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

13-AMRP-0106

FEB 08 2013

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

Dear Mr. Faulk:

TRANSMITTAL OF APPROVED WASTE SITE RECLASSIFICATION FORM NO. 2012-099 AND SUPPORTING DOCUMENTATION FOR THE 316-3, 307 DISPOSAL TRENCHES, PROCESS WATER TRENCHES, REVISION 0

Attached for your use is the approved Waste Site Reclassification Form No. 2012-099 and supporting, "Remaining Sites Verification Package for the 316-3, 307 Disposal Trenches, Process Water Trenches," Rev. 0. If you have questions, please contact me or your staff may contact Rudy Guercia, of my staff, at (509) 376-5494.

Sincerely,

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

AMRC:RFG

Attachment

cc w/attach:
L. E. Gadbois, EPA
Administrative Record, H6-08 (300-FF-2 OU)

cc w/o attach:
S. L. Feaster, WCH
T. Q. Howell, WCH
D. L. Plung, WCH
J. P. Shearer, CHPRC
G. B. Snow, WCH
C. P. Strand, WCH

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 300-FF-2 **Control No.:** 2012-099

Waste Site Code(s)/Subsite Code(s): 316-3

Reclassification Category: Interim ☒ Final ☐

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

Approvals Needed: DOE ☒ Ecology ☐ EPA ☒

Description of current waste site condition:

The 316-3, 307 Disposal Trenches, Process Water Trenches waste site is located on the eastern side of the 300 Area, southeast of the 340 Facility within the 324 Building security fence line. From 1953 to 1963, the site received wastes from the 300 Area Laboratory expansion facilities including the 329 Biophysics Laboratory, 327 Radiometallurgy Building, 324 Radiochemistry Building, 326 Pile Technology Building, and 329 Mechanical Development Building. The trenches were taken out of service in 1963, and the contaminated sediments were excavated and transported to the 618-10 Burial Ground. In 1965, the unit was backfilled with uranium-contaminated material scraped from the bottom of the 316-1 South Process Pond, and covered in fly ash from the 300 Area Ash Pits. Several 300 Area buildings were built on top of the backfilled trenches. In 2008, all of these facilities were demolished and only building slabs remain.

Excavations and sampling in the backfilled trenches in 1987 found discolored soil and radionuclide, metals, and organic chemicals contamination. Three remedial investigation boreholes were drilled through the trenches in late 1991 and early 1992 to investigate the nature and extent of contamination. The analytical results showed uranium and polychlorinated biphenyls to be elevated but below industrial direct exposure cleanup levels. Additional subsurface characterization was conducted in 2012 with a *316-3 Waste Site Subsurface Investigation Plan*, PLN-0012, Rev. 0, June 2012, Washington Closure Hanford, Richland, Washington (WCH 2012) to confirm the results of the previous investigations and determine if the site may be closed out as a No Action site. Seven test pits (WCH 2012) were excavated in accordance with remedial action objectives established by the *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington (300-FF-2 ROD) (EPA 2001). The selected remedy involved (1) evaluating the subsite using available process information, (2) demonstrating through subsurface investigation sampling and field screening that cleanup goals have been achieved, and (3) proposing the subsite for reclassification to No Action.

Basis for reclassification:

Test pit focused sampling results were evaluated in comparison to cleanup levels. In accordance with this evaluation, the investigation sampling results support a reclassification of the 316-3 waste site to No Action. The current site conditions achieve the remedial action goals for an industrial scenario established by the 300-FF-2 ROD (EPA 2001). The results of test pit sampling demonstrate that residual contaminant concentrations meet human health direct exposure cleanup levels for industrial land use and applicable standards for groundwater and river protection. Because the waste site was determined to only achieve cleanup levels for industrial land use, institutional controls to maintain industrial land use are required as established in the 300-FF-2 ROD (EPA 2001). The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 316-3, 307 Disposal Trenches, Process Water Trenches Waste Site* (attached).

WASTE SITE RECLASSIFICATION FORM

Operable Unit: 300-FF-2 **Control No.:** 2012-099

Waste Site Code(s)/Subsite Code(s): 316-3

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:

The 316-3 waste site does not meet the remedial action goals and remedial action objectives for unrestricted land use; therefore, institutional controls to maintain industrial land use at this site is required as established in the 300-FF-2 ROD (EPA 2001).

M. S. French	Mark S French	1/17/13
DOE Federal Project Director (printed)	Signature	Date
N/A		
Ecology Project Manager (printed)	Signature	Date
L. Gadbois	Larry Gadbois	Jan 17 2013
EPA Project Manager (printed)	Signature	Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 316-3, 307 DISPOSAL TRENCHES, PROCESS WATER TRENCHES WASTE SITE

Attachment to Waste Site Reclassification Form 2012-099

February 2013

REMAINING SITES VERIFICATION PACKAGE FOR THE 316-3, 307 DISPOSAL TRENCHES, PROCESS WATER TRENCHES WASTE SITE

EXECUTIVE SUMMARY

The 316-3, 307 Disposal Trenches, Process Water Trenches waste site is identified as a 300-FF-2 Operable Unit candidate site in the *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington* (300-FF-2 ROD) (EPA 2001). The 316-3 waste site consisted of two trenches, each 180 m (600 ft) long, and 9.1 m (30 ft) wide at the east end, tapering to 3.0 m (10 ft) wide at the west end. Each trench contained a 13-cm (5-in.) vitrified clay pipe across the length of the unit. Most of the 316-3 waste site is within the 324 Building security fence.

The 316-3 waste site received wastes from the 300 Area Laboratory expansion facilities including the 329 Biophysics Laboratory, 327 Radiometallurgy Building, 324 Radiochemistry Building, 326 Pile Technology Building, and 329 Mechanical Development Building from 1953 to 1963. When the trenches were taken out of service in 1963, the contaminated sediments were excavated and taken to the 300 North (618-10) Burial Ground. The trenches were backfilled with 316-1 process pond scrapings and fly ash from the 300 Area Ash Pits in 1965. Several 300 Area buildings were built on top of the backfilled trenches.

Excavations and sampling in the backfilled trenches in 1987 found discolored soil and radionuclide, metals, and organic chemicals contamination. Three remedial investigation boreholes were drilled through the trenches in late 1991 and early 1992 to investigate the nature and extent of contamination. The analytical results showed uranium and polychlorinated biphenyls (PCBs) to be elevated, but below industrial direct exposure cleanup levels. Additional subsurface characterization has been conducted per the *316-3 Waste Site Subsurface Investigation Plan* (WCH 2012a) to confirm the results of the previous investigations, and determine if the site may be closed out as "No Action" or if the waste site requires further remediation. Seven test pits were excavated to collect samples for additional site evaluation.

The results of test pit sampling indicated that the 316-3 waste site achieved compliance with the remedial action objectives and remedial action goals for industrial land use. A summary of the cleanup evaluation for the soil results against the applicable criteria is presented in Table ES-1. The results of the test pit sampling are used to make reclassification decisions for the 316-3 waste site in accordance with the TPA-MP-14 procedure in the *Tri-Party Agreement Handbook Management Procedures* (DOE-RL 2011).

Table ES-1. Summary of Remedial Action Goals Attainment for the 316-3 Subsite. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Direct Exposure – Radionuclides	Attain 15-mrem/yr dose rate above background over 1,000 years.	Maximum dose rate for the 316-3 waste site predicted using RESRAD modeling is 3.92 mrem/yr, which is below the dose limitation of 15 mrem/yr.	Yes
Direct Exposure – Nonradionuclides	Attain individual COPC RAGs.	All individual COC and COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements – Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	The hazard quotients for individual nonradionuclide COCs/COPCs are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient for all sampling areas (7.8×10^{-1}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	Excess cancer risk values for individual nonradionuclide COCs/COPCs are $<1 \times 10^{-6}$.	
	Attain a cumulative excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess carcinogenic risk for all sampling areas (1.2×10^{-7}) is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COC groundwater and river RAGs.	No radionuclide COPCs were quantified above groundwater/river protection lookup values.	Yes
	Attain National Primary Drinking Water Regulations: 4 mrem/yr (beta/gamma) dose standard to target receptor/organ[a].	No radionuclide COPCs were quantified above groundwater/river protection lookup values.	
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide for DOE Order 5400.5[b].	No alpha-emitting radionuclide COPCs were quantified above groundwater/river protection lookup values.	
	Meet total uranium standard of 21.2 pCi/L[c].	Uranium was quantified below levels that are protective of 300 Area groundwater.	

Table ES-1. Summary of Remedial Action Goals Attainment for the 316-3 Subsite. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and Columbia River cleanup requirements.	Residual concentrations of barium, beryllium, boron, cadmium, chromium, copper, lead, manganese, mercury, nickel, selenium, silver, uranium, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, aroclor-1248, aroclor-1254, aroclor-1260, trichloroethene, and TPH-motor oil exceeded soil RAGs for the protection of groundwater and/or the Columbia River. However, RESRAD modeling predicts that these constituents will not migrate to groundwater (and thus the Columbia River) at concentrations exceeding groundwater or river protection criteria within 1,000 years. Therefore, residual contaminant concentrations achieve the remedial action objectives for groundwater and river protection [d, e].	Yes

[a] "National Primary Drinking Water Regulations" (40 CFR 141).

[b] *Radiation Protection of the Public and Environment* (DOE Order 5400.5).

[c] Based on the isotopic distribution of uranium in the 100 Area, the 30 µg/L MCL corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater* (BHI 2001).

[d] Based on RESRAD modeling discussed in Appendix B of the 300 Area RDR/RAWP (DOE-RL 2009), and an evaluation of dilution-attenuation in the saturated zone using the formulas from the EPA *Soil Screening Guidance: User's Guide* (EPA 1996), maximum residual concentrations of boron, selenium and trichloroethene are predicted to be protective of the Columbia River for 1,000 years (Appendix B).

[e] Based on fate and transport modeling using RESRAD input parameters for the industrial land use scenario from the 300 Area RDR/RAWP (DOE-RL 2009) constituents with soil-partitioning coefficients greater than 8.8 mL/g are predicted to show no migration through vadose-zone soil. The lowest distribution coefficient of the contaminants that exceeded the RAGs is 8.9 mL/g for uranium. The vadose zone underlying the soil below the site is approximately 8.8 m (28.9 ft) thick based on the elevation at the maximum excavation depth of 114.1 m (374.3 ft) and a groundwater elevation of 105.3 m (345.5 ft) (DOE-RL 2010). Therefore, residual concentrations of barium, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, silver, total uranium, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, aroclor-1248, aroclor-1254, aroclor-1260, TPH-motor oil are predicted to be protective of groundwater and the Columbia River.

CFR = *Code of Federal Regulations*
COC = contaminant of concern
COPC = contaminant of potential concern
MCL = maximum contaminant level
NA = not applicable
RAG = remedial action goal
RDR/RAWP = Remedial Design Report/Remedial Action Work Plan
RESRAD = RESidual RADioactivity (dose model)

In accordance with this evaluation, the 316-3 waste site sampling investigation supports a reclassification of this site to No Action. The results of subsurface investigation sampling show that residual contaminant concentrations meet human health direct exposure cleanup levels for industrial land use and applicable standards for groundwater and river protection in the shallow zone (i.e., surface to 4.6 m [15 ft] deep), as established in the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (DOE-RL 2009) and the *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington* (300-FF-2 ROD)

(EPA 2001). Institutional controls to maintain industrial land use are required as established in the 300-FF-2 ROD (EPA 2001).

Soil cleanup levels were established in the 300-FF-2 ROD (EPA 2001) based in part on a limited ecological risk assessment. Although not required by the 300-FF-2 ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern, contaminants of potential concern, and other constituents. Those constituents exceeding the ecological screening level in the *Washington Administrative Code* 173-340, "Model Toxics Control Act – Cleanup," Table 749-3, were barium, boron, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, uranium, vanadium, and zinc. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for barium, cadmium, chromium, copper, lead, manganese, nickel, selenium, silver, vanadium, and zinc. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the maximum focused sample levels of vanadium are below Hanford Site background levels, it is believed that the presence of this constituent does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for ecological effects as a part of the final closeout decision for the Columbia River Corridor portion of the Hanford Site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 316-3, 307 DISPOSAL TRENCHES, PROCESS WATER TRENCHES WASTE SITE

STATEMENT OF PROTECTIVENESS

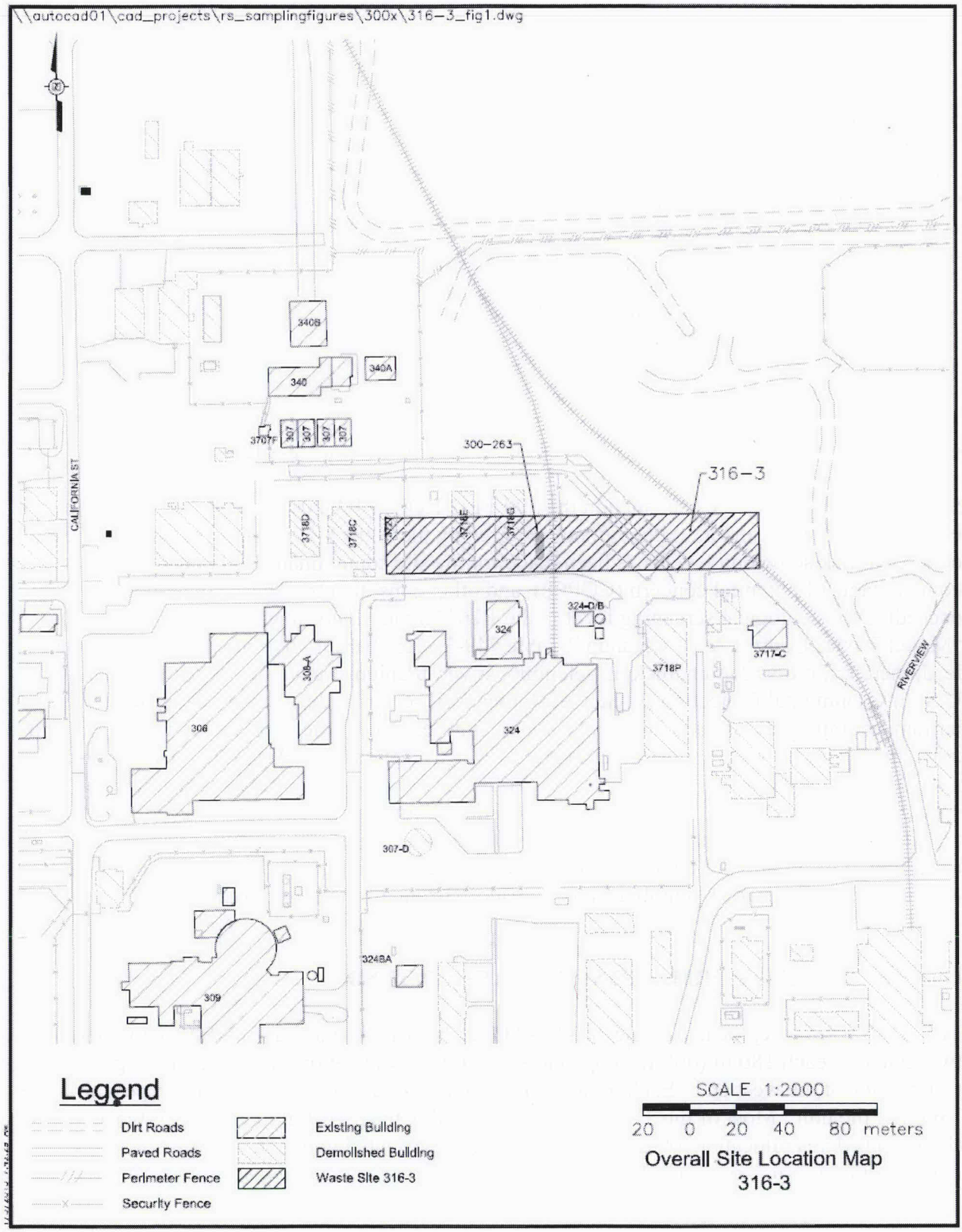
The 316-3, 307 Disposal Trenches, Process Water Trenches waste site is identified as a 300-FF-2 Operable Unit candidate site in the *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington* (300-FF-2 ROD) (EPA 2001). The 316-3 waste site characterization data, site evaluations, and supporting documentation demonstrate that this site meets the industrial land use objectives for reclassification to No Action as established in the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (RDR/RAWP) (DOE-RL 2009) and the 300-FF-2 ROD (EPA 2001). The waste site is evaluated using the human health direct exposure cleanup levels for industrial land use and applicable standards for groundwater and river protection in the shallow zone (i.e., surface to 4.6 m [15 ft] deep). The waste site contamination does not extend into the deep zone soils. Institutional controls to maintain industrial land use are required as established in the 300-FF-2 ROD (EPA 2001).

Soil cleanup levels were established in the 300-FF-2 ROD (EPA 2001) based in part on a limited ecological risk assessment. Although not required by the 300-FF-2 ROD, a comparison against ecological risk screening levels has been made for the site contaminants of concern, contaminants of potential concern (COPCs), and other constituents. Those constituents exceeding the ecological screening level in the *Washington Administrative Code* 173-340, "Model Toxics Control Act – Cleanup," Table 749-3, were barium, boron, chromium, copper, lead, mercury, molybdenum, nickel, selenium, silver, uranium, vanadium, and zinc. The U.S. Environmental Protection Agency ecological soil screening levels were exceeded for barium, cadmium, chromium, copper, lead, manganese, nickel, selenium, silver, vanadium, and zinc. Exceedance of screening values is intended to trigger additional evaluation and does not necessarily indicate the existence of risk to ecological receptors. Because the maximum focused sample levels of vanadium are below Hanford Site background levels, it is believed that the presence of this constituent does not pose a risk to ecological receptors. All exceedances will be evaluated in the context of additional lines of evidence for ecological effects as a part of the final closeout decision for the Columbia River Corridor portion of the Hanford Site.

GENERAL SITE INFORMATION AND BACKGROUND

The 316-3 waste site, located in the 300-FF-2 Operable Unit of the Hanford Site, consisted of two trenches, each 180 m (600 ft) long, and 9.1 m (30 ft) wide at the east end, tapering to 3.0 m (10 ft) wide at the west end. Each trench contained a 13-cm (5-in.) vitrified clay pipe across the length of the unit. Most of the 316-3 waste site is within the 324 Building security fence (Figure 1). The collocated 300-263 waste site is not associated with 316-3 waste site and will not be further discussed in the 316-3 Remaining Sites Verification Package.

Figure 1. The 316-3 Waste Site Location Map.



The 316-3 trenches were constructed in 1952. From 1953 to 1963, process sewer effluent with contamination levels below discharge limits was released from the 307 Retention Basins and discharged to the two west-east-trending parallel trenches. Effluent above discharge limits was transported to the 200 Area for disposal. The 316-3 waste site received wastes from the 300 Area Laboratory expansion facilities including the 329 Biophysics Laboratory, 327 Radiometallurgy Building, 324 Radiochemistry Building, 326 Pile Technology Building, and 329 Mechanical Development Building.

The 316-3 waste site trenches were taken out of service in 1963 and the contaminated sediments were excavated and transported to the 618-10 Burial Ground. In 1965, the unit was backfilled with approximately 7,600 m^3 (10,000 yd^3) of uranium-contaminated material scraped from the bottom of the South Process Pond (316-1) and covered in fly ash from the 300 Area Ash Pits. Several 300 Area buildings were built on top of the backfilled trenches, including the 3727, 3719E, and 3718G Buildings.

In 1987, the west end of the 316-3 waste site was used to test a grout liquid waste solidification process. A 15.2 by 6.1 by 3.0 m (50 by 20 by 9 ft) trench was excavated immediately west of the former 3718E Building, and contaminated material was encountered. The Geiger/Mueller radiological detector measured maximum radiological activities of 378 picocuries per gram (pCi/g) beta and 234 pCi/g alpha.

Previous 316-3 Waste Site Investigations

In 1987, five samples (003A001, 003A002, 003B001, 003B002, and 003C001) were collected for a test pit located in the western end of the 307 trenches, adjacent to the east side of the 3727 Building. The 15-m (50 ft) long, 6-m (20 ft) wide, 2.7-m (9 ft) deep trench was dug for a waste grout testing project. Four soil samples were collected near the bottom of the excavation in what appeared to be contaminated backfill. Field readings with Geiger/Mueller detector found maximum radioactivity readings of 500 counts per minute. One sample was collected near the top of the excavation, within backfill material and had no detectable radioactivity. The samples were analyzed for inductively coupled plasma (ICP) metals, metals, volatile organics, pH, PCBs, gross alpha, and gross beta activity. The analytical results indicated that metals and PCB concentrations did not exceed the current industrial direct exposure soil cleanup levels. However, barium, beryllium, cadmium, copper, mercury, nickel, silver, zinc, and aroclor-1248 exceeded groundwater and/or Columbia River soil cleanup levels. Gross alpha data results ranged from 87.3 to 234 pCi/g and gross beta levels ranged from 151 to 378 pCi/g.

In December 1991 and January 1992, three boreholes were drilled within the 316-3 waste site in support of the *Draft Remedial Investigation Work Plan for the 316-3 Waste Disposal Trenches* (PNL 1987). According to the *Summary of Drilling and Test Pit Activities for the 300-FF-1 Operable Unit* (WHC 1992) report, the total depth of borings ranged from 18.3 to 20.7 m (60 to 68 ft). The trench backfill material depth ranged from 6 to 8 m (20 to 27 ft). Soil below the 316-3 backfill material was observed to be sand, silt, and gravel of the Hanford formation. A thin layer of asphalt was observed to cover the western portions of the trenches, and coal fly ash covered the eastern portions. The *Summary of Remedial Investigations at the 307 Retention Basins and 307 Trenches* (WHC 1994) summarized analytical data results for the three boreholes

399-3-15, 399-3-16, and 399-3-17. Soil samples collected from these three boreholes were analyzed for organics, inorganics (metals and cyanide), general chemistry, and radionuclides. Field instruments detected beta-gamma radiation up to 650 counts per minute in borehole 399-3-17 and up to 150 counts per minute in borehole 399-3-16. In borehole 399-3-15, a hard, gray material was encountered between 7.62 and 8.23 m (25 and 27 ft) bgs. This material was concluded to be cement grout that may have been poured into the trench prior to backfilling.

Analytical data for the three boreholes presented in the Summary of Remedial Investigations at the 307 Retention Basins and 307 trenches (316-3) (DOE 1994) suggests that no analytes were found to exceed the current 300 Area Industrial direct exposure soil cleanup levels.

SUBSURFACE INVESTIGATION SAMPLING

Subsurface investigation sampling for the 316-3 waste site was conducted between August 13 and September 11, 2012. Samples were collected from seven test pits to support a determination that residual contaminant concentrations at this site meet the cleanup criteria specified in the RDR/RAWP (DOE-RL 2009) and the 300-FF-2 ROD (EPA 2001). The subsurface investigation sample results are provided in Appendix B. The following subsections provide additional discussion of the information used to develop the subsurface investigation sample design. A more detailed discussion of the subsurface investigation sample design can be found in the *316-3 Waste Site Subsurface Investigation Plan* (WCH 2012a).

Subsurface Investigation Sample Design

The 316-3 investigation plan (WCH 2012a) selected seven test pit locations for further investigation of the 316-3 waste site (Figure 2). The test pits were specifically focused throughout the 316-3 waste site for maximum site evaluation. Due to buried utilities in the area, the test pits locations were adjusted to minimize the potential impact of encountering active utility lines. Because the waste site had potentially contaminated backfill material, it was planned to perform sampling at 2-m (6.6-ft) depth intervals to analyze potential vertical contamination and the soil underlying the backfill material. Table 1 includes the details for each test pit location and the depth intervals of sample collection.

Contaminants of Potential Concern

The COPCs for the 316-3 waste site were identified based on the process history of the 307 trenches and previous waste site sampling data. The only potential contaminant of concern listed in the 300-FF-2 ROD (EPA 2001) for the 316-3 waste site is uranium. Based on the process history of the trenches, the radionuclides americium, carbon-14, nickel-63, strontium-90, tritium, plutonium, and technetium are included as 316- waste site COPCs. The following chemicals are also COPCs based on process history: PCBs, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), IC anions, nitrate/nitrite, and total cyanide.

Figure 2. 316-3 Subsurface Investigation Test Pit Locations.

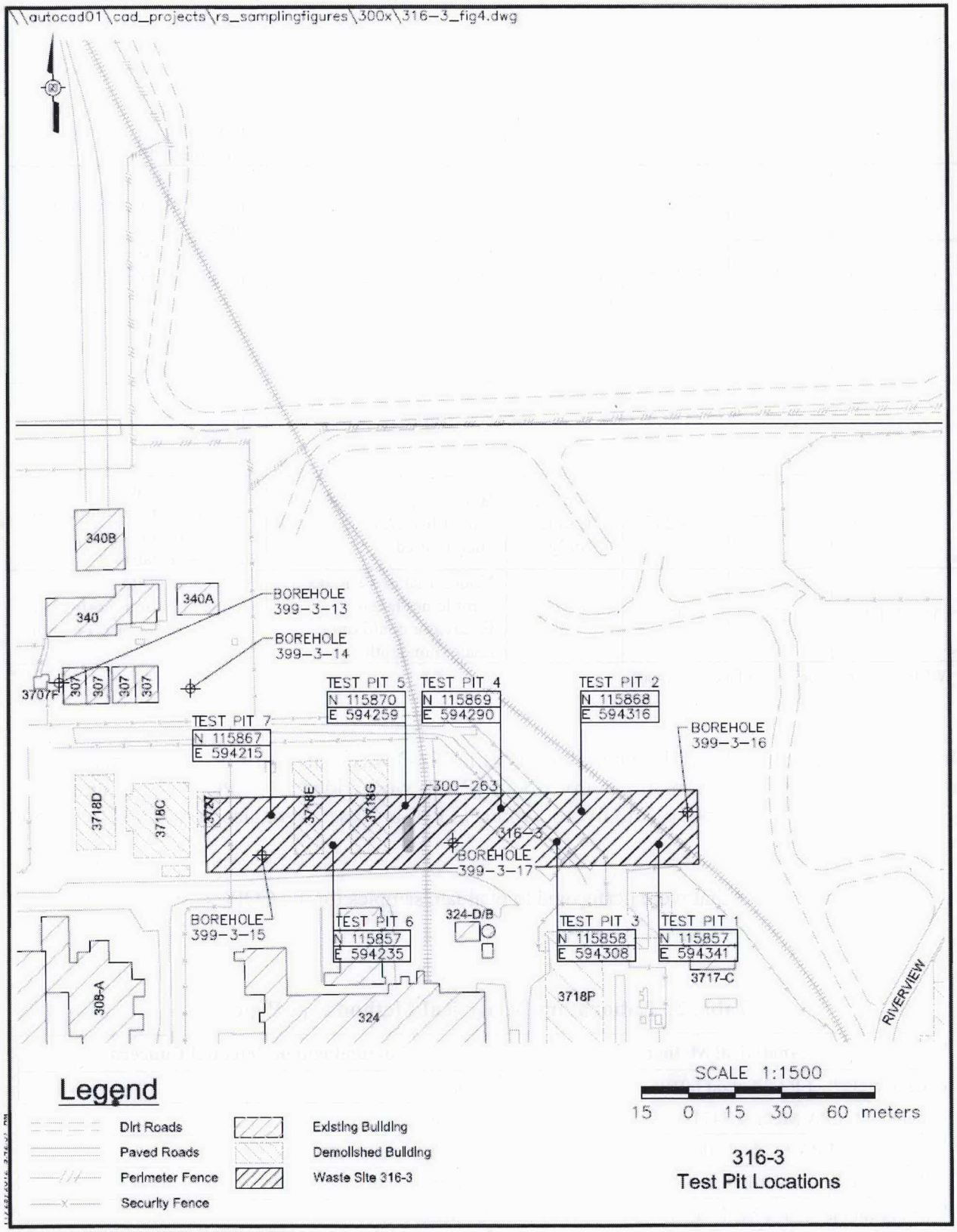


Table 1. 316-3 Test Pit Sample Descriptions.

Test Pit Location	WSP Northing (m)	WSP Easting (m)	Sample Depths (m bgs)	Sampling Interferences	Rationale for Location Selection
316-3-TP-1	115857	594341	0.5, 2, 4, 6	None	316-3 waste site characterization, east end; 10 m SW of Borehole 399-3-17
316-3-TP-2	115868	594316	0.5, 2, 4, 6	None	316-3 waste site characterization, northeast corner
316-3-TP-3	115858	594308	0.5, 1.5-2	Several unknown electrical interferences encountered.	316-3 waste site characterization, northeast center section
316-3-TP-4	115869	594290	0.5, 2, 4, 6	None	316-3 waste site characterization, southeast center section
316-3-TP-5	115870	594259	0.5, 2, 4, 6	Near-surface red wire encountered.	316-3 waste site characterization, northwest center section, east of 3718-G slab
316-3-TP-6	115857	594247	Surface soil sample only.	Buried asphalt pad and other obstacles encountered.	316-3 waste site characterization, southwest center section, south portion of 3718-G slab
316-3-TP-7	115867	594215	2, 4, 6	None. Planned 8 m deep sample not taken. Excavator could only reach 6 m depth.	316-3 waste site characterization, northwest corner; former north end of 1987 trench

WSP = Washington State Plane coordinates

In consideration of the backfill material used at the 316-3 waste site in 1965, ICP metals, mercury, and polycyclic aromatic hydrocarbons (PAH) were added as COPCs. Gross alpha, gross beta, pH, and total petroleum hydrocarbons (TPH) analyses were also performed to support waste site evaluation.

The laboratory analyses that were performed to evaluate samples for the COPCs are identified in Table 2.

Table 2. Laboratory Analytical Methods. (2 Pages)

Analytical Method	Contaminant of Potential Concern
ICP metals [a] – EPA Method 6010	Lead
Mercury – EPA Method 7471	Mercury
IC anions – EPA Method 300.0[b]	Nitrate, nitrite, sulfate
Nitrate/nitrite –EPA Method 353.2[c]	Nitrate, nitrite
Total cyanide – EPA Method 9010	Cyanide, sulfide

Table 2. Laboratory Analytical Methods. (2 Pages)

Analytical Method	Contaminant of Potential Concern
SVOA – EPA Method 8270	Semivolatile organic compounds
VOA – EPA Method 8260	Volatile organic compounds
PAH – EPA Method 8310	Polycyclic aromatic hydrocarbons
PCB – EPA Method 8082	Polychlorinated biphenyls
TPH – NWTPH–Dx	Total petroleum hydrocarbons
pH – EPA Method 9045[d]	pH soil
Gross alpha – Proportional counting	Alpha-emitting radionuclides
Gross beta – Proportional counting	Beta-emitting radionuclides
GEA – Gamma spectroscopy	Cesium-137, cobalt-60, europium-152, europium-154, europium-155
Isotopic americium	Americium-241
Carbon-14 – liquid scintillation	Carbon-14
Nickel-63 – liquid scintillation	Nickel-63
Strontium-90 – liquid scintillation	Strontium-90
Tritium – liquid scintillation	Tritium
Technetium-99 – beta counting	Technetium-99
Plutonium-241 – liquid scintillation	Plutonium-241
Isotopic plutonium	Plutonium
Isotopic uranium	Uranium-233/234, uranium-235, uranium-238

[a] Analysis for the expanded list of ICP metals included aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, and zinc.
[b] Analyses were performed for the expanded list of IC anions including bromide, chloride, fluoride, phosphate, and sulfate.
[c] To preclude holding time issues associated with EPA Method 300.0 for nitrites and nitrates, EPA Method 353.2 was performed.
[d] pH is not a regulated quantity, but was added to aid in the evaluation of the data.

EPA = U.S. Environmental Protection Agency
GEA = gamma energy analysis
IC = ion chromatography
ICP = inductively coupled plasma
NWTPH = Northwest total petroleum hydrocarbons
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbons
VOA = volatile organic analysis

Subsurface Investigation Sampling Activities

Test pit 1 was excavated on September 11, 2012. The first sample (J1PXC5) was collected at the depth of 0.5 m (1.6 ft) below ground surface (bgs). After removing additional material from the test pit, a second sample (J1PXC6) was collected from the soils at 2 m (6.6 ft) bgs. The excavation continued to the depth of 4 m (13.1 ft) bgs, where the third sample (J1PXC7) was collected. The final depth of the excavation was 6 m (20 ft) bgs and the fourth sample (J1PXC8) was collected from the soils at the bottom of the test pit.

Test pit 2 excavation was performed on August 20, 2012. The first sample (J1PX99) was collected at the depth of 0.5 m (1.6 ft) bgs. Additional material was removed to the depth of 2 m (6.6 ft) bgs, and a second sample (J1PXC0) was collected from the soils at this depth. The third sample (J1PXC1) was collected a depth of 4 m (13.1 ft) bgs and the fourth sample (J1PXC2) was collected from the soils at the bottom of the test pit at the depth of 6 m (20 ft) bgs.

Test pit 3 excavation began on August 23, 2012. A layer of asphalt was discovered at approximately 0.33 m (1 ft) depth. After excavating through the layer of asphalt a soil sample (J1PXC3) was collected at 0.5 m (1.6 ft) bgs. The excavation continued to approximately 1.5 to 2.0 m (4.9 to 6.6 ft) bgs where the excavator bucket came in contact with the two square (side-by-side) metal conduit/ducts. The top of the conduit was peeled back by the excavator bucket, exposing three wires. Following an inspection by an electrical subject matter expert, the lines were found to be de-energized. Excavation of test pit 3 resumed on August 29, 2012; however, additional subsurface interferences were encountered. A concrete cable tray at least 0.9 to 1.2 m (3 to 4 ft) wide and 0.9 to 1.2 m (3 to 4 ft) deep was encountered under the exposed conduits. The excavation was discontinued due to the number of unknown electrical subsurface interferences. A soil sample (J1PXC4) was collected at the 1.5 to 2 m (4.9 to 6.6 ft) depth, and the excavation was backfilled.

Test pit 4 excavation was performed on August 14, 2012. The first sample (J1PX91) was collected at the depth of 0.5 m (1.6 ft) bgs. After removing additional material from the test pit, a second sample (J1PX92) was collected from the soils at 2 m (6.6 ft) bgs. The excavation continued to the depth of 4 m (13.1) bgs, where the third sample (J1PX93) was collected. The final depth of the excavation was 6 m (20 ft) bgs, where the fourth sample (J1PX94) was collected from the soils at the bottom of the test pit.

Test pit 5 excavation was performed on August 15, 2012. Red wire was encountered before the depth of 0.5 m (1.6 ft) bgs was reached. The excavation was stopped and an electrical subject matter expert conducted an appropriate inspection. The line was determined to be abandoned and the excavation resumed on August 16, 2012. Excavation continued to a depth of 0.5 m (1.6 ft) and soil sample J1PX95 was collected. Excavation continued in lifts where samples J1PX96, J1PX97, and J1PX98 were collected at depths 2 m (6.6 ft), 4 m (13.1 ft), and 6 m (20 ft) bgs, respectively.

Test pit 6 excavation was performed on August 21, 2012. A buried asphalt pad was discovered at approximate depth of 0.5 m (1.6) bgs. After additional research and discussions it was decided to relocate TP-6, 5 m (16.4 ft) north of the planned location. However, due to the close proximity of other interferences such as RLWS line and 300-15 process sewer line, the test pit could not be excavated safely; therefore, only one surface soil sample (J1R0M5) was collected at the TP-6 location.

Test pit 7 excavation was performed on August 13, 2012. A soil sample (J1PX88) was collected at 2 m (6.6 ft) bgs. Excavation continued to a depth of 4 m (13.1 ft) bgs, and soil sample (J1PX89) was collected at this depth. The final depth of the excavated TP-6 was at 6 m (20 ft) bgs and sample (J1PX90) was collected from the soils at the bottom of the test pit.

Excavation could not extend to 8 m (26.2 ft) bgs due to the maximum excavator reach of 6 m bgs (20 ft).

All samples were analyzed for ICP metals, mercury, IC anions, nitrate/nitrite, pH, total cyanide, TPH, VOCs, SVOCs, PCBs, PAH, GEA, isotopic plutonium, isotopic uranium, gross alpha, gross beta, carbon-14, nickel-63, strontium-90, technetium-99, tritium, and plutonium-241. Table 3 provides the summary of the subsurface investigation samples collected at 316-3 waste site.

Table 3. 316-3 Subsurface Investigation Sampling Summary Table.

Sample Location	Sample Depth (m)	HEIS Number	Washington State Plane Coordinates		Sample Analysis
			Northing (m)	Easting (m)	
TP-1	0.5	J1PXC5	115870.5	594349.0	ICP metals [a], mercury, IC anions, cyanide, nitrate/nitrite, pH, TPH, VOA, SVOA, PCBs, PAH, GEA, isotopic americium, isotopic plutonium, isotopic uranium, gross alpha, gross beta, carbon-14, nickel-63, strontium-90, tritium, technetium-99, plutonium-241
	2.0	J1PXC6			
	4.0	J1PXC7			
	6.0	J1PXC8			
TP-2	0.5	J1PX99	115868	594316	
	2.0	J1PXC0			
	4.0	J1PXC1			
	6.0	J1PXC2			
TP-3	0.5	J1PXC3	115858	594308	
	1.5 – 2.0	J1PXC4			
TP-4	0.5	J1PX91	115869	594290	
	2.0	J1PX92			
	4.0	J1PX93			
	6.0	J1PX94			
TP-5	0.5	J1PX95	115870	594259	
	2.0	J1PX96			
	4.0	J1PX97			
	6.0	J1PX98			
TP-6	Surface	J1R0M5	155857	594235	
TP-7	2.0	J1PX88	115869	594290	
	4.0	J1PX89			
	6.0	J1PX90			

[a] Sample analysis for ICP metals will include antimony, arsenic, barium, beryllium, boron, cadmium, chromium (total), cobalt, copper, lead, manganese, molybdenum, nickel, selenium, silver, vanadium, zinc, and zirconium.

GEA = gamma energy analysis
HEIS = Hanford Environmental Information System
IC = ion chromatography
ICP = inductively coupled plasma
PAH = polycyclic aromatic hydrocarbons
PCB = polychlorinated biphenyl
SVOA = semivolatile organic analysis
TPH = total petroleum hydrocarbons
VOA = volatile organic analysis

SUBSURFACE INVESTIGATION SAMPLING RESULTS

Subsurface investigation samples were analyzed using EPA-approved analytical methods. The sampling data is provided in Appendix A. Comparisons of the maximum results for COPCs against the industrial site RAGs for the 316-3 waste site are summarized in Table 4.

Table 4. Comparison of Maximum Contaminant Concentrations Against Remedial Action Goals for 316-3 Test Pit Investigation Sampling. (2 Pages)

Contaminants of Potential Concern	Maximum Result (pCi/g)	Soil Lookup Values [a]			Do the Statistical or Maximum Results Exceed RAGs?	Do the Statistical or Maximum Results Pass RESRAD Modeling?
		Industrial Direct Exposure	Protective of Groundwater	Protective of the River		
Americium-241	0.711	210	NA	NA	No	--
Carbon-14	2.20	82	NA	NA	No	--
Cesium-137	0.126 (<BG)	25	NA	NA	No	--
Plutonium-239/240	4.63	245	NA	NA	No	--
Plutonium-241	13.2	12,900	NA	NA	No	--
Technetium-99	1.19	410,000	239	33.2	No	--
Uranium-233/234	77.5	167	127.4	127.4	No	--
Uranium-235	7.14	16	13.2	13.2	No	--
Uranium-238	86.3	167	127.4	127.4	No	--
Contaminants of Potential Concern	**Maximum Result (mg/kg)**	**Remedial Action Goals [a]**			**Do the Statistical or Maximum Results Exceed RAGs?**	**Do the Statistical or Maximum Results Pass RESRAD Modeling?**
		Industrial Direct Exposure	**Protective of Groundwater**	**Protective of the River**		
Arsenic	6.6	58	20 [b]	20 [b]	No	--
Barium	1330	4,900 [c]	200	400	Yes	Yes [d]
Beryllium	1.72 (<BG)	104 [c]	1.51 [e]	1.51 [e]	Yes	Yes [d]
Boron	412	700,000	320	NA	Yes	Yes [f]
Cadmium	0.948	139 [c]	0.81 [e]	0.81 [e]	Yes	Yes [d]
Chromium, total	152	5,250,000	18.5 [e]	18.5 [e]	Yes	Yes [d]
Cobalt	9.54 (<BG)	1,050	15.7 [e]	NA	No	--
Copper	1340	130,000	59.2	22.0 [e]	Yes	Yes [d]
Lead	111	1,000	10.2 [e]	10.2 [e]	Yes	Yes [d]
Lithium	18.5 (<BG)	7,000	33.5 [e]	NA	No	--
Manganese	614	165,000	512 [e]	512 [e]	Yes	Yes [d]
Mercury	2.65	1,050	0.33 [e]	0.33 [e]	Yes	Yes [d]
Molybdenum	1.74	17,500	8	NA	No	--
Nickel	151	70,000	19.1 [e]	27.4	Yes	Yes [d]
Selenium	4.05	17,500	5	1	Yes	Yes [f]
Silver	20.6	17,500	8	0.73 [e]	Yes	Yes [d]
Uranium (total)	370	505	53	106	Yes	Yes [d]
Vanadium	75.0 (<BG)	24,500	85.1 [e]	NA	No	--
Zinc	91.5	1,050,000	480	67.8 [e]	Yes	Yes [d]
Chloride	63.4 (<BG)	NA	25,000	NA	No	--
Fluoride	12.3	210,000	96	400	No	--
Nitrogen in nitrate	65.3	5,600,000	1,000	2,000	No	--
Nitrogen in nitrite and nitrate	111	5,600,000	1,000	2,000	No	--
Sulfate	477	NA	25,000	NA	No	--
Acenaphthene	0.210	210,000	96	129	No	--
Acenaphthylene [g]	3.24	210,000	96	129	No	--

Table 4. Comparison of Maximum Contaminant Concentrations Against Remedial Action Goals for 316-3 Test Pit Investigation Sampling. (2 Pages)

Contaminants of Potential Concern	Maximum Result (mg/kg)	Remedial Action Goals [a]			Do the Statistical or Maximum Results Exceed RAGs?	Do the Statistical or Maximum Results Pass RESRAD Modeling?
		Industrial Direct Exposure	Protective of Groundwater	Protective of the River		
Anthracene	0.0247	1,050,000	240	1,920	No	--
Benzo(a)anthracene	0.0545	180	0.015 [h]	0.015 [h]	Yes	Yes [d]
Benzo(a)pyrene	0.0318	18	0.015 [h]	0.015 [h]	Yes	Yes [d]
Benzo(b)fluoranthene	0.00913	180	0.015 [h]	0.015 [h]	No	--
Benzo(k)fluoranthene	0.0161	180	0.015 [h]	0.015 [h]	Yes	Yes [d]
Chrysene	0.0146	1,800	0.12	0.1 [h]	No	--
Dibenz(a,h)anthracene	0.0125	180	0.03 [h]	0.03 [h]	No	--
Fluoranthene	0.545	140,000	64	18.0	No	--
Fluorene	0.124	140,000	64	260	No	--
Indeno(1,2,3-cd)pyrene	0.0109	180	0.33	0.33	No	--
Naphthalene	0.316	70,000	16.0	988	No	--
Phenanthrene [g]	0.277	1,050,000	240	1,920	No	--
Pyrene	0.0389	105,000	48	192	No	--
Aroclor-1248	2.58	65.6	0.017 [h]	0.017 [h]	Yes	Yes [d]
Aroclor-1254	1.32	65.6	0.017 [h]	0.017 [h]	Yes	Yes [d]
Aroclor-1260	1.97	65.6	0.017 [h]	0.017 [h]	Yes	Yes [d]
Total PCBs	5.87	65.6	0.017 [h]	0.017 [h]	Yes	Yes [d]
2-methylnaphthalene	0.320	14,000	3.2	NA	No	--
Dibenzofuran	0.0701	7,000	3.20	NA	No	--
Methylene chloride	0.105	17,500	0.5	0.94	No	--
Tetrachloroethene	0.0354	243	0.0810	0.0392	No	--
Trichloroethene	0.0928	1,050	0.270	0.0492	Yes	Yes [f]
TPH- diesel range	90.7	200	200	200	No	--
TPH- motor oil	203	200	200	200	Yes	Yes [d i]

[a] Industrial lookup values and RAGs and background values obtained from Tables 2-1 and 2-2 in the RDR/RAWP (DOE-RL 2009), unless otherwise noted.

