V0133	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie JK	Date:	7/31/2012
Subject:	600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 7 of 12	

Table 4. Relative Percent Difference Calculations for the 600-310 Waste Site.

600-310 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-310-1a	J1PPC9	5/30/2012	8650		1.4	2.3	M	0.60	80.4		0.069	0.20		0.030	2.8		0.89
Duplicate of J1PPC9	J1PPD2	5/30/2012	8930		1.4	2.4		0.61	83.2		0.070	0.20		0.030	2.6		0.90

Analysis:

TDL		5	10	2	0.2	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	3.2%		3.4%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable

600-310 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-310-1a	J1PPC9	5/30/2012	0.12	B	0.037	3790		12.8	19.2		0.053	5.9	X	0.091	14.3		0.20
Duplicate of J1PPC9	J1PPD2	5/30/2012	0.13	B	0.038	3850		12.9	15.8		0.053	6.2	X	0.092	169		0.20

Analysis:

TDL		0.2	100	1	2	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		1.6%	19.4%		*168.8%*
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable

600-310 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-310-1a	J1PPC9	5/30/2012	18100		3.5	6.8		0.25	3960		3.4	283		0.091	0.0090	B	0.0048
Duplicate of J1PPC9	J1PPD2	5/30/2012	18400		3.5	11.6		0.25	4090		3.4	292		0.092	0.011	B	0.0051

Analysis:

TDL		5	5	75	5	0.2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	1.6%		3.2%	3.1%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable

600-310 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Nickel			Potassium			Selenium			Silicon			Sodium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-310-1a	J1PPC9	5/30/2012	10.6		0.11	1660		37.4	0.87	B	0.78	331	XMN	5.2	232		53.8
Duplicate of J1PPC9	J1PPD2	5/30/2012	10.9		0.11	1650		37.6	1.1		0.79	208	X	5.2	232		54.1

Analysis:

TDL		4	400	10	2	50
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)
	RPD				*45.6%*	
	Difference > 2 TDL?	No - acceptable	No - acceptable	No - acceptable	Not applicable	No - acceptable

600-310 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Vanadium			Zinc			TPH Diesel			TPH Diesel Extended		
			mg/kg	Q	PQL	mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
600-310-1a	J1PPC9	5/30/2012	41.4		0.086	41.6	M	0.36	5800		670	11000		990
Duplicate of J1PPC9	J1PPD2	5/30/2012	41.4		0.086	75.1		0.37	6100		660	12000		970

Analysis:

TDL		2.5	1.0	5000	5000
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	0.0%	*57.4%*		
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	No - acceptable

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	7/31/2012	Calc. No.:	0600X-CA-V0133	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	7/31/2012
Subject:	600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 8 of 12	

Table 5. Relative Percent Difference Calculations for the 600-311 Waste Site.

600-311 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-311	J1P8D8	5/17/2012	6880		1.4	2.3		0.60	62.1		0.069	0.22		0.030	1.4	B	0.90
Duplicate of J1P8D8	J1P8D9	5/17/2012	6970		1.5	1.7		0.62	63.7		0.071	0.23		0.031	1.5	B	0.92

Analysis:

TDL		5	10	2	0.2	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	1.3%		2.5%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable

600-311 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-311	J1P8D8	5/17/2012	0.12	B	0.037	3170		12.9	10.2		0.053	5.8	X	0.091	10.8		0.20
Duplicate of J1P8D8	J1P8D9	5/17/2012	0.13	B	0.039	3140		13.2	10.5		0.054	5.6	X	0.094	10.7		0.20

Analysis:

TDL		0.2	100	1	2	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		1.0%	2.9%		0.9%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable

600-311 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese			Nickel		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-311	J1P8D8	5/17/2012	17700		3.5	3.8		0.25	3780		3.4	249		0.091	10.1		0.11
Duplicate of J1P8D8	J1P8D9	5/17/2012	17300		3.6	3.4		0.25	3810		3.5	250		0.094	9.9		0.12

Analysis:

TDL		5	5	75	5	4
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	2.3%		0.8%	0.4%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable

600-311 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Potassium			Silicon			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-311	J1P8D8	5/17/2012	1260		37.5	283		5.2	176		53.9	46.9		0.086	32.5		0.36
Duplicate of J1P8D8	J1P8D9	5/17/2012	1270		38.5	293		5.3	174		55.4	44.4		0.088	32.2		0.37

Analysis:

TDL		400	2	50	2.5	1.0
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD		3.5%		5.5%	0.9%
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable

600-311 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	TPH Diesel			TPH Diesel Extended		
			ug/kg	Q	PQL	ug/kg	Q	PQL
600-311	J1P8D8	5/17/2012	4700		650	8200		960
Duplicate of J1P8D8	J1P8D9	5/17/2012	4100		670	7000		980

Analysis:

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	7/31/2012	Calc. No.:	0600X-CA-V0133	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	7/31/2012
Subject:	600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 9 of 12	

Table 6. Relative Percent Difference Calculations for the 600-312 Waste Site.

600-312 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-312	J1P8D5	5/17/2012	7220	X	1.5	1.7		0.64	62.2		0.073	0.18	B	0.032	1.4	B	0.94
Duplicate of J1P8D5	J1P8D6	5/17/2012	6890	X	1.5	1.5		0.62	61.1		0.071	0.18	B	0.031	1.3	B	0.92

Analysis:

TDL		5	10	2	0.2	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	4.7%		1.8%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable

600-312 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-312	J1P8D5	5/17/2012	0.13	B	0.040	3440		13.6	11.7	X	0.056	5.7	X	0.096	10.4		0.21
Duplicate of J1P8D5	J1P8D6	5/17/2012	0.14	B	0.038	3150		13.2	10.5	X	0.054	5.6	X	0.094	9.8		0.20

Analysis:

TDL		0.2	100	1	2	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		8.8%	10.8%		5.9%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable

600-312 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese			Molybdenum		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-312	J1P8D5	5/17/2012	17800		3.7	3.3		0.26	3750	X	3.6	266	X	0.096	0.26	B	0.25
Duplicate of J1P8D5	J1P8D6	5/17/2012	17100		3.6	3.2		0.25	3620	X	3.5	256	X	0.094	0.25	B	0.24

Analysis:

TDL		5	5	75	5	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	4.0%		3.5%	3.8%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable

600-312 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	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
600-312	J1P8D5	5/17/2012	10.0	X	0.12	1300		39.5	361	X	5.5	192		56.8	44.0	X	0.091
Duplicate of J1P8D5	J1P8D6	5/17/2012	10.2	X	0.12	1270		38.5	367	X	5.3	175		55.3	42.4	X	0.088

Analysis:

TDL		4	400	2	50	2.5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD			1.6%		3.7%
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable

600-312 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Zinc			TPH Diesel			TPH Diesel Extended		
			mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
600-312	J1P8D5	5/17/2012	34.3	X	0.38	1800	J	670	3900	J	990
Duplicate of J1P8D5	J1P8D6	5/17/2012	32.9	X	0.37	1800	J	640	3200	J	950

Analysis:

TDL		1.0	5000	5000
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	4.2%		
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	7/31/2012	Calc. No.:	0600X-CA-V0133	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	7/31/2012
Subject:	600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No.	10 of 12

Table 7. Relative Percent Difference Calculations for the 600-317 Waste Site.

600-317 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-317a	J1PP95	5/30/2012	6730		1.5	2.2		0.63	87.5		0.072	0.18	B	0.031	0.14	B	0.039
Duplicate of J1PP95	J1PPF4	5/30/2012	6770		1.4	2.2		0.59	96.4		0.068	0.17	B	0.030	0.13	B	0.037

Analysis:

TDL		5	10	2	0.2	0.2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	0.6%		9.7%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable

600-317 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	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
600-317a	J1PP95	5/30/2012	6800		13.4	13.6		0.055	5.2	X	0.095	13.7		0.21	14100		3.6
Duplicate of J1PP95	J1PPF4	5/30/2012	6500		12.6	13.8		0.052	5.4	X	0.090	14.1		0.19	14700		3.4

Analysis:

TDL		100	1	2	1	5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD	4.5%	1.5%		2.9%	4.2%
	Difference > 2 TDL?	Not applicable	Not applicable	No - acceptable	Not applicable	Not applicable

600-317 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Lead			Magnesium			Manganese			Mercury			Nickel		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-317a	J1PP95	5/30/2012	6.9		0.26	4400		3.5	236		0.095	0.011	BC	0.0055	13.0		0.12
Duplicate of J1PP95	J1PPF4	5/30/2012	6.2		0.24	4540		3.3	245		0.090	0.011	BC	0.0050	13.5		0.11

Analysis:

TDL		5	75	5	0.2	4
Duplicate Analysis	Both > PQL?	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)
	RPD		3.1%	3.7%		
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	No - acceptable

600-317 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Potassium			Silicon			Sodium			Vanadium			Zinc		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-317a	J1PP95	5/30/2012	971		38.8	359	N	5.4	196		55.9	34.6		0.089	75.5		0.38
Duplicate of J1PP95	J1PPF4	5/30/2012	907		36.8	343		5.1	206		52.9	36.8		0.084	72.4		0.36

Analysis:

TDL		400	2	50	2.5	1.0
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)
	RPD		4.6%		6.2%	4.2%
	Difference > 2 TDL?	No - acceptable	Not applicable	No - acceptable	Not applicable	Not applicable

600-317 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	TPH Diesel			TPH Diesel Extended		
			ug/kg	Q	PQL	ug/kg	Q	PQL
600-317a	J1PP95	5/30/2012	2600	J	630	3700		930
Duplicate of J1PP95	J1PPF4	5/30/2012	1800	J	670	2800	J	990

Analysis:

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	7/31/2012	Calc. No.:	0600X-CA-V0133	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	7/31/2012
Subject:	600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 11 of 12	

Table 8. Relative Percent Difference Calculations for the 600-319 Waste Site.

600-319 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Aluminum			Arsenic			Barium			Beryllium			Boron		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-319:1	J1PP90	5/30/2012	8510	X	1.4	3.1		0.61	75.4	X	0.070	0.24	B	0.15	1.7	B	0.90
Duplicate of J1PP90	J1PP91	5/30/2012	8140	X	1.3	2.4		0.56	76.5	X	0.064	0.25	B	0.14	1.4	B	0.83

Analysis:

TDL		5	10	2	0.2	2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	4.4%		1.4%		
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	No - acceptable	No - acceptable

600-319 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Cadmium			Calcium			Chromium			Cobalt			Copper		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-319:1	J1PP90	5/30/2012	0.12	B	0.038	3950	X	12.9	9.7	X	0.053	9.3		0.46	41.9	M	1.0
Duplicate of J1PP90	J1PP91	5/30/2012	0.11	B	0.035	3850	X	12.0	9.2	X	0.049	9.3		0.42	32.3		0.92

Analysis:

TDL		0.2	100	1	2	1
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD		2.6%	5.3%		25.9%
	Difference > 2 TDL?	No - acceptable	Not applicable	Not applicable	No - acceptable	Not applicable

600-319 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Iron			Lead			Magnesium			Manganese			Mercury		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-319:1	J1PP90	5/30/2012	25900	X	3.5	14.7		1.2	4750		17.0	389	X	0.092	0.015	BCM	0.0052
Duplicate of J1PP90	J1PP91	5/30/2012	24200	X	3.2	11.9		1.1	4880		15.7	371	X	0.085	0.011	BC	0.0054

Analysis:

TDL		5	5	75	5	0.2
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)	Yes (calc RPD)	No-Stop (acceptable)
	RPD	6.8%		2.7%	4.7%	
	Difference > 2 TDL?	Not applicable	No - acceptable	Not applicable	Not applicable	No - acceptable

600-319 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	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
600-319:1	J1PP90	5/30/2012	10.4	X	0.11	1700		37.6	283	XN	5.2	223		54.1	69.1		0.43
Duplicate of J1PP90	J1PP91	5/30/2012	9.7	X	0.10	1590		34.8	191	X	4.8	199		50.1	68.7		0.40

Analysis:

TDL		4	400	2	50	2.5
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	No-Stop (acceptable)	No-Stop (acceptable)	Yes (calc RPD)	No-Stop (acceptable)	Yes (calc RPD)
	RPD			38.8%		0.6%
	Difference > 2 TDL?	No - acceptable	No - acceptable	Not applicable	No - acceptable	Not applicable

600-319 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	Zinc			TPH Diesel			TPH Diesel Extended		
			mg/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
600-319:1	J1PP90	5/30/2012	55.2	X	0.37	2000	J	680	3500	J	1000
Duplicate of J1PP90	J1PP91	5/30/2012	49.4	X	0.34	2600	J	660	5600		970

Analysis:

TDL		1.0	5000	5000
Duplicate Analysis	Both > PQL?	Yes (continue)	Yes (continue)	Yes (continue)
	Both >5xTDL?	Yes (calc RPD)	No-Stop (acceptable)	No-Stop (acceptable)
	RPD	11.1%		
	Difference > 2 TDL?	Not applicable	No - acceptable	No - acceptable

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	7/31/2012	Calc. No.:	0600X-CA-V0133	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	J. D. Skoglie	Date:	7/31/2012
Subject:	600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites RPD and Direct Contact Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 12 of 12	

Table 9. Relative Percent Difference Calculations for the 600-324 Waste Site.

600-324 Waste Site Duplicate Analysis

Sampling Area	HEIS Number	Sample Date	TPH Diesel			TPH Diesel Extended		
			ug/kg	Q	PQL	ug/kg	Q	PQL
600-324	J1P1L5	5/1/2012	9400		690	22000		1000
Duplicate of J1P1L5	J1P1L6	5/1/2012	8300		640	15000		940

Analysis:

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

CONCLUSION:

The calculations in Tables 1, 2, 3, 4, 5, 6, 7, 8, and 9 demonstrate that the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites meet the requirements for the hazard quotients and carcinogenic (excess cancer) risk and RPDs, respectively, as identified in the RDR/RAWP (DOE-RL 2009a) and SAP (DOE-RL 2009b). The hazard quotients and carcinogenic (excess cancer) risk and RPD calculations are for use in the RSVP for this site.

