

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 100-IU-2 and 100-IU-6

Control No.: 2015-073

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

600-279, Vegetation-Free Area Between White Bluffs and 100-F
600-293, White Bluffs Service Station #1
600-294, White Bluffs Service Station #2
600-298, Stained Soil and Surface Debris
600-299, Surface Debris/Batteries
600-300, Miscellaneous Surface Debris
600-301, White Bluffs Sanitary Sewer Pipelines
600-303, Vertical Pipes
600-316, Dry Cell Batteries
600-318, Wet Cell Batteries
600-320, Oil Stains
600-321, Suspect ACM Sites
600-328, Lead Slag
600-356, Tar Deposit West of Susie Junction

600-368, Segment 4 Stained Soil #1
600-369, Segment 4 Bare Ground and Crusted Soil Areas
600-370, Segment 4 Debris Area #1
600-371, Segment 4 Chalky Material Area
600-372, Segment 4 Oil Stain and Filter Area #1
600-373, Segment 4 Bare Ground and White Stain Area
600-374, Segment 4 Drum Remnant Area
600-375, Segment 4 Dry Cell Battery Debris Area #1
600-376, Segment 4 Stained Soil Area #2
600-377, Segment 4 Oil Stain and Filter Area #2
600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage tank
600-379, Segment 4 Burn Area #1

Reclassification Category: Interim Final

Reclassification Status: Closed Out No Action Rejected
RCRA Postclosure Consolidated None

Approvals Needed: DOE Ecology EPA

Description of current waste site condition:

These waste sites were previously remediated and reclassified under the *Interim Action Record of Decision for the 100 BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100 IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington (Remaining Sites ROD), U.S. Environmental Protection Agency, Region 10, Seattle, Washington (EPA 1999).*

Basis for reclassification:

These waste sites were identified for remove, treat, and dispose (RTD) in the *Record of Decision, Hanford 100-Area Superfund Site, 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units (100-F/IU Area ROD)*. The included waste sites were interim reclassified based on remediation, sampling, and evaluation under an interim action ROD, but the post-remediation conditions were not evaluated in development of the 100-F/IU Area ROD due to concurrent timing of remediation and ROD development efforts. Final reclassification of these waste sites is performed in accordance with TPA-MP-14 in the *Tri Party Agreement Handbook Management Procedures (DOE-RL 2011)*. The basis for reclassification is described in detail in the *Final Action Evaluation of Additional 100-IU-2 & 100-IU-6 Waste Sites (attached)*.

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 600-377, Segment 4 Oil Stain and Filter Area #2
 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage tank
 600-379, Segment 4 Burn Area #1

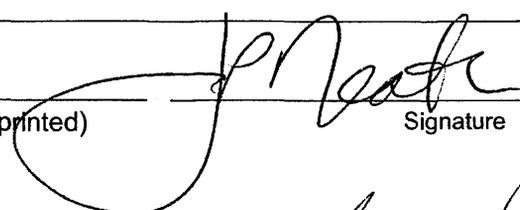
Regulator comments:

Waste Site Controls:

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

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

J. P. Neath
 DOE Federal Project Director (printed)



Signature

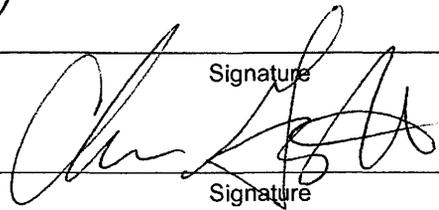
10/21/15
 Date

N/A
 Ecology Project Manager (printed)

Signature

Date

C. J. Guzzetti
 EPA Project Manager (printed)



Signature

10/28/15
 Date

**FINAL ACTION EVALUATION OF ADDITIONAL
100-IU-2 & 100-IU-6 WASTE SITES**

Attachment to Waste Site Reclassification Form 2015-073

December 2015

FINAL ACTION EVALUATION OF ADDITIONAL 100-IU-2 & 100-IU-6 WASTE SITES

INTRODUCTION

This attachment documents evaluations performed to support final reclassification of multiple waste sites identified for remove, treat, and dispose (RTD) in the *Record of Decision, Hanford 100 Area Superfund Site, 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (100-F/IU Area ROD) (EPA 2014). The included waste sites were interim reclassified based on remediation, sampling, and evaluation under an interim action ROD but were not evaluated in the *Remedial Investigation/Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (DOE-RL 2014) due to concurrent timing of remediation and RI/FS development efforts. Final reclassification of these waste sites is performed in accordance with TPA-MP-14 in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011).

Based upon evaluation of the previous waste site reclassification data against the 100-F/IU Area ROD cleanup levels, no further RTD is required for any of these sites. Evaluations for the following waste sites are provided to support reclassification to Final Closed Out:

- 600-279, Vegetation-Free Area Between White Bluffs and 100-F
- 600-293, White Bluffs Service Station #1
- 600-294, White Bluffs Service Station #2
- 600-298, Stained Soil and Surface Debris
- 600-299, Surface Debris/Batteries
- 600-300, Miscellaneous Surface Debris
- 600-301, White Bluffs Sanitary Sewer Pipelines
- 600-303, Vertical Pipes
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- 600-375, Segment 4 Dry Cell Battery Debris Area #1
- 600-376, Segment 4 Stained Soil Area #2
- 600-377, Segment 4 Oil Stain and Filter Area #2
- 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage tank
- 600-379, Segment 4 Burn Area #1.

600-279 Waste Site – Vegetation-Free Area Between White Bluffs and 100-FInterim Action Summary

The 600-279 waste site was an area of no vegetation covered with ash and pieces of burned debris. The site was remediated from September 30 to October 22, 2013. Due to the sloped topography at the location, the site was excavated to a depth of approximately 3.7 to 6.1 m (12 to 20 ft) below ground surface (bgs). Verification sampling was performed on October 23 and November 13, 2013, as summarized in Table 1. Additional information is available in the *Remaining Sites Verification Package for the 600-279, Vegetation Free Area Between White Bluffs and 100F* (WCH 2014a).

Table 1. 600-279 Verification Sample Summary.

Sample Location	HEIS Sample Number	Washington State Plane Coordinates		Sample Analysis
		Northing	Easting	
EXC-1	J1T469	148073.7	579576.0	ICP metals ^a , mercury, IC anions ^b , sulfide, SVOA, herbicides, pesticides, pH
EXC-2	J1T470	148073.7	579586.6	
EXC-3	J1T471	148082.9	579570.8	
EXC-4	J1T472	148082.9	579581.3	
EXC-5	J1T473	148082.9	579591.9	
EXC-6	J1T474	148092.0	579565.5	
EXC-7	J1T475	148092.0	579576.0	
EXC-8	J1T476	148092.0	579586.6	
EXC-9	J1T477	148092.0	579597.2	
EXC-10	J1T478	148101.1	579570.8	
EXC-11	J1T479	148101.1	579581.3	
EXC-12	J1T480	148101.1	579591.9	
Duplicate of EXC-1	J1T481	148073.7	579576.0	
FS-1 ^c	J1T461	148087.0	579578.0	ICP metals ^a , mercury, IC anions ^b , cyanide, sulfide, SVOA, herbicides, pesticides, pH
Equipment blank	J1T482	NA	NA	ICP metals ^a , mercury

^a The expanded list of ICP metals included antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.

^b The expanded list of IC anions included bromide, chloride, fluoride, nitrate, nitrite, phosphate, and sulfate in the analytical results package.

^c One focused soil sample was collected from a yellow stained soil found at the bottom of the deeper excavation.

EXC = excavation (random, gridded sample)
 FS = focused sample
 HEIS = Hanford Environmental Information System
 IC = ion chromatography

ICP = inductively coupled plasma
 NA = not applicable
 pH = hydrogen ion concentration
 SVOA = semivolatiles organic analysis

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-279 waste site achieve the applicable cleanup levels (CULs) developed to support unrestricted land use for the 100-F/IU Area as

established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each contaminant of concern (COC) detected at the 600-279 waste site against the CULs are shown in Tables 2 and 3 for the statistical and focused sample results, respectively. Analytes that were detected in the samples above soil background levels but are not considered COCs are reported in Table 4. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 2. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-279 Excavation Statistical Verification Samples.

COC	Statistical Result ^{b, c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	13.9	20	--	No
Lead	28.3	250	--	No
Mercury	0.00451 (<BG)	24	--	No
Nitrogen in nitrate and nitrite	6.00 (<BG) ^d	128,217 ^e	1,436 ^e	No
BAP TEC	0.0489 ^f	0.14	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014a), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Maximum of values for nitrogen in nitrate reported in WCH (2014a) based on analyses by EPA Method 300.0 and EPA Method 353.2.

^e Nitrate-based CULs from EPA (2014) have been adjusted to a nitrogen-basis using a factor of 4.43.

^f Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

Table 3. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-279 Excavation Focused Verification Samples.

COC	Maximum Result ^{b, c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	3.96 (<BG)	20	--	No
Lead	4.04 (<BG)	250	--	No
Mercury	0.00573 (<BG)	24	--	No
Nitrogen in nitrate and nitrite	0.536 (<BG) ^d	128,216 ^e	1,436 ^e	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014a), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Maximum of values for nitrogen in nitrate reported in WCH (2014a) based on analyses by EPA Method 300.0 and EPA Method 353.2.

^e Nitrate-based CULs from EPA (2014) have been adjusted to a nitrogen-basis using a factor of 4.43.

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

EPA = U.S. Environmental Protection Agency

Evaluation of verification sampling results at the 600-279 waste site listed in Tables 2 and 3 demonstrates that all COCs were quantified below the applicable CULs. Evaluation of residual concentrations of carcinogenic polycyclic aromatic hydrocarbons (PAHs) considers mixtures of these carcinogenic PAHs as a single hazardous substance, compared against the cleanup level established for benzo(a)pyrene. Concentrations for each carcinogenic PAH are multiplied by a corresponding toxicity equivalency factor and then summed to a total value, as shown in Appendix A.

Table 4. Analytes Detected Above Background at the 600-279 Waste Site that are not Identified as Contaminants of Concern.

Fluoride	Sulfate	Benzo(a)anthracene ^a
Benzo(b)fluoranthene ^a	Benzo(k)fluoranthene ^a	Chrysene ^a
Fluoranthene	Pyrene	

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Assessment of the residual risk for the 600-279 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-279 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 3.57×10^{-7} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-279 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-279 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site nominally extended into deep zone soils (below 4.6 m [15 ft] bgs), but the entire site was sampled and evaluated against the more stringent shallow zone criteria. Therefore, no site-specific institutional controls are required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-279 waste site to Final Closed Out.

600-293 Waste Site – White Bluffs Service Station #1

Interim Action Summary

The 600-293 waste site consisted of several suspect features that appeared to be part of a gas station infrastructure. The site was confirmatory sampled on October 18, 2010. Based on confirmatory sampling results the 600-293 waste site was recommended for remove, treat, and dispose. The site was

remediated on March 25, June 24, and October 23, 2013. The floor of the 600-293 waste site excavation varied from approximately 2.4 to 3 m (8 to 10 ft) bgs. Verification sampling was performed on August 26 and October 24, 2013, as summarized in Table 5. Additional information is available in the *Remaining Sites Verification Package for the 600-293, White Bluffs Service Station #1 Waste Site* (WCH 2014b).

Table 5. 600-293 Verification Sample Summary.

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

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

HEIS = Hanford Environmental Information System

PCB = polychlorinated biphenyl

ICP = inductively coupled plasma

TPH = total petroleum hydrocarbons

NA = not applicable

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-293 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each contaminant of concern (COC) detected at the 600-293 waste site against the CULs are shown in Table 6 for the focused sample results. Analytes that were detected in the samples above soil background levels but that are not considered COCs are reported in Table 7. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 6. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-293 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	2.44 (<BG)	20	--	No
Lead	14.3	250	--	No
Aroclor-1254	0.0970	0.50	--	No
Aroclor-1260	0.247	0.50	--	No
TPH – diesel range + motor oil	86	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014b), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

TPH = total petroleum hydrocarbons

Table 7. Analytes Detected Above Background at the 600-293 Waste Site that are not Identified as Contaminants of Concern.

Molybdenum	Aroclor-1242	
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Evaluation of verification sampling results at the 600-293 waste site listed in Table 6 demonstrates that all COCs were quantified below the applicable CULs.

Assessment of the residual risk for the 600-293 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-293 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 6.06×10^{-2} , which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 6.88×10^{-7} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-293 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-293 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-293 waste site to Final Closed Out.

600-294 Waste Site – White Bluffs Service Station #2

Interim Action Summary

The 600-294 waste site consisted of an area of a service station with the potential for underground storage tanks, associated piping, and contaminated underlying soils. The site was confirmatory sampled on October 20, 2010. Based on confirmatory sampling results, the 600-294 waste site was recommended for remove, treat, and dispose. The site was remediated between March 28 and July 16, 2013. The final depth of the south area excavation was approximately 1.8 m (6 ft) bgs. The final depth of the northern excavated area was 3 m (10 ft) bgs. Verification sampling was performed on September 4 and October 30, 2013, as summarized in Table 8. Additional information is available in the *Remaining Sites Verification Package for the 600-294, White Bluffs Service Station #2 Waste Site* (WCH 2014c).

Table 8. 600-294 Sample Summary.

Sample Location	HEIS Sample Number	WSP Coordinates (m) (Center for Composite Samples)		Sample Analysis
		Northing	Easting	
EXC-1	J1RWL7/ J1RWN4	147601.0	577495.5	ICP metals ^a , mercury, hexavalent chromium, SVOA, TPH, and asbestos
EXC-2	J1RWL8/ J1RWN5	147605.1	577493.2	
EXC-3 ^b	J1RWL9/ J1RWN6, J1T4N1	147605.1	577497.9	
EXC-4	J1RWM0/ J1RWN7	147609.2	577490.8	
EXC-5	J1RWM1/ J1RWN8	147609.2	577495.5	
EXC-6	J1RWM2/ J1RWN9	147621.5	577488.4	
EXC-7	J1RWM3/ J1RWP0	147621.5	577493.2	
EXC-8 ^b	J1RWM4/ J1RWP1, J1T4N2	147625.6	577486.1	
EXC-9	J1RWM5/ J1RWP2	147625.6	577490.8	
EXC-10	J1RWM6/ J1RWP3	147625.6	577495.5	
EXC-11 ^b	J1RWM7/ J1RWP4, J1T4N3	147629.7	577488.4	
EXC-12	J1RWM8/ J1RWP5	147629.7	577493.2	
Duplicate of J1RWL7/J1RWN4	J1RWM9/ J1RWP6	147601.0	577495.5	ICP metals ^a , mercury, hexavalent chromium, SVOA, TPH, and asbestos
Comp-1	J1RWN0/ J1RWP7	147607	577484	
Comp-2	J1RWN1/ J1RWP8	147607	577486	
Duplicate J1RWN0/J1RWP7	J1RWN2/ J1RWP9	147607	577484	ICP metals ^a , mercury and SVOA
Equipment blank	J1RWN3	NA	NA	
Trip blank	J1T4N4	NA	NA	BTEX

^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.

^b Per regulator concurrence, VOA-BTEX analysis was performed on sampling locations EXC-3, EXC-8, and EXC-11, where TPH verification sampling results were detected above 200 mg/kg (WCH 2014c).

BTEX = benzene, toluene, ethylbenzene, and xylenes

SVOA = semivolatle organic analysis

EXC = excavation (random, gridded sample)

TPH = total petroleum hydrocarbons

HEIS = Hanford Environmental Information System

VOA = volatile organic analysis

ICP = inductively coupled plasma

WSP = Washington State Plane

NA = not applicable

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-294 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-294 waste site against the CULs are shown in Tables 9 and 10 for the statistical and focused sample results, respectively. Analytes that were detected in the samples above soil background levels but that are not considered COCs are reported in Table 11. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 9. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-294 Excavation Statistical Verification Samples.

COC	Statistical Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	2.55 (<BG)	20	--	No
Hexavalent Chromium	0.230	240	2.0	No
Lead	64.3	250	--	No
Mercury	0.00953 (<BG)	0.50	--	No
TPH – diesel range + motor oil	222	2,000	2,000	No
BAP TEC	0.00150 ^d	0.14	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014c), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbon

Table 10. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-294 Overburden Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	2.57 (<BG)	20	--	No
Lead	9.56 (<BG)	250	--	No
Hexavalent Chromium	0.169	240	2.0	No
TPH – diesel range + motor oil	50	2,000	2,000	No
BAP TEC	0.00174 ^d	0.14	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014c), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbon

Table 11. Analytes Detected Above Background at the 600-294 Waste Site that are not Identified as Contaminants of Concern.

Antimony	Total Chromium	Molybdenum
Benzo(g,h,i)perylene	Indeno(1,2,3-cd)pyrene ^a	Methylnaphthalene, 2-
Naphthalene	Phenanthrene	Phenol

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Evaluation of verification sampling results at the 600-294 waste site listed in Tables 9 and 10 demonstrates that all COCs were quantified below the applicable CULs. Evaluation of residual concentrations of carcinogenic PAHs considers mixtures of these carcinogenic PAHs as a single hazardous substance, compared against the cleanup level established for benzo(a)pyrene. Concentrations for each carcinogenic PAH are multiplied by a corresponding toxicity equivalency factor and then summed to a total value, as shown in Appendix A.

Assessment of the residual risk for the 600-294 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-294 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 9.58×10^{-4} , which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 1.27×10^{-8} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-294 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-294 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-294 waste site to Final Closed Out.

600-298 Waste Site – Stained Soil and Surface Debris

Interim Action Summary

The 600-298 waste site included eight areas in the Central Shops Area of White Bluffs, reported as eight subsites, with surface debris and stained soil. The site was remediated between February 21, 2012, and January 29, 2013. The remediation depth for each of the eight subsites varied between 0.9 to 2.4 m

(3 to 8 ft) Verification sampling was performed on April 4, April 23, May 15, May 17, and May 30, 2012, and February 5, 2013, as summarized in Table 12. Additional information is available in the *Remaining Sites Verification Package for the 600-298, Stained Soil/Surface Debris; 600-299, Surface Debris/Batteries; and 600-300, Miscellaneous Surface Debris Waste Sites* (WCH 2013a).

Table 12. Verification Sample Summary Table for the 600-298 Waste Site.

Sample Location	HEIS Sample Numbers	Sample Date	WSP Locations		Sample Analyses	
			Northing	Easting		
600-298:1 A	J1P296	5/15/2012	147543.4	577392.8	ICP metals ^a , mercury, PAH, PCBs, pesticides, TPH	
600-298:1 B	J1P297		147559.3	577406.9		
600-298:2	J1P298		147510.8	577400.2		
600-298:3 A	J1P8C8	5/17/2012	148110.4	577510.6		
600-298:3 B	J1P8C9		148114.1	577505.2		
600-298:4 A5	J1P110	4/23/2012	147749.0	577704.4		
600-298:4 A6	J1P111		147757.4	577699.6		
600-298:4 A6 resample ^b	J1RDW6	2/5/2013	147751.0	577689.0		
Duplicate of J1RDW6 ^b	J1RDW8		147751.0	577689.0		
600-298:4 A7	J1P112	4/23/2012	147738.3	577675.7		
600-298:4 A8	J1P113		147731.0	577681.7		
600-298:4 B1	J1P106	4/23/2012	147738.3	577729.3		
600-298:4 B2	J1P107		147744.6	577721.9		
600-298:4 B3	J1P108		147736.1	577713.5		
600-298:4 B4	J1P109		147730.0	577719.3		
600-298:5-1 (east)	J1NP97		4/4/2012	148008.1		577968.1
Duplicate of J1NP97	J1NP99	148008.1		577968.1		
600-298:5-2 (west)	J1NP98	148001.8		577956.0		
600-298:6	J1P8D4	5/17/2012	147740.8	577911.9		
600-298:7	J1PPC6	5/30/2012	148052.0	578778.8		
600-298:8	J1PPC7		148079.4	578932.6		
Equipment blank (600-298:5)	J1NPC0	4/4/2012	NA	NA		ICP metals ^a , mercury, PAH, PCBs, pesticides, TPH
Equipment blank (600-298:4)	J1RDW5	2/5/2013	NA	NA		ICP metals ^a , mercury, PAH, PCBs, pesticides, TPH

^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.

^b Resample was analyzed for ICP metals and mercury only.

HEIS = Hanford Environmental Information System

ICP = inductively coupled plasma

NA = not applicable

PAH = polycyclic aromatic hydrocarbons

PCB = polychlorinated biphenyl

TPH = total petroleum hydrocarbons

WSP = Washington State Plane

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-298 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014).

Comparisons of the results for each COC detected at the 600-298 waste site against the CULs are shown in Table 13 for the focused sample results. Analytes that were detected in the samples above soil background levels but that are not considered COCs are reported in Table 14. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 13. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-298 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	18.3	20	--	No
Lead	13.5	250	--	No
Mercury	0.0082 (<BG)	0.50	--	No
TPH – diesel range + motor oil	89	2,000	2,000	No
BAP TEC	0.032 ^d	0.14	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013a), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 14. Analytes Detected Above Background at the 600-298 Waste Site that are not Identified as Contaminants of Concern.

Antimony	Total Chromium	Copper
Molybdenum	Nickel	Selenium
Acenaphthene	Benzo(a)anthracene ^a	Benzo(b)fluoranthene ^a
Benzo(g,h,i)perylene	Benzo(k)fluoranthene ^a	Chrysene ^a
Fluoranthene	Indeno(1,2,3-cd)pyrene ^a	Phenanthrene
Pyrene	DDE, 4,4'-	DDT, 4,4'-
Endosulfan (I, II, sulfate)	Heptachlor epoxide	

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyl trichloroethane

Evaluation of verification sampling results at the 600-298 waste site listed in Table 13 demonstrates that all COCs were quantified below the applicable CULs. Evaluation of residual concentrations of carcinogenic PAHs considers mixtures of these carcinogenic PAHs as a single hazardous substance compared against the cleanup level established for benzo(a)pyrene. Concentrations for each

carcinogenic PAH are multiplied by a corresponding toxicity equivalency factor and then summed to a total value, as shown in Appendix A.

Assessment of the residual risk for the 600-298 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-298 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 2.35×10^{-7} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-298 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-298 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-298 waste site to Final Closed Out.

600-299 Waste Site – Surface Debris/Batteries

Interim Action Summary

The 600-299 waste site included six areas in the Central Shops Area of White Bluff, reported as six subsites, with surface debris and/or batteries. The site was remediated between January 16, 2012, and February 4, 2013. The remediation depth for each 600-299 subsite was approximately 0.3 m (1 ft) bgs. Verification sampling was performed on January 31, May 15, May 17, and May 30, 2012, and February 6, 2013, as summarized in Table 15. Additional information is available in the *Remaining Sites Verification Package for the 600-298, Stained Soil/Surface Debris; 600-299, Surface Debris/Batteries; and 600-300, Miscellaneous Surface Debris Waste Sites* (WCH 2013a).