[b] The arsenic cleanup level of 20 mg/kg has been agreed to by the Tri-Party Agreement Project managers.

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

[d] Based on fate and transport modeling using RESRAD input parameters for the industrial land use scenario from the 300 Area RDR/RAWP (DOE-RL 2009) constituents with soil-partitioning coefficients greater than 8.8 mL/g are predicted to show no migration through vadose-zone soil. The lowest distribution coefficient of the contaminants that exceeded the RAGs is 8.9 mL/g for uranium. The vadose zone underlying the soil below the site is approximately 8.8 m (28.9 ft) thick based on an elevation at maximum excavation depth of 114.1 m (374.3 ft) and a groundwater elevation of 105.3 m (345.5 ft) (DOE-RL 2010). Therefore, residual concentrations of barium, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, silver, total uranium, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, aroclor-1248, aroclor-1254, aroclor-1260, total PCBs, and TPH-motor oil are predicted to be protective of groundwater and the Columbia River.

[e] Where cleanup levels are less than background, cleanup levels default to background per WAC 173-340-700(4)(d) (Ecology 1996).

[f] Based on RESRAD modeling discussed in Appendix B of the 300 Area RDR/RAWP (DOE-RL 2009), and an evaluation of dilution-attenuation in the saturated zone using the formulas from the EPA *Soil Screening Guidance: User's Guide* (EPA 1996), maximum residual concentrations of boron, selenium and trichloroethene are predicted to be protective of Columbia River for 1,000 years (Appendix B).

[g] Toxicity data for this chemical are not available. Cleanup levels are based on surrogate chemicals.
Contaminant: acenaphthylene; surrogate; acenaphthene.
Contaminant: phenanthrene; surrogate; anthracene.

[h] Where cleanup levels are less than RDLs, cleanup levels default to RDLs per Ecology (1996), WAC 173-340-702(2).

[i] Soil RAGs for TPH presented in the 300 Area RDR/RAWP DOE-RL (2009) are based on the WAC 173-340-740 (1996) Method A value for protection of groundwater only.

-- = not applicable
BG = background
NA = not available
PCB = polychlorinated biphenyl
RAG = remedial action goal
RDL = required detection limit
RDR/RAWP = Remedial Design Repot/Remedial Action Work Plan
RESRAD = RESidual RADioactivity
TPH = total petroleum hydrocarbons
WAC = *Washington Administrative Code*

Contaminants that were not detected by laboratory analysis are excluded from this table, but are reported in Appendix A. Calculated cleanup levels are not presented in the Cleanup Levels and Risk Calculations Database (Ecology 2011) under *Washington Administrative Code* (WAC) 173-340-740(3) for calcium, magnesium, potassium, silicon, and sodium. The EPA's *Risk Assessment Guidance for Superfund* (EPA 1989) recommends that aluminum and iron not be considered in site risk evaluations. Therefore, aluminum, calcium, iron, magnesium, potassium, silicon, and sodium are not considered site COPCs and are also not included in these tables.

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

DATA EVALUATION

This section demonstrates that contaminant concentrations at the 316-3 waste site achieve the applicable RAGs developed to support industrial land use in the 300 Area as established in the 300-FF-2 ROD (EPA 2001) and documented in the 300 Area RDR/RAWP (DOE-RL 2009). Table 4 compares the subsurface investigation focused sample results to the applicable soil RAGs for direct exposure, protection of groundwater, and protection of the Columbia River.

Attainment of Radionuclide Industrial Direct Exposure RAGs

The sum of fractions evaluation was not performed for the radionuclide maximum results from the focused samples presented in Table 4. Total activity of uranium isotopes obtained from maximum results of focused samples was projected to exceed lookup values for the direct exposure dose limitation of 15 mrem/yr above background. Therefore, a site-specific RESRAD evaluation (Appendix A; *316-3 RESRAD Calculation of Industrial Dose*, 0300X-CA-V0164, Rev. 0) was performed to predict the radiological dose in an industrial scenario over a period of 1,000 years. The sum of fractions calculations are based on industrial direct exposure from a generic waste site with an assumed area of 10,000 m^2. The site-specific RESRAD evaluation was performed using an actual waste site area of only 3,918 m^2, which provided a more accurate, site-specific dose rate for the 316-3 waste site. The maximum all-pathways dose rate for the 316-3, 307 Disposal Trenches focused sample radionuclide concentrations is 3.92 mrem/yr (Appendix A), which is less than the 15 mrem/yr dose limitation.

Attainment of Radionuclide Groundwater and River Protection RAGS

The attainment of groundwater and river protection RAGs for radionuclides is determined by meeting single contaminant of concern/COPC groundwater and river RAGs and meeting the National Primary Drinking Water Regulations (40 *Code of Federal Regulations* [CFR] 141) 4 mrem/yr (beta/gamma) dose standard to target receptor/organs. The RESRAD model (Appendix A; *316-3 RESRAD Calculation of Industrial Dose*, 0300X-CA-V0164, Rev. 0) predicts that technetium-99 and uranium will impact groundwater within the 1,000 years of the RESRAD evaluation. Technetium-99 has a maximum predicted groundwater concentration of

2.83 pCi/L, which is below the RAG of 900 pCi/L. Maximum total predicted uranium concentration (8.39 pCi/L) is less than the RAG for total uranium in groundwater of 21.2 pCi/L (corresponding to the maximum contaminant level [MCL] for total uranium of 30 mg/L).

Nonradionuclide Direct Contact Hazard Quotient and Carcinogenic Risk RAGs Attained

Nonradionuclide risk requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative carcinogenic risk of less than 1×10^{-5}. For the 316-3 waste site, these risk values were not calculated for constituents that were either not detected or were detected at concentrations below Hanford Site or Washington State background levels. All individual hazard quotients for noncarcinogenic constituents were less than 1.0. The cumulative hazard quotient for those noncarcinogenic constituents above background or detected levels is 7.8×10^{-1}. The carcinogenic risk value for the carcinogenic constituents above background or detected levels is 1.2×10^{-7}, which is less than the criteria of 1×10^{-5}.

Total Petroleum Hydrocarbon Soil RAG Exceedance

Total petroleum hydrocarbons were detected above soil RAGs in a single focused sample collected from the 316-3 TP-3 location at an approximate depth of 1.5 to 2.0 m (4.9 to 6.6 ft) (J1PXC4; 203 mg/kg). The TPH results for the samples collected from adjacent test pits were much lower. A soil RAG value of 200 mg/kg for direct exposure, protection of groundwater, and protection of the Columbia River is listed in the 300 Area RDR/RAWP (DOE-RL 2009). However, this soil RAG value is obtained from WAC 173-340-740 (1996), Method A, and is identified as being a cleanup level for protection of groundwater only. Based on the RESRAD modeling discussed in Appendix A of DOE-RL (2009) and the listed TPH soil K_d of 50 mL/g, TPH compounds are predicted to migrate less than 1 m (3 ft) vertically in 1,000 years. The vadose zone underlying the 316-3 site is approximately 8.8 m (28.9 ft) thick; therefore, residual TPH concentrations are protective of groundwater.

There is no WAC 173-340-740 (1996) Method B TPH value for direct exposure or Method B TPH values for protection of groundwater or surface water. Total petroleum hydrocarbons represent a broad compound class analysis typically used for soil screening in lieu of more specific analytical methods. Potential direct exposure risks are better evaluated by analysis of specific individual constituents. In the case of the 316-3 waste site, analysis was performed for VOCs (including benzene, toluene, ethylbenzene, and xylenes), SVOCs (including naphthalenes), and PAHs. These analyses encompass the major individual compound risk drivers associated with petroleum hydrocarbon compounds. These constituents were all either undetected or detected well below direct exposure soil RAG values at TP-3 sample location.

Nonradionuclide Soil RAGs for Groundwater and River Protection Attained

Evaluation of the results listed in Table 4 from the investigation sampling at the 316-3 waste site indicates that all nonradionuclide COPCs were undetected and/or quantified below RAGs and lookup values except for barium, beryllium, cadmium, total chromium, copper, lead, manganese, mercury, nickel, silver, total uranium, zinc, benzo(a)anthracene, benzo(a)pyrene,

benzo(k)fluoranthene, aroclor-1248, aroclor-1254, aroclor-1260, and TPH-motor oil. Residual concentrations of these constituents exceeded soil RAGs for the protection of groundwater and/or the Columbia River. Data were not collected on the vertical extent of these contaminants, but based on RESidual RADioactivity (RESRAD) input parameters and soil-partitioning coefficients for industrial land use from Appendix B, Table B-8a, of the 300 Area RDR/RAWP (DOE-RL 2009), constituents with soil-partitioning coefficients greater than 8.8 mL/g are predicted to show no migration through vadose zone soil. The lowest soil-partitioning coefficient of the contaminants exceeding the RAGs is 8.9 mL/g for uranium and the vadose zone beneath the deepest sampling point of the 316-3 waste site is approximately 8.8 m (28.9 ft) thick. Therefore, residual concentrations of barium, beryllium, cadmium, total chromium, copper, lead, manganese, mercury, nickel, silver, total uranium, zinc, benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, aroclor-1248, aroclor-1254, aroclor-1260, total PCBs, and TPH-motor oil are predicted to be protective of groundwater and the Columbia River.

Three nonradionuclide constituents (boron, selenium, and trichloroethene) exceeded the RAGs for vadose zone soil concentrations to be protective of groundwater and/or the Columbia River and have soil-partitioning coefficients less than 8.8 mL/g. Therefore, these analytes were evaluated by RESRAD modeling for nonradionuclides using input parameters from Appendix B of the 300 Area RDR/RAWP (DOE-RL 2009). Site-specific RESRAD calculations were performed to predict the concentrations in groundwater due to nonradionuclides in the soil over a period of 1,000 years. Dilution and attenuation of nonradionuclide concentrations in groundwater as it flows from the area of the 316-3 waste site to the Columbia River were calculated using the U.S. Environmental Protection Agency (EPA) *Soil Screening Guidance: User's Guide* (EPA 1996). Maximum predicted groundwater concentrations within 1,000 years were calculated to be 57.7 µg/L for boron, 0.348 µg/L for selenium, and 0.147 for trichloroethene. The calculated concentrations are less than the groundwater cleanup RAGs of 320 µg/L for boron, 50 µg/L for selenium, and 0.492 µg/L for trichloroethene obtained from Appendix D, Table D-1 of the 300 Area RDR/RAWP (DOE-RL 2009). The maximum predicted surface water concentrations (i.e., groundwater concentrations at the Columbia River) within 1,000 years are 0.5 ug/L for boron, 0.003 ug/L for selenium, and 0.001 ug/L for TCE, which are less than the surface water cleanup RAGs of 5 ug/L for selenium and 2.70 ug/L for TCE from Appendix D, Table D-1 of the 300 Area RDR/RAWP (DOE-RL 2009). Boron has no surface water cleanup RAG.

DATA QUALITY ASSESSMENT

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

The DQA for the 316-3 waste site established that the data are of the right type, quality, and quantity to support site closeout decisions within specified error tolerances. The evaluation verified that the sample design was sufficient for the purpose of clean site confirmation. The investigation sample analytical data are stored in the ENRE project-specific database for data

evaluation prior to archival in the HEIS and are provided as an attachment to the direct contact hazard quotient calculation in Appendix A. The detailed DQA is presented in Appendix B.

SUMMARY FOR NO ACTION

The 316-3 waste site has been evaluated in accordance with the 300-FF-2 ROD (EPA 2001) and the RDR/RAWP (DOE-RL 2009). Subsurface investigation sampling was performed, and the analytical results indicate that the residual concentrations of COPCs at this site meet the remedial action objectives for industrial direct exposure, groundwater protection, and river protection. In accordance with this evaluation, the subsurface investigation sampling and modeling results support a reclassification of the 316-3 waste site to No Action. The waste site is evaluated using the human health direct exposure cleanup levels for industrial land use and applicable standards for groundwater and river protection in the shallow zone (i.e., surface to 4.6 m [15 ft] deep). The waste site contamination does not extend into the deep zone soils. The 316-3 waste site does not meet the RAGs and remedial action objectives for unrestricted land use; therefore, institutional controls to maintain industrial land use of the site are required.

REFERENCES

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

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

DOE, 1994, *Summary of Remedial Investigations at the 307 Retention Basins and 307 Trenches (316-3)*, 300-FF-2 Operable Unit, WHC-SD-EN-TI-279, Rev. 0, June 24, 1994.

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

DOE-RL, 2009, *Remedial Design Report/Remedial Action Work Plan for the 300 Area,* DOE/RL-2001-47, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2010, *Hanford Site Groundwater Monitoring and Performance Report for 2009 Volumes 1 & 2,* DOE/RL-2010-11, Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

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

Ecology, 2011, Cleanup Levels and Risk Calculations (CLARC) Database, Washington State Department of Ecology, Olympia, Washington, https://fortress.wa.gov/ecy/clarc.CLARCHome.aspx.

EPA, 1989, *Risk Assessment Guidance for Superfund: Volume 1, Human Health Evaluation Manual, Part A; Interim Final*, EPA/540/1-89/002, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 1996, *Soil Screening Guidance: User's Guide,* OSWER 9355.4-23, July, 1996, U.S. Environmental Protection Agency, Washington, D.C.

EPA, 2001, *Interim Action Record of Decision for the 300-FF-2 Operable Unit, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

PNL, 1987, *Draft Level 1 Remedial Investigation Work Plan 316-3 Waste Disposal Trenches,* PNL-7252, September, 1987, Pacific Northwest National Laboratories, Richland, Washington.

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

WCH, 2012a, *316-3 Waste Site Subsurface Investigation Plan*, PLN-0012, Rev. 0, June 2012, Washington Closure Hanford, Richland, Washington.

WCH, 2012b, *300-FF-2, 340 Ramp Dailies, 316-3 Disposal Trenches – Test Pits*, Logbook EL-1663-03, pp. 52-100, Washington Closure Hanford, Richland, Washington.

WCH, 2012c, *D4 Waste Site Miscellaneous Sampling*, Logbook EL-1663-04, pp. 1-15, Washington Closure Hanford, Richland, Washington.

WHC, 1992, *Summary of Drilling and Test Pit Activities for the 300-FF-1 Operable Unit,* WHC-SD-EN-TI-038, Westinghouse Hanford Company, Richland, Washington.

WHC, 1994, *Summary of Remedial Investigations at the 307 Retention Basins and 307 Trenches, 300-FF-2 Operable Unit*, Rev. 0, WHC-SD-EN-TI-279, Westinghouse Hanford Company, Richland, Washington.

WDOH, 1997, *Hanford Guidance for Radiological Cleanup*, WDOH/320-015, Rev. 1, Washington State Department of Health, Olympia, 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 file will be stored in a U.S. Department of Energy, Richland Operations Office repository. This calculation has been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculation," Washington Closure Hanford, Richland, Washington. The following calculations are provided in this appendix:

316-3 *Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculation,* 0300X-CA-V0163, Rev. 0, Washington Closure Hanford, Richland, Washington.

316-3 *RESRAD Calculation of Industrial Dose,* 0300X-CA-V0164, Rev. 1, Washington Closure Hanford, Richland, Washington.

316-3 *Nonradionuclide Calc Brief for Groundwater and River Protection*, 0300X-CA-V0165, Rev. 0, Washington Closure Hanford, Richland, Washington.

DISCLAIMER FOR CALCULATIONS

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

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 300 Area Field Remediation **Job No. 14655**

Area: 300

Discipline: Environmental *Calculation No: 0300X-CA-V0163

Subject: 316-3 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculation

Computer Program: Excel Program No: Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover = 1 Sheets = 5 Attachment = 18 Total = 24	N. K. Schiffern	I. B. Berezovskiy	J. D. Skoglie	T. Q. Howell	1/24/13

SUMMARY OF REVISION

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	11/15/12	Calc. No.:	0300X-CA-V0163	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/15/12
Subject:	316-3 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	1 of 5

PURPOSE:

Provide documentation to support the calculation of the direct contact hazard quotient (HQ) and excess carcinogenic risk for the 316-3 waste site. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2009), the following criteria must be met:

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

GIVEN/REFERENCES:

1) DOE-RL, 2009, *Remedial Design Report/Remedial Action Work Plan for the 300 Area,* DOE/RL-2001-47, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2) DOE-RL, 2011, 300 Area Remedial Action Sampling and Analysis Plan, DOE/RL-2001-48, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

4) WCH, 2012, *Remaining Sites Verification Package for the 316-3 waste site, 307 Disposal Trenches, Process Water Trenches,* Attachment to Waste Site Reclassification Form 2012-099, Washington Closure Hanford, Inc., Richland, Washington.

SOLUTION:

1) Generate an HQ for each noncarcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the individual HQ of <1.0 (DOE-RL 2009).

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

3) Generate an excess cancer risk value for each carcinogenic constituent detected above background or required detection limit/practical quantitation limit and compare it to the excess cancer risk of $<1 \times 10^{-6}$ (DOE-RL 2009).

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

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	11/15/12	Calc. No.:	0300X-CA-V0163	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/15/12
Subject:	316-3 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	2 of 5

METHODOLOGY:

The 316-3 waste site is comprised of seven test pits for investigation sampling. The direct contact hazard quotient and carcinogenic risk calculations for the 316-3 waste site was conservatively calculated for the entire waste site using the maximum value for each analyte in the entire waste site from WCH (2012). Of the contaminants of potential concern (COPCs) for this site, barium, beryllium, cadmium, total chromium, copper, lead, manganese, mercury, nickel, selenium, silver, uranium, zinc, and the detected anions are included because they are quantitated at concentrations above Hanford Site background. Boron, molybdenum, polychlorinated biphenyls (PCBs), detected polycyclic aromatic hydrocarbons (PAHs), detected semivolatiles, and detected volatiles require HQ and risk calculations because these analytes were detected and a Washington State or Hanford Site background value is not available. Arsenic was detected above background; however, arsenic cleanup level is not toxicity based, and therefore HQ and risk calculations for arsenic are not performed. Lead was detected above background; however, lead does not have a reference dose for calculation of a hazard quotient because toxic effects of lead are correlated with blood-lead levels rather than exposure levels or daily intake. Although total petroleum hydrocarbons (motor oil plus diesel range) were detected and no background value is available, the risk associated with total petroleum hydrocarbons do not contribute to the cumulative toxicity calculation. All other site nonradionuclide COPCs were not detected or were quantified below background levels. Due to an exceedance of the residential carcinogenic risk criteria for benzo(a)pyrene and detected PCBs and HQ for uranium, the entire data set was evaluated against the industrial HQ and risk standard. An example of the HQ and risk calculations is presented below:

1) For example, the maximum value for boron is 412 mg/kg, divided by the noncarcinogenic RAG value of 700,000 mg/kg (calculated in accordance with the noncarcinogenic toxics effects formula in WAC 173-340-740[3]), is 5.9×10^{-4}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculation is completed for the appropriate analytes, the cumulative HQ can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation. The sum of the HQ values is 7.8×10^{-1}. Comparing this value to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum value is divided by the carcinogenic RAG value, and then multiplied by 1.0×10^{-6}. For example, the maximum value for aroclor-1248 is 2.58 mg/kg, divided by 65.6 mg/kg, and multiplied as indicated, is 3.9×10^{-8}. Comparing this value to the requirement of $<1 \times 10^{-6}$, this criterion is met.

4) After these calculations are completed for the carcinogenic analytes, the cumulative excess cancer risk can be obtained by summing the individual values. To avoid errors due to intermediate rounding, the individual cancer risk values prior to rounding are used for this calculation. The sum of the excess cancer risk values is 1.2×10^{-7}. Comparing these values to the requirement of $<1 \times 10^{-5}$, this criterion is met.

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	11/15/12	Calc. No.:	0300X-CA-V0163	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/15/12
Subject:	316-3 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	3 of 5

RESULTS:

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

Table 1 shows the results of the calculations.

Table 1. Industrial Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 316-3 Waste Site (2 pages)

Contaminants of Potential Concern	Maximum Value[a] (mg/kg)	Industrial Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Industrial Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Arsenic	6.60	1050	--	58	--
Barium [c]	1330	700,000	1.9E-03	4,900	--
Beryllium [c]	1.72	7,000	2.5E-04	104	1.7E-08
Boron	412	700,000	5.9E-04	--	--
Cadmium [c]	0.948	3,500	2.7E-04	139	6.8E-09
Chromium, total	152	5,250,000	2.9E-05	--	--
Copper	1340	130,000	1.0E-02	--	--
Lead	111	1,000	--	--	--
Manganese	614	165,000	3.7E-03	--	--
Mercury	2.65	1050	2.5E-03	--	--
Molybdenum	1.74	17,500	9.9E-05	--	--
Nickel	151	70,000	2.2E-03	--	--
Selenium	4.05	17,500	2.3E-04	--	--
Silver	20.6	17,500	1.2E-03	--	--
Uranium [d]	370	505	7.3E-01	--	--
Zinc	91.5	1,050,000	8.7E-05	--	--
Semivolatiles					
Dibenzofuran	0.0701	7,000	1.0E-05	--	--
Methylnapthalene; 2-	0.320	14,000	2.3E-05	--	--
Anions					
Fluoride	12.3	210,000	5.9E-05	--	--
Nitrate as Nitrogen [e]	65.3	5,600,000	1.2E-05	--	--
Total Petroleum Hydrocarbons					
Motor Oil plus diesel range [f]	294	200	--	--	--

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	11/15/12	Calc. No.:	0300X-CA-V0163	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/15/12
Subject:	316-3 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	4 of 5

Table 1. Industrial Direct Contact Hazard Quotient and Excess Cancer Risk Results for the 316-3 Waste Site (2 pages)

Contaminants of Potential Concern	Maximum Value[a] (mg/kg)	Industrial Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Industrial Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Polycyclic Aromatic Hydrocarbons					
Acenaphthene	0.210	210,000	1.0E-06	--	--
Acenaphthylene[g]	3.240	210,000	1.5E-05	--	--
Anthracene	0.0247	1,050,000	2.4E-08	--	--
Benzo(a)anthracene	0.0545	--	--	180	3.0E-10
Benzo(a)pyrene	0.0318	--	--	18	1.8E-09
Benzo(b)fluoranthene	0.00913	--	--	180	5.1E-11
Benzo(k)fluoranthene	0.0161	--	--	180	8.9E-11
Chrysene	0.0146	--	--	1800	8.1E-12
Dibenz(a,h)anthracene	0.0125	--	--	180	6.9E-11
Fluoranthene	0.545	140,000	3.9E-06	--	--
Fluorene	0.124	140,000	8.9E-07	--	--
Indeno(1,2,3-cd)pyrene	0.0109	--	--	180	6.1E-11
Naphthalene	0.316	70,000	4.5E-06	--	--
Phenanthrene[g]	0.277	1,050,000	2.6E-07	--	--
Pyrene	0.0389	105,000	3.7E-07	--	--
Polychlorinated Biphenyls					
Aroclor-1248	2.58	--	--	65.6	3.9E-08
Aroclor-1254	1.32	70.0	1.9E-02	65.6	2.0E-08
Aroclor-1260	1.97	--	--	65.6	3.0E-08
Volatiles					
Methylenechloride	0.105	210,000	5.0E-07	17,500	6.0E-12
Tetrachloroethene	0.0354	35,000	1.0E-06	243	1.5E-10
Trichloroethene	0.0928	1,750	5.3E-05	2,850	3.3E-11
Totals					
Cumulative Hazard Quotient:			**7.8E-01**		
Cumulative Excess Cancer Risk:					**1.2E-07**

Notes:

[a] = From WCH (2012).

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

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

[d] = based on the calculated isotopic distribution of uranium in the 300 Area and activity-based industrial direct exposure cleanup level of 350 pCi/g for total uranium, the corresponding mass-based uranium concentration is 505 mg/kg for 300-FF-2 Operable Unit sites.

[e] = Values converted from nitrate values from WCH (2012)

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

[g] = Toxicity data for these chemicals are not available. The cleanup levels are based on use of surrogate chemicals.

acenaphthylene surrogate: acenaphthene

phenanthrene surrogate: anthracene

-- = not applicable

RAG = remedial action goal

Washington Closure Hanford, Inc. CALCULATION SHEET

Originator:	N. K. Schiffern	Date:	11/14/12	Calc. No.:	0300X-CA-V0163	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	I. B. Berezovskiy	Date:	11/14/12
Subject:	316-3 Waste Site Direct Contact Hazard Quotient and Carcinogenic Risk Calculation					Sheet No.	5 of 5

CONCLUSION:

The calculations in Table 1 demonstrate that the 316-3 waste site meets the requirements for the direct contact hazard quotients and carcinogenic (excess cancer) risk, respectively, as identified in the RDR/RAWP (DOE-RL 2009) and SAP (DOE-RL 2011). The direct contact hazard quotients and carcinogenic (excess cancer) risk calculations are for use in the RSVP for this site.

Attachment 1. 316-3 Waste Site Investigation Sampling Results (Radionuclides).

Sample Location	HEIS Number	Sample Date	Americium-241			Americium-241, AEA			Antimony-125			Bismuth-214			Carbon-14			Cerium-144			Cesium-134		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
TP-1, 0.5 m	J1PXC5	9/11/2012	0.272	U	0.272	0.026	U	0.095	0.113	U	0.113	1.20		0.102	2.20		0.864	0.292	U	0.292	0.071	U	0.071
TP-1, 2 m	J1PXC6	9/11/2012	0.480	U	0.480	0.017	U	0.065	0.179	U	0.179	0.444		0.157	1.79		0.833	0.419	U	0.419	0.091	U	0.091
TP-1, 4 m	J1PXC7	9/11/2012	0.157	U	0.157	0	U	0.357	0.187	U	0.187	0.399		0.162	1.99		0.844	0.378	U	0.378	0.103	U	0.103
TP-1, 6 m	J1PXC8	9/11/2012	0.216	U	0.216	-0.017	U	0.064	0.054	U	0.054	0.422		0.053	0.943		0.797	0.168	U	0.168	0.037	U	0.037
TP-2, 0.5 m	J1PX99	8/20/2012	0.289	U	0.289	0.177	U	0.242	0.237	U	0.237				0.090	UJ	4.78	0.559	U	0.559	0.173	U	0.173
TP-2, 2 m	J1PXC0	8/20/2012	0.135	U	0.135	0.711		0.284	0.062	U	0.062				-0.446	UJ	4.71	0.144	U	0.144	0.041	U	0.041
TP-2, 4 m	J1PXC1	8/20/2012	0.150	U	0.150	0.124	U	0.238	0.182	U	0.182				-0.300	UJ	4.52	0.464	U	0.464	0.101	U	0.101
TP-2, 6 m	J1PXC2	8/20/2012	0.658	U	0.658	0.182	U	0.348	0.242	U	0.242				0.348	UJ	4.60	0.555	U	0.555	0.116	U	0.116
TP-3, 0.5 m	J1PXC3	8/23/2012	0.173	U	0.173	0	U	0.262	0.136	U	0.136				0.321	U	4.20	0.342	U	0.342	0.078	U	0.078
TP-3, 1.5-2 m	J1PXC4	8/29/2012	0.249	U	0.249	0.063	U	0.201	0.213	U	0.213				-2.11	U	4.04	0.450	U	0.450	0.104	U	0.104
TP-4, 0.5 m	J1PX91	8/14/2012	0.206	U	0.206	0	U	0.385	0.171	U	0.171				2.14	U	4.33	0.382	U	0.382	0.088	U	0.088
TP-4, 2 m	J1PX92	8/14/2012	0.114	U	0.114	0.021	U	0.075	0.172	U	0.172				0.252	U	4.33	0.330	U	0.330	0.091	U	0.091
TP-4, 4 m	J1PX93	8/14/2012	0.229	U	0.229	0.012	U	0.108	0.148	U	0.148				-0.953	U	4.09	0.308	U	0.308	0.095	U	0.095
TP-4, 6 m	J1PX94	8/14/2012	0.631	U	0.631	-0.026	U	0.093	0.232	U	0.232				1.26	U	4.32	0.545	U	0.545	0.125	U	0.125
TP-5, 0.5 m	J1PX95	8/16/2012	0.046	U	0.046	0.025	U	0.193	0.019	U	0.019				-0.884	UJ	4.25	0.056	U	0.056	0.011	U	0.011
TP-5, 2 m	J1PX96	8/16/2012	0.047	U	0.047	-0.047	U	0.260	0.050	U	0.050				-1.48	UJ	5.03	0.126	U	0.126	0.028	U	0.028
TP-5, 4 m	J1PX97	8/16/2012	0.097	U	0.097	0	U	0.211	0.045	U	0.045				-0.341	UJ	4.00	0.108	U	0.108	0.026	U	0.026
TP-5, 6 m	J1PX98	8/16/2012	0.309	U	0.309	0.067	U	0.248	0.084	U	0.084				-2.64	UJ	4.64	0.240	U	0.240	0.043	U	0.043
TP-7, 2 m	J1PX88	8/13/2012	0.551	U	0.551	0.165	U	0.316	0.248	U	0.248				0.558	U	4.11	0.510	U	0.510	0.138	U	0.138
TP-7, 4 m	J1PX89	8/13/2012	0.415	U	0.415	0.132	U	0.316	0.185	U	0.185				2.35	U	4.74	0.506	U	0.506	0.115	U	0.115
TP-7, 6 m	J1PX90	8/13/2012	1.59	U	1.59	0	U	0.512	0.335	U	0.335				-0.131	U	4.50	1.07	U	1.07	0.201	U	0.201

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

Gray cells indicate not applicable.

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

B = detected but below the reporting limitm result is an estimated concentration.

D = result reported from a dilution

HEIS=Hanford Environmental Information System

J = estimated

MDA = minimum detected activity

PAH = polycyclic aromatic hydrocarbons

PCB = polycchlorinated byphenyls

PQL = practical quantitation limit

R =rejected

Q = qualifier

QC = quality control.

SVOA = semivolatile organic analysis

TP = test pit

TPH = total petroleum hydrocarbon

U = analyzed for and not detected.

VOA = volatile organic analysis

Attachment	1	Sheet No.	1 of 18
Originator	N. K. Schiffern	Date	11/14/12
Checked	I. B. Berezovskiy	Date	11/14/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results (Radionuclides).

Sample Location	HEIS Number	Sample Date	Cesium-137			Cobalt-60			Curium-242			Curium-243/244			Europium-152			Europium-154			Europium-155		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
TP-1, 0.5 m	J1PXC5	9/11/2012	0.051	U	0.051	0.046	U	0.046	0.005	U	0.050	0.031	U	0.078	0.158	U	0.158	0.137	U	0.137	0.168	U	0.168
TP-1, 2 m	J1PXC6	9/11/2012	0.091	U	0.091	0.078	U	0.078	0.007	U	0.027	-0.003	U	0.052	0.210	U	0.210	0.293	U	0.293	0.240	U	0.240
TP-1, 4 m	J1PXC7	9/11/2012	0.094	U	0.094	0.071	U	0.071	0	U	0.296	0.037	U	0.286	0.216	U	0.216	0.192	U	0.192	0.249	U	0.249
TP-1, 6 m	J1PXC8	9/11/2012	0.031		0.020	0.025	U	0.025	0.021	U	0.026	-0.013	U	0.051	0.068	U	0.068	0.091	U	0.091	0.108	U	0.108
TP-2, 0.5 m	J1PX99	8/20/2012	0.103	U	0.103	0.082	U	0.082	0.054	UJ	0.208	0.025	U	0.194	0.289	U	0.289	0.293	U	0.293	0.273	U	0.273
TP-2, 2 m	J1PXC0	8/20/2012	0.030	U	0.030	0.027	U	0.027	0.032	UJ	0.245	0.059	U	0.227	0.073	U	0.073	0.097	U	0.097	0.098	U	0.098
TP-2, 4 m	J1PXC1	8/20/2012	0.056	U	0.056	0.079	U	0.079	0.054	UJ	0.205	0.050	U	0.191	0.220	U	0.220	0.256	U	0.256	0.245	U	0.245
TP-2, 6 m	J1PXC2	8/20/2012	0.116	U	0.116	0.086	U	0.086	0	UJ	0.300	0.036	U	0.279	0.253	U	0.253	0.301	U	0.301	0.332	U	0.332
TP-3, 0.5 m	J1PXC3	8/23/2012	0.074	U	0.074	0.054	U	0.054	0.028	U	0.218	-0.027	U	0.210	0.174	U	0.174	0.192	U	0.192	0.184	U	0.184
TP-3, 1.5-2 m	J1PXC4	8/29/2012	0.083	U	0.083	0.083	U	0.083	0.022	U	0.167	0.021	U	0.161	0.256	U	0.256	0.224	U	0.224	0.232	U	0.232
TP-4, 0.5 m	J1PX91	8/14/2012	0.075	U	0.075	0.074	U	0.074	0.050	U	0.385	0.151	U	0.481	0.194	U	0.194	0.190	U	0.190	0.197	U	0.197
TP-4, 2 m	J1PX92	8/14/2012	0.072	U	0.072	0.066	U	0.066	-0.004	U	0.035	-0.004	U	0.065	0.220	U	0.220	0.205	U	0.205	0.167	U	0.167
TP-4, 4 m	J1PX93	8/14/2012	0.073	U	0.073	0.065	U	0.065	0	U	0.049	-0.043	U	0.108	0.190	U	0.190	0.264	U	0.264	0.181	U	0.181
TP-4, 6 m	J1PX94	8/14/2012	0.097	U	0.097	0.109	U	0.109	0.027	U	0.042	0.042	U	0.110	0.267	U	0.267	0.311	U	0.311	0.312	U	0.312
TP-5, 0.5 m	J1PX95	8/16/2012	0.026		0.007	0.007	U	0.007	0	UJ	0.212	-0.025	U	0.193	0.023	U	0.023	0.025	U	0.025	0.053	U	0.053
TP-5, 2 m	J1PX96	8/16/2012	0.022	U	0.022	0.018	U	0.018	0.026	UJ	0.198	-0.024	U	0.180	0.059	U	0.059	0.058	U	0.058	0.060	U	0.060
TP-5, 4 m	J1PX97	8/16/2012	0.025		0.021	0.018	U	0.018	0.024	UJ	0.185	0.022	U	0.169	0.055	U	0.055	0.062	U	0.062	0.063	U	0.063
TP-5, 6 m	J1PX98	8/16/2012	0.056	U	0.056	0.033	U	0.033	0.123	UJ	0.188	0.045	U	0.172	0.101	U	0.101	0.108	U	0.108	0.143	U	0.143
TP-7, 2 m	J1PX88	8/13/2012	0.110	U	0.110	0.136	U	0.136	0	U	0.263	-0.033	U	0.252	0.253	U	0.253	0.368	U	0.368	0.288	U	0.288
TP-7, 4 m	J1PX89	8/13/2012	0.126		0.107	0.068	U	0.068	0.103	U	0.263	0.033	U	0.253	0.214	U	0.214	0.199	U	0.199	0.302	U	0.302
TP-7, 6 m	J1PX90	8/13/2012	0.166	U	0.166	0.118	U	0.118	0.056	U	0.427	0	U	0.41	0.396	U	0.396	0.380	U	0.380	0.679	U	0.679

Sample Location	HEIS Number	Sample Date	Gross alpha			Gross beta			Nickel-63			Niobium-94			Plutonium-238			Plutonium-239/240			Plutonium-241		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
TP-1, 0.5 m	J1PXC5	9/11/2012	8.48		3.10	8.53		6.02	-0.471	U	3.00	0.043	U	0.043	0	U	0.426	0	U	0.426	1.95	U	11.8
TP-1, 2 m	J1PXC6	9/11/2012	33.5		3.35	41.6		5.40	0.045	U	3.41	0.076	U	0.076	0.065	U	0.498	1.76		0.498	13.2		12.4
TP-1, 4 m	J1PXC7	9/11/2012	58.0		3.16	59.2		5.99	0.878	U	3.53	0.070	U	0.070	0.062	U	0.476	2.42		0.476	4.33	U	11.3
TP-1, 6 m	J1PXC8	9/11/2012	19.8		2.94	33.3		5.34	1.60	U	3.13	0.023	U	0.023	0	U	0.555	0.797		0.555	14.3	U	17.6
TP-2, 0.5 m	J1PX99	8/20/2012	11.3		3.12	13.7		6.91	-0.461	U	3.40	0.074	U	0.074	-0.033	U	0.317	0	U	0.254	-1.40	U	12.4
TP-2, 2 m	J1PXC0	8/20/2012	23.5		3.77	42.8		6.45	0.209	U	3.39	0.027	U	0.027	0	U	0.328	2.76		0.227	-4.56	U	12.1
TP-2, 4 m	J1PXC1	8/20/2012	92.4		3.78	120		5.76	-0.596	U	3.22	0.060	U	0.060	-0.035	U	0.264	4.63		0.264	-1.86	U	11.9
TP-2, 6 m	J1PXC2	8/20/2012	75.6		3.49	71.1		6.32	-0.667	U	3.18	0.095	U	0.095	0	U	0.379	2.97		0.303	0.568	U	13.0
TP-3, 0.5 m	J1PXC3	8/23/2012	8.02		3.68	18.2		6.03	-0.097	U	3.87	0.053	U	0.053	0	U	0.566	0	U	0.566	-2.92	U	23.7
TP-3, 1.5-2 m	J1PXC4	8/29/2012	9.53		2.95	10.7		5.70	-0.116	U	3.03	0.071	U	0.071	0.069	U	0.142	0.046	U	0.088	-1.36	U	14.6
TP-4, 0.5 m	J1PX91	8/14/2012	8.16		3.60	15.4		5.44	-1.60	U	3.18	0.066	U	0.066	0.077	U	0.590	0.077	U	0.590	4.21	U	16.5
TP-4, 2 m	J1PX92	8/14/2012	9.80		3.02	15.4		5.96	0.075	U	3.14	0.054	U	0.054	0.068	U	0.518	0	U	0.518	-1.25	U	14.6
TP-4, 4 m	J1PX93	8/14/2012	23.1		2.79	33.8		5.28	-1.21	U	3.27	0.053	U	0.053	-0.076	U	0.582	0.076	U	0.582	5.69	U	15.2
TP-4, 6 m	J1PX94	8/14/2012	39.4		3.26	47.2		6.05	-1.26	U	3.29	0.084	U	0.084	0.046	U	0.355	1.48		0.355	3.64	U	13.5
TP-5, 0.5 m	J1PX95	8/16/2012	18.6		3.42	30.9		5.30	0.357	U	3.22	0.006	U	0.006	0	U	0.318	1.16		0.318	0.525	U	12.0
TP-5, 2 m	J1PX96	8/16/2012	20.5		2.97	25.3		5.91	0.884	U	3.26	0.017	U	0.017	-0.04	U	0.309	0.323		0.309	-2.40	U	16.0
TP-5, 4 m	J1PX97	8/16/2012	19.2		3.74	25.8		4.86	3.13	U	3.17	0.017	U	0.017	0.023	U	0.224	0.093	U	0.178	-0.719	U	11.5
TP-5, 6 m	J1PX98	8/16/2012	61.3		3.41	76.1		5.63	-0.156	U	3.17	0.031	U	0.031	0.078	U	0.198	0.285		0.198	-0.997	U	12.3
TP-7, 2 m	J1PX88	8/13/2012	14.8		3.04	21.5		5.72	-2.11	U	3.21	0.108	U	0.108	0.191	U	0.488	0.510		0.488	8.04	U	15.7
TP-7, 4 m	J1PX89	8/13/2012	77.1		2.99	61.9		5.65	-0.397	U	3.32	0.068	U	0.068	0.062	U	0.476	0.373	U	0.476	7.53	U	15.3
TP-7, 6 m	J1PX90	8/13/2012	94.2		2.57	86.2		5.27	-2.09	U	3.18	0.129	U	0.129	0	U	0.578	0.454	U	0.578	8.71	U	19.6

Attachment	I	Sheet No.	2 of 18
Originator	N. K. Schiffern	Date	11/14/12
Checked	I. B. Berezovskiy	Date	11/14/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results (Radionuclides).