Attachment 1. 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites Verification 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
600-308 Comp-1	J1PPD8	5/30/2012	8540		1.5	0.36	BJ	0.36	2.5		0.62	75.2		0.071	0.25		0.031	1.9		0.92
Duplicate of J1PPD8	J1PPF0	5/30/2012	8860		1.6	0.39	UJ	0.39	1.9		0.68	85.3		0.078	0.25		0.034	1.7	B	1.0
600-308 Comp-2	J1PPD9	5/30/2012	7750		1.5	0.37	UJ	0.37	1.8		0.64	69.2		0.074	0.21		0.032	1.5	B	0.95
600-309a	J1PPD4	5/30/2012	6550		1.4	0.35	U	0.35	1.6	M	0.61	60.5		0.071	0.23		0.031	1.1	B	0.91
Duplicate of J1PPD4	J1PPD6	5/30/2012	6930		1.5	0.36	U	0.36	2.2		0.62	64.3		0.071	0.24		0.031	1.1	B	0.92
600-309b	J1PPD5	5/30/2012	7320		1.5	0.36	U	0.36	1.9		0.63	65.6		0.073	0.25		0.032	1.3	B	0.94
600-310-1a	J1PPC9	5/30/2012	8650		1.4	0.35	U	0.35	2.3	M	0.60	80.4		0.069	0.20		0.030	2.8		0.89
Duplicate of J1PPC9	J1PPD2	5/30/2012	8930		1.4	0.35	U	0.35	2.4		0.61	83.2		0.070	0.20		0.030	2.6		0.90
600-310-1b	J1PPD0	5/30/2012	8240		1.4	0.35	U	0.35	2.3		0.61	74.5		0.070	0.19		0.030	2.5		0.90
600-310-1c	J1PPD1	5/30/2012	7640		1.3	0.33	U	0.33	2.7		0.57	68.1		0.065	0.20		0.028	1.8		0.84
600-311	J1P8D8	5/17/2012	6880		1.4	0.35	U	0.35	2.3		0.60	62.1		0.069	0.22		0.030	1.4	B	0.90
Duplicate of J1P8D8	J1P8D9	5/17/2012	6970		1.5	0.36	U	0.36	1.7		0.62	63.7		0.071	0.23		0.031	1.5	B	0.92
600-312	J1P8D5	5/17/2012	7220	X	1.5	0.64		0.37	1.7		0.64	62.2		0.073	0.18	B	0.032	1.4	B	0.94
Duplicate of J1P8D5	J1P8D6	5/17/2012	6890	X	1.5	0.36	U	0.36	1.5		0.62	61.1		0.071	0.18	B	0.031	1.3	B	0.92
600-317a	J1PP95	5/30/2012	6730		1.5	0.49	BJ	0.36	2.2		0.63	87.5		0.072	0.18	B	0.031	1.2	B	0.93
Duplicate of J1PP95	J1PPF4	5/30/2012	6770		1.4	0.34	UJ	0.34	2.2		0.59	96.4		0.068	0.17	B	0.030	0.88	U	0.88
600-317b	J1PP96	5/30/2012	6710		1.5	0.50	BJ	0.36	2.0		0.62	65.1		0.072	0.16	B	0.031	1.3	B	0.92
600-319:1	J1PP90	5/30/2012	8510	X	1.4	0.35	U	0.35	3.1		0.61	75.4	X	0.070	0.24	B	0.15	1.7	B	0.90
Duplicate of J1PP90	J1PP91	5/30/2012	8140	X	1.3	0.32	U	0.32	2.4		0.56	76.5	X	0.064	0.25	B	0.14	1.4	B	0.83
600-319:2	J1P295	5/15/2012	8150	X	1.3	0.32	U	0.32	4.2		0.56	77.2	X	0.064	0.39		0.028	1.1	B	0.83
600-319:3	J1MXJ5	12/6/2011	9960	X	1.4	1.1		0.35	3.2		0.61	97.7		0.070	0.031	U	0.031	2.1		0.91
Equipment Blank 1	J1PPF1	5/30/2012	202		1.3	0.32	UJ	0.32	0.56	U	0.56	2.0		0.065	0.028	U	0.028	0.84	U	0.84
Equipment Blank 2	J1PPD7	5/30/2012	175		1.4	0.35	U	0.35	0.60	U	0.60	2.0		0.069	0.030	U	0.030	0.89	U	0.89
Equipment Blank 3	J1PPD3	5/30/2012	179		1.4	0.35	U	0.35	0.61	U	0.61	1.8		0.070	0.030	U	0.030	0.90	U	0.90
Equipment Blank 4	J1P8F0	5/17/2012	237		1.3	0.32	U	0.32	0.66	B	0.56	2.3		0.065	0.035	B	0.028	0.84	U	0.84
Equipment Blank 5	J1P8D7	5/17/2012	182	X	1.4	0.35	U	0.35	0.61	U	0.61	1.9		0.070	0.031	U	0.031	0.91	U	0.91
Equipment Blank 6	J1PPK4	5/30/2012	196	NJ	1.4	0.34	U	0.34	0.59	U	0.59	2.0		0.068	0.029	B	0.029	0.88	U	0.88
Equipment Blank 7	J1PPF5	5/30/2012	203		1.4	0.35	UJ	0.35	0.60	U	0.60	2.2		0.069	0.030	U	0.030	0.89	U	0.89
Equipment Blank 8	J1PP92	5/30/2012	176	X	1.6	0.38	U	0.38	0.66	U	0.66	1.9	X	0.076	0.033	U	0.033	0.98	U	0.98

Attachment	1	Sheet No.	1 of 9
Originator	N. K. Schiffern	Date	7/31/12
Checked	J. D. Skoglie	Date	7/31/12
Calc. No.	0600X-CA-V0133	Rev. No.	0

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

Gray cells indicate not applicable.

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

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

C = detected in bith the sample abd the QC blank, and the sample concentration was <= 5X the blank concentration.

HEIS=Hanford Environmental Information System

J = estimated

M = sample duplicate precision not met.

MDA = minimum detectable activity

N = recovery exceeds upper or lower control limits.

ND (asbestos) = nondetect

PCB = polychlorinated biphenyls

PQL = practical quantitation limit

Q = qualifier

R = rejected.

SVOA = semivolatile organic analysis

U = analyzed for and not detected.

UJ = analyzed for and not detected, and due to a minor QC deficiency, the associated quantification limit is an estimate.

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

X (SVOAs) = recovery exceeds upper or lower control limits.

Attachment 1. 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites Verification Sample Results - Metals.

Sample Location	HEIS Number	Sample Date	Cadmium			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
600-308 Comp-1	J1PPD8	5/30/2012	0.12	B	0.038	3330		13.2	11.6		0.054	6.6	X	0.094	11.9		0.20	18900		3.6
Duplicate of J1PPD8	J1PPF0	5/30/2012	0.16	B	0.042	3500		14.4	11.1		0.059	6.7	X	0.10	11.8		0.22	19400		3.9
600-308 Comp-2	J1PPD9	5/30/2012	0.13	B	0.040	3420		13.7	9.9		0.056	6.1	X	0.097	10.7		0.21	17900		3.7
600-309a	J1PPD4	5/30/2012	0.10	B	0.038	5720		13.1	9.2		0.054	5.2		0.093	11.0		0.20	14400		3.5
Duplicate of J1PPD4	J1PPD6	5/30/2012	0.091	B	0.038	6540		13.2	9.4		0.054	5.2		0.094	11.6		0.20	15100		3.6
600-309b	J1PPD5	5/30/2012	0.10	B	0.039	4150		13.5	9.2		0.056	5.3		0.096	11.9		0.21	15200		3.6
600-310-1a	J1PPC9	5/30/2012	0.12	B	0.037	3790		12.8	19.2		0.053	5.9	X	0.091	14.3		0.20	18100		3.5
Duplicate of J1PPC9	J1PPD2	5/30/2012	0.13	B	0.038	3850		12.9	15.8		0.053	6.2	X	0.092	169		0.20	18400		3.5
600-310-1b	J1PPD0	5/30/2012	0.12	B	0.038	3910		12.9	17.1		0.053	5.9	X	0.092	13.9		0.20	17700		3.5
600-310-1c	J1PPD1	5/30/2012	0.12	B	0.035	4920		12.1	14.2		0.050	5.5	X	0.086	14.5		0.19	16300		3.3
600-311	J1P8D8	5/17/2012	0.12	B	0.037	3170		12.9	10.2		0.053	5.8	X	0.091	10.8		0.20	17700		3.5
Duplicate of J1P8D8	J1P8D9	5/17/2012	0.13	B	0.039	3140		13.2	10.5		0.054	5.6	X	0.094	10.7		0.20	17300		3.6
600-312	J1P8D5	5/17/2012	0.13	B	0.040	3440		13.6	11.7	X	0.056	5.7	X	0.096	10.4		0.21	17800		3.7
Duplicate of J1P8D5	J1P8D6	5/17/2012	0.14	B	0.038	3150		13.2	10.5	X	0.054	5.6	X	0.094	9.8		0.20	17100		3.6
600-317a	J1PP95	5/30/2012	0.14	B	0.039	6800		13.4	13.6		0.055	5.2	X	0.095	13.7		0.21	14100		3.6
Duplicate of J1PP95	J1PPF4	5/30/2012	0.13	B	0.037	6500		12.6	13.8		0.052	5.4	X	0.090	14.1		0.19	14700		3.4
600-317b	J1PP96	5/30/2012	0.15	B	0.039	5200		13.3	11.3		0.055	6.2	X	0.094	14.0		0.20	17100		3.6
600-319:1	J1PP90	5/30/2012	0.12	B	0.038	3950	X	12.9	9.7	X	0.053	9.3		0.46	41.9	M	1.0	25900	X	3.5
Duplicate of J1PP90	J1PP91	5/30/2012	0.11	B	0.035	3850	X	12.0	9.2	X	0.049	9.3		0.42	32.3		0.92	24200	X	3.2
600-319:2	J1P295	5/15/2012	0.067	B	0.035	3540	X	11.9	9.8	X	0.049	7.3	X	0.085	14.2		0.18	22900	X	3.2
600-319:3	J1MXJ5	12/6/2011	0.088	B	0.038	3560	X	13.0	12.4	X	0.054	7.5	X	0.092	13.6		0.20	21000	X	3.5
Equipment Blank 1	J1PPF1	5/30/2012	0.035	U	0.035	49.5		12.1	0.15	B	0.050	0.085	UX	0.085	0.23	B	0.19	206		3.2
Equipment Blank 2	J1PPD7	5/30/2012	0.037	U	0.037	49.9		12.8	0.11	B	0.053	0.091	U	0.091	0.20	U	0.20	186		3.5
Equipment Blank 3	J1PPD3	5/30/2012	0.038	U	0.038	56.7	C	12.9	0.12	B	0.053	0.092	UX	0.092	0.34	BC	0.20	220		3.5
Equipment Blank 4	J1P8F0	5/17/2012	0.035	U	0.035	49.1		12.1	0.21		0.050	0.11	BX	0.085	0.19	U	0.19	245		3.2
Equipment Blank 5	J1P8D7	5/17/2012	0.038	U	0.038	39.1	B	13.1	0.11	BX	0.054	0.095	BX	0.093	0.20	U	0.20	220		3.5
Equipment Blank 6	J1PPK4	5/30/2012	0.037	U	0.037	57.0		12.6	0.17	B	0.052	0.089	U	0.089	0.19	U	0.19	189		3.4
Equipment Blank 7	J1PPF5	5/30/2012	0.037	U	0.037	54.7		12.8	0.17	B	0.053	0.17	BX	0.091	0.26	B	0.20	213		3.5
Equipment Blank 8	J1PP92	5/30/2012	0.041	U	0.041	60.6	CX	14.1	0.15	BX	0.058	0.10	U	0.10	0.74	BC	0.22	198	X	3.8

Attachment	1	Sheet No.	2 of 9
Originator	N. K. Schiffern	Date	7/31/12
Checked	J. D. Skoglie	Date	7/31/12
Calc. No.	0600X-CA-V0133	Rev. No.	0

Attachment 1. 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites Verification Sample Results - Metals.

Sample Location	HEIS Number	Sample Date	Lead			Magnesium			Manganese			Mercury			Molybdenum			Nickel		
			mg/Kg	Q	PQL	mg/Kg	Q	PQL	mg/Kg	Q	PQL	mg/Kg	Q	PQL	mg/Kg	Q	PQL	mg/Kg	Q	PQL
600-308 Comp-1	J1PPD8	5/30/2012	4.6		0.25	3740		3.5	314		0.094	0.0089	BM	0.0059	0.24	U	0.24	11.1		0.12
Duplicate of J1PPD8	J1PPF0	5/30/2012	4.4		0.28	3800		3.8	317		0.10	0.0071	B	0.0069	0.27	U	0.27	11.4		0.13
600-308 Comp-2	J1PPD9	5/30/2012	4.1		0.26	3560		3.6	295		0.097	0.0058	U	0.0058	0.27	B	0.25	10		0.12
600-309a	J1PPD4	5/30/2012	5.6		0.25	3880		3.4	236		0.093	0.013	BC	0.0048	0.24	U	0.24	9.8		0.11
Duplicate of J1PPD4	J1PPD6	5/30/2012	4.9		0.25	4110		3.5	246		0.094	0.012	BC	0.0058	0.24	U	0.24	9.9		0.12
600-309b	J1PPD5	5/30/2012	5.4		0.26	3730		3.6	257		0.096	0.014	BC	0.0066	0.25	U	0.25	15.6		0.12
600-310-1a	J1PPC9	5/30/2012	6.8		0.25	3960		3.4	283		0.091	0.0090	B	0.0048	0.24	U	0.24	10.6		0.11
Duplicate of J1PPC9	J1PPD2	5/30/2012	11.6		0.25	4090		3.4	292		0.092	0.011	B	0.0051	0.24	U	0.24	10.9		0.11
600-310-1b	J1PPD0	5/30/2012	6.8		0.25	3810		3.4	274		0.092	0.012	B	0.0055	0.24	U	0.24	10.3		0.11
600-310-1c	J1PPD1	5/30/2012	9.4		0.23	3990		3.2	276		0.086	0.011	B	0.0054	0.22	U	0.22	11.7		0.11
600-311	J1P8D8	5/17/2012	3.8		0.25	3780		3.4	249		0.091	0.0057	U	0.0057	0.24	U	0.24	10.1		0.11
Duplicate of J1P8D8	J1P8D9	5/17/2012	3.4		0.25	3810		3.5	250		0.094	0.0061	U	0.0061	0.24	U	0.24	9.9		0.12
600-312	J1P8D5	5/17/2012	3.3		0.26	3750	X	3.6	266	X	0.096	0.0058	U	0.0058	0.26	B	0.25	10	X	0.12
Duplicate of J1P8D5	J1P8D6	5/17/2012	3.2		0.25	3620	X	3.5	256	X	0.094	0.0060	U	0.0060	0.25	B	0.24	10.2	X	0.12
600-317a	J1PP95	5/30/2012	6.9		0.26	4400		3.5	236		0.095	0.011	BCUJ	0.0055	0.25	U	0.25	13.0		0.12
Duplicate of J1PP95	J1PPF4	5/30/2012	6.2		0.24	4540		3.3	245		0.090	0.011	BCUJ	0.0050	0.23	U	0.23	13.5		0.11
600-317b	J1PP96	5/30/2012	15.0		0.25	4420		3.5	275		0.094	0.011	BCUJ	0.0047	0.25	U	0.25	11.5		0.12
600-319:1	J1PP90	5/30/2012	14.7		1.2	4750		17.0	389	X	0.092	0.015	BCM	0.0052	0.24	U	0.24	10.4	X	0.11
Duplicate of J1PP90	J1PP91	5/30/2012	11.9		1.1	4880		15.7	371	X	0.085	0.011	BC	0.0054	0.22	U	0.22	9.7	X	0.10
600-319:2	J1P295	5/15/2012	8.1		0.23	4030	X	3.1	364	X	0.085	0.0064	U	0.0064	0.22	U	0.22	9.4	X	0.10
600-319:3	J1MXJ5	12/6/2011	6.8		0.25	4450		3.4	360	X	0.092	0.0056	U	0.0056	0.24	U	0.24	11.5	X	0.11
Equipment Blank 1	J1PPF1	5/30/2012	0.23	U	0.23	29.8		3.2	3.7		0.085	0.0061	U	0.0061	0.22	U	0.22	0.19	B	0.11
Equipment Blank 2	J1PPD7	5/30/2012	0.25	U	0.25	28.5		3.4	3.6		0.091	0.0057	BC	0.0050	0.24	U	0.24	0.17	B	0.11
Equipment Blank 3	J1PPD3	5/30/2012	0.25	U	0.25	29.5		3.4	4.3		0.092	0.0058	U	0.0058	0.24	U	0.24	0.20	BC	0.11
Equipment Blank 4	J1P8F0	5/17/2012	0.29	B	0.23	33.7		3.2	5.2		0.085	0.0061	U	0.0061	0.22	U	0.22	0.14	B	0.11
Equipment Blank 5	J1P8D7	5/17/2012	0.50		0.25	22.1	X	3.4	5.2	X	0.093	0.0055	U	0.0055	0.24	U	0.24	0.11	UX	0.11
Equipment Blank 6	J1PPK4	5/30/2012	0.37	B	0.24	29.9		3.3	3.8		0.089	0.0058	BCMNUJ	0.0053	0.23	U	0.23	0.21	B	0.11
Equipment Blank 7	J1PPF5	5/30/2012	0.46		0.25	29.7		3.4	9.0		0.091	0.0076	BCUJ	0.0065	0.24	U	0.24	0.24	BCUJ	0.11
Equipment Blank 8	J1PP92	5/30/2012	0.34	B	0.27	29.8		3.7	4.0	X	0.10	0.0062	BC	0.0052	0.26	U	0.26	0.22	BXC	0.12