Table 15. Verification Sample Summary Table for the 600-299 Waste Site.

Sample Location	HEIS Sample Numbers	Sample Date	WSP Locations		Sample Analyses
			Northing	Easting	
600-299:1	J1P8D0	5/17/2012	148036.9	577370.1	ICP metals ^a , mercury
600-299:2 ^b	J1N3J1	1/31/2012	149122.3	579511.9	
Duplicate of J1N3J1 ^b	J1N3J2		149122.3	579511.9	
600-299:2 resample 1 ^b	J1P291	5/15/2012	149229.8	579512.8	
600-299:2 resample 2	J1RF24	2/6/2013	149122.0	579511.0	
Duplicate of J1RF24	J1RF25		149122.0	579511.0	
600-299:3	J1P8D1	5/17/2012	146932.0	576994.2	
600-299:4	J1P8D2		146914.5	577025.7	
600-299:5	J1P8D3		147072.7	577024.8	
600-299:6	J1PPC8		147736.9	578863.5	
Equipment blank (600-299:2)	J1N3J3	1/31/2012	NA	NA	ICP metals ^a , mercury
Equipment blank (600-299:2)	J1RF23	2/6/2013	NA	NA	ICP metals ^a , mercury

^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.

^b Sample results exceeded RAGs. This location was further remediated and was resampled for all analyses.

HEIS = Hanford Environmental Information System

RAG = remedial action goal

ICP = inductively coupled plasma

WSP = Washington State Plane

NA = not applicable

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-299 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-299 waste site against the CULs are shown in Table 16 focused sample results. Analytes that were detected in the samples above soil background levels but that are not considered COCs are reported in Table 17. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 16. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-299 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	1.1 (<BG)	20	--	No
Lead	84.0	250	--	No
Mercury	0.027	0.50	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013a), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

Table 17. Analytes Detected Above Background at the 600-299 Waste Site that are not Identified as Contaminants of Concern.

Antimony	Cadmium	Copper
Manganese	Molybdenum	Zinc

Evaluation of verification sampling results at the 600-299 waste site listed in Table 16 demonstrates that all COCs were quantified below the applicable CULs.

Assessment of the residual risk for the 600-299 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-299 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 1.13×10^{-3} , which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-299 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-299 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-299 waste site to Final Closed Out.

600-300 Waste Site – Miscellaneous Surface Debris

Interim Action Summary

The 600-300 waste site consisted of 12 areas in the Central Shops Area of White Bluffs, reported as twelve subsites, including miscellaneous scattered debris. The site was remediated between February 28, 2012, and March 5, 2013. The remediation depth for each 600-300 waste site was approximately 0.3 m (1 ft) bgs. Verification sampling was performed on March 1, May 21, and May 30, 2012, and February 12 and March 5, 2013, as summarized in Table 18. Additional information is available in the *Remaining Sites Verification Package for the 600-298, Stained Soil/Surface Debris; 600-299, Surface Debris/Batteries; and 600-300, Miscellaneous Surface Debris Waste Sites* (WCH 2013a).

Table 18. Verification Sample Summary Table for 600-300 Waste Site.

Sample Location	HEIS Sample Numbers	Sample Date	WSP Locations		Sample Analyses
			Northing	Easting	
600-300:1 ^a	J1PPF3	5/30/2012	147450.1	577304.9	ICP metals ^b , mercury, PAH, PCBs, pesticides, TPH
600-300:1 resample ^{a, c}	J1RHC2	3/5/2013	147450.1	577304.9	
Duplicate of J1RHC2 ^{a, c}	J1RHC3		147450.1	577304.9	
600-300:2 ^c	J1NL71	3/1/2012	147603.2	577568.1	
Duplicate of J1NL71 ^c	J1NL72		147603.2	577568.1	
600-300:3 ^c	J1P8F6	5/30/2012	147119.3	578207.8	
600-300:4	J1P8F5	5/21/2012	147516.7	578305.3	
600-300:5	J1P8F7	5/30/2012	147729.0	578472.7	
600-300:6	J1P8F2	5/21/2012	148147.7	578216.4	
600-300:7	J1P8F3		148139.9	578256.0	
600-300:8	J1P8F4		148123.6	578324.9	
600-300:9	J1PP99	5/30/2012	148183.6	578791.6	
600-300:10	J1PPC0		148146.4	578816.4	
600-300:11	J1PPC1	5/31/2012	149408.5	578578.3	
600-300:11 resample ^d	J1RF30	2/12/2013	149408.0	578578.0	
Duplicate of J1RF30 ^d	J1RF31		149408.0	578578.0	
600-300:12 a ^c	J1PPC3	5/31/2012	148619.9	579584.8	
600-300:12 b ^c	J1PPC4		148653.8	579595.3	
600-300:12 c ^c	J1PPC5		148668.7	579587.8	
Equipment blank (600-300:2)	J1NL73	3/1/2012	NA	NA	
Equipment blank (600-300)	J1RF29	2/12/2013	NA	NA	ICP metals ^b , mercury

^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.

^b The WSP coordinates for the 600-300:1, 600-300:2, 600-300:3, and 600-300:12 subsites are centroid coordinates.

^c Resample was analyzed for PAH only.

^d Resample was analyzed for ICP metals and mercury only.

HEIS = Hanford Environmental Information System

ICP = inductively coupled plasma

NA = not applicable

PAH = polycyclic aromatic hydrocarbons

PCB = polychlorinated biphenyl

TPH = total petroleum hydrocarbons

WSP = Washington State Plane

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-300 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-300 waste site against the CULs are shown in Table 19 for the focused sample results. Analytes that were detected in the samples above soil background levels but that are not considered COCs are reported in Table 20. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 19. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-300 Excavation Focused Verification Samples.

COC	Maximum Result ^{b, c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	28.6	20	--	No ^d
Lead	203	250	--	No
Mercury	0.016	0.50	--	No
Aroclor-1260	0.0097	0.50	--	No
BAP TEC	0.0597 ^e	0.14	--	No
TPH - diesel range extended	130	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013a), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Elevated residual arsenic has been determined to be the result of pre-Hanford pesticide use. Former orchard areas and associated residual elevated lead and arsenic will be addressed separately from the 100-IU-2 Operable Unit.

^e Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 20. Analytes Detected Above Background at the 600-300 Waste Site that are not Identified as Contaminants of Concern.

Antimony	Boron	Zinc
Acenaphthene	Anthracene	Benzo(a)anthracene ^a
Benzo(b)fluoranthene ^a	Benzo(g,h,i)perylene	Benzo(k)fluoranthene ^a
Chrysene ^a	Dibenz(a,h)anthracene ^a	Fluoranthene
Fluorene	Indeno(1,2,3-cd)pyrene ^a	Phenanthrene
Pyrene	DDE, 4,4'-	DDT, 4,4'-
Endrin (and ketone, aldehyde)	Methoxychlor	

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyl trichloroethane

Evaluation of verification sampling results at the 600-300 waste site listed in Table 19 demonstrates that all COCs were quantified below the applicable CULs, with the exception of arsenic. Residual elevated arsenic concentrations at this site are associated with former pesticide usage at pre-Hanford orchard areas. Such contamination will be addressed as part of the 100-OL-1 Operable Unit, separate from the 600-300 waste site. Evaluation of residual concentrations of carcinogenic PAHs considers mixtures of these carcinogenic PAHs as a single hazardous substance, compared against the cleanup level established for benzo(a)pyrene. Concentrations for each carcinogenic PAH are multiplied by a corresponding toxicity equivalency factor and then summed to a total value, as shown in Appendix A.

Assessment of the residual risk for the 600-300 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-300 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 6.67×10^{-4} , which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 4.55×10^{-7} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-300 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-300 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-300 waste site to Final Closed Out.

600-301 Waste Site – White Bluffs Sanitary Sewer Pipelines

Interim Action Summary

The 600-301 waste site consisted of the sanitary sewer system that served the White Bluffs shop area. The waste site remediation occurred between April 22 and June 20, 2013. The maximum depth of the excavation was approximately 2.1 m (7.0 ft) bgs. Verification sampling was performed on September 5, 2013, as summarized in Table 21. Additional information is available in the *Remaining Sites Verification Package for the 600-301, White Bluffs Sanitary Sewer Pipelines Waste Site* (WCH 2014d).

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-301 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-301 waste site against the CULs are shown in Tables 22, 23, and 24 for the statistical, focused, and confirmatory sample results, respectively. Analytes that were detected in the samples above soil background levels but that are not considered COCs are reported in Table 25. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 21. 600-301 Verification Sample Summary.

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

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

^b NWTPH – Dx analyzes for both diesel and heavy oil range organics.

^c The duplicate soil sample will be collected at a location selected at the project analytical lead's discretion.

FS = focused sample

HEIS = Hanford Environmental Information System

ICP = inductively coupled plasma

NA = not applicable

NWTPH-Dx = Northwest total petroleum hydrocarbons – diesel range organics

VSP = Visual Sample Plan

Table 22. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-301 Excavation Statistical Verification Samples.

COC	Statistical or Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	4.88 (<BG)	20	--	No
Lead	5.91 (<BG)	250	--	No
Mercury	0.00922 (<BG)	0.50	--	No
Nitrogen in Nitrate and Nitrite	3.97 ^d (<BG)	128,217 ^e	1,436 ^e	No
TPH – motor oil	6.1	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Maximum of values for nitrogen in nitrate reported in WCH (2014d) based on analyses by EPA Method 300.0 and EPA Method 353.2.

^e Nitrate-based CULs from EPA (2014) have been adjusted to a nitrogen-basis using a factor of 4.43.

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

EPA = U.S. Environmental Protection Agency

TPH = total petroleum hydrocarbons

Table 23. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-301 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Lead	23.1	250	--	No
Nitrogen in Nitrate and Nitrite	28.1 ^d (<BG)	128,217 ^e	1,436 ^e	No
TPH – motor oil + diesel range	16.4	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Maximum of values for nitrogen in nitrate reported in WCH (2014d) based on analyses by EPA Method 300.0 and EPA Method 353.2.

^e Nitrate-based CULs from EPA (2014) have been adjusted to a nitrogen-basis using a factor of 4.43.

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

EPA = U.S. Environmental Protection Agency

TPH = total petroleum hydrocarbons

Table 24. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-301 Waste Site Confirmatory Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Lead	15.4	250	--	No
Nitrogen in Nitrate and Nitrite	7.9 (<BG) ^d	128,217 ^e	1,436 ^e	No
TPH – motor oil + diesel range	32	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Maximum of values for nitrogen in nitrate reported in WCH (2014d) based on analyses by EPA Method 300.0 and EPA Method 353.2.

^e Nitrate-based CULs from EPA (2014) have been adjusted to a nitrogen-basis using a factor of 4.43.

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

EPA = U.S. Environmental Protection Agency

TPH = total petroleum hydrocarbons

Table 25. Analytes Detected Above Background at the 600-301 Waste Site that are not Identified as Contaminants of Concern.

Antimony	Molybdenum	Nickel
Zinc	DDE, 4,4'-	DDT, 4,4'-
Endrin (and ketone, aldehyde)		

DDE = dichlorodiphenyldichloroethylene

DDT = dichlorodiphenyl trichloroethane

Evaluation of verification sampling results at the 600-301 waste site listed in Tables 22, 23 and 24 demonstrates that all COCs were quantified below the applicable CULs.

Assessment of the residual risk for the 600-301 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-301 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 9.88×10^{-4} , which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-301 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-301 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-301 waste site to Final Closed Out.

600-303 Waste Site – Vertical Pipes

Interim Action Summary

The 600-303 waste site included an area with four vertical pipes protruding slightly out of the ground. The waste site remediation occurred between February 11 and February 12, 2012. The soil within this waste site was excavated to a depth of approximately 1.8 m (6 ft) bgs. Verification sampling was performed on February 20, 2013, as summarized in Table 26. Additional information is available in the *Remaining Sites Verification Package for the 600-303, Vertical Pipes; and 600-321, Suspect Asbestos Containing Material and Debris* (WCH 2013b).

Table 26. Verification Sample Summary Table for 600-303 Waste Site.

Waste Site/Subsite	Sample Location	HEIS Number	Sample Date	Coordinate Locations (WSP)	Sample Analysis
600-303	600-303, Base of excavation	JIRFN3	2/20/2013	N. 148907.0 E. 577420.0	ICP metals ^a , mercury, IC anions, nitrate/nitrite, PAH
	Duplicate of JIRFN3	JIRFN4	2/20/2013	N. 148907.0 E. 577420.0	
NA	Equipment blank	JIRFN2	2/20/2013	NA	ICP metals ^a , mercury

^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

WSP = Washington State Plane coordinates, meters

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-303 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-303 waste site against the CULs are shown in Table 27 for the focused sample results. Antimony was detected in the samples above soil background levels but is not considered a COC. The additional potential risk contributions associated with the residual concentrations of antimony, a non-COC analyte, are not significant.

Table 27. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-303 Excavation Focused Verification Samples.

COC	Statistical or Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	0.49 (<BG)	20	--	No
Lead	16.2	250	--	No
Nitrogen in Nitrate	2.5 (<BG) ^d	128,217 ^e	1,436 ^e	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013b), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Maximum of values for nitrogen in nitrate reported in WCH (2013b) based on analyses by EPA Method 300.0 and EPA Method 353.2.

^e Nitrate-based CULs from EPA (2014) have been adjusted to a nitrogen-basis using a factor of 4.43.

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

EPA = U.S. Environmental Protection Agency

Evaluation of verification sampling results at the 600-303 waste site listed in Table 27 demonstrates that all COCs were quantified below the applicable CULs.

Assessment of the residual risk for the 600-303 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-303 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-303 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-303 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-303 waste site to Final Closed Out.

600-316 Waste Site – Dry Cell Batteries

Interim Action Summary

The 600-316 waste site included six areas (subsites) where dry cell battery debris was found on the ground surface. The waste site remediation occurred between May 3, 2012, and February 4, 2013. The soil within these subsites was excavated to a depth of approximately 0.3 to 1 m (1 to 3.3 ft) bgs. Verification sampling was performed between May 15, 2012, and February 12, 2013, as summarized in Table 28. Additional information is available in the *Remaining Sites Verification Package for the 600-316, Dry Cell Batteries and 600-318, Wet Cell Batteries* (WCH 2013c).

Table 28. Sample Summary Table for the 600-316 Waste Site.

Sample Location	HEIS Number	Sample Analysis
600-316:1 Area 1	J1PP97	ICP metals ^a , mercury
600-316:2 Area 2	J1P292	
600-316:2 Area 3	J1PP65	
600-316:4 Area 4	J1RF27	
600-316:5 Area 5A	J1PP68	
600-316:5 Area 5B	J1PP69	
600-316:6 Area 6	J1PP98	
600-316:2 Duplicate (Area 2)	J1P293	
600-316:4 Duplicate (Area 4)	J1RF28	
Equipment blank (600-316:2)	J1P294	
Equipment blank (600-316:4)	J1RF26	

^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

ICP = inductively coupled plasma

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-316 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-316 waste site against the CULs are shown in Table 29 for the focused sample results. Analytes that were detected in the samples above soil background levels but are not considered COCs are reported in Table 30. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 29. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-316 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	6.6	20	--	No
Lead	26.9	250	--	No
Mercury	0.076	0.50	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013c), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

COC = contaminant of concern

CUL = cleanup level

Table 30. Analytes Detected Above Background at the 600-316 Waste Site that are not Identified as Contaminants of Concern.

Antimony	Cadmium	Manganese
Zinc		

Evaluation of verification sampling results at the 600-316 waste site listed in Table 29 demonstrates that all COCs were quantified below the applicable CULs.

Assessment of the residual risk for the 600-316 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-316 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 3.17×10^{-3} , which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-316 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-316 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-316 waste site to Final Closed Out.

600-318 Waste Site – Wet Cell Batteries

Interim Action Summary

The 600-318 waste site included five areas (subsites) of wet cell batteries located on the ground surface, generally in areas containing automotive debris. The waste site remediation occurred between July 6, 2011, and February 7, 2013. The soil within these subsites was excavated to a depth of approximately 0.3 to 1 m (1 to 3.3 ft) bgs. Verification sampling was performed between December 7, 2011, and March 6, 2013, as summarized in Table 31. Additional information is available in the *Remaining Sites Verification Package for the 600-316, Dry Cell Batteries and 600-318, Wet Cell Batteries* (WCH 2013c).

**Table 31. Sample Summary Table for the
600-318 Waste Site.**

Sample Location	HEIS Number	Sample Analysis
600-318:1 Area 1	J1PP93	ICP metals ^a , mercury
600-318:2 Area 2	J1PP94	
600-318:3 Area 3 ^b	J1PIL2	
600-318:3 Area 3 resample	J1RH87	
600-318:4 Area 4 ^b	J1MXR1	
600-318:4 Area 4 resample	J1N3J8	
600-318:5 Area 5	J1MXR2	
600-318:3 Duplicate (Area 3) ^b	J1PIL3	
600-318:3 Duplicate (Area 3 resample)	J1RH88	
Equipment blank (600-318:3)	J1PIL4	
Equipment blank (600-318:3 resample)	J1RH86	

^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.

^b Samples J1PIL2, J1PIL3, and J1MXR1 from Areas 3 and 4 exceeded remedial action goals for lead and were not used in the calculations for waste site reclassification. After further remediation at these locations, samples J1RH87, J1RH88, and J1N3J8 were collected and used for waste site reclassification.

HEIS = Hanford Environmental Information System

ICP = inductively coupled plasma

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-318 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-318 waste site against the CULs are shown in Table 32 for the focused sample results. Analytes that were detected in the samples above soil background levels but that are not considered COCs are reported in Table 33. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 32. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-318 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	4.8 (<BG)	20	--	No
Lead	168	250	--	No
Mercury	0.0093 (<BG)	0.50	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013c), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

Table 33. Analytes Detected Above Background at the 600-318 Waste Site that are not Identified as Contaminants of Concern.

Antimony	Boron	Copper
Molybdenum		

Evaluation of verification sampling results at the 600-316 waste site listed in Table 32 demonstrates that all COCs were quantified below the applicable CULs.

Assessment of the residual risk for the 600-318 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-318 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-318 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-318 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this

waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-318 waste site to Final Closed Out.

600-320 Waste Site – Oil Stains

(Including 600-320:1, 600-320:2, 600-320:3, 600-320:4, 600-320:5, 600-320:6, 600-320:7, 600-320:8 and 600-320:9 Subsites)

Interim Action Summary

The 600-320 waste site included nine areas (subsites) of suspected oil dump areas. Remedial action and verification sampling activities at the 600-320 subsites are summarized in Table 34. Verification sampling performed for each subsite is summarized in Tables 35 and 36. Additional information is available in the *Remaining Sites Verification Package for the 600 320, Oil Stains Waste Site* (WCH 2013d).

Table 34. Remedial Action Summary.

Subsite	Remediation Date	Verification Sampling Dates
600-320:1	May 11 to 14, 2012	May 24, 2012
600-320:2	May 9, 2012	May 15, 2012
600-320:3	April 30, 2012, to March 21, 2013	May 24, 2012 March 6, 2013 March 25, 2013 April 30, 2013
600-320:4	April 30 to May 8, 2012	May 24, 2012
600-320:5	April 30 to May 2, 2012	May 24, 2012
600-320:6	May 4, 2012	May 24, 2012
600-320:7	January 16 to 31, 2012	January 31, 2012
600-320:8	June 27, 2011, to January 17, 2012	December 7, 2011 January 21, 2012
600-320:9	May 23, 2012, to January 24, 2013	May 30, 2012 February 6, 2013
Total	June 27, 2011, to March 21, 2013	

Table 35. Verification Sample Summary for the 600-320:1, 600-320:2, 600-320:4, 600-320:5, 600-320:6, 600-320:7, 600-320:8, and 600-320:9 Composite Samples.

Sample Location	HEIS Number	Sample Date	Washington State Plane Coordinate Locations (m)	Sample Analysis
600-320:1	J1PP56	5/24/2012	N 144521.2 E 580232.2	ICP metals ^a , mercury, TPH, PAH
600-320:2	J1P299	5/15/2012	N 142045.3 E 581894.5	
600-320:4a	J1PP61	5/24/2012	N 140219.7 E 583138.6	
600-320:4b	J1PP62		N 140218.5 E 583160.8	
600-320:4c	J1PP63		N 140246.2 E 583144.5	
600-320:5	J1PP64		N 140081.3 E 583217.7	
600-320:6	J1PP82		N 140271.1 E 583472.8	
600-320:7	J1N3J9		1/31/2012	
600-320:8	J1MXX4	12/7/2011	N 137843.3 E 587461.7	
Duplicate of J1MXX4	J1MXX5			
600-320:8 Resample	J1N3J4	1/31/2012		
600-320:9	J1PP89	5/30/2012	N 144926.5 E 580204.0	
600-320:9 Resample	J1RDX0	2/6/2013	N 144925.0 E 580201.0	
Duplicate of J1RDX0	J1RDX1			
Equipment blank (600-320:8)	J1MXX6	12/7/2011	NA	ICP metals ^a , mercury
Equipment blank (600-320:9)	J1RDW9	2/6/2013		ICP metals ^a

^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

ICP = inductively coupled plasma

NA = not applicable

PAH = polycyclic aromatic hydrocarbons

TPH = total petroleum hydrocarbons

Table 36. Verification Sample Summary for the 600-320:3 Statistical and Focused Samples.