Sample Location	HEIS Number	Sample Date	Potassium-40			Radium-226			Radium-228			Ruthenium-106			Technetium-99			Thorium-228			Thorium-232		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
TP-1, 0.5 m	J1PXC5	9/11/2012	3.58		0.374	1.17		0.099	0.967		0.182	0.416	U	0.416	-0.047	U	0.362	0.830		0.065	0.967		0.182
TP-1, 2 m	J1PXC6	9/11/2012	7.24		0.850	0.432		0.153	0.418		0.301	0.666	U	0.666	-0.072	U	0.281	0.635		0.152	0.418		0.301
TP-1, 4 m	J1PXC7	9/11/2012	9.18		0.509	0.387		0.157	0.935		0.249	0.625	U	0.625	0.112	U	0.289	0.607		0.092	0.935		0.249
TP-1, 6 m	J1PXC8	9/11/2012	15.3		0.271	0.410		0.051	0.873		0.113	0.206	U	0.206	-0.009	U	0.292	0.683		0.034	0.873		0.113
TP-2, 0.5 m	J1PX99	8/20/2012	5.79		0.810	0.916		0.221	1.08		0.311	0.751	U	0.751	0.475		0.324	0.798		0.129	1.08		0.311
TP-2, 2 m	J1PXC0	8/20/2012	11.0		0.206	0.399		0.048	0.691		0.097	0.247	U	0.247	-0.009	U	0.277	0.616		0.036	0.691		0.097
TP-2, 4 m	J1PXC1	8/20/2012	9.66		0.622	0.340		0.141	0.668		0.330	0.593	U	0.593	0.082	U	0.266	0.822		0.140	0.668		0.330
TP-2, 6 m	J1PXC2	8/20/2012	7.36		0.866	0.459		0.236	0.670		0.394	0.881	U	0.881	0.016	U	0.277	0.660		0.177	0.670		0.394
TP-3, 0.5 m	J1PXC3	8/23/2012	12.0		0.567	0.338		0.124	0.694		0.235	0.506	U	0.506	0.022	U	0.287	0.594		0.085	0.694		0.235
TP-3, 1.5-2 m	J1PXC4	8/29/2012	5.83		0.744	0.919		0.172	0.803		0.319	0.620	U	0.620	0.001	U	0.264	0.721		0.105	0.803		0.319
TP-4, 0.5 m	J1PX91	8/14/2012	11.5		0.528	0.479		0.149	0.719		0.280	0.581	U	0.581	0.067	U	0.279	0.715		0.151	0.719		0.280
TP-4, 2 m	J1PX92	8/14/2012	9.46		0.755	0.447		0.157	0.860		0.338	0.630	U	0.630	0.126	U	0.286	0.586		0.149	0.860		0.338
TP-4, 4 m	J1PX93	8/14/2012	10.4		0.667	0.412		0.141	0.590		0.257	0.620	U	0.620	0.126	U	0.269	0.722		0.090	0.590		0.257
TP-4, 6 m	J1PX94	8/14/2012	10.0		0.879	0.293		0.217	0.836		0.358	0.968	U	0.968	0.020	U	0.325	0.832		0.210	0.836		0.358
TP-5, 0.5 m	J1PX95	8/16/2012	14.4		0.067	0.405		0.016	0.818		0.038	0.063	U	0.063	0.166	U	0.271	0.795		0.012	0.818		0.038
TP-5, 2 m	J1PX96	8/16/2012	11.2		0.138	0.359		0.046	0.760		0.084	0.165	U	0.165	0.145	U	0.288	0.626		0.028	0.760		0.084
TP-5, 4 m	J1PX97	8/16/2012	12.5		0.212	0.321		0.035	0.602		0.085	0.171	U	0.171	-0.011	U	0.310	0.636		0.037	0.602		0.085
TP-5, 6 m	J1PX98	8/16/2012	9.34		0.368	0.328		0.071	0.872		0.173	0.313	U	0.313	0.189	U	0.288	0.903		0.066	0.872		0.173
TP-7, 2 m	J1PX88	8/13/2012	10.2		0.731	0.344		0.242	0.584	U	0.584	0.852	U	0.852	0.236	U	0.309	0.681		0.199	0.584	U	0.584
TP-7, 4 m	J1PX89	8/13/2012	8.84		0.643	0.334		0.155	0.886		0.304	0.734	U	0.734	0.639		0.293	0.933		0.146	0.886		0.304
TP-7, 6 m	J1PX90	8/13/2012	8.02		1.09	0.379		0.269	1.21		0.487	1.27	U	1.27	1.19		0.282	1.54		0.266	1.21		0.487

Sample Location	HEIS Number	Sample Date	Tritium			Uranium-233/234, AEA			Uranium-235			Uranium-235, AEA			Uranium-238			Uranium-238, AEA			Zinc-65		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
TP-1, 0.5 m	J1PXC5	9/11/2012	1.20	U	3.63	1.47		0.175	0.354	U	0.354	0.056	U	0.212	6.01	U	6.01	1.47		0.175	0.093	U	0.093
TP-1, 2 m	J1PXC6	9/11/2012	-0.061	U	3.68	17.2		0.087	0.731		0.570	1.02		0.032	18.0		10.5	19.6		0.081	0.193	U	0.193
TP-1, 4 m	J1PXC7	9/11/2012	0.114	U	3.47	40.0		0.122	1.37		0.475	2.34		0.025	36.2		7.46	44.6		0.116	0.137	U	0.137
TP-1, 6 m	J1PXC8	9/11/2012	0.064	U	3.86	12.2		0.083	0.769		0.230	0.836		0.027	19.5		3.64	13.6		0.078	0.066	U	0.066
TP-2, 0.5 m	J1PX99	8/20/2012	-3.72	UJ	6.60	3.45		0.214	0.626	U	0.626	0.170	UJ	0.260	11.5	U	11.5	3.36		0.214	0.168	U	0.168
TP-2, 2 m	J1PXC0	8/20/2012	-2.68	UJ	6.52	16.0		0.274	0.284		0.189	0.869	J	0.229	9.22		3.96	19.2		0.274	0.079	U	0.079
TP-2, 4 m	J1PXC1	8/20/2012	-3.55	UJ	6.30	78.6		0.597	1.61		0.741	7.25	J	0.189	34.0		10.1	87.4		0.571	0.156	U	0.156
TP-2, 6 m	J1PXC2	8/20/2012	-2.95	UJ	6.46	44.6		0.441	1.28		0.692	3.43	J	0.195	30.8		9.31	52.2		0.429	0.234	U	0.234
TP-3, 0.5 m	J1PXC3	8/23/2012	1.37	U	4.92	1.00		0.179	0.377	U	0.377	0.028	U	0.216	7.40	U	7.40	0.911		0.179	0.145	U	0.145
TP-3, 1.5-2 m	J1PXC4	8/29/2012	-1.63	U	5.61	1.47		0.274	0.528	U	0.528	0.173	U	0.331	9.31	U	9.31	1.72		0.274	0.135	U	0.135
TP-4, 0.5 m	J1PX91	8/14/2012	-1.54	U	5.23	0.913		0.304	0.430	U	0.430	0.048	U	0.368	8.65	U	8.65	1.07		0.304	0.124	U	0.124
TP-4, 2 m	J1PX92	8/14/2012	-0.087	U	5.33	1.11		0.292	0.386	U	0.386	0.092	U	0.354	9.27	U	9.27	1.49		0.292	0.179	U	0.179
TP-4, 4 m	J1PX93	8/14/2012	-1.45	U	5.22	16.2		0.334	0.794		0.554	1.02		0.251	14.0		10.2	16.4		0.300	0.144	U	0.144
TP-4, 6 m	J1PX94	8/14/2012	-0.083	U	5.08	24.1		0.399	0.993		0.702	1.73		0.276	15.9		12.2	27.4		0.399	0.242	U	0.242
TP-5, 0.5 m	J1PX95	8/16/2012	0.197	UJ	6.48	11.4		0.207	0.526		0.071	0.747	J	0.143	10.6		1.06	12.3		0.190	0.016	U	0.016
TP-5, 2 m	J1PX96	8/16/2012	-1.25	UJ	6.87	12.0		0.227	0.882		0.170	0.820	J	0.146	14.8		2.40	12.9		0.194	0.045	U	0.045
TP-5, 4 m	J1PX97	8/16/2012	-0.785	UJ	5.73	7.75		0.238	0.265		0.138	0.660	J	0.153	6.36		2.64	7.40		0.183	0.048	U	0.048
TP-5, 6 m	J1PX98	8/16/2012	0.966	UJ	6.35	47.4		0.508	2.93		0.303	4.44	J	0.202	52.1		4.62	46.3		0.484	0.076	U	0.076
TP-7, 2 m	J1PX88	8/13/2012	-0.743	U	5.04	6.59		0.067	0.894	U	0.894	0.493		0.027	16.4	U	16.4	7.16		0.065	0.294	U	0.294
TP-7, 4 m	J1PX89	8/13/2012	-0.178	U	5.44	62.8		0.529	4.54		0.743	5.36		0.194	81.2		11.0	62.8		0.508	0.167	U	0.167
TP-7, 6 m	J1PX90	8/13/2012	-1.94	U	5.38	64.3		0.582	9.44		1.46	4.05		0.282	150		18.9	64.3		0.561	0.276	U	0.276

Attachment 1 Sheet No. 3 of 18
Originator N. K. Schiffern Date 11/14/12
Checked I. B. Berezovskiy Date 11/14/12
Calc. No. 0300X-CA-V0163 Rev. No. 0

Attachment 1. 316-3 Waste Site Investigation Sampling Results (Metals).

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium			Boron			Cadmium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP-1, 0.5 m	J1PXC5	9/11/2012	13700		18.4	2.20	U	2.20	6.60		3.67	1330		1.84	1.72		0.734	412		7.34	0.948		0.734
TP-1, 2 m	J1PXC6	9/11/2012	10700		14.9	1.79	U	1.79	3.36		2.98	197		1.49	0.434	B	0.597	36.3		5.97	0.184	B	0.597
TP-1, 4 m	J1PXC7	9/11/2012	14900		15.8	1.90	U	1.90	3.90		3.17	229		1.58	0.460	B	0.633	36.3		6.33	0.213	B	0.633
TP-1, 6 m	J1PXC8	9/11/2012	8400		14.6	1.75	U	1.75	3.55		2.91	85.9		1.46	0.284	B	0.582	3.60	B	5.82	0.582	U	0.582
TP-2, 0.5 m	J1PX99	8/20/2012	13200	J	5.46	0.655	UJ	0.655	1.99		1.09	786		0.546	1.03		0.218	197		2.18	0.252		0.218
TP-2, 2 m	J1PXC0	8/20/2012	7530	J	4.69	0.563	UJ	0.563	1.95		0.938	64.0		0.469	0.250		0.188	15.2		1.88	0.0911	B	0.188
TP-2, 4 m	J1PXC1	8/20/2012	13600	J	4.93	0.592	UJ	0.592	3.28		0.987	114		0.493	0.289		0.197	34.4		1.97	0.175	B	0.197
TP-2, 6 m	J1PXC2	8/20/2012	10000	J	5.36	0.644	UJ	0.644	3.00		1.07	119		0.536	0.300		0.215	12.4		2.15	0.150	B	0.215
TP-3, 0.5 m	J1PXC3	8/23/2012	7650		14.3	1.71	U	1.71	2.99		2.86	118		1.43	0.327	B	0.572	8.37		5.72	0.148	B	0.572
TP-3, 1.5-2 m	J1PXC4	8/29/2012	14800		17.4	2.09	U	2.09	3.04	B	3.48	838		1.74	1.13		0.696	190		6.96	0.290	B	0.696
TP-4, 0.5 m	J1PX91	8/14/2012	7170		11.8	1.41	U	1.41	2.47		2.35	129		1.18	0.319	B	0.470	8.24		4.70	0.470	U	0.470
TP-4, 2 m	J1PX92	8/14/2012	8740		13.9	1.67	U	1.67	3.12		2.78	283		1.39	0.500	B	0.556	28.7		5.56	0.206	B	0.556
TP-4, 4 m	J1PX93	8/14/2012	11400		11.9	1.43	U	1.43	4.48		2.38	111		1.19	0.424	B	0.476	8.22		4.76	0.146	B	0.476
TP-4, 6 m	J1PX94	8/14/2012	10800		12.4	1.49	U	1.49	5.18		2.49	107		1.24	0.390	B	0.498	5.60		4.98	0.134	B	0.498
TP-5, 0.5 m	J1PX95	8/16/2012	7760	J	4.66	0.560	UJ	0.560	2.75		0.933	81.7		0.466	0.262		0.187	1.54	B	1.87	0.147	B	0.187
TP-5, 2 m	J1PX96	8/16/2012	7710	J	5.18	0.622	UJ	0.622	2.60		1.04	71.4		0.518	0.254		0.207	1.70	B	2.07	0.129	B	0.207
TP-5, 4 m	J1PX97	8/16/2012	6070	J	5.02	0.603	UJ	0.603	2.48		1.00	60.1		0.502	0.219		0.201	1.04	B	2.01	0.0732	B	0.201
TP-5, 6 m	J1PX98	8/16/2012	11100	J	5.83	0.699	UJ	0.699	3.58		1.17	101		0.583	0.304		0.233	2.03	B	2.33	0.250		0.233
TP-6, surface	J1R0M5	8/21/2012							3.60	U	3.60	46.7		0.280	0.201		0.0900				1.04	U	1.04
TP-7, 2 m	J1PX88	8/13/2012	9060		12.9	1.55	U	1.55	3.42		2.58	92.5		1.29	0.344	B	0.516	1.73	B	5.16	0.516	U	0.516
TP-7, 4 m	J1PX89	8/13/2012	14800		14.4	1.73	U	1.73	3.61		2.89	129		1.44	0.379	B	0.578	2.46	B	5.78	0.273	B	0.578
TP-7, 6 m	J1PX90	8/13/2012	15300		13.8	1.66	U	1.66	3.65		2.76	111		1.38	0.349	B	0.553	2.92	B	5.53	0.356	B	0.553

Sample Location	HEIS Number	Sample Date	Calcium			Chromium			Cobalt			Copper			Iron			Lead			Lithium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP-1, 0.5 m	J1PXC5	9/11/2012	55000		367	17.1		0.734	7.34	U	7.34	34.6		3.67	18500		73.4	111		1.84	11.0		9.18
TP-1, 2 m	J1PXC6	9/11/2012	11000		298	20.0		0.597	7.72		5.97	53.8		2.98	25100		59.7	12.1		1.49	7.98		7.46
TP-1, 4 m	J1PXC7	9/11/2012	13600		317	60.9		0.633	8.30		6.33	216		3.17	28400		63.3	14.9		1.58	9.61		7.92
TP-1, 6 m	J1PXC8	9/11/2012	5480		291	23.3		0.582	5.75	B	5.82	78.1		2.91	19300		58.2	6.44		1.46	8.17		7.28
TP-2, 0.5 m	J1PX99	8/20/2012	42200		109	11.1		0.218	2.26		2.18	21.4		1.09	16600		21.8	14.9		0.546	12.9		2.73
TP-2, 2 m	J1PXC0	8/20/2012	5010		93.8	13.3		0.188	7.11		1.88	45.3		0.938	20000		18.8	3.84		0.469	5.78		2.35
TP-2, 4 m	J1PXC1	8/20/2012	9960		98.7	40.8		0.197	6.25		1.97	116		0.987	21400		19.7	9.33		0.493	7.77		2.47
TP-2, 6 m	J1PXC2	8/20/2012	9940		107	27.0		0.215	6.45		2.15	149		1.07	20100		21.5	6.70		0.536	6.97		2.68
TP-3, 0.5 m	J1PXC3	8/23/2012	8510		286	12.5		0.572	6.68		5.72	21.0		2.86	22600		57.2	8.27		1.43	8.28		7.14
TP-3, 1.5-2 m	J1PXC4	8/29/2012	53000		348	13.3		0.696	6.96	U	6.96	23.2		3.48	20700		69.6	15.0		1.74	18.5		8.70
TP-4, 0.5 m	J1PX91	8/14/2012	8360		235	9.45		0.470	6.17		4.70	16.6		2.35	21200		47.0	7.19		1.18	6.44		5.88
TP-4, 2 m	J1PX92	8/14/2012	14700		278	12.9		0.556	6.00		5.56	21.5		2.78	21400		55.6	14.2		1.39	7.93		6.95
TP-4, 4 m	J1PX93	8/14/2012	9670		238	34.1		0.476	8.85		4.76	267		2.38	27200		47.6	8.88		1.19	8.95		5.95
TP-4, 6 m	J1PX94	8/14/2012	8720		249	36.3		0.498	9.02		4.98	280		2.49	26200		49.8	8.15		1.24	9.45		6.22
TP-5, 0.5 m	J1PX95	8/16/2012	5510		93.3	28.3		0.187	5.43		1.87	206		0.933	17800		18.7	8.01		0.466	7.17		2.33
TP-5, 2 m	J1PX96	8/16/2012	6080		104	30.7		0.207	5.60		2.07	225		1.04	18500		20.7	10.4		0.518	6.91		2.59
TP-5, 4 m	J1PX97	8/16/2012	4680		100	13.6		0.201	4.92		2.01	56.8		1.00	16800		20.1	3.96		0.502	6.40		2.51
TP-5, 6 m	J1PX98	8/16/2012	8420		117	83.3		0.233	7.19		2.33	775		1.17	21100		23.3	17.6		0.583	6.98		2.91
TP-6, surface	J1R0M5	8/21/2012				8.28		4.00										2.28		1.84			
TP-7, 2 m	J1PX88	8/13/2012	7460		258	20.3		0.516	8.23		5.16	117		2.58	26200		51.6	5.77		1.29	8.31		6.46
TP-7, 4 m	J1PX89	8/13/2012	12500		289	117		0.578	9.54		5.78	1060		2.89	29900		57.8	28.3		1.44	7.84		7.22
TP-7, 6 m	J1PX90	8/13/2012	8150		276	152		0.553	7.07		5.53	1340		2.76	21100		55.3	38.8		1.38	8.06		6.91

Attachment	1	Sheet No.	4 of 18
Originator	N. K. Schiffern	Date	11/14/12
Checked	I. B. Berezovskiy	Date	11/14/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results (Metals).

Sample Location	HEIS Number	Sample Date	Magnesium			Manganese			Mercury			Molybdenum			Nickel			Potassium			Selenium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP-1, 0.5 m	J1PXC5	9/11/2012	17500		275	70.5		18.4	0.171		0.0384	1.74	B	7.34	10.6	B	14.7	778	B	1470	4.05		1.10
TP-1, 2 m	J1PXC6	9/11/2012	6360		224	327		14.9	0.906		0.0279	0.841	B	5.97	13.3		11.9	960	B	1190	0.895	U	0.895
TP-1, 4 m	J1PXC7	9/11/2012	7310		238	359		15.8	2.00		0.0916	0.777	B	6.33	23.5		12.7	1130	B	1270	0.950	U	0.950
TP-1, 6 m	J1PXC8	9/11/2012	4380		218	287		14.6	0.255		0.0262	5.82	U	5.82	12.9		11.6	1230		1160	0.874	U	0.874
TP-2, 0.5 m	J1PX99	8/20/2012	10500		81.8	80.2		5.46	0.420		0.0355	0.928	B	2.18	7.33		4.36	660		436	0.960		0.327
TP-2, 2 m	J1PXC0	8/20/2012	4640		70.4	279		4.69	0.380		0.0242	0.399	B	1.88	10.3		3.75	653		375	0.281	U	0.281
TP-2, 4 m	J1PXC1	8/20/2012	4510		74.0	270		4.93	2.65		0.131	0.452	B	1.97	14.4		3.95	1000		395	0.296	U	0.296
TP-2, 6 m	J1PXC2	8/20/2012	4390		80.5	261		5.36	1.11		0.0279	0.463	B	2.15	14.8		4.29	919		429	0.322	U	0.322
TP-3, 0.5 m	J1PXC3	8/23/2012	5240		214	323		14.3	0.0286		0.0282	5.72	U	5.72	11.5		11.4	1150		1140	0.857	U	0.857
TP-3, 1.5-2 m	J1PXC4	8/29/2012	12200		261	123		17.4	0.420		0.0350	1.12	B	6.96	9.09	B	13.9	737	B	1390	1.18		1.04
TP-4, 0.5 m	J1PX91	8/14/2012	4520		176	289		11.8	0.0489		0.0246	4.70	U	4.70	9.82		9.41	1060		941	0.705	U	0.705
TP-4, 2 m	J1PX92	8/14/2012	6330		208	258		13.9	0.102		0.0310	5.56	U	5.56	12.3		11.1	1130		1110	0.834	U	0.834
TP-4, 4 m	J1PX93	8/14/2012	5310		179	425		11.9	0.858		0.0322	4.76	U	4.76	23.0		9.52	1250		952	0.714	U	0.714
TP-4, 6 m	J1PX94	8/14/2012	5240		187	396		12.4	0.822		0.0263	4.98	U	4.98	23.1		9.96	1300		996	0.747	U	0.747
TP-5, 0.5 m	J1PX95	8/16/2012	4030		70.0	270		4.66	0.384		0.0294	0.488	B	1.87	20.1		3.73	1120		373	0.280	U	0.280
TP-5, 2 m	J1PX96	8/16/2012	4060		77.8	282		5.18	0.400		0.0270	0.567	B	2.07	26.3		4.15	1040		415	0.311	U	0.311
TP-5, 4 m	J1PX97	8/16/2012	3770		75.3	237		5.02	0.117		0.0254	0.373	B	2.01	12.6		4.02	932		402	0.301	U	0.301
TP-5, 6 m	J1PX98	8/16/2012	5110		87.4	573		5.83	1.32		0.0324	0.875	B	2.33	74.6		4.66	920		466	0.350	U	0.350
TP-6, surface	J1R0M5	8/21/2012																			3.40	U	3.40
TP-7, 2 m	J1PX88	8/13/2012	5300		194	391		12.9	0.251		0.0296	5.16	U	5.16	15.7		10.3	1190		1030	0.775	U	0.775
TP-7, 4 m	J1PX89	8/13/2012	7320		217	614		14.4	1.62		0.0306	1.05	B	5.78	119		11.6	933	B	1160	0.866	U	0.866
TP-7, 6 m	J1PX90	8/13/2012	6030		207	308		13.8	1.62		0.0536	0.800	B	5.53	151		11.1	1170		1110	0.829	U	0.829

Sample Location	HEIS Number	Sample Date	Silicon			Silver			Sodium			Uranium			Vanadium			Zinc			Zirconium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP-1, 0.5 m	J1PXC5	9/11/2012	363		7.34	0.734	U	0.734	1440		184	73.4	U	73.4	37.0		9.18	91.5		36.7	37.0		9.18
TP-1, 2 m	J1PXC6	9/11/2012	376		5.97	4.67		0.597	489		149	41.7	B	59.7	72.7		7.46	56.1		29.8	36.8		7.46
TP-1, 4 m	J1PXC7	9/11/2012	233		6.33	17.7		0.633	602		158	114		63.3	73.6		7.92	67.2		31.7	59.9		7.92
TP-1, 6 m	J1PXC8	9/11/2012	236		5.82	4.96		0.582	232		146	47.0	B	58.2	51.9		7.28	44.6		29.1	24.3		7.28
TP-2, 0.5 m	J1PX99	8/20/2012	552	J	2.18	0.218	U	0.218	1770		54.6	21.8	U	21.8	26.2		2.73	40.7		10.9	28.7		2.73
TP-2, 2 m	J1PXC0	8/20/2012	472	J	1.88	2.80		0.188	401		46.9	13.2	B	18.8	63.8		2.35	49.6		9.38	25.9		2.35
TP-2, 4 m	J1PXC1	8/20/2012	253	J	1.97	13.9		0.197	448		49.3	101		19.7	65.9		2.47	60.5		9.87	39.2		2.47
TP-2, 6 m	J1PXC2	8/20/2012	518	J	2.15	7.87		0.215	468		53.6	64.1		21.5	51.6		2.68	47.9		10.7	38.8		2.68
TP-3, 0.5 m	J1PXC3	8/23/2012	643		5.72	0.572	U	0.572	333		143	57.2	U	57.2	64.3		7.14	50.3		28.6	19.0		7.14
TP-3, 1.5-2 m	J1PXC4	8/29/2012	765		6.96	0.696	U	0.696	1690		174	69.6	U	69.6	41.8		8.70	35.0		34.8	35.8		8.70
TP-4, 0.5 m	J1PX91	8/14/2012	435		4.70	0.470	U	0.470	260		118	47.0	U	47.0	56.3		5.88	44.7		23.5	20.6		5.88
TP-4, 2 m	J1PX92	8/14/2012	543		5.56	0.556	U	0.556	356		139	55.6	U	55.6	54.9		6.95	52.9		27.8	20.0		6.95
TP-4, 4 m	J1PX93	8/14/2012	407		4.76	7.06		0.476	409		119	22.8	B	47.6	74.3		5.95	60.5		23.8	71.6		5.95
TP-4, 6 m	J1PX94	8/14/2012	437		4.98	6.73		0.498	346		124	37.8	B	49.8	62.6		6.22	54.4		24.9	70.1		6.22
TP-5, 0.5 m	J1PX95	8/16/2012	953	J	1.87	4.19		0.187	219		46.6	16.1	B	18.7	46.5		2.33	45.0		9.33	57.1		2.33
TP-5, 2 m	J1PX96	8/16/2012	737	J	2.07	3.71		0.207	216		51.8	34.2		20.7	49.7		2.59	49.0		10.4	51.2		2.59
TP-5, 4 m	J1PX97	8/16/2012	593	J	2.01	0.770		0.201	201		50.2	11.2	B	20.1	48.0		2.51	37.9		10.0	27.6		2.51
TP-5, 6 m	J1PX98	8/16/2012	363	J	2.33	10.9		0.233	361		58.3	155		23.3	60.3		2.91	59.4		11.7	110		2.91
TP-6, surface	J1R0M5	8/21/2012				3.60	U	3.60															
TP-7, 2 m	J1PX88	8/13/2012	1230		5.16	2.46		0.516	271		129	5.93	B	51.6	68.0		6.46	52.8		25.8	44.0		6.46
TP-7, 4 m	J1PX89	8/13/2012	463		5.78	16.4		0.578	387		144	252		57.8	75.0		7.22	74.2		28.9	79.3		7.22
TP-7, 6 m	J1PX90	8/13/2012	480		5.53	20.6		0.553	282		138	370		55.3	56.1		6.91	70.8		27.6	138		6.91

Attachment	1	Sheet No.	5 of 18
Originator	N. K. Schiffern	Date	11/14/12
Checked	I. B. Berezovskiy	Date	11/14/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results (TPH and Physical).

Sample Location	HEIS Number	Sample Date	TPH - Diesel			TPH - Motor oil			Percent moisture (wet sample)			Percent Solids			pH Measurement		
			ug/kg	Q	PQL	ug/kg	Q	PQL	%	Q	PQL	%	Q	PQL	pH	Q	PQL
TP-1, 0.5 m	J1PXC5	9/11/2012	54000		4400	128000		13200	24.3		0.10	75.7		0.1	8.16		0.10
TP-1, 2 m	J1PXC6	9/11/2012	4180		3500	11000		10500	5.18		0.10	94.8		0.1	8.38		0.10
TP-1, 4 m	J1PXC7	9/11/2012	9910		3670	25900		11000	10.6		0.10	89.4		0.1	8.25		0.10
TP-1, 6 m	J1PXC8	9/11/2012	4150		3460	10300	J	10400	4.62		0.10	95.4		0.1	8.47		0.10
TP-2, 0.5 m	J1PX99	8/20/2012	87900	J	4070	178000	J	12200	18.2		0.10	81.8		0.1	8.49	J	0.10
TP-2, 2 m	J1PXC0	8/20/2012	1230	J	3410	10200	UJ	10200	4.82		0.10	95.2		0.1	8.75	J	0.10
TP-2, 4 m	J1PXC1	8/20/2012	3720	UJ	3720	14500	J	11100	11.1		0.10	88.9		0.1	8.27	J	0.10
TP-2, 6 m	J1PXC2	8/20/2012	3630	UJ	3630	13700	J	10900	10.4		0.10	89.6		0.1	8.43	J	0.10
TP-3, 0.5 m	J1PXC3	8/23/2012	9620	J	14100	32300	J	42400	6.27		0.10	93.7		0.1	8.75		0.10
TP-3, 1.5-2 m	J1PXC4	8/29/2012	90700		4390	203000		13200	24.3		0.10	75.7		0.1	8.31		0.10
TP-4, 0.5 m	J1PX91	8/14/2012	19300		3460	52200		10400	6.18		0.10	93.8		0.1	8.48		0.10
TP-4, 2 m	J1PX92	8/14/2012	34900		3970	80300		11900	17.0		0.10	83.0		0.1	8.00		0.10
TP-4, 4 m	J1PX93	8/14/2012	3690	U	3690	16400		11100	9.97		0.10	90.0		0.1	8.37		0.10
TP-4, 6 m	J1PX94	8/14/2012	3670	U	3670	11000	U	11000	10.1		0.10	89.9		0.1	8.34		0.10
TP-5, 0.5 m	J1PX95	8/16/2012	3310	UJ	3310	18700	J	9930	4.30		0.10	95.7		0.1	8.90	J	0.10
TP-5, 2 m	J1PX96	8/16/2012	3510	UJ	3510	25200	J	10500	7.26		0.10	92.7		0.1	8.61	J	0.10
TP-5, 4 m	J1PX97	8/16/2012	3470	UJ	3470	3870	J	10400	4.29		0.10	95.7		0.1	9.20	J	0.10
TP-5, 6 m	J1PX98	8/16/2012	3880	UJ	3880	41700	J	11600	15.9		0.10	84.1		0.1	8.65	J	0.10
TP-6, surface	J1R0M5	8/21/2012															
TP-7, 2 m	J1PX88	8/13/2012	3610	U	3610	4400	J	10800	7.80		0.10	92.2		0.1	8.38		0.10
TP-7, 4 m	J1PX89	8/13/2012	68100		3820	120000		11500	13.4		0.10	86.6		0.1	8.25		0.10
TP-7, 6 m	J1PX90	8/13/2012	41200		3830	78800		11500	13.8		0.10	86.2		0.1	7.96		0.10

Attachment 1. 316-3 Waste Site Investigation Sampling Results (TCLP Metals).

Sample Location	HEIS Number	Sample Date	Arsenic			Barium			Cadmium			Chromium			Lead			Mercury		
			mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL	mg/L	Q	PQL
TP-1, 0.5 m	J1PXC5	9/11/2012	0.0750	U	0.0750	0.484		0.00500	0.0150	U	0.0150	0.00397	B	0.0250	0.0500	U	0.0500	0.000200	U	0.000200
TP-1, 2 m	J1PXC6	9/11/2012	0.0750	U	0.0750	0.886		0.00500	0.00104	B	0.0150	0.00337	B	0.0250	0.0500	U	0.0500	0.000200	U	0.000200
TP-1, 4 m	J1PXC7	9/11/2012	0.0750	U	0.0750	0.783		0.00500	0.0150	U	0.0150	0.00564	B	0.0250	0.0500	U	0.0500	0.000200	U	0.000200
TP-1, 6 m	J1PXC8	9/11/2012	0.0750	U	0.0750	0.526		0.00500	0.00153	B	0.0150	0.0105	B	0.0250	0.0500	U	0.0500	0.000200	U	0.000200

Sample Location	HEIS Number	Sample Date	Selenium			Silver		
			mg/L	Q	PQL	mg/L	Q	PQL
TP-1, 0.5 m	J1PXC5	9/11/2012	0.0416	B	0.100	0.0300	U	0.0300
TP-1, 2 m	J1PXC6	9/11/2012	0.100	U	0.100	0.0300	U	0.0300
TP-1, 4 m	J1PXC7	9/11/2012	0.100	U	0.100	0.0300	U	0.0300
TP-1, 6 m	J1PXC8	9/11/2012	0.100	U	0.100	0.0300	U	0.0300

Attachment	1	Sheet No.	6 of 18
Originator	N. K. Schiffern	Date	11/14/12
Checked	I. B. Berezovskiy	Date	11/14/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results (Anions).

Sample Location	HEIS Number	Sample Date	Bromide			Chloride			Cyanide			Fluoride			Nitrate			Nitrite			Nitrogen in Nitrite and Nitrate		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP-1, 0.5 m	J1PXC5	9/11/2012	1.3	U	1.3	9.2		1.3	0.65	U	0.65	1.4	B	1.3	289	D	6.6	1.3	U	1.3	111	D	1.32
TP-1, 2 m	J1PXC6	9/11/2012	1.0	U	1.0	4.5	B	1.0	0.52	U	0.52	1.0	U	1.0	124	D	2.0	1.0	U	1.0	41.3	D	0.51
TP-1, 4 m	J1PXC7	9/11/2012	1.1	U	1.1	4.3	B	1.1	0.56	U	0.56	1.1	U	1.1	170	D	2.2	1.1	U	1.1	53.0	D	1.08
TP-1, 6 m	J1PXC8	9/11/2012	1.0	U	1.0	2.1	B	1.0	0.52	U	0.52	2.0	B	1.0	170	D	2.0	1.0	U	1.0	37.7	D	0.50
TP-2, 0.5 m	J1PX99	8/20/2012	1.2	U	1.2	1.7	B	1.2	0.61	U	0.61	2.2	B	1.2	211	DJ	2.4	1.2	UR	1.2	45.2	D	1.22
TP-2, 2 m	J1PXC0	8/20/2012	1.0	U	1.0	3.8	B	1.0	0.52	U	0.52	2.6	B	1.0	25.5	J	1.0	1.0	UR	1.0	5.61		0.10
TP-2, 4 m	J1PXC1	8/20/2012	1.1	U	1.1	3.0	B	1.1	0.56	U	0.56	5.0	B	1.1	65.9	J	1.1	1.1	UR	1.1	16.1	D	0.22
TP-2, 6 m	J1PXC2	8/20/2012	1.1	U	1.1	1.6	B	1.1	0.55	U	0.55	5.9		1.1	52.0	J	1.1	1.1	UR	1.1	11.5	D	0.22
TP-3, 0.5 m	J1PXC3	8/23/2012	1.0	U	1.0	6.3		1.0	0.53	U	0.53	1.0	U	1.0	36.8		1.0	1.0	U	1.0	8.53		0.10
TP-3, 1.5-2 m	J1PXC4	8/29/2012	1.3	U	1.3	38.2		1.3	0.66	U	0.66	3.0	B	1.3	137	D	2.6	1.3	U	1.3	30.7	D	0.66
TP-4, 0.5 m	J1PX91	8/14/2012	1.0	U	1.0	1.8	B	1.0	0.52	U	0.52	1.7	B	1.0	46.3		1.0	1.0	U	1.0	10.3	D	0.20
TP-4, 2 m	J1PX92	8/14/2012	1.2	U	1.2	63.4		1.2	0.59	U	0.59	4.0	B	1.2	62.3		1.2	1.2	U	1.2	13.5	D	0.23
TP-4, 4 m	J1PX93	8/14/2012	1.0	U	1.0	8.5		1.0	0.54	U	0.54	12.3		1.0	43.1		1.0	1.0	U	1.0	8.96	D	0.20
TP-4, 6 m	J1PX94	8/14/2012	1.1	U	1.1	3.8	B	1.1	0.56	U	0.56	11.3		1.1	54.7		1.1	1.1	U	1.1	12.0	D	0.22
TP-5, 0.5 m	J1PX95	8/16/2012	1.0	U	1.0	1.4	B	1.0	0.52	U	0.52	1.0	U	1.0	1.6	BJ	1.0	1.0	UR	1.0	0.16	B	0.10
TP-5, 2 m	J1PX96	8/16/2012	1.1	U	1.1	2.0	B	1.1	0.54	U	0.54	5.7		1.1	4.1	BJ	1.1	1.1	UR	1.1	0.69		0.11
TP-5, 4 m	J1PX97	8/16/2012	1.0	U	1.0	1.7	B	1.0	0.52	U	0.52	3.4	B	1.0	7.7	J	1.0	1.0	UR	1.0	1.60		0.10
TP-5, 6 m	J1PX98	8/16/2012	1.1	U	1.1	4.5	B	1.1	0.59	U	0.59	7.7		1.1	13.3	J	1.1	1.1	UR	1.1	2.94		0.11
TP-7, 2 m	J1PX88	8/13/2012	1.0	U	1.0	1.1	B	1.0	0.54	U	0.54	5.5		1.0	6.9		1.0	1.0	U	1.0	1.53		0.10
TP-7, 4 m	J1PX89	8/13/2012	1.2	U	1.2	2.2	B	1.2	0.58	U	0.58	9.5		1.2	20.5		1.2	1.2	U	1.2	4.79		0.12
TP-7, 6 m	J1PX90	8/13/2012	1.0	U	1.0	1.6	B	1.0	0.57	U	0.57	10.6		1.0	17.7		1.0	1.0	U	1.0	4.08		0.10

Sample Location	HEIS Number	Sample Date	Phosphate			Sulfate			Sulfide		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
TP-1, 0.5 m	J1PXC5	9/11/2012	2.6	U	2.6	477	D	6.6	52.9	U	52.9
TP-1, 2 m	J1PXC6	9/11/2012	2.0	U	2.0	123	D	2.0	42.2	U	42.2
TP-1, 4 m	J1PXC7	9/11/2012	2.2	U	2.2	145	D	5.4	44.8	U	44.8
TP-1, 6 m	J1PXC8	9/11/2012	2.0	B	2.0	24.4		1.0	41.9	U	41.9
TP-2, 0.5 m	J1PX99	8/20/2012	2.4	UR	2.4	90.0		1.2	48.9	UJ	48.9
TP-2, 2 m	J1PXC0	8/20/2012	2.0	UR	2.0	26.3		1.0	42.0	UJ	42.0
TP-2, 4 m	J1PXC1	8/20/2012	2.1	UR	2.1	76.6		1.1	45.0	UJ	45.0
TP-2, 6 m	J1PXC2	8/20/2012	2.2	UR	2.2	156	D	2.2	44.6	UJ	44.6
TP-3, 0.5 m	J1PXC3	8/23/2012	2.1	U	2.1	24.8		1.0	42.7	U	42.7
TP-3, 1.5-2 m	J1PXC4	8/29/2012	2.6	U	2.6	89.4		1.3	52.9	U	52.9
TP-4, 0.5 m	J1PX91	8/14/2012	2.0	U	2.0	24.0		1.0	42.6	U	42.6
TP-4, 2 m	J1PX92	8/14/2012	2.3	U	2.3	45.6		1.2	48.2	U	48.2
TP-4, 4 m	J1PX93	8/14/2012	4.7	B	2.0	22.8		1.0	44.4	U	44.4
TP-4, 6 m	J1PX94	8/14/2012	5.0	B	2.2	25.1		1.1	44.5	U	44.5
TP-5, 0.5 m	J1PX95	8/16/2012	4.6	BJ	2.1	4.5	B	1.0	41.8	UJ	41.8
TP-5, 2 m	J1PX96	8/16/2012	4.1	BJ	2.1	5.2	B	1.1	43.1	UJ	43.1
TP-5, 4 m	J1PX97	8/16/2012	3.0	BJ	2.1	5.7		1.0	41.8	UJ	41.8
TP-5, 6 m	J1PX98	8/16/2012	2.1	UR	2.1	12.9		1.1	47.6	UJ	47.6
TP-7, 2 m	J1PX88	8/13/2012	5.3	B	2.0	50.4		1.0	43.4	U	43.4
TP-7, 4 m	J1PX89	8/13/2012	2.3	U	2.3	30.7		1.2	46.2	U	46.2
TP-7, 6 m	J1PX90	8/13/2012	2.1	U	2.1	66.9		1.0	46.4	U	46.4

Attachment	1	Sheet No.	7 of 18
Originator	N. K. Schiffern	Date	11/14/12
Checked	I. B. Berezovskiy	Date	11/14/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sample Results. (Organics)

Constituents	Class	J1PXC5, TP-1, 0.5 m 9/11/12			J1PXC6, TP-1, 2 m 9/11/12			J1PXC7, TP-1, 4 m 9/11/12			J1PXC8, TP-1, 6 m 9/11/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
1,2-Dichlorobenzene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
1,3-Dichlorobenzene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
1,4-Dichlorobenzene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
2,4,5-Trichlorophenol	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
2,4,6-Trichlorophenol	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
2,4-Dichlorophenol	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
2,4-Dimethylphenol	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
2,4-Dinitrophenol	SVOA	4240	UD	4240	1740	U	1740	1830	U	1830	1730	U	1730
2,4-Dinitrotoluene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
2,6-Dinitrotoluene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
2-Chloronaphthalene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
2-Chlorophenol	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
2-Methylnaphthalene	SVOA	138	DJ	847	348	U	348	365	U	365	149	J	345
2-Methylphenol (cresol, o-)	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
2-Nitroaniline	SVOA	4240	UD	4240	1740	U	1740	1830	U	1830	1730	U	1730
2-Nitrophenol	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
3+4 Methylphenol (cresol, m+p)	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
3,3'-Dichlorobenzidine	SVOA	1690	UD	1690	695	U	695	730	U	730	690	U	690
3-Nitroaniline	SVOA	4240	UD	4240	1740	U	1740	1830	U	1830	1730	U	1730
4,6-Dinitro-2-methylphenol	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
4-Bromophenylphenyl ether	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
4-Chloro-3-methylphenol	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
4-Chloroaniline	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
4-Chlorophenylphenyl ether	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
4-Nitroaniline	SVOA	4240	UD	4240	1740	U	1740	1830	U	1830	1730	U	1730
4-Nitrophenol	SVOA	4240	UD	4240	1740	U	1740	1830	U	1830	1730	U	1730
Acenaphthene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Acenaphthylene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Anthracene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Benzo(a)anthracene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Benzo(a)pyrene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Benzo(b)fluoranthene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Benzo(ghi)perylene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Benzo(k)fluoranthene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Bis(2-chloro-1-methylethyl)ether	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Bis(2-Chloroethoxy)methane	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Bis(2-chloroethyl) ether	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Bis(2-ethylhexyl) phthalate	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Butylbenzylphthalate	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Carbazole	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Chrysene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Di-n-butylphthalate	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Di-n-octylphthalate	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Dibenz[a,h]anthracene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Dibenzofuran	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Diethyl phthalate	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Dimethyl phthalate	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Fluoranthene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Fluorene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Hexachlorobenzene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Hexachlorobutadiene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Hexachlorocyclopentadiene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Hexachloroethane	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Indeno(1,2,3-cd)pyrene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Isophorone	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
N-Nitroso-di-n-dipropylamine	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
N-Nitrosodiphenylamine	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Naphthalene	SVOA	847	UD	847	348	U	348	365	U	365	129	J	345
Nitrobenzene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Pentachlorophenol	SVOA	4240	UD	4240	1740	U	1740	1830	U	1830	1730	U	1730
Phenanthrene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Phenol	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345
Pyrene	SVOA	847	UD	847	348	U	348	365	U	365	345	U	345