Attachment	1	Sheet No.	3 of 9
Originator	N. K. Schiffern	Date	7/31/12
Checked	J. D. Skoglie	Date	7/31/12
Calc. No.	0600X-CA-V0133	Rev. No.	0

Attachment 1. 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites Verification Sample Results - Metals.

Sample Location	HEIS Number	Sample Date	Potassium			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	mg/Kg	Q	PQL
600-308 Comp-1	J1PPD8	5/30/2012	1740		38.5	0.81	U	0.81	636	NXJ	5.3	0.15	U	0.15	202		55.4	43.7		0.088
Duplicate of J1PPD8	J1PPF0	5/30/2012	1750		42.0	0.88	U	0.88	735	XJ	5.8	0.16	U	0.16	205		60.4	44.4		0.096
600-308 Comp-2	J1PPD9	5/30/2012	1490		39.9	0.84	U	0.84	348	XJ	5.5	0.16	U	0.16	191		57.5	44.4		0.092
600-309a	J1PPD4	5/30/2012	1200		38.1	0.80	U	0.80	357	N	5.3	0.15	U	0.15	174		54.9	32.4		0.087
Duplicate of J1PPD4	J1PPD6	5/30/2012	1270		38.4	0.81	U	0.81	387		5.3	0.15	U	0.15	181		55.3	33.2		0.088
600-309b	J1PPD5	5/30/2012	1450		39.4	0.83	U	0.83	379		5.4	0.15	U	0.15	180		56.6	33.2		0.090
600-310-1a	J1PPC9	5/30/2012	1660		37.4	0.87	B	0.78	331	XM	5.2	0.15	U	0.15	232		53.8	41.4		0.086
Duplicate of J1PPC9	J1PPD2	5/30/2012	1650		37.6	1.1		0.79	208	X	5.2	0.15	U	0.15	232		54.1	41.4		0.086
600-310-1b	J1PPD0	5/30/2012	1490		37.6	1.4		0.79	189	X	5.2	0.15	U	0.15	223		54.1	40.2		0.086
600-310-1c	J1PPD1	5/30/2012	1310		35.3	1.0		0.74	202	X	4.9	0.14	U	0.14	189		50.8	35.5		0.081
600-311	J1P8D8	5/17/2012	1260		37.5	0.79	U	0.79	283		5.2	0.15	U	0.15	176		53.9	46.9		0.086
Duplicate of J1P8D8	J1P8D9	5/17/2012	1270		38.5	0.81	U	0.81	293		5.3	0.15	U	0.15	174		55.4	44.4		0.088
600-312	J1P8D5	5/17/2012	1300		39.5	0.83	U	0.83	361	X	5.5	0.15	U	0.15	192		56.8	44.0	X	0.091
Duplicate of J1P8D5	J1P8D6	5/17/2012	1270		38.5	0.81	U	0.81	367	X	5.3	0.15	U	0.15	175		55.3	42.4	X	0.088
600-317a	J1PP95	5/30/2012	971		38.8	0.81	U	0.81	359	NJ	5.4	0.15	U	0.15	196		55.9	34.6		0.089
Duplicate of J1PP95	J1PPF4	5/30/2012	907		36.8	0.77	U	0.77	343	J	5.1	0.14	U	0.14	206		52.9	36.8		0.084
600-317b	J1PP96	5/30/2012	999		38.7	0.81	U	0.81	331	J	5.3	0.15	U	0.15	214		55.6	43.9		0.089
600-319:1	J1PP90	5/30/2012	1700		37.6	0.85	B	0.79	283	XN	5.2	0.15	U	0.15	223		54.1	69.1		0.43
Duplicate of J1PP90	J1PP91	5/30/2012	1590		34.8	0.73	U	0.73	191	X	4.8	0.14	U	0.14	199		50.1	68.7		0.40
600-319:2	J1P295	5/15/2012	1780	X	34.7	0.73	U	0.73	352	XN	4.8	0.14	U	0.14	188		50.0	58.6	X	0.080
600-319:3	J1MXJ5	12/6/2011	2660		37.9	0.80	U	0.80	596	XN	5.2	0.15	U	0.15	216		54.6	45.8		0.087
Equipment Blank 1	J1PPF1	5/30/2012	42.3	B	35.0	0.74	U	0.74	115	XJ	4.8	0.14	U	0.14	50.4	U	50.4	0.30	B	0.080
Equipment Blank 2	J1PPD7	5/30/2012	43.9	B	37.3	0.78	U	0.78	112		5.1	0.15	U	0.15	53.6	U	53.6	0.26	B	0.085
Equipment Blank 3	J1PPD3	5/30/2012	37.8	B	37.6	0.79	U	0.79	105	X	5.2	0.15	U	0.15	54.2	U	54.2	0.27	B	0.086
Equipment Blank 4	J1P8F0	5/17/2012	65.3	B	35.0	0.74	U	0.74	141		4.8	0.14	U	0.14	50.4	U	50.4	0.33	B	0.080
Equipment Blank 5	J1P8D7	5/17/2012	38.0	U	38.0	0.80	U	0.80	137	X	5.2	0.15	U	0.15	54.6	U	54.6	0.18	BX	0.087
Equipment Blank 6	J1PPK4	5/30/2012	42.5	B	36.6	0.77	U	0.77	114	J	5.1	0.14	U	0.14	52.7	U	52.7	0.31	B	0.084
Equipment Blank 7	J1PPF5	5/30/2012	45.9	B	37.3	0.78	U	0.78	137	J	5.1	0.15	U	0.15	53.7	U	53.7	0.28	B	0.086
Equipment Blank 8	J1PP92	5/30/2012	41.0	U	41.0	0.86	U	0.86	106	X	5.7	0.16	U	0.16	59.0	U	59.0	0.33	B	0.094

Attachment	1	Sheet No.	4 of 9
Originator	N. K. Schiffern	Date	7/31/12
Checked	J. D. Skoglie	Date	7/31/12
Calc. No.	0600X-CA-V0133	Rev. No.	0

Attachment 1. 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites Verification Sample Results - Metals, Physical, and TPHs.

Sample Location	HEIS Number	Sample Date	Zinc			Percent moisture (wet sample)			pH Measurement			TPH Diesel			TPH Diesel Extended		
			mg/Kg	Q	PQL	%	Q	PQL	pH	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
600-308 Comp-1	J1PPD8	5/30/2012	40.0	X	0.37	3.1		0.10									
Duplicate of J1PPD8	J1PPF0	5/30/2012	41.5	X	0.41	2.4		0.10									
600-308 Comp-2	J1PPD9	5/30/2012	36.8	X	0.39	2.2		0.10									
600-309a	J1PPD4	5/30/2012	30.9	X	0.37	1.4		0.10				17000		620	33000		920
Duplicate of J1PPD4	J1PPD6	5/30/2012	32.3	X	0.37	1.2		0.10				37000		650	68000		950
600-309b	J1PPD5	5/30/2012	33.0	X	0.38	0.80		0.10				4100		660	9400		970
600-310-1a	J1PPC9	5/30/2012	41.6	M	0.36	1.1		0.10				5800		670	11000		990
Duplicate of J1PPC9	J1PPD2	5/30/2012	75.1		0.37	0.89		0.10				6100		660	12000		970
600-310-1b	J1PPD0	5/30/2012	41.8		0.36	0.85		0.10				5200		640	8500		930
600-310-1c	J1PPD1	5/30/2012	39.9		0.34	0.69		0.10				15000		680	30000		1000
600-311	J1P8D8	5/17/2012	32.5		0.36	1.5		0.10				4700		650	8200		960
Duplicate of J1P8D8	J1P8D9	5/17/2012	32.2		0.37	1.4		0.10				4100		670	7000		980
600-312	J1P8D5	5/17/2012	34.3	X	0.38	1.1		0.10				1800	J	670	3900	J	990
Duplicate of J1P8D5	J1P8D6	5/17/2012	32.9	X	0.37	1.3		0.10				1800	J	640	3200	J	950
600-313	J1PPK2	5/30/2012				0.71		0.10									
Duplicate of J1PPK2	J1PPK3	5/30/2012				0.85		0.10									
600-317a	J1PP95	5/30/2012	75.5		0.38	0.43		0.10	9.04	J	0.100	2600	J	630	3700		930
Duplicate of J1PP95	J1PPF4	5/30/2012	72.4		0.36	0.45		0.10	9.01	J	0.100	1800	J	670	2800	J	990
600-317b	J1PP96	5/30/2012	132		0.38	0.88		0.10	9.02	J	0.100	2000	J	670	4800		990
600-319:1	J1PP90	5/30/2012	55.2	X	0.37	0.92		0.10				2000	J	680	3500	J	1000
Duplicate of J1PP90	J1PP91	5/30/2012	49.4	X	0.34	0.96		0.10				2600	J	660	5600		970
600-319:2	J1P295	5/15/2012	42.6	X	0.34	0.76		0.10				3900	J	670	8500		990
600-319:3	J1MXJ5	12/6/2011	44.7	X	0.37	1.7		0.10				870	J	650	2800	J	960
600-324	J1P1L5	5/1/2012				1.3		0.10				9400		690	22000		1000
Duplicate of J1P1L5	J1P1L6	5/1/2012				1.4		0.10				8300		640	15000		940
Equipment Blank 1	J1PPF1	5/30/2012	1.2	XCUJ	0.34	0.10	U	0.10									
Equipment Blank 2	J1PPD7	5/30/2012	1.1	CX	0.36	0.10	U	0.10									
Equipment Blank 3	J1PPD3	5/30/2012	1.1	C	0.37	0.10	U	0.10									
Equipment Blank 4	J1P8F0	5/17/2012	1.0		0.34	0.10	U	0.10									
Equipment Blank 5	J1P8D7	5/17/2012	0.71	BX	0.37	0.10	U	0.10									
Equipment Blank 6	J1PPK4	5/30/2012	1.2	CUJ	0.36	0.10	U	0.10									
Equipment Blank 7	J1PPF5	5/30/2012	1.3	CUJ	0.36	0.10	U	0.10									
Equipment Blank 8	J1PP92	5/30/2012	1.1	XC	0.40	0.10	U	0.10									
Equipment Blank 9	J1P1L7	5/1/2012				0.10	U	0.10				7200		620	8200		920

Attachment	1	Sheet No.	5 of 9
Originator	N. K. Schiffern	Date	7/31/12
Checked	J. D. Skoglie	Date	7/31/12
Calc. No.	0600X-CA-V0133	Rev. No.	0

Attachment 1. 600-305, 300-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites Verification Sample Results - Anions.

Sample Location	HEIS Number	Sample Date	Bromide			Chloride			Fluoride			Nitrogen in Nitrate			Nitrogen in Nitrite		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-317a	J1PP95	5/30/2012	0.39	U	0.39	2.0	B	2.0	1.1	B	0.82	0.71	BJ	0.31	0.33	UR	0.33
Duplicate of J1PP95	J1PPF4	5/30/2012	0.39	U	0.39	2.0	B	2.0	1.1	B	0.82	0.72	BJ	0.31	0.33	UR	0.33
600-317b	J1PP96	5/30/2012	0.38	U	0.38	3.1	B	1.9	0.96	B	0.81	1.6	BJ	0.31	0.33	UR	0.33

Sample Location	HEIS Number	Sample Date	Nitrogen in Nitrite and Nitrate			Phosphorous in phosphate			Sulfate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
600-317a	J1PP95	5/30/2012	0.30	U	0.30	1.3	BCUR	1.2	5.6		1.7
Duplicate of J1PP95	J1PPF4	5/30/2012	0.29	U	0.29	1.2	BCUR	1.2	6.5		1.7
600-317b	J1PP96	5/30/2012	1.2		0.30	1.4	BCUR	1.2	4.3	B	1.7

Attachment	1	Sheet No.	6 of 9
Originator	N. K. Schiffern	Date	7/31/12
Checked	J. D. Skoglie	Date	7/31/12
Calc. No.	0600X-CA-V0133	Rev. No.	0

Attachment 1. 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites Verification Sample Results - Organics.