Sample Location	Sample Date	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
			Northing	Easting	
600-320:3a	5/24/2012	J1PP57	140277.6	583060.4	ICP metals ^a , mercury, TPH, PAH
600-320:3b		J1PP58	140272.9	583071.7	
600-320:3c		J1PP59	140267.0	583084.1	
600-320:3d		J1PP60	140262.7	583095.4	
VSP-1	3/6/2013	J1RHR1	140257.0	583080.1	
VSP-2		J1RHR0	140257.0	583090.2	
VSP-3		J1RHP8	140257.0	583100.2	
VSP-4		J1RHR8	140265.7	583065.1	
VSP-5		J1RHR4	140265.7	583075.1	
	3/25/2013	J1RJL2			
VSP-6	3/6/2013	J1RHR2	140265.7	583085.2	ICP metals ^a , mercury, TPH, PAH
		J1RHP9			
VSP-7	3/25/2013	J1RJL3	140265.7	583095.2	TPH
	4/30/2013	J1RKR5			VOA (BTEX)
VSP-8	3/6/2013	J1RHT0	140274.4	583060.1	ICP metals ^a , mercury, TPH, PAH
VSP-9		J1RHR6			
Duplicate of VSP-9		J1RHR7	140274.4	583070.1	
VSP-10		J1RHR3	140274.4	583080.1	
VSP-11		J1RHT1	140283.1	583055.1	
VSP-12		J1RHR9	140283.1	583065.1	
Equipment blank		J1RHR5	NA	NA	

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

BTEX = benzene, toluene, ethylbenzene, and xylene
 HEIS = Hanford Environmental Information System
 ICP = inductively coupled plasma
 NA = not applicable

PAH = polycyclic aromatic hydrocarbons
 TPH = total petroleum hydrocarbons
 VSP = Visual Sample Plan
 VOA = volatile organic analysis

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-320 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-320 subsites against the CULs are shown in Tables 37, 39 to 41, 43 to 46, 48, and 50 for the verification sample results. Analytes that were detected in the samples above soil background levels, but that are not considered COCs, are reported in Tables 38, 42, 47, and 49 for each applicable subsite. Antimony was detected in the 600-320:6 and 600-320:9 verification samples above soil background levels but is not considered a COC. The additional potential risk contributions associated with these residual antimony concentrations and other non-COC analytes listed in Tables 38, 42, 47, and 49 are not significant.

Table 37. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-320:1 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	1.7 (<BG)	20	--	No
Lead	4.0 (<BG)	250	--	No
BAP TEC	0.123 ^d	0.14	--	No
TPH – diesel range + motor oil	20	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 38. Analytes Detected Above Background at the 600-320:1 Subsite that are not Identified as Contaminants of Concern.

Antimony	Benzo(a)anthracene ^a	Benzo(b)fluoranthene ^a
Benzo(g,h,i)perylene	Benzo(k)fluoranthene ^a	Chrysene ^a
Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene ^a
Phenanthrene	Pyrene	

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Table 39. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-320:2 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	2.9 (<BG)	20	--	No
Lead	4.0 (<BG)	250	--	No
TPH – diesel range extended	5.5	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

TPH = total petroleum hydrocarbons

Table 40. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-320:3 Excavation Statistical Verification Samples.

COC	Statistical Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	4.6 (<BG)	20	--	No
Lead	4.9 (<BG)	250	--	No
Mercury	0.013 (<BG)	24	--	No
BAP TEC	0.148 ^d	0.14	--	Yes ^e
TPH – diesel range extended	100	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

^e Calculated BAP TEC value is based on a single sample in the statistical set and overstates the residual polycyclic aromatic hydrocarbon concentrations at the site.

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 41. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-320:3 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	5.0 (<BG)	20	--	No
Lead	5.6 (<BG)	250	--	No
Mercury	0.0091 (<BG)	24	--	No
BAP TEC ^d	0.014 ^d	0.14	--	No
TPH – diesel range extended	310	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 42. Analytes Detected Above Background at the 600-320:3 Subsite that are not Identified as Contaminants of Concern.

Benzo(a)anthracene ^a	Benzo(k)fluoranthene ^a	Fluoranthene
Naphthalene		

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Table 43. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-320:4 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	2.5 (<BG)	20	--	No
Lead	4.9 (<BG)	250	--	No
Mercury	0.0070 (<BG)	24	--	No
TPH – diesel range extended	67	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

TPH = total petroleum hydrocarbons

Table 44. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-320:5 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	1.9 (<BG)	20	--	No
Lead	4.1 (<BG)	250	--	No
Mercury	0.0069 (<BG)	24	--	No
TPH – diesel range extended	3.1	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

TPH = total petroleum hydrocarbons

Table 45. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-320:6 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	2.0 (<BG)	20	--	No
Lead	3.9 (<BG)	250	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

Table 46. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-320:7 Excavation focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	18.2	20	--	No
Lead	62.9	250	--	No
Mercury	0.011 (<BG)	24	--	No
BAP TEC	0.014 ^d	0.14	--	No
TPH – diesel range extended	32	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 47. Analytes Detected Above Background at the 600-320:7 Subsite that are not Identified as Contaminants of Concern.

Benzo(b)fluoranthene ^a	Benzo(g,h,i)perylene	Benzo(k)fluoranthene ^a
Chrysene ^a	Fluoranthene	Indeno(1,2,3-cd)pyrene ^a

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Table 48. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-320:8 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	57.5	20	--	No ^d
Lead	142	250	--	No
BAP TEC	0.068 ^c	0.14	--	No
TPH – diesel range extended	36	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Elevated residual arsenic has been determined to be the result of pre-Hanford pesticide use. Former orchard areas and associated residual elevated lead and arsenic will be addressed separately from the 100-IU-6 Operable Unit.

^e Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 49. Analytes Detected Above Background at the 600-320:8 Subsite that are not Identified as Contaminants of Concern.

Benzo(a)anthracene ^a	Benzo(b)fluoranthene ^a	Benzo(g,h,i)perylene
Benzo(k)fluoranthene ^a	Chrysene ^a	Fluoranthene
Pyrene	Indeno(1,2,3-cd)pyrene ^a	Phenanthrene

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Table 50. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-320:9 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	1.6 (<BG)	20	--	No
Lead	6.1 (<BG)	250	--	No
TPH – diesel range extended	3.7	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013d), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

TPH = total petroleum hydrocarbons

Evaluation of verification sampling results at the 600-320 subsites listed in Table 37, 39 to 41, 43 to 46, 48, and 50 demonstrates that all COCs were quantified below the applicable CULs, with the exception of benzo(a)pyrene toxic equivalency concentration (BAP TEC) at the 600-320:3 subsite and arsenic at the 600-320:8 subsite. The calculated BAP TEC value for the 600-320:3 subsite is associated with single detections of carcinogenic PAHs in a statistical data set with no detections in the other samples in the set. In such cases of heavily left-censored data, the maximum detected value is conservatively used for evaluation of the set, but this overstates the residual PAH concentrations, resulting in an apparent slight exceedance for the summed PAH values. Considering nondetects, the total site concentrations are significantly lower and do not represent a CUL exceedance. Residual elevated arsenic concentrations at the 600-320:8 subsite are associated with former pesticide usage at pre-Hanford orchard areas. Such contamination will be addressed as part of the 100-OL-1 Operable Unit, separate from the 600-320 waste site.

Assessment of the residual risk for the 600-320:1 through 600-320:9 subsites is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels.

For the 600-320:1 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 8.96×10^{-7} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-320:1 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-320:2 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-320:2 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-320:3 subsite, all individual hazard quotients were less than 1.0. The individual excess carcinogenic risk value for BAP TEC was 1.08×10^{-6} , greater than 1×10^{-6} . As previously described, this slight nominal exceedance is an overstatement of risk for the subsite and does not require further consideration. The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 1.08×10^{-6} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-320:3 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-320:4 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-320:4 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-320:5 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-320:5 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-320:6 subsite, none of the detected COCs qualified for the calculation of the hazard quotient and excess carcinogenic risk values for direct contact; therefore, the calculation was not performed for COCs. The 600-320:6 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-320:7 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 1.05×10^{-7} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-320:7 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-320:8 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 4.96×10^{-7} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-320:8 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-320:9 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-320:9 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-320 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-320 waste site to Final Closed Out.

600-321 Waste Site – Suspect ACM SitesInterim Action Summary

The 600-321 waste site included four surface areas in the former Hanford Construction Camp, reported as four subsites, with scattered metal, firebrick, suspect friable asbestos, and pipe lagging. Remediation of the 600-321 waste site occurred from June 28, 2011, through March 19, 2013. Cleanup verification sampling was performed on December 7, 2011; March 5, 2013; and March 26, 2013, as summarized in Table 51. Additional information is available in the *Remaining Sites Verification Package for the 600-303, Vertical Pipes; and 600-321, Suspect Asbestos Containing Material and Debris* (WCH 2013b).

**Table 51. Verification Sample Summary Table for
600-321 Waste Site. (2 Pages)**

Waste Site/Subsite	Sample Location	HEIS Number	Sample Date	Coordinate Locations (WSP)	Sample Analysis
600-321:1	Northeast quadrant	J1RHD0	3/5/2013	N. 144157.0 E. 580447.0	Asbestos
	Duplicate of J1RHD0	J1RHD1	3/5/2013	N. 144157.0 E. 580447.0	
	Northwest quadrant	J1RHC9	3/5/2013	N. 144156.0 E. 580442.0	
	Southeast quadrant	J1RHC8	3/5/2013	N. 144147.0 E. 580450.0	
	Resample of J1RHC8	J1RJN0	3/26/2013	N. 144147.0 E. 580450.0	
	Southwest quadrant	J1RHC7	3/5/2013	N. 144146.0 E. 580443.0	
600-321:2	600-321:2a (south)	J1MXJ9	12/7/2011	N. 138027.9 E. 586083.7	Asbestos
	600-321:2a (north)	J1MXK0	12/7/2011	N. 138030.4 E. 586078.7	
	600-321:2b (east)	J1MXJ7	12/7/2011	N. 138017.9 E. 586099.1	
	600:321:2b (west)	J1MXJ8	12/7/2011	N. 138014.5 E. 586095.3	
600-321:3	600-321:3	J1MXK1	12/7/2011	N. 138189.2 E. 586169.2	Asbestos

Table 51. Verification Sample Summary Table for 600-321 Waste Site. (2 Pages)

Waste Site/Subsite	Sample Location	HEIS Number	Sample Date	Coordinate Locations (WSP)	Sample Analysis
600-321:4	600-321:4	J1MXK2	12/7/2011	N. 138757.1 E. 586859.1	Asbestos
	Duplicate of J1MXK2	J1MXK3	12/7/2011	N. 138757.1 E. 586859.1	

HEIS = Hanford Environmental Information System

WSP = Washington State Plane coordinates, meters

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-321 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). No comparison table is prepared for the 600-321 waste site since this waste site underwent sampling for asbestos only. Asbestos was detected at the southeast quadrant (sample HEIS number: J1RH8); therefore, this location underwent re-sampling after additional remediation was performed. Final verification samples indicated that asbestos was non-detected for each of the 600-321 waste site sample locations.

Summary for Final Closure

The 600-321 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that all asbestos was removed from the 600-321 waste site excavation; therefore, the residual site condition supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-321 waste site to Final Closed Out.

600-328 Waste Site – Lead SlagInterim Action Summary

The 600-328 waste site consisted of several surface deposits of lead slag and a small area of stained soil that was presumed to be due to petroleum. The waste site remediation occurred between January 30, 2013, and February 4, 2013. The final excavation depth for the 600-328 waste site is approximately 0.9 m (3 ft). Verification sampling was performed on February 12, 2013, as summarized in Table 31. Additional information is available in the *Remaining Sites Verification Package for the 600-328, Lead Slag Waste Site* (WCH 2013e).

Table 52. Verification Sample Summary for the 600-328 Waste Site.

Composite Sample Location	HEIS Number	Sample Date	Coordinate Locations (WSP)	Sample Analysis
Northwest half	J1RF93	2/12/2013	N 138524 E 586119	ICP metals ^a
Southeast half	J1RF95	2/12/2013	N 138519 E 586124	
Duplicate of J1RF93	J1RF94	2/12/2013	N 138524 E 586119	
Equipment blank	J1RF92	2/12/2013	NA	

^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
ICP = inductively coupled plasma

NA = not applicable
WSP = Washington State Plane, meters

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-318 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-318 waste site against the CULs are shown in Table 53 for the focused sample results.

Table 53. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-328 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	5.3 (<BG)	20	--	No
Lead	17.5	250	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2013e), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

Evaluation of verification sampling results at the 600-328 waste site listed in Table 53 demonstrates that all COCs were quantified below the applicable CULs.

Assessment of the residual risk for the 600-328 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-328 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Therefore, the 600-328 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-328 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-328 waste site to Final Closed Out.

600-356 Waste Site – Tar Deposit West of Susie Junction

Interim Action Summary

The 600-356 waste site consisted of a total area of approximately 1,624 m² (17,481 ft²) that contained pebbles, rocks, and visible dark tar material. The 600-356 waste site was located west of the railroad junction known as Susie Junction. The site was remediated between July 9, 2013, and December 12, 2013. The maximum depth of the excavation was approximately 3.6 m (12 ft). Verification sampling was performed on February 18, 2014, as summarized in Table 54. Additional information is available in the *Remaining Sites Verification Package for the 600-356, Tar Deposit West of Susie Junction Waste Site* (WCH 2014e).

Table 54. 600-356 Waste Site Verification Sample Summary. (2 Pages)

Sample Location	HEIS Sample Number	Washington State Plane (m)		Sample analysis
		Easting	Northing	
EXC-1	J1T932	566632.4	140606.1	ICP metals ^a , NWTPH-Dx ^b , PAH, PCB
EXC-2	J1T933	566644.9	140606.1	
EXC-3	J1T934	566626.2	140616.9	
EXC-4	J1T935	566638.7	140616.9	
EXC-5	J1T936	566607.4	140627.8	
EXC-6	J1T937	566619.9	140627.8	
EXC-7	J1T938	566632.4	140627.8	
EXC-8	J1T939	566601.2	140638.6	
EXC-9	J1T940	566613.7	140638.6	
EXC-10	J1T941	566626.2	140638.6	
EXC-11	J1T942	566594.9	140649.4	
EXC-12	J1T943	566607.4	140649.4	
Duplicate of J1T932	J1T944	566632.4	140606.1	

Table 54. 600-356 Waste Site Verification Sample Summary. (2 Pages)

Sample Location	HEIS Sample Number	Washington State Plane (m)		Sample analysis
		Easting	Northing	
Equipment blank	J1T945	NA	NA	ICP metals ^a , PAH

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

^b NWTPH – Dx analyzed for both diesel and heavy oil range organics.

EXC = excavation (random, gridded sample)

HEIS = Hanford Environmental Information System

ICP = inductively coupled plasma

NA = not applicable

NWTPH-Dx = Northwest total petroleum hydrocarbons – diesel range organics

PAH = polycyclic aromatic hydrocarbons

PCB = polychlorinated biphenyl

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-356 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-356 waste site against the CULs are shown in Table 55 for the statistical sample results. Analytes that were detected in the samples above soil background levels but that are not considered COCs are reported in Table 56. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 55. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-356 Excavation Statistical Verification Samples.

COC	Statistical Result ^{b, c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	5.24 (<BG)	20	--	No
Lead	6.34 (<BG)	250	--	No
BAP TEC	0.00250 ^d	0.14	--	No
TPH – diesel range + motor oil	36	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014e), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 56. Analytes Detected Above Background at the 600-356 Waste Site that are not Identified as Contaminants of Concern.

Silver	Benzo(b)fluoranthene ^a	Benzo(g,h,i)perylene
Chrysene ^a	Fluoranthene	Pyrene

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Evaluation of verification sampling results at the 600-356 waste site listed in Table 55 demonstrates that all COCs were quantified below the applicable CULs. Evaluation of residual concentrations of carcinogenic PAHs considers mixtures of these carcinogenic PAHs as a single hazardous substance, compared against the cleanup level established for benzo(a)pyrene. Concentrations for each carcinogenic PAH are multiplied by a corresponding toxicity equivalency factor and then summed to a total value, as shown in Appendix A.

Assessment of the residual risk for the 600-356 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-356 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 1.82×10^{-8} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-356 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-356 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-356 waste site to Final Closed Out.

600-368 Waste Site – Segment 4, Stained Soil #1

Interim Action Summary

The 600-368 waste site consisted of a 15-m² (157-ft²) area covered with green granules. The site was remediated on March 28, 2013. The approximate depth of the 600-368 excavation is 0.5 to 1 m (1.5 to 3.3 ft) bgs. Verification sampling was performed on May 16, 2013, as summarized in Table 57.

Table 57. Sample Summary Table for the 600-368 Waste Site.

Sample Location	HEIS Number	Sample Analysis
600-368	J1RML8	ICP metals ^a , mercury, PAH, nitrite/nitrate, hexavalent chromium
600-368, duplicate of J1RML8	J1RML9	
Equipment blank (600-368)	J1RMM0	ICP metals ^a , mercury

^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

PAH = polycyclic aromatic hydrocarbons

ICP = inductively coupled plasma

Additional information is available in the *Remaining Sites Verification Package for the 600-368, Segment 4 Stained Soil #1; and 600-369, Segment 4 Bare Ground and Crusted Soil Areas Waste Sites* (WCH 2014f).

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-368 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-368 waste site against the CULs are shown in Table 58 for the focused sample results. Antimony was detected in the samples above soil background levels but is not considered a COC. The additional potential risk contributions associated with the residual concentrations of antimony, a non-COC analyte, are not significant.

Table 58. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-368 Excavation Maximum Verification Samples.

COC	Statistical Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	3.1 (<BG)	20	--	No
Hexavalent Chromium	0.231	240	2.0	No
Lead	6.8 (<BG)	250	--	No
Nitrogen in Nitrate and Nitrite ^d	4.1 (<BG)	128,217 ^e	1,436 ^e	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014f), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Maximum of values for nitrogen in nitrate reported in WCH (2014f) based on analyses by EPA Method 300.0 and EPA Method 353.2.

^e Nitrate-based CULs from EPA (2014) have been adjusted to a nitrogen-basis using a factor of 4.43.

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

EPA = U.S. Environmental Protection Agency

Evaluation of verification sampling results at the 600-368 waste site listed in Table 58 demonstrates that all COCs were quantified below the applicable CULs.

Assessment of the residual risk for the 600-368 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-368 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 9.63×10^{-4} , which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-368 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-368 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-368 waste site to Final Closed Out.

600-369 Waste Site – Segment 4, Bare Ground and Crusted Soil Areas

Interim Action Summary

The 600-369 waste site was divided into eight subsites: 600-369:1, 600-369:2, 600-369:3, 600-369:4, 600-369:5, 600-369:6, 600-369:7, and 600-369:8. All subsites consisted of areas devoid of vegetation located near the Leazer Spur in the 100-IU-6 Operable Unit of the Hanford Site. Remediation of the 600-369 waste site, including all eight subsites (600-369:1, 600-369:2, 600-369:3, 600-369:4, 600-369:5, 600-369:6, 600-369:7, and 600-369:8), was performed from March 28 through May 6, 2013. The approximate excavation depth of the 600-369 subsites varied from 0.5 to 1 m (1.5 to 3.3 ft) bgs. Verification sampling was performed on May 16, 28, and 29, 2013, as summarized in Tables 59 and 60. Additional information is available in the *Remaining Sites Verification Package for the 600-368, Segment 4 Stained Soil #1; and 600-369, Segment 4 Bare Ground and Crusted Soil Areas Waste Sites* (WCH 2014f).

Table 59. Sample Summary Table for the 600-369:1, 600-369:2, 600-369:4, 600-369:6, 600-369:7, and 600-369:8 Subsites.

Sample Location	HEIS Number	Sample Analysis
600-369:1, Area 1	J1RMN7	ICP metals ^a , mercury, TPH, PAH
600-369:1, Area 2	J1RMN8	
600-369:2	J1RMN9	
600-369:4, Area A	J1RMP0	
600-369:4, Area B	J1RMP1	
600-369:6, Area A	J1RMP2	
600-369:6, Area B	J1RMP3	
600-369:7	J1RMP4	
600-369:8, Area A	J1RMP5	
600-369:8, Area B	J1RMP6	
600-369:8, Area C	J1RMP7	
600-369:8, Area D	J1RMP8	
600-369:8, duplicate of J1RMP8	J1RMP9	

^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

PAH = polycyclic aromatic hydrocarbons

ICP = inductively coupled plasma

TPH = total petroleum hydrocarbons

Table 60. 600-369:3 and 600-369:5 Sample Summary. (2 Pages)

Sample Location	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
		Northing	Easting	
EXC3-1	J1RN42	145185.1	579791.0	ICP metals ^a , TPH, PAH, pesticides, PCBs
EXC3-2	J1RN43	145185.1	579812.4	
EXC3-3	J1RN44	145185.1	579833.9	
EXC3-4	J1RN45	145185.1	579855.4	
EXC3-5	J1RN46	145203.7	579780.2	
EXC3-6	J1RN47	145203.7	579801.7	
EXC3-7	J1RN48	145203.7	579823.2	
EXC3-8	J1RN49	145203.7	579844.6	
EXC3-9	J1RN50	145222.3	579791.0	
EXC3-10	J1RN51	145222.3	579812.4	
EXC3-11	J1RN52	145222.3	579833.9	
EXC3-12	J1RN53	145240.9	579823.2	
Duplicate of J1RN49	J1RN54	145203.7	579844.6	

Table 60. 600-369:3 and 600-369:5 Sample Summary. (2 Pages)

Sample Location	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
		Northing	Easting	
EXC5-1	J1RN56	145332.0	579930.8	ICP metals ^a , TPH, PAH, pesticides, PCBs
EXC5-2	J1RN57	145332.0	579945.4	
EXC5-3	J1RN58	145332.0	579960.0	
EXC5-4	J1RN59	145344.7	579938.1	
EXC5-5	J1RN60	145344.7	579952.7	
EXC5-6	J1RN61	145344.7	579967.3	
EXC5-7	J1RN62	145357.3	579930.8	
EXC5-8	J1RN63	145357.3	579945.4	
EXC5-9	J1RN64	145357.3	579960.0	
EXC5-10	J1RN65	145357.3	579974.6	
EXC5-11	J1RN66	145369.9	579938.1	
EXC5-12	J1RN67	145369.9	579952.7	
Duplicate of J1RN67	J1RN68	145369.9	579952.7	
Equipment blank (600-369:3)	J1RN55	NA	NA	ICP metals ^a
Equipment blank (600-369:5)	J1RN69	NA	NA	

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

EXC = excavation (random, gridded sample)

HEIS = Hanford Environmental Information System

ICP = inductively coupled plasma

NA = not applicable

PAH = polycyclic aromatic hydrocarbons

PCB = polychlorinated biphenyl

TPH = total petroleum hydrocarbons

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-369 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at 600-369 subsites against the CULs are shown in Tables 61-63, 65, 67-69, and 70 for the focused and/or statistical sample results. Analytes that were detected in the samples above soil background levels, but that are not considered COCs, are reported in Tables 64 and 66 for each applicable subsite. Antimony was detected in the 600-369:1 subsite samples above soil background levels but is not considered a COC. Benzo(b)fluoranthene was detected in the 600-369:2 subsite samples above soil background levels but is not considered a COC. Benzo(b)fluoranthene and chrysene were detected in the 600-369:5 subsite samples above soil background levels but is not considered a COC. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 61. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-369:1 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	2.5 (<BG)	20	--	No
Lead	4.0 (<BG)	250	--	No
TPH – diesel range extended	82	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014f), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

TPH = total petroleum hydrocarbons

Table 62. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-369:2 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	2.7 (<BG)	20	--	No
Lead	3.8 (<BG)	250	--	No
BAP TEC	0.0010 ^d	0.14	--	No
TPH – diesel range extended	6.0	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014f), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 63. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-369:3 Excavation Statistical Verification Samples. (2 Pages)

COC	Statistical Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	12.5	20	--	No
Lead	52.4	250	--	No
BAP TEC	0.125 ^d	0.14	--	No

Table 63. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-369:3 Excavation Statistical Verification Samples. (2 Pages)

COC	Statistical Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
TPH – diesel range extended	31	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014f), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 64. Analytes Detected Above Background at the 600-369:3 Subsite that are not Identified as Contaminants of Concern.