Attachment 1 Sheet No. 8 of 18
Originator N. K. Schiffern Date 11/13/12
Checked I. B. Berezovskiy Date 11/13/12
Calc. No. 0300X-CA-V0163 Rev. No. 0

Attachment 1. 316-3 Waste Site Investigation Sampling Results. (Organics)

Constituents	Class	J1PXC5, TP-1, 0.5 m 9/11/12			J1PXC6, TP-1, 2 m 9/11/12			J1PXC7, TP-1, 4 m 9/11/12			J1PXC8, TP-1, 6 m 9/11/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	4.38	U	4.38	3.38	U	3.38	3.68	U	3.68	3.46	U	3.46
Acenaphthylene	PAH	648		4.38	50.7		3.38	70.9		3.68	79.4		3.46
Anthracene	PAH	7.24		4.38	3.38	U	3.38	3.68	U	3.68	3.46	U	3.46
Benzo(a)anthracene	PAH	42.3		4.38	3.38	U	3.38	4.37		3.68	4.38		3.46
Benzo(a)pyrene	PAH	4.38	U	4.38	3.38	U	3.38	12.0		3.68	3.46	U	3.46
Benzo(b)fluoranthene	PAH	4.38	U	4.38	3.38	U	3.38	3.68	U	3.68	3.46	U	3.46
Benzo(ghi)perylene	PAH	4.38	U	4.38	3.38	U	3.38	3.68	U	3.68	3.46	U	3.46
Benzo(k)fluoranthene	PAH	4.38	U	4.38	3.38	U	3.38	16.1		3.68	3.46	U	3.46
Chrysene	PAH	3.53	J	4.38	3.38	U	3.38	3.68	U	3.68	1.04	J	3.46
Dibenz[a,h]anthracene	PAH	4.38	U	4.38	3.38	U	3.38	3.68	U	3.68	3.46	U	3.46
Fluoranthene	PAH	147		4.38	3.30	J	3.38	3.68	U	3.68	24.6		3.46
Fluorene	PAH	20.6		4.38	1.64	J	3.38	3.68	U	3.68	1.61	J	3.46
Indeno(1,2,3-cd)pyrene	PAH	4.38	U	4.38	3.38	U	3.38	3.68	U	3.68	4.81		3.46
Naphthalene	PAH	147		4.38	11.7		3.38	11.0		3.68	15.3		3.46
Phenanthrene	PAH	57.0		4.38	2.89	J	3.38	3.68	U	3.68	4.87		3.46
Pyrene	PAH	6.10		4.38	3.38	U	3.38	3.68	U	3.68	3.46	U	3.46
Aroclor-1016	PCB	17.4	U	17.4	13.5	U	13.5	14.8	U	14.8	13.6	U	13.6
Aroclor-1221	PCB	17.4	U	17.4	13.5	U	13.5	14.8	U	14.8	13.6	U	13.6
Aroclor-1232	PCB	17.4	U	17.4	13.5	U	13.5	14.8	U	14.8	13.6	U	13.6
Aroclor-1242	PCB	17.4	U	17.4	13.5	U	13.5	14.8	U	14.8	13.6	U	13.6
Aroclor-1248	PCB	17.4	U	17.4	16.8		13.5	40.3		14.8	27.0		13.6
Aroclor-1254	PCB	17.4	U	17.4	26.6		13.5	96.2		14.8	31.8		13.6
Aroclor-1260	PCB	17.4	U	17.4	13.5	U	13.5	14.8	U	14.8	6.62	J	13.6
Aroclor-1262	PCB	17.4	U	17.4	13.5	U	13.5	14.8	U	14.8	13.6	U	13.6
Aroclor-1268	PCB	17.4	U	17.4	13.5	U	13.5	14.8	U	14.8	13.6	U	13.6
1,1,1-Trichloroethane	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
1,1,2,2-Tetrachloroethane	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
1,1,2-Trichloroethane	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
1,1-Dichloroethane	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
1,1-Dichloroethene	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
1,2-Dichloroethane	VOA	18.4	U	18.4	7.19	U	7.19	8.17	U	8.17	7.84	U	7.84
1,2-Dichloroethene(Total)	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
1,2-Dichloropropane	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
2-Butanone	VOA	36.7	U	36.7	14.4	U	14.4	16.3	U	16.3	15.7	U	15.7
2-Hexanone	VOA	36.7	U	36.7	14.4	U	14.4	16.3	U	16.3	15.7	U	15.7
4-Methyl-2-Pentanone	VOA	36.7	U	36.7	14.4	U	14.4	16.3	U	16.3	15.7	U	15.7
Acetone	VOA	36.7	U	36.7	14.4	U	14.4	16.3	U	16.3	15.7	U	15.7
Benzene	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Bromodichloromethane	VOA	18.4	U	18.4	7.19	U	7.19	8.17	U	8.17	7.84	U	7.84
Bromoform	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Bromomethane	VOA	30.6	U	30.6	12.0	U	12.0	13.6	U	13.6	13.1	U	13.1
Carbon disulfide	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Carbon tetrachloride	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Chlorobenzene	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Chloroethane	VOA	30.6	U	30.6	12.0	U	12.0	13.6	U	13.6	13.1	U	13.1
Chloroform	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Chloromethane	VOA	30.6	U	30.6	12.0	U	12.0	13.6	U	13.6	13.1	U	13.1
cis-1,2-Dichloroethylene	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
cis-1,3-Dichloropropene	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Dibromochloromethane	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Ethylbenzene	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Methylenechloride	VOA	12.5	J	18.4	7.19	U	7.19	8.17	U	8.17	7.84	U	7.84
Styrene	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Tetrachloroethene	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Toluene	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
trans-1,2-Dichloroethylene	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
trans-1,3-Dichloropropene	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Trichloroethene	VOA	25.0		15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54
Vinyl chloride	VOA	30.6	U	30.6	12.0	U	12.0	13.6	U	13.6	13.1	U	13.1
Xylenes (total)	VOA	15.3	U	15.3	5.99	U	5.99	6.81	U	6.81	6.54	U	6.54

Attachment	1	Sheet No.	9 of 18
Originator	N. K. Schiffern	Date	11/13/12
Checked	I. B. Berezovskiy	Date	11/13/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results. (Organics)

Constituents	Class	J1PX99, TP-2, 0.5 m			J1PXC0, TP-2, 2 m			J1PXC1, TP-2, 4 m			J1PXC2, TP-2, 6 m		
		8/20/12			8/20/12			8/20/12			8/20/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	398	UJ	398	343	UJ	343	363	UJ	363	361	UJ	361
1,2-Dichlorobenzene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
1,3-Dichlorobenzene	SVOA	398	UJ	398	343	UJ	343	363	UJ	363	361	UJ	361
1,4-Dichlorobenzene	SVOA	398	UJ	398	343	UJ	343	363	UJ	363	361	UJ	361
2,4,5-Trichlorophenol	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
2,4,6-Trichlorophenol	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
2,4-Dichlorophenol	SVOA	398	UJ	398	343	U	343	363	U	363	361	U	361
2,4-Dimethylphenol	SVOA	398	UJ	398	343	UJ	343	363	UJ	363	361	UJ	361
2,4-Dinitrophenol	SVOA	1990	UJ	1990	1720	UJ	1720	1820	UJ	1820	1800	UJ	1800
2,4-Dinitrotoluene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
2,6-Dinitrotoluene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
2-Chloronaphthalene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
2-Chlorophenol	SVOA	398	UJ	398	343	U	343	363	U	363	361	U	361
2-Methylnaphthalene	SVOA	320	J	398	343	U	343	363	U	363	361	U	361
2-Methylphenol (cresol, o-)	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
2-Nitroaniline	SVOA	1990	U	1990	1720	U	1720	1820	U	1820	1800	U	1800
2-Nitrophenol	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
3+4 Methylphenol (cresol, m+p)	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
3,3'-Dichlorobenzidine	SVOA	797	U	797	687	U	687	726	U	726	721	U	721
3-Nitroaniline	SVOA	1990	U	1990	1720	U	1720	1820	U	1820	1800	U	1800
4,6-Dinitro-2-methylphenol	SVOA	398	UJ	398	343	UJ	343	363	UJ	363	361	UJ	361
4-Bromophenylphenyl ether	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
4-Chloro-3-methylphenol	SVOA	398	UJ	398	343	U	343	363	U	363	361	U	361
4-Chloroaniline	SVOA	398	UJ	398	343	UJ	343	363	UJ	363	361	UJ	361
4-Chlorophenylphenyl ether	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
4-Nitroaniline	SVOA	1990	U	1990	1720	U	1720	1820	U	1820	1800	U	1800
4-Nitrophenol	SVOA	1990	U	1990	1720	U	1720	1820	U	1820	1800	U	1800
Acenaphthene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Acenaphthylene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Anthracene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Benzo(a)anthracene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Benzo(a)pyrene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Benzo(b)fluoranthene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Benzo(ghi)perylene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Benzo(k)fluoranthene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Bis(2-chloro-1-methylethyl)ether	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Bis(2-Chloroethoxy)methane	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Bis(2-chloroethyl) ether	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Bis(2-ethylhexyl) phthalate	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Butylbenzylphthalate	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Carbazole	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Chrysene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Di-n-butylphthalate	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Di-n-octylphthalate	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Dibenz[a,h]anthracene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Dibenzofuran	SVOA	70.1	J	398	343	U	343	363	U	363	361	U	361
Diethyl phthalate	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Dimethyl phthalate	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Fluoranthene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Fluorene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Hexachlorobenzene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Hexachlorobutadiene	SVOA	398	UJ	398	343	UJ	343	363	UJ	363	361	UJ	361
Hexachlorocyclopentadiene	SVOA	398	UJ	398	343	UJ	343	363	UJ	363	361	UJ	361
Hexachloroethane	SVOA	398	UJ	398	343	UJ	343	363	UJ	363	361	UJ	361
Indeno(1,2,3-cd)pyrene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Isophorone	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
N-Nitroso-di-n-dipropylamine	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
N-Nitrosodiphenylamine	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Naphthalene	SVOA	222	J	398	343	U	343	363	U	363	361	U	361
Nitrobenzene	SVOA	398	UJ	398	343	UJ	343	363	UJ	363	361	UJ	361
Pentachlorophenol	SVOA	1990	UJ	1990	1720	UJ	1720	1820	UJ	1820	1800	UJ	1800
Phenanthrene	SVOA	153	J	398	343	U	343	363	U	363	361	U	361
Phenol	SVOA	398	U	398	343	U	343	363	U	363	361	U	361
Pyrene	SVOA	398	U	398	343	U	343	363	U	363	361	U	361

Attachment	1	Sheet No.	10 of 18
Originator	N. K. Schiffern	Date	11/13/12
Checked	I. B. Berezovskiy	Date	11/13/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results. (Organics)

Constituents	Class	J1PX99, TP-2, 0.5 m			J1PXC0, TP-2, 2 m			J1PXC1, TP-2, 4 m			J1PXC2, TP-2, 6 m		
		8/20/12			8/20/12			8/20/12			8/20/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	210	D	19.9	3.46	U	3.46	3.66	U	3.66	2.65	J	3.70
Acenaphthylene	PAH	3240	D	19.9	9.70		3.46	2.75	J	3.66	21.9		3.70
Anthracene	PAH	24.7	D	19.9	3.46	U	3.46	3.66	U	3.66	3.70	U	3.70
Benzo(a)anthracene	PAH	21.3	D	19.9	3.46	U	3.46	1.28	J	3.66	0.945	J	3.70
Benzo(a)pyrene	PAH	19.9	UD	19.9	10.6		3.46	1.58	J	3.66	3.70	U	3.70
Benzo(b)fluoranthene	PAH	19.9	UD	19.9	3.46	U	3.46	3.66	U	3.66	3.70	U	3.70
Benzo(ghi)perylene	PAH	19.9	UD	19.9	3.46	U	3.46	3.66	U	3.66	3.70	U	3.70
Benzo(k)fluoranthene	PAH	19.9	UD	19.9	6.67		3.46	3.66	U	3.66	3.70	U	3.70
Chrysene	PAH	14.6	JD	19.9	3.46	U	3.46	3.66	U	3.66	3.70	U	3.70
Dibenz[a,h]anthracene	PAH	19.9	UD	19.9	3.46	U	3.46	3.66	U	3.66	3.70	U	3.70
Fluoranthene	PAH	545	D	19.9	1.16	J	3.46	3.85		3.66	5.37		3.70
Fluorene	PAH	124	D	19.9	1.39	J	3.46	3.66	U	3.66	1.85	J	3.70
Indeno(1,2,3-cd)pyrene	PAH	19.9	UD	19.9	3.46	U	3.46	1.10	J	3.66	1.98	J	3.70
Naphthalene	PAH	225	D	19.9	0.866	UJ	3.46	3.30	UJ	3.66	7.41	U	3.70
Phenanthrene	PAH	277	D	19.9	3.46	U	3.46	1.47	J	3.66	2.96	J	3.70
Pyrene	PAH	38.9	D	19.9	3.46	U	3.46	1.19	J	3.66	3.70	U	3.70
Aroclor-1016	PCB	79.1	UD	79.1	13.9	U	13.9	14.6	U	14.6	14.4	U	14.4
Aroclor-1221	PCB	79.1	UD	79.1	13.9	U	13.9	14.6	U	14.6	14.4	U	14.4
Aroclor-1232	PCB	79.1	UD	79.1	13.9	U	13.9	14.6	U	14.6	14.4	U	14.4
Aroclor-1242	PCB	79.1	UD	79.1	13.9	U	13.9	14.6	U	14.6	14.4	U	14.4
Aroclor-1248	PCB	79.1	UD	79.1	9.31	J	13.9	17.3		14.6	30.5		14.4
Aroclor-1254	PCB	79.1	UD	79.1	13.7	J	13.9	71.0		14.6	59.3		14.4
Aroclor-1260	PCB	79.1	UD	79.1	3.89	J	13.9	30.0	J	14.6	16.5	J	14.4
Aroclor-1262	PCB	79.1	UD	79.1	13.9	U	13.9	14.6	U	14.6	14.4	U	14.4
Aroclor-1268	PCB	79.1	UD	79.1	13.9	U	13.9	14.6	U	14.6	14.4	U	14.4
1,1,1-Trichloroethane	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
1,1,2,2-Tetrachloroethane	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
1,1,2-Trichloroethane	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
1,1-Dichloroethane	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
1,1-Dichloroethene	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
1,2-Dichloroethane	VOA	15.5	U	15.5	6.20	U	6.20	8.59	U	8.59	5.22	U	5.22
1,2-Dichloroethene(Total)	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
1,2-Dichloropropane	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
2-Butanone	VOA	30.9	U	30.9	12.4	U	12.4	17.2	U	17.2	10.4	U	10.4
2-Hexanone	VOA	30.9	U	30.9	12.4	U	12.4	17.2	U	17.2	10.4	U	10.4
4-Methyl-2-Pentanone	VOA	30.9	U	30.9	12.4	U	12.4	17.2	U	17.2	10.4	U	10.4
Acetone	VOA	30.9	U	30.9	12.4	U	12.4	17.2	U	17.2	10.4	U	10.4
Benzene	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
Bromodichloromethane	VOA	15.5	U	15.5	6.20	U	6.20	8.59	U	8.59	5.22	U	5.22
Bromoform	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
Bromomethane	VOA	25.8	U	25.8	10.3	U	10.3	14.3	U	14.3	8.70	U	8.70
Carbon disulfide	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
Carbon tetrachloride	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
Chlorobenzene	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
Chloroethane	VOA	25.8	U	25.8	10.3	U	10.3	14.3	U	14.3	8.70	U	8.70
Chloroform	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
Chloromethane	VOA	25.8	U	25.8	10.3	U	10.3	14.3	U	14.3	8.70	U	8.70
cis-1,2-Dichloroethylene	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
cis-1,3-Dichloropropene	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
Dibromochloromethane	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
Ethylbenzene	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
Methylenechloride	VOA	105	J	15.5	4.35	J	6.20	6.15	J	8.59	6.04		5.22
Styrene	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
Tetrachloroethene	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
Toluene	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
trans-1,2-Dichloroethylene	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
trans-1,3-Dichloropropene	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35
Trichloroethene	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	0.986	J	4.35
Vinyl chloride	VOA	25.8	U	25.8	10.3	U	10.3	14.3	U	14.3	8.70	U	8.70
Xylenes (total)	VOA	12.9	U	12.9	5.17	U	5.17	7.15	U	7.15	4.35	U	4.35

Attachment	1	Sheet No.	11 of 18
Originator	N. K. Schiffern	Date	11/13/12
Checked	I. B. Berezovskiy	Date	11/13/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results. (Organics)

Constituents	Class	J1PXC3, TP-3, 0.5 m			J1PXC4, TP-3, 1.5-2 m			J1PX91, TP-4, 0.5 m			J1PX92, TP-4 2 m		
		8/23/12			8/29/12			8/14/12			8/14/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
1,2-Dichlorobenzene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
1,3-Dichlorobenzene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
1,4-Dichlorobenzene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
2,4,5-Trichlorophenol	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
2,4,6-Trichlorophenol	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
2,4-Dichlorophenol	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
2,4-Dimethylphenol	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
2,4-Dinitrophenol	SVOA	34200	UD	34200	6390	UD	6390	3490	U	3490	9930	UD	9930
2,4-Dinitrotoluene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
2,6-Dinitrotoluene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
2-Chloronaphthalene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
2-Chlorophenol	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
2-Methylnaphthalene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
2-Methylphenol (cresol, o-)	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
2-Nitroaniline	SVOA	34200	UD	34200	6390	UD	6390	3490	U	3490	9930	UD	9930
2-Nitrophenol	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
3+4 Methylphenol (cresol, m+p)	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
3,3'-Dichlorobenzidine	SVOA	13700	UD	13700	2550	UD	2550	1400	U	1400	3970	UD	3970
3-Nitroaniline	SVOA	34200	UD	34200	6390	UD	6390	3490	U	3490	9930	UD	9930
4,6-Dinitro-2-methylphenol	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
4-Bromophenylphenyl ether	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
4-Chloro-3-methylphenol	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
4-Chloroaniline	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
4-Chlorophenylphenyl ether	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
4-Nitroaniline	SVOA	34200	UD	34200	6390	UD	6390	3490	U	3490	9930	UD	9930
4-Nitrophenol	SVOA	34200	UD	34200	6390	UD	6390	3490	U	3490	9930	UD	9930
Acenaphthene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Acenaphthylene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Anthracene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Benzo(a)anthracene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Benzo(a)pyrene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Benzo(b)fluoranthene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Benzo(ghi)perylene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Benzo(k)fluoranthene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Bis(2-chloro-1-methylethyl)ether	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Bis(2-Chloroethoxy)methane	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Bis(2-chloroethyl) ether	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Bis(2-ethylhexyl) phthalate	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Butylbenzylphthalate	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Carbazole	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Chrysene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Di-n-butylphthalate	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Di-n-octylphthalate	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Dibenz[a,h]anthracene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Dibenzofuran	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Diethyl phthalate	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Dimethyl phthalate	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Fluoranthene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Fluorene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Hexachlorobenzene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Hexachlorobutadiene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Hexachlorocyclopentadiene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Hexachloroethane	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Indeno(1,2,3-cd)pyrene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Isophorone	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
N-Nitroso-di-n-dipropylamine	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
N-Nitrosodiphenylamine	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Naphthalene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Nitrobenzene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Pentachlorophenol	SVOA	34200	UD	34200	6390	UD	6390	3490	U	3490	9930	UD	9930
Phenanthrene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Phenol	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990
Pyrene	SVOA	6840	UD	6840	1280	UD	1280	698	U	698	1990	UD	1990

Attachment	1	Sheet No.	12 of 18
Originator	N. K. Schiffern	Date	11/13/12
Checked	I. B. Berezovskiy	Date	11/13/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results. (Organics)

Constituents	Class	J1PXC3, TP-3, 0.5 m			J1PXC4, TP-3, 1.5-2 m			J1PX91, TP-4, 0.5 m			J1PX92, TP-4 2 m		
		8/23/12			8/29/12			8/14/12			8/14/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	3.51	U	3.51	21.9	UD	21.9	3.51	U	3.51	3.94	U	3.94
Acenaphthylene	PAH	138		3.51	1420	D	21.9	218		3.51	408		3.94
Anthracene	PAH	1.23	J	3.51	21.9	UD	21.9	2.71	J	3.51	3.94	U	3.94
Benzo(a)anthracene	PAH	28.4		3.51	54.0	D	21.9	21.2		3.51	17.8		3.94
Benzo(a)pyrene	PAH	3.51	U	3.51	21.9	UD	21.9	31.8		3.51	3.94	U	3.94
Benzo(b)fluoranthene	PAH	9.13		3.51	21.9	UD	21.9	3.51	U	3.51	3.94	U	3.94
Benzo(ghi)perylene	PAH	3.51	U	3.51	21.9	UD	21.9	3.51	U	3.51	3.94	U	3.94
Benzo(k)fluoranthene	PAH	3.51	U	3.51	21.9	UD	21.9	3.51	U	3.51	3.94	U	3.94
Chrysene	PAH	1.93	J	3.51	21.9	UD	21.9	7.06		3.51	3.94	U	3.94
Dibenz[a,h]anthracene	PAH	3.51	U	3.51	12.5	JD	21.9	3.51	U	3.51	3.94	U	3.94
Fluoranthene	PAH	49.0		3.51	265	D	21.9	69.1		3.51	60.6		3.94
Fluorene	PAH	7.90		3.51	29.8	D	21.9	6.89		3.51	8.30		3.94
Indeno(1,2,3-cd)pyrene	PAH	3.51	U	3.51	10.9	JD	21.9	1.91	J	3.51	3.94	U	3.94
Naphthalene	PAH	57.6		3.51	316	D	21.9	48.7		3.51	75.0		3.94
Phenanthrene	PAH	22.3		3.51	174	D	21.9	31.6		3.51	23.4		3.94
Pyrene	PAH	6.50		3.51	15.8	JD	21.9	23.0		3.51	3.71	J	3.94
Aroclor-1016	PCB	13.9	U	13.9	17.1	U	17.1	14.1	U	14.1	15.9	U	15.9
Aroclor-1221	PCB	13.9	U	13.9	17.1	U	17.1	14.1	U	14.1	15.9	U	15.9
Aroclor-1232	PCB	13.9	U	13.9	17.1	U	17.1	14.1	U	14.1	15.9	U	15.9
Aroclor-1242	PCB	13.9	U	13.9	17.1	U	17.1	14.1	U	14.1	15.9	U	15.9
Aroclor-1248	PCB	13.9	U	13.9	17.1	U	17.1	14.1	U	14.1	15.9	U	15.9
Aroclor-1254	PCB	32.9		13.9	17.1	U	17.1	13.4	J	14.1	12.9	J	15.9
Aroclor-1260	PCB	21.7		13.9	17.1	U	17.1	9.72	J	14.1	9.59	J	15.9
Aroclor-1262	PCB	13.9	U	13.9	17.1	U	17.1	14.1	U	14.1	15.9	U	15.9
Aroclor-1268	PCB	13.9	U	13.9	17.1	U	17.1	14.1	U	14.1	15.9	U	15.9
1,1,1-Trichloroethane	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
1,1,2,2-Tetrachloroethane	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
1,1,2-Trichloroethane	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
1,1-Dichloroethane	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
1,1-Dichloroethene	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
1,2-Dichloroethane	VOA	6.02	U	6.02	11.4	U	11.4	7.80	U	7.80	11.0	U	11.0
1,2-Dichloroethene(Total)	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
1,2-Dichloropropane	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
2-Butanone	VOA	12.0	U	12.0	22.9	U	22.9	15.6	U	15.6	22.0	U	22.0
2-Hexanone	VOA	12.0	U	12.0	22.9	U	22.9	15.6	U	15.6	22.0	U	22.0
4-Methyl-2-Pentanone	VOA	12.0	U	12.0	22.9	U	22.9	15.6	U	15.6	22.0	U	22.0
Acetone	VOA	12.0	U	12.0	22.9	U	22.9	15.6	U	15.6	22.0	U	22.0
Benzene	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
Bromodichloromethane	VOA	6.02	U	6.02	11.4	U	11.4	7.80	U	7.80	11.0	U	11.0
Bromoform	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
Bromomethane	VOA	10.0	U	10.0	19.0	U	19.0	13.0	U	13.0	18.3	U	18.3
Carbon disulfide	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
Carbon tetrachloride	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
Chlorobenzene	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
Chloroethane	VOA	10.0	U	10.0	19.0	U	19.0	13.0	U	13.0	18.3	U	18.3
Chloroform	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
Chloromethane	VOA	10.0	U	10.0	19.0	U	19.0	13.0	U	13.0	18.3	U	18.3
cis-1,2-Dichloroethylene	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
cis-1,3-Dichloropropene	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
Dibromochloromethane	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
Ethylbenzene	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
Methylenechloride	VOA	2.19	J	6.02	7.56	BJ	11.4	2.97	BJ	7.80	4.78	BJ	11.0
Styrene	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
Tetrachloroethene	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
Toluene	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
trans-1,2-Dichloroethylene	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
trans-1,3-Dichloropropene	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15
Trichloroethene	VOA	5.01	U	5.01	12.5		9.52	6.50	U	6.50	1.96	J	9.15
Vinyl chloride	VOA	10.0	U	10.0	19.0	U	19.0	13.0	U	13.0	18.3	U	18.3
Xylenes (total)	VOA	5.01	U	5.01	9.52	U	9.52	6.50	U	6.50	9.15	U	9.15

Attachment	1	Sheet No.	13 of 18
Originator	N. K. Schiffern	Date	11/13/12
Checked	I. B. Berezovskiy	Date	11/13/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results. (Organics)

Constituents	Class	J1PX93, TP-4, 4 m 8/14/12			J1PX94, TP-4, 6 m 8/14/12			J1PX95, TP-5, 0.5 m 8/16/12			J1PX96, TP-5, 2 m 8/16/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	359	U	359	364	U	364	344	UJ	344	357	UJ	357
1,2-Dichlorobenzene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
1,3-Dichlorobenzene	SVOA	359	U	359	364	U	364	344	UJ	344	357	UJ	357
1,4-Dichlorobenzene	SVOA	359	U	359	364	U	364	344	UJ	344	357	UJ	357
2,4,5-Trichlorophenol	SVOA	359	U	359	364	U	364	344	U	344	357	UJ	357
2,4,6-Trichlorophenol	SVOA	359	U	359	364	U	364	344	U	344	357	UJ	357
2,4-Dichlorophenol	SVOA	359	U	359	364	U	364	344	U	344	357	UJ	357
2,4-Dimethylphenol	SVOA	359	U	359	364	U	364	344	UJ	344	357	UJ	357
2,4-Dinitrophenol	SVOA	1800	U	1800	1820	U	1820	1720	UJ	1720	1780	UJ	1780
2,4-Dinitrotoluene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
2,6-Dinitrotoluene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
2-Chloronaphthalene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
2-Chlorophenol	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
2-Methylnaphthalene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
2-Methylphenol (cresol, o-)	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
2-Nitroaniline	SVOA	1800	U	1800	1820	U	1820	1720	U	1720	1780	U	1780
2-Nitrophenol	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
3+4 Methylphenol (cresol, m+p)	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
3,3'-Dichlorobenzidine	SVOA	718	U	718	729	U	729	688	U	688	713	U	713
3-Nitroaniline	SVOA	1800	U	1800	1820	U	1820	1720	U	1720	1780	U	1780
4,6-Dinitro-2-methylphenol	SVOA	359	U	359	364	U	364	344	UJ	344	357	UJ	357
4-Bromophenylphenyl ether	SVOA	359	U	359	364	U	364	344	U	344	357	UJ	357
4-Chloro-3-methylphenol	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
4-Chloroaniline	SVOA	359	U	359	364	U	364	344	UJ	344	357	UJ	357
4-Chlorophenylphenyl ether	SVOA	359	U	359	364	U	364	344	U	344	357	UJ	357
4-Nitroaniline	SVOA	1800	U	1800	1820	U	1820	1720	U	1720	1780	U	1780
4-Nitrophenol	SVOA	1800	U	1800	1820	U	1820	1720	U	1720	1780	U	1780
Acenaphthene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Acenaphthylene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Anthracene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Benzo(a)anthracene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Benzo(a)pyrene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Benzo(b)fluoranthene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Benzo(ghi)perylene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Benzo(k)fluoranthene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Bis(2-chloro-1-methylethyl)ether	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Bis(2-Chloroethoxy)methane	SVOA	359	U	359	364	U	364	344	U	344	357	UJ	357
Bis(2-chloroethyl) ether	SVOA	359	U	359	364	U	364	344	U	344	357	UJ	357
Bis(2-ethylhexyl) phthalate	SVOA	359	U	359	364	U	364	344	U	344	357	UJ	357
Butylbenzylphthalate	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Carbazole	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Chrysene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Di-n-butylphthalate	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Di-n-octylphthalate	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Dibenz[a,h]anthracene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Dibenzofuran	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Diethyl phthalate	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Dimethyl phthalate	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Fluoranthene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Fluorene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Hexachlorobenzene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Hexachlorobutadiene	SVOA	359	U	359	364	U	364	344	UJ	344	357	UJ	357
Hexachlorocyclopentadiene	SVOA	359	U	359	364	U	364	344	UJ	344	357	UJ	357
Hexachloroethane	SVOA	359	U	359	364	U	364	344	UJ	344	357	UJ	357
Indeno(1,2,3-cd)pyrene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Isophorone	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
N-Nitroso-di-n-dipropylamine	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
N-Nitrosodiphenylamine	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Naphthalene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Nitrobenzene	SVOA	359	U	359	364	U	364	344	UJ	344	357	UJ	357
Pentachlorophenol	SVOA	1800	U	1800	1820	U	1820	1720	UJ	1720	1780	UJ	1780
Phenanthrene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Phenol	SVOA	359	U	359	364	U	364	344	U	344	357	U	357
Pyrene	SVOA	359	U	359	364	U	364	344	U	344	357	U	357

Attachment	1	Sheet No.	14 of 18
Originator	N. K. Schiffern	Date	11/14/12
Checked	I. B. Berezovskiy	Date	11/14/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results. (Organics)

Constituents	Class	J1PX93, TP-4, 4 m			J1PX94, TP-4, 6 m			J1PX95, TP-5, 0.5 m			J1PX96, TP-5, 2 m		
		8/14/12			8/14/12			8/16/12			8/16/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	3.65	U	3.65	3.70	U	3.70	3.43	U	3.43	3.52	U	3.52
Acenaphthylene	PAH	35.4		3.65	3.70	U	3.70	16.3		3.43	8.86		3.52
Anthracene	PAH	3.65	U	3.65	3.70	U	3.70	3.43	U	3.43	3.52	U	3.52
Benzo(a)anthracene	PAH	3.92		3.65	1.20	J	3.70	0.859	J	3.43	5.96		3.52
Benzo(a)pyrene	PAH	3.65	U	3.65	3.70	U	3.70	1.44	J	3.43	1.41	J	3.52
Benzo(b)fluoranthene	PAH	2.65	J	3.65	3.70	U	3.70	3.43	U	3.43	3.53		3.52
Benzo(ghi)perylene	PAH	3.65	U	3.65	3.70	U	3.70	3.43	U	3.43	3.52	U	3.52
Benzo(k)fluoranthene	PAH	1.09	J	3.65	3.70	U	3.70	3.43	U	3.43	3.52	U	3.52
Chrysene	PAH	3.65	U	3.65	3.70	U	3.70	0.98	J	3.43	3.52	U	3.52
Dibenz[a,h]anthracene	PAH	3.65	U	3.65	3.70	U	3.70	3.43	U	3.43	3.52	U	3.52
Fluoranthene	PAH	8.68		3.65	3.70	U	3.70	2.58	J	3.43	2.29	J	3.52
Fluorene	PAH	2.08	J	3.65	3.70	U	3.70	1.72	J	3.43	1.89	J	3.52
Indeno(1,2,3-cd)pyrene	PAH	3.65	U	3.65	1.37	J	3.70	5.71		3.43	8.24		3.52
Naphthalene	PAH	6.22		3.65	3.70	U	3.70	6.36	U	3.43	9.00	U	3.52
Phenanthrene	PAH	2.83	J	3.65	3.70	U	3.70	1.37	J	3.43	1.06	J	3.52
Pyrene	PAH	2.66	J	3.65	3.70	U	3.70	1.03	J	3.43	0.935	J	3.52
Aroclor-1016	PCB	14.7	U	14.7	14.6	U	14.6	136	UD	136	55.6	UD	55.6
Aroclor-1221	PCB	14.7	U	14.7	14.6	U	14.6	136	UD	136	55.6	UD	55.6
Aroclor-1232	PCB	14.7	U	14.7	14.6	U	14.6	136	UD	136	55.6	UD	55.6
Aroclor-1242	PCB	14.7	U	14.7	14.6	U	14.6	136	UD	136	55.6	UD	55.6
Aroclor-1248	PCB	75.9		14.7	45.0		14.6	136	UD	136	200	D	55.6
Aroclor-1254	PCB	72.6		14.7	53.4		14.6	618	D	136	233	D	55.6
Aroclor-1260	PCB	11.5	J	14.7	9.36	J	14.6	1970	DJ	136	67.2	DJ	55.6
Aroclor-1262	PCB	14.7	U	14.7	14.6	U	14.6	136	UD	136	55.6	UD	55.6
Aroclor-1268	PCB	14.7	U	14.7	14.6	U	14.6	136	UD	136	55.6	UD	55.6
1,1,1-Trichloroethane	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
1,1,2,2-Tetrachloroethane	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
1,1,2-Trichloroethane	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
1,1-Dichloroethane	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
1,1-Dichloroethene	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
1,2-Dichloroethane	VOA	7.42	U	7.42	7.87	U	7.87	6.45	U	6.45	8.01	U	8.01
1,2-Dichloroethene(Total)	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
1,2-Dichloropropane	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
2-Butanone	VOA	14.8	U	14.8	15.7	U	15.7	12.9	U	12.9	16.0	U	16.0
2-Hexanone	VOA	14.8	U	14.8	15.7	U	15.7	12.9	U	12.9	16.0	U	16.0
4-Methyl-2-Pentanone	VOA	14.8	U	14.8	15.7	U	15.7	12.9	U	12.9	16.0	U	16.0
Acetone	VOA	14.8	U	14.8	15.7	U	15.7	12.9	U	12.9	16.0	U	16.0
Benzene	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
Bromodichloromethane	VOA	7.42	U	7.42	7.87	U	7.87	6.45	U	6.45	8.01	U	8.01
Bromoform	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
Bromomethane	VOA	12.4	U	12.4	13.1	U	13.1	10.7	U	10.7	13.3	U	13.3
Carbon disulfide	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
Carbon tetrachloride	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
Chlorobenzene	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
Chloroethane	VOA	12.4	U	12.4	13.1	U	13.1	10.7	U	10.7	13.3	U	13.3
Chloroform	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
Chloromethane	VOA	12.4	U	12.4	13.1	U	13.1	10.7	U	10.7	13.3	U	13.3
cis-1,2-Dichloroethylene	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
cis-1,3-Dichloropropene	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
Dibromochloromethane	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
Ethylbenzene	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
Methylenechloride	VOA	2.64	BJ	7.42	7.87	U	7.87	6.45	UJ	6.45	3.27	J	8.01
Styrene	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
Tetrachloroethene	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	2.37	J	6.67
Toluene	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
trans-1,2-Dichloroethylene	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
trans-1,3-Dichloropropene	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67
Trichloroethene	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.96		6.67
Vinyl chloride	VOA	12.4	U	12.4	13.1	U	13.1	10.7	U	10.7	13.3	U	13.3
Xylenes (total)	VOA	6.18	U	6.18	6.56	U	6.56	5.37	U	5.37	6.67	U	6.67

Attachment	1	Sheet No.	15 of 18
Originator	N. K. Schiffern	Date	11/13/12
Checked	I. B. Berezovskiy	Date	11/13/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results. (Organics)

Constituents	Class	J1PX97, TP-5, 4 m 8/16/12			J1PX98, TP-5, 6 m 8/16/12			J1PX88, TP-7, 2 m 8/13/12			J1PX89, TP-7, 4 m 8/13/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	334	UJ	334	392	UJ	392	348	U	348	379	U	379
1,2-Dichlorobenzene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
1,3-Dichlorobenzene	SVOA	334	UJ	334	392	UJ	392	348	U	348	379	U	379
1,4-Dichlorobenzene	SVOA	334	UJ	334	392	UJ	392	348	U	348	379	U	379
2,4,5-Trichlorophenol	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
2,4,6-Trichlorophenol	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
2,4-Dichlorophenol	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
2,4-Dimethylphenol	SVOA	334	UJ	334	392	UJ	392	348	U	348	379	U	379
2,4-Dinitrophenol	SVOA	1670	UJ	1670	1960	UJ	1960	1740	U	1740	1890	U	1890
2,4-Dinitrotoluene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
2,6-Dinitrotoluene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
2-Chloronaphthalene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
2-Chlorophenol	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
2-Methylnaphthalene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
2-Methylphenol (cresol, o-)	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
2-Nitroaniline	SVOA	1670	U	1670	1960	U	1960	1740	U	1740	1890	U	1890
2-Nitrophenol	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
3+4 Methylphenol (cresol, m+p)	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
3,3'-Dichlorobenzidine	SVOA	667	U	667	783	U	783	695	U	695	757	U	757
3-Nitroaniline	SVOA	1670	U	1670	1960	U	1960	1740	U	1740	1890	U	1890
4,6-Dinitro-2-methylphenol	SVOA	334	UJ	334	392	UJ	392	348	U	348	379	U	379
4-Bromophenylphenyl ether	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
4-Chloro-3-methylphenol	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
4-Chloroaniline	SVOA	334	UJ	334	392	UJ	392	348	U	348	379	U	379
4-Chlorophenylphenyl ether	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
4-Nitroaniline	SVOA	1670	U	1670	1960	U	1960	1740	U	1740	1890	U	1890
4-Nitrophenol	SVOA	1670	U	1670	1960	U	1960	1740	U	1740	1890	U	1890
Acenaphthene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Acenaphthylene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Anthracene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Benzo(a)anthracene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Benzo(a)pyrene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Benzo(b)fluoranthene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Benzo(ghi)perylene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Benzo(k)fluoranthene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Bis(2-chloro-1-methylethyl)ether	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Bis(2-Chloroethoxy)methane	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Bis(2-chloroethyl) ether	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Bis(2-ethylhexyl) phthalate	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Butylbenzylphthalate	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Carbazole	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Chrysene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Di-n-butylphthalate	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Di-n-octylphthalate	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Dibenz[a,h]anthracene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Dibenzofuran	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Diethyl phthalate	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Dimethyl phthalate	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Fluoranthene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Fluorene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Hexachlorobenzene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Hexachlorobutadiene	SVOA	334	UJ	334	392	UJ	392	348	U	348	379	U	379
Hexachlorocyclopentadiene	SVOA	334	UJ	334	392	UJ	392	348	U	348	379	U	379
Hexachloroethane	SVOA	334	UJ	334	392	UJ	392	348	U	348	379	U	379
Indeno(1,2,3-cd)pyrene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Isophorone	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
N-Nitroso-di-n-dipropylamine	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
N-Nitrosodiphenylamine	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Naphthalene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Nitrobenzene	SVOA	334	UJ	334	392	UJ	392	348	U	348	379	U	379
Pentachlorophenol	SVOA	1670	UJ	1670	1960	UJ	1960	1740	U	1740	1890	U	1890
Phenanthrene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Phenol	SVOA	334	U	334	392	U	392	348	U	348	379	U	379
Pyrene	SVOA	334	U	334	392	U	392	348	U	348	379	U	379

Attachment	1	Sheet No.	16 of 18
Originator	N. K. Schiffern	Date	11/13/12
Checked	I. B. Berezovskiy	Date	11/13/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results. (Organics)