Constituents	CLASS	J1PP95, 600-317a			J1PPF4, Duplicate of J1PP95			J1PP96, 600-317b			J1PP90, 600-319:1			J1PP91, Duplicate of J1PP90		
		5/30/2012			5/30/2012			5/30/2012			5/30/2012			5/30/2012		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	9.8	U	9.8	9.8	U	9.8	9.9	U	9.9	10	U	10	9.8	U	9.8
Acenaphthylene	PAH	8.8	U	8.8	8.8	U	8.8	8.9	U	8.9	9.0	U	9.0	8.8	U	8.8
Anthracene	PAH	3.0	U	3.0	3.0	U	3.0	3.0	U	3.0	3.0	U	3.0	3.0	U	3.0
Benzo(a)anthracene	PAH	3.1	U	3.1	3.1	U	3.1	3.2	U	3.2	3.2	U	3.2	3.1	U	3.1
Benzo(a)pyrene	PAH	6.3	U	6.3	6.3	U	6.3	6.4	U	6.4	6.4	U	6.4	6.3	U	6.3
Benzo(b)fluoranthene	PAH	4.1	U	4.1	4.1	U	4.1	4.2	U	4.2	4.2	U	4.2	4.1	U	4.1
Benzo(ghi)perylene	PAH	7.1	U	7.1	7.0	U	7.0	7.1	U	7.1	7.2	U	7.2	7.1	U	7.1
Benzo(k)fluoranthene	PAH	3.9	U	3.9	3.9	U	3.9	3.9	U	3.9	3.9	U	3.9	3.9	U	3.9
Chrysene	PAH	4.7	U	4.7	4.7	U	4.7	4.8	U	4.8	4.8	U	4.8	4.7	U	4.7
Dibenz[a,h]anthracene	PAH	11	U	11	11	U	11	11	U	11	11	U	11	11	U	11
Fluoranthene	PAH	13	U	13	13	U	13	13	U	13	13	U	13	13	U	13
Fluorene	PAH	5.2	U	5.2	5.2	U	5.2	5.2	U	5.2	5.3	U	5.3	5.2	U	5.2
Indeno(1,2,3-cd)pyrene	PAH	12	U	12	12	U	12	12	U	12	12	U	12	12	U	12
Naphthalene	PAH	12	U	12	12	U	12	12	U	12	12	U	12	12	U	12
Phenanthrene	PAH	12	U	12	12	U	12	12	U	12	12	U	12	12	U	12
Pyrene	PAH	12	U	12	12	U	12	12	U	12	12	U	12	12	U	12
Aroclor-1016	PCB										2.8	U	2.8	2.7	U	2.7
Aroclor-1221	PCB										8.0	U	8.0	7.9	U	7.9
Aroclor-1232	PCB										2.0	U	2.0	2.0	U	2.0
Aroclor-1242	PCB										4.7	U	4.7	4.6	U	4.6
Aroclor-1248	PCB										4.7	U	4.7	4.6	U	4.6
Aroclor-1254	PCB										2.6	U	2.6	2.5	U	2.5
Aroclor-1260	PCB										2.6	U	2.6	2.5	U	2.5

Constituents	CLASS	J1P295, 600-319:2			J1MXJ5, 600-319:3			J1P1L5, 600-324			J1P1L6, Duplicate of J1P1L5		
		5/15/2012			12/6/2011			5/1/2012			5/1/2012		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	10	U	10	9.8	U	9.8	9.9	U	9.9	10	U	10
Acenaphthylene	PAH	9.0	U	9.0	8.9	U	8.9	8.9	U	8.9	9.0	U	9.0
Anthracene	PAH	3.0	U	3.0	3.0	U	3.0	3.0	U	3.0	3.1	U	3.1
Benzo(a)anthracene	PAH	3.2	U	3.2	3.1	U	3.1	3.2	U	3.2	3.2	U	3.2
Benzo(a)pyrene	PAH	6.4	U	6.4	6.3	U	6.3	6.4	U	6.4	6.4	U	6.4
Benzo(b)fluoranthene	PAH	4.2	U	4.2	4.1	U	4.1	4.2	U	4.2	4.2	U	4.2
Benzo(ghi)perylene	PAH	7.2	U	7.2	7.1	U	7.1	7.2	U	7.2	7.2	U	7.2
Benzo(k)fluoranthene	PAH	3.9	U	3.9	3.9	U	3.9	3.9	U	3.9	3.9	U	3.9
Chrysene	PAH	4.8	U	4.8	4.8	U	4.8	4.8	U	4.8	4.8	U	4.8
Dibenz[a,h]anthracene	PAH	11	U	11	11	U	11	11	U	11	11	U	11
Fluoranthene	PAH	13	U	13	13	U	13	13	U	13	13	U	13
Fluorene	PAH	5.3	U	5.3	5.2	U	5.2	5.2	U	5.2	5.3	U	5.3
Indeno(1,2,3-cd)pyrene	PAH	12	U	12	12	U	12	12	U	12	12	U	12
Naphthalene	PAH	12	U	12	12	U	12	12	U	12	12	U	12
Phenanthrene	PAH	12	U	12	12	U	12	12	U	12	12	U	12
Pyrene	PAH	12	U	12	12	U	12	12	U	12	12	U	12
Aroclor-1016	PCB	2.8	U	2.8	2.8	U	2.8						
Aroclor-1221	PCB	8.0	U	8.0	8.0	U	8.0						
Aroclor-1232	PCB	2.0	U	2.0	2.0	U	2.0						
Aroclor-1242	PCB	4.7	U	4.7	4.7	U	4.7						
Aroclor-1248	PCB	4.7	U	4.7	4.7	U	4.7						
Aroclor-1254	PCB	2.6	U	2.6	2.6	U	2.6						
Aroclor-1260	PCB	2.6	U	2.6	2.6	U	2.6						

Attachment	1	Sheet No.	7 of 9
Originator	N. K. Schiffern	Date	7/31/12
Checked	J. D. Skoglie	Date	7/31/12
Calc. No.	0600X-CA-V0133	Rev. No.	0

Attachment 1. 600-305, 300-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites Verification Sample Results (Organics).

Constituents	CLASS	J1PPK2, 600-313			J1PPK3, Duplicate of J1PPK2		
		5/30/2012			5/30/2012		
		ug/kg	Q	PQL	ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	28	U	28	28	U	28
1,2-Dichlorobenzene	SVOA	22	U	22	22	U	22
1,3-Dichlorobenzene	SVOA	12	U	12	12	U	12
1,4-Dichlorobenzene	SVOA	14	U	14	13	U	13
2,4,5-Trichlorophenol	SVOA	10	U	10	9.9	U	9.9
2,4,6-Trichlorophenol	SVOA	10	U	10	9.9	U	9.9
2,4-Dichlorophenol	SVOA	10	U	10	9.9	U	9.9
2,4-Dimethylphenol	SVOA	66	U	66	65	U	65
2,4-Dinitrophenol	SVOA	330	UJ	330	330	UXJ	330
2,4-Dinitrotoluene	SVOA	66	U	66	65	U	65
2,6-Dinitrotoluene	SVOA	28	U	28	28	U	28
2-Chloronaphthalene	SVOA	10	U	10	9.9	U	9.9
2-Chlorophenol	SVOA	21	U	21	21	U	21
2-Methylnaphthalene	SVOA	19	U	19	19	U	19
2-Methylphenol (cresol, o-)	SVOA	13	U	13	13	U	13
2-Nitroaniline	SVOA	50	U	50	49	U	49
2-Nitrophenol	SVOA	10	U	10	9.9	U	9.9
3+4 Methylphenol (cresol, m+p)	SVOA	33	U	33	33	U	33
3,3'-Dichlorobenzidine	SVOA	90	UJ	90	89	UJ	89
3-Nitroaniline	SVOA	73	U	73	72	U	72
4,6-Dinitro-2-methylphenol	SVOA	330	UJ	330	330	UXJ	330
4-Bromophenylphenyl ether	SVOA	19	U	19	19	U	19
4-Chloro-3-methylphenol	SVOA	66	U	66	65	U	65
4-Chloroaniline	SVOA	82	U	82	81	U	81
4-Chlorophenylphenyl ether	SVOA	21	U	21	21	U	21
4-Nitroaniline	SVOA	72	U	72	71	U	71
4-Nitrophenol	SVOA	97	U	97	96	U	96
Acenaphthene	SVOA	10	U	10	10	U	10
Acenaphthylene	SVOA	17	U	17	17	U	17
Anthracene	SVOA	17	U	17	17	U	17
Benzo(a)anthracene	SVOA	20	U	20	20	U	20
Benzo(a)pyrene	SVOA	20	U	20	20	U	20
Benzo(b)fluoranthene	SVOA	26	U	26	26	U	26
Benzo(ghi)perylene	SVOA	16	U	16	16	U	16
Benzo(k)fluoranthene	SVOA	40	U	40	39	U	39
Bis(2-chloro-1-methylethyl)ether	SVOA	23	U	23	23	U	23
Bis(2-Chloroethoxy)methane	SVOA	23	U	23	23	U	23
Bis(2-chloroethyl) ether	SVOA	17	U	17	16	U	16
Bis(2-ethylhexyl) phthalate	SVOA	46	U	46	45	U	45
Butylbenzylphthalate	SVOA	43	U	43	42	U	42
Carbazole	SVOA	36	U	36	35	U	35
Chrysene	SVOA	27	U	27	27	U	27

Constituents	CLASS	J1PPK2, 600-313			J1PPK3, Duplicate of J1PPK2		
		5/30/2012			5/30/2012		
		ug/kg	Q	PQL	ug/kg	Q	PQL
Di-n-butylphthalate	SVOA	29	U	29	29	U	29
Di-n-octylphthalate	SVOA	14	U	14	14	U	14
Dibenz[a,h]anthracene	SVOA	19	U	19	19	U	19
Dibenzofuran	SVOA	20	U	20	20	U	20
Diethyl phthalate	SVOA	26	U	26	26	U	26
Dimethyl phthalate	SVOA	23	U	23	23	U	23
Fluoranthene	SVOA	36	U	36	35	U	35
Fluorene	SVOA	25	J	18	18	U	18
Hexachlorobenzene	SVOA	29	U	29	29	U	29
Hexachlorobutadiene	SVOA	10	U	10	9.9	U	9.9
Hexachlorocyclopentadiene	SVOA	50	U	50	49	U	49
Hexachloroethane	SVOA	21	U	21	21	U	21
Indeno(1,2,3-cd)pyrene	SVOA	22	U	22	22	U	22
Isophorone	SVOA	17	U	17	17	U	17
N-Nitroso-di-n-dipropylamine	SVOA	31	U	31	31	U	31
N-Nitrosodiphenylamine	SVOA	21	U	21	21	U	21
Naphthalene	SVOA	31	U	31	31	U	31
Nitrobenzene	SVOA	22	U	22	22	U	22
Pentachlorophenol	SVOA	330	U	330	330	U	330
Phenanthrene	SVOA	17	U	17	17	U	17
Phenol	SVOA	18	U	18	18	U	18
Pyrene	SVOA	12	U	12	12	U	12

Attachment	1	Sheet No.	8 of 9
Originator	N. K. Schiffern	Date	7/31/12
Checked	J. D. Skoglie	Date	7/31/12
Calc. No.	0600X-CA-V0133	Rev. No.	0

Attachment 1. 600-305, 300-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 Waste Sites Verification Sample Results - Asbestos[a].

Sample Location	HEIS Number	Sample Date	Chrysotile	Amosite	Crocidolite	Tremolite	Actinolite	Anthophyllite
			%	%	%	%	%	%
600-305:2	J1NPC9	4/5/2012	ND	ND	ND	ND	ND	ND
Duplicate of J1NPC7	J1NPC8	4/5/2012	ND	ND	ND	ND	ND	ND
600-305:1	J1NPC7	4/5/2012	ND	ND	ND	ND	ND	ND
600-305:3	J1P8F9	5/21/2012	ND	ND	ND	ND	ND	ND
600-305:4	J1P8F8	5/21/2012	ND	ND	ND	ND	ND	ND
500-305:5	J1P8H0	5/21/2012	ND	ND	ND	ND	ND	ND
600-308 ASB	J1PPF2	5/30/2012	ND	ND	ND	ND	ND	ND

[a] The required detection limit for asbestos is 1 %.

Attachment	1	Sheet No.	9 of 9
Originator	N. K. Schiffern	Date	7/31/12
Checked	J. D. Skoglie	Date	7/31/12
Calc. No.	0600X-CA-V0133	Rev. No.	0

APPENDIX B

SITE-SPECIFIC RESRAD CALCULATION FOR SELENIUM

APPENDIX B

SITE-SPECIFIC RESRAD CALCULATION FOR SELENIUM

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:

600-310 RESRAD Calculation Brief for Groundwater and River Protection, 0100X-CA-V0134, 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.

CALCULATION COVER SHEET

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

Area: 100-IU-2

Discipline: Environmental *Calculation No: 0600X-CA-V0134

Subject: 600-310 RESRAD Calculation Brief for Groundwater and River Protection

Computer Program: RESRAD Program No: Version 6.5

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 pg Summary – 5 pg Attm. 1 - 20 pg Attm. 2 - 10 pg Total – 36 pages	S. W. Clark	M. W. Perrott	J. R. Davidson	S. W. Callison	7-2-12

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:	S. W. Clark	Date:	7/2/12	Calc. No.:	0600X-CA-V0134	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	7/2/12
Subject:	600-310 RESRAD Calculation Brief for Groundwater and River Protection					Sheet No. 1 of 5	

PURPOSE:

Predict the selenium concentrations in groundwater and Columbia River over a period of 1,000 years from selenium analyses of the soil at the 600-310 confirmatory sampling site.

GIVEN/REFERENCES:

1) The maximum focused sample result for selenium during cleanup verification sampling at the 600-310 waste site (HEIS # J1PPD0) was 1.4 mg/kg which exceeds the soil cleanup level for protection of the Columbia River (1 mg/kg). The maximum selenium analysis was evaluated by site-specific RESidual RADioactivity (RESRAD) modeling for nonradionuclides as described in Appendix C of the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) to predict the selenium concentrations in groundwater. The focused sample represents a site area of 100 m^2 (1,076 ft^2). Dilution and attenuation of selenium concentrations in groundwater as it flows from the area of the 600-310 waste site to the Columbia River was calculated using the U.S. Environmental Protection Agency (EPA) *Soil Screening Guidance: User's Guide.*
2) The selenium data for HEIS # J1PPD0 was obtained from WCH, 2012, *Remaining Sites Verification Package for 600-309, Burn Site #3; 600-310, Burn Site #4; 600-311, Burn Site #5; 600-312, Burn Site #6; 600-313, Burned Area and Oil Stained Soil; 600-314, Telecommunications Components; 600-317, Battery and Burn Area; and 600-324, Burnt Debris Area*, Attachment to Waste Site Reclassification Forms Control Numbers 2012-040, 2012-041, 2012-042, 2012-43, 2012-44, 2012-45, 2012-46, and 2012-48, July 2012, Washington Closure Hanford, Richland, Washington.
3) Use of site-specific RESRAD evaluations to predict constituent concentrations in groundwater due to constituent concentrations in the soil is discussed in Appendix C of the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
4) The RESidual RADioactivity (RESRAD) computer code, version 6.5, was developed for the U.S. Department of Energy by the Environmental Assessment Division of Argonne National Laboratory, Argonne, Illinois, to calculate compliance with residual radioactivity guidelines and may be accessed at < http://www.ead.anl.gov/resrad >.
5) Formulas for calculation of dilution and attenuation in groundwater between the 600-310 site and the Columbia River were obtained from the *Soil Screening Guidance: User's Guide*, OSWER 9355.4-23, July 1996, U.S. Environmental Protection Agency, Washington, D.C.