Antimony	Acenaphthene	Benzo(a)anthracene ^a
Benzo(b)fluoranthene ^a	Benzo(g,h,i)perylene	Benzo(k)fluoranthene ^a
Chrysene ^a	Fluoranthene	Fluorene
Indeno(1,2,3-cd)pyrene ^a	Phenanthrene	Pyrene

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Table 65. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-369:4 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	27.0	20	--	No ^d
Lead	59.6	250	--	No
BAP TEC	0.018 ^e	0.14	--	No
TPH – diesel range extended	14	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014f), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Elevated residual arsenic has been determined to be the result of pre-Hanford pesticide use. Former orchard areas and associated residual elevated lead and arsenic will be addressed separately from the 100-IU-6 Operable Unit.

^e Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 66. Analytes Detected Above Background at the 600-369:4 Subsite that are not Identified as Contaminants of Concern.

Benzo(a)anthracene ^a	Benzo(b)fluoranthene ^a	Benzo(g,h,i)perylene
Benzo(k)fluoranthene ^a	Chrysene ^a	Fluoranthene
Pyrene		

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Table 67. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-369:5 Excavation Statistical Verification Samples.

COC	Statistical Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	3.4 (<BG)	20	--	No
Lead	5.0 (<BG)	250	--	No
BAP TEC	0.00082 ^d	0.14	--	No
TPH – diesel range extended	25	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014f), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 68. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-369:6 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	2.8 (<BG)	20	--	No
Lead	4.2 (<BG)	250	--	No
TPH – diesel range extended	78	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014f), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

TPH = total petroleum hydrocarbons

Table 69. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-369:7 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	3.3 (<BG)	20	--	No
Lead	5.5 (<BG)	250	--	No
TPH – diesel range extended	6.8	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014f), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

TPH = total petroleum hydrocarbons

Table 70. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-369:8 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	3.3 (<BG)	20	--	No
Lead	3.5 (<BG)	250	--	No
TPH – diesel range extended	130	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014f), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

TPH = total petroleum hydrocarbons

Evaluation of verification sampling results at the 600-369 waste site listed in Tables 61-63, 65, 67-69, and 70 demonstrates that all COCs were quantified below the applicable CULs with the exception of arsenic at the 600-369:4 subsite. Residual elevated arsenic concentrations are associated with former pesticide usage at pre-Hanford orchard areas. Such contamination will be addressed as part of the 100-OL-1 Operable Unit, separate from the 600-369 waste site. Evaluation of residual concentrations of carcinogenic PAHs considers mixtures of these carcinogenic PAHs as a single hazardous substance compared against the cleanup level established for benzo(a)pyrene. Concentrations for each carcinogenic PAH are multiplied by a corresponding toxicity equivalency factor and then summed to a total value, as shown in Appendix A.

Assessment of the residual risk for each of the 600-369 subsite is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels.

For the 600-369:1 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-369:1 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-369:2 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 7.30×10^{-9} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-369:2 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-369:3 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 9.10×10^{-7} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-369:3 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-369:4 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 1.34×10^{-7} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-369:4 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-369:5 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 5.98×10^{-9} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-369:5 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-369:6 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-369:6 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-369:7 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Therefore, the 600-369:7 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-369:8 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Therefore, the 600-369:8 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-369 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-369 waste site to Final Closed Out.

600-370 Waste Site – Segment 4 Debris Areas #1

Interim Action Summary

The 600-370 waste site consisted of multiple burn sites with burn remnants, transite, insulators, wood, and concrete. The site was remediated between May 8 and July 9, 2013. The approximate depth of the 600-370 excavation was 0.3 to 1.5 m (1 to 5 ft) bgs. Verification sampling was performed on July 25 and September 10, 2013, as summarized in Table 71. Additional information is available in the *Remaining Sites Verification Package for the 600-370, Segment 4 Debris Area #1 Waste Site* (WCH 2014g).

Table 71. 600-370 Sample Summary.

Sample Location	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
		Northing	Easting	
EXC-1	J1RVL2/ J1RVM7	144960.3	577808.4	ICP metals ^a , TPH, PAH, asbestos
EXC-2	J1RVL4/ J1RVM9	144983.4	577768.4	
EXC-3	J1RVL5/ J1RVN0	144983.4	577795.1	
EXC-4	J1RVL6/ J1RVN1	144983.4	577821.7	
EXC-5	J1RVL7/ J1RVN2	145006.4	577728.5	ICP metals ^a , TPH, PAH, asbestos
EXC-6	J1RVL8/ J1RVN3	145006.4	577755.1	
EXC-7	J1RVL9/ J1RVN4	145006.4	577781.7	
EXC-8	J1RVM0/ J1RVN5	145029.5	577715.2	
EXC-9	J1RVM1/ J1RVN6	145029.5	577741.8	
EXC-10	J1RVM2/ J1RVN7	145029.5	577768.4	
EXC-11	J1RVM3/ J1RVN8	145029.5	577795.1	
EXC-12	J1RVM4/ J1RVN9	145052.6	577755.1	
FS-1	J1RVM5/ J1RVP0	145012.0	577720.4	
FS-2	J1RVM6/ J1RVP1	145054.9	577763.5	
Duplicate of J1RVL2/J1RVM7	J1RVL3/ J1RVM8	144960.3	577808.4	
Equipment blank	J1RVL1	NA	NA	

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

EXC = excavation (random, gridded sample)

FS = focused sample

HEIS = Hanford Environmental Information System

ICP = inductively coupled plasma

NA = not applicable

PAH = polycyclic aromatic hydrocarbons

TPH = total petroleum hydrocarbons

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-370 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the

600-370 waste site against the CULs are shown in Tables 72 and 73 for the statistical and focused sample results, respectively. Analytes that were detected in the samples above soil background levels but are not considered COCs are reported in Table 74. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 72. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-370 Excavation Statistical Verification Samples.

COC	Statistical Result ^{b, c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	3.65 (<BG)	20	--	No
Lead	37.9	250	--	No
BAP TEC	0.0553 ^d	0.14	--	No
TPH – motor oil	9.35	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014g), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 73. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-370 Excavation Focused Verification Samples.

COC	Maximum Result ^{b, c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	2.68 (<BG)	20	--	No
Lead	7.85 (<BG)	250	--	No
BAP TEC	0.00221 ^d	0.14	--	No
TPH – diesel range	6.59	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014g), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 74. Analytes Detected Above Background at the 600-370 Waste Site that are not Identified as Contaminants of Concern.

Cadmium	Copper	Molybdenum
Silver	Vanadium	Zinc
Benzo(a)anthracene ^a	Benzo(b)fluoranthene ^a	Benzo(g,h,i)perylene
Chrysene ^a	Fluoranthene	Pyrene

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Evaluation of verification sampling results at the 600-370 waste site listed in Tables 72 and 73 demonstrate that all COCs were quantified below the applicable CULs. Evaluation of residual concentrations of carcinogenic PAHs considers mixtures of these carcinogenic PAHs as a single hazardous substance compared against the cleanup level established for benzo(a)pyrene. Concentrations for each carcinogenic PAH are multiplied by a corresponding toxicity equivalency factor and then summed to a total value, as shown in Appendix A.

Assessment of the residual risk for the 600-370 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-370 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 4.03×10^{-7} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-370 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-370 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-370 waste site to Final Closed Out.

600-371 Waste Site – Segment 4 Chalky Material Area

Interim Action Summary

The 600-371 waste site consisted of multiple spots within one general area of white chalky substance that resembled either grout or bentonite. The site was remediated on July 17 and 18, 2013.

The approximate depth of the 600-371 excavation was 0.6 m (2 ft) bgs. Verification sampling was performed on July 23, 2013, as summarized in Table 75. Additional information is available in the *Remaining Sites Verification Package for the 600-371, Segment 4 Chalky Material Area Waste Site* (WCH 2014h).

Table 75. Sample Summary Table for the 600-371 Waste Site.

Sample Location	HEIS Number	Sample Analysis
600-371, southeast quadrant	J1RVJ7	ICP metals, mercury, SVOCs
600-371, northeast quadrant	J1RVJ9	
600-371, southwest quadrant	J1RVK0	
600-371, northwest quadrant	J1RVK1	
Duplicate of J1RVJ7	J1RVJ8	
Equipment blank	J1RVJ6	ICP metals ^a , mercury

^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

ICP = inductively coupled plasma

SVOC = semivolatile organic compound

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-371 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-371 waste site against the CULs are shown in Table 76 for the focused sample results. Boron was detected in the samples above soil background levels but is not considered a COC. The additional potential risk contributions associated with the residual concentrations of boron, a non-COC analyte, are not significant.

Table 76. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-371 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	4.17 (<BG)	20	--	No
Lead	8.16 (<BG)	250	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014h), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

Evaluation of verification sampling results at the 600-371 waste site listed in Table 76 demonstrates that all COCs were quantified below the applicable CULs.

For the 600-371 waste site, none of the detected COCs qualified for the calculation of the hazard quotient and excess carcinogenic risk values for direct contact; therefore, the calculation was not performed for COCs. The 600-371 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-371 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and therefore supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-371 waste site to Final Closed Out.

600-372 Waste Site – Segment 4 Oil Stains and Filter Areas

Interim Action Summary

The 600-372 waste site consisted of two areas that had discarded oil filters and were devoid of vegetation. Remediation of the 600-372 waste site was performed on July 18 and September 10 and 11, 2013. The approximate depth of the 600-372 excavation was 0.6 m (2 ft) bgs. Verification sampling was performed on July 23 and September 17, 2013, as summarized in Table 77. Additional information is available in the *Remaining Sites Verification Package for the 600-372, Segment 4 Oil Stains and Filter Areas Waste Site* (WCH 2014i).

Table 77. Sample Summary Table for the 600-372 Waste Site.

Sample Location	HEIS Number	Sample Analysis
600-372:1	J1RVK3	ICP metals, mercury, PAH, PCBs, TPH
600-372:2	J1T118	
Duplicate of J1RVK3	J1RVK4	
Equipment blank	J1RVK2	ICP metals ^a , mercury

^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

ICP = inductively coupled plasma

PAH = polycyclic aromatic hydrocarbons

PCB = polychlorinated biphenyl

TPH = total petroleum hydrocarbons

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-372 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-372 waste site against the CULs are shown in Table 78 for the focused sample results. Analytes that were detected in the samples above soil background levels but are not considered COCs are reported in Table 79. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 78. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-372 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	5.36 (<BG)	20	--	No
Lead	10 (<BG)	250	--	No
BAP TEC	0.00240 ^d	0.14	--	No
TPH –motor oil	18.1	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014i), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 79. Analytes Detected Above Background at the 600-372 Waste Site that are not Identified as Contaminants of Concern.

Silver	Benzo(a)anthracene ^a	Benzo(b)fluoranthene ^a
Benzo(g,h,i)perylene	Chrysene ^a	Fluoranthene
Pyrene		

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Evaluation of verification sampling results at the 600-372 waste site listed in Table 78 demonstrates that all COCs were quantified below the applicable CULs. Evaluation of residual concentrations of carcinogenic PAHs considers mixtures of these carcinogenic PAHs as a single hazardous substance compared against the cleanup level established for benzo(a)pyrene. Concentrations for each carcinogenic PAH are multiplied by a corresponding toxicity equivalency factor and then summed to a total value, as shown in Appendix A.

Assessment of the residual risk for the 600-372 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-372 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 1.75×10^{-8} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-372 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-372 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-372 waste site to Final Closed Out.

600-373 Waste Site – Bare Ground and White Stain Area

Interim Action Summary

The 600-373 waste site consisted of a 28-m² (303-ft²) area devoid of vegetation and covered by a white stain and crusted soil/grass debris. Remediation of the 600-373 waste site was performed on July 18 and September 9 and 10, 2013. The approximate depth of the 600-373 excavation was 0.3 to 0.9 m (1 to 3 ft) bgs. Verification sampling was performed on September 23, 2013, as summarized in Table 80. Additional information is available in the *Remaining Sites Verification Package for the 600-373, Segment 4 Bare Ground and White Stain Area; and 600-374, Segment 4 Drum Remnant Area Waste Sites* (WCH 2014j).

Table 80. Sample Summary Table for the 600-373 Waste Site. (2 Pages)

Sample Location	HEIS Number	Sample Analysis
600-373, Comp-1	J1RVK6 ^a	ICP metals ^b , mercury, TPH, PAH, and PCBs
600-373, Duplicate of J1RVK6 ^b	J1RVK7 ^a	
600-373, Comp-1	J1RW08	ICP metals ^b , mercury, TPH, PAH and PCBs
600-373, Comp-2	J1RW09	

Table 80. Sample Summary Table for the 600-373 Waste Site. (2 Pages)

Sample Location	HEIS Number	Sample Analysis
Equipment blank (600-373)	J1RVK5	ICP metals ^b , mercury

^a Arsenic, lead, and TPH were quantified above remedial action goals in samples J1RVK6 and J1RVK7. Additional remediation was performed and replacement verification samples J1RW08 and J1RW09 were collected.

^b 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

PCB = polychlorinated biphenyl

IC = ion chromatography

SVOA = semivolatle organic analysis

ICP = inductively coupled plasma

TPH = total petroleum hydrocarbons

PAH = polycyclic aromatic hydrocarbons

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-373 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-373 waste site against the CULs are shown in Table 81 for the focused sample results. Analytes that were detected in the samples above soil background levels but that are not considered COCs are reported in Table 82. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 81. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-373 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	65.7	20	--	No ^d
Lead	322	250	--	No ^d
BAP TEC	0.0187 ^e	0.14	--	No
TPH – diesel range + motor oil	46.5	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014j), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Elevated residual lead and arsenic have been determined to be the result of pre-Hanford pesticide use. Former orchard areas and associated residual elevated lead and arsenic will be addressed separately from the 100-IU-2 Operable Unit.

^e Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 82. Analytes Detected Above Background at the 600-373 Waste Site that are not Identified as Contaminants of Concern.

Molybdenum	Silver	Benzo(a)anthracene ^a
Benzo(b)fluoranthene ^a	Benzo(g,h,i)perylene	Chrysene ^a
Dibenz(a,h)anthracene ^a	Fluoranthene	Phenanthrene
Pyrene		

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Evaluation of verification sampling results at the 600-373 waste site listed in Table 81 demonstrates that all COCs were quantified below the applicable CULs, with the exception of lead and arsenic. Residual elevated lead and arsenic concentrations at the 600-373 site are associated with former pesticide usage at pre-Hanford orchard areas. Such contamination will be addressed as part of the 100-OL-1 Operable Unit, separate from the 600-373 waste site. Evaluation of residual concentrations of carcinogenic PAHs considers mixtures of these carcinogenic PAHs as a single hazardous substance compared against the cleanup level established for benzo(a)pyrene. Concentrations for each carcinogenic PAH are multiplied by a corresponding toxicity equivalency factor and then summed to a total value, as shown in Appendix A.

Assessment of the residual risk for the 600-373 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-373 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 1.37×10^{-7} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-373 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-373 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-373 waste site to Final Closed Out.

600-374 Waste Site – Drum Remnant AreaInterim Action Summary

The 600-374 waste site consisted of an empty 208-L (55-gal) crushed drum surrounded by a small area devoid of vegetation. Remediation of the 600-374 waste site was performed on September 18, 2013. The approximate depth of the 600-374 excavation was 0.3 to 0.5 m (1 to 1.5 ft) bgs. Verification sampling was performed on September 23, 2013, as summarized in Table 83. Additional information is available in the *Remaining Sites Verification Package for the 600-373, Segment 4 Bare Ground and White Stain Area; and 600-374, Segment 4 Drum Remnant Area Waste Sites* (WCH 2014j).

Table 83. Sample Summary Table for the 600-374 Waste Site.

Sample Location	HEIS Number	Sample Analysis
600-374, Comp-1	J1T1V0	ICP metals ^a , mercury, pesticides, IC anions, SVOA and PCBs
600-374, Duplicate of J1T1V0	J1T1V1	
Equipment blank (600-374)	J1T1V2	ICP metals ^a , mercury

^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

PCB = polychlorinated biphenyl

SVOA = semivolatile organic analysis

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-374 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-374 waste site against the CULs are shown in Table 84 for the focused sample results. Molybdenum was detected in the samples above soil background levels but is not considered a COC. The additional potential risk contributions associated with the residual concentrations of molybdenum, a non-COC analyte, are not significant.

Evaluation of verification sampling results at the 600-374 waste site listed in Table 84 demonstrates that all COCs were quantified below the applicable CULs.

Table 84. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-374 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	4.89 (<BG)	20	--	No
Lead	6.49 (<BG)	250	--	No
Mercury	0.00512 (<BG)	24	--	No
Nitrogen in Nitrite and Nitrate	6.60 (<BG) ^d	128,217 ^e	1,436 ^e	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014j), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Maximum of values for nitrogen in nitrate reported in WCH (2014j) based on analyses by EPA Method 300.0 and EPA Method 353.2.

^e Nitrate-based CULs from EPA (2014) have been adjusted to a nitrogen-basis using a factor of 4.43.

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

EPA = U.S. Environmental Protection Agency

Assessment of the residual risk for the 600-374 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-374 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 1.53×10^{-3} , which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-374 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-374 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-374 waste site to Final Closed Out.

600-375 Waste Site – Drum Remnant Area

Interim Action Summary

The 600-375 waste site consisted of five locations with stained soil and dry cell battery debris. The five locations have been divided into subsites 600-375:1, 600-375:2, 600-375:3, 600-375:4, and 600-375:5. Remediation of the 600-375 waste site was performed between August 8 and October 29, 2013. The approximate depths of the excavations range from 0.3 to 0.7 m (1 to 2.3 ft)bgs. Verification sampling was performed between August 12 and October 29, 2013, as summarized in Table 85. Additional information is available in the *Remaining Sites Verification Package for the 600-375, Segment 4 Dry Cell Battery Debris Area #1 Waste Site* (WCH 2014k).

Table 85. 600-375 Verification Sample Summary.

Sample Location	HEIS Sample Number	Sample Date	Washington State Plane Coordinates (m)		Sample Analysis
			Northing	Easting	
600-375:1	J1RW10	8/12/2013	150161	577207	ICP metals ^a , mercury
Duplicate of 600-375:1	J1RW11	8/12/2013	150161	577207	ICP metals ^a , mercury
600-375:2	J1T1V7	9/24/2013	148913	576719	ICP metals ^a , mercury
600-375:3a	J1T483	10/29/2013	147357	576956	ICP metals ^a , mercury
600-375:3b	J1T484	10/29/2013	147367	576951	ICP metals ^a , mercury
600-375:4	J1T293	9/30/2013	147102	576266	ICP metals ^a , mercury
600-375:5	J1T1V8	9/24/2013	148492	576155	ICP metals ^a , mercury
Equipment blank	J1RW12	8/12/2013	NA	NA	ICP metals ^a , mercury

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

HEIS = Hanford Environmental Information System

ICP = inductively coupled plasma

NA = not applicable

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-375 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-375 waste site against the CULs are shown in Table 86 for the focused sample results. Analytes that were detected in the samples above soil background levels but that are not considered COCs are reported in Table 87. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 86. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-375 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	4.50 (<BG)	20	--	No
Lead	13.0	250	--	No
Mercury	0.203	24	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014k), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

Table 87. Analytes Detected Above Background at the 600-375 Waste Site that are not Identified as Contaminants of Concern.

Cadmium	Manganese	Molybdenum
Silver	Zinc	

Evaluation of verification sampling results at the 600-375 waste site listed in Table 86 demonstrates all COCs were quantified below the applicable CULs.

Assessment of the residual risk for the 600-375 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-375 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 8.46×10^{-3} , which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-375 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-375 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this

waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-375 waste site to Final Closed Out.

600-376 Waste Site – Stained Soil Area #2

Interim Action Summary

The 600-376 waste site consisted of two subsites (600-376:1 and 600-376:2) that included stained soil areas and patches of bare ground. Remediation of the 600-376 waste site was performed between September 16 and 23, 2013. The final excavation depth for the 600-376:1 and 600-376:2 subsite was 0.6 m (2 ft) and 1 m (3.3 ft), respectively. Verification sampling was performed on September 17 and 24, 2013, as summarized in Table 88. Additional information is available in the *Remaining Sites Verification Package for the 600-376, Segment 4 Stained Soil Area #2* (WCH 2014).

Table 88. Verification Sample Summary for the 600-376:1 and 600-376:2 Composite Samples.

Sample Location	HEIS Number	Sample Date	Washington State Plane Coordinate Locations (m)	Sample Analysis
600-376:1, Comp-1	J1T1P5	9/17/2013	N 150178	ICP metals ^a , mercury
Duplicate of J1T1P5	J1T1P6	9/17/2013	E 575917	
600-376:2, Comp-1	J1T1V3	9/24/2013	N 149545 E 576268	
600-376:2, Comp-2	J1T1V4	9/24/2013	N 149546 E 576274	
Equipment blank (600-376:1)	J1T1P7	9/17/2013	NA	

^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

ICP = inductively coupled plasma

NA = not applicable

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-376 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-376:1 and 600-376:2 subsite against the CULs are shown in Tables 89 and 90 for the focused sample results, respectively. Antimony and molybdenum were detected in the 600-376:1 subsite samples above soil background levels but are not considered COCs. Chromium and molybdenum were detected in the 600-376:2 subsite samples above soil background levels, but are not considered COCs. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 89. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-376:1 Subsite Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	3.14 (<BG)	20	--	No
Lead	31.1	250	--	No
Mercury	0.0182	24	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

Table 90. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-376:2 Subsite Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	3.74 (<BG)	20	--	No
Lead	78.6	250	--	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

Evaluation of verification sampling results at the 600-376 waste site listed in Tables 89 and 90 demonstrate that all COCs were quantified below the applicable CULs.

Assessment of the residual risk for the 600-376 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels.