Constituents	Class	J1PX97, TP-5, 4 m 8/16/12			J1PX98, TP-5, 6 m 8/16/12			J1PX88, TP-7, 2 m 8/13/12			J1PX89, TP-7, 4 m 8/13/12		
		ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL	ug/kg	Q	PQL
Acenaphthene	PAH	3.45	U	3.45	2.52	J	3.96	3.54	U	3.54	4.12		3.74
Acenaphthylene	PAH	2.93	J	3.45	23.4		3.96	3.54	U	3.54	32.5		3.74
Anthracene	PAH	3.45	U	3.45	3.96	U	3.96	3.54	U	3.54	3.74	U	3.74
Benzo(a)anthracene	PAH	3.45	U	3.45	11.7		3.96	3.54	U	3.54	52.7		3.74
Benzo(a)pyrene	PAH	6.12		3.45	1.84	J	3.96	3.54	U	3.54	3.74	U	3.74
Benzo(b)fluoranthene	PAH	3.45	U	3.45	3.96	U	3.96	3.54	U	3.54	1.52	J	3.74
Benzo(ghi)perylene	PAH	3.45	U	3.45	3.96	U	3.96	3.54	U	3.54	3.74	U	3.74
Benzo(k)fluoranthene	PAH	7.26		3.45	3.96	U	3.96	3.54	U	3.54	3.74	U	3.74
Chrysene	PAH	3.45	U	3.45	3.96	U	3.96	0.939	J	3.54	1.27	J	3.74
Dibenz[a,h]anthracene	PAH	3.45	U	3.45	3.96	U	3.96	3.54	U	3.54	3.74	U	3.74
Fluoranthene	PAH	3.45	U	3.45	4.56		3.96	3.54	U	3.54	4.96		3.74
Fluorene	PAH	1.21	J	3.45	2.77	J	3.96	3.54	U	3.54	2.23	J	3.74
Indeno(1,2,3-cd)pyrene	PAH	3.00	J	3.45	3.88	J	3.96	2.43	J	3.54	3.74	U	3.74
Naphthalene	PAH	1.55	UJ	3.45	11.9	U	3.96	0.992	J	3.54	8.55		3.74
Phenanthrene	PAH	3.45	U	3.45	5.35		3.96	3.54	U	3.54	8.77		3.74
Pyrene	PAH	3.45	U	3.45	2.18	J	3.96	3.54	U	3.54	1.68	J	3.74
Aroclor-1016	PCB	13.6	U	13.6	152	UD	152	14.0	U	14.0	150	UD	150
Aroclor-1221	PCB	13.6	U	13.6	152	UD	152	14.0	U	14.0	150	UD	150
Aroclor-1232	PCB	13.6	U	13.6	152	UD	152	14.0	U	14.0	150	UD	150
Aroclor-1242	PCB	13.6	U	13.6	152	UD	152	14.0	U	14.0	150	UD	150
Aroclor-1248	PCB	41.8		13.6	930	D	152	9.35	J	14.0	2580	D	150
Aroclor-1254	PCB	62.1		13.6	711	D	152	28.5		14.0	1320	D	150
Aroclor-1260	PCB	74.0	J	13.6	138	JD	152	6.92	J	14.0	181	D	150
Aroclor-1262	PCB	13.6	U	13.6	152	UD	152	14.0	U	14.0	150	UD	150
Aroclor-1268	PCB	13.6	U	13.6	152	UD	152	14.0	U	14.0	150	UD	150
1,1,1-Trichloroethane	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
1,1,2,2-Tetrachloroethane	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
1,1,2-Trichloroethane	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
1,1-Dichloroethane	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
1,1-Dichloroethene	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
1,2-Dichloroethane	VOA	7.68	U	7.68	9.88	U	9.88	7.33	U	7.33	6.83	U	6.83
1,2-Dichloroethene(Total)	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
1,2-Dichloropropane	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
2-Butanone	VOA	15.4	U	15.4	19.8	U	19.8	14.7	U	14.7	13.7	U	13.7
2-Hexanone	VOA	15.4	U	15.4	19.8	U	19.8	14.7	U	14.7	13.7	U	13.7
4-Methyl-2-Pentanone	VOA	15.4	U	15.4	19.8	U	19.8	14.7	U	14.7	13.7	U	13.7
Acetone	VOA	15.4	U	15.4	19.8	U	19.8	14.7	U	14.7	13.7	U	13.7
Benzene	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
Bromodichloromethane	VOA	7.68	U	7.68	9.88	U	9.88	7.33	U	7.33	6.83	U	6.83
Bromoform	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
Bromomethane	VOA	12.8	U	12.8	16.5	U	16.5	12.2	U	12.2	11.4	U	11.4
Carbon disulfide	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
Carbon tetrachloride	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
Chlorobenzene	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
Chloroethane	VOA	12.8	U	12.8	16.5	U	16.5	12.2	U	12.2	11.4	U	11.4
Chloroform	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
Chloromethane	VOA	12.8	U	12.8	16.5	U	16.5	12.2	U	12.2	11.4	U	11.4
cis-1,2-Dichloroethylene	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
cis-1,3-Dichloropropene	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
Dibromochloromethane	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
Ethylbenzene	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
Methylenechloride	VOA	7.68	UJ	7.68	5.14	J	9.88	3.62	BJ	7.33	3.83	BJ	6.83
Styrene	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
Tetrachloroethene	VOA	1.45	J	6.40	1.68	J	8.23	6.11	U	6.11	3.95	J	5.70
Toluene	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
trans-1,2-Dichloroethylene	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
trans-1,3-Dichloropropene	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70
Trichloroethene	VOA	4.56	J	6.40	5.95	J	8.23	6.11	U	6.11	6.48		5.70
Vinyl chloride	VOA	12.8	U	12.8	16.5	U	16.5	12.2	U	12.2	11.4	U	11.4
Xylenes (total)	VOA	6.40	U	6.40	8.23	U	8.23	6.11	U	6.11	5.70	U	5.70

Attachment	1	Sheet No.	17 of 18
Originator	N. K. Schiffern	Date	11/13/12
Checked	I. B. Berezovskiy	Date	11/13/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

Attachment 1. 316-3 Waste Site Investigation Sampling Results. (Organics)

Constituents	Class	J1PX90, TP-7, 6 m 8/13/12		
		ug/kg	Q	PQL
1,2,4-Trichlorobenzene	SVOA	372	U	372
1,2-Dichlorobenzene	SVOA	372	U	372
1,3-Dichlorobenzene	SVOA	372	U	372
1,4-Dichlorobenzene	SVOA	372	U	372
2,4,5-Trichlorophenol	SVOA	372	U	372
2,4,6-Trichlorophenol	SVOA	372	U	372
2,4-Dichlorophenol	SVOA	372	U	372
2,4-Dimethylphenol	SVOA	372	U	372
2,4-Dinitrophenol	SVOA	1860	U	1860
2,4-Dinitrotoluene	SVOA	372	U	372
2,6-Dinitrotoluene	SVOA	372	U	372
2-Chloronaphthalene	SVOA	372	U	372
2-Chlorophenol	SVOA	372	U	372
2-Methylnaphthalene	SVOA	372	U	372
2-Methylphenol (cresol, o-)	SVOA	372	U	372
2-Nitroaniline	SVOA	1860	U	1860
2-Nitrophenol	SVOA	372	U	372
3+4 Methylphenol (cresol, m+p)	SVOA	372	U	372
3,3'-Dichlorobenzidine	SVOA	744	U	744
3-Nitroaniline	SVOA	1860	U	1860
4,6-Dinitro-2-methylphenol	SVOA	372	U	372
4-Bromophenylphenyl ether	SVOA	372	U	372
4-Chloro-3-methylphenol	SVOA	372	U	372
4-Chloroaniline	SVOA	372	U	372
4-Chlorophenylphenyl ether	SVOA	372	U	372
4-Nitroaniline	SVOA	1860	U	1860
4-Nitrophenol	SVOA	1860	U	1860
Acenaphthene	SVOA	372	U	372
Acenaphthylene	SVOA	372	U	372
Anthracene	SVOA	372	U	372
Benzo(a)anthracene	SVOA	372	U	372
Benzo(a)pyrene	SVOA	372	U	372
Benzo(b)fluoranthene	SVOA	372	U	372
Benzo(ghi)perylene	SVOA	372	U	372
Benzo(k)fluoranthene	SVOA	372	U	372
Bis(2-chloro-1-methylethyl)ether	SVOA	372	U	372
Bis(2-Chloroethoxy)methane	SVOA	372	U	372
Bis(2-chloroethyl) ether	SVOA	372	U	372
Bis(2-ethylhexyl) phthalate	SVOA	372	U	372
Butylbenzylphthalate	SVOA	372	U	372
Carbazole	SVOA	372	U	372
Chrysene	SVOA	372	U	372
Di-n-butylphthalate	SVOA	372	U	372
Di-n-octylphthalate	SVOA	372	U	372
Dibenz[a,h]anthracene	SVOA	372	U	372
Dibenzofuran	SVOA	372	U	372
Diethyl phthalate	SVOA	372	U	372
Dimethyl phthalate	SVOA	372	U	372
Fluoranthene	SVOA	372	U	372
Fluorene	SVOA	372	U	372
Hexachlorobenzene	SVOA	372	U	372
Hexachlorobutadiene	SVOA	372	U	372
Hexachlorocyclopentadiene	SVOA	372	U	372
Hexachloroethane	SVOA	372	U	372
Indeno(1,2,3-cd)pyrene	SVOA	372	U	372
Isophorone	SVOA	372	U	372
N-Nitroso-di-n-dipropylamine	SVOA	372	U	372
N-Nitrosodiphenylamine	SVOA	372	U	372
Naphthalene	SVOA	372	U	372
Nitrobenzene	SVOA	372	U	372
Pentachlorophenol	SVOA	1860	U	1860
Phenanthrene	SVOA	372	U	372
Phenol	SVOA	372	U	372
Pyrene	SVOA	372	U	372

Constituents	Class	J1PX90, TP-7, 6 m 8/13/12		
		ug/kg	Q	PQL
Acenaphthene	PAH	3.75	U	3.75
Acenaphthylene	PAH	38.3		3.75
Anthracene	PAH	3.75	U	3.75
Benzo(a)anthracene	PAH	54.5		3.75
Benzo(a)pyrene	PAH	3.75	U	3.75
Benzo(b)fluoranthene	PAH	6.93		3.75
Benzo(ghi)perylene	PAH	3.75	U	3.75
Benzo(k)fluoranthene	PAH	3.75	U	3.75
Chrysene	PAH	3.75	U	3.75
Dibenz[a,h]anthracene	PAH	3.75	U	3.75
Fluoranthene	PAH	8.42		3.75
Fluorene	PAH	2.31	J	3.75
Indeno(1,2,3-cd)pyrene	PAH	3.19	J	3.75
Naphthalene	PAH	9.13		3.75
Phenanthrene	PAH	4.94		3.75
Pyrene	PAH	3.68	J	3.75
Aroclor-1016	PCB	153	UD	153
Aroclor-1221	PCB	153	UD	153
Aroclor-1232	PCB	153	UD	153
Aroclor-1242	PCB	153	UD	153
Aroclor-1248	PCB	1900	D	153
Aroclor-1254	PCB	1270	D	153
Aroclor-1260	PCB	189	D	153
Aroclor-1262	PCB	153	UD	153
Aroclor-1268	PCB	153	UD	153
1,1,1-Trichloroethane	VOA	8.46	U	8.46
1,1,2,2-Tetrachloroethane	VOA	8.46	U	8.46
1,1,2-Trichloroethane	VOA	8.46	U	8.46
1,1-Dichloroethane	VOA	8.46	U	8.46
1,1-Dichloroethene	VOA	8.46	U	8.46
1,2-Dichloroethane	VOA	10.1	U	10.1
1,2-Dichloroethene(Total)	VOA	8.46	U	8.46
1,2-Dichloropropane	VOA	8.46	U	8.46
2-Butanone	VOA	20.3	U	20.3
2-Hexanone	VOA	20.3	U	20.3
4-Methyl-2-Pentanone	VOA	20.3	U	20.3
Acetone	VOA	20.3	U	20.3
Benzene	VOA	8.46	U	8.46
Bromodichloromethane	VOA	10.1	U	10.1
Bromoform	VOA	8.46	U	8.46
Bromomethane	VOA	16.9	U	16.9
Carbon disulfide	VOA	8.46	U	8.46
Carbon tetrachloride	VOA	8.46	U	8.46
Chlorobenzene	VOA	8.46	U	8.46
Chloroethane	VOA	16.9	U	16.9
Chloroform	VOA	8.46	U	8.46
Chloromethane	VOA	16.9	U	16.9
cis-1,2-Dichloroethylene	VOA	8.46	U	8.46
cis-1,3-Dichloropropene	VOA	8.46	U	8.46
Dibromochloromethane	VOA	8.46	U	8.46
Ethylbenzene	VOA	8.46	U	8.46
Methylenechloride	VOA	10.1	U	10.1
Styrene	VOA	8.46	U	8.46
Tetrachloroethene	VOA	35.4		8.46
Toluene	VOA	8.46	U	8.46
trans-1,2-Dichloroethylene	VOA	8.46	U	8.46
trans-1,3-Dichloropropene	VOA	8.46	U	8.46
Trichloroethene	VOA	92.8		8.46
Vinyl chloride	VOA	16.9	U	16.9
Xylenes (total)	VOA	8.46	U	8.46

Attachment	1	Sheet No.	18 of 18
Originator	N. K. Schiffern	Date	11/13/12
Checked	I. B. Berezovskiy	Date	11/13/12
Calc. No.	0300X-CA-V0163	Rev. No.	0

CALCULATION COVER SHEET

Project Title: 300 Area Field Remediation **Job No. 14655**

Area: 300 Area

Discipline: Environmental *Calculation No: 0300X-CA-V0164

Subject: 316-3 RESRAD Calculation of Industrial Dose

Computer Program: RESRAD Program No: Version 6.5

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover – 1 pg Summary – 4 pg Attm. 1 - 28 pg Attm. 2 - 17 pg Total – 50 pages	*Signed* S. W. Clark	*Signed* M. W. Perrott	*Signed* I. B. Berezovskiy	*Signed* T.Q. Howell	*Approved, 12/6/12*
1	No Change	S. W. Clark	M. W. Perrott	I. B. Berezovskiy	T.Q. Howell	1/3/13

SUMMARY OF REVISION

1	It was necessary to revise this calculation brief to correct typographical errors in the Plutonium 239/240 and Plutonium-241 assays in Table 2 (the correct activities are 4.63 pCi/g and 13.2 pCi/g, respectively, that were used in the calculations). The changes are indicated by change bars in the left margin of the affected page.

WCH-DE-018 *Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	1/3/13	Calc. No.:	0300X-CA-V0164	Rev.:	1
Project:	300 Area Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	1/3/13
Subject:	316-3 RESRAD Calculation of Industrial Dose					Sheet No.	1 of 4

PURPOSE:

Perform RESRAD calculations of the radiological dose contributions and groundwater concentrations over a period of 1,000 years from the activities of radionuclides at focused sampling sites in the 316-3, 307 Disposal Trenches, Process Water Trenches waste site where sum of fractions evaluations of radionuclide dose exceeded the 15 mrem/yr dose limitation.

GIVEN/REFERENCES:

1) Focused samples were collected from test pits at six locations in the 316-3 waste site. Sum of fractions evaluations described in Appendix B of the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (300 Area RDR/RAWP), DOE/RL-2001-47, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2009), performed for maximum concentrations of focused samples exceeded the 15 mrem/yr radiological dose limitation. Therefore, the analyses were evaluated by RESidual RADioactivity (RESRAD) modeling for radionuclides as described in Appendix D of the 300 Area RDR/RAWP (DOE-RL 2009). Site-specific RESRAD calculations were performed to predict the radiological dose in an industrial scenario over a period of 1,000 years and to predict the concentrations in groundwater due to radionuclides in the soil.
2) For the purpose of performing RESRAD calculations for the contaminants of the 316-3 waste site focused sampling sites, the radionuclide soil analyses were obtained from data summaries, in the *Remaining Sites Verification Package for the 316-3, 307 Disposal Trenches, Process Water Trenches Waste Site* (WCH 2012), 2012-099, Washington Closure Hanford, Richland, Washington.
3) The RESidual RADioactivity (RESRAD) computer code, version 6.5, was developed for the U.S. Department of Energy by the Environmental Assessment Division of Argonne National Laboratory, Argonne, Illinois, to calculate compliance with residual radioactivity guidelines and may be accessed at < http://www.ead.anl.gov/resrad >..
4) The 316-3:1 test pit sample design is available from the *316-3 Waste Site Subsurface Investigation Plan*, PLN-0012, Rev. 0, June, 2012, Washington Closure Hanford, Richland, Washington.
5) Groundwater elevations for determination of vadose zone thickness for RESRAD calculations were obtained from *Hanford Groundwater Monitoring for Fiscal Year 2009,* DOE/RL-2010-11, Rev. 1, U.S. Department of Energy, Richland, Washington.

SOLUTION:

1) Individual RESRAD runs were performed to determine the radiological dose in an industrial scenario and to predict concentrations of radionuclides in groundwater. Although both shallow and deep zone horizons are present in the 316-3 waste site the RESRAD evaluations used shallow zone criteria to evaluate radiological dose and groundwater and river protection. Table 1 shows the waste site area and thickness for RESRAD modeling. Table 2 shows the radionuclide analyses used in the RESRAD evaluations. Input factors for each run are shown in the "Summary" sections of the RESRAD "Mixture Sums and Single Radionuclide Guidelines" printouts in Attachment 1 to this Calculation Summary.

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	1/3/13	Calc. No.:	0300X-CA-V0164	Rev.:	1
Project:	300 Area Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	1/3/13
Subject:	316-3 RESRAD Calculation of Industrial Dose					Sheet No.	2 of 4

Table 1. 316-3 Waste Site Dimensions for RESRAD Modeling

Parameter	Units	316-3 Waste Site
Contaminated Zone Dimensions		
Cover Depth	m	0
Area of Contaminated Zone (CZ)	m^2	3,918
Length Parallel to Aquifer Flow	m	63
Thickness of Vadose Zone Horizons		
Thickness: Contaminated Zone	m	6
Thickness: Unsaturated Zone	m	0

Table 2. 316-3 Radionuclide Analyses for RESRAD Modeling

Radionuclide	Focused Sample Analyses (pCi/g)
Americium-241	0.711
Carbon-14	2.20
Cesium-137	0.126
Plutonium-239/240	~~0.356~~ 4.63
Plutonium-241	~~3.33~~ 13.2
Technetium-99	1.19
Uranium-233/234	77.5
Uranium-235	7.14
Uranium-238	86.3

2) The year when the peak dose (or concentration) occurs from each individual radionuclide COC and layer was determined by a preliminary run. This year was then added for all horizons for the final RESRAD runs. For the direct exposure pathway (i.e. soil ingestion and inhalation and external radiation), the peak year occurred at year zero (year 2012) for all of the radionuclide COPCs. For the water pathways (i.e. drinking water and food ingestion) the peak year also occurred at year zero (year 2012).

METHODOLOGY:

1) Runs of RESRAD version 6.5 were completed for the 316-3 waste site soils cleanup verification focused sampling analyses for the radionuclides in Table 2. RESRAD numerical output reports for dose and concentration are presented in the Attachments to this calculation summary.

Washington Closure Hanford			CALCULATION SHEET				
Originator:	S. W. Clark	Date:	1/3/13	Calc. No.:	0300X-CA-V0164	Rev.:	1
Project:	300 Area Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	1/3/13
Subject:	316-3 RESRAD Calculation of Industrial Dose					Sheet No.	3 of 4

RESULTS:

1) Radionuclide Industrial Scenario Dose Rate

The dose rates for an industrial scenario at the 316-3 waste site are shown in Table 3. The maximum dose rate for the test pit focused sample radionuclide concentrations is 3.92 mrem/yr at year zero (2012) which is below the dose limitation of 15 mrem/yr.

Table 3. Industrial Scenario Dose Rate (mrem/yr)

RESRAD Run	Vadose Zone Horizons	Industrial Scenario Dose Contributions in mrem/yr at Each Time Slice (yr)							
		0	1	3	10	30	100	300	1000
Test Pit Focused Sample	Shallow Zone	3.92E+00	3.92E+00	3.91E+00	3.90E+00	3.88E+00	3.83E+00	3.76E+00	3.71E+00

2) Radionuclide Groundwater Protection

The radionuclide concentrations in groundwater predicted by the RESRAD model are summarized in Table 4. Technetium and uranium are predicted to reach groundwater in the 1,000 years of the RESRAD model evaluation with peak concentrations occurring at year zero. Peak concentration of technetium-99 in groundwater is predicted to be 2.83 pCi/L, which is below the remedial action goal [RAG] of 900 pCi/L. Maximum total uranium concentration (8.39 pCi/L) occurs at year zero and is less than the RAG for total uranium in groundwater of 21.2 pCi/L (corresponding to the maximum contaminant level [MCL] for total uranium of 30 mg/L).

Table 4. Predicted Groundwater (Well Water/Drinking Water) Concentrations

Radionuclide	Groundwater Concentrations in pCi/L at Each Time Slice (yr)								[a] RAG, pCi/L
	0	1	3	10	30	100	300	1000	
Technetium-99	2.83	2.82	2.78	2.67	2.37	1.56	0.47	0.01	900
Uranium-233/234	3.80	3.80	3.80	3.80	3.79	3.76	3.66	3.36	--
Uranium-235	0.35	0.35	0.35	0.35	0.35	0.35	0.34	0.31	--
Uranium-238	4.24	4.24	4.23	4.23	4.22	4.18	4.08	3.74	--
Total Uranium	8.39	8.39	8.38	8.38	8.36	8.29	8.18	7.41	21.2 [b]

[a] Based on radionuclide drinking water RAGs, as discussed in Appendix D and Table D-6, of the 300 Area RDR/RAWP (DOE-RL 2009).

[b] Based on the isotopic distribution of uranium, the MCL of 30 µg/L corresponds to 21.2 pCi/L. Concentration-to-activity calculations are documented in *Calculation of Total Uranium Activity Corresponding to a Maximum Contaminant Level for Total Uranium of 30 Micrograms per Liter in Groundwater*, 0100X-CA-V0038, Rev. 0, Bechtel Hanford, Inc., Richland, Washington (BHI 2001).

CONCLUSIONS:

- The maximum industrial scenario dose rates are shown in Table 3. The maximum industrial scenario dose rate for the 316-3 waste site test pit focused samples is 3.92 mrem/yr at year zero (2012) which is below the dose limitation of 15 mrem/yr.

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	1/3/13	Calc. No.:	0300X-CA-V0164	Rev.:	1
Project:	300 Area Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	1/3/13
Subject:	316-3 RESRAD Calculation of Industrial Dose					Sheet No. 4 of 4	

- Technetium and uranium are predicted to reach groundwater in the 1,000 years of the RESRAD model evaluation with peak concentrations occurring at year zero. Peak concentration of technetium-99 in groundwater is predicted to be 2.83 pCi/L, which is below the remedial action goal [RAG] of 900 pCi/L. Maximum total uranium concentration (8.39 pCi/L) occurs at year zero and is less than the RAG for total uranium in groundwater of 21.2 pCi/L (corresponding to the maximum contaminant level [MCL] for total uranium of 30 mg/L).

ATTACHMENTS:

1. RESRAD Output: 316-3 RESRAD Evaluation of Industrial Dose – Mixture Sums and Single Radionuclide Guidelines (28 pages).
2. RESRAD Output: 316-3 RESRAD Evaluation of Groundwater Protection – Concentration of Radionuclides, (17 pages).

ATTACHMENT 1

```
1RESRAD, Version 6.5      T« Limit = 180 days       12/06/2012  13:12  Page   1
 Summary : 316-3 RESRAD Evaluation of Industrial Dose
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

                      Table of Contents
                      ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
   Part I: Mixture Sums and Single Radionuclide Guidelines
   ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ

 Dose Conversion Factor (and Related) Parameter Summary ...    2
 Site-Specific Parameter Summary ..........................    7
 Summary of Pathway Selections ............................   13
 Contaminated Zone and Total Dose Summary .................   14
 Total Dose Components
      Time = 0.000E+00 ....................................   15
      Time = 1.000E+00 ....................................   16
      Time = 3.000E+00 ....................................   17
      Time = 1.000E+01 ....................................   18
      Time = 3.000E+01 ....................................   19
      Time = 1.000E+02 ....................................   20
      Time = 3.000E+02 ....................................   21
      Time = 1.000E+03 ....................................   22
 Dose/Source Ratios Summed Over All Pathways ..............   23
 Single Radionuclide Soil Guidelines ......................   24
 Dose Per Nuclide Summed Over All Pathways ................   25
 Soil Concentration Per Nuclide ...........................   27
```

Attachment 1 Sheet No. 1 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 2
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

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

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-225 (Source: FGR 12)	6.371E-02	6.371E-02	DCF1(1)
A-1	Ac-227 (Source: FGR 12)	4.951E-04	4.951E-04	DCF1(2)
A-1	Am-241 (Source: FGR 12)	4.372E-02	4.372E-02	DCF1(3)
A-1	At-217 (Source: FGR 12)	1.773E-03	1.773E-03	DCF1(4)
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(5)
A-1	Ba-137m (Source: FGR 12)	3.606E+00	3.606E+00	DCF1(6)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(7)
A-1	Bi-211 (Source: FGR 12)	2.559E-01	2.559E-01	DCF1(8)
A-1	Bi-213 (Source: FGR 12)	7.660E-01	7.660E-01	DCF1(9)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(10)
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1(11)
A-1	Cs-137 (Source: FGR 12)	7.510E-04	7.510E-04	DCF1(12)
A-1	Fr-221 (Source: FGR 12)	1.536E-01	1.536E-01	DCF1(13)
A-1	Fr-223 (Source: FGR 12)	1.980E-01	1.980E-01	DCF1(14)
A-1	Np-237 (Source: FGR 12)	7.790E-02	7.790E-02	DCF1(15)
A-1	Pa-231 (Source: FGR 12)	1.906E-01	1.906E-01	DCF1(16)
A-1	Pa-233 (Source: FGR 12)	1.020E+00	1.020E+00	DCF1(17)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(18)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(19)
A-1	Pb-209 (Source: FGR 12)	7.734E-04	7.734E-04	DCF1(20)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(21)
A-1	Pb-211 (Source: FGR 12)	3.064E-01	3.064E-01	DCF1(22)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(23)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(24)
A-1	Po-211 (Source: FGR 12)	4.764E-02	4.764E-02	DCF1(25)
A-1	Po-213 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(26)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(27)
A-1	Po-215 (Source: FGR 12)	1.016E-03	1.016E-03	DCF1(28)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(29)
A-1	Pu-239 (Source: FGR 12)	2.952E-04	2.952E-04	DCF1(30)
A-1	Pu-241 (Source: FGR 12)	5.904E-06	5.904E-06	DCF1(31)
A-1	Ra-223 (Source: FGR 12)	6.034E-01	6.034E-01	DCF1(32)
A-1	Ra-225 (Source: FGR 12)	1.102E-02	1.102E-02	DCF1(33)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(34)
A-1	Rn-219 (Source: FGR 12)	3.083E-01	3.083E-01	DCF1(35)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(36)
A-1	Tc-99 (Source: FGR 12)	1.255E-04	1.255E-04	DCF1(37)
A-1	Th-227 (Source: FGR 12)	5.212E-01	5.212E-01	DCF1(38)
A-1	Th-229 (Source: FGR 12)	3.213E-01	3.213E-01	DCF1(39)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(40)
A-1	Th-231 (Source: FGR 12)	3.643E-02	3.643E-02	DCF1(41)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(42)
A-1	Tl-207 (Source: FGR 12)	1.980E-02	1.980E-02	DCF1(43)
A-1	Tl-209 (Source: FGR 12)	1.293E+01	1.293E+01	DCF1(44)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(45)
A-1	U-233 (Source: FGR 12)	1.397E-03	1.397E-03	DCF1(46)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(47)
A-1	U-235 (Source: FGR 12)	7.211E-01	7.211E-01	DCF1(48)
A-1	U-237 (Source: FGR 12)	5.306E-01	5.306E-01	DCF1(49)

Attachment 1 Sheet No. 2 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 3
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

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

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(50)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.724E+00	6.700E+00	DCF2(1)
B-1	Am-241	4.440E-01	4.440E-01	DCF2(2)
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2(3)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GInhDCF
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(5)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(6)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(7)
B-1	Pu-239	4.290E-01	4.290E-01	DCF2(8)
B-1	Pu-241	8.250E-03	8.250E-03	DCF2(9)
B-1	Pu-241+D	8.254E-03	8.250E-03	DCF2(10)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(11)
B-1	Tc-99	8.320E-06	8.320E-06	DCF2(12)
B-1	Th-229+D	2.169E+00	2.150E+00	DCF2(13)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(14)
B-1	U-233	1.350E-01	1.350E-01	DCF2(15)
B-1	U-234	1.320E-01	1.320E-01	DCF2(16)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(17)
B-1	U-238	1.180E-01	1.180E-01	DCF2(18)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(19)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.410E-02	DCF3(1)
D-1	Am-241	3.640E-03	3.640E-03	DCF3(2)
D-1	C-14	2.090E-06	2.090E-06	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Np-237+D	4.444E-03	4.440E-03	DCF3(5)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(6)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(7)
D-1	Pu-239	3.540E-03	3.540E-03	DCF3(8)
D-1	Pu-241	6.840E-05	6.840E-05	DCF3(9)
D-1	Pu-241+D	7.157E-05	6.840E-05	DCF3(10)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(11)
D-1	Tc-99	1.460E-06	1.460E-06	DCF3(12)
D-1	Th-229+D	4.027E-03	3.530E-03	DCF3(13)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(14)
D-1	U-233	2.890E-04	2.890E-04	DCF3(15)
D-1	U-234	2.830E-04	2.830E-04	DCF3(16)
D-1	U-235+D	2.673E-04	2.660E-04	DCF3(17)
D-1	U-238	2.550E-04	2.550E-04	DCF3(18)
D-1	U-238+D	2.687E-04	2.550E-04	DCF3(19)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				

Attachment 1 Sheet No. 3 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 4
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

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

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Am-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(2,1)
D-34	Am-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-05	5.000E-05	RTF(2,2)
D-34	Am-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-06	2.000E-06	RTF(2,3)
D-34				
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(3,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(3,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(3,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(5,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(5,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(6,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(6,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(6,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(7,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(7,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(7,3)
D-34				
D-34	Pu-239 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(8,1)
D-34	Pu-239 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(8,2)
D-34	Pu-239 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(8,3)
D-34				
D-34	Pu-241 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(9,1)
D-34	Pu-241 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(9,2)
D-34	Pu-241 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(9,3)
D-34				
D-34	Pu-241+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(10,1)
D-34	Pu-241+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(10,2)
D-34	Pu-241+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-06	1.000E-06	RTF(10,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(11,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(11,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(11,3)
D-34				
D-34	Tc-99 , plant/soil concentration ratio, dimensionless	5.000E+00	5.000E+00	RTF(12,1)
D-34	Tc-99 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(12,2)
D-34	Tc-99 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(12,3)
D-34				
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(13,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(13,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(13,3)
D-34				

Attachment 1 Sheet No. 4 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 5
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

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

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(14,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(14,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(14,3)
D-34				
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(15,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(15,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(15,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(16,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(16,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(16,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(17,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(17,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(17,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(18,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(18,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(18,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(19,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(19,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(19,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Am-241 , fish	3.000E+01	3.000E+01	BIOFAC(2,1)
D-5	Am-241 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(2,2)
D-5				
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(3,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(3,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5				
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(5,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(5,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(6,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(7,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(7,2)
D-5				
D-5	Pu-239 , fish	3.000E+01	3.000E+01	BIOFAC(8,1)
D-5	Pu-239 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(8,2)
D-5				

Attachment 1 Sheet No. 5 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 6
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

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

0 Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Pu-241 , fish	3.000E+01	3.000E+01	BIOFAC(9,1)
D-5	Pu-241 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(9,2)
D-5				
D-5	Pu-241+D , fish	3.000E+01	3.000E+01	BIOFAC(10,1)
D-5	Pu-241+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(10,2)
D-5				
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(11,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(11,2)
D-5				
D-5	Tc-99 , fish	2.000E+01	2.000E+01	BIOFAC(12,1)
D-5	Tc-99 , crustacea and mollusks	5.000E+00	5.000E+00	BIOFAC(12,2)
D-5				
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(13,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(13,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(14,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(14,2)
D-5				
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(15,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(15,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(16,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(16,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(17,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(17,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(18,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(18,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(19,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(19,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Attachment 1 Sheet No. 6 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 7
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	3.918E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	6.000E+00	2.000E+00	---	THICKO
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Am-241	7.110E-01	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): C-14	2.200E+00	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Cs-137	1.260E-01	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Pu-239	4.630E+00	0.000E+00	---	S1(8)
R012	Initial principal radionuclide (pCi/g): Pu-241	1.320E+01	0.000E+00	---	S1(9)
R012	Initial principal radionuclide (pCi/g): Tc-99	1.190E+00	0.000E+00	---	S1(12)
R012	Initial principal radionuclide (pCi/g): U-234	7.750E+01	0.000E+00	---	S1(16)
R012	Initial principal radionuclide (pCi/g): U-235	7.140E+00	0.000E+00	---	S1(17)
R012	Initial principal radionuclide (pCi/g): U-238	8.630E+01	0.000E+00	---	S1(18)
R012	Concentration in groundwater (pCi/L): Am-241	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Pu-239	not used	0.000E+00	---	W1(8)
R012	Concentration in groundwater (pCi/L): Pu-241	not used	0.000E+00	---	W1(9)
R012	Concentration in groundwater (pCi/L): Tc-99	not used	0.000E+00	---	W1(12)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(16)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(17)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(18)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVERO
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.200E-03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	1.500E+01	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.524E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH

Attachment 1 Sheet No. 7 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 8
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	not used	1.000E-03	Romberg failures occurred	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R016	Distribution coefficients for Am-241				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+01	---	DCNUCC(2)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.710E-06	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	2.000E+02	0.000E+00	---	DCNUCC(3)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.710E-06	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Cs-137				
R016	Contaminated zone (cm**3/g)	5.000E+01	4.600E+03	---	DCNUCC(4)
R016	Saturated zone (cm**3/g)	not used	4.600E+03	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.277E-05	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for Pu-239				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(8)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.710E-06	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R016	Distribution coefficients for Pu-241				
R016	Contaminated zone (cm**3/g)	2.000E+02	2.000E+03	---	DCNUCC(9)
R016	Saturated zone (cm**3/g)	not used	2.000E+03	---	DCNUCS(9)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.710E-06	ALEACH(9)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(9)

Attachment 1 Sheet No. 8 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 9
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Tc-99				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(12)
R016	Saturated zone (cm**3/g)	not used	0.000E+00	---	DCNUCS(12)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.096E-03	ALEACH(12)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(12)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	8.900E+00	5.000E+01	---	DCNUCC(16)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(16)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.258E-04	ALEACH(16)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(16)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	8.900E+00	5.000E+01	---	DCNUCC(17)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(17)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.258E-04	ALEACH(17)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(17)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	8.900E+00	5.000E+01	---	DCNUCC(18)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(18)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.258E-04	ALEACH(18)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(18)
R016	Distribution coefficients for daughter Ac-227				
R016	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.662E-05	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for daughter Np-237				
R016	Contaminated zone (cm**3/g)	-1.000E+00	-1.000E+00	2.574E+02	DCNUCC(5)
R016	Saturated zone (cm**3/g)	not used	-1.000E+00	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.437E-06	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for daughter Pa-231				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(6)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.277E-05	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for daughter Pb-210				
R016	Contaminated zone (cm**3/g)	1.000E+02	1.000E+02	---	DCNUCC(7)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.141E-05	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)

Attachment 1 Sheet No. 9 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 10
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Site-Specific Parameter Summary (continued)

0 Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for daughter Ra-226				
R016	Contaminated zone (cm**3/g)	7.000E+01	7.000E+01	---	DCNUCC(11)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(11)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.628E-05	ALEACH(11)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(11)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(13)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(13)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.905E-08	ALEACH(13)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(13)
R016	Distribution coefficients for daughter Th-230				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(14)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(14)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.905E-08	ALEACH(14)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(14)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(15)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(15)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.277E-05	ALEACH(15)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(15)
R017	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	2.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	1.650E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	5.500E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Attachment 1 Sheet No. 10 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 11
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	2.500E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)

Attachment 1 Sheet No. 11 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 12
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS

Attachment 1 Sheet No. 12 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

```
1RESRAD, Version 6.5      T« Limit = 180 days       12/06/2012  13:12  Page  13
 Summary : 316-3 RESRAD Evaluation of Industrial Dose
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD
```

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	1	---	---	LYMAX
TITL	Maximum number of integration points for risk	5	---	---	KYMAX

Summary of Pathway Selections

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

Attachment 1 Sheet No. 13 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

```
1RESRAD, Version 6.5     T« Limit = 180 days        12/06/2012  13:12  Page  14
 Summary : 316-3 RESRAD Evaluation of Industrial Dose
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

     Contaminated Zone Dimensions           Initial Soil Concentrations, pCi/g
     ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ           ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
       Area:   3918.00 square meters              Am-241     7.110E-01
  Thickness:      6.00 meters                     C-14       2.200E+00
Cover Depth:      0.00 meters                     Cs-137     1.260E-01
                                                  Pu-239     4.630E+00
                                                  Pu-241     1.320E+01
                                                  Tc-99      1.190E+00
                                                  U-234      7.750E+01
                                                  U-235      7.140E+00
                                                  U-238      8.630E+01
0
                                Total Dose TDOSE(t), mrem/yr
                            Basic Radiation Dose Limit = 1.500E+01 mrem/yr
              Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)
              ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
   t (years):  0.000E+00  1.000E+00  3.000E+00  1.000E+01  3.000E+01  1.000E+02  3.000E+02  1.000E+03
    TDOSE(t):  3.919E+00  3.918E+00  3.914E+00  3.904E+00  3.879E+00  3.826E+00  3.760E+00  3.711E+00
        M(t):  2.613E-01  2.612E-01  2.610E-01  2.603E-01  2.586E-01  2.551E-01  2.507E-01  2.474E-01
OMaximum TDOSE(t):  3.919E+00 mrem/yr   at t = 0.000E+00 years
```

Attachment 1 Sheet No. 14 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 15
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	fract.	Inhalation mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	Soil mrem/yr	fract.
Am-241	5.026E-03	0.0013	7.319E-03	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.423E-02	0.0036
C-14	4.831E-06	0.0000	1.479E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.529E-05	0.0000
Cs-137	6.699E-02	0.0171	9.318E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.465E-05	0.0000
Pu-239	2.182E-04	0.0001	4.605E-02	0.0117	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.015E-02	0.0230
Pu-241	3.988E-05	0.0000	2.525E-03	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.966E-03	0.0013
Tc-99	2.393E-05	0.0000	2.295E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.556E-06	0.0000
U-234	5.031E-03	0.0013	2.372E-01	0.0605	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.206E-01	0.0308
U-235	8.624E-01	0.2200	2.036E-02	0.0052	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.050E-02	0.0027
U-238	2.062E+00	0.5261	2.362E-01	0.0603	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.275E-01	0.0325
Total	3.002E+00	0.7658	5.497E-01	0.1403	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.681E-01	0.0939

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
0 Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	fract.	Fish mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	All Pathways* mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.658E-02	0.0068
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.780E-04	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.703E-02	0.0171
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.364E-01	0.0348
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.530E-03	0.0019
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.372E-05	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.628E-01	0.0926
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.932E-01	0.2279
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.426E+00	0.6189
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.919E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 15 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 16
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	5.018E-03	0.0013	7.307E-03	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.421E-02	0.0036
C-14	1.598E-06	0.0000	4.892E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.367E-06	0.0000
Cs-137	6.546E-02	0.0167	9.105E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.386E-05	0.0000
Pu-239	2.182E-04	0.0001	4.605E-02	0.0118	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.014E-02	0.0230
Pu-241	1.840E-04	0.0000	2.619E-03	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.146E-03	0.0013
Tc-99	2.379E-05	0.0000	2.281E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.498E-06	0.0000
U-234	5.030E-03	0.0013	2.371E-01	0.0605	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.206E-01	0.0308
U-235	8.623E-01	0.2201	2.036E-02	0.0052	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.051E-02	0.0027
U-238	2.062E+00	0.5262	2.361E-01	0.0603	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.275E-01	0.0326
Total	3.000E+00	0.7657	5.497E-01	0.1403	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.682E-01	0.0940

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.654E-02	0.0068
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.888E-05	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.550E-02	0.0167
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.364E-01	0.0348
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.948E-03	0.0020
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.351E-05	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.628E-01	0.0926
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.931E-01	0.2280
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.425E+00	0.6191
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.918E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 16 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 17
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	5.002E-03	0.0013	7.283E-03	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.417E-02	0.0036
C-14	1.749E-07	0.0000	5.354E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.158E-07	0.0000
Cs-137	6.250E-02	0.0160	8.694E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.233E-05	0.0000
Pu-239	2.181E-04	0.0001	4.604E-02	0.0118	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.014E-02	0.0230
Pu-241	4.515E-04	0.0001	2.792E-03	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.479E-03	0.0014
Tc-99	2.350E-05	0.0000	2.254E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.382E-06	0.0000
U-234	5.031E-03	0.0013	2.371E-01	0.0606	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.206E-01	0.0308
U-235	8.621E-01	0.2202	2.037E-02	0.0052	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.052E-02	0.0027
U-238	2.061E+00	0.5265	2.361E-01	0.0603	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.275E-01	0.0326
Total	2.996E+00	0.7655	5.497E-01	0.1404	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.684E-01	0.0941

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.645E-02	0.0068
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.445E-06	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.254E-02	0.0160
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.364E-01	0.0348
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.723E-03	0.0022
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.310E-05	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.627E-01	0.0927
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.929E-01	0.2281
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.425E+00	0.6194
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.914E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 17 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 18
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Independent Pathways (Inhalation excludes radon)

0	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	4.946E-03	0.0013	7.202E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.401E-02	0.0036
C-14	7.589E-11	0.0000	2.323E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.973E-10	0.0000
Cs-137	5.316E-02	0.0136	7.394E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.750E-05	0.0000
Pu-239	2.181E-04	0.0001	4.603E-02	0.0118	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.011E-02	0.0231
Pu-241	1.202E-03	0.0003	3.275E-03	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.403E-03	0.0016
Tc-99	2.251E-05	0.0000	2.160E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.990E-06	0.0000
U-234	5.052E-03	0.0013	2.369E-01	0.0607	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.205E-01	0.0309
U-235	8.614E-01	0.2206	2.041E-02	0.0052	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-02	0.0027
U-238	2.059E+00	0.5275	2.359E-01	0.0604	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.274E-01	0.0326
Total	2.985E+00	0.7647	5.497E-01	0.1408	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.690E-01	0.0945

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0 Water Dependent Pathways

0	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Radio-Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.615E-02	0.0067
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.796E-09	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.319E-02	0.0136
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.364E-01	0.0349
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.088E-02	0.0028
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.172E-05	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.625E-01	0.0928
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.924E-01	0.2286
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.423E+00	0.6205
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.904E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 18 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 19
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	4.790E-03	0.0012	6.974E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.356E-02	0.0035
C-14	1.873E-20	0.0000	5.732E-19	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.804E-20	0.0000
Cs-137	3.347E-02	0.0086	4.656E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.731E-05	0.0000
Pu-239	2.179E-04	0.0001	4.600E-02	0.0119	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.005E-02	0.0232
Pu-241	2.315E-03	0.0006	3.953E-03	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.701E-03	0.0020
Tc-99	1.993E-05	0.0000	1.912E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.958E-06	0.0000
U-234	5.253E-03	0.0014	2.364E-01	0.0610	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.202E-01	0.0310
U-235	8.598E-01	0.2217	2.067E-02	0.0053	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.085E-02	0.0028
U-238	2.054E+00	0.5296	2.353E-01	0.0607	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.271E-01	0.0328
Total	2.960E+00	0.7631	5.493E-01	0.1416	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.695E-01	0.0953

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.533E-02	0.0065
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.900E-19	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.349E-02	0.0086
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.363E-01	0.0351
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.397E-02	0.0036
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.808E-05	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.619E-01	0.0933
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.913E-01	0.2298
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.416E+00	0.6230
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.879E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 19 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 20
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	4.282E-03	0.0011	6.231E-03	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.212E-02	0.0032
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	6.632E-03	0.0017	9.224E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.430E-06	0.0000
Pu-239	2.175E-04	0.0001	4.589E-02	0.0120	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.984E-02	0.0235
Pu-241	2.714E-03	0.0007	3.969E-03	0.0010	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.721E-03	0.0020
Tc-99	1.300E-05	0.0000	1.247E-07	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.192E-06	0.0000
U-234	7.584E-03	0.0020	2.347E-01	0.0613	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.193E-01	0.0312
U-235	8.554E-01	0.2236	2.218E-02	0.0058	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.209E-02	0.0032
U-238	2.036E+00	0.5321	2.333E-01	0.0610	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.260E-01	0.0329
Total	2.913E+00	0.7613	5.462E-01	0.1428	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.671E-01	0.0959