SOLUTION:

1) As discussed in Section 3.6.9 of the RDR/RAWP, the residual concentrations of nonradionuclides in the soil are compared to the soil remedial action goals (RAGs) for Columbia River protection developed in Table B-6 of Appendix B of the RDR/RAWP. The river protection RAG is attained if the residual concentrations in soil are less than the Table B-6 RAGs and each sample data set meets the requirements of the WAC 173-340-

740(7)(e) (1996) three-part test. If this is not the case, a more detailed assessment using RESRAD or other appropriate methods (e.g., dilution-attenuation evaluations) is used to assess the potential of residual site soil contaminants to impact groundwater and the river. If this assessment indicates that the residual contamination in the site soils will not impact groundwater or the river at concentrations above groundwater or surface water cleanup levels, then the groundwater and river protection RAGs have been attained.

2) A site-specific RESRAD evaluation was performed for the maximum selenium concentration at the 600-310 waste site focused sample location (HEIS # J1PPD0). The focused sample represents a site area of 100 m^2 (1,076 ft^2). Table 1 shows the waste site area dimensions and thickness of each soil horizon used in the RESRAD and dilution-attenuation calculations. Input factors for each run are shown in the "Summary" section of the RESRAD "Mixture Sums and Single Radionuclide Guidelines" printout in Attachment 1 to this Calculation Summary.

Table 1. Waste Site-Specific Parameters for RESRAD and Dilution-Attenuation Modeling

Parameter	Units	Shallow Zone
Contaminant-Specific Input Parameters		
Selenium Maximum Concentration	mg/kg	1.4
Selenium Kd Value	mL/g	5
Contaminated Zone Dimensions		
Cover Depth	m	0
Area of Contaminated Zone (CZ)	m^2	100
Length Parallel to Aquifer Flow	m	10
Thickness of Vadose Zone Horizons		
Thickness: Contaminated Zone	m	1.0
Thickness: Unsaturated Zone	m	7.9
Distance from the Waste Site to the Columbia River		
Saturated Zone Groundwater Flow Distance	m	1,828

3) The year when the peak selenium concentration is predicted to occur in groundwater from the waste site was determined by a preliminary run. This year was then added for all horizons for the final RESRAD runs. For the water pathways, the peak year for selenium in groundwater is predicted to occur at year 314.

METHODOLOGY:

1) Using the methodology described in Appendix C of the RDR/RAWP, RESRAD modeling was used to determine if residual soil concentrations of selenium are protective of groundwater. Runs of RESRAD version 6.5 were completed for the maximum selenium concentration in the 600-310 waste site confirmatory focused sampling activities using the uranium-238 isotope as a surrogate for selenium with the selenium Kd of 5 ml/g. RESRAD

numerical output reports of selenium concentrations in soil and groundwater are presented in the Attachments to this calculation summary.

2) Methodology for modeling to protect the Columbia River is similar to that for modeling the protection of groundwater, with the groundwater concentration reduced by using a factor to account for dilution and attenuation as contaminants migrate through the groundwater to the river. Calculation of an appropriate dilution factor is accomplished using the formulas in the EPA *Soil Screening Guidance: User's Guide.*

The following Excel spreadsheet incorporates the formulas for calculation of the dilution factor to account for dilution and attenuation as contaminants migrate through the groundwater to the river:

Table 2. Excel Calculation of Dilution Factor for Protection of the Columbia River

	A	B	C	D	E	F	G	H
1	Apparent Mixing Zone Depth (d) is calculated per the EPA *Soil Screening Guidance: User's Guide*, Equation 12:							
2	Apparent Mixing Zone Depth (d) = $(0.0112*L^2)^{0.5} + d_a(1 - \exp((-L*I)/(K*i*d_a)))$							
3	Variable	Value	Description					
4	L	1,828	m, Distance to the Columbia River					
5	d_a	10	m, Aquifer Thickness					
6	I	0.07992	m/yr, Infiltration Rate, from I = (1-Ce((1-Cr)Pr + Irr					
7	Ce	0.91	Evapotranspiration Coefficient					
8	Cr	0.2	Runoff Coefficient					
9	Pr	0.16	m/yr, Precipitation					
10	Irr	0.76	m/yr, Irrigation					
11	K	5,530	m/yr, Aquifer Hydraulic Conductivity					
12	i	0.00125	m/m, Hydraulic Gradient					
13	d	202	m, Apparent Mixing Zone Depth (see formula below)					
14	Calculation of Dilution Factor per the EPA *Soil Screening Guidance: User's Guide*, Equation 11.							
15	Dilution Factor, D = 1 + (K*i*d/I*L)							
16	Variable	Value	Description					
17	K	5,530	m/yr, Aquifer Hydraulic Conductivity					
18	i	0.00125	m/m, Hydraulic Gradient					
19	d	194	m, Apparent Mixing Zone Depth (default to d_a, Aquifer Thickness)					
20	I	0.07992	m/yr, Infiltration Rate, from I = (1-Ce((1-Cr)Pr + Irr					
21	L1	10	m, Source Length Parallel to GW Flow					
22								
23	Apparent Mixing Zone Depth (d) = E26 = ((0.0112*B4*B4)^0.5)+(B5*(1-EXP((-B4)*(B6)/(B11*B12*B5)))							
24	Dilution Factor (D) = E27 = 1+((B17*B18*B19)/(B20*B21))							
25								
26	Apparent Mixing Zone Depth (d) =				10	m, (default to d_a, Aquifer Thickness)		
27	Dilution Factor (D) =				8.7			

RESULTS:

1) Groundwater Protection

Predicted selenium concentrations in groundwater at different time intervals up to 1,000 years were calculated by the RESRAD model using uranium-238 as a surrogate for selenium.

RESRAD output is presented in Attachment 2 and summarized in Table 3. Selenium is predicted to reach groundwater within the 1,000 years of the RESRAD model evaluation and to peak at year 314 at a maximum groundwater concentration of 6.58 ug/L. The result is less than the groundwater remedial action goal (RAG) of 50 ug/L per Table B-2 of Appendix B of the RDR/RAWP.

Table 3. Predicted Groundwater (Well Water/Drinking Water) Concentration at 600-310

Contaminant	RESRAD Run	Groundwater Concentrations in ug/L at Each Time Interval (yr)								RAG, ug/L
		0	1	10	30	100	300	314	1000	
Selenium	600-310	0	0	0	0	0	0	6.58	0.0082	50[a]

[a] Based on the maximum contaminant level (MCL) for selenium from 40 CFR 141, as discussed in Appendix B, Table B-2, of the 100 Area RDR/RAWP.

2) Columbia River Protection

Predicted selenium concentrations in groundwater at the Columbia River were calculated by dividing the predicted groundwater concentrations at the 600-310 waste site in Table 3 by the dilution factor of 8.7 determined in Table 2. Results are summarized in Table 4. Due to dilution and attenuation, selenium is predicted to reach the river at year 314 with a maximum concentration of 0.76 ug/L, which is less than the RAG of 5.0 ug/L per Table B-3 of Appendix B of the RDR/RAWP.

Table 4. Predicted Groundwater Concentration at the Columbia River Based on Dilution and Attenuation of Groundwater from 600-310

Contaminant	RESRAD Run	Groundwater Concentrations in ug/L at Each Time Interval (yr)								RAG, ug/L
		0	1	10	30	100	300	314	1000	
Selenium	600-310	0	0	0	0	0	0	0.76	0.001	5.0[a]

[a] Based on the surface water ambient water quality criteria (AWQC) for selenium from 40 CFR 131.36, as discussed in Appendix B, Table B-3, of the 100 Area RDR/RAWP.

CONCLUSIONS:

- Maximum selenium concentrations in the soil at the 600-310 waste site are predicted to be protective of groundwater and the Columbia River for 1,000 years based upon RESRAD vadose zone modeling and evaluation of dilution-attenuation in the saturated zone using the formulas from the EPA *Soil Screening Guidance: User's Guide*.

- Selenium concentrations in groundwater are predicted to peak at year 314 at a maximum concentration of 6.58 ug/L, which is less than the groundwater cleanup RAG of 50 ug/L per Table B-2 of Appendix B of the RDR/RAWP.

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	7/2/12	Calc. No.:	0600X-CA-V0134	Rev.:	0
Project:	100-IU-2/6 Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	7/2/12
Subject:	600-310 RESRAD Calculation Brief for Groundwater and River Protection					Sheet No. 5 of 5	

- Selenium is predicted to reach the river at a maximum concentration of 0.76 ug/L, which is less than the surface water cleanup RAG of 5.0 ug/L per Table B-3 of Appendix B of the RDR/RAWP.

ATTACHMENTS:

1. RESRAD Output: 600-310 Selenium Groundwater and River Protection – Mixture Sums and Single Radionuclide Guidelines (20 pages)
2. RESRAD Output: 600-310 Selenium Groundwater and River Protection – Concentration of Radionuclides, (10 pages)

ATTACHMENT 1

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page   1
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD
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Attachment 1 Sheet No. 1 of 20
Originator: S. W. Clark SWC Date 7/2/2012
Chk'd By M. W. Perrott MWP Date 7/2/2012
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File : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(1)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(2)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(3)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(4)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(5)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(6)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(7)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(8)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(9)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(10)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(11)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(12)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(13)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(14)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(15)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(16)
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(17)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(1)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(2)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(3)
B-1	U-234	1.320E-01	1.320E-01	DCF2(4)
B-1	U-238	1.180E-01	1.180E-01	DCF2(5)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(6)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(1)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(2)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(3)
D-1	U-234	2.830E-04	2.830E-04	DCF3(4)
D-1	U-238	2.550E-04	2.550E-04	DCF3(5)
D-1	U-238+D	2.687E-04	2.550E-04	DCF3(6)
D-34	Food transfer factors:			
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(1,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(1,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(1,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(2,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(2,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(2,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(3,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(3,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(3,3)
D-34				

Attachment 1 Sheet No. 2 of 20
Originator: S. W. Clark Date 7/2/2012
Chk'd By M. W. Perrott Date 7/2/2012
Calc. No. 0600X-CA-V0134 Rev. No. 0

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1RESRAD, Version 6.5       T« Limit = 180 days        06/27/2012  08:16  Page   3
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

                    Dose Conversion Factor (and Related) Parameter Summary (continued)
                                   Dose Library: FGR 12 & FGR 11
0      ³                                                          ³  Current  ³   Base    ³  Parameter
 Menu ³                        Parameter                          ³  Value#   ³   Case*   ³    Name
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 D-34 ³ U-234      , plant/soil concentration ratio, dimensionless  ³ 2.500E-03 ³ 2.500E-03 ³ RTF(  4,1)
 D-34 ³ U-234      , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  ³ 3.400E-04 ³ 3.400E-04 ³ RTF(  4,2)
 D-34 ³ U-234      , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   ³ 6.000E-04 ³ 6.000E-04 ³ RTF(  4,3)
 D-34 ³                                                             ³           ³           ³
 D-34 ³ U-238      , plant/soil concentration ratio, dimensionless  ³ 2.500E-03 ³ 2.500E-03 ³ RTF(  5,1)
 D-34 ³ U-238      , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  ³ 3.400E-04 ³ 3.400E-04 ³ RTF(  5,2)
 D-34 ³ U-238      , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   ³ 6.000E-04 ³ 6.000E-04 ³ RTF(  5,3)
 D-34 ³                                                             ³           ³           ³
 D-34 ³ U-238+D    , plant/soil concentration ratio, dimensionless  ³ 2.500E-03 ³ 2.500E-03 ³ RTF(  6,1)
 D-34 ³ U-238+D    , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)  ³ 3.400E-04 ³ 3.400E-04 ³ RTF(  6,2)
 D-34 ³ U-238+D    , milk/livestock-intake ratio, (pCi/L)/(pCi/d)   ³ 6.000E-04 ³ 6.000E-04 ³ RTF(  6,3)
      ³                                                             ³           ³           ³
 D-5  ³ Bioaccumulation factors, fresh water, L/kg:                 ³           ³           ³
 D-5  ³ Pb-210+D   , fish                                           ³ 3.000E+02 ³ 3.000E+02 ³ BIOFAC(  1,1)
 D-5  ³ Pb-210+D   , crustacea and mollusks                         ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(  1,2)
 D-5  ³                                                             ³           ³           ³
 D-5  ³ Ra-226+D   , fish                                           ³ 5.000E+01 ³ 5.000E+01 ³ BIOFAC(  2,1)
 D-5  ³ Ra-226+D   , crustacea and mollusks                         ³ 2.500E+02 ³ 2.500E+02 ³ BIOFAC(  2,2)
 D-5  ³                                                             ³           ³           ³
 D-5  ³ Th-230     , fish                                           ³ 1.000E+02 ³ 1.000E+02 ³ BIOFAC(  3,1)
 D-5  ³ Th-230     , crustacea and mollusks                         ³ 5.000E+02 ³ 5.000E+02 ³ BIOFAC(  3,2)
 D-5  ³                                                             ³           ³           ³
 D-5  ³ U-234      , fish                                           ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(  4,1)
 D-5  ³ U-234      , crustacea and mollusks                         ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(  4,2)
 D-5  ³                                                             ³           ³           ³
 D-5  ³ U-238      , fish                                           ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(  5,1)
 D-5  ³ U-238      , crustacea and mollusks                         ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(  5,2)
 D-5  ³                                                             ³           ³           ³
 D-5  ³ U-238+D    , fish                                           ³ 1.000E+01 ³ 1.000E+01 ³ BIOFAC(  6,1)
 D-5  ³ U-238+D    , crustacea and mollusks                         ³ 6.000E+01 ³ 6.000E+01 ³ BIOFAC(  6,2)
ííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííííí
 #For DCF1(xxx) only, factors are for infinite depth & area.  See ETFG table in Ground Pathway of Detailed Report.
 *Base Case means Default.Lib w/o Associate Nuclide contributions.
```

Attachment 1 Sheet No. 3 of 20
Originator: S. W. Clark Date 7/2/2012
Chk'd By M. W. Perrott Date 7/2/2012
Calc. No. 0600X-CA-V0134 Rev. No. 0

ATTACHMENT 1

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page   4
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD
```