For the 600-376:1 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 7.58×10^{-4} , which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not

considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-376:1 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

For the 600-376:2 subsite, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 0, which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-376:2 subsite meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-376 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-376 waste site to Final Closed Out.

600-377 Waste Site – Oil Stain and Filter Area #2

Interim Action Summary

The 600-377 waste site consisted of a 3-m² (32-ft²) area devoid of vegetation and containing multiple oil filters. Remediation of the 600-377 waste site was performed on December 16, 2013. The 600-377 waste site excavation area was approximately 8 m² (86 ft²), with the approximate depth of 0.30 m (1 ft) bgs. Verification sampling was performed on January 6, 2014, as summarized in Table 91. Additional information is available in the *Remaining Sites Verification Package for the 600-377, Segment 4 Oil Stain and Filter Area #2 Waste Site* (WCH 2014m).

Table 91. 600-377 Sample Summary.

Sample Location	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
		Northing	Easting	
COMP-1	J1T714	142187	572340	ICP metals ^a , mercury, PAH, PCBs, TPH
Duplicate of J1T714	J1T715			
Equipment blank	J1T716	NA	NA	ICP metals ^a

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

HEIS = Hanford Environmental Information System

ICP = inductively coupled plasma

NA = not applicable

PAH = polycyclic aromatic hydrocarbons

PCB = polychlorinated biphenyl

TPH = total petroleum hydrocarbons

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-377 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-377 waste site against the CULs are shown in Table 92 for the focused sample results.

Table 92. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-377 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	3.87 (<BG)	20	--	No
Lead	10.0 (<BG)	250	--	No
Aroclor-1260	0.0386	0.50	--	No
TPH – motor oil	22.8	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014m), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

-- = No CUL / not applicable

BG = background

COC = contaminant of concern

CUL = cleanup level

TPH = total petroleum hydrocarbons

Evaluation of verification sampling results at the 600-377 waste site listed in Table 92 demonstrates that all COCs were quantified below the applicable CULs.

Assessment of the residual risk for the 600-377 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-377 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 7.72×10^{-8} , which is less than the criterion of 1×10^{-5} . Therefore, the 600-377 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-377 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs);

therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-377 waste site to Final Closed Out.

600-378 Waste Site – 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank

Interim Action Summary

The 600-378 waste site consisted of a 379-L (100-gal) underground storage tank used to store fuel for the 506 telephone exchange emergency generator building. Remediation of the 600-378 waste site was performed on December 18, 2013, and January 8 and April 30, 2014. The final excavation depth was approximately 2.2 m (7.2 ft) bgs. Verification sampling was performed on February 25 and April 30, 2014, as summarized in Table 93. Additional information is available in the *Remaining Sites Verification Package for the 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank Waste Site* (WCH 2014n).

Table 93. 600-378 Sample Summary.

Sample Location	HEIS Sample Number	Washington State Plane Coordinates (m)		Sample Analysis
		Northing	Easting	
FS-1	J1TDP6	138768.3	581235.5	ICP metals ^a , mercury, PAH, and TPH
FS-2	J1TDP7	138768.3	581236.7	
FS-3	J1TDP8	138770.1	581235.5	
FS-4	J1TDP9	138766.7	581234.8	
Duplicate ^b	J1TDR0	138768.3	581235.5	
Equipment blank	J1TDR1	NA	NA	ICP metals ^a , mercury

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

^b One duplicate soil sample was collected at a location selected at the project analytical lead's discretion.

FS = focused sample

PAH = polycyclic aromatic hydrocarbons

HEIS = Hanford Environmental Information System

TPH = total petroleum hydrocarbons

ICP = inductively coupled plasma

NA = not applicable

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-378 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-378 waste site against the CULs are shown in Table 94 for the focused sample results. Analytes that were detected in the samples above soil background levels but are not considered COCs are reported in Table 95. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 94. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-378 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	4.86 (<BG)	20	--	No
Lead	11.9	250	--	No
BAP TEC	0.117 ^d	0.14	--	No
TPH – motor oil	31..2	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014n), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Table 95. Analytes Detected Above Background at the 600-378 Waste Site that are not Identified as Contaminants of Concern.

Antimony	Boron	Cadmium
Silver	Zinc	Anthracene
Benzo(a)anthracene ^a	Benzo(b)fluoranthene ^a	Benzo(g,h,i)perylene
Benzo(k)fluoranthene ^a	Chrysene ^a	Dibenz(a,h)anthracene ^a
Fluoranthene	Phenanthrene	Pyrene

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Evaluation of verification sampling results at the 600-378 waste site listed in Table 94 demonstrates that all COCs were quantified below the applicable CULs. Evaluation of residual concentrations of carcinogenic PAHs considers mixtures of these carcinogenic PAHs as a single hazardous substance compared against the cleanup level established for benzo(a)pyrene. Concentrations for each carcinogenic PAH are multiplied by a corresponding toxicity equivalency factor and then summed to a total value, as shown in Appendix A.

Assessment of the residual risk for the 600-378 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the 600-378 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 0, which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 8.52×10^{-7} , which is less than the criterion of 1×10^{-5} .

Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-378 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-378 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-378 waste site to Final Closed Out.

600-379 Waste Site – Segment 4 Burn Area #1

Interim Action Summary

The 600-379 waste site consisted of a burn area with visible remnants. Remediation of the 600-379 waste site was performed between December 18, 2013, and January 8, 2014. The final excavation depth was approximately 0.6 m (2 ft) bgs. Verification sampling was performed on January 8, 2014, as summarized in Table 96. Additional information is available in the *Remaining Sites Verification Package for the 600-379, Segment 4 Burn Area #1 Waste Site* (WCH 2014o).

Table 96. 600-379 Waste Site Sample Summary.

Sample Location	HEIS Sample Number	Sample Date	Washington State Plane Coordinates (m)		Sample Analysis
			Northing	Easting	
COMP-1	J1T717	1/8/2014	140000.46	578653.76	ICP metals ^a , mercury, TPH, PAH, and PCB
Duplicate of J1T717	J1T718	1/8/2014	140000.46	578653.76	ICP metals ^a , mercury, TPH, PAH, and PCB
Equipment blank	J1T719	1/8/2014	NA	NA	ICP metals ^a , mercury

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

HEIS = Hanford Environmental Information System

ICP = inductively coupled plasma

NA = not applicable

PAH = polycyclic aromatic hydrocarbons

PCB = polychlorinated biphenyl

TPH = total petroleum hydrocarbons

Final Action Data Evaluation

This section demonstrates that residual contaminant concentrations at the 600-379 waste site achieve the applicable CULs developed to support unrestricted land use for the 100-F/IU Area as established in the 100-F/IU Area ROD (EPA 2014). Comparisons of the results for each COC detected at the 600-379 waste site against the CULs are shown in Table 97 for the focused sample results.

Table 97. Comparison of Contaminant Concentrations to Cleanup Levels for the 600-379 Excavation Focused Verification Samples.

COC	Maximum Result ^{b,c} (mg/kg)	Soil CULs ^a (mg/kg)		Do the Results Exceed CULs?
		Direct Exposure	Protection of Groundwater and Surface Water	
Arsenic	4.52 (<BG)	20	--	No
Lead	6.11 (<BG)	250	--	No
Mercury	0.0358	24	--	No
BAP TEC	0.00207 ^d	0.14	--	No
TPH – diesel range + motor oil	21.2	2,000	2,000	No

^a CULs obtained from EPA (2014).

^b Values obtained from WCH (2014o), unless otherwise noted.

^c Background values obtained from DOE-RL (2014).

^d Value is the summed BAP TEC of all detected carcinogenic polycyclic aromatic hydrocarbons (Appendix A).

-- = No CUL / not applicable

BAP = benzo(a)pyrene

BG = background

COC = contaminant of concern

CUL = cleanup level

TEC = toxic equivalency concentration

TPH = total petroleum hydrocarbons

Analytes that were detected in the samples above soil background levels but are not considered COCs are reported in Table 98. The additional potential risk contributions associated with the residual concentrations of these non-COC analytes are not significant.

Table 98. Analytes Detected Above Background at the 600-378 Waste Site that are not Identified as Contaminants of Concern.

Antimony	Benzo(b)fluoranthene ^a	Benzo(g,h,i)perylene
Indeno(1,2,3-cd)pyrene		

^a Included in calculation of the benzo(a)pyrene toxic equivalency concentration.

Evaluation of verification sampling results at the 600-379 waste site listed in Table 97 demonstrates that all COCs were quantified below the applicable CULs. Evaluation of residual concentrations of carcinogenic PAHs considers mixtures of these carcinogenic PAHs as a single hazardous substance compared against the cleanup level established for benzo(a)pyrene. Concentrations for each carcinogenic PAH are multiplied by a corresponding toxicity equivalency factor and then summed to a total value, as shown in Appendix A.

Assessment of the residual risk for the 600-379 waste site is determined by calculation of the hazard quotient and excess carcinogenic risk values for direct contact (Appendix A). Nonradionuclide risk requirements for residential cleanup 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} . Risk values were not calculated for constituents that were either not detected or were detected at concentrations below soil background levels. For the

600-379 waste site, all individual hazard quotients were less than 1.0 and all individual excess carcinogenic risk values were less than 1×10^{-6} . The cumulative hazard quotient for COCs detected above background is 1.49×10^{-3} , which is less than the criterion of 1.0. The cumulative excess carcinogenic risk value for COCs detected above background is 1.51×10^{-8} , which is less than the criterion of 1×10^{-5} . Incremental risk contributions from constituents detected above background that are not considered COCs are not significant relative to the threshold cumulative criteria. Therefore, the 600-379 waste site meets the nonradionuclide risk requirements under the unrestricted land use scenario.

Summary for Final Closure

The 600-379 waste site was remediated and has been evaluated against the criteria of the 100-F/IU Area ROD (EPA 2014). Verification sampling results demonstrate that the site meets the CULs for direct exposure and protection of groundwater and surface water, and, therefore, supports an unrestricted land use. Remediation of the waste site did not extend into the deep zone soils (below 4.6 m [15 ft] bgs); therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone of this waste site are not required. In accordance with this evaluation, the verification sampling results support a reclassification of the 600-379 waste site to Final Closed Out.

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- WCH, 2013b, *Attachment Remaining Sites Verification Package for the 600-303, Vertical Pipes; and 600-321, Suspect Asbestos Containing Material and Debris*, 2013-046, Rev. 0, Washington Closure Hanford, Richland, Washington.
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- WCH, 2014b, Attachment *Remaining Sites Verification Package for the 600-293, White Bluffs Service Station #1 Waste Site*, 2013-120, Rev. 0, Washington Closure Hanford, Richland, Washington.
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- WCH, 2014d, Attachment *Remaining Sites Verification Package for the 600-301, White Bluffs Sanitary Sewer Pipelines Waste Site*, 2013-129, Rev. 0, Washington Closure Hanford, Richland, Washington.
- WCH, 2014e, Attachment *Remaining Sites Verification Package for the 600-356, Tar Deposit West of Susie Junction Waste Site*, 2014-053, Rev. 0, Washington Closure Hanford, Richland, Washington.
- WCH, 2014f, Attachment *Remaining Sites Verification Package for the 600-368, Segment 4 Stained Soil #1; and 600-369, Segment 4 Bare Ground and Crusted Soil Areas Waste Sites*, 2013-083, Rev. 0, Washington Closure Hanford, Richland, Washington.
- WCH, 2014g, Attachment *Remaining Sites Verification Package for the 600-370, Segment 4 Debris Area #1 Waste Site*, 2013-084, Rev. 0, Washington Closure Hanford, Richland, Washington.
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- WCH, 2014l, Attachment *Remaining Sites Verification Package for the 600-376, Segment 4 Stained Soil Area #2*, 2013-093, Rev. 0, Washington Closure Hanford, Richland, Washington.
- WCH, 2014m, Attachment *Remaining Sites Verification Package for the 600-377, Segment 4 Oil Stain and Filter Area #2 Waste Site*, 2013-088, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH, 2014n, Attachment *Remaining Sites Verification Package for the 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank Waste Site*, 2014-051, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH, 2014o, Attachment *Remaining Sites Verification Package for the 600-379, Segment 4 Burn Area #1 Waste Site*, 2013-089, Rev. 0, Washington Closure Hanford, Richland, Washington.

APPENDIX A
CALCULATIONS

**APPENDIX A
CALCULATIONS**

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

100-F/IU Final Closeout Evaluations – Hazard Quotient, Excess Carcinogenic Risk, and Benzo(a)pyrene Toxic Equivalent Concentration Calculations,
0100F-CA-V0409, Rev. 0, Washington Closure Hanford,
Richland, Washington A-3

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-F/IU Closure Operations Job No. **14655**

Area: 600 Area

Discipline: Environmental *Calculation No: 0100F-CA-V0409

Subject: 100-F/IU Final Closeout Evaluations - Hazard Quotient, Excess Risk, and Benzo(a)pyrene Toxic Equivalent Concentration Calculations

Computer Program: Excel Program No: Excel 2010

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

Committed Calculation Preliminary Superseded Voided

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Summary = 9 Attachment 1 = 24 Attachment 2 = 11 Total = 56	<i>I. B. Berezovskiy</i> I. B. Berezovskiy	J. M. Capron	B. L. Vedder	S. G. Wilkinson	11/12/15

SUMMARY OF REVISION

Washington Closure Hanford		CALCULATION SHEET					
Originator:	I. B. Berezovskiy	Date:	08/26/15	Calc. No.:	0100F-CA-V0409	Rev.:	0
Project:	100-F/IU Closure Operations	Job No.:	14655	Checked:	J. M. Capron	Date:	08/26/15
Subject:	100-F/IU Final Closeout Evaluations – Hazard Quotient, Excess Carcinogenic Risk, and Benzo(a)pyrene Toxic Equivalent Concentration Calculations					Sheet No.	1 of 9

1 **PURPOSE:**

2
3 Provide documentation to support evaluations for waste sites listed as requiring remove, treat, and
4 dispose (RTD) in the *Record of Decision for the Hanford 100 Area Superfund Site, 100-FR-1, 100-FR-2,*
5 *100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (100-F/IU Area ROD) (EPA 2014) where
6 remediation was completed under interim action decisions. The verification sampling data for these
7 waste sites were not included in remedial investigation/feasibility study (RI/FS) evaluations for
8 development of the 100-F/IU Area ROD due to concurrent timing of interim action remediation and
9 ROD development. This calculation brief provides calculations for direct contact hazard quotients
10 (HQs), excess carcinogenic risk values, and benzo(a)pyrene (BAP) toxic equivalent concentrations
11 (TECs).

12
13 Nonradionuclide risk standards include the following criteria:

- 14
15 1) An HQ of <1.0 for all individual noncarcinogens
16 2) A cumulative HQ of <1.0 for noncarcinogens
17 3) An excess carcinogenic risk value of <1 x 10⁻⁶ for individual carcinogens
18 4) A cumulative excess carcinogenic risk value of <1 x 10⁻⁵ for carcinogens.

19
20 BAP TEC values are calculated for those waste sites/waste site groupings where multiple carcinogenic
21 polycyclic aromatic hydrocarbons (PAHs) were detected. The calculated BAP TEC value is used in
22 comparison to cleanup levels and within the HQ and excess carcinogenic risk calculations to evaluate
23 carcinogenic PAH mixtures as a single substance with respect to risk evaluation requirements. The
24 PAHs potentially included within the BAP TEC are benzo(a)anthracene, BAP, benzo(b)fluoranthene,
25 benzo(k)fluoroanthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

26
27 **GIVEN/REFERENCES:**

- 28
29 1) DOE-RL, 2014, *Remedial Investigation/Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3,*
30 *100-IU-2, and 100 IU-6 Operable Units*, DOE/RL-2010-98, Rev. 0, U.S. Department of Energy,
31 Richland Operations Office, Richland, Washington.
32
33 2) Ecology, 2007, WAC 173-340-708 (8), "*Model Toxic Control Act - Cleanup*" Washington
34 Administrative Code, November 2007 Revision.
35
36 3) EPA, 2014, *Record of Decision, Hanford 100-Area Superfund Site, 100-FR-1, 100 FR 2, 100-FR-3,*
37 *100-IU-2, and 100-IU-6 Operable Units*, September 2014, U.S. Environmental Protection Agency,
38 Region 10, Seattle, Washington.
39
40 4) WCH, 2013a, *Remaining Sites Verification Package for the 600-298, Stained Soil/Surface Debris;*
41 *600-299, Surface Debris/Batteries; and 600-300, Miscellaneous Surface Debris Waste Sites*, RSVP-
42 2013-040, Rev. 0, Washington Closure Hanford, Richland, Washington.
43
44 5) WCH, 2013b, *Remaining Sites Verification Package for the 600-303, Vertical Pipes; and 600-321,*
45 *Suspect Asbestos Containing Material and Debris*, RSVP-2013-046, Rev. 0, Washington Closure
46 Hanford, Richland, Washington.
47

Washington Closure Hanford		CALCULATION SHEET					
Originator:	I. B. Berezovskiy	Date:	08/26/15	Calc. No.:	0100F-CA-V0409	Rev.:	0
Project:	100-F/IU Closure Operations	Job No:	14655	Checked:	J. M. Capron	Date:	08/26/15
Subject:	100-F/IU Final Closeout Evaluations – Hazard Quotient, Excess Carcinogenic Risk, and Benzo(a)pyrene Toxic Equivalent Concentration Calculations					Sheet No. 2 of 9	

- 1 6) WCH, 2013c, *Remaining Sites Verification Package for the 600-316, Dry Cell Batteries; and 600-*
2 *318, Wet Cell Batteries*, RSVP-2013-034, Rev. 0, Washington Closure Hanford, Richland,
3 Washington.
- 4
- 5 7) WCH, 2013d, *Remaining Sites Verification Package for the 600-320, Oil Stains Waste Site*, RSVP-
6 2012-047, Rev. 1, Washington Closure Hanford, Richland, Washington.
- 7
- 8 8) WCH, 2013e, *Remaining Sites Verification Package for the 600-328, Lead Slag Waste Site*, RSVP-
9 2013-054, Rev. 0, Washington Closure Hanford, Richland, Washington.
- 10
- 11 9) WCH, 2014a, *Remaining Sites Verification Package for the 600-279, Vegetation Free Area Between*
12 *White Bluffs and 100F*, RSVP-2013-134, Rev. 0, Washington Closure Hanford, Richland,
13 Washington.
- 14
- 15 10) WCH, 2014b, *Remaining Sites Verification Package for the 600-293, White Bluffs Service Station #1*
16 *Waste Site*, RSVP-2013-120, Rev. 0, Washington Closure Hanford, Richland, Washington.
- 17
- 18 11) WCH, 2014c, *Remaining Sites Verification Package for the 600-294, White Bluffs Service Station #2*
19 *Waste Site*, RSVP-2013-132, Rev. 0, Washington Closure Hanford, Richland, Washington.
- 20
- 21 12) WCH, 2014d, *Remaining Sites Verification Package for the 600-301, White Bluffs Sanitary Sewer*
22 *Pipelines Waste Site*, RSVP-2013-129, Rev. 0, Washington Closure Hanford, Richland, Washington.
- 23
- 24 13) WCH, 2014e, *Remaining Sites Verification Package for the 600-356, Tar Deposit West of Susie*
25 *Junction Waste Site*, RSVP-2014-053, Rev. 0, Washington Closure Hanford, Richland, Washington.
- 26
- 27 14) WCH, 2014f, *Remaining Sites Verification Package for the 600-368, Segment 4 Stained Soil #1 and*
28 *600-369, Segment 4 Bare Ground and Crusted Soil Areas Waste Sites*, RSVP-2013-083, Rev. 0,
29 Washington Closure Hanford, Richland, Washington.
- 30
- 31 15) WCH, 2014g, *Remaining Sites Verification Package for the 600-370, Segment 4 Debris Area #1*
32 *Waste Site*, RSVP-2013-084, Rev. 0, Washington Closure Hanford, Richland, Washington.
- 33
- 34 16) WCH, 2014h, *Remaining Sites Verification Package for the 600-371, Segment 4 Chalky Material*
35 *Area Waste Site*, RSVP-2013-085, Rev. 0, Washington Closure Hanford, Richland, Washington.
- 36
- 37 17) WCH, 2014i, *Remaining Sites Verification Package for the 600-372, Segment 4 Oil Stains and Filter*
38 *Areas Waste Site*, RSVP-2013-091, Rev. 0, Washington Closure Hanford, Richland, Washington.
- 39
- 40 18) WCH, 2014j, *Remaining Sites Verification Package for the 600-373, Segment 4 Bare Ground and*
41 *White Stain Area; and 600-374 Segment 4 Drum Remnant Area Waste Sites*, RSVP-2013-086, Rev.
42 0, Washington Closure Hanford, Richland, Washington.
- 43
- 44 19) WCH, 2014k, *Remaining Sites Verification Package for the 600-375, Segment 4 Dry Cell Battery*
45 *Debris Area #1 Waste Site*, RSVP-2013-092, Rev. 0, Washington Closure Hanford, Richland,
46 Washington.
- 47
- 48 20) WCH, 2014l, *Remaining Sites Verification Package for the 600-376, Segment 4 Stained Soil Area*
49 *#2*, RSVP-2013-093, Rev. 0, Washington Closure Hanford, Richland, Washington.

Washington Closure Hanford		CALCULATION SHEET					
Originator:	I. B. Berezovskiy	Date:	08/26/15	Calc. No.:	0100F-CA-V0409	Rev.:	0
Project:	100-F/IU Closure Operations	Job No.:	14655	Checked:	J. M. Capron	Date:	08/26/15
Subject:	100-F/IU Final Closeout Evaluations – Hazard Quotient, Excess Carcinogenic Risk, and Benzo(a)pyrene Toxic Equivalent Concentration Calculations					Sheet No. 3 of 9	

21) WCH, 2014m, *Remaining Sites Verification Package for the 600-377, Segment 4 Oil Stain and Filter Area #2*, RSVP-2013-088, Rev. 0, Washington Closure Hanford, Richland, Washington.

22) WCH, 2014n, *Remaining Sites Verification Package for the 600-378, 506 Telephone Exchange Emergency Generator Building Underground Fuel Storage Tank*, RSVP-2014-051, Rev. 0, Washington Closure Hanford, Richland, Washington.

23) WCH, 2014o, *Remaining Sites Verification Package for the 600-379, Segment 4 Burn Area #1 Waste Site*, RSVP-2013-089, Rev. 0, Washington Closure Hanford, Richland, Washington.

SOLUTION:

Hazard Quotient and Excess Carcinogenic Risk Calculations

The HQ and excess carcinogenic risk values are calculated by rearranging Equations 740-1 and 740-2 from WAC 173-340-740 (Ecology 2007), considering HQ and excess carcinogenic risk values other than 1 and 1×10^{-6} , respectively, as shown in Tables 1 and 2.