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.263E-02	0.0059
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.635E-03	0.0017
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.359E-01	0.0355
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.440E-02	0.0038
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.832E-05	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.616E-01	0.0945
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.896E-01	0.2325
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.395E+00	0.6260
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.826E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 20 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 21
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-Nuclide	Ground mrem/yr	fract.	Inhalation mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	Soil mrem/yr	fract.
Am-241	3.111E-03	0.0008	4.517E-03	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.784E-03	0.0023
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	6.498E-05	0.0000	9.038E-11	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.361E-08	0.0000
Pu-239	2.161E-04	0.0001	4.557E-02	0.0121	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.922E-02	0.0237
Pu-241	1.990E-03	0.0005	2.890E-03	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.621E-03	0.0015
Tc-99	3.840E-06	0.0000	3.683E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.533E-06	0.0000
U-234	2.743E-02	0.0073	2.297E-01	0.0611	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.172E-01	0.0312
U-235	8.444E-01	0.2246	2.709E-02	0.0072	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.591E-02	0.0042
U-238	1.986E+00	0.5281	2.276E-01	0.0605	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.229E-01	0.0327
Total	2.863E+00	0.7614	5.374E-01	0.1429	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.597E-01	0.0957

0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

0 Water Dependent Pathways

0 Radio-Nuclide	Water mrem/yr	fract.	Fish mrem/yr	fract.	Radon mrem/yr	fract.	Plant mrem/yr	fract.	Meat mrem/yr	fract.	Milk mrem/yr	fract.	All Pathways* mrem/yr	fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.641E-02	0.0044
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.501E-05	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.350E-01	0.0359
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.050E-02	0.0028
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.410E-06	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.744E-01	0.0996
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.874E-01	0.2360
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.336E+00	0.6213
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.760E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 21 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 22
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Am-241	1.025E-03	0.0003	1.465E-03	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.850E-03	0.0008
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	6.051E-12	0.0000	8.416E-18	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.130E-15	0.0000
Pu-239	2.113E-04	0.0001	4.449E-02	0.0120	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.709E-02	0.0235
Pu-241	6.553E-04	0.0002	9.374E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.823E-03	0.0005
Tc-99	5.371E-08	0.0000	5.152E-10	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.145E-08	0.0000
U-234	2.239E-01	0.0603	2.136E-01	0.0576	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.136E-01	0.0306
U-235	8.075E-01	0.2176	4.305E-02	0.0116	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.830E-02	0.0076
U-238	1.818E+00	0.4901	2.089E-01	0.0563	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.128E-01	0.0304
Total	2.852E+00	0.7685	5.124E-01	0.1381	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.465E-01	0.0934

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Am-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.340E-03	0.0014
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.054E-12	0.0000
Pu-239	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.318E-01	0.0355
Pu-241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.416E-03	0.0009
Tc-99	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.568E-08	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.511E-01	0.1485
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.788E-01	0.2368
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.140E+00	0.5768
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.711E+00	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 22 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 23
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	3.738E-02	3.732E-02	3.720E-02	3.679E-02	3.562E-02	3.182E-02	2.307E-02	7.476E-03
Am-241	Np-237+D	1.000E+00	0.000E+00	6.820E-08	2.043E-07	6.771E-07	1.999E-06	6.303E-06	1.623E-05	3.383E-05
Am-241	U-233	1.000E+00	0.000E+00	3.498E-15	3.145E-14	3.481E-13	3.099E-12	3.316E-11	2.690E-10	2.162E-09
Am-241	Th-229+D	1.000E+00	0.000E+00	7.235E-18	1.952E-16	7.207E-15	1.929E-13	6.934E-12	1.723E-10	4.892E-09
Am-241	äDSR(j)		3.738E-02	3.732E-02	3.720E-02	3.679E-02	3.562E-02	3.183E-02	2.308E-02	7.510E-03
0C-14	C-14	1.000E+00	8.090E-05	2.676E-05	2.929E-06	1.271E-09	3.136E-19	0.000E+00	0.000E+00	0.000E+00
0Cs-137+D	Cs-137+D	1.000E+00	5.320E-01	5.198E-01	4.963E-01	4.221E-01	2.658E-01	5.266E-02	5.160E-04	4.805E-11
0Pu-239	Pu-239	1.000E+00	2.946E-02	2.946E-02	2.946E-02	2.945E-02	2.943E-02	2.936E-02	2.916E-02	2.846E-02
Pu-239	U-235+D	1.000E+00	0.000E+00	1.232E-10	3.695E-10	1.231E-09	3.687E-09	1.222E-08	3.609E-08	1.138E-07
Pu-239	Pa-231	1.000E+00	0.000E+00	1.230E-15	1.107E-14	1.229E-13	1.105E-12	1.222E-11	1.085E-10	1.150E-09
Pu-239	Ac-227+D	1.000E+00	0.000E+00	6.095E-17	1.620E-15	5.681E-14	1.325E-12	3.226E-11	4.149E-10	5.082E-09
Pu-239	äDSR(j)		2.946E-02	2.946E-02	2.946E-02	2.945E-02	2.943E-02	2.936E-02	2.916E-02	2.846E-02
0Pu-241	Pu-241	1.000E+00	5.684E-04	5.417E-04	4.920E-04	3.512E-04	1.341E-04	4.612E-06	3.037E-10	7.036E-25
Pu-241	Am-241	1.000E+00	0.000E+00	5.848E-05	1.671E-04	4.717E-04	9.237E-04	1.086E-03	7.950E-04	2.577E-04
Pu-241	Np-237+D	1.000E+00	0.000E+00	5.384E-11	4.689E-10	4.665E-09	3.156E-08	1.688E-07	5.105E-07	1.117E-06
Pu-241	U-233	1.000E+00	0.000E+00	1.848E-18	4.869E-17	1.659E-15	3.603E-14	7.456E-13	7.878E-12	6.968E-11
Pu-241	Th-229+D	1.000E+00	0.000E+00	2.873E-21	2.282E-19	2.634E-17	1.787E-15	1.352E-13	4.733E-12	1.543E-10
Pu-241	äDSR(j)		5.684E-04	6.002E-04	6.590E-04	8.229E-04	1.058E-03	1.091E-03	7.955E-04	2.588E-04
0Pu-241+D	Pu-241+D	2.450E-05	2.089E-06	1.991E-06	1.808E-06	1.291E-06	4.929E-07	1.695E-08	1.116E-12	2.586E-27
Pu-241+D	Np-237+D	2.450E-05	0.000E+00	1.633E-12	4.671E-12	1.327E-11	2.654E-11	3.444E-11	3.469E-11	3.458E-11
Pu-241+D	U-233	2.450E-05	0.000E+00	8.440E-20	7.360E-19	7.350E-18	5.032E-17	2.825E-16	9.904E-16	3.435E-15
Pu-241+D	Th-229+D	2.450E-05	0.000E+00	1.752E-22	4.620E-21	1.578E-19	3.456E-18	7.379E-17	8.562E-16	1.017E-14
Pu-241+D	äDSR(j)		2.089E-06	1.991E-06	1.808E-06	1.291E-06	4.929E-07	1.699E-08	3.581E-11	3.459E-11
0Tc-99	Tc-99	1.000E+00	2.833E-05	2.816E-05	2.782E-05	2.666E-05	2.360E-05	1.540E-05	4.546E-06	6.359E-08
0U-234	U-234	1.000E+00	4.682E-03	4.681E-03	4.680E-03	4.676E-03	4.664E-03	4.622E-03	4.504E-03	4.117E-03
U-234	Th-230	1.000E+00	0.000E+00	9.690E-08	2.907E-07	9.684E-07	2.901E-06	9.625E-06	2.848E-05	9.052E-05
U-234	Ra-226+D	1.000E+00	0.000E+00	3.439E-09	3.094E-08	3.433E-07	3.078E-06	3.373E-05	2.920E-04	2.840E-03
U-234	Pb-210+D	1.000E+00	0.000E+00	8.325E-13	2.213E-11	7.766E-10	1.814E-08	4.416E-07	5.585E-06	6.305E-05
U-234	äDSR(j)		4.682E-03	4.681E-03	4.680E-03	4.677E-03	4.670E-03	4.666E-03	4.831E-03	7.111E-03
0U-235+D	U-235+D	1.000E+00	1.251E-01	1.251E-01	1.251E-01	1.249E-01	1.246E-01	1.235E-01	1.205E-01	1.103E-01
U-235+D	Pa-231	1.000E+00	0.000E+00	2.498E-06	7.493E-06	2.496E-05	7.476E-05	2.477E-04	7.307E-04	2.296E-03
U-235+D	Ac-227+D	1.000E+00	0.000E+00	1.852E-07	1.632E-06	1.686E-05	1.252E-04	8.152E-04	3.081E-03	1.047E-02
U-235+D	äDSR(j)		1.251E-01	1.251E-01	1.251E-01	1.250E-01	1.248E-01	1.246E-01	1.243E-01	1.231E-01
0U-238	U-238	5.400E-05	2.244E-07	2.244E-07	2.243E-07	2.241E-07	2.235E-07	2.216E-07	2.161E-07	1.979E-07

Attachment 1 Sheet No. 23 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 24
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

0 Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
U-238+D	U-238+D	9.999E-01	2.811E-02	2.810E-02	2.810E-02	2.807E-02	2.800E-02	2.776E-02	2.707E-02	2.478E-02
U-238+D	U-234	9.999E-01	0.000E+00	1.327E-08	3.980E-08	1.325E-07	3.966E-07	1.310E-06	3.832E-06	1.169E-05
U-238+D	Th-230	9.999E-01	0.000E+00	1.374E-13	1.236E-12	1.372E-11	1.233E-10	1.362E-09	1.204E-08	1.259E-07
U-238+D	Ra-226+D	9.999E-01	0.000E+00	3.250E-15	8.771E-14	3.245E-12	8.729E-11	3.193E-09	8.321E-08	2.727E-06
U-238+D	Pb-210+D	9.999E-01	0.000E+00	5.909E-19	4.726E-17	5.587E-15	4.024E-13	3.504E-11	1.455E-09	5.867E-08
U-238+D	äDSR(j)		2.811E-02	2.810E-02	2.810E-02	2.807E-02	2.800E-02	2.776E-02	2.707E-02	2.480E-02

The DSR includes contributions from associated (half-life ó 180 days) daughters.
0

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 1.500E+01 mrem/yr

ONuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	4.013E+02	4.019E+02	4.032E+02	4.078E+02	4.211E+02	4.712E+02	6.499E+02	1.997E+03
C-14	1.854E+05	5.605E+05	5.120E+06	1.180E+10	*4.455E+12	*4.455E+12	*4.455E+12	*4.455E+12
Cs-137	2.820E+01	2.886E+01	3.022E+01	3.553E+01	5.643E+01	2.849E+02	2.907E+04	3.122E+11
Pu-239	5.091E+02	5.091E+02	5.092E+02	5.093E+02	5.096E+02	5.109E+02	5.144E+02	5.270E+02
Pu-241	2.629E+04	2.491E+04	2.270E+04	1.820E+04	1.417E+04	1.375E+04	1.886E+04	5.796E+04
Tc-99	5.294E+05	5.327E+05	5.392E+05	5.627E+05	6.357E+05	9.743E+05	3.300E+06	2.359E+08
U-234	3.204E+03	3.204E+03	3.205E+03	3.207E+03	3.212E+03	3.215E+03	3.105E+03	2.110E+03
U-235	1.199E+02	1.199E+02	1.199E+02	1.200E+02	1.202E+02	1.204E+02	1.207E+02	1.219E+02
U-238	5.337E+02	5.338E+02	5.339E+02	5.344E+02	5.357E+02	5.404E+02	5.541E+02	6.049E+02

*At specific activity limit
0

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

ONuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Am-241	7.110E-01	0.000E+00	3.738E-02	4.013E+02	3.738E-02	4.013E+02
C-14	2.200E+00	0.000E+00	8.090E-05	1.854E+05	8.090E-05	1.854E+05
Cs-137	1.260E-01	0.000E+00	5.320E-01	2.820E+01	5.320E-01	2.820E+01
Pu-239	4.630E+00	0.000E+00	2.946E-02	5.091E+02	2.946E-02	5.091E+02
Pu-241	1.320E+01	60.4 ñ 0.1	1.130E-03	1.328E+04	5.705E-04	2.629E+04
Tc-99	1.190E+00	0.000E+00	2.833E-05	5.294E+05	2.833E-05	5.294E+05
U-234	7.750E+01	1.000E+03	7.111E-03	2.110E+03	4.682E-03	3.204E+03
U-235	7.140E+00	0.000E+00	1.251E-01	1.199E+02	1.251E-01	1.199E+02
U-238	8.630E+01	0.000E+00	2.811E-02	5.337E+02	2.811E-02	5.337E+02

Attachment 1 Sheet No. 24 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 25
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

ONuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	2.658E-02	2.654E-02	2.645E-02	2.615E-02	2.533E-02	2.263E-02	1.640E-02	5.316E-03
Am-241	Pu-241	1.000E+00	0.000E+00	7.720E-04	2.205E-03	6.227E-03	1.219E-02	1.434E-02	1.049E-02	3.401E-03
Am-241	äDOSE(j)		2.658E-02	2.731E-02	2.866E-02	3.238E-02	3.752E-02	3.697E-02	2.689E-02	8.717E-03
ONp-237	Am-241	1.000E+00	0.000E+00	4.849E-08	1.452E-07	4.814E-07	1.421E-06	4.482E-06	1.154E-05	2.405E-05
Np-237	Pu-241	1.000E+00	0.000E+00	7.106E-10	6.190E-09	6.158E-08	4.166E-07	2.228E-06	6.739E-06	1.475E-05
Np-237	Pu-241	2.450E-05	0.000E+00	2.155E-11	6.166E-11	1.752E-10	3.503E-10	4.546E-10	4.579E-10	4.564E-10
Np-237	äDOSE(j)		0.000E+00	4.922E-08	1.515E-07	5.432E-07	1.838E-06	6.710E-06	1.828E-05	3.880E-05
OU-233	Am-241	1.000E+00	0.000E+00	2.487E-15	2.236E-14	2.475E-13	2.204E-12	2.358E-11	1.913E-10	1.537E-09
U-233	Pu-241	1.000E+00	0.000E+00	2.440E-17	6.427E-16	2.190E-14	4.756E-13	9.842E-12	1.040E-10	9.197E-10
U-233	Pu-241	2.450E-05	0.000E+00	1.114E-18	9.715E-18	9.702E-17	6.642E-16	3.729E-15	1.307E-14	4.534E-14
U-233	äDOSE(j)		0.000E+00	2.513E-15	2.301E-14	2.695E-13	2.680E-12	3.342E-11	2.953E-10	2.457E-09
OTh-229	Am-241	1.000E+00	0.000E+00	5.144E-18	1.388E-16	5.124E-15	1.372E-13	4.930E-12	1.225E-10	3.479E-09
Th-229	Pu-241	1.000E+00	0.000E+00	3.793E-20	3.012E-18	3.477E-16	2.359E-14	1.784E-12	6.248E-11	2.037E-09
Th-229	Pu-241	2.450E-05	0.000E+00	2.313E-21	6.098E-20	2.084E-18	4.562E-17	9.740E-16	1.130E-14	1.343E-13
Th-229	äDOSE(j)		0.000E+00	5.185E-18	1.418E-16	5.474E-15	1.608E-13	6.716E-12	1.850E-10	5.516E-09
OC-14	C-14	1.000E+00	1.780E-04	5.888E-05	6.445E-06	2.796E-09	6.900E-19	0.000E+00	0.000E+00	0.000E+00
OCs-137	Cs-137	1.000E+00	6.703E-02	6.550E-02	6.254E-02	5.319E-02	3.349E-02	6.635E-03	6.501E-05	6.054E-12
OPu-239	Pu-239	1.000E+00	1.364E-01	1.364E-01	1.364E-01	1.364E-01	1.363E-01	1.359E-01	1.350E-01	1.318E-01
OU-235	Pu-239	1.000E+00	0.000E+00	5.704E-10	1.711E-09	5.700E-09	1.707E-08	5.659E-08	1.671E-07	5.267E-07
U-235	U-235	1.000E+00	8.932E-01	8.931E-01	8.929E-01	8.921E-01	8.899E-01	8.821E-01	8.601E-01	7.876E-01
U-235	äDOSE(j)		8.932E-01	8.931E-01	8.929E-01	8.921E-01	8.899E-01	8.821E-01	8.601E-01	7.876E-01
OPa-231	Pu-239	1.000E+00	0.000E+00	5.696E-15	5.125E-14	5.692E-13	5.116E-12	5.657E-11	5.023E-10	5.322E-09
Pa-231	U-235	1.000E+00	0.000E+00	1.784E-05	5.350E-05	1.782E-04	5.338E-04	1.769E-03	5.217E-03	1.639E-02
Pa-231	äDOSE(j)		0.000E+00	1.784E-05	5.350E-05	1.782E-04	5.338E-04	1.769E-03	5.217E-03	1.639E-02
OAc-227	Pu-239	1.000E+00	0.000E+00	2.822E-16	7.499E-15	2.630E-13	6.136E-12	1.494E-10	1.921E-09	2.353E-08
Ac-227	U-235	1.000E+00	0.000E+00	1.322E-06	1.165E-05	1.204E-04	8.941E-04	5.821E-03	2.200E-02	7.478E-02
Ac-227	äDOSE(j)		0.000E+00	1.322E-06	1.165E-05	1.204E-04	8.941E-04	5.821E-03	2.200E-02	7.478E-02
OPu-241	Pu-241	1.000E+00	7.503E-03	7.150E-03	6.494E-03	4.636E-03	1.770E-03	6.088E-05	4.009E-09	9.287E-24
Pu-241	Pu-241	2.450E-05	2.758E-05	2.628E-05	2.387E-05	1.704E-05	6.506E-06	2.238E-07	1.473E-11	3.413E-26
Pu-241	äDOSE(j)		7.530E-03	7.176E-03	6.518E-03	4.653E-03	1.777E-03	6.111E-05	4.024E-09	9.321E-24
OTc-99	Tc-99	1.000E+00	3.372E-05	3.351E-05	3.310E-05	3.172E-05	2.808E-05	1.832E-05	5.410E-06	7.568E-08
OU-234	U-234	1.000E+00	3.628E-01	3.628E-01	3.627E-01	3.624E-01	3.614E-01	3.582E-01	3.491E-01	3.190E-01
U-234	U-238	9.999E-01	0.000E+00	1.145E-06	3.435E-06	1.144E-05	3.423E-05	1.131E-04	3.307E-04	1.009E-03
U-234	äDOSE(j)		3.628E-01	3.628E-01	3.627E-01	3.624E-01	3.615E-01	3.583E-01	3.494E-01	3.200E-01
OTh-230	U-234	1.000E+00	0.000E+00	7.510E-06	2.253E-05	7.505E-05	2.249E-04	7.459E-04	2.207E-03	7.015E-03
Th-230	U-238	9.999E-01	0.000E+00	1.185E-11	1.067E-10	1.184E-09	1.064E-08	1.175E-07	1.039E-06	1.086E-05
Th-230	äDOSE(j)		0.000E+00	7.510E-06	2.253E-05	7.506E-05	2.249E-04	7.460E-04	2.208E-03	7.026E-03

Attachment 1 Sheet No. 25 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 26
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

ONuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr						
		t=	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Ra-226	U-234	1.000E+00	0.000E+00	2.665E-07	2.398E-06	2.661E-05	2.385E-04	2.614E-03	2.263E-02	2.201E-01
Ra-226	U-238	9.999E-01	0.000E+00	2.805E-13	7.570E-12	2.800E-10	7.533E-09	2.756E-07	7.181E-06	2.353E-04
Ra-226	äDOSE(j)		0.000E+00	2.665E-07	2.398E-06	2.661E-05	2.385E-04	2.615E-03	2.264E-02	2.204E-01
OPb-210	U-234	1.000E+00	0.000E+00	6.452E-11	1.715E-09	6.019E-08	1.406E-06	3.422E-05	4.329E-04	4.886E-03
Pb-210	U-238	9.999E-01	0.000E+00	5.100E-17	4.079E-15	4.822E-13	3.472E-11	3.024E-09	1.256E-07	5.063E-06
Pb-210	äDOSE(j)		0.000E+00	6.452E-11	1.715E-09	6.019E-08	1.406E-06	3.422E-05	4.330E-04	4.891E-03
OU-238	U-238	5.400E-05	1.936E-05	1.936E-05	1.936E-05	1.934E-05	1.929E-05	1.912E-05	1.865E-05	1.708E-05
U-238	U-238	9.999E-01	2.426E+00	2.425E+00	2.425E+00	2.423E+00	2.416E+00	2.395E+00	2.336E+00	2.139E+00
U-238	äDOSE(j)		2.426E+00	2.425E+00	2.425E+00	2.423E+00	2.416E+00	2.395E+00	2.336E+00	2.139E+00

THF(i) is the thread fraction of the parent nuclide.

Attachment 1 Sheet No. 26 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 13:12 Page 27
Summary : 316-3 RESRAD Evaluation of Industrial Dose
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

ONuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Am-241	Am-241	1.000E+00	7.110E-01	7.099E-01	7.076E-01	6.996E-01	6.775E-01	6.053E-01	4.387E-01	1.422E-01
Am-241	Pu-241	1.000E+00	0.000E+00	2.065E-02	5.899E-02	1.666E-01	3.262E-01	3.836E-01	2.807E-01	9.099E-02
Am-241	äS(j):		7.110E-01	7.305E-01	7.666E-01	8.662E-01	1.004E+00	9.889E-01	7.194E-01	2.332E-01
ONp-237	Am-241	1.000E+00	0.000E+00	2.301E-07	6.892E-07	2.284E-06	6.744E-06	2.127E-05	5.476E-05	1.141E-04
Np-237	Pu-241	1.000E+00	0.000E+00	3.372E-09	2.937E-08	2.922E-07	1.977E-06	1.057E-05	3.198E-05	6.998E-05
Np-237	Pu-241	2.450E-05	0.000E+00	1.023E-10	2.926E-10	8.314E-10	1.662E-09	2.157E-09	2.173E-09	2.166E-09
Np-237	äS(j):		0.000E+00	2.336E-07	7.189E-07	2.577E-06	8.723E-06	3.184E-05	8.674E-05	1.841E-04
OU-233	Am-241	1.000E+00	0.000E+00	5.033E-13	4.525E-12	5.008E-11	4.459E-10	4.771E-09	3.870E-08	3.110E-07
U-233	Pu-241	1.000E+00	0.000E+00	4.936E-15	1.300E-13	4.431E-12	9.623E-11	1.991E-09	2.104E-08	1.861E-07
U-233	Pu-241	2.450E-05	0.000E+00	2.254E-16	1.966E-15	1.963E-14	1.344E-13	7.545E-13	2.645E-12	9.174E-12
U-233	äS(j):		0.000E+00	5.084E-13	4.657E-12	5.453E-11	5.422E-10	6.763E-09	5.974E-08	4.971E-07
OTh-229	Am-241	1.000E+00	0.000E+00	1.584E-17	4.274E-16	1.578E-14	4.225E-13	1.518E-11	3.773E-10	1.071E-08
Th-229	Pu-241	1.000E+00	0.000E+00	1.168E-19	9.278E-18	1.071E-15	7.266E-14	5.496E-12	1.924E-10	6.273E-09
Th-229	Pu-241	2.450E-05	0.000E+00	7.124E-21	1.878E-19	6.417E-18	1.405E-16	3.000E-15	3.481E-14	4.137E-13
Th-229	äS(j):		0.000E+00	1.597E-17	4.369E-16	1.686E-14	4.953E-13	2.068E-11	5.697E-10	1.699E-08
OC-14	C-14	1.000E+00	2.200E+00	7.278E-01	7.967E-02	3.456E-05	8.529E-15	0.000E+00	0.000E+00	0.000E+00
OCs-137	Cs-137	1.000E+00	1.260E-01	1.231E-01	1.176E-01	9.998E-02	6.296E-02	1.247E-02	1.222E-04	1.138E-11
OPu-239	Pu-239	1.000E+00	4.630E+00	4.630E+00	4.630E+00	4.628E+00	4.625E+00	4.614E+00	4.582E+00	4.473E+00
OU-235	Pu-239	1.000E+00	0.000E+00	4.560E-09	1.368E-08	4.556E-08	1.365E-07	4.524E-07	1.336E-06	4.210E-06
U-235	U-235	1.000E+00	7.140E+00	7.139E+00	7.137E+00	7.131E+00	7.113E+00	7.051E+00	6.876E+00	6.296E+00
U-235	äS(j):		7.140E+00	7.139E+00	7.137E+00	7.131E+00	7.113E+00	7.051E+00	6.876E+00	6.296E+00
OPa-231	Pu-239	1.000E+00	0.000E+00	4.824E-14	4.341E-13	4.821E-12	4.333E-11	4.791E-10	4.254E-09	4.507E-08
Pa-231	U-235	1.000E+00	0.000E+00	1.511E-04	4.531E-04	1.509E-03	4.521E-03	1.498E-02	4.418E-02	1.388E-01
Pa-231	äS(j):		0.000E+00	1.511E-04	4.531E-04	1.509E-03	4.521E-03	1.498E-02	4.418E-02	1.388E-01
OAc-227	Pu-239	1.000E+00	0.000E+00	5.078E-16	1.350E-14	4.733E-13	1.104E-11	2.688E-10	3.457E-09	4.235E-08
Ac-227	U-235	1.000E+00	0.000E+00	2.379E-06	2.096E-05	2.167E-04	1.609E-03	1.047E-02	3.959E-02	1.346E-01
Ac-227	äS(j):		0.000E+00	2.379E-06	2.096E-05	2.167E-04	1.609E-03	1.047E-02	3.959E-02	1.346E-01
OPu-241	Pu-241	1.000E+00	1.320E+01	1.258E+01	1.142E+01	8.156E+00	3.114E+00	1.071E-01	7.053E-06	1.634E-20
Pu-241	Pu-241	2.450E-05	3.234E-04	3.082E-04	2.799E-04	1.998E-04	7.630E-05	2.624E-06	1.728E-10	4.003E-25
Pu-241	äS(j):		1.320E+01	1.258E+01	1.142E+01	8.156E+00	3.114E+00	1.071E-01	7.053E-06	1.634E-20
OTc-99	Tc-99	1.000E+00	1.190E+00	1.183E+00	1.168E+00	1.120E+00	9.910E-01	6.466E-01	1.909E-01	2.671E-03
OU-234	U-234	1.000E+00	7.750E+01	7.749E+01	7.747E+01	7.740E+01	7.720E+01	7.651E+01	7.457E+01	6.815E+01
U-234	U-238	9.999E-01	0.000E+00	2.446E-04	7.337E-04	2.443E-03	7.311E-03	2.416E-02	7.065E-02	2.154E-01
U-234	äS(j):		7.750E+01	7.749E+01	7.747E+01	7.740E+01	7.721E+01	7.653E+01	7.464E+01	6.836E+01
OTh-230	U-234	1.000E+00	0.000E+00	6.976E-04	2.093E-03	6.972E-03	2.089E-02	6.929E-02	2.050E-01	6.516E-01
Th-230	U-238	9.999E-01	0.000E+00	1.101E-09	9.908E-09	1.100E-07	9.884E-07	1.092E-05	9.653E-05	1.009E-03
Th-230	äS(j):		0.000E+00	6.976E-04	2.093E-03	6.972E-03	2.089E-02	6.930E-02	2.051E-01	6.527E-01

Attachment 1 Sheet No. 27 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 1

```
1RESRAD, Version 6.5      T« Limit = 180 days        12/06/2012  13:12  Page  28
 Summary : 316-3 RESRAD Evaluation of Industrial Dose
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_INDUSTRIAL.RAD

                                  Individual Nuclide Soil Concentration
                                Parent Nuclide and Branch Fraction Indicated
ONuclide Parent   THF(i)                                      S(j,t), pCi/g
   (j)     (i)            t= 0.000E+00 1.000E+00 3.000E+00 1.000E+01 3.000E+01 1.000E+02 3.000E+02 1.000E+03
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ   ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 Ra-226  U-234   1.000E+00    0.000E+00 1.511E-07 1.359E-06 1.508E-05 1.352E-04 1.482E-03 1.283E-02 1.248E-01
 Ra-226  U-238   9.999E-01    0.000E+00 1.590E-13 4.291E-12 1.587E-10 4.270E-09 1.562E-07 4.071E-06 1.334E-04
 Ra-226  äS(j):              0.000E+00 1.511E-07 1.359E-06 1.508E-05 1.352E-04 1.482E-03 1.283E-02 1.249E-01
OPb-210  U-234   1.000E+00    0.000E+00 1.553E-09 4.129E-08 1.449E-06 3.385E-05 8.239E-04 1.042E-02 1.176E-01
 Pb-210  U-238   9.999E-01    0.000E+00 1.228E-15 9.820E-14 1.161E-11 8.360E-10 7.280E-08 3.023E-06 1.219E-04
 Pb-210  äS(j):              0.000E+00 1.553E-09 4.129E-08 1.449E-06 3.385E-05 8.240E-04 1.042E-02 1.178E-01
OU-238   U-238   5.400E-05    4.660E-03 4.660E-03 4.658E-03 4.654E-03 4.643E-03 4.602E-03 4.488E-03 4.109E-03
 U-238   U-238   9.999E-01    8.630E+01 8.628E+01 8.626E+01 8.619E+01 8.597E+01 8.522E+01 8.310E+01 7.610E+01
 U-238   äS(j):              8.630E+01 8.629E+01 8.627E+01 8.619E+01 8.597E+01 8.522E+01 8.310E+01 7.610E+01
 ïïïïïïï ïïïïïïï ïïïïïïïïï   ïïïïïïïïï ïïïïïïïïï ïïïïïïïïï ïïïïïïïïï ïïïïïïïïï ïïïïïïïïï ïïïïïïïïï
 THF(i) is the thread fraction of the parent nuclide.
ORESCALC.EXE execution time =   10.61 seconds
 Total water/soil iteration failures = 6.000E+00.
```

Attachment 1 Sheet No. 28 of 28
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

```
1RESRAD, Version 6.5      T« Limit = 180 days        12/06/2012  14:46  Page   1
 Concent : 316-3 RESRAD Evaluation of Groundwater Protection
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

                     Table of Contents
                     ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
           Part IV: Concentration of Radionuclides
           ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ

 Concentration of radionuclides in different media
      Time= 0.000E+00 .....................................   2
      Time= 1.000E+00 .....................................   4
      Time= 3.000E+00 .....................................   6
      Time= 1.000E+01 .....................................   8
      Time= 3.000E+01 .....................................  10
      Time= 1.000E+02 .....................................  12
      Time= 3.000E+02 .....................................  14
      Time= 1.000E+03 .....................................  16
```

Attachment 2 Sheet No. 1 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 2
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Ac-227	0.000E+00	0.000E+00	0.000E+00	6.337E-09	5.567E-09
Am-241	7.110E-01	7.110E-01	1.622E-05	2.645E-05	2.323E-05
C-14	2.200E+00	2.200E+00	5.018E-05	4.959E-05	4.356E-05
Cs-137	1.260E-01	1.260E-01	2.874E-06	7.458E-05	6.551E-05
Np-237	0.000E+00	0.000E+00	0.000E+00	5.837E-12	5.127E-12
Pa-231	0.000E+00	0.000E+00	0.000E+00	9.016E-08	7.920E-08
Pb-210	0.000E+00	0.000E+00	0.000E+00	3.279E-09	2.880E-09
Pu-239	4.630E+00	4.630E+00	1.056E-04	1.722E-04	1.513E-04
Pu-241	1.320E+01	1.320E+01	3.011E-04	4.911E-04	4.314E-04
Ra-226	0.000E+00	0.000E+00	0.000E+00	4.725E-09	4.151E-09
Tc-99	1.190E+00	1.190E+00	2.714E-05	2.832E+00	2.487E+00
Th-229	0.000E+00	0.000E+00	0.000E+00	2.258E-19	1.983E-19
Th-230	0.000E+00	0.000E+00	0.000E+00	1.797E-10	1.578E-10
U-233	0.000E+00	0.000E+00	0.000E+00	3.084E-16	2.709E-16
U-234	7.750E+01	7.750E+01	1.768E-03	3.804E+00	3.341E+00
U-235	7.140E+00	7.140E+00	1.629E-04	3.504E-01	3.078E-01
U-238	8.630E+01	8.630E+01	1.968E-03	4.236E+00	3.721E+00

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

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 0.000E+00 pCi/m**3

Attachment 2 Sheet No. 2 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 3
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Ac-227	6.337E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.337E-12	2.028E-11	8.350E-08	5.567E-06
Am-241	2.645E-05	7.114E-01	7.131E-01	7.133E-01	7.133E-01	2.020E-02	7.895E-04	6.970E-04	2.323E-02
C-14	4.959E-05	1.540E+04	3.466E+03	1.302E+04	5.854E+03	9.248E+03	2.699E+03	2.178E+00	3.964E-01
Cs-137	7.458E-05	5.040E+00	5.040E+00	5.040E+00	5.040E+00	1.217E+01	2.722E+00	1.310E-01	6.551E-03
Np-237	5.837E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.919E-13	4.670E-15	1.538E-10	2.051E-09
Pa-231	9.016E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.254E-08	7.213E-11	7.920E-07	8.712E-06
Pb-210	3.279E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.312E-10	1.574E-10	8.641E-07	2.880E-07
Pu-239	1.722E-04	4.633E+00	4.644E+00	4.645E+00	4.645E+00	2.631E-01	2.571E-03	4.539E-03	1.513E-02
Pu-241	4.911E-04	1.321E+01	1.324E+01	1.324E+01	1.324E+01	7.501E-01	7.328E-03	1.294E-02	4.314E-02
Ra-226	4.725E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	2.363E-10	7.561E-10	2.075E-07	1.038E-06
Tc-99	2.832E+00	5.950E+03	5.950E+03	5.950E+03	5.950E+03	4.053E+01	3.283E+02	4.975E+01	1.244E+01
Th-229	2.258E-19	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.129E-21	1.806E-22	1.983E-17	9.916E-17
Th-230	1.797E-10	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.984E-13	1.437E-13	1.578E-08	7.892E-08
U-233	3.084E-16	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.243E-18	2.961E-17	2.709E-15	1.625E-14
U-234	3.804E+00	1.938E+02	1.940E+02	1.940E+02	1.940E+02	1.773E+01	3.002E+01	3.341E+01	2.005E+02
U-235	3.504E-01	1.785E+01	1.787E+01	1.787E+01	1.787E+01	1.633E+00	2.765E+00	3.078E+00	1.847E+01
U-238	4.236E+00	2.158E+02	2.160E+02	2.160E+02	2.160E+02	1.974E+01	3.343E+01	3.721E+01	2.232E+02

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

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

Attachment 2 Sheet No. 3 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

```
1RESRAD, Version 6.5      T« Limit = 180 days        12/06/2012  14:46  Page   4
 Concent : 316-3 RESRAD Evaluation of Groundwater Protection
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Ac-227	2.379E-06	2.379E-06	5.427E-11	7.453E-09	6.547E-09
Am-241	7.305E-01	7.305E-01	1.666E-05	0.000E+00	0.000E+00
C-14	7.278E-01	7.278E-01	1.660E-05	0.000E+00	0.000E+00
Cs-137	1.231E-01	1.231E-01	2.808E-06	0.000E+00	0.000E+00
Np-237	2.336E-07	2.336E-07	5.328E-12	0.000E+00	0.000E+00
Pa-231	1.511E-04	1.511E-04	3.446E-09	7.742E-08	6.801E-08
Pb-210	1.553E-09	1.553E-09	3.543E-14	5.300E-09	4.655E-09
Pu-239	4.630E+00	4.630E+00	1.056E-04	0.000E+00	0.000E+00
Pu-241	1.258E+01	1.258E+01	2.869E-04	0.000E+00	0.000E+00
Ra-226	1.511E-07	1.511E-07	3.446E-12	7.564E-09	6.645E-09
Tc-99	1.183E+00	1.183E+00	2.698E-05	2.815E+00	2.473E+00
Th-229	1.597E-17	1.597E-17	3.642E-22	0.000E+00	0.000E+00
Th-230	6.976E-04	6.976E-04	1.591E-08	2.937E-10	2.579E-10
U-233	5.084E-13	5.084E-13	1.160E-17	0.000E+00	0.000E+00
U-234	7.749E+01	7.749E+01	1.768E-03	3.803E+00	3.341E+00
U-235	7.139E+00	7.139E+00	1.628E-04	3.504E-01	3.078E-01
U-238	8.629E+01	8.629E+01	1.968E-03	4.235E+00	3.720E+00

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

 Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters,
 i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air  =  0.000E+00 pCi/m**3
```

Attachment 2 Sheet No. 4 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 5
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Ac-227	7.442E-09	7.280E-06	6.054E-06	8.971E-06	9.800E-06	1.420E-06	3.454E-08	9.727E-08	6.439E-06
Am-241	0.000E+00	7.310E-01	7.327E-01	7.319E-01	7.328E-01	2.079E-02	8.111E-04	0.000E+00	0.000E+00
C-14	0.000E+00	5.318E+03	1.150E+03	5.244E+03	2.226E+03	3.725E+03	1.026E+03	0.000E+00	0.000E+00
Cs-137	0.000E+00	4.925E+00	4.925E+00	4.931E+00	4.926E+00	1.189E+01	2.660E+00	0.000E+00	0.000E+00
Np-237	0.000E+00	4.499E-06	4.660E-06	3.861E-06	4.106E-06	3.732E-07	1.712E-09	0.000E+00	0.000E+00
Pa-231	9.761E-08	1.467E-03	1.508E-03	1.289E-03	1.367E-03	7.971E-04	9.129E-07	1.922E-06	1.490E-05
Pb-210	5.292E-09	2.048E-08	1.593E-08	2.429E-08	2.807E-08	2.642E-09	9.761E-10	1.382E-06	4.617E-07
Pu-239	0.000E+00	4.633E+00	4.644E+00	4.645E+00	4.645E+00	2.631E-01	2.570E-03	0.000E+00	0.000E+00
Pu-241	0.000E+00	1.259E+01	1.262E+01	1.265E+01	1.262E+01	7.148E-01	6.984E-03	0.000E+00	0.000E+00
Ra-226	7.554E-09	5.602E-06	6.012E-06	4.121E-06	4.656E-06	3.491E-07	3.324E-07	3.290E-07	1.645E-06
Tc-99	2.815E+00	5.915E+03	5.914E+03	5.920E+03	5.918E+03	4.033E+01	3.266E+02	4.946E+01	1.236E+01
Th-229	0.000E+00	1.984E-17	1.622E-17	3.092E-17	3.480E-17	1.865E-18	1.155E-19	0.000E+00	0.000E+00
Th-230	9.403E-08	7.381E-04	7.025E-04	7.905E-04	8.269E-04	4.708E-05	2.706E-06	5.789E-06	3.471E-05
U-233	0.000E+00	1.929E-12	1.322E-12	2.931E-12	3.176E-12	2.343E-13	2.565E-13	0.000E+00	0.000E+00
U-234	3.803E+00	1.938E+02	1.940E+02	1.940E+02	1.940E+02	1.772E+01	3.001E+01	3.341E+01	2.005E+02
U-235	3.504E-01	1.785E+01	1.787E+01	1.787E+01	1.787E+01	1.633E+00	2.765E+00	3.078E+00	1.847E+01
U-238	4.235E+00	2.158E+02	2.160E+02	2.160E+02	2.160E+02	1.974E+01	3.342E+01	3.720E+01	2.232E+02

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

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

Attachment 2 Sheet No. 5 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 6
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Ac-227	2.096E-05	2.096E-05	4.782E-10	2.117E-08	1.859E-08
Am-241	7.666E-01	7.666E-01	1.748E-05	0.000E+00	0.000E+00
C-14	7.967E-02	7.967E-02	1.817E-06	0.000E+00	0.000E+00
Cs-137	1.176E-01	1.176E-01	2.681E-06	0.000E+00	0.000E+00
Np-237	7.189E-07	7.189E-07	1.640E-11	0.000E+00	0.000E+00
Pa-231	4.531E-04	4.531E-04	1.033E-08	1.218E-07	1.070E-07
Pb-210	4.129E-08	4.129E-08	9.418E-13	8.336E-09	7.322E-09
Pu-239	4.630E+00	4.630E+00	1.056E-04	0.000E+00	0.000E+00
Pu-241	1.142E+01	1.142E+01	2.606E-04	0.000E+00	0.000E+00
Ra-226	1.359E-06	1.359E-06	3.100E-11	1.190E-08	1.045E-08
Tc-99	1.168E+00	1.168E+00	2.665E-05	2.781E+00	2.443E+00
Th-229	4.369E-16	4.369E-16	9.965E-21	0.000E+00	0.000E+00
Th-230	2.093E-03	2.093E-03	4.773E-08	4.620E-10	4.058E-10
U-233	4.657E-12	4.657E-12	1.062E-16	0.000E+00	0.000E+00
U-234	7.747E+01	7.747E+01	1.767E-03	3.803E+00	3.340E+00
U-235	7.137E+00	7.137E+00	1.628E-04	3.503E-01	3.077E-01
U-238	8.627E+01	8.627E+01	1.968E-03	4.234E+00	3.719E+00