Site-Specific Parameter Summary

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.140E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): U-238	1.400E+00	0.000E+00	---	S1(5)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(5)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	7.600E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	1.500E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	0.000E+00	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW

Attachment 1 Sheet No. 4 of 20
Originator: S. W. Clark Date 7/2/2012
Chk'd By M. W. Perrott Date 7/2/2012
Calc. No. 0600X-CA-V0134 Rev. No. 0

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page   5
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD
```

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	7.900E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	1.500E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	2.500E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	4.050E+00	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	5.000E+00	5.000E+01	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+00	5.000E+01	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	5.000E+00	5.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.754E-03	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.989E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.123E-04	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	8.325E-07	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter U-234				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	9.966E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	not used	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	not used	5.000E-01	---	FIND

Attachment	1	Sheet No.	5 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
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Summary : 600-310 Selenium Groundwater and Columbia River Protection
File : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fraction of time spent outdoors (on site)	not used	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5

Attachment 1 Sheet No. 6 of 20
Originator: S. W. Clark Date 7/2/2012
Chk'd By M. W. Perrott Date 7/2/2012
Calc. No. 0600X-CA-V0134 Rev. No. 0

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 Summary : 600-310 Selenium Groundwater and Columbia River Protection
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```

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	not used	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL

Attachment	1	Sheet No.	7 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page   8
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD
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Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS
TITL	Maximum number of integration points for dose	1	---	---	LYMAX
TITL	Maximum number of integration points for risk	5	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	suppressed
2 -- inhalation (w/o radon)	suppressed
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	suppressed
9 -- radon	suppressed
Find peak pathway doses	suppressed

Attachment	1	Sheet No.	8 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

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Contaminated Zone Dimensions	
Area:	100.00 square meters
Thickness:	1.00 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g	
U-238	1.400E+00

0

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 1.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	3.140E+02	1.000E+03
TDOSE(t):	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.292E+00	1.653E-03
M(t):	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.611E-02	1.102E-04

0Maximum TDOSE(t): 1.298E+00 mrem/yr at t = 313.5 ñ 0.6 years
0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.135E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.135E+02 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
U-238	1.298E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.298E+00	1.0000
Total	1.298E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.298E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1	Sheet No. 9 of 20
Originator: S. W. Clark	Date 7/2/2012
Chk'd By M. W. Perrott	Date 7/2/2012
Calc. No. 0600X-CA-V0134	Rev. No. 0

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page  10
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
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                        Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                     As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0                                       Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon            Plant            Meat             Milk              Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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fract.
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 U-238   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
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 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
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0
                        Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                     As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0                                                Water Dependent Pathways
0            Water            Fish             Radon            Plant            Meat             Milk             All
Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr
fract.
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 U-238   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
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0.0000
0*Sum of all water independent and dependent pathways.
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Attachment	1	Sheet No.	10 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page  11
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                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0                                   Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon              Plant              Meat               Milk               Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr
fract.
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 U-238   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
0.0000
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 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
0.0000
0

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0                                   Water Dependent Pathways
0            Water             Fish              Radon              Plant              Meat               Milk               All
Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr
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0*Sum of all water independent and dependent pathways.
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Attachment	1	Sheet No.	11 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

ATTACHMENT 1

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1RESRAD, Version 6.5       T« Limit = 180 days        06/27/2012  08:16  Page  12
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0                                   Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon            Plant            Meat             Milk              Soil
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                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0                                                   Water Dependent Pathways
0            Water            Fish             Radon            Plant            Meat             Milk             All
Pathways*
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0*Sum of all water independent and dependent pathways.
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Attachment	1	Sheet No.	12 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

ATTACHMENT 1

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page  13
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0                                   Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon             Plant             Meat              Milk              Soil
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                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0                                      Water Dependent Pathways
0            Water             Fish              Radon             Plant             Meat              Milk              All
Pathways*
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0.0000
0*Sum of all water independent and dependent pathways.
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Attachment	1	Sheet No.	13 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

ATTACHMENT 1

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1RESRAD, Version 6.5       T« Limit = 180 days        06/27/2012  08:16  Page  14
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0                                   Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon            Plant            Meat             Milk              Soil
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                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0                                   Water Dependent Pathways
0            Water            Fish            Radon            Plant            Meat             Milk             All
Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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0*Sum of all water independent and dependent pathways.
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Attachment	1	Sheet No.	14 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

ATTACHMENT 1

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page  15
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0                                   Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon             Plant             Meat              Milk              Soil
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                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0                                   Water Dependent Pathways
0            Water             Fish              Radon             Plant             Meat              Milk              All
Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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0*Sum of all water independent and dependent pathways.
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Attachment	1	Sheet No.	15 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

ATTACHMENT 1

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page  16
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                              As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0                                Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon            Plant            Meat             Milk              Soil
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 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
0.0000
0
                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                              As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
0                                   Water Dependent Pathways
0            Water            Fish             Radon            Plant            Meat             Milk             All
Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr
fract.
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 U-238   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
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 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
0.0000
0*Sum of all water independent and dependent pathways.
```

Attachment	1	Sheet No.	16 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

ATTACHMENT 1

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page  17
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 3.140E+02 years
0                                   Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon             Plant             Meat              Milk              Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr
fract.
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 U-238   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
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 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
0.0000
0
                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 3.140E+02 years
0                                      Water Dependent Pathways
0            Water             Fish              Radon             Plant             Meat              Milk              All
Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr
fract.
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 U-238   1.292E+00 1.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.292E+00
1.0000
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 Total   1.292E+00 1.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.292E+00
1.0000
0*Sum of all water independent and dependent pathways.
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Attachment	1	Sheet No.	17 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

ATTACHMENT 1

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page  18
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                              As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0                                Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon           Plant           Meat            Milk            Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr
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 U-238   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
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 Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00
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0
                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                              As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
0                                     Water Dependent Pathways
0            Water            Fish            Radon           Plant           Meat            Milk            All
Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
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 Nuclide  mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr  fract.   mrem/yr
fract.
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 U-238   1.653E-03 1.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.653E-03
1.0000
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 Total   1.653E-03 1.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  1.653E-03
1.0000
0*Sum of all water independent and dependent pathways.
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Attachment	1	Sheet No.	18 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page  19
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

                                   Dose/Source Ratios Summed Over All Pathways
                          Parent and Progeny Principal Radionuclide Contributions Indicated
0  Parent    Product    Thread                    DSR(j,t) At Time in Years   (mrem/yr)/(pCi/g)
   (i)        (j)      Fraction   0.000E+00 1.000E+00 3.000E+00 1.000E+01 3.000E+01 1.000E+02 3.000E+02 3.140E+02 1.000E+03
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 U-238      U-238      5.400E-05  0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 4.728E-05 5.872E-08
0U-238+D    U-238+D    9.999E-01  0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 9.226E-01 1.146E-03
 U-238+D    U-234      9.999E-01  0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 1.416E-06 3.371E-05
 U-238+D    Th-230     9.999E-01  0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 2.557E-12 3.755E-10
 U-238+D    Ra-226+D   9.999E-01  0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 5.116E-09 2.543E-07
 U-238+D    Pb-210+D   9.999E-01  0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 1.974E-08 9.540E-07
 U-238+D    äDSR(j)               0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 9.226E-01 1.181E-03
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 The DSR includes contributions from associated (half-life ó 180 days) daughters.
0
                                 Single Radionuclide Soil Guidelines G(i,t) in pCi/g
                                    Basic Radiation Dose Limit = 1.500E+01 mrem/yr
0Nuclide
   (i)     t= 0.000E+00   1.000E+00   3.000E+00   1.000E+01   3.000E+01   1.000E+02   3.000E+02   3.140E+02   1.000E+03
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 U-238     *3.361E+05  *3.361E+05  *3.361E+05  *3.361E+05  *3.361E+05  *3.361E+05  *3.361E+05  1.626E+01  1.270E+04
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 *At specific activity limit
0
            Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
            and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
         at tmin = time of minimum single radionuclide soil guideline
      and at tmax = time of maximum total dose =   313.5 ñ 0.6 years
0Nuclide  Initial        tmin       DSR(i,tmin) G(i,tmin) DSR(i,tmax) G(i,tmax)
   (i)    (pCi/g)       (years)                  (pCi/g)               (pCi/g)
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 U-238   1.400E+00   313.5 ñ 0.6   9.273E-01 1.618E+01 9.273E-01 1.618E+01
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Attachment	1	Sheet No.	19 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page  20
 Summary : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

                                   Individual Nuclide Dose Summed Over All Pathways
                                     Parent Nuclide and Branch Fraction Indicated
0Nuclide Parent   THF(i)                                        DOSE(j,t), mrem/yr
   (j)     (i)            t= 0.000E+00 1.000E+00 3.000E+00 1.000E+01 3.000E+01 1.000E+02 3.000E+02 3.140E+02 1.000E+03
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 U-238   U-238   5.400E-05    0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 6.619E-05 8.220E-08
 U-238   U-238   9.999E-01    0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 1.292E+00 1.604E-03
 U-238   äDOSE(j)             0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 1.292E+00 1.604E-03
0U-234   U-238   9.999E-01    0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 1.982E-06 4.719E-05
0Th-230  U-238   9.999E-01    0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 3.580E-12 5.257E-10
0Ra-226  U-238   9.999E-01    0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 7.162E-09 3.560E-07
0Pb-210  U-238   9.999E-01    0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 0.000E+00 2.764E-08 1.336E-06
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 THF(i) is the thread fraction of the parent nuclide.


                                     Individual Nuclide Soil Concentration
                                     Parent Nuclide and Branch Fraction Indicated
0Nuclide Parent   THF(i)                                          S(j,t), pCi/g
   (j)     (i)            t= 0.000E+00 1.000E+00 3.000E+00 1.000E+01 3.000E+01 1.000E+02 3.000E+02 3.140E+02 1.000E+03
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 U-238   U-238   5.400E-05    7.560E-05 7.487E-05 7.342E-05 6.857E-05 5.642E-05 2.850E-05 4.052E-06 3.535E-06 4.390E-09
 U-238   U-238   9.999E-01    1.400E+00 1.386E+00 1.360E+00 1.270E+00 1.045E+00 5.278E-01 7.504E-02 6.546E-02 8.130E-05
 U-238   äS(j):               1.400E+00 1.386E+00 1.360E+00 1.270E+00 1.045E+00 5.279E-01 7.504E-02 6.547E-02 8.130E-05
0U-234   U-238   9.999E-01    0.000E+00 3.947E-06 1.172E-05 3.762E-05 1.016E-04 2.393E-04 3.116E-04 3.100E-04 1.668E-04
0Th-230  U-238   9.999E-01    0.000E+00 1.780E-11 1.590E-10 1.724E-09 1.447E-08 1.277E-07 6.610E-07 7.001E-07 2.151E-06
0Ra-226  U-238   9.999E-01    0.000E+00 2.572E-15 6.903E-14 2.504E-12 6.378E-11 1.944E-09 3.215E-08 3.573E-08 3.448E-07
0Pb-210  U-238   9.999E-01    0.000E+00 1.987E-17 1.582E-15 1.840E-13 1.264E-11 9.320E-10 2.481E-08 2.792E-08 3.227E-07
 íííííííí íííííííí íííííííí    íííííííí íííííííí íííííííí íííííííí íííííííí íííííííí íííííííí íííííííí íííííííí
 THF(i) is the thread fraction of the parent nuclide.
0RESCALC.EXE execution time =     1.20 seconds
```

Attachment	1	Sheet No.	20 of 20
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

ATTACHMENT 2

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1RESRAD, Version 6.5      T« Limit = 180 days       06/27/2012  08:16  Page   1
 Concent : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

                       Table of Contents
                       ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
            Part IV: Concentration of Radionuclides
            ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
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Concentration of radionuclides in different media

Time= 0.000E+00 2
Time= 1.000E+00 3
Time= 3.000E+00 4
Time= 1.000E+01 5
Time= 3.000E+01 6
Time= 1.000E+02 7
Time= 3.000E+02 8
Time= 3.140E+02 9
Time= 1.000E+03 10

Attachment 2 Sheet No. 1 of 10
Originator: S. W. Clark Date 7/2/2012
Chk'd By M. W. Perrott Date 7/2/2012
Calc. No. 0600X-CA-V0134 Rev. No. 0

ATTACHMENT 2

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page   2
 Concent : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD
```

Concentration of radionuclides in environmental media
at t = 0.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	1.400E+00	1.400E+00	1.081E-05	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 0.000E+00 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Pb-210	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ra-226	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Th-230	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-234	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
U-238	0.000E+00	3.501E+00	3.503E+00	3.503E+00	3.503E+00	3.190E-01	5.356E-01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment	2	Sheet No.	2 of 10
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
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1RESRAD, Version 6.5 T« Limit = 180 days 06/27/2012 08:16 Page 3
Concent : 600-310 Selenium Groundwater and Columbia River Protection
File : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

Concentration of radionuclides in environmental media
at t = 1.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Pb-210	1.987E-17	1.987E-17	1.535E-22	0.000E+00	0.000E+00
Ra-226	2.572E-15	2.572E-15	1.987E-20	0.000E+00	0.000E+00
Th-230	1.780E-11	1.780E-11	1.375E-16	0.000E+00	0.000E+00
U-234	3.947E-06	3.947E-06	3.049E-11	0.000E+00	0.000E+00
U-238	1.386E+00	1.386E+00	1.071E-05	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 1.000E+00 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Pb-210	0.000E+00	2.793E-16	2.054E-16	3.108E-16	3.801E-16	3.180E-17	9.655E-18	0.000E+00	0.000E+00
Ra-226	0.000E+00	9.188E-14	1.021E-13	5.809E-14	6.972E-14	5.064E-15	5.110E-15	0.000E+00	0.000E+00
Th-230	0.000E+00	1.982E-11	1.798E-11	2.175E-11	2.389E-11	1.375E-12	8.800E-14	0.000E+00	0.000E+00
U-234	0.000E+00	9.871E-06	9.877E-06	9.341E-06	9.852E-06	8.996E-07	1.510E-06	0.000E+00	0.000E+00
U-238	0.000E+00	3.468E+00	3.469E+00	3.475E+00	3.473E+00	3.162E-01	5.306E-01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment	2	Sheet No.	3 of 10
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