Table 1. Single Contaminant Hazard Quotient Calculation for Residential Land Use.

Rearranging Equation 740-1 of WAC 173-340 (2007), for variable HQ values:		
$HQ = (\text{Concentration}) * (\text{SIR} * \text{AB1} * \text{EF} * \text{ED}) / (\text{RfD} * \text{ABW} * \text{UCF} * \text{AT})$		
HQ = (Concentration)/(RfD)*Daily Intake Factor		
Variable	Value	Description
SIR	200	Soil ingestion rate (mg/day)
AB1	1	Gastrointestinal absorption fraction (unitless)
EF	1	Exposure frequency (unitless)
ED	6	Exposure duration (years)
ABW	16	Average body weight (kg)
UCF	1,000,000	Unit conversion factor (mg/kg)
AT	6	Averaging time (years)
RfD	(Variable)	Chemical-specific reference dose (mg/kg-day)
Daily Intake Factor =	1.25E-05	per day

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CALCULATION SHEET

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Subject:	100-F/IU Final Closeout Evaluations – Hazard Quotient, Excess Carcinogenic Risk, and Benzo(a)pyrene Toxic Equivalent Concentration Calculations					Sheet No. 4 of 9	

Table 2. Single Contaminant Excess Carcinogenic Risk Calculation for Residential Land Use

Rearranging Equation 740-2 of WAC 173-340 (2007), for variable risk values:		
Cancer Risk = (Concentration)*(CPF*SIR*AB1*ED*EF)/(ABW*AT*UCF)		
Cancer Risk = (Concentration)*(CPF)*(Daily Intake Factor)		
<u>Variable</u>	<u>Value</u>	<u>Description</u>
CPF	(Variable)	Chemical-specific carcinogenic potency factor (kg-day/mg)
SIR	200	Soil ingestion rate (mg/day)
AB1	1	Gastrointestinal absorption fraction (unitless)
ED	6	Exposure duration (years)
EF	1	Exposure frequency (unitless)
ABW	16	Average body weight (kg)
AT	75	Averaging time (years)
UCF	1,000,000	Unit conversion factor (mg/kg)
Daily Intake Factor =	1.00E-06	per day

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1) Generate an HQ for each constituent with noncarcinogenic effects detected above background and compare it to the individual HQ criterion of <1.0. Use the chemical-specific oral reference dose values used for development of the 100-F/IU Area ROD (EPA 2014), as documented in the *Remedial Investigation/Feasibility Study for the 100-FR-1, 100-FR-2, 100-FR-3, 100-IU-2, and 100-IU-6 Operable Units* (100-F/IU RI/FS) (DOE-RL 2014).

2) Sum the HQs and compare to the cumulative HQ criterion of <1.0.

3) Generate an excess carcinogenic risk value for each carcinogenic constituent detected above background and compare it to the excess carcinogenic risk criterion of <1 x 10⁻⁶. Use the chemical-specific carcinogenic potency factor values used for development of the 100-F/IU Area ROD (EPA 2014), as documented in the 100-F/IU RI/FS (DOE-RL 2014).

4) Sum the excess carcinogenic risk values and compare to the cumulative carcinogenic risk criterion of <1 x 10⁻⁵.

Benzo(a)pyrene Toxic Equivalency Concentration Calculations

For mixtures of carcinogenic PAHs, compliance with cleanup levels is determined by considering the mixture as a single hazardous substance (BAP) in accordance with WAC 173-340-708 (2007). The representative values for each carcinogenic PAH in the decision unit are first determined. Each value is then multiplied by the corresponding toxicity equivalency factor shown in Table 3 to obtain the BAP

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Project:	100-F/IU Closure Operations	Job No:	14655	Checked:	J. M. Capron	Date:	08/26/15
Subject:	100-F/IU Final Closeout Evaluations – Hazard Quotient, Excess Carcinogenic Risk, and Benzo(a)pyrene Toxic Equivalent Concentration Calculations					Sheet No.	5 of 9

- 1 TEC for that PAH. The individual TECs for the decision unit are then summed to obtain the
2 representative total BAP TEC for that decision unit.

Table 3. Toxic Equivalency Factors for Carcinogenic Polycyclic Aromatic Hydrocarbons^a

Polycyclic Aromatic Hydrocarbon	Toxic Equivalency Factor
Benzo(a)pyrene	1
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Chrysene	0.01
Dibenz(a,h)anthracene	0.1
Indeno(1,2,3-cd)pyrene	0.1

^a From WAC 173-340-708 (2007), Table 708-2.

METHODOLOGY:

Hazard Quotient and Excess Carcinogenic Risk Calculations

The waste sites/waste site groupings evaluated are comprised of one or more decision units with one or more corresponding verification data sets, as established in the previously approved interim reclassification documentation for these sites (WCH 2013a-e, WCH 2014a-o). The appropriate representative values for each constituent were obtained from these documents without further calculation. Only those constituents quantified above background are considered in HQ and excess carcinogenic risk calculations. (The 100-F/IU RI/FS included tasking to consider revised Hanford site-specific background values for some metals; these revised values are considered within this evaluation.) The HQ and excess carcinogenic risk calculations were performed considering contaminants of concern (COCs) and other constituents separately. These calculations are also summed for information purposes to allow consideration of incremental risk contributions from constituents above background that are not considered COCs.

An example of the HQ and excess carcinogenic risk calculations (using the 600-293 site) is presented below:

- 1) To calculate the HQ, the maximum value for aroclor-1254 is 0.0970 mg/kg, multiplied by the daily intake factor (1.25×10^{-5} per day) and divided by the reference dose (RfD) of 2.0×10^{-5} mg/kg-day, resulting in an HQ of 6.06×10^{-2} . Comparing this value, and all other individual values for the 600-293 site calculation, to the requirement of <1.0, this criterion is met.
- 2) After the HQ calculation is completed for the appropriate COCs, the cumulative HQ is 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 6.06×10^{-2} for

Washington Closure Hanford		CALCULATION SHEET					
Originator:	I. B. Berezovskiy	Date:	08/26/15	Calc. No.:	0100F-CA-V0409	Rev.:	0
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1 the 600-293 waste site COCs only calculation. Comparing this value to the requirement of <1.0, this
2 criterion is met.

3
4 3) To calculate the excess cancer risk, the maximum value for aroclor-1260, 0.247 mg/kg, is multiplied
5 by the daily intake factor (1.0×10^{-6} per day) and the cancer potency factor of 2.0 mg/kg-day, with a
6 resulting value of 4.94×10^{-7} . Comparing this value, and all other individual values for the 600-293
7 waste site calculation, to the threshold of $<1 \times 10^{-6}$, this criterion is met.

8
9 4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer
10 risk is obtained by summing the individual values. The sum of the cumulative cancer risk values is
11 6.88×10^{-7} for the 600-293 waste site calculation. Comparing this value to the requirement of
12 $<1 \times 10^{-5}$, this criterion is met.

13 14 **Benzo(a)pyrene Toxic Equivalency Concentration Calculations**

15
16 The waste sites/waste site groupings evaluated are comprised of one or more decision units with one or
17 more corresponding verification data sets, as established in the previously approved interim
18 reclassification documentation for these sites (WCH 2013a-e, WCH 2014a-o). The appropriate
19 representative values for each constituent were obtained from these documents without further
20 calculation. A BAP TEC calculation is performed only for those decision units where non-BAP
21 carcinogenic PAHs were detected.

22
23 An example of the BAP TEC calculations (using the 600-298 site) is presented below:

- 24
25 1) To calculate the BAP TEC for chrysene, the maximum value for chrysene, 0.026 mg/kg, is
26 multiplied by the toxic equivalency factor for chrysene (0.01) from Table 3. The resulting BAP TEC
27 value for chrysene is 0.00026 mg/kg.
28
29 2) After BAP TEC values have been calculated for all individual carcinogenic PAH, the total BAP TEC
30 is calculated by summing the individual values. For the 600-298 waste site, the total BAP TEC
31 value is 0.032 mg/kg.
32
33

34 **RESULTS:**

35
36 Table 4 summarizes the results of the HQ and excess carcinogenic risk calculations for each waste site.
37 Table 5 summarizes the results of the BAP TEC calculations for waste site where non-BAP carcinogenic
38 PAHs were detected. Attachments 1 and 2 present the individual waste site HQ/excess carcinogenic risk
39 and BAP TEC calculations, respectively.
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Washington Closure Hanford		CALCULATION SHEET					
Originator:	I. B. Berezovskiy	Date:	08/26/15	Calc. No.:	0100F-CA-V0409	Rev.:	0
Project:	100-F/IU Closure Operations	Job No:	14655	Checked:	J. M. Capron	Date:	08/26/15
Subject:	100-F/IU Final Closeout Evaluations – Hazard Quotient, Excess Carcinogenic Risk, and Benzo(a)pyrene Toxic Equivalent Concentration Calculations					Sheet No. 7 of 9	

Table 4. Summary of Hazard Quotient and Excess Carcinogenic Risk Calculations.

Waste Site	COCs				Non-COCs			
	Individual HQ<1?	Cummulative HQ value	Individual Cancer Risk < 1 x 10 ⁻⁶ ?	Cummulative Cancer Risk Value	Individual HQ<1?	Cummulative HQ value	Individual Cancer Risk < 1 x 10 ⁻⁶ ?	Cummulative Cancer Risk Value
600-279	Yes	0.00E+00	Yes	3.57E-07	Yes	3.22E-05	Yes	0.00E+00
600-293	Yes	6.06E-02	Yes	6.88E-07	Yes	1.23E-03	Yes	8.84E-09
600-294	Yes	9.58E-04	Yes	1.27E-08	Yes	6.94E-02	Yes	0.00E+00
600-298	Yes	0.00E+00	Yes	2.35E-07	Yes	2.05E-01	Yes	6.66E-09
600-299	Yes	1.13E-03	Yes	0.00E+00	Yes	1.66E-01	Yes	0.00E+00
600-300	Yes	6.67E-04	Yes	4.55E-07	Yes	1.94E-02	Yes	2.72E-09
600-301	Yes	9.88E-04	Yes	0.00E+00	Yes	9.00E-02	Yes	4.83E-09
600-303	Yes	0.00E+00	Yes	0.00E+00	Yes	1.53E-02	Yes	0.00E+00
600-316	Yes	3.17E-03	Yes	0.00E+00	Yes	1.79E-01	Yes	0.00E+00
600-318	Yes	0.00E+00	Yes	0.00E+00	Yes	1.07E-01	Yes	0.00E+00
600-320:1	Yes	0.00E+00	Yes	8.96E-07	Yes	4.33E-04	Yes	0.00E+00
600-320:2	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00
600-320:3	Yes	0.00E+00	No	1.08E-06	Yes	2.71E-04	Yes	0.00E+00
600-320:4	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00
600-320:5	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00
600-320:6	Yes	0.00E+00	Yes	0.00E+00	Yes	2.22E-02	Yes	0.00E+00
600-320:7	Yes	0.00E+00	Yes	1.05E-07	Yes	1.80E-05	Yes	0.00E+00
600-320:8	Yes	0.00E+00	Yes	4.96E-07	Yes	3.49E-05	Yes	0.00E+00
600-320:9	Yes	0.00E+00	Yes	0.00E+00	Yes	1.25E-02	Yes	0.00E+00
600-321	NA	NA	NA	NA	NA	NA	NA	NA
600-328	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00
600-356	Yes	0.00E+00	Yes	1.82E-08	Yes	1.34E-03	Yes	0.00E+00
600-368	Yes	9.63E-04	Yes	0.00E+00	Yes	1.59E-02	Yes	0.00E+00
600-369:1	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00
600-369:2	Yes	0.00E+00	Yes	7.30E-09	Yes	0.00E+00	Yes	0.00E+00
600-369:3	Yes	0.00E+00	Yes	0.00E+00	Yes	1.67E-02	Yes	0.00E+00
600-369:4	Yes	0.00E+00	Yes	1.34E-07	Yes	2.60E-05	Yes	0.00E+00
600-369:5	Yes	0.00E+00	Yes	5.98E-09	Yes	0.00E+00	Yes	0.00E+00
600-369:6	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00
600-369:7	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00
600-369:8	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00	Yes	0.00E+00
600-370	Yes	0.00E+00	Yes	4.03E-07	Yes	2.74E-01	Yes	0.00E+00
600-371	Yes	0.00E+00	Yes	0.00E+00	Yes	2.91E-04	Yes	0.00E+00
600-372	Yes	0.00E+00	Yes	1.75E-08	Yes	7.73E-04	Yes	0.00E+00
600-373	Yes	0.00E+00	Yes	1.37E-07	Yes	2.23E-03	Yes	0.00E+00
600-374	Yes	0.00E+00	Yes	0.00E+00	Yes	1.53E-03	Yes	0.00E+00
600-375	Yes	8.46E-03	Yes	0.00E+00	Yes	2.44E-01	Yes	0.00E+00
600-376:1	Yes	7.58E-04	Yes	0.00E+00	Yes	9.97E-02	Yes	0.00E+00
600-376:2	Yes	0.00E+00	Yes	0.00E+00	Yes	1.80E-03	Yes	0.00E+00
600-377	Yes	0.00E+00	Yes	7.72E-08	Yes	0.00E+00	Yes	0.00E+00
600-378	Yes	0.00E+00	Yes	8.52E-07	Yes	1.14E-01	Yes	0.00E+00
600-379	Yes	1.49E-03	Yes	1.51E-08	Yes	5.75E-02	Yes	0.00E+00

NA = not applicable

Washington Closure Hanford

CALCULATION SHEET

Originator:	I. B. Berezovskiy	Date:	08/26/15	Calc. No.:	0100F-CA-V0409	Rev.:	0
Project:	100-F/IU Closure Operations	Job No.:	14655	Checked:	J. M. Capron	Date:	08/26/15
Subject:	100-F/IU Final Closeout Evaluations – Hazard Quotient, Excess Carcinogenic Risk, and Benzo(a)pyrene Toxic Equivalent Concentration Calculations					Sheet No. 8 of 9	

Table 5. Summary of Benzo(a)pyrene Toxic Equivalent Concentration Calculations.

Waste Site	Data Set	BAP TEC (mg/kg)
600-279	Statistical	0.049
600-293	NA	NA
600-294	Statistical	0.00150
600-294	Focused	0.00174
600-298	Focused	0.032
600-299	NA	NA
600-300	Focused	0.060
600-301	NA	NA
600-303	NA	NA
600-316	NA	NA
600-318	NA	NA
600-320:1	Focused	0.12
600-320:2	NA	NA
600-320:3	Statistical	0.148
600-320:3	Focused	0.014
600-320:4	NA	NA
600-320:5	NA	NA
600-320:6	NA	NA
600-320:7	Focused	0.014
600-320:8	Statistical	0.068
600-320:9	NA	NA
600-321	NA	NA
600-328	NA	NA
600-356	Statistical	0.00250
600-368	NA	NA
600-369:1	NA	NA
600-369:2	Focused	0.0010
600-369:3	Statistical	0.125
600-369:4	Focused	0.018
600-369:5	Statistical	0.00082
600-369:6	NA	NA
600-369:7	NA	NA
600-369:8	NA	NA
600-370	Statistical	0.0553
600-370	Focused	0.0022
600-371	NA	NA
600-372	Focused	0.0024
600-373	Focused	0.0187
600-374	NA	NA
600-375	NA	NA
600-376:1	NA	NA
600-376:2	NA	NA
600-377	NA	NA
600-378	Focused	0.117
600-379	Focused	0.00207

BAP = benzo(a)pyrene

NA = not applicable

TEC = toxic equivalent concentration

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Project:	100-F/IU Closure Operations	Job No:	14655	Checked:	J. M. Capron <i>JC</i>	Date:	08/26/15
Subject:	100-F/IU Final Closeout Evaluations – Hazard Quotient, Excess Carcinogenic Risk, and Benzo(a)pyrene Toxic Equivalent Concentration Calculations					Sheet No. 9 of 9	

1 **CONCLUSION:**

2

3 The HQ and excess carcinogenic risk calculations presented demonstrate that these waste sites meet the

4 individual contaminant and cumulative risk requirements. The calculated BAP TEC values are used in

5 the direct contact hazard quotients and excess carcinogenic risk calculations, as applicable. The direct

6 contact hazard quotients, excess carcinogenic risk, and BAP TEC calculations are for use in the final

7 closeout documentation for these waste sites.

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ATTACHMENT 1

Direct Contact Hazard Quotient and Excess Cancer Risk

Table 1-1. Direct Contact HQ and Excess Carcinogenic Risk for 600-279 Waste Site.

COCs	Statistical or Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Arsenic ^c	13.9	3.00E-04	-- ^c	1.50E+00	-- ^c
Lead ^d	28.3	--	--	--	--
BAP equivalence concentration ^e	0.0489	--	--	7.30E+00	3.57E-07
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					3.57E-07

Non-COCs	Statistical or Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Inorganics					
Fluoride	6.95	6.00E-02	1.45E-03	--	--
Sulfate	6080	--	--	--	--
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(a)anthracene ^f	0.0336	--	--	7.30E-01	-- ^f
Benzo(b)fluoranthene ^f	0.0406	--	--	7.30E-01	-- ^f
Benzo(k)fluoranthene ^f	0.0155	--	--	7.30E-01	-- ^f
Chrysene ^f	0.0346	--	--	7.30E-02	-- ^f
Fluoranthene	0.0438	4.00E-02	1.37E-05	--	--
Pyrene	0.0445	3.00E-02	1.85E-05	--	--
Non-COCs Cumulative Hazard Quotient:			3.22E-05		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:	3.22E-05	
Total Cumulative Excess Cancer Risk:		3.57E-07

a = From WCH (2014a). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Arsenic cleanup level in EPA (2014) is not toxicity-based. Therefore, hazard quotient and excess carcinogenic risk calculations are not performed for arsenic.

d = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

e = From Table 2-1. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

f = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

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Table 1-2. Direct Contact HQ and Excess Carcinogenic Risk for 600-293 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Lead ^c	14.3	--	--	--	--
PCB Aroclor 1254	0.0970	2.00E-05	6.06E-02	2.00E+00	1.94E-07
PCB Aroclor 1260	0.247	--	--	2.00E+00	4.94E-07
TPH-Diesel Range +Motor Oil ^d	86	--	--	--	--
COCs Cumulative Hazard Quotient:			6.06E-02		
COCs Cumulative Excess Carcinogenic Risk:					6.88E-07

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Molybdenum	0.493	5.00E-03	1.23E-03	--	--
Pesticides and Polychlorinated Biphenyls					
PCB Aroclor 1242 ^e	0.00442	--	--	2.00E+00	8.84E-09
Non-COCs Cumulative Hazard Quotient:			1.23E-03		
Non-COCs Cumulative Excess Carcinogenic Risk:					8.84E-09

Total Cumulative Hazard Quotient:			6.19E-02		
Total Cumulative Excess Cancer Risk:					6.97E-07

a = From WCH (2014b). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

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

e = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: aroclor-1242; surrogate: aroclor-1260

-- = no value / not applicable

COC = contaminant of concern

PCB = polychlorinated biphenyl

TPH = total petroleum hydrocarbons

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Table 1-3. Direct Contact HQ and Excess Carcinogenic Risk for 600-294 Waste Site.