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

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 0.000E+00 pCi/m**3

Attachment 2 Sheet No. 6 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 7
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Ac-227	2.115E-08	5.652E-05	5.277E-05	6.312E-05	6.513E-05	4.779E-06	2.812E-07	2.773E-07	1.843E-05
Am-241	0.000E+00	7.670E-01	7.689E-01	7.681E-01	7.690E-01	2.181E-02	8.511E-04	0.000E+00	0.000E+00
C-14	0.000E+00	5.821E+02	1.259E+02	5.739E+02	2.437E+02	4.077E+02	1.123E+02	0.000E+00	0.000E+00
Cs-137	0.000E+00	4.702E+00	4.703E+00	4.709E+00	4.703E+00	1.136E+01	2.539E+00	0.000E+00	0.000E+00
Np-237	0.000E+00	1.420E-05	1.437E-05	1.353E-05	1.379E-05	1.273E-06	5.587E-09	0.000E+00	0.000E+00
Pa-231	1.421E-07	4.488E-03	4.529E-03	4.310E-03	4.389E-03	2.579E-03	2.499E-06	2.313E-06	1.920E-05
Pb-210	8.331E-09	4.601E-07	4.165E-07	5.271E-07	5.531E-07	5.125E-08	1.599E-08	2.185E-06	7.298E-07
Pu-239	0.000E+00	4.632E+00	4.643E+00	4.645E+00	4.645E+00	2.631E-01	2.570E-03	0.000E+00	0.000E+00
Pu-241	0.000E+00	1.143E+01	1.146E+01	1.149E+01	1.146E+01	6.492E-01	6.343E-03	0.000E+00	0.000E+00
Ra-226	1.189E-08	5.303E-05	5.428E-05	4.823E-05	5.002E-05	3.938E-06	3.431E-06	5.201E-07	2.600E-06
Tc-99	2.781E+00	5.843E+03	5.842E+03	5.848E+03	5.847E+03	3.984E+01	3.226E+02	4.887E+01	1.222E+01
Th-229	0.000E+00	4.659E-16	4.400E-16	5.266E-16	5.526E-16	3.108E-17	1.756E-18	0.000E+00	0.000E+00
Th-230	9.418E-08	2.134E-03	2.102E-03	2.190E-03	2.226E-03	1.263E-04	6.578E-06	5.803E-06	3.478E-05
U-233	0.000E+00	1.372E-11	1.181E-11	1.758E-11	1.811E-11	1.474E-12	1.992E-12	0.000E+00	0.000E+00
U-234	3.803E+00	1.937E+02	1.939E+02	1.939E+02	1.939E+02	1.772E+01	3.001E+01	3.340E+01	2.004E+02
U-235	3.503E-01	1.785E+01	1.786E+01	1.787E+01	1.787E+01	1.632E+00	2.764E+00	3.077E+00	1.846E+01
U-238	4.234E+00	2.157E+02	2.159E+02	2.160E+02	2.160E+02	1.973E+01	3.341E+01	3.719E+01	2.232E+02

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

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

Attachment 2 Sheet No. 7 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 8
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Ac-227	2.167E-04	2.167E-04	4.943E-09	1.056E-07	9.273E-08
Am-241	8.662E-01	8.662E-01	1.976E-05	0.000E+00	0.000E+00
C-14	3.456E-05	3.456E-05	7.883E-10	0.000E+00	0.000E+00
Cs-137	9.998E-02	9.998E-02	2.281E-06	0.000E+00	0.000E+00
Np-237	2.577E-06	2.577E-06	5.879E-11	0.000E+00	0.000E+00
Pa-231	1.509E-03	1.509E-03	3.443E-08	2.555E-07	2.244E-07
Pb-210	1.449E-06	1.449E-06	3.305E-11	1.840E-08	1.616E-08
Pu-239	4.628E+00	4.628E+00	1.056E-04	0.000E+00	0.000E+00
Pu-241	8.156E+00	8.156E+00	1.860E-04	0.000E+00	0.000E+00
Ra-226	1.508E-05	1.508E-05	3.440E-10	2.625E-08	2.306E-08
Tc-99	1.120E+00	1.120E+00	2.554E-05	2.667E+00	2.343E+00
Th-229	1.686E-14	1.686E-14	3.846E-19	0.000E+00	0.000E+00
Th-230	6.972E-03	6.972E-03	1.590E-07	9.685E-10	8.508E-10
U-233	5.453E-11	5.453E-11	1.244E-15	0.000E+00	0.000E+00
U-234	7.740E+01	7.740E+01	1.766E-03	3.799E+00	3.337E+00
U-235	7.131E+00	7.131E+00	1.627E-04	3.500E-01	3.075E-01
U-238	8.619E+01	8.619E+01	1.966E-03	4.231E+00	3.716E+00

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

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 0.000E+00 pCi/m**3

Attachment 2 Sheet No. 8 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 9
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Ac-227	1.055E-07	5.556E-04	5.434E-04	5.803E-04	5.859E-04	1.828E-05	2.811E-06	1.387E-06	9.239E-05
Am-241	0.000E+00	8.668E-01	8.688E-01	8.684E-01	8.690E-01	2.463E-02	9.618E-04	0.000E+00	0.000E+00
C-14	0.000E+00	2.525E-01	5.462E-02	2.490E-01	1.057E-01	1.769E-01	4.872E-02	0.000E+00	0.000E+00
Cs-137	0.000E+00	3.999E+00	4.000E+00	4.005E+00	4.000E+00	9.659E+00	2.160E+00	0.000E+00	0.000E+00
Np-237	0.000E+00	5.135E-05	5.154E-05	5.060E-05	5.089E-05	4.722E-06	2.044E-08	0.000E+00	0.000E+00
Pa-231	2.757E-07	1.505E-02	1.510E-02	1.488E-02	1.496E-02	8.813E-03	8.046E-06	3.487E-06	3.212E-05
Pb-210	1.839E-08	1.503E-05	1.453E-05	1.593E-05	1.616E-05	1.515E-06	4.881E-07	4.838E-06	1.616E-06
Pu-239	0.000E+00	4.631E+00	4.642E+00	4.644E+00	4.644E+00	2.630E-01	2.570E-03	0.000E+00	0.000E+00
Pu-241	0.000E+00	8.162E+00	8.181E+00	8.205E+00	8.184E+00	4.635E-01	4.528E-03	0.000E+00	0.000E+00
Ra-226	2.624E-08	5.988E-04	6.030E-04	5.824E-04	5.886E-04	4.707E-05	3.991E-05	1.151E-06	5.754E-06
Tc-99	2.667E+00	5.599E+03	5.598E+03	5.604E+03	5.602E+03	3.818E+01	3.091E+02	4.686E+01	1.172E+01
Th-229	0.000E+00	1.718E-14	1.693E-14	1.770E-14	1.798E-14	1.019E-15	5.265E-17	0.000E+00	0.000E+00
Th-230	9.460E-08	7.016E-03	6.995E-03	7.085E-03	7.121E-03	4.036E-04	2.012E-05	5.842E-06	3.497E-05
U-233	0.000E+00	1.439E-10	1.370E-10	1.588E-10	1.604E-10	1.397E-11	2.164E-11	0.000E+00	0.000E+00
U-234	3.799E+00	1.936E+02	1.937E+02	1.938E+02	1.938E+02	1.770E+01	2.998E+01	3.337E+01	2.002E+02
U-235	3.500E-01	1.783E+01	1.785E+01	1.785E+01	1.785E+01	1.631E+00	2.762E+00	3.075E+00	1.845E+01
U-238	4.231E+00	2.155E+02	2.157E+02	2.158E+02	2.158E+02	1.971E+01	3.338E+01	3.716E+01	2.230E+02

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

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

Attachment 2 Sheet No. 9 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 10
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Ac-227	1.609E-03	1.609E-03	3.670E-08	5.779E-07	5.076E-07
Am-241	1.004E+00	1.004E+00	2.289E-05	0.000E+00	0.000E+00
C-14	8.529E-15	8.529E-15	1.945E-19	0.000E+00	0.000E+00
Cs-137	6.296E-02	6.296E-02	1.436E-06	0.000E+00	0.000E+00
Np-237	8.723E-06	8.723E-06	1.990E-10	0.000E+00	0.000E+00
Pa-231	4.521E-03	4.521E-03	1.031E-07	6.189E-07	5.437E-07
Pb-210	3.385E-05	3.385E-05	7.721E-10	4.233E-08	3.718E-08
Pu-239	4.625E+00	4.625E+00	1.055E-04	0.000E+00	0.000E+00
Pu-241	3.114E+00	3.114E+00	7.103E-05	0.000E+00	0.000E+00
Ra-226	1.352E-04	1.352E-04	3.084E-09	6.043E-08	5.308E-08
Tc-99	9.910E-01	9.910E-01	2.260E-05	2.366E+00	2.078E+00
Th-229	4.953E-13	4.953E-13	1.130E-17	0.000E+00	0.000E+00
Th-230	2.089E-02	2.089E-02	4.764E-07	2.346E-09	2.061E-09
U-233	5.422E-10	5.422E-10	1.237E-14	0.000E+00	0.000E+00
U-234	7.721E+01	7.721E+01	1.761E-03	3.790E+00	3.329E+00
U-235	7.113E+00	7.113E+00	1.622E-04	3.492E-01	3.067E-01
U-238	8.597E+01	8.597E+01	1.961E-03	4.220E+00	3.707E+00

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

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 0.000E+00 pCi/m**3

Attachment 2 Sheet No. 10 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 11
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Ac-227	5.778E-07	4.065E-03	4.030E-03	4.147E-03	4.159E-03	6.794E-05	2.066E-05	7.605E-06	5.068E-04
Am-241	0.000E+00	1.004E+00	1.007E+00	1.007E+00	1.007E+00	2.852E-02	1.114E-03	0.000E+00	0.000E+00
C-14	0.000E+00	6.232E-11	1.348E-11	6.144E-11	2.609E-11	4.365E-11	1.202E-11	0.000E+00	0.000E+00
Cs-137	0.000E+00	2.518E+00	2.518E+00	2.522E+00	2.519E+00	6.082E+00	1.360E+00	0.000E+00	0.000E+00
Np-237	0.000E+00	1.742E-04	1.745E-04	1.734E-04	1.737E-04	1.614E-05	6.957E-08	0.000E+00	0.000E+00
Pa-231	6.391E-07	4.517E-02	4.522E-02	4.500E-02	4.508E-02	2.658E-02	2.386E-05	6.677E-06	6.723E-05
Pb-210	4.233E-08	3.433E-04	3.389E-04	3.522E-04	3.539E-04	3.331E-05	1.095E-05	1.114E-05	3.722E-06
Pu-239	0.000E+00	4.628E+00	4.639E+00	4.640E+00	4.640E+00	2.628E-01	2.568E-03	0.000E+00	0.000E+00
Pu-241	0.000E+00	3.116E+00	3.124E+00	3.133E+00	3.125E+00	1.770E-01	1.729E-03	0.000E+00	0.000E+00
Ra-226	6.043E-08	5.395E-03	5.408E-03	5.346E-03	5.365E-03	4.309E-04	3.627E-04	2.652E-06	1.326E-05
Tc-99	2.366E+00	4.956E+03	4.955E+03	4.960E+03	4.959E+03	3.379E+01	2.736E+02	4.157E+01	1.039E+01
Th-229	0.000E+00	4.986E-13	4.969E-13	5.039E-13	5.066E-13	2.871E-14	1.431E-15	0.000E+00	0.000E+00
Th-230	9.575E-08	2.094E-02	2.095E-02	2.105E-02	2.108E-02	1.194E-03	5.875E-05	5.949E-06	3.549E-05
U-233	0.000E+00	1.381E-09	1.359E-09	1.434E-09	1.439E-09	1.288E-10	2.101E-10	0.000E+00	0.000E+00
U-234	3.790E+00	1.931E+02	1.933E+02	1.933E+02	1.933E+02	1.766E+01	2.990E+01	3.329E+01	1.997E+02
U-235	3.492E-01	1.779E+01	1.780E+01	1.781E+01	1.781E+01	1.627E+00	2.755E+00	3.067E+00	1.840E+01
U-238	4.220E+00	2.150E+02	2.152E+02	2.152E+02	2.152E+02	1.966E+01	3.330E+01	3.707E+01	2.224E+02

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

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

Attachment 2 Sheet No. 11 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 12
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Ac-227	1.047E-02	1.047E-02	2.389E-07	3.338E-06	2.932E-06
Am-241	9.889E-01	9.889E-01	2.256E-05	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	1.247E-02	1.247E-02	2.845E-07	0.000E+00	0.000E+00
Np-237	3.184E-05	3.184E-05	7.263E-10	0.000E+00	0.000E+00
Pa-231	1.498E-02	1.498E-02	3.417E-07	1.873E-06	1.645E-06
Pb-210	8.240E-04	8.240E-04	1.879E-08	1.282E-07	1.126E-07
Pu-239	4.614E+00	4.614E+00	1.052E-04	0.000E+00	0.000E+00
Pu-241	1.071E-01	1.071E-01	2.443E-06	0.000E+00	0.000E+00
Ra-226	1.482E-03	1.482E-03	3.381E-08	1.883E-07	1.654E-07
Tc-99	6.466E-01	6.466E-01	1.475E-05	1.556E+00	1.367E+00
Th-229	2.068E-11	2.068E-11	4.718E-16	0.000E+00	0.000E+00
Th-230	6.930E-02	6.930E-02	1.581E-06	7.101E-09	6.238E-09
U-233	6.763E-09	6.763E-09	1.543E-13	0.000E+00	0.000E+00
U-234	7.653E+01	7.653E+01	1.746E-03	3.757E+00	3.300E+00
U-235	7.051E+00	7.051E+00	1.608E-04	3.461E-01	3.041E-01
U-238	8.522E+01	8.522E+01	1.944E-03	4.184E+00	3.675E+00

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

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 0.000E+00 pCi/m**3

Attachment 2 Sheet No. 12 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 13
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Ac-227	3.338E-06	2.633E-02	2.623E-02	2.664E-02	2.666E-02	2.945E-04	1.341E-04	4.396E-05	2.930E-03
Am-241	0.000E+00	9.895E-01	9.919E-01	9.922E-01	9.922E-01	2.810E-02	1.098E-03	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	4.989E-01	4.989E-01	4.996E-01	4.990E-01	1.205E+00	2.694E-01	0.000E+00	0.000E+00
Np-237	0.000E+00	6.366E-04	6.369E-04	6.358E-04	6.362E-04	5.915E-05	2.545E-07	0.000E+00	0.000E+00
Pa-231	1.893E-06	1.498E-01	1.498E-01	1.496E-01	1.497E-01	8.830E-02	7.878E-05	1.768E-05	1.883E-04
Pb-210	1.282E-07	8.293E-03	8.246E-03	8.401E-03	8.411E-03	7.929E-04	2.627E-04	3.377E-05	1.128E-05
Pu-239	0.000E+00	4.617E+00	4.628E+00	4.629E+00	4.629E+00	2.622E-01	2.562E-03	0.000E+00	0.000E+00
Pu-241	0.000E+00	1.072E-01	1.074E-01	1.077E-01	1.075E-01	6.086E-03	5.947E-05	0.000E+00	0.000E+00
Ra-226	1.883E-07	5.924E-02	5.929E-02	5.908E-02	5.914E-02	4.758E-03	3.994E-03	8.267E-06	4.134E-05
Tc-99	1.556E+00	3.234E+03	3.233E+03	3.237E+03	3.236E+03	2.205E+01	1.785E+02	2.734E+01	6.834E+00
Th-229	0.000E+00	2.073E-11	2.075E-11	2.084E-11	2.087E-11	1.182E-12	5.812E-14	0.000E+00	0.000E+00
Th-230	9.970E-08	6.938E-02	6.951E-02	6.961E-02	6.965E-02	3.945E-03	1.931E-04	6.318E-06	3.728E-05
U-233	0.000E+00	1.700E-08	1.693E-08	1.721E-08	1.723E-08	1.560E-09	2.597E-09	0.000E+00	0.000E+00
U-234	3.757E+00	1.914E+02	1.916E+02	1.916E+02	1.916E+02	1.750E+01	2.964E+01	3.300E+01	1.980E+02
U-235	3.461E-01	1.763E+01	1.765E+01	1.765E+01	1.765E+01	1.613E+00	2.731E+00	3.041E+00	1.824E+01
U-238	4.184E+00	2.131E+02	2.133E+02	2.133E+02	2.133E+02	1.949E+01	3.301E+01	3.675E+01	2.205E+02

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

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

Attachment 2 Sheet No. 13 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 14
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Ac-227	3.959E-02	3.959E-02	9.030E-07	1.226E-05	1.077E-05
Am-241	7.194E-01	7.194E-01	1.641E-05	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	1.222E-04	1.222E-04	2.788E-09	0.000E+00	0.000E+00
Np-237	8.674E-05	8.674E-05	1.978E-09	0.000E+00	0.000E+00
Pa-231	4.418E-02	4.418E-02	1.008E-06	5.383E-06	4.728E-06
Pb-210	1.042E-02	1.042E-02	2.378E-07	6.667E-07	5.857E-07
Pu-239	4.582E+00	4.582E+00	1.045E-04	0.000E+00	0.000E+00
Pu-241	7.053E-06	7.053E-06	1.609E-10	0.000E+00	0.000E+00
Ra-226	1.283E-02	1.283E-02	2.927E-07	1.109E-06	9.744E-07
Tc-99	1.909E-01	1.909E-01	4.355E-06	4.696E-01	4.125E-01
Th-229	5.697E-10	5.697E-10	1.299E-14	0.000E+00	0.000E+00
Th-230	2.051E-01	2.051E-01	4.679E-06	2.044E-08	1.795E-08
U-233	5.974E-08	5.974E-08	1.363E-12	0.000E+00	0.000E+00
U-234	7.464E+01	7.464E+01	1.702E-03	3.665E+00	3.219E+00
U-235	6.876E+00	6.876E+00	1.568E-04	3.376E-01	2.966E-01
U-238	8.310E+01	8.310E+01	1.896E-03	4.081E+00	3.585E+00

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

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 0.000E+00 pCi/m**3

Attachment 2 Sheet No. 14 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 15
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Ac-227	1.226E-05	9.940E-02	9.912E-02	1.004E-01	1.004E-01	9.854E-04	5.063E-04	1.614E-04	1.076E-02
Am-241	0.000E+00	7.199E-01	7.216E-01	7.218E-01	7.218E-01	2.044E-02	7.988E-04	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	4.888E-03	4.889E-03	4.895E-03	4.889E-03	1.181E-02	2.640E-03	0.000E+00	0.000E+00
Np-237	0.000E+00	1.735E-03	1.735E-03	1.734E-03	1.734E-03	1.613E-04	6.938E-07	0.000E+00	0.000E+00
Pa-231	5.402E-06	4.418E-01	4.420E-01	4.418E-01	4.418E-01	2.606E-01	2.321E-04	4.848E-05	5.273E-04
Pb-210	6.668E-07	1.047E-01	1.043E-01	1.057E-01	1.057E-01	9.972E-03	3.311E-03	1.756E-04	5.867E-05
Pu-239	0.000E+00	4.585E+00	4.596E+00	4.597E+00	4.597E+00	2.604E-01	2.544E-03	0.000E+00	0.000E+00
Pu-241	0.000E+00	7.057E-06	7.074E-06	7.095E-06	7.077E-06	4.008E-07	3.916E-09	0.000E+00	0.000E+00
Ra-226	1.109E-06	5.132E-01	5.134E-01	5.128E-01	5.130E-01	4.128E-02	3.463E-02	4.871E-05	2.436E-04
Tc-99	4.696E-01	9.549E+02	9.547E+02	9.557E+02	9.554E+02	6.511E+00	5.272E+01	8.251E+00	2.063E+00
Th-229	0.000E+00	5.704E-10	5.714E-10	5.723E-10	5.726E-10	3.243E-11	1.588E-12	0.000E+00	0.000E+00
Th-230	1.108E-07	2.053E-01	2.057E-01	2.059E-01	2.059E-01	1.166E-02	5.701E-04	7.349E-06	4.230E-05
U-233	0.000E+00	1.496E-07	1.496E-07	1.503E-07	1.504E-07	1.367E-08	2.288E-08	0.000E+00	0.000E+00
U-234	3.665E+00	1.866E+02	1.868E+02	1.868E+02	1.868E+02	1.707E+01	2.891E+01	3.219E+01	1.932E+02
U-235	3.376E-01	1.719E+01	1.721E+01	1.721E+01	1.721E+01	1.573E+00	2.663E+00	2.966E+00	1.779E+01
U-238	4.081E+00	2.078E+02	2.080E+02	2.080E+02	2.080E+02	1.901E+01	3.219E+01	3.585E+01	2.151E+02

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

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

Attachment 2 Sheet No. 15 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 16
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Ac-227	1.346E-01	1.346E-01	3.070E-06	4.158E-05	3.652E-05
Am-241	2.332E-01	2.332E-01	5.319E-06	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	1.138E-11	1.138E-11	2.596E-16	0.000E+00	0.000E+00
Np-237	1.841E-04	1.841E-04	4.199E-09	0.000E+00	0.000E+00
Pa-231	1.388E-01	1.388E-01	3.166E-06	1.690E-05	1.485E-05
Pb-210	1.178E-01	1.178E-01	2.686E-06	6.976E-06	6.128E-06
Pu-239	4.473E+00	4.473E+00	1.020E-04	0.000E+00	0.000E+00
Pu-241	1.634E-20	1.634E-20	3.727E-25	0.000E+00	0.000E+00
Ra-226	1.249E-01	1.249E-01	2.849E-06	1.053E-05	9.245E-06
Tc-99	2.671E-03	2.671E-03	6.092E-08	7.105E-03	6.241E-03
Th-229	1.699E-08	1.699E-08	3.875E-13	0.000E+00	0.000E+00
Th-230	6.527E-01	6.527E-01	1.489E-05	6.447E-08	5.663E-08
U-233	4.971E-07	4.971E-07	1.134E-11	0.000E+00	0.000E+00
U-234	6.836E+01	6.836E+01	1.559E-03	3.364E+00	2.955E+00
U-235	6.296E+00	6.296E+00	1.436E-04	3.099E-01	2.722E-01
U-238	7.610E+01	7.610E+01	1.736E-03	3.745E+00	3.290E+00

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

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of gaseous C-14 in air = 0.000E+00 pCi/m**3

Attachment 2 Sheet No. 16 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/06/2012 14:46 Page 17
Concent : 316-3 RESRAD Evaluation of Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_GROUNDWATER.RAD

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Ac-227	4.158E-05	3.378E-01	3.369E-01	3.409E-01	3.409E-01	3.233E-03	1.721E-03	5.476E-04	3.650E-02
Am-241	0.000E+00	2.333E-01	2.339E-01	2.340E-01	2.339E-01	6.625E-03	2.589E-04	0.000E+00	0.000E+00
C-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	4.552E-10	4.552E-10	4.558E-10	4.553E-10	1.099E-09	2.458E-10	0.000E+00	0.000E+00
Np-237	0.000E+00	3.682E-03	3.683E-03	3.683E-03	3.683E-03	3.425E-04	1.473E-06	0.000E+00	0.000E+00
Pa-231	1.692E-05	1.388E+00	1.389E+00	1.388E+00	1.389E+00	8.191E-01	7.290E-04	1.496E-04	1.640E-03
Pb-210	6.977E-06	1.182E+00	1.178E+00	1.192E+00	1.192E+00	1.124E-01	3.736E-02	1.838E-03	6.138E-04
Pu-239	0.000E+00	4.476E+00	4.486E+00	4.488E+00	4.488E+00	2.542E-01	2.483E-03	0.000E+00	0.000E+00
Pu-241	0.000E+00	1.635E-20	1.639E-20	1.644E-20	1.639E-20	9.284E-22	9.071E-24	0.000E+00	0.000E+00
Ra-226	1.053E-05	4.996E+00	4.997E+00	4.995E+00	4.996E+00	4.021E-01	3.372E-01	4.623E-04	2.311E-03
Tc-99	7.106E-03	1.336E+01	1.336E+01	1.337E+01	1.337E+01	9.108E-02	7.376E-01	1.248E-01	3.121E-02
Th-229	0.000E+00	1.700E-08	1.704E-08	1.705E-08	1.705E-08	9.658E-10	4.721E-11	0.000E+00	0.000E+00
Th-230	1.474E-07	6.531E-01	6.546E-01	6.549E-01	6.549E-01	3.709E-02	1.812E-03	1.076E-05	5.890E-05
U-233	0.000E+00	1.244E-06	1.244E-06	1.246E-06	1.246E-06	1.134E-07	1.902E-07	0.000E+00	0.000E+00
U-234	3.364E+00	1.709E+02	1.711E+02	1.711E+02	1.711E+02	1.564E+01	2.648E+01	2.955E+01	1.773E+02
U-235	3.099E-01	1.574E+01	1.576E+01	1.576E+01	1.576E+01	1.440E+00	2.439E+00	2.722E+00	1.633E+01
U-238	3.745E+00	1.903E+02	1.905E+02	1.905E+02	1.905E+02	1.741E+01	2.948E+01	3.290E+01	1.974E+02

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

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

Attachment 2 Sheet No. 17 of 17
Originator: S. W. Clark Date 1/3/2013
Chk'd By M. W. Perrott Date 1/3/2013
Calc. No. 0300X-CA-V0164 Rev. No. 1

CALCULATION COVER SHEET

Project Title: 300 Area Field Remediation **Job No. 14655**

Area: 300 Area

Discipline: Environmental *Calculation No: 0300X-CA-V0165

Subject: 316-3 Nonradionuclide Calc Brief for Groundwater and River Protection

Computer Program: RESRAD; Excel Program No: Version 6.5; Microsoft Excel 2003

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

Committed Calculation ☒ Preliminary ☐ Superseded ☐ Voided ☐

Rev.	Sheet Numbers	Originator	Checker	Reviewer	Approval	Date
0	Cover – 1 pg Summary – 6 pg Attm. 1 - 19 pg Attm. 2 - 9 pg Total – 35 pages	S. W. Clark	M. W. Perrott	I. B. Berezovskiy	T. Q. Howell	12/11/12

SUMMARY OF REVISION

WCH-DE-018 *Obtain Calc. No. from Document Control and Form from Intranet

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	12/11/12	Calc. No.:	0300X-CA-V0165	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	12/11/12
Subject:	316-3 Nonradionuclide Calc Brief for Groundwater and River Protection					Sheet No.	1 of 6

PURPOSE:

Predict concentrations of nonradionuclides (boron, selenium, and trichloroethene) in groundwater and the Columbia River within 1,000 years due to contaminant concentrations in vadose zone soil. Soil concentrations of boron, selenium, and trichloroethene exceed lookup values for groundwater and/or river protection in focused samples from test pits at the 316-3, 307 Disposal Trenches, Process Water Trenches waste site.

GIVEN/REFERENCES:

1) Focused samples were collected from test pits at six locations in the 316-3 waste site. Cleanup levels (i.e., lookup values) for vadose zone soil concentrations to be protective of groundwater and the Columbia River determined in Appendix D of the *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (300 Area RDR/RAWP), DOE/RL-2001-47, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2009a), were exceeded for several nonradionuclides (boron, selenium, and trichloroethene). Therefore, the analyses were evaluated by RESidual RADioactivity (RESRAD) modeling for nonradionuclides using input parameters and soil-partitioning coefficients from Appendix B of the 300 Area RDR/RAWP (DOE-RL 2009a). Site-specific RESRAD calculations were performed to predict the concentrations in groundwater due to nonradionuclides in the soil over a period of 1,000 years. Dilution and attenuation of nonradionuclide concentrations in groundwater as it flows from the area of the 316-3 waste site to the Columbia River were calculated using the U.S. Environmental Protection Agency (EPA) *Soil Screening Guidance: User's Guide,* OSWER 9355.4-23, July 1996, U.S. Environmental Protection Agency, Washington, D.C.
2) For the purpose of performing RESRAD calculations, nonradionuclide soil analyses for the contaminants of the 316-3 waste site focused sampling sites were obtained from the *Remaining Sites Verification Package for the 316-3, 307 Disposal Trenches, Process Water Trenches Waste Site* (WCH 2012), Waste Site Reclassification Form 2012-099, Washington Closure Hanford, Richland, Washington.
3) The RESidual RADioactivity (RESRAD) computer code, version 6.5, was developed for the U.S. Department of Energy by the Environmental Assessment Division of Argonne National Laboratory, Argonne, Illinois, to calculate compliance with residual radioactivity guidelines and may be accessed at < http://www.ead.anl.gov/resrad >. Use of site-specific RESRAD evaluations with surrogate radionuclides to predict nonradionuclide concentrations in groundwater due to concentrations in the soil is discussed in Appendix C of the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington (DOE-RL 2009b).
4) The 316-3 test pit sample design is available from the *316-3 Waste Site Subsurface Investigation Plan*, PLN-0012, Rev. 0, June, 2012, Washington Closure Hanford, Richland, Washington.
5) Groundwater elevations for determination of vadose zone thickness for RESRAD calculations were obtained from *Hanford Groundwater Monitoring for Fiscal Year 2009,* DOE/RL-2010-11, Rev. 1, U.S. Department of Energy, Richland, Washington.

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	12/11/12	Calc. No.:	0300X-CA-V0165	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	12/11/12
Subject:	316-3 Nonradionuclide Calc Brief for Groundwater and River Protection					Sheet No.	2 of 6

SOLUTION:

1) As discussed in Section 2.4 of the 300 Area RDR/RAWP (DOE-RL 2009a), site-specific factors such as the concentration of the contaminant at depth, the type of waste site (solid or liquid), and contaminant K_d values are used to verify that remaining concentrations of contaminants are protective of groundwater and the Columbia River (see Appendix D of the 300 Area RDR/RAWP). Development of a site-specific contaminant distribution model may be necessary to more accurately describe actual site conditions and show that contaminant concentrations decrease with soil depth. The model information is used to determine if the remaining residual concentrations of contaminants in the unsaturated vadose zone are protective of groundwater and the river, or if further excavation of remaining contamination in the unsaturated vadose zone is required.
2) Individual RESRAD runs were performed to predict concentrations of nonradionuclides in groundwater, assuming that the entire vadose zone was contaminated. Table 1 shows the waste site area and thickness for RESRAD modeling and the distance from the waste site to the Columbia River used in dilution-attenuation calculations. Table 2 shows the nonradionuclide analyses and the K_d values of the analytes used in the RESRAD evaluations. Input factors for each run are shown in the "Summary" sections of the RESRAD "Mixture Sums and Single Radionuclide Guidelines" printouts in Attachment 1 to this Calculation Summary.

Table 1. 316-3 Waste Site Dimensions for RESRAD Modeling

Parameter	Units	316-3 Waste Site Dimensions
Contaminated Zone Dimensions		
Cover Depth	m	0
Area of Contaminated Zone (CZ)	m^2	3,918
Length Parallel to Aquifer Flow	m	63
Thickness of Vadose Zone Horizons		
Thickness: Contaminated Zone	m	6
Thickness: Unsaturated, Uncontaminated Zone	m	0
Distance from the Waste Site to the Columbia River		
Saturated Zone Groundwater Flow Distance	m	235

Washington Closure Hanford				CALCULATION SHEET			
Originator:	S. W. Clark	Date:	12/11/12	Calc. No.:	0300X-CA-V0165	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	12/11/12
Subject:	316-3 Nonradionuclide Calc Brief for Groundwater and River Protection					Sheet No.	3 of 6

Table 2. 316-3 Nonradionuclide Analyses for RESRAD Modeling of Groundwater and Columbia River Protection

Nonradionuclide	Focused Sample Analyses (mg/kg) [a]	Nonradionuclide K_d Values (mL/g)	Surrogate Radionuclides [b]
Boron	412	3 [c]	Al-26
Selenium	4.05	5 [c]	Cl-36
Trichloroethene	0.0928	0.094 [d]	Np-237

[a] From *Remaining Sites Verification Package for the 316-3, 307 Disposal Trenches, Process Water Trenches Waste Site* (WCH 2012), Waste Site Reclassification Form 2012-099, Washington Closure Hanford, Richland, Washington.

[b] As discussed in Appendix C of the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 6, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

[c] K_d values from the 2nd column of Table 2-1 of the 300 Area RDR/RAWP (DOE-RL 2009a).

[d] This is the K_d value cited for trichloroethene (0.094 mL/g) in the 2nd column of Table 2-1 of the 300 Area RDR/RAWP (DOE-RL 2009a) per TPA-CN-407 (DOE-RL 2010). DOE-RL, 2010: Tri-Party Agreement Change Notice TPA-CN-407, December 2010, Modify *Remedial Design Report/Remedial Action Work Plan for the 300 Area* (DOE/RL-2001-47, Rev. 3) on page 2-17 of the document, make corrections to Table 2-1 for "lead" as detailed in Attachment 1, add "Trichloroethylene" to Table 2-1 on page 2-17 as specified in Attachment 1, make corrections to Tables B-8a, B-8b, D-1, D-2, D-3, and D-4 per Attachment 1. U.S. Department of Energy, Richland Operations Office, Richland, Washington.

3) The year when the peak dose (or concentration) occurs from each individual radionuclide COC and layer was determined by a preliminary run. This year was then added for all horizons for the final RESRAD runs. For the water pathways (i.e. well/drinking water and food ingestion) the peak year occurred at year zero (year 2012) for boron and trichloroethene and at year 3 (year 2015) for selenium.

METHODOLOGY:

1) Using the methodology described in Appendix C of the 100 Area RDR/RAWP (DOE-RL 2009b), RESRAD modeling was used to determine if vadose zone soil concentrations of boron, selenium, and trichloroethene (i.e., trichloroethylene; TCE) are protective of groundwater. Runs of RESRAD version 6.5 were completed for the contaminant concentrations in Table 2. The long half-life radionuclide surrogates aluminum-26 (Al-26), chlorine-36 (Cl-36), and neptunium-237 (Np-237) were used to represent the boron, selenium, and TCE concentrations as shown in Table 2. Radionuclide surrogate parameters were replaced with parameters specific to boron, selenium, and TCE. RESRAD numerical output reports of predicted boron, selenium, and TCE concentrations in groundwater are presented in Table 3, below, and in Attachment 2 to this calculation summary.

RESULTS:

1) Groundwater Protection

The boron, selenium, and TCE concentrations in groundwater at different time intervals up to 1,000 years were calculated by the RESRAD model using Al-26, Cl-36, and Np-237 as radionuclide surrogates. RESRAD output is presented in Attachment 2 and summarized in Table 3, below. Boron, selenium, and TCE are predicted to reach groundwater within the

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	12/11/12	Calc. No.:	0300X-CA-V0165	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	12/11/12
Subject:	316-3 Nonradionuclide Calc Brief for Groundwater and River Protection					Sheet No.	4 of 6

1,000 years of the RESRAD model evaluation and are predicted to peak at year zero for boron and TCE and year 3 for selenium. Maximum predicted groundwater (well water) concentrations within 1,000 years are shown in Table 3 (57.7 ug/L for boron, 0.348 ug/L for selenium, and 0.147 ug/L for TCE), which are less than the groundwater cleanup remedial action goals (RAGs) of 320 ug/L for boron, 50 ug/L for selenium, and 0.492 ug/L for TCE from Appendix D, Table D-1 of the 300 Area RDR/RAWP (DOE-RL 2009a).

Table 3. Predicted Groundwater Concentrations Due to 316-3 Vadose Zone Soil Contaminants

Contaminant	Predicted Groundwater Concentrations in ug/L at Each Time Interval (yr)								RAGs
	0	1	3	10	30	100	300	1000	
Boron, ug/L	57.7	57.6	57.6	57.6	57.3	56.5	54.4	47.4	320 ug/L [a]
Selenium, ug/L	0.224	0.281	0.348	0.348	0.348	0.346	0.342	0.329	50 ug/L [a]
TCE, ug/L	0.147	0.146	0.145	0.141	0.131	0.099	0.045	0.0029	0.492 ug/L [b]

[a] Based on the minimum groundwater cleanup level or MCL for boron and selenium from Appendix D, Table D-1 of the 300 Area RDR/RAWP (DOE-RL 2009a).

[b] This is the groundwater cleanup level (0.492 ug/L) used to calculate the soil cleanup level protective of groundwater for trichloroethylene (trichloroethene [TCE]) (0.0492 mg/kg) reported in column 6 of Table 2-1 of the 300 Area RDR/RAWP (DOE-RL 2009a) per TPA-CN-407 (DOE-RL 2010).

RAGs = Remedial Action Goals
MCL = Maximum Contaminant Level (EPA standard for drinking water)
TCE = trichloroethylene (trichloroethene)

2) Columbia River Protection

Methodology to predict if residual soil concentrations are protective of the Columbia River use the predicted groundwater concentrations which are reduced by using a dilution factor to account for dilution and attenuation as contaminants migrate through the groundwater to the river. Calculation of an appropriate dilution factor is accomplished using the formulas in the EPA *Soil Screening Guidance: User's Guide*. The following Excel spreadsheet, Table 4, incorporates the *User's Guide* formulas for calculation of the dilution factor to account for dilution and attenuation as contaminants migrate through the groundwater to the river:

Table 4. Excel Calculation of Dilution Factor for Protection of the Columbia River (2 Pages)

	A	B	C	D	E	F	G	H
1	Apparent Mixing Zone Depth (d) is calculated per the EPA *Soil Screening Guidance: User's Guide*, Equation 12:							
2	Apparent Mixing Zone Depth (d) = $(0.0112*L^2)^{0.5} + d_a(1 - \exp((-L*I)/(K*i*d_a)))$							
3	Variable	Value	Description					
4	L	235	m, Distance to the Columbia River					
5	d_a	25	m, Aquifer Thickness					
6	I	0.01152	m/yr, Infiltration Rate, from I = (1-Ce)((1-Cr)(Pr) + Irr)					
7	Ce	0.91	Evapotranspiration Coefficient					
8	Cr	0.2	Runoff Coefficient					
9	Pr	0.16	m/yr, Precipitation					
10	Irr	0	m/yr, Irrigation (Industrial Scenario)					
11	K	673,846	m/yr, Aquifer Hydraulic Conductivity					
12	i	0.0005	m/m, Hydraulic Gradient					
13	d	24.9	m, Apparent Mixing Zone Depth (see formula below)					

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	12/11/12	Calc. No.:	0300X-CA-V0165	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	12/11/12
Subject:	316-3 Nonradionuclide Calc Brief for Groundwater and River Protection					Sheet No.	5 of 6

14	Calculation of Dilution Factor per the EPA *Soil Screening Guidance: User's Guide*, Equation 11.				
15	Dilution Factor, D = 1 + (K*i*d/I*L)				
16	Variable	Value	Description		
17	K	673,846	m/yr, Aquifer Hydraulic Conductivity		
18	i	0.0005	m/m, Hydraulic Gradient		
19	d	24.9	m, Apparent Mixing Zone Depth (less than d_a, Aquifer Thickness)		
20	I	0.01152	m/yr, Infiltration Rate, from I = (1-Ce((1-Cr)Pr + Irr		
21	L1	63	m, Source Length Parallel to GW Flow		
22					
23	Apparent Mixing Zone Depth (d) = E26 = ((0.0112*B4*B4)^0.5)+(B5*(1-EXP((-B4)*(B6)/(B11*B12*B5)))				
24	Dilution Factor (D) = E27 = 1+((B17*B18*B19)/(B20*B21))				
25					
26	Apparent Mixing Zone Depth (d) =			24.9	m, (less than d_a, Aquifer Thickness)
27	Dilution Factor (D) =			115.6	

Predicted contaminant concentrations in groundwater at the Columbia River were calculated by dividing the predicted groundwater concentrations at the 316-3 waste site in Table 3 by the dilution factor of 115.6 determined in Table 4. Results are summarized in Table 5. Due to dilution and attenuation, all contaminants are predicted to reach the river with concentrations much less than the surface water cleanup RAGs from Table D-2 of Appendix D of the 300 Area RDR/RAWP (DOE-RL 2009a). Maximum predicted surface water concentrations (i.e., groundwater concentrations at the Columbia River) within 1,000 years are 0.5 ug/L for boron, 0.003 ug/L for selenium, and 0.001 ug/L for TCE, which are less than the surface water cleanup RAGs of 5 ug/L for selenium, and 2.70 ug/L for TCE from Appendix D, Table D-1 of the 300 Area RDR/RAWP (DOE-RL 2009a). Boron has no surface water RAG.

Table 5. Predicted Groundwater Concentrations at the Columbia River Based on Dilution and Attenuation of Groundwater from 316-3

Contaminant	Predicted Groundwater Concentrations in ug/L at Each Time Interval (yr)								RAGs
	0	1	3	10	30	100	300	1000	
Boron, ug/L	0.5	0.5	0.5	0.5	0.5	0.49	0.47	0.41	NA
Selenium, ug/L	0.002	0.002	0.003	0.003	0.003	0.003	0.003	0.003	5 ug/L [a]
TCE, ug/L	0.001	0.001	0.001	0.001	0.001	0.0008	0.0004	0.0002	2.70 ug/L [b]

[a] Based on the ambient water quality criteria for from Appendix D, Table D-2 of the 300 Area RDR/RAWP (DOE-RL 2009a).

[b] This is the surface water cleanup level (2.70 ug/L) used to calculate the soil cleanup level protective of groundwater for trichloroethene (TCE) (0.270 mg/kg) reported in column 7 of Table 2-1 of the 300 Area RDR/RAWP (DOE-RL 2009a) per TPA-CN-407 (DOE-RL 2010).

CONCLUSIONS:

- The maximum predicted groundwater (well water) concentrations within 1,000 years are shown in Table 3 (57.7 ug/L for boron, 0.348 ug/L for selenium, and 0.147 ug/L for TCE), which are less than the groundwater cleanup remedial action goals (RAGs) of 320 ug/L for boron, 50 ug/L for selenium, and 0.492 ug/L for TCE from Appendix D, Table D-1 of the 300 Area RDR/RAWP (DOE-RL 2009a).

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	12/11/12	Calc. No.:	0300X-CA-V0165	Rev.:	0
Project:	300 Area Field Remediation	Job No:	14655	Checked:	M. W. Perrott	Date:	12/11/12
Subject:	316-3 Nonradionuclide Calc Brief for Groundwater and River Protection					Sheet No. 6 of 6	

- The maximum predicted surface water concentrations (i.e., groundwater concentrations at the Columbia River) within 1,000 years are shown in Table 5 (0.5 ug/L for boron, 0.003 ug/L for selenium, and 0.001 ug/L for TCE), which are less than the surface water cleanup RAGs of 5 ug/L for selenium and 2.70 ug/L for TCE from Appendix D, Table D-1 of the 300 Area RDR/RAWP (DOE-RL 2009a). Boron has no surface water cleanup RAG.

ATTACHMENTS:

1. RESRAD Output: 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection – Mixture Sums and Single Radionuclide Guidelines (19 pages).
2. RESRAD Output: 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection – Concentration of Radionuclides, (9 pages).