ATTACHMENT 2

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1RESRAD, Version 6.5       T« Limit = 180 days        06/27/2012  08:16  Page   4
 Concent : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD
```

Concentration of radionuclides in environmental media
at t = 3.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Pb-210	1.582E-15	1.582E-15	1.222E-20	0.000E+00	0.000E+00
Ra-226	6.903E-14	6.903E-14	5.332E-19	0.000E+00	0.000E+00
Th-230	1.590E-10	1.590E-10	1.229E-15	0.000E+00	0.000E+00
U-234	1.172E-05	1.172E-05	9.050E-11	0.000E+00	0.000E+00
U-238	1.360E+00	1.360E+00	1.050E-05	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.000E+00 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Pb-210	0.000E+00	1.818E-14	1.600E-14	2.117E-14	2.259E-14	2.059E-15	6.235E-16	0.000E+00	0.000E+00
Ra-226	0.000E+00	2.660E-12	2.754E-12	2.308E-12	2.437E-12	1.898E-13	1.685E-13	0.000E+00	0.000E+00
Th-230	0.000E+00	1.651E-10	1.598E-10	1.724E-10	1.782E-10	1.014E-11	5.563E-13	0.000E+00	0.000E+00
U-234	0.000E+00	2.930E-05	2.931E-05	2.879E-05	2.929E-05	2.670E-06	4.482E-06	0.000E+00	0.000E+00
U-238	0.000E+00	3.401E+00	3.402E+00	3.408E+00	3.406E+00	3.101E-01	5.203E-01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment	2	Sheet No.	4 of 10
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page   5
 Concent : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD
```

Concentration of radionuclides in environmental media
at t = 1.000E+01 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Pb-210	1.840E-13	1.840E-13	1.421E-18	0.000E+00	0.000E+00
Ra-226	2.504E-12	2.504E-12	1.934E-17	0.000E+00	0.000E+00
Th-230	1.724E-09	1.724E-09	1.332E-14	0.000E+00	0.000E+00
U-234	3.762E-05	3.762E-05	2.906E-10	0.000E+00	0.000E+00
U-238	1.270E+00	1.270E+00	9.810E-06	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 1.000E+01 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Pb-210	0.000E+00	1.928E-12	1.846E-12	2.072E-12	2.113E-12	1.975E-13	6.299E-14	0.000E+00	0.000E+00
Ra-226	0.000E+00	9.906E-11	1.001E-10	9.506E-11	9.656E-11	7.698E-12	6.562E-12	0.000E+00	0.000E+00
Th-230	0.000E+00	1.744E-09	1.729E-09	1.771E-09	1.789E-09	1.015E-10	5.154E-12	0.000E+00	0.000E+00
U-234	0.000E+00	9.407E-05	9.413E-05	9.366E-05	9.413E-05	8.573E-06	1.439E-05	0.000E+00	0.000E+00
U-238	0.000E+00	3.176E+00	3.177E+00	3.183E+00	3.181E+00	2.896E-01	4.860E-01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment	2	Sheet No.	5 of 10
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

ATTACHMENT 2

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page   6
 Concent : 600-310 Selenium Groundwater and Columbia River Protection
 File    : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD
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Concentration of radionuclides in environmental media
at t = 3.000E+01 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Pb-210	1.264E-11	1.264E-11	9.762E-17	0.000E+00	0.000E+00
Ra-226	6.378E-11	6.378E-11	4.927E-16	0.000E+00	0.000E+00
Th-230	1.447E-08	1.447E-08	1.118E-13	0.000E+00	0.000E+00
U-234	1.016E-04	1.016E-04	7.850E-10	0.000E+00	0.000E+00
U-238	1.045E+00	1.045E+00	8.071E-06	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.000E+01 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Pb-210	0.000E+00	1.286E-10	1.266E-10	1.327E-10	1.336E-10	1.256E-11	4.113E-12	0.000E+00	0.000E+00
Ra-226	0.000E+00	2.542E-09	2.551E-09	2.508E-09	2.521E-09	2.023E-10	1.705E-10	0.000E+00	0.000E+00
Th-230	0.000E+00	1.453E-08	1.450E-08	1.462E-08	1.467E-08	8.317E-10	4.115E-11	0.000E+00	0.000E+00
U-234	0.000E+00	2.541E-04	2.542E-04	2.539E-04	2.543E-04	2.316E-05	3.888E-05	0.000E+00	0.000E+00
U-238	0.000E+00	2.614E+00	2.614E+00	2.619E+00	2.618E+00	2.383E-01	3.998E-01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 2 Sheet No. 6 of 10
Originator: S. W. Clark Date 7/2/2012
Chk'd By M. W. Perrott Date 7/2/2012
Calc. No. 0600X-CA-V0134 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 06/27/2012 08:16 Page 7
Concent : 600-310 Selenium Groundwater and Columbia River Protection
File : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

Concentration of radionuclides in environmental media
at t = 1.000E+02 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Pb-210	9.320E-10	9.320E-10	7.200E-15	0.000E+00	0.000E+00
Ra-226	1.944E-09	1.944E-09	1.502E-14	0.000E+00	0.000E+00
Th-230	1.277E-07	1.277E-07	9.863E-13	0.000E+00	0.000E+00
U-234	2.393E-04	2.393E-04	1.848E-09	0.000E+00	0.000E+00
U-238	5.279E-01	5.279E-01	4.078E-06	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 1.000E+02 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Pb-210	0.000E+00	9.390E-09	9.327E-09	9.528E-09	9.544E-09	8.995E-10	2.977E-10	0.000E+00	0.000E+00
Ra-226	0.000E+00	7.767E-08	7.775E-08	7.738E-08	7.749E-08	6.232E-09	5.234E-09	0.000E+00	0.000E+00
Th-230	0.000E+00	1.279E-07	1.279E-07	1.282E-07	1.284E-07	7.277E-09	3.567E-10	0.000E+00	0.000E+00
U-234	0.000E+00	5.984E-04	5.987E-04	5.987E-04	5.988E-04	5.453E-05	9.155E-05	0.000E+00	0.000E+00
U-238	0.000E+00	1.320E+00	1.321E+00	1.323E+00	1.322E+00	1.204E-01	2.020E-01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment	2	Sheet No.	7 of 10
Originator:	S. W. Clark	Date	7/2/2012
Chk'd By	M. W. Perrott	Date	7/2/2012
Calc. No.	0600X-CA-V0134	Rev. No.	0

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 06/27/2012 08:16 Page 8
Concent : 600-310 Selenium Groundwater and Columbia River Protection
File : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

Concentration of radionuclides in environmental media
at t = 3.000E+02 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Pb-210	2.481E-08	2.481E-08	1.917E-13	0.000E+00	0.000E+00
Ra-226	3.215E-08	3.215E-08	2.483E-13	0.000E+00	0.000E+00
Th-230	6.610E-07	6.610E-07	5.106E-12	0.000E+00	0.000E+00
U-234	3.116E-04	3.116E-04	2.407E-09	0.000E+00	0.000E+00
U-238	7.504E-02	7.504E-02	5.797E-07	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.000E+02 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Pb-210	0.000E+00	2.493E-07	2.483E-07	2.518E-07	2.519E-07	2.375E-08	7.884E-09	0.000E+00	0.000E+00
Ra-226	0.000E+00	1.285E-06	1.286E-06	1.284E-06	1.285E-06	1.034E-07	8.673E-08	0.000E+00	0.000E+00
Th-230	0.000E+00	6.615E-07	6.624E-07	6.629E-07	6.630E-07	3.759E-08	1.838E-09	0.000E+00	0.000E+00
U-234	0.000E+00	7.792E-04	7.796E-04	7.798E-04	7.798E-04	7.100E-05	1.192E-04	0.000E+00	0.000E+00
U-238	0.000E+00	1.877E-01	1.878E-01	1.881E-01	1.880E-01	1.711E-02	2.872E-02	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 2 Sheet No. 8 of 10
Originator: S. W. Clark Date 7/2/2012
Chk'd By M. W. Perrott Date 7/2/2012
Calc. No. 0600X-CA-V0134 Rev. No. 0

ATTACHMENT 2

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1RESRAD, Version 6.5      T« Limit = 180 days        06/27/2012  08:16  Page   9
 Concent : 600-310 Selenium Groundwater and Columbia River Protection
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Concentration of radionuclides in environmental media
at t = 3.140E+02 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Pb-210	2.792E-08	2.792E-08	2.157E-13	5.153E-09	2.050E-11
Ra-226	3.573E-08	3.573E-08	2.760E-13	7.356E-09	2.927E-11
Th-230	7.001E-07	7.001E-07	5.408E-12	8.630E-12	3.433E-14
U-234	3.100E-04	3.100E-04	2.395E-09	9.550E-06	3.800E-08
U-238	6.547E-02	6.547E-02	5.057E-07	6.585E+00	2.620E-02

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.140E+02 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Pb-210	5.204E-09	2.881E-07	3.125E-07	3.142E-07	3.168E-07	2.864E-08	9.675E-09	6.551E-09	2.188E-09
Ra-226	7.428E-09	1.440E-06	1.477E-06	1.472E-06	1.476E-06	1.183E-07	1.002E-07	1.559E-09	7.796E-09
Th-230	8.949E-12	7.006E-07	7.016E-07	7.021E-07	7.023E-07	3.981E-08	1.946E-09	3.722E-12	1.868E-11
U-234	9.595E-06	7.887E-04	8.364E-04	8.553E-04	8.561E-04	7.283E-05	1.222E-04	3.927E-07	2.356E-06
U-238	6.585E+00	8.812E+00	4.160E+01	4.563E+01	4.561E+01	1.178E+00	2.157E+00	2.620E-01	1.572E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

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ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 06/27/2012 08:16 Page 10
Concent : 600-310 Selenium Groundwater and Columbia River Protection
File : X:\RESRAD INPUT FILES\RESRAD 6.5 INPUT FILES 06-19-12\600-310_SELENIUM.RAD

Concentration of radionuclides in environmental media
at t = 1.000E+03 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Pb-210	3.227E-07	3.227E-07	2.493E-12	2.514E-07	1.000E-09
Ra-226	3.448E-07	3.448E-07	2.664E-12	3.692E-07	1.469E-09
Th-230	2.151E-06	2.151E-06	1.661E-11	1.308E-09	5.206E-12
U-234	1.668E-04	1.668E-04	1.289E-09	2.284E-04	9.088E-07
U-238	8.130E-05	8.130E-05	6.280E-10	8.178E-03	3.254E-05

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 1.000E+03 years*

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Pb-210	2.514E-07	3.571E-06	4.812E-06	5.004E-06	5.004E-06	4.129E-07	1.431E-07	3.000E-07	1.002E-07
Ra-226	3.692E-07	1.428E-05	1.613E-05	1.634E-05	1.634E-05	1.302E-06	1.130E-06	7.344E-08	3.672E-07
Th-230	1.314E-09	2.154E-06	2.164E-06	2.167E-06	2.167E-06	1.223E-07	5.977E-09	5.221E-10	2.612E-09
U-234	2.284E-04	7.171E-04	1.855E-03	1.992E-03	1.992E-03	7.831E-05	1.377E-04	9.088E-06	5.453E-05
U-238	8.178E-03	1.094E-02	5.166E-02	5.667E-02	5.664E-02	1.463E-03	2.679E-03	3.254E-04	1.953E-03

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

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Originator:	S. W. Clark	Date	7/2/2012
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APPENDIX C

DATA QUALITY ASSESSMENT

APPENDIX C

DATA QUALITY ASSESSMENT

VERIFICATION SAMPLING DATA QUALITY ANALYSIS

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 2011). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2009).

A review of the sample design (WCH 2011), the field logbooks (WCH 2012a, 2012b), and applicable analytical data packages has been performed as part of this DQA. Verification data analyzed in this DQA are for the following group of waste sites: 600-305:1, 600-305:2, 600-305:3, 600-305:4, 600-305:5, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-314:1, 600-314:2, 600-314:3, 600-314:4, 600-314:5, 600-317, 600-319:1, 600-319:2, 600-319:3 and 600-324. As indicated in the verification work instruction (WCH 2011), no samples were collected from 600-314:1, 600-314:2, 600-314:3, 600-314:4, or 600-314:5 subsites; therefore, no data validation is required for these subsites. For the purposes of this DQA, the sites listed above hereafter will be listed collectively as follows: 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites. Each waste site within this grouping had site-specific sampling parameters and analysis lists based on the nature of the waste site (WCH 2011).

All samples were collected and analyzed per the sample design, with minimal alterations, as warranted by field conditions. Two composite samples, instead of one, were collected from the 600-308 waste site excavation for verification sampling. Two, instead of four, composite verification samples were collected from the 600-309 waste site excavation.

To ensure quality data, the SAP data assurance requirements and the data validation procedure 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 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites were provided by the laboratories in 14 sample delivery groups (SDGs): SDG MA04834, SDG MA05079, SDG MA05130, SDG J01543, SDG J01542, SDG J01541, SDG J01514, SDG J01513, SDG J01545, SDG J01537, SDG J01360, SDG J01508, SDG J01535, and SDG J01494. SDG K3916 was submitted for third-party validation. Major and minor deficiencies are discussed for the 600-305, 600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 data sets, 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

Samples were collected on May 30, 2012, and analyzed on June 5 through 12, 2012. Due to the holding time exceedances of greater than twice the limit (48 hours) in method 300.0, third-party validation qualified the undetected nitrite results in SDG KJ01537 as rejected with "UR" flags. All method 300.0 detected nitrate, nitrite, and orthophosphate results are qualified as estimated with "J" flags by third-party validation. This result was anticipated, and EPA analytical method 353.2 was also requested to provide acceptable nitrate/nitrite data for decision-making purposes. Phosphate is not a regulated chemical under *Washington Administrative Code* (WAC) 173-340, "Model Toxics Control Act – Cleanup." The estimated data for undetected nitrite and orthophosphate analytes do not hinder the evaluation of the 600-317 waste site.

MINOR DEFICIENCIES

SDG MA04834

This SDG comprises three focused composite soil samples (J1NPC7 through J1NPC9) from the 600-305:1 and 600-305:2 subsite excavations. This SDG includes one field duplicate pair (J1NPC9/J1NPC8). These samples were analyzed for bulk asbestos. No major or minor deficiencies were found in SDG MA04834. The data are usable for decision-making purposes.

SDG MA05079

This SDG comprises three focused composite soil samples (J1P8F8, J1P8F9, and J1P8H0) from the 600-305:3, 600-305:4, and 600-305:5 subsite excavations. These samples were analyzed for bulk asbestos. No major or minor deficiencies were found in SDG MA05079. The data are usable for decision-making purposes.

SDG MA05130

This SDG comprises one focused composite soil sample (J1PPF2) from the 600-308 waste site excavation. These samples were analyzed for bulk asbestos. No major or minor deficiencies were found in SDG MA05130. The data are usable for decision-making purposes.