COCs	Statistical or Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Chromium (Hexavalent)	0.230	3.00E-03	9.58E-04	--	--
Lead ^c	64.3	--	--	--	--
BAP equivalence concentration ^d	0.00174	--	--	7.30E+00	1.27E-08
TPH-Diesel Range+ Motor Oil ^e	222	--	--	--	--
COCs Cumulative Hazard Quotient:			9.58E-04		
COCs Cumulative Excess Carcinogenic Risk:					1.27E-08

Non-COCs	Statistical or Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	2.17	4.00E-04	6.78E-02	--	--
Chromium (Total)	18.7	1.50E+00	1.56E-04	--	--
Molybdenum	0.538	5.00E-03	1.35E-03	--	--
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(g,h,i)perylene ^f	0.0277	3.00E-02	1.15E-05	--	--
Indeno(1,2,3-cd)pyrene ^g	0.0174	--	--	7.30E-01	-- ^g
Methylnaphthalene, 2-	0.0263	4.00E-03	8.22E-05	--	--
Naphthalene	0.0203	2.00E-02	1.27E-05	--	--
Phenanthrene ^f	0.0120	3.00E-01	5.00E-07	--	--
Phenol	0.104	3.00E-01	4.33E-06	--	--
Non-COCs Cumulative Hazard Quotient:			6.94E-02		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:	7.04E-02	
Total Cumulative Excess Cancer Risk:		1.27E-08

a = From WCH (2014c). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

d = From Table 2-2. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

e = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

f = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

Contaminant: phenanthrene; surrogate: anthracene.

g = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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Table 1-4. Direct Contact HQ and Excess Carcinogenic Risk for 600-298 Waste Site. (Page 1 of 2)

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Arsenic ^c	18.3	3.00E-04	-- ^c	1.50E+00	-- ^c
Lead ^d	13.5	--	--	--	--
BAP equivalence concentration ^e	0.032	--	--	7.30E+00	2.35E-07
TPH-Diesel Range Extended ^f	89	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					2.35E-07

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	0.70	4.00E-04	2.19E-02	--	--
Chromium (Total)	125	1.50E+00	1.04E-03	--	--
Copper	504	4.00E-02	1.58E-01	--	--
Molybdenum	0.65	5.00E-03	1.63E-03	--	--
Nickel	32.3	2.00E-02	2.02E-02	--	--
Selenium	0.80	5.00E-03	2.00E-03	--	--

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Table 1-4. Direct Contact HQ and Excess Carcinogenic Risk for 600-298 Waste Site. (Page 2 of 2)

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Acenaphthene	0.017	6.00E-02	3.54E-06	--	--
Benzo(a)anthracene ^h	0.028	--	--	7.30E-01	-- ^h
Benzo(b)fluoranthene ^h	0.029	--	--	7.30E-01	-- ^h
Benzo(g,h,i)perylene ^g	0.023	3.00E-02	9.58E-06	--	--
Benzo(k)fluoranthene ^h	0.013	--	--	7.30E-01	-- ^h
Chrysene ^h	0.026	--	--	7.30E-02	-- ^h
Fluoranthene	0.073	4.00E-02	2.28E-05	--	--
Indeno(1,2,3-cd)pyrene ^h	0.020	--	--	7.30E-01	-- ^h
Phenanthrene ^g	0.046	3.00E-01	1.92E-06	--	--
Pyrene	0.054	3.00E-02	2.25E-05	--	--
Pesticides and Polychlorinated Biphenyls					
DDE, 4,4'-	0.0017	--	--	3.40E-01	5.78E-10
DDT, 4,4'-	0.0029	5.00E-04	7.25E-05	3.40E-01	9.86E-10
Endosulfan (I, II, sulfate)	0.00046	6.00E-03	9.58E-07	--	--
Heptachlor epoxide	0.00056	1.30E-05	5.38E-04	9.10E+00	5.10E-09
Non-COCs Cumulative Hazard Quotient:			2.05E-01		
Non-COCs Cumulative Excess Carcinogenic Risk:					6.66E-09
Total Cumulative Hazard Quotient:			2.05E-01		
Total Cumulative Excess Cancer Risk:					2.42E-07

a = From WCH (2013a). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Arsenic cleanup level in EPA (2014) is not toxicity-based. Therefore, hazard quotient and excess carcinogenic risk calculations are not performed for arsenic.

d = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

e = From Table 2-3. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

f = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

g = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

Contaminant: phenanthrene; surrogate: anthracene.

h = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

TPH = total petroleum hydrocarbons

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Table 1-5. Direct Contact HQ and Excess Carcinogenic Risk for 600-299 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Lead ^c	84	--	--	--	--
Mercury	0.027	3.00E-04	1.13E-03	--	--
COCs Cumulative Hazard Quotient:			1.13E-03		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	1.1	4.00E-04	3.44E-02	--	--
Cadmium	3.0	1.00E-03	3.75E-02	--	--
Copper	33.2	4.00E-02	1.04E-02	--	--
Manganese	762	1.40E-01	6.80E-02	--	--
Molybdenum	0.60	5.00E-03	1.50E-03	--	--
Zinc	340	3.00E-01	1.42E-02	--	--
Non-COCs Cumulative Hazard Quotient:			1.66E-01		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00
Total Cumulative Hazard Quotient:			1.67E-01		
Total Cumulative Excess Cancer Risk:					0.00E+00

a = From WCH (2013a). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

-- = no value / not applicable

COC = contaminant of concern

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Table 1-6. Direct Contact HQ and Excess Carcinogenic Risk for 600-300 Waste Site. (Page 1 of 2)

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Arsenic ^c	28.6	3.00E-04	-- ^c	1.50E+00	-- ^c
Lead ^d	203	--	--	--	--
Mercury	0.016	3.00E-04	6.67E-04	--	--
PCB Aroclor 1260	0.0097	--	--	2.00E+00	1.94E-08
BAP equivalence concentration ^e	0.05973	--	--	7.30E+00	4.36E-07
TPH-Diesel Range Extended ^f	130	--	--	--	--
COCs Cumulative Hazard Quotient:			6.67E-04		
COCs Cumulative Excess Carcinogenic Risk:					4.55E-07

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	0.48	4.00E-04	1.50E-02	--	--
Boron	4.3	2.00E-01	2.69E-04	--	--
Zinc	70.7	3.00E-01	2.95E-03	--	--
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Acenaphthene	0.021	6.00E-02	4.38E-06	--	--
Anthracene	0.0049	3.00E-01	2.04E-07	--	--
Benzo(a)anthracene ^h	0.0038	--	--	7.30E-01	-- ^h
Benzo(b)fluoranthene ^h	0.072	--	--	7.30E-01	-- ^h
Benzo(g,h,i)perylene ^g	0.025	3.00E-02	1.04E-05	--	--
Benzo(k)fluoranthene ^h	0.028	--	--	7.30E-01	-- ^h
Chrysene ^h	0.055	--	--	7.30E-02	-- ^h
Dibenz[a,h]anthracene ^h	0.013	--	--	7.30E-01	-- ^h
Fluoranthene	0.17	4.00E-02	5.31E-05	--	--
Fluorene	0.0086	4.00E-02	2.69E-06	--	--
Indeno(1,2,3-cd)pyrene ^h	0.035	--	--	7.30E-01	-- ^h
Phenanthrene ^g	0.066	3.00E-01	2.75E-06	--	--
Pyrene	0.16	3.00E-02	6.67E-05	--	--

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Table 1-6. Direct Contact HQ and Excess Carcinogenic Risk for 600-300 Waste Site. (Page 2 of 2)

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Pesticides and Polychlorinated Biphenyls					
DDE, 4,4'-	0.0011	--	--	3.40E-01	3.74E-10
DDT, 4,4'-	0.0069	5.00E-04	1.73E-04	3.40E-01	2.35E-09
Endrin (and ketone, aldehyde)	0.020	3.00E-04	8.33E-04	--	--
Methoxychlor	0.0066	5.00E-03	1.65E-05	--	--
Non-COCs Cumulative Hazard Quotient:			1.94E-02		
Non-COCs Cumulative Excess Carcinogenic Risk:					2.72E-09
Total Cumulative Hazard Quotient:			2.00E-02		
Total Cumulative Excess Cancer Risk:					4.58E-07

a = From WCH (2013a). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Arsenic cleanup level in EPA (2014) is not toxicity-based. Therefore, hazard quotient and excess carcinogenic risk calculations are not performed for arsenic.

d = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

e = From Table 2-4. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

f = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

g = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

Contaminant: phenanthrene; surrogate: anthracene.

h = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

TPH = total petroleum hydrocarbons

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Table 1-7. Direct Contact HQ and Excess Carcinogenic Risk for 600-301 Waste Site.

COCs	Statistical or Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Lead ^c	23.1	--	--	--	--
Mercury	0.0237	3.00E-04	9.88E-04	--	--
TPH–Diesel Range + Motor Oil ^d	32	--	--	--	--
COCs Cumulative Hazard Quotient:			9.88E-04		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Non-COCs	Statistical or Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	0.353	4.00E-04	1.10E-02	--	--
Molybdenum	0.607	5.00E-03	1.52E-03	--	--
Nickel	26.3	2.00E-02	1.64E-02	--	--
Zinc	1460	3.00E-01	6.08E-02	--	--
Pesticides and Polychlorinated Biphenyls					
DDE, 4,4'-	0.0065	--	--	3.40E-01	2.21E-09
DDT, 4,4'-	0.0077	5.00E-04	1.93E-04	3.40E-01	2.62E-09
Endrin (and ketone, aldehyde)	0.00036	3.00E-04	1.50E-05	--	--
Non-COCs Cumulative Hazard Quotient:			9.00E-02		
Non-COCs Cumulative Excess Carcinogenic Risk:					4.83E-09

Total Cumulative Hazard Quotient:	9.10E-02
Total Cumulative Excess Cancer Risk:	4.83E-09

a = From WCH (2014d). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

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

-- = no value / not applicable

COC = contaminant of concern

TPH = total petroleum hydrocarbons

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Table 1-8. Direct Contact HQ and Excess Carcinogenic Risk for 600-303 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Lead ^c	16.2	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	0.49	4.00E-04	1.53E-02	--	--
Non-COCs Cumulative Hazard Quotient:			1.53E-02		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:			1.53E-02		
Total Cumulative Excess Cancer Risk:					0.00E+00

a = From WCH (2013b). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

-- = no value / not applicable

COC = contaminant of concern

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Table 1-9. Direct Contact HQ and Excess Carcinogenic Risk for 600-316 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Arsenic ^c	6.6	3.00E-04	-- ^c	1.50E+00	-- ^c
Lead ^d	26.9	--	--	--	--
Mercury	0.076	3.00E-04	3.17E-03	--	--
COCs Cumulative Hazard Quotient:			3.17E-03		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	1.0	4.00E-04	3.13E-02	--	--
Cadmium	3.0	1.00E-03	3.75E-02	--	--
Manganese	887	1.40E-01	7.92E-02	--	--
Zinc	756	3.00E-01	3.15E-02	--	--
Non-COCs Cumulative Hazard Quotient:			1.79E-01		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:			1.83E-01		
Total Cumulative Excess Cancer Risk:					0.00E+00

a = From WCH (2013c). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Arsenic cleanup level in EPA (2014) is not toxicity-based. Therefore, hazard quotient and excess carcinogenic risk calculations are not performed for arsenic.

d = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

COC = contaminant of concern

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Table 1-10. Direct Contact HQ and Excess Carcinogenic Risk for 600-318 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Lead ^c	168	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	1.9	4.00E-04	5.94E-02	--	--
Boron	4.0	2.00E-01	2.50E-04	--	--
Copper	136	4.00E-02	4.25E-02	--	--
Molybdenum	1.9	5.00E-03	4.75E-03	--	--
Non-COCs Cumulative Hazard Quotient:			1.07E-01		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:			1.07E-01		
Total Cumulative Excess Cancer Risk:					0.00E+00

a = From WCH (2013c). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

COC = contaminant of concern

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Table 1-11. Direct Contact HQ and Excess Carcinogenic Risk for 600-320:1 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
BAP equivalence concentration ^c	0.123	--	--	7.30E+00	8.96E-07
TPH-Diesel Range Extended ^d	20	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					8.96E-07

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	0.79	4.00E-04	2.47E-02	--	--
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(a)anthracene ^e	0.15	--	--	7.30E-01	-- ^e
Benzo(b)fluoranthene ^e	0.11	--	--	7.30E-01	-- ^e
Benzo(g,h,i)perylene ^f	0.092	3.00E-02	3.83E-05	--	--
Benzo(k)fluoranthene ^e	0.040	--	--	7.30E-01	-- ^e
Chrysene ^e	0.17	--	--	7.30E-02	-- ^e
Fluoranthene	0.38	4.00E-02	1.19E-04	--	--
Fluorene	0.043	4.00E-02	1.34E-05	--	--
Indeno(1,2,3-cd)pyrene ^e	0.060	--	--	7.30E-01	-- ^e
Phenanthrene ^f	0.39	3.00E-01	1.63E-05	--	--
Pyrene	0.59	3.00E-02	2.46E-04	--	--
Non-COCs Cumulative Hazard Quotient:			4.33E-04		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00
Total Cumulative Hazard Quotient:			4.33E-04		
Total Cumulative Excess Cancer Risk:					8.96E-07

a = From WCH (2013d). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = From Table 2-5. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

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

e = Included in BAP equivalence concentration.

f = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

Contaminant: phenanthrene; surrogate: anthracene.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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Table 1-12. Direct Contact HQ and Excess Carcinogenic Risk for 600-320:2 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
TPH-Diesel Range Extended ^c	5.5	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00
Total Cumulative Hazard Quotient:			0.0E+00		
Total Cumulative Excess Cancer Risk:					0.00E+00

a = From WCH (2013d). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

COC = contaminant of concern

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Table 1-13. Direct Contact HQ and Excess Carcinogenic Risk for 600-320:3 Subsite.

COCs	Statistical or Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
BAP equivalence concentration ^c	0.148	--	--	7.30E+00	1.08E-06
TPH-Diesel Range Extended ^d	310	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					1.08E-06

Non-COCs	Statistical or Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(a)anthracene ^e	1.3	--	--	7.30E-01	-- ^e
Benzo(k)fluoranthene ^e	0.18	--	--	7.30E-01	-- ^e
Fluoranthene	0.69	4.00E-02	2.16E-04	--	--
Naphthalene	0.089	2.00E-02	5.56E-05	--	--
Non-COCs Cumulative Hazard Quotient:			2.71E-04		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:	2.71E-04				
Total Cumulative Excess Cancer Risk:					1.08E-06

a = From WCH (2013d). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = From Table 2-6. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

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

e = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

Table 1-14. Direct Contact HQ and Excess Carcinogenic Risk for 600-320:4 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
TPH-Diesel Range Extended ^c	67	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

a = From WCH (2013d). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

-- = no value / not applicable

COC = contaminant of concern

TPH = total petroleum hydrocarbons

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Table 1-15. Direct Contact HQ and Excess Carcinogenic Risk for 600-320:5 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
TPH-Diesel Range Extended ^c	3.1	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

a = From WCH (2013d). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

-- = no value / not applicable

COC = contaminant of concern

TPH = total petroleum hydrocarbons

Table 1-16. Direct Contact HQ and Excess Carcinogenic Risk for 600-320:6 Subsite.

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	0.71	4.00E-04	2.22E-02	--	--
Non-COCs Cumulative Hazard Quotient:			2.22E-02		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

a = From WCH (2013d). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

-- = no value / not applicable

COC = contaminant of concern

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Table 1-17. Direct Contact HQ and Excess Carcinogenic Risk for 600-320:7 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Arsenic ^c	18.2	3.00E-04	-- ^c	1.50E+00	-- ^c
Lead ^d	62.9	--	--	--	--
BAP equivalence concentration ^e	0.014	--	--	7.30E+00	1.05E-07
TPH–Diesel Range Extended ^f	32	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					1.05E-07

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(b)fluoranthene ^h	0.022	--	--	7.30E-01	-- ^h
Benzo(g,h,i)perylene ^g	0.032	3.00E-02	1.33E-05	--	--
Benzo(k)fluoranthene ^h	0.0089	--	--	7.30E-01	-- ^h
Chrysene ^h	0.0073	--	--	7.30E-02	-- ^h
Fluoranthene	0.015	4.00E-02	4.69E-06	--	--
Indeno(1,2,3-cd)pyrene ^h	0.032	--	--	7.30E-01	-- ^h
Non-COCs Cumulative Hazard Quotient:			1.80E-05		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:	1.80E-05	
Total Cumulative Excess Cancer Risk:		1.05E-07

a = From WCH (2013d). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Arsenic cleanup level in EPA (2014) is not toxicity-based. Therefore, hazard quotient and excess carcinogenic risk calculations are not performed for arsenic.

d = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

e = From Table 2-8. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

f = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

g = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

h = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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Table 1-18. Direct Contact HQ and Excess Carcinogenic Risk for 600-320:8 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Arsenic ^c	57.5	3.00E-04	-- ^c	1.50E+00	-- ^c
Lead ^d	142	--	--	--	--
BAP equivalence concentration ^e	0.068	--	--	7.30E+00	4.96E-07
TPH-Diesel Range Extended ^f	36	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					4.96E-07

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(a)anthracene ^h	0.023	--	--	7.30E-01	-- ^h
Benzo(b)fluoranthene ^h	0.060	--	--	7.30E-01	-- ^h
Benzo(g,h,i)perylene ^g	0.045	3.00E-02	1.88E-05	--	--
Benzo(k)fluoranthene ^h	0.023	--	--	7.30E-01	-- ^h
Chrysene ^h	0.026	--	--	7.30E-02	-- ^h
Fluoranthene	0.021	4.00E-02	6.56E-06	--	--
Indeno(1,2,3-cd)pyrene ^h	0.051	--	--	7.30E-01	-- ^h
Phenanthrene ^g	0.021	3.00E-01	8.75E-07	--	--
Pyrene	0.021	3.00E-02	8.75E-06	--	--
Non-COCs Cumulative Hazard Quotient:			3.49E-05		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:	3.49E-05	
Total Cumulative Excess Cancer Risk:		4.96E-07

a = From WCH (2013d). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Arsenic cleanup level in EPA (2014) is not toxicity-based. Therefore, hazard quotient and excess carcinogenic risk calculations are not performed for arsenic.

d = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

e = From Table 2-9. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

f = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

g = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

Contaminant: phenanthrene; surrogate: anthracene.

h = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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Table 1-19. Direct Contact HQ and Excess Carcinogenic Risk for 600-320:9 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
TPH-Diesel Range Extended ^c	3.7	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	0.40	4.00E-04	1.25E-02	--	--
Non-COCs Cumulative Hazard Quotient:			1.25E-02		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:	1.25E-02				
Total Cumulative Excess Cancer Risk:					0.00E+00

a = From WCH (2013d). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

-- = no value / not applicable

COC = contaminant of concern

TPH = total petroleum hydrocarbons

Table 1-20. Direct Contact HQ and Excess Carcinogenic Risk for 600-328 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Lead ^c	17.5	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

a = From WCH (2013e). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

-- = no value / not applicable

COC = contaminant of concern

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Table 1-21. Direct Contact HQ and Excess Carcinogenic Risk for 600-356 Waste Site.

COCs	Statistical Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
BAP equivalence concentration ^c	0.00250	--	--	7.30E+00	1.82E-08
TPH-Diesel Range + Motor Oil ^d	36	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					1.82E-08

Non-COCs	Statistical Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Silver	0.533	5.00E-03	1.33E-03	--	--
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(b)fluoranthene ^f	0.0118	--	--	7.30E-01	-- ^f
Benzo(g,h,i)perylene ^e	0.00474	3.00E-02	1.98E-06	--	--
Chrysene ^f	0.00391	--	--	7.30E-02	-- ^f
Fluoranthene	0.00463	4.00E-02	1.45E-06	--	--
Pyrene	0.00549	3.00E-02	2.29E-06	--	--
Non-COCs Cumulative Hazard Quotient:			1.34E-03		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:			1.34E-03		
Total Cumulative Excess Cancer Risk:					1.82E-08

a = From WCH (2014e). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = From Table 2-10. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

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

e = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

f = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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Table 1-22. Direct Contact HQ and Excess Carcinogenic Risk for 600-368 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Chromium (Hexavalent)	0.231	3.00E-03	9.63E-04	--	--
COCs Cumulative Hazard Quotient:				9.63E-04	
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	0.51	4.00E-04	1.59E-02	--	--
Non-COCs Cumulative Hazard Quotient:				1.59E-02	
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:			1.69E-02		
Total Cumulative Excess Cancer Risk:					0.00E+00

a = From WCH (2014f). Analytes quantified below background values listed in Table G-13 of the

100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

-- = no value / not applicable

COC = contaminant of concern

Table 1-23. Direct Contact HQ and Excess Carcinogenic Risk for 600-369:1 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
TPH-Diesel Range Extended ^c	82	--	--	--	--
COCs Cumulative Hazard Quotient:				0.00E+00	
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

a = From WCH (2014f). Analytes quantified below background values listed in Table G-13 of the

100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

-- = no value / not applicable

COC = contaminant of concern

TPH = total petroleum hydrocarbons

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Table 1-24. Direct Contact HQ and Excess Carcinogenic Risk for 600-369:2 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
BAP equivalence concentration ^c	0.0010	--	--	7.30E+00	7.30E-09
TPH-Diesel Range extended ^d	6.0	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					7.30E-09

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(b)fluoranthene ^e	0.01	--	--	7.30E-01	-- ^e
Non-COCs Cumulative Hazard Quotient:			0.00E+00		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:	0.00E+00				
Total Cumulative Excess Cancer Risk:					7.30E-09

a = From WCH (2014f). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = From Table 2-11. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

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

e = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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Table 1-25. Direct Contact HQ and Excess Carcinogenic Risk for 600-369:3 Subsite.

COCs	Statistical Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Arsenic ^c	12.5	3.00E-04	-- ^c	1.50E+00	-- ^c
Lead ^d	52.4	--	--	--	--
BAP equivalence concentration ^e	0.125	--	--	7.30E+00	9.10E-07
TPH-Diesel Range Extended ^f	31	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					9.10E-07

Non-COCs	Statistical Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	0.53	4.00E-04	1.66E-02	--	--
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Acenaphthene	0.018	6.00E-02	3.75E-06	--	--
Benzo(a)anthracene ^h	0.070	--	--	7.30E-01	-- ^h
Benzo(b)fluoranthene ^h	0.12	--	--	7.30E-01	-- ^h
Benzo(g,h,i)perylene ^f	0.075	3.00E-02	3.13E-05	--	--
Benzo(k)fluoranthene ^h	0.053	--	--	7.30E-01	-- ^h
Chrysene ^h	0.10	--	--	7.30E-02	-- ^h
Fluoranthene	0.17	4.00E-02	5.31E-05	--	--
Fluorene	0.081	4.00E-02	2.53E-05	--	--
Indeno(1,2,3-cd)pyrene ^h	0.074	--	--	7.30E-01	-- ^h
Phenanthrene ^f	0.064	3.00E-01	2.67E-06	--	--
Pyrene	0.13	3.00E-02	5.42E-05	--	--
Non-COCs Cumulative Hazard Quotient:			1.67E-02		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:	1.67E-02	
Total Cumulative Excess Cancer Risk:		9.10E-07

a = From WCH (2014f). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Arsenic cleanup level in EPA (2014) is not toxicity-based. Therefore, hazard quotient and excess carcinogenic risk calculations are not performed for arsenic.

d = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

e = From Table 2-12. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

f = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

g = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

Contaminant: phenanthrene; surrogate: anthracene.

h = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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Table 1-26. Direct Contact HQ and Excess Carcinogenic Risk for 600-369:4 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Arsenic ^c	27.0	3.00E-04	-- ^c	1.50E+00	-- ^c
Lead ^d	59.6	--	--	--	--
BAP equivalence concentration ^e	0.018	--	--	7.30E+00	1.34E-07
TPH-Diesel Range Extended ^f	14	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					1.34E-07

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(a)anthracene ^h	0.013	--	--	7.30E-01	-- ^h
Benzo(b)fluoranthene ^h	0.023	--	--	7.30E-01	-- ^h
Benzo(g,h,i)perylene ^g	0.015	3.00E-02	6.25E-06	--	--
Benzo(k)fluoranthene ^h	0.0061	--	--	7.30E-01	-- ^h
Chrysene ^h	0.014	--	--	7.30E-02	-- ^h
Fluoranthene	0.026	4.00E-02	8.13E-06	--	--
Pyrene	0.028	3.00E-02	1.17E-05	--	--
Non-COCs Cumulative Hazard Quotient:			2.60E-05		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:	2.60E-05	
Total Cumulative Excess Cancer Risk:		1.34E-07

a = From WCH (2014f). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Arsenic cleanup level in EPA (2014) is not toxicity-based. Therefore, hazard quotient and excess carcinogenic risk calculations are not performed for arsenic.

d = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

e = From Table 2-13. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

f = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

g = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

h = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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Table 1-27. Direct Contact HQ and Excess Carcinogenic Risk for 600-396:5 Subsite.

COCs	Statistical Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
BAP equivalence concentration ^c	0.00082	--	--	7.30E+00	5.98E-09
TPH-Diesel Range Extended ^d	25	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					5.98E-09

Non-COCs	Statistical Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(b)fluoranthene ^e	0.0076	--	--	7.30E-01	-- ^e
Chrysene ^e	0.0059	--	--	7.30E-02	-- ^e
Non-COCs Cumulative Hazard Quotient:			0.00E+00		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:			0.00E+00		
Total Cumulative Excess Cancer Risk:					5.98E-09

a = From WCH (2014f). Analytes quantified below background values listed in Table G-13 of the

100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = From Table 2-14. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

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

e = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

Table 1-28. Direct Contact HQ and Excess Carcinogenic Risk for 600-369:6 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
TPH-Diesel Range Extended ^c	78	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

a = From WCH (2014f). Analytes quantified below background values listed in Table G-13 of the

100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

-- = no value / not applicable

COC = contaminant of concern

TPH = total petroleum hydrocarbons

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Table 1-29. Direct Contact HQ and Excess Carcinogenic Risk for 600-369:7 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
TPH-Diesel Range Extended ^c	6.8	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

a = From WCH (2014f). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

-- = no value / not applicable

COC = contaminant of concern

TPH = total petroleum hydrocarbons

Table 1-30. Direct Contact HQ and Excess Carcinogenic Risk for 600-369:8 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
TPH-Diesel Range Extended ^c	130	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

a = From WCH (2014f). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

-- = no value / not applicable

COC = contaminant of concern

TPH = total petroleum hydrocarbons

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Table 1-31. Direct Contact HQ and Excess Carcinogenic Risk for 600-370 Waste Site.