SDG J01543

This SDG comprises three focused composite soil samples (J1PPD8, J1PPD9, J1PPF0) collected from the 600-308 waste site excavation. This SDG includes one field duplicate pair (J1PPD8/J1PPF1). These samples were analyzed for inductively coupled plasma (ICP) metals and mercury. SDG J01543 was submitted for third-party validation. Minor deficiencies are as follows:

In the ICP metals analysis, zinc was detected in the method blank (MB) at low levels, less than $1/25^{th}$ of the most stringent cleanup limit. All zinc results in SDG J01543 in equipment blank

sample J1PPF1 were qualified as undetected with "UJ" flags by third-party validation. The data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory control sample (LCS) recovery for silicon is below the laboratory and project recovery limits at 19%. All silicon results in SDG J01543 are qualified as estimated by third-party validation with "J" flags. The data are usable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries are out of project acceptance criteria for five analytes (aluminum, antimony, iron, manganese, and silicon). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. The MS recoveries for antimony and silicon were 51% and -10%, respectively. All antimony and silicon results for SDG J01543 were qualified as estimated by third-party validation with "J" flags. Estimated data are usable for decision-making purposes.

SDG J01542

This SDG comprises three composite soil samples (J1PPD4 through J1PPD7), collected from two focused locations at 600-309 waste site excavation. This SDG includes one field duplicate pair (J1PPD4/J1PPD6). These samples were analyzed for ICP metals, mercury and total petroleum hydrocarbons (TPH). In addition, one equipment blank (J1PPD7) was collected and analyzed for ICP metals, and mercury. Minor deficiencies are as follows:

In the ICP metals analysis, zinc was detected in the MB at very low levels, less than 1/25th of the most stringent cleanup limit. All zinc results in SDG J01542 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS and MS recoveries for silicon are below the project recovery limits, at 14% and 13%, respectively. Silicon is not a contaminant of concern or contaminant of potential concern (COPC) for the 600-309 waste site, nor is it a regulated compound under WAC 173-340. All silicon results in SDG J01542 may be considered estimated. The data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for six analytes (aluminum, antimony, calcium, iron, manganese, and silicon). For aluminum, calcium, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. The MS recoveries for antimony and silicon were 51% and 13%, respectively. All antimony and silicon results for SDG J01542 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate relative percent difference (RPD) for arsenic is above the acceptance criteria of 30%, at 34%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. All arsenic results in SDG J01542 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J01541

This SDG comprises four composite soil samples (J1PPC9, J1PPD1, J1PPD2, and J1PPD0), collected from three focused locations at the 600-310 waste site excavation. This SDG includes one field duplicate pair (J1PPC9/J1PPD2). These samples were analyzed for ICP metals, mercury, and TPH. In addition, one equipment blank (J1PPD3) was collected and analyzed for ICP metals and mercury. Minor deficiencies are as follows:

In the ICP metals analysis, calcium, copper, nickel, and zinc were detected in the MB, at low levels. Calcium is not a regulated constituent and is not a COPC for the 600-310 waste site. Copper, nickel, and zinc were detected at significantly smaller concentrations in the laboratory blank sample than in the field samples. The data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon is below the project recovery limits, at 21%. All silicon results in SDG J01541 may be considered estimated. The data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for four analytes (aluminum, antimony, iron, and silicon). For aluminum and iron, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. The MS recoveries for antimony and silicon were 48% and -9%, respectively. All antimony and silicon results for SDG J01541 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate RPDs for arsenic, silicon, and zinc are above the acceptance criteria of 30%, at 37%, 53%, and 55%, respectively. Elevated RPDs in environmental soil samples are generally attributed to natural heterogeneities in the sample matrix. All arsenic, silicon, and zinc results in SDG J01541 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J01514

This SDG comprises one composite soil sample and one duplicate (J1P8D8/J1P8D9), collected from the 600-311 waste site excavation. These samples were analyzed for ICP metals, mercury, and TPH. In addition, one equipment blank (J1P8F0) was collected and analyzed for ICP metals and mercury. Minor deficiencies are as follows:

In the ICP metals analysis, barium was detected in the MB, at very low levels. Barium is detected at significantly smaller concentrations in the MB than in the field samples. There is no significant impact to the field sample data. The data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon is below the project recovery limits, at 11%. Silicon is not a COC or COPC for the 600-311 waste site, nor is it a regulated compound under WAC 173-340. All silicon results in SDG J01514 may be considered estimated. The data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for five analytes (aluminum, antimony, iron, manganese, and silicon). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. The MS recoveries for antimony and silicon are 54% and 35%, respectively. All antimony and silicon results for SDG J01514 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J01513

This SDG comprises one composite soil sample and one duplicate (J1P8D5/J1P8D6) collected from the 600-312 waste site excavation. These samples were analyzed for ICP metals, mercury, and TPH. In addition, one equipment blank (J1P8D7) was collected and analyzed for ICP metals and mercury. Minor deficiencies are as follows:

In the ICP metals analysis, barium was detected in the MB at very low levels. Barium was detected at significantly smaller quantity in the MB than in field samples. There is no significant impact on the field sample data. The data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon is below the project recovery limits at 16%. All silicon results in SDG J01513 may be considered estimated. The data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for five analytes (aluminum, antimony, iron, manganese, and silicon). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. The MS recoveries for antimony and silicon were 52% and 31%, respectively. All antimony and silicon results for SDG J01513 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J01545

This SDG comprises one composite soil sample and one duplicate (J1PPK2/J1PPK3) collected from the 600-313 waste site excavation. These samples were analyzed for semivolatile organic compounds (SVOCs). In addition, one equipment blank (J1PPK4) was collected and analyzed for ICP metals and mercury. SDG J01545 was submitted for third-party validation. Minor deficiencies are as follows:

In the ICP metals analysis, zinc and mercury were detected in the MB at very low levels, less than 1/25th of the most stringent cleanup limit. All zinc results in SDG J01545 are qualified as undetected with "UJ" flags by third-party validation. All other detected zinc and mercury results in SDG J01545 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon is below the project recovery limits at 20%. All silicon results in SDG J01545 were qualified as estimated by third-party validation with "J" flags. The data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for two analytes (aluminum and silicon). Aluminum and silicon did not have mismatched spike and native concentrations in the MS. The MS recoveries for aluminum and silicon were 241% and 32%, respectively. All aluminum and silicon results for SDG J01545 were qualified as estimated by third-party validation with "J" flags. Estimated data are usable for decision-making purposes.

In the SVOCs analysis, the LCS recovery for 3,3-dichlorobenzidiene is below the project recovery limits at 44%. All 3,3-ddichlorobenzidiene results in SDG J01545 were qualified as estimated by third-party validation with "J" flags. The data are usable for decision-making purposes.

In the SVOCs analysis, the MS and matrix spike duplicate (MSD) recoveries are out of project acceptance criteria for two analytes (4,6-dinitro-2-methylphenol and 2,4-dinitrophenol). The MS and MSD recoveries for 4,6-dinitro-2-methylphenol are 46% and 38%, respectively. The MS and MSD recoveries for 2,4-dinitrophenol are 21% and 19%, respectively. All 4,6-dinitro-2-methylphenol and 2,4-dinitrophenol results in SDG J01545 are qualified as estimated by third-party validation with "J" flags. The data are usable for decision-making purposes.

SDG J01537

This SDG comprises two composite soil samples (J1PP95/J1PP96) collected from the 600-317 waste site excavation. This SDG includes one field duplicate pair (J1PP95/J1PPF4). These samples were analyzed for ICP metals, mercury, ion chromatography (IC) anions, nitrate/nitrite, hydrogen ion concentration (pH), TPH, and polycyclic aromatic hydrocarbons (PAH). In addition, one equipment blank (J1PPF5) was collected and analyzed for ICP metals and mercury. SDG J01537 was submitted for third-party validation. Minor deficiencies are as follows:

In the method 300.0 IC anion analysis, the holding times for nitrate, nitrite, and orthophosphate were exceeded by more than twice the acceptable range on all samples. All undetected nitrite and orthophosphate results in SDG J01537 were rejected by third-party validation with "UR" flags. The nondetected nitrate, nitrite, and orthophosphate results are further discussed in the "Major Deficiencies" section. All detected nitrate and pH analytes were qualified as estimated by third-party validation with "J" flags. Estimated data are usable for decision-making purposes.

In the method 300.0 IC anion analysis, orthophosphate was detected in the MB. All of the detected field sample results for orthophosphate were similar to the MB result. Third-party validation qualified all orthophosphate results in SDG J01537 as undetected with "U" flags due to MB contamination. The data are usable for decision-making purposes.

In the ICP metals analysis, nickel, zinc, and mercury are present in the MB at low levels, less than 1/25th of the most stringent cleanup limit. All nickel and zinc results in the field equipment blank sample were qualified as undetected with "UJ" flags by third-party validation. Mercury was qualified as undetected by third-party validation with "UJ" flags for all samples in SDG J01537. All other detected nickel and zinc results in SDG J01537 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon is below the project recovery limits, at 22%. All silicon results in SDG J01537 were qualified as estimated by third-party validation, with "J" flags. The data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for five analytes (aluminum, antimony, iron, manganese, and silicon). For aluminum, iron, and manganese, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. The MS recoveries for antimony and silicon are 56% and 10%, respectively. All antimony and silicon results for SDG J01537 are qualified as estimated by third-party validation with "J" flags. Estimated data are usable for decision-making purposes.

SDG J01360

This SDG comprises one composite soil sample (J1MXJ5) collected from the 600-319:3 subsite excavation. This sample was analyzed for ICP metals, mercury, TPH, PAH, polychlorinated biphenyls (PCBs), and also by the toxicity characteristic leaching procedure (TCLP) for metals. Minor deficiencies are as follows:

In the ICP metals analysis, the LCS recovery for silicon is below the project recovery limits at 16%. All silicon results in SDG J01360 may be considered estimated. The data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for four analytes (aluminum, antimony, iron, and silicon). For aluminum and iron, the spiking

concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. The MS recoveries for antimony and silicon are 42% and -19%, respectively. All antimony and silicon results for SDG J01360 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J01508

This SDG comprises one composite soil sample (J1P295) collected from the 600-319:2 subsite excavation. This sample was analyzed for ICP metals, mercury, TPH, PAH, TCLP metals, and PCBs. Minor deficiencies are as follows:

In the ICP metals analysis, the LCS recovery for silicon is below the project recovery limits at 22%. All silicon results in SDG J01508 may be considered estimated. The data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for four analytes (aluminum, antimony, iron, and silicon). For aluminum and iron, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. The MS recoveries for antimony and silicon are 42% and 10%, respectively. All antimony and silicon results for SDG J01508 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J01535

This SDG comprises one composite soil sample (J1PP90) collected from the 600-319:1 subsite excavation. This SDG includes one field duplicate pair (J1PP90/J1PP91). These samples were analyzed for ICP metals, mercury, TPH, PAH, and PCBs. In addition, one equipment blank (J1PP92) was collected and analyzed for ICP metals and mercury. Minor deficiencies are as follows:

In the ICP metals analysis, calcium, copper, nickel, and zinc were detected in the MB at low levels. Calcium is not a regulated constituent and is not a COPC for the 600-319 waste site. Copper, nickel, and zinc were detected at significantly smaller concentrations than their associated most stringent cleanup limits. All calcium, copper, nickel, and zinc results in SDG J01535 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recovery for silicon is below the project recovery limits at 23%. All silicon results in SDG J01535 may be considered estimated. The data are usable for decision-making purposes.

In the ICP metals analysis, the MS recoveries are out of project acceptance criteria for six analytes (aluminum, antimony, iron, manganese, copper, and silicon). For aluminum, iron, manganese, and copper, the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The deficiency in the MS is a reflection of the variability of the native concentration rather than a measure of the recovery from the sample. Antimony and silicon did not have mismatched spike and native concentrations in the MS. The MS recoveries for antimony and silicon are 49% and 13%, respectively. All antimony and silicon results for SDG J01535 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the laboratory duplicate RPD for copper, lead, and mercury is above the acceptance criteria of 30%, at 111%, 31%, and 39%, respectively. All copper, lead, and mercury results in SDG J01535 may be considered estimated. Estimated data are usable for decision-making purposes.

SDG J01494

This SDG comprises one composite soil sample (J1P1L5) collected from the 600-324 waste site excavation. This SDG includes one field duplicate pair (J1P1L5/J1P1L6). These samples were analyzed for TPH and PAH. In addition, one equipment blank (J1P1L7) was collected and analyzed for TPH and PAH.

No minor deficiencies affecting the quality of the data were found in SDG J01494.

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)/quality control (QC) measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples listed in the field logbooks (WCH 2012a, 2012b) are shown in Table C-1. The main and QA/QC sample results are presented in Appendix A.

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

Sample Area	Main Sample	Duplicate Sample
600-305 Area 2 (asbestos only)	J1NPC9	J1NPC8
600-308 North excavation	J1PPD8	J1PPF0
600-309 Burn site #3	J1PPD4	J1PPD6
600-310 Excavation 1A	J1PPC9	J1PPD2
600-311 Burn Site #5	J1P8D8	J1P8D9
600-312 Burn Site #6	J1P8D5	J1P8D6
600-313 Burn/Oil stain	J1PPK2	J1PPK3
600-317 Battery/Burn area	J1PP95	J1PPF4
600-319 Area 1 Misc. debris	J1PP90	J1PP91
600-324 Burnt debris	J1P1L5	J1P1L6

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 (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 A provides details on duplicate pair evaluation and RPD calculation.

The calculated TPH diesel range extended (69.3%) RPD for the 600-309 waste site duplicate analysis is above the acceptance criteria of 30%. The calculated copper (168.8%), silicon (45.6%), and zinc (57.4%) RPDs for 600-310 waste site duplicate analysis are above the acceptance criteria of 30%. The calculated silicon (38.8%) RPD for the 600-319 waste site is above the acceptance criteria of 30%. Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. There is no indication that the analytical system was operating out of control. The data are usable for decision-making purposes.

A secondary check of the data variability is used when one or both of the samples being evaluated (main and duplicate) is less than five times the 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. The 600-309 waste site, TPH diesel range duplicate sample required this check. A visual inspection of all of the data is also performed. No additional major or minor deficiencies are noted. The data are usable for decision-making purposes.

Summary

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 600-305,

600-308, 600-309, 600-310, 600-311, 600-312, 600-313, 600-317, 600-319, and 600-324 waste sites' 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 these waste sites concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for decision-making purposes.

The verification sample analytical data are stored in the Environmental Restoration project-specific database prior to being submitted for inclusion in the Hanford Environmental Information System) database. The verification sample analytical data are also summarized in Appendix A.

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