COCs	Statistical or Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Lead ^c	37.9	--	--	--	--
BAP equivalence concentration ^d	0.0553	--	--	7.30E+00	4.03E-07
TPH-Diesel Range + Motor Oil ^e	16	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					4.03E-07

Non-COCs	Statistical or Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Cadmium	0.998	1.00E-03	1.25E-02	--	--
Copper	42.0	4.00E-02	1.31E-02	--	--
Molybdenum	0.743	5.00E-03	1.86E-03	--	--
Silver	0.759	5.00E-03	1.90E-03	--	--
Vanadium	96.1	5.00E-03	2.40E-01	--	--
Zinc	104	3.00E-01	4.33E-03	--	--
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(a)anthracene ^f	0.0165	--	--	7.30E-01	-- ^g
Benzo(b)fluoranthene ^f	0.0405	--	--	7.30E-01	-- ^g
Benzo(g,h,i)perylene ^f	0.0695	3.00E-02	2.90E-05	--	--
Chrysene ^f	0.0155	--	--	7.30E-02	-- ^g
Fluoranthene	0.0116	4.00E-02	3.63E-06	--	--
Pyrene	0.0114	3.00E-02	4.75E-06	--	--
Non-COCs Cumulative Hazard Quotient:			2.74E-01		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:			2.74E-01		
Total Cumulative Excess Cancer Risk:					4.03E-07

a = From WCH (2014g). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

d = From Table 2-15. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

e = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

f = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

g = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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Table 1-32. Direct Contact HQ and Excess Carcinogenic Risk for 600-371 Waste Site.

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Boron	4.66	2.00E-01	2.91E-04	--	--
Non-COCs Cumulative Hazard Quotient:			2.91E-04		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

a = From WCH (2014h). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

-- = no value / not applicable

COC = contaminant of concern

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Table 1-33. Direct Contact HQ and Excess Carcinogenic Risk for 600-372 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
BAP equivalence concentration ^c	0.00240	--	--	7.30E+00	1.75E-08
TPH-Motor Oil ^d	18.1	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					1.75E-08

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Silver	0.308	5.00E-03	7.70E-04	--	--
Semi-volatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(a)anthracene ^f	0.00194	--	--	7.30E-01	-- ^f
Benzo(b)fluoranthene ^f	0.00140	--	--	7.30E-01	-- ^f
Benzo(g,h,i)perylene ^e	0.00107	3.00E-02	4.46E-07	--	--
Chrysene ^f	0.00180	--	--	7.30E-02	-- ^f
Fluoranthene	0.00240	4.00E-02	7.50E-07	--	--
Pyrene	0.00329	3.00E-02	1.37E-06	--	--
Non-COCs Cumulative Hazard Quotient:			7.73E-04		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:	7.73E-04	
Total Cumulative Excess Cancer Risk:		1.75E-08

a = From WCH (2014). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = From Table 2-17. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

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

e = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

f = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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Table 1-34. Direct Contact HQ and Excess Carcinogenic Risk for 600-373 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Arsenic ^c	65.7	3.00E-04	-- ^c	1.50E+00	-- ^c
Lead ^d	322	--	--	--	--
BAP equivalence concentration ^e	0.0187	--	--	7.30E+00	1.37E-07
TPH-Diesel Range ^f	2.57	--	--	--	--
TPH-Motor Oil ^f	46.5	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					1.37E-07

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Molybdenum	0.566	5.00E-03	1.42E-03	--	--
Silver	0.316	5.00E-03	7.90E-04	--	--
Semi-volatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(a)anthracene ^h	0.0187	--	--	7.30E-01	-- ^h
Benzo(b)fluoranthene ^h	0.0123	--	--	7.30E-01	-- ^h
Benzo(g,h,i)perylene ^g	0.0101	3.00E-02	4.21E-06	--	--
Chrysene ^h	0.0203	--	--	7.30E-02	-- ^h
Dibenz[a,h]anthracene ^h	0.00105	--	--	7.30E-01	-- ^h
Fluoranthene	0.0249	4.00E-02	7.78E-06	--	--
Phenanthrene ^g	0.0241	3.00E-01	1.00E-06	--	--
Pyrene	0.0328	3.00E-02	1.37E-05	--	--
Non-COCs Cumulative Hazard Quotient:			2.23E-03		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:	2.23E-03
Total Cumulative Excess Cancer Risk:	1.37E-07

a = From WCH (2014j). Analytes quantified below background values listed in Table G-13 of the 100-F/10 RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/10 RI/FS (DOE-RL 2014).

c = Arsenic cleanup level in EPA (2014) is not toxicity-based. Therefore, hazard quotient and excess carcinogenic risk calculations are not performed for arsenic.

d = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

e = From Table 2-18. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

f = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

g = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

Contaminant: phenanthrene; surrogate: anthracene.

h = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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Table 1-35. Direct Contact HQ and Excess Carcinogenic Risk for 600-374 Waste Site.

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Molybdenum	0.612	5.00E-03	1.53E-03	--	--
Non-COCs Cumulative Hazard Quotient:			1.53E-03		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

a = From WCH (2014j). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

-- = no value / not applicable

COC = contaminant of concern

Table 1-36. Direct Contact HQ and Excess Carcinogenic Risk for 600-375 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Lead ^c	13.0	--	--	--	--
Mercury	0.203	3.00E-04	8.46E-03	--	--
COCs Cumulative Hazard Quotient:			8.46E-03		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Cadmium	5.09	1.00E-03	6.36E-02	--	--
Manganese	1540	1.40E-01	1.38E-01	--	--
Molybdenum	1.07	5.00E-03	2.68E-03	--	--
Silver	0.465	5.00E-03	1.16E-03	--	--
Zinc	937	3.00E-01	3.90E-02	--	--
Non-COCs Cumulative Hazard Quotient:			2.44E-01		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:			2.52E-01		
Total Cumulative Excess Cancer Risk:					0.00E+00

a = From WCH (2014k). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

-- = no value / not applicable

COC = contaminant of concern

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Table 1-37. Direct Contact HQ and Excess Carcinogenic Risk for 600-376:1 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Arsenic ^c	10.2	3.00E-04	-- ^d	1.50E+00	-- ^e
Lead ^d	31.1	--	--	--	--
Mercury	0.0182	3.00E-04	7.58E-04	--	--
COCs Cumulative Hazard Quotient:			7.58E-04		
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	3.14	4.00E-04	9.81E-02	--	--
Molybdenum	0.614	5.00E-03	1.54E-03	--	--
Non-COCs Cumulative Hazard Quotient:			9.97E-02		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:			1.00E-01		
Total Cumulative Excess Cancer Risk:					0.00E+00

a = From WCH (2014). Analytes quantified below background values listed in Table G-13 of the

100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Arsenic cleanup level in EPA (2014) is not toxicity-based. Therefore, hazard quotient and excess carcinogenic risk calculations are not performed for arsenic.

d = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

-- = no value / not applicable

COC = contaminant of concern

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Table 1-38. Direct Contact HQ and Excess Carcinogenic Risk for 600-376:2 Subsite.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Lead ^c	78.6	--	--	--	--
COCs Cumulative Hazard Quotient:				0.00E+00	
COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Chromium (Total)	28.8	1.50E+00	2.40E-04	--	--
Molybdenum	0.624	5.00E-03	1.56E-03	--	--
Non-COCs Cumulative Hazard Quotient:				1.80E-03	
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:			1.80E-03		
Total Cumulative Excess Cancer Risk:					0.00E+00

a = From WCH (2014). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

-- = no value / not applicable

COC = contaminant of concern

Table 1-39. Direct Contact HQ and Excess Carcinogenic Risk for 600-377 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
PCB Aroclor 1260	0.0386	--	--	2.00E+00	7.72E-08
TPH-Motor Oil ^c	22.8	--	--	--	--
COCs Cumulative Hazard Quotient:				0.00E+00	
COCs Cumulative Excess Carcinogenic Risk:					7.72E-08

a = From WCH (2014m). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

-- = no value / not applicable

COC = contaminant of concern

TPH = total petroleum hydrocarbons

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Table 1-40. Direct Contact HQ and Excess Carcinogenic Risk for 600-378 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Lead ^c	11.9	--	--	--	--
BAP equivalence concentration ^d	0.117	--	--	7.30E+00	8.52E-07
TPH-Motor Oil ^e	31.2	--	--	--	--
COCs Cumulative Hazard Quotient:			0.00E+00		
COCs Cumulative Excess Carcinogenic Risk:					8.52E-07

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	3.18	4.00E-04	9.94E-02	--	--
Boron	5.63	2.00E-01	3.52E-04	--	--
Cadmium	0.778	1.00E-03	9.73E-03	--	--
Silver	0.638	5.00E-03	1.60E-03	--	--
Zinc	77.7	3.00E-01	3.24E-03	--	--
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Anthracene	0.0217	3.00E-01	9.04E-07	--	--
Benzo(a)anthracene ^g	0.114	--	--	7.30E-01	.. ^g
Benzo(b)fluoranthene ^g	0.101	--	--	7.30E-01	.. ^g
Benzo(g,h,i)perylene ^f	0.053	3.00E-02	2.21E-05	--	--
Benzo(k)fluoranthene ^g	0.0503	--	--	7.30E-01	.. ^g
Chrysene ^g	0.095	--	--	7.30E-02	.. ^g
Dibenz[a,h]anthracene ^g	0.00251	--	--	7.30E-01	.. ^g
Fluoranthene	0.179	4.00E-02	5.59E-05	--	--
Phenanthrene ^f	0.107	3.00E-01	4.46E-06	--	--
Pyrene	0.184	3.00E-02	7.67E-05	--	--
Non-COCs Cumulative Hazard Quotient:			1.14E-01		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00

Total Cumulative Hazard Quotient:	1.14E-01	
Total Cumulative Excess Cancer Risk:		8.52E-07

a = From WCH (2014n). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = Lead does not have a reference dose or cancer potency factor because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake.

d = From Table 2-19. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

e = The risk associated with total petroleum hydrocarbons does not contribute to the cumulative toxicity calculation.

f = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

Contaminant: phenanthrene; surrogate: anthracene.

g = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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Table 1-41. Direct Contact HQ and Excess Carcinogenic Risk for 600-379 Waste Site.

COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Mercury	0.0358	3.00E-04	1.49E-03	--	--
BAP equivalence concentration ^c	0.00207	--	--	7.30E+00	1.51E-08
TPH-Motor oil + Diesel Range ^d	21.2	--	--	--	--
COCs Cumulative Hazard Quotient:			1.49E-03		
COCs Cumulative Excess Carcinogenic Risk:					1.51E-08

Non-COCs	Maximum Value ^a (mg/kg)	Oral Reference Dose (RfD) ^b (mg/kg-day)	Hazard Quotient	Oral Carcinogenic Potency Factor ^b (mg/kg-day) ⁻¹	Excess Carcinogenic Risk
Metals					
Antimony	1.84	4.00E-04	5.75E-02	--	--
Semivolatile Organic Compounds, Including Polycyclic Aromatic Hydrocarbons					
Benzo(b)fluoranthene ^f	0.00192	--	--	7.30E-01	-- ^f
Benzo(g,h,i)perylene ^e	0.00329	3.00E-02	1.37E-06	--	--
Indeno(1,2,3-cd)pyrene ^f	0.00184	--	--	7.30E-01	-- ^f
Non-COCs Cumulative Hazard Quotient:			5.75E-02		
Non-COCs Cumulative Excess Carcinogenic Risk:					0.00E+00
Total Cumulative Hazard Quotient:			5.90E-02		
Total Cumulative Excess Cancer Risk:					1.51E-08

a = From WCH (2014o). Analytes quantified below background values listed in Table G-13 of the 100-F/IU RI/FS (DOE-RL 2014) are not included in risk calculations.

b = Values obtained from Table G-12 of the 100-F/IU RI/FS (DOE-RL 2014).

c = From Table 2-20. Evaluation of the compliance of BAP with cleanup levels includes the toxic equivalency concentrations of detected carcinogenic PAHs.

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

e = Toxicity data for these chemicals are not available. Cleanup levels are based on surrogate chemicals:

Contaminant: benzo(g,h,i)perylene; surrogate: pyrene

f = Included in BAP equivalence concentration.

-- = no value / not applicable

BAP = benzo(a)pyrene

COC = contaminant of concern

PAH = polycyclic aromatic hydrocarbon

TPH = total petroleum hydrocarbons

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ATTACHMENT 2

Benzo(a)pyrene Toxic Equivalent Concentration Calculations

Table 2-1. 600-279 Waste Site Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Statistical Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.0396	1	0.0396
Benzo[a]anthracene	0.0336	0.1	0.00336
Benzo[b]fluoranthene	0.0406	0.1	0.00406
Benzo[k]fluoranthene	0.0155	0.1	0.00155
Chrysene	0.0346	0.01	0.000346
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	--	0.1	--
<i>Total BAP TEC:</i>			0.0489

^a From WCH (2014a).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

Table 2-2. 600-294 Waste Site Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	--	1	--
Benzo[a]anthracene	--	0.1	--
Benzo[b]fluoranthene	--	0.1	--
Benzo[k]fluoranthene	--	0.1	--
Chrysene	--	0.01	--
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	0.0174	0.1	0.00174
<i>Total BAP TEC:</i>			0.00174

^a From WCH (2014c).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

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Table 2-3. 600-294 Waste Site Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	--	1	--
Benzo[a]anthracene	--	0.1	--
Benzo[b]fluoranthene	--	0.1	--
Benzo[k]fluoranthene	--	0.1	--
Chrysene	--	0.01	--
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	0.0174	0.1	0.00174
<i>Total BAP TEC:</i>			0.00174

^a From WCH (2014c).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

Table 2-4. 600-298 Waste Site Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.023	1	0.023
Benzo[a]anthracene	0.028	0.1	0.0028
Benzo[b]fluoranthene	0.029	0.1	0.0029
Benzo[k]fluoranthene	0.013	0.1	0.0013
Chrysene	0.026	0.01	0.00026
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	0.020	0.1	0.0020
<i>Total BAP TEC:</i>			0.032

^a From WCH (2013a).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

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Table 2-5. 600-300 Waste Site Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclicaromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.044	1	0.044
Benzo[a]anthracene	0.0038	0.1	0.00038
Benzo[b]fluoranthene	0.072	0.1	0.0072
Benzo[k]fluoranthene	0.028	0.1	0.0028
Chrysene	0.055	0.01	0.00055
Dibenz[a,h]anthracene	0.013	0.1	0.0013
Indeno[1,2,3-cd]pyrene	0.035	0.1	0.0035
<i>Total BAP TEC:</i>			0.060

^a From WCH (2013a).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

Table 2-6. 600-320:1 Subsite Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.085	1	0.085
Benzo[a]anthracene	0.15	0.1	0.015
Benzo[b]fluoranthene	0.11	0.1	0.011
Benzo[k]fluoranthene	0.040	0.1	0.004
Chrysene	0.17	0.01	0.0017
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	0.06	0.1	0.0060
<i>Total BAP TEC:</i>			0.123

^a From WCH (2013d).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

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Table 2-7. 600-320:3 Subsite Statistical Sampling Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Statistical Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	--	1	--
Benzo[a]anthracene	1.3	0.1	0.13
Benzo[b]fluoranthene	--	0.1	--
Benzo[k]fluoranthene	0.18	0.1	0.018
Chrysene	--	0.01	--
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	--	0.1	--
<i>Total BAP TEC:</i>			0.148

^a From WCH (2013d).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

Table 2-8. 600-320:3 Subsite Focused Sampling Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.012	1	0.012
Benzo[a]anthracene	0.011	0.1	0.0011
Benzo[b]fluoranthene	--	0.1	--
Benzo[k]fluoranthene	0.0073	0.1	0.00073
Chrysene	--	0.01	--
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	--	0.1	--
<i>Total BAP TEC:</i>			0.014

^a From WCH (2013d).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

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Table 2-9. 600-320:7 Subsite Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.0080	1	0.0080
Benzo[a]anthracene	--	0.1	--
Benzo[b]fluoranthene	0.022	0.1	0.0022
Benzo[k]fluoranthene	0.0089	0.1	0.00089
Chrysene	0.0073	0.01	0.000073
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	0.032	0.1	0.0032
<i>Total BAP TEC:</i>			0.014

^a From WCH (2013d).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

Table 2-10. 600-320:8 Subsite Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.052	1	0.052
Benzo[a]anthracene	0.023	0.1	0.0023
Benzo[b]fluoranthene	0.060	0.1	0.0060
Benzo[k]fluoranthene	0.023	0.1	0.0023
Chrysene	0.026	0.01	0.00026
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	0.051	0.1	0.0051
<i>Total BAP TEC:</i>			0.068

^a From WCH (2013d).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

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Table 2-11. 600-356 Waste Site Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Statistical Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.00128	1	0.00128
Benzo[a]anthracene	--	0.1	--
Benzo[b]fluoranthene	0.0118	0.1	0.00118
Benzo[k]fluoranthene	--	0.1	--
Chrysene	0.00391	0.01	0.000391
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	--	0.1	--
<i>Total BAP TEC:</i>			0.00250

^a From WCH (2014e).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

Table 2-12. 600-369:2 Subsite Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	--	1	--
Benzo[a]anthracene	--	0.1	--
Benzo[b]fluoranthene	0.0100	0.1	0.0010
Benzo[k]fluoranthene	--	0.1	--
Chrysene	--	0.01	--
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	--	0.1	--
<i>Total BAP TEC:</i>			0.0010

^a From WCH (2014f).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

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Table 2-13. 600-369:3 Subsite Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Statistical Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.092	1	0.092
Benzo[a]anthracene	0.070	0.1	0.0070
Benzo[b]fluoranthene	0.12	0.1	0.012
Benzo[k]fluoranthene	0.053	0.1	0.0053
Chrysene	0.10	0.01	0.0010
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	0.074	0.1	0.0074
<i>Total BAP TEC:</i>			0.125

^a From WCH (2014f).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

Table 2-14. 600-369:4 Subsite Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.014	1	0.014
Benzo[a]anthracene	0.013	0.1	0.0013
Benzo[b]fluoranthene	0.023	0.1	0.0023
Benzo[k]fluoranthene	0.0061	0.1	0.0006
Chrysene	0.014	0.01	0.0001
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	--	0.1	--
<i>Total BAP TEC:</i>			0.018

^a From WCH (2014f).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

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Table 2-15. 600-369:5 Subsite Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Statistical Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	--	1	--
Benzo[a]anthracene	--	0.1	--
Benzo[b]fluoranthene	0.0076	0.1	0.00076
Benzo[k]fluoranthene	--	0.1	--
Chrysene	0.0059	0.01	0.000059
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	--	0.1	--
<i>Total BAP TEC:</i>			0.00082

^a From WCH (2014f).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

Table 2-16. 600-370 Waste Site Excavation Statistical Sampling Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Statistical Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.0494	1	0.0494
Benzo[a]anthracene	0.0165	0.1	0.00165
Benzo[b]fluoranthene	0.0405	0.1	0.00405
Benzo[k]fluoranthene	--	0.1	--
Chrysene	0.0155	0.01	0.000155
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	--	0.1	--
<i>Total BAP TEC:</i>			0.0553

^a From WCH (2014g).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

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Table 2-17. 600-370 Waste Site Excavation Focused Sampling Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.00187	1	0.00187
Benzo[a]anthracene	0.00104	0.1	0.000104
Benzo[b]fluoranthene	0.00230	0.1	0.000230
Benzo[k]fluoranthene	--	0.1	--
Chrysene	0.000679	0.01	0.0000679
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	--	0.1	--
<i>Total BAP TEC:</i>			0.00221

^a From WCH (2014g).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

Table 2-18. 600-372 Waste Site Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.00205	1	0.00205
Benzo[a]anthracene	0.00194	0.1	0.000194
Benzo[b]fluoranthene	0.0014	0.1	0.000140
Benzo[k]fluoranthene	--	0.1	--
Chrysene	0.0018	0.01	0.000018
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	--	0.1	--
<i>Total BAP TEC:</i>			0.00240

^a From WCH (2014i).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

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Table 2-19. 600-373 Waste Site Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.0154	1	0.0154
Benzo[a]anthracene	0.0187	0.1	0.00187
Benzo[b]fluoranthene	0.0123	0.1	0.00123
Benzo[k]fluoranthene	--	0.1	--
Chrysene	0.0203	0.01	0.000203
Dibenz[a,h]anthracene	0.00105	0.1	--
Indeno[1,2,3-cd]pyrene	--	0.1	--
<i>Total BAP TEC:</i>			0.0187

^a From WCH (2014j).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

Table 2-20. 600-378 Waste Site Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.089	1	0.0890
Benzo[a]anthracene	0.114	0.1	0.0114
Benzo[b]fluoranthene	0.101	0.1	0.0101
Benzo[k]fluoranthene	0.0503	0.1	0.00503
Chrysene	0.095	0.01	0.00095
Dibenz[a,h]anthracene	0.00251	0.1	0.000251
Indeno[1,2,3-cd]pyrene	--	0.1	--
<i>Total BAP TEC:</i>			0.117

^a From WCH (2014n).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

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Table 2-21. 600-379 Waste Site Toxic Equivalent Concentrations of Benzo(a)pyrene.

Carcinogenic Polycyclic Aromatic Hydrocarbons	Maximum Result (mg/kg) ^a	Toxic Equivalency Factor (Unitless)	BAP TEC (mg/kg)
Benzo[a]pyrene	0.00169	1	0.00169
Benzo[a]anthracene	--	0.1	--
Benzo[b]fluoranthene	0.00192	0.1	0.000192
Benzo[k]fluoranthene	--	0.1	--
Chrysene	--	0.01	--
Dibenz[a,h]anthracene	--	0.1	--
Indeno[1,2,3-cd]pyrene	0.00184	0.1	0.000184
<i>Total BAP TEC:</i>			0.00207

^a From WCH (2014o).

-- = not detected

BAP TEC = Benzo(a)pyrene toxic equivalent concentration

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