ATTACHMENT 1

```
1RESRAD, Version 6.5      T« Limit = 180 days        12/11/2012  06:47  Page   1
 Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

                      Table of Contents
                      ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
   Part I: Mixture Sums and Single Radionuclide Guidelines
   ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ

 Dose Conversion Factor (and Related) Parameter Summary ...   2
 Site-Specific Parameter Summary ..........................   4
 Summary of Pathway Selections ............................   8
 Contaminated Zone and Total Dose Summary .................   9
 Total Dose Components
      Time = 0.000E+00 ....................................  10
      Time = 1.000E+00 ....................................  11
      Time = 3.000E+00 ....................................  12
      Time = 1.000E+01 ....................................  13
      Time = 3.000E+01 ....................................  14
      Time = 1.000E+02 ....................................  15
      Time = 3.000E+02 ....................................  16
      Time = 1.000E+03 ....................................  17
 Dose/Source Ratios Summed Over All Pathways ..............  18
 Single Radionuclide Soil Guidelines ......................  18
 Dose Per Nuclide Summed Over All Pathways ................  19
 Soil Concentration Per Nuclide ...........................  19
```

Attachment 1 Sheet No. 1 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 2
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

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

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-225 (Source: FGR 12)	6.371E-02	6.371E-02	DCF1(1)
A-1	Al-26 (Source: FGR 12)	1.741E+01	1.741E+01	DCF1(2)
A-1	At-217 (Source: FGR 12)	1.773E-03	1.773E-03	DCF1(3)
A-1	Bi-213 (Source: FGR 12)	7.660E-01	7.660E-01	DCF1(4)
A-1	Cl-36 (Source: FGR 12)	2.391E-03	2.391E-03	DCF1(5)
A-1	Fr-221 (Source: FGR 12)	1.536E-01	1.536E-01	DCF1(6)
A-1	Np-237 (Source: FGR 12)	7.790E-02	7.790E-02	DCF1(7)
A-1	Pa-233 (Source: FGR 12)	1.020E+00	1.020E+00	DCF1(8)
A-1	Pb-209 (Source: FGR 12)	7.734E-04	7.734E-04	DCF1(9)
A-1	Po-213 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(10)
A-1	Ra-225 (Source: FGR 12)	1.102E-02	1.102E-02	DCF1(11)
A-1	Th-229 (Source: FGR 12)	3.213E-01	3.213E-01	DCF1(12)
A-1	Tl-209 (Source: FGR 12)	1.293E+01	1.293E+01	DCF1(13)
A-1	U-233 (Source: FGR 12)	1.397E-03	1.397E-03	DCF1(14)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Al-26	7.960E-05	7.960E-05	DCF2(1)
B-1	Cl-36	2.190E-05	2.190E-05	DCF2(2)
B-1	Np-237+D	5.400E-01	5.400E-01	DCF2(3)
B-1	Th-229+D	2.169E+00	2.150E+00	DCF2(4)
B-1	U-233	1.350E-01	1.350E-01	DCF2(5)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Al-26	1.460E-05	1.460E-05	DCF3(1)
D-1	Cl-36	3.030E-06	3.030E-06	DCF3(2)
D-1	Np-237+D	4.444E-03	4.440E-03	DCF3(3)
D-1	Th-229+D	4.027E-03	3.530E-03	DCF3(4)
D-1	U-233	2.890E-04	2.890E-04	DCF3(5)
D-34	Food transfer factors:			
D-34	Al-26 , plant/soil concentration ratio, dimensionless	4.000E-03	4.000E-03	RTF(1,1)
D-34	Al-26 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-04	5.000E-04	RTF(1,2)
D-34	Al-26 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-04	2.000E-04	RTF(1,3)
D-34	Cl-36 , plant/soil concentration ratio, dimensionless	2.000E+01	2.000E+01	RTF(2,1)
D-34	Cl-36 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	6.000E-02	6.000E-02	RTF(2,2)
D-34	Cl-36 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-02	2.000E-02	RTF(2,3)
D-34	Np-237+D , plant/soil concentration ratio, dimensionless	2.000E-02	2.000E-02	RTF(3,1)
D-34	Np-237+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(3,2)
D-34	Np-237+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(3,3)
D-34	Th-229+D , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(4,1)
D-34	Th-229+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(4,2)
D-34	Th-229+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(4,3)
D-34	U-233 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(5,1)
D-34	U-233 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(5,2)
D-34	U-233 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(5,3)

Attachment 1 Sheet No. 2 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 3
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

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

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Al-26 , fish	5.000E+02	5.000E+02	BIOFAC(1,1)
D-5	Al-26 , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Cl-36 , fish	1.000E+03	1.000E+03	BIOFAC(2,1)
D-5	Cl-36 , crustacea and mollusks	1.900E+02	1.900E+02	BIOFAC(2,2)
D-5				
D-5	Np-237+D , fish	3.000E+01	3.000E+01	BIOFAC(3,1)
D-5	Np-237+D , crustacea and mollusks	4.000E+02	4.000E+02	BIOFAC(3,2)
D-5				
D-5	Th-229+D , fish	1.000E+02	1.000E+02	BIOFAC(4,1)
D-5	Th-229+D , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(4,2)
D-5				
D-5	U-233 , fish	1.000E+01	1.000E+01	BIOFAC(5,1)
D-5	U-233 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(5,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.
*Base Case means Default.Lib w/o Associate Nuclide contributions.

Attachment 1 Sheet No. 3 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 4
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	3.918E+03	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	6.000E+00	2.000E+00	---	THICKO
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	6.300E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	1.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Al-26	4.120E+02	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Cl-36	4.050E+00	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Np-237	9.280E-02	0.000E+00	---	S1(3)
R012	Concentration in groundwater (pCi/L): Al-26	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Cl-36	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Np-237	not used	0.000E+00	---	W1(3)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	0.000E+00	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	3.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.200E-03	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	1.500E+01	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.524E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	0.000E+00	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+07	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	3.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	3.000E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	6.738E+05	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	5.000E-04	2.000E-02	---	HGWT
R014	Saturated zone b parameter	3.500E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT

Attachment 1 Sheet No. 4 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 5
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	0	1	---	NS
R016	Distribution coefficients for Al-26				
R016	Contaminated zone (cm**3/g)	3.000E+00	0.000E+00	---	DCNUCC(1)
R016	Saturated zone (cm**3/g)	3.000E+00	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.586E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Cl-36				
R016	Contaminated zone (cm**3/g)	5.000E+00	1.000E-01	---	DCNUCC(2)
R016	Saturated zone (cm**3/g)	5.000E+00	1.000E-01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.203E-04	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Np-237				
R016	Contaminated zone (cm**3/g)	9.400E-02	-1.000E+00	---	DCNUCC(3)
R016	Saturated zone (cm**3/g)	9.400E-02	-1.000E+00	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.060E-03	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for daughter Th-229				
R016	Contaminated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCC(4)
R016	Saturated zone (cm**3/g)	6.000E+04	6.000E+04	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.905E-08	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)
R016	Distribution coefficients for daughter U-233				
R016	Contaminated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCC(5)
R016	Saturated zone (cm**3/g)	5.000E+01	5.000E+01	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.277E-05	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---	MLINH
R017	Exposure duration	3.000E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	not used	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	not used	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	not used	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular AREA.	FS

Attachment 1 Sheet No. 5 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 6
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	1.100E+02	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	2.700E+00	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	1.000E+02	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	3.600E+01	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	1.970E+01	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	9.000E-01	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	2.500E+02	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	1.000E+00	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	1.000E+00	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	5.000E-01	5.000E-01	---	FR9
R018	Contamination fraction of plant food	-1	-1	0.500E+00	FPLANT
R018	Contamination fraction of meat	-1	-1	0.196E+00	FMEAT
R018	Contamination fraction of milk	-1	-1	0.196E+00	FMILK
R019	Livestock fodder intake for meat (kg/day)	6.800E+01	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	5.500E+01	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	5.000E+01	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	1.600E+02	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	5.000E-01	5.000E-01	---	LSI

Attachment 1 Sheet No. 6 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 7
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R019	Mass loading for foliar deposition (g/m**3)	1.000E-04	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
R019	Depth of roots (m)	9.000E-01	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	1.000E+00	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	1.000E+00	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	1.100E+00	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	8.000E-02	8.000E-02	---	TE(3)
R19B	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	1.000E+00	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	2.500E-01	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	2.500E-01	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	2.500E-01	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	2.000E+01	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL

Attachment 1 Sheet No. 7 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 8
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Site-Specific Parameter Summary (continued)

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

Summary of Pathway Selections

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

Attachment 1 Sheet No. 8 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

```
1RESRAD, Version 6.5      T« Limit = 180 days       12/11/2012  06:47  Page   9
 Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

      Contaminated Zone Dimensions           Initial Soil Concentrations, pCi/g
      ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ           ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
        Area:   3918.00 square meters              Al-26      4.120E+02
   Thickness:      6.00 meters                     Cl-36      4.050E+00
 Cover Depth:      0.00 meters                     Np-237     9.280E-02
0
                                  Total Dose TDOSE(t), mrem/yr
                              Basic Radiation Dose Limit = 1.500E+01 mrem/yr
             Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)
             ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
    t (years):  0.000E+00  1.000E+00  3.000E+00  1.000E+01  3.000E+01  1.000E+02  3.000E+02  1.000E+03
     TDOSE(t):  3.267E+01  3.267E+01  3.265E+01  3.257E+01  3.236E+01  3.167E+01  2.997E+01  2.540E+01
         M(t):  2.178E+00  2.178E+00  2.176E+00  2.171E+00  2.157E+00  2.111E+00  1.998E+00  1.693E+00
0Maximum TDOSE(t):  3.267E+01 mrem/yr   at t = 0.000E+00 years
```

Attachment 1 Sheet No. 9 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 10
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.356E+00	0.0415	1.638E-02	0.0005	1.697E-02	0.0005	0.000E+00	0.0000
Cl-36	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.383E+01	0.4233	7.065E+00	0.2162	5.291E+00	0.1619	0.000E+00	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.648E-01	0.0142	5.410E-03	0.0002	6.463E-05	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.565E+01	0.4790	7.086E+00	0.2169	5.308E+00	0.1625	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Al-26	2.105E-01	0.0064	3.975E+00	0.1217	0.000E+00	0.0000	0.000E+00	0.0000	1.484E-04	0.0000	5.277E-04	0.0000	5.575E+00	0.1706
Cl-36	1.700E-04	0.0000	5.934E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	1.439E-05	0.0000	4.262E-05	0.0000	2.619E+01	0.8016
Np-237	1.634E-01	0.0050	2.730E-01	0.0084	0.000E+00	0.0000	0.000E+00	0.0000	2.304E-04	0.0000	1.024E-05	0.0000	9.068E-01	0.0278
Total	3.740E-01	0.0114	4.254E+00	0.1302	0.000E+00	0.0000	0.000E+00	0.0000	3.933E-04	0.0000	5.806E-04	0.0000	3.267E+01	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 10 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

```
1RESRAD, Version 6.5     T« Limit = 180 days       12/11/2012  06:47  Page  11
 Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD
```

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.356E+00	0.0415	1.637E-02	0.0005	1.697E-02	0.0005	0.000E+00	0.0000
Cl-36	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.383E+01	0.4233	7.063E+00	0.2162	5.290E+00	0.1619	0.000E+00	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.629E-01	0.0142	5.391E-03	0.0002	6.440E-05	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.565E+01	0.4790	7.085E+00	0.2169	5.307E+00	0.1625	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Al-26	2.104E-01	0.0064	3.974E+00	0.1217	0.000E+00	0.0000	0.000E+00	0.0000	1.484E-04	0.0000	5.276E-04	0.0000	5.574E+00	0.1706
Cl-36	2.125E-04	0.0000	7.320E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	1.719E-05	0.0000	5.316E-05	0.0000	2.619E+01	0.8017
Np-237	1.627E-01	0.0050	2.719E-01	0.0083	0.000E+00	0.0000	0.000E+00	0.0000	2.296E-04	0.0000	1.020E-05	0.0000	9.033E-01	0.0277
Total	3.734E-01	0.0114	4.253E+00	0.1302	0.000E+00	0.0000	0.000E+00	0.0000	3.952E-04	0.0000	5.910E-04	0.0000	3.267E+01	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 11 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 12
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.355E+00	0.0415	1.636E-02	0.0005	1.695E-02	0.0005	0.000E+00	0.0000
Cl-36	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.382E+01	0.4234	7.060E+00	0.2163	5.288E+00	0.1620	0.000E+00	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.592E-01	0.0141	5.348E-03	0.0002	6.388E-05	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.563E+01	0.4789	7.082E+00	0.2169	5.305E+00	0.1625	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Al-26	2.103E-01	0.0064	3.973E+00	0.1217	0.000E+00	0.0000	0.000E+00	0.0000	1.483E-04	0.0000	5.274E-04	0.0000	5.571E+00	0.1707
Cl-36	2.638E-04	0.0000	9.209E-03	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	2.232E-05	0.0000	6.614E-05	0.0000	2.618E+01	0.8019
Np-237	1.615E-01	0.0049	2.698E-01	0.0083	0.000E+00	0.0000	0.000E+00	0.0000	2.278E-04	0.0000	1.012E-05	0.0000	8.961E-01	0.0274
Total	3.721E-01	0.0114	4.252E+00	0.1302	0.000E+00	0.0000	0.000E+00	0.0000	3.985E-04	0.0000	6.037E-04	0.0000	3.265E+01	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 12 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 13
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.351E+00	0.0415	1.632E-02	0.0005	1.691E-02	0.0005	0.000E+00	0.0000
Cl-36	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.380E+01	0.4237	7.049E+00	0.2164	5.280E+00	0.1621	0.000E+00	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.463E-01	0.0137	5.198E-03	0.0002	6.209E-05	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.560E+01	0.4789	7.071E+00	0.2171	5.297E+00	0.1626	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Al-26	2.101E-01	0.0064	3.967E+00	0.1218	0.000E+00	0.0000	0.000E+00	0.0000	1.481E-04	0.0000	5.267E-04	0.0000	5.562E+00	0.1708
Cl-36	2.637E-04	0.0000	9.205E-03	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	2.231E-05	0.0000	6.612E-05	0.0000	2.614E+01	0.8025
Np-237	1.571E-01	0.0048	2.625E-01	0.0081	0.000E+00	0.0000	0.000E+00	0.0000	2.216E-04	0.0000	9.848E-06	0.0000	8.714E-01	0.0268
Total	3.674E-01	0.0113	4.239E+00	0.1301	0.000E+00	0.0000	0.000E+00	0.0000	3.921E-04	0.0000	6.027E-04	0.0000	3.257E+01	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 13 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 14
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.342E+00	0.0415	1.620E-02	0.0005	1.679E-02	0.0005	0.000E+00	0.0000
Cl-36	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.374E+01	0.4245	7.018E+00	0.2169	5.256E+00	0.1624	0.000E+00	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.115E-01	0.0127	4.792E-03	0.0001	5.727E-05	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.549E+01	0.4787	7.039E+00	0.2175	5.273E+00	0.1629	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Al-26	2.092E-01	0.0065	3.952E+00	0.1221	0.000E+00	0.0000	0.000E+00	0.0000	1.476E-04	0.0000	5.247E-04	0.0000	5.536E+00	0.1711
Cl-36	2.634E-04	0.0000	9.194E-03	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	2.229E-05	0.0000	6.604E-05	0.0000	2.602E+01	0.8041
Np-237	1.452E-01	0.0045	2.426E-01	0.0075	0.000E+00	0.0000	0.000E+00	0.0000	2.049E-04	0.0000	9.103E-06	0.0000	8.044E-01	0.0249
Total	3.547E-01	0.0110	4.203E+00	0.1299	0.000E+00	0.0000	0.000E+00	0.0000	3.747E-04	0.0000	5.998E-04	0.0000	3.236E+01	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 14 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 15
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Independent Pathways (Inhalation excludes radon)

0 Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.308E+00	0.0413	1.580E-02	0.0005	1.637E-02	0.0005	0.000E+00	0.0000
Cl-36	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.353E+01	0.4270	6.909E+00	0.2181	5.175E+00	0.1634	0.000E+00	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.097E-01	0.0098	3.607E-03	0.0001	4.315E-05	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.514E+01	0.4781	6.929E+00	0.2188	5.191E+00	0.1639	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years
0 Water Dependent Pathways

0 Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Al-26	2.064E-01	0.0065	3.898E+00	0.1231	0.000E+00	0.0000	0.000E+00	0.0000	1.455E-04	0.0000	5.175E-04	0.0000	5.445E+00	0.1719
Cl-36	2.623E-04	0.0000	9.157E-03	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	2.220E-05	0.0000	6.577E-05	0.0000	2.562E+01	0.8089
Np-237	1.103E-01	0.0035	1.843E-01	0.0058	0.000E+00	0.0000	0.000E+00	0.0000	1.556E-04	0.0000	6.913E-06	0.0000	6.080E-01	0.0192
Total	3.169E-01	0.0100	4.091E+00	0.1292	0.000E+00	0.0000	0.000E+00	0.0000	3.233E-04	0.0000	5.902E-04	0.0000	3.167E+01	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 15 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 16
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.217E+00	0.0406	1.471E-02	0.0005	1.524E-02	0.0005	0.000E+00	0.0000
Cl-36	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.294E+01	0.4316	6.608E+00	0.2205	4.949E+00	0.1651	0.000E+00	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.375E-01	0.0046	1.601E-03	0.0001	1.927E-05	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.429E+01	0.4768	6.625E+00	0.2210	4.965E+00	0.1656	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years
Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Al-26	1.984E-01	0.0066	3.748E+00	0.1250	0.000E+00	0.0000	0.000E+00	0.0000	1.399E-04	0.0000	4.976E-04	0.0000	5.194E+00	0.1733
Cl-36	2.593E-04	0.0000	9.051E-03	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	2.194E-05	0.0000	6.502E-05	0.0000	2.450E+01	0.8176
Np-237	5.024E-02	0.0017	8.395E-02	0.0028	0.000E+00	0.0000	0.000E+00	0.0000	7.088E-05	0.0000	3.150E-06	0.0000	2.734E-01	0.0091
Total	2.489E-01	0.0083	3.841E+00	0.1281	0.000E+00	0.0000	0.000E+00	0.0000	2.328E-04	0.0000	5.658E-04	0.0000	2.997E+01	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 16 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 17
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	Soil mrem/yr	Soil fract.
Al-26	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.465E-01	0.0373	1.143E-02	0.0005	1.185E-02	0.0005	0.000E+00	0.0000
Cl-36	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.107E+01	0.4359	5.655E+00	0.2227	4.235E+00	0.1668	0.000E+00	0.0000
Np-237	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.018E-03	0.0003	9.336E-05	0.0000	1.324E-06	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.202E+01	0.4735	5.666E+00	0.2231	4.247E+00	0.1672	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Milk mrem/yr	Milk fract.	All Pathways* mrem/yr	All Pathways* fract.
Al-26	1.730E-01	0.0068	3.267E+00	0.1286	0.000E+00	0.0000	0.000E+00	0.0000	1.220E-04	0.0000	4.337E-04	0.0000	4.410E+00	0.1737
Cl-36	2.490E-04	0.0000	8.691E-03	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	2.107E-05	0.0000	6.243E-05	0.0000	2.097E+01	0.8257
Np-237	3.205E-03	0.0001	5.356E-03	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	4.522E-06	0.0000	2.013E-07	0.0000	1.668E-02	0.0007
Total	1.764E-01	0.0069	3.281E+00	0.1292	0.000E+00	0.0000	0.000E+00	0.0000	1.476E-04	0.0000	4.964E-04	0.0000	2.540E+01	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 1 Sheet No. 17 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

```
1RESRAD, Version 6.5      T« Limit = 180 days        12/11/2012  06:47  Page  18
 Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

                                Dose/Source Ratios Summed Over All Pathways
                          Parent and Progeny Principal Radionuclide Contributions Indicated
0  Parent     Product     Thread                    DSR(j,t) At Time in Years   (mrem/yr)/(pCi/g)
    (i)         (j)      Fraction   0.000E+00 1.000E+00 3.000E+00 1.000E+01 3.000E+01 1.000E+02 3.000E+02 1.000E+03
 ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 Al-26       Al-26       1.000E+00  1.353E-02 1.353E-02 1.352E-02 1.350E-02 1.344E-02 1.322E-02 1.261E-02 1.070E-02
0Cl-36       Cl-36       1.000E+00  6.467E+00 6.466E+00 6.464E+00 6.454E+00 6.425E+00 6.326E+00 6.050E+00 5.177E+00
0Np-237+D    Np-237+D    1.000E+00  9.772E+00 9.734E+00 9.656E+00 9.390E+00 8.668E+00 6.552E+00 2.946E+00 1.797E-01
 Np-237+D    U-233       1.000E+00  4.644E-09 2.646E-07 6.467E-07 1.959E-06 5.506E-06 1.587E-05 3.330E-05 4.573E-05
 Np-237+D    Th-229+D    1.000E+00  6.820E-12 6.273E-11 4.572E-10 4.756E-09 4.108E-08 4.137E-07 2.910E-06 1.679E-05
 Np-237+D    äDSR(j)                9.772E+00 9.734E+00 9.656E+00 9.390E+00 8.668E+00 6.552E+00 2.946E+00 1.797E-01
 ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ
 The DSR includes contributions from associated (half-life ó 180 days) daughters.
0
                                Single Radionuclide Soil Guidelines G(i,t) in pCi/g
                                  Basic Radiation Dose Limit = 1.500E+01 mrem/yr
0Nuclide
   (i)     t= 0.000E+00   1.000E+00   3.000E+00   1.000E+01   3.000E+01   1.000E+02   3.000E+02   1.000E+03
 ÄÄÄÄÄÄÄ     ÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ
 Al-26       1.108E+03   1.109E+03   1.109E+03   1.111E+03   1.116E+03   1.135E+03   1.190E+03   1.401E+03
 Cl-36       2.319E+00   2.320E+00   2.321E+00   2.324E+00   2.335E+00   2.371E+00   2.479E+00   2.897E+00
 Np-237      1.535E+00   1.541E+00   1.553E+00   1.597E+00   1.730E+00   2.289E+00   5.092E+00   8.346E+01
 ÍÍÍÍÍÍÍ     ÍÍÍÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍ
0
              Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
              and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
          at tmin = time of minimum single radionuclide soil guideline
       and at tmax = time of maximum total dose = 0.000E+00 years
0Nuclide  Initial       tmin       DSR(i,tmin) G(i,tmin) DSR(i,tmax) G(i,tmax)
   (i)    (pCi/g)      (years)                  (pCi/g)               (pCi/g)
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 Al-26   4.120E+02   0.000E+00   1.353E-02 1.108E+03 1.353E-02 1.108E+03
 Cl-36   4.050E+00   0.000E+00   6.467E+00 2.319E+00 6.467E+00 2.319E+00
 Np-237  9.280E-02   0.000E+00   9.772E+00 1.535E+00 9.772E+00 1.535E+00
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ
```

Attachment 1 Sheet No. 18 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 1

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 19
Summary : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

ONuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr							
			t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Al-26	Al-26	1.000E+00	5.575E+00	5.574E+00	5.571E+00	5.562E+00	5.536E+00	5.445E+00	5.194E+00	4.410E+00
0Cl-36	Cl-36	1.000E+00	2.619E+01	2.619E+01	2.618E+01	2.614E+01	2.602E+01	2.562E+01	2.450E+01	2.097E+01
0Np-237	Np-237	1.000E+00	9.068E-01	9.033E-01	8.961E-01	8.714E-01	8.044E-01	6.080E-01	2.734E-01	1.667E-02
0U-233	Np-237	1.000E+00	4.309E-10	2.455E-08	6.002E-08	1.818E-07	5.110E-07	1.473E-06	3.090E-06	4.243E-06
0Th-229	Np-237	1.000E+00	6.329E-13	5.822E-12	4.243E-11	4.414E-10	3.812E-09	3.840E-08	2.700E-07	1.558E-06

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

ONuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g							
			t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
Al-26	Al-26	1.000E+00	4.120E+02	4.119E+02	4.116E+02	4.105E+02	4.076E+02	3.974E+02	3.699E+02	2.876E+02
0Cl-36	Cl-36	1.000E+00	4.050E+00	4.049E+00	4.047E+00	4.041E+00	4.023E+00	3.961E+00	3.788E+00	3.242E+00
0Np-237	Np-237	1.000E+00	9.280E-02	9.242E-02	9.168E-02	8.911E-02	8.216E-02	6.183E-02	2.745E-02	1.600E-03
0U-233	Np-237	1.000E+00	0.000E+00	4.050E-07	1.210E-06	3.976E-06	1.146E-05	3.331E-05	7.004E-05	9.618E-05
0Th-229	Np-237	1.000E+00	0.000E+00	1.914E-11	1.717E-10	1.890E-09	1.655E-08	1.674E-07	1.179E-06	6.804E-06

THF(i) is the thread fraction of the parent nuclide.
ORESCALC.EXE execution time = 1.28 seconds

Attachment 1 Sheet No. 19 of 19
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 2

```
1RESRAD, Version 6.5      T« Limit = 180 days       12/11/2012  06:47  Page    1
 Concent : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
 File    : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

                      Table of Contents
                      ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
             Part IV: Concentration of Radionuclides
             ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ
```

Concentration of radionuclides in different media

Attachment 2 Sheet No. 1 of 9
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 2
Concent : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Al-26	4.120E+02	4.120E+02	9.398E-03	5.766E+01	5.065E+01
Cl-36	4.050E+00	4.050E+00	9.238E-05	2.244E-01	1.971E-01
Np-237	9.280E-02	9.280E-02	2.117E-06	1.471E-01	1.292E-01
Th-229	0.000E+00	0.000E+00	0.000E+00	1.197E-13	1.051E-13
U-233	0.000E+00	0.000E+00	0.000E+00	4.116E-09	3.616E-09

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

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

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Al-26	5.766E+01	1.648E+03	1.649E+03	1.649E+03	1.649E+03	1.605E+02	6.119E+01	2.533E+04	5.065E+04
Cl-36	2.244E-01	8.100E+04	8.100E+04	8.100E+04	8.100E+04	3.306E+05	8.914E+04	1.971E+02	3.745E+01
Np-237	1.471E-01	1.856E+00	1.856E+00	1.856E+00	1.856E+00	1.800E-01	8.601E-04	3.876E+00	5.168E+01
Th-229	1.197E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.985E-16	9.576E-17	1.051E-11	5.257E-11
U-233	4.116E-09	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.998E-11	3.952E-10	3.616E-08	2.169E-07

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

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

Attachment 2 Sheet No. 2 of 9
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 3
Concent : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Al-26	4.119E+02	4.119E+02	9.394E-03	5.765E+01	5.064E+01
Cl-36	4.049E+00	4.049E+00	9.236E-05	2.811E-01	2.469E-01
Np-237	9.242E-02	9.242E-02	2.108E-06	1.465E-01	1.287E-01
Th-229	1.914E-11	1.914E-11	4.365E-16	1.534E-13	1.347E-13
U-233	4.050E-07	4.050E-07	9.238E-12	7.561E-09	6.641E-09

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

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

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Al-26	5.765E+01	1.648E+03	1.649E+03	1.649E+03	1.649E+03	1.605E+02	6.117E+01	2.532E+04	5.064E+04
Cl-36	2.805E-01	8.098E+04	8.098E+04	8.099E+04	8.098E+04	3.305E+05	8.912E+04	2.431E+02	4.620E+01
Np-237	1.465E-01	1.849E+00	1.849E+00	1.850E+00	1.850E+00	1.794E-01	8.569E-04	3.861E+00	5.148E+01
Th-229	1.554E-13	2.180E-11	1.935E-11	2.848E-11	3.078E-11	1.717E-12	1.038E-13	1.375E-11	7.133E-11
U-233	9.304E-09	1.284E-06	1.033E-06	1.831E-06	1.883E-06	1.505E-07	1.842E-07	3.893E-07	4.709E-06

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

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

Attachment 2 Sheet No. 3 of 9
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 4
Concent : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Al-26	4.116E+02	4.116E+02	9.387E-03	5.763E+01	5.062E+01
Cl-36	4.047E+00	4.047E+00	9.232E-05	3.482E-01	3.059E-01
Np-237	9.168E-02	9.168E-02	2.091E-06	1.453E-01	1.277E-01
Th-229	1.717E-10	1.717E-10	3.917E-15	2.798E-13	2.458E-13
U-233	1.210E-06	1.210E-06	2.760E-11	1.340E-08	1.177E-08

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

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

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Al-26	5.763E+01	1.647E+03	1.647E+03	1.648E+03	1.648E+03	1.604E+02	6.112E+01	2.531E+04	5.062E+04
Cl-36	3.482E-01	8.095E+04	8.095E+04	8.095E+04	8.095E+04	3.304E+05	8.908E+04	3.059E+02	5.812E+01
Np-237	1.453E-01	1.834E+00	1.834E+00	1.835E+00	1.835E+00	1.779E-01	8.500E-04	3.830E+00	5.107E+01
Th-229	2.833E-13	1.789E-10	1.727E-10	1.914E-10	1.977E-10	1.119E-11	6.105E-13	2.496E-11	1.274E-10
U-233	1.513E-08	3.295E-06	3.048E-06	3.839E-06	3.891E-06	3.336E-07	4.926E-07	4.382E-07	4.983E-06

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

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

Attachment 2 Sheet No. 4 of 9
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 5
Concent : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Al-26	4.105E+02	4.105E+02	9.364E-03	5.755E+01	5.055E+01
Cl-36	4.041E+00	4.041E+00	9.217E-05	3.481E-01	3.058E-01
Np-237	8.911E-02	8.911E-02	2.032E-06	1.414E-01	1.242E-01
Th-229	1.890E-09	1.890E-09	4.310E-14	7.017E-13	6.164E-13
U-233	3.976E-06	3.976E-06	9.070E-11	3.248E-08	2.853E-08

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

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

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Al-26	5.755E+01	1.642E+03	1.643E+03	1.644E+03	1.644E+03	1.600E+02	6.097E+01	2.528E+04	5.055E+04
Cl-36	3.481E-01	8.082E+04	8.082E+04	8.082E+04	8.082E+04	3.299E+05	8.895E+04	3.058E+02	5.810E+01
Np-237	1.414E-01	1.782E+00	1.782E+00	1.784E+00	1.783E+00	1.729E-01	8.263E-04	3.727E+00	4.969E+01
Th-229	7.102E-13	1.913E-09	1.897E-09	1.949E-09	1.969E-09	1.116E-10	5.665E-12	6.233E-11	3.145E-10
U-233	3.416E-08	1.021E-05	9.972E-06	1.074E-05	1.079E-05	9.627E-07	1.552E-06	5.971E-07	5.873E-06

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

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

Attachment 2 Sheet No. 5 of 9
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 6
Concent : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Al-26	4.076E+02	4.076E+02	9.297E-03	5.732E+01	5.035E+01
Cl-36	4.023E+00	4.023E+00	9.176E-05	3.477E-01	3.054E-01
Np-237	8.216E-02	8.216E-02	1.874E-06	1.307E-01	1.148E-01
Th-229	1.655E-08	1.655E-08	3.774E-13	1.885E-12	1.656E-12
U-233	1.146E-05	1.146E-05	2.613E-10	8.344E-08	7.329E-08

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

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

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Al-26	5.732E+01	1.631E+03	1.632E+03	1.632E+03	1.632E+03	1.588E+02	6.054E+01	2.518E+04	5.035E+04
Cl-36	3.477E-01	8.046E+04	8.046E+04	8.046E+04	8.046E+04	3.284E+05	8.855E+04	3.054E+02	5.803E+01
Np-237	1.307E-01	1.643E+00	1.643E+00	1.645E+00	1.644E+00	1.595E-01	7.621E-04	3.445E+00	4.593E+01
Th-229	1.907E-12	1.662E-08	1.660E-08	1.674E-08	1.680E-08	9.519E-10	4.712E-11	1.671E-10	8.388E-10
U-233	8.500E-08	2.889E-05	2.870E-05	2.941E-05	2.945E-05	2.664E-06	4.417E-06	1.021E-06	8.244E-06

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

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

Attachment 2 Sheet No. 6 of 9
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 7
Concent : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Al-26	3.974E+02	3.974E+02	9.066E-03	5.654E+01	4.967E+01
Cl-36	3.961E+00	3.961E+00	9.034E-05	3.463E-01	3.042E-01
Np-237	6.183E-02	6.183E-02	1.410E-06	9.927E-02	8.720E-02
Th-229	1.674E-07	1.674E-07	3.819E-12	5.960E-12	5.235E-12
U-233	3.331E-05	3.331E-05	7.597E-10	2.334E-07	2.050E-07

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

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

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Al-26	5.654E+01	1.590E+03	1.591E+03	1.591E+03	1.591E+03	1.549E+02	5.906E+01	2.483E+04	4.967E+04
Cl-36	3.463E-01	7.922E+04	7.922E+04	7.922E+04	7.922E+04	3.233E+05	8.718E+04	3.042E+02	5.779E+01
Np-237	9.927E-02	1.237E+00	1.237E+00	1.238E+00	1.237E+00	1.200E-01	5.743E-04	2.616E+00	3.488E+01
Th-229	6.020E-12	1.677E-07	1.679E-07	1.684E-07	1.685E-07	9.546E-09	4.682E-10	5.273E-10	2.642E-09
U-233	2.345E-07	8.347E-05	8.338E-05	8.392E-05	8.395E-05	7.632E-06	1.278E-05	2.269E-06	1.522E-05

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

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

Attachment 2 Sheet No. 7 of 9
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 8
Concent : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Al-26	3.699E+02	3.699E+02	8.437E-03	5.437E+01	4.776E+01
Cl-36	3.788E+00	3.788E+00	8.641E-05	3.423E-01	3.007E-01
Np-237	2.745E-02	2.745E-02	6.260E-07	4.523E-02	3.973E-02
Th-229	1.179E-06	1.179E-06	2.689E-11	1.720E-11	1.511E-11
U-233	7.004E-05	7.004E-05	1.598E-09	4.930E-07	4.331E-07

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

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

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Al-26	5.437E+01	1.480E+03	1.481E+03	1.481E+03	1.481E+03	1.442E+02	5.502E+01	2.388E+04	4.776E+04
Cl-36	3.423E-01	7.577E+04	7.577E+04	7.577E+04	7.577E+04	3.093E+05	8.338E+04	3.007E+02	5.713E+01
Np-237	4.523E-02	5.490E-01	5.490E-01	5.494E-01	5.493E-01	5.335E-02	2.559E-04	1.192E+00	1.589E+01
Th-229	1.732E-11	1.180E-06	1.182E-06	1.184E-06	1.184E-06	6.705E-08	3.280E-09	1.518E-09	7.601E-09
U-233	4.936E-07	1.752E-04	1.753E-04	1.756E-04	1.756E-04	1.599E-05	2.685E-05	4.430E-06	2.731E-05

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

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

Attachment 2 Sheet No. 8 of 9
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.5 T« Limit = 180 days 12/11/2012 06:47 Page 9
Concent : 316-3 RESRAD Evaluation of Nonradionuclide Groundwater Protection
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\316-3_NONRAD_GROUNDWATER.RAD

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

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/L	Surface Water pCi/L
Al-26	2.876E+02	2.876E+02	6.559E-03	4.739E+01	4.163E+01
Cl-36	3.242E+00	3.242E+00	7.394E-05	3.287E-01	2.887E-01
Np-237	1.600E-03	1.600E-03	3.649E-08	2.885E-03	2.534E-03
Th-229	6.804E-06	6.804E-06	1.552E-10	5.362E-11	4.710E-11
U-233	9.618E-05	9.618E-05	2.194E-09	6.992E-07	6.142E-07

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

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

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

Radio-Nuclide	Drinking Water pCi/L	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/L	Fish pCi/kg	Crustacea pCi/kg
Al-26	4.739E+01	1.150E+03	1.151E+03	1.151E+03	1.151E+03	1.122E+02	4.294E+01	2.081E+04	4.163E+04
Cl-36	3.287E-01	6.483E+04	6.483E+04	6.484E+04	6.483E+04	2.646E+05	7.135E+04	2.887E+02	5.485E+01
Np-237	2.885E-03	3.200E-02	3.200E-02	3.202E-02	3.201E-02	3.122E-03	1.511E-05	7.604E-02	1.014E+00
Th-229	5.380E-11	6.809E-06	6.825E-06	6.828E-06	6.828E-06	3.867E-07	1.890E-08	4.721E-09	2.362E-08
U-233	6.993E-07	2.405E-04	2.407E-04	2.408E-04	2.408E-04	2.193E-05	3.687E-05	6.148E-06	3.694E-05

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

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

Attachment 2 Sheet No. 9 of 9
Originator: S. W. Clark Date 12/11/2012
Chk'd By M. W. Perrott Date 12/11/2012
Calc. No. 0300X-CA-V0165 Rev. No. 0

APPENDIX B

DATA QUALITY ASSESSMENT

APPENDIX B

DATA QUALITY ASSESSMENT

INVESTIGATIVE SAMPLING

A data quality assessment (DQA) was performed to compare the investigative sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample design (WCH 2012a). This DQA was performed in accordance with site-specific data quality objectives found in the *300 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2011).

A review of the sample design (WCH 2012a), the field logbooks (WCH 2012b, WCH 2012c), and the applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design, with the exception of the duplicate and equipment blank (EB) samples, which were not collected. The lack of duplicate and EB samples does not impact the field sample data, which are usable for decision-making purposes. To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical analysis (BHI 2000) are used as appropriate. This review involves evaluation of the data to determine if they are of the right type, quality, and quantity to support the intended use (i.e., closeout decisions). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2006).

Investigative sample data collected at the 316-3 waste site were provided by the laboratories in five sample delivery groups (SDGs) KP0120, KP0123, KP0125, KP0127, and KP0134. SDG KP0123 was submitted for third-party validation. Major deficiencies were identified in the analytical data set. Major and minor deficiencies are discussed for the 316-3 data set, as follows below. If no comments are made about a specific analysis, it should be assumed that no deficiencies affecting the quality of the data were found.

Major Deficiencies

In the Method 300.0 anions analysis, holding times for nitrate, nitrite, and orthophosphate were exceeded for all of the SDGs. Third-party validation qualified the nondetected results for these analytes in SDG KP0123 as rejected with "UR' flags. The project has qualified the nondetected results for these analytes in SDGs KP0120, KP0125, KP0127, and KP0134 as rejected. The short holding time in the Method 300.0 analysis was recognized and Method 353.2 was also requested to obtain usable data for nitrate and nitrite. The Method 353.2 data effectively replaces the rejected nitrate and nitrite data. Orthophosphate is not a regulated compound. The resulting data set is sufficient and usable for decision-making purposes.

Minor Deficiencies

SDG KP0120

This SDG comprises seven soil samples (J1PX88 through J1PX94) from the 316-3 waste site. These samples were analyzed for gross alpha, gross beta, gamma emitting analytes, isotopic uranium, americium-241, curium-241, isotopic plutonium, nickel-63, carbon-14, tritium, volatile organic analysis (VOA), semivolatile organic analysis (SVOA), polychlorinated biphenyls (PCBs), diesel range total petroleum hydrocarbons (TPH-Dx), polynuclear aromatic compounds (PAH), inductively coupled plasma (ICP) metals, mercury, cyanide, anions (by Method 300.0 and 353.2), and pH and mercury. Minor deficiencies are as follows:

In the isotopic plutonium analysis, the final plating solution was split to allow other analysis resulting in a low tracer yield. However, this discrepancy is explained by the reduced solution volume and does not indicate any problems with the analytical methodology or equipment. The data are usable for decision-making purposes.

In the PCB analysis, samples J1PX89 and J1PX90 required 10-flold dilutions due to high concentrations of target analytes. As a result, the surrogate recovery (tetrachloro-meta-xylene) in sample J1PX88 is below the quality assurance (QA) range at 31%. This is an expected result of the dilutions. The data are usable for decision-making purposes.

In the TPH-Dx analysis, surrogate recoveries for samples J1PX90 and J1PX93 are above the QA range at 137% and 131%, respectively. This may suggest a high bias in the sample results. These data may be considered estimated. High biased and estimated data are usable for decision-making purposes.

In the TPH-Dx analysis, the matrix spike duplicate (MSD) recovery is above the QA range at 170%. This may suggest a high bias in the sample results. These data may be considered estimated. High biased and estimated data are usable for decision-making purposes.

In the ICP metals analysis, the matrix spike (MS) recoveries for eight analytes (aluminum, antimony, calcium, copper, iron, magnesium, manganese, silicon) are outside the QA range. For most of these analytes the spiking concentration was insignificant compared to the native concentration in the sample from which the MS was prepared. The laboratory ran post digestion spikes (PDSs) with good results. The discrepancy is, therefore, a measure of the natural heterogeneity of the native sample. For antimony, the spiking level was not insignificant compared to the spiking concentration. Results for antimony may be considered estimated. Estimated data are usable for decision-making purposes.

In the Method 300.0 anions analysis, holding times for nitrate, nitrite, and orthophosphate were exceeded by more than twice the QA holding time. The project predicted this result and Method 353.2 was also run with longer holding times for nitrate and nitrite. Orthophosphate is not a regulated compound. The Method 353.2 data effectively replaces the Method 300.0 data that exceeds hold times. The resulting data set is usable for decision-making purposes.

In the isotopic uranium and curium-242 analyses, no laboratory control sample (LCS) was prepared for uranium-235 or curium-242. These data may be considered estimated. Estimated data are usable for decision-making purposes.

In the tritium and carbon-14 analysis, no MS was prepared for these analytes. These data may be considered estimated. Estimated data are usable for decision-making purposes.

SDG KP0123

This SDG comprises eight soil samples (J1PX95 through J1PX99, J1PXC0 through J1PXC2) from the 316-3 waste site. These samples were analyzed for gross alpha, gross beta, gamma emitting analytes, isotopic uranium, americium-241, curium-241, isotopic plutonium, nickel-63, carbon-14, tritium, VOA, SVOA, PCBs, TPH-Dx, PAHs, ICP metals, mercury, cyanide, anions (by Method 300.0 and 353.2), and pH and mercury. SDG KP0123 was submitted for third party validation. Minor deficiencies are as follows:

In the PAH analysis, naphthalene was detected in the method blank (MB). Third-party validation qualified naphthalene results in the impacted samples (J1PX95 through J1PX98, J1PXC0 through J1PXC2) as undetected and applied "U" flags. The data are usable for decision-making purposes.

In the SVOA, LCS recoveries for 2,4-dinitrophenol (25%), 4,6-dinitro-2-methylphenol (41%), 4-chlolroanaline (49%), and pentachlorophenol (43%) are outside the QC range. Third-party validation qualified all results for these analytes in SDG KP0123 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the SVOA, MS recoveries for 1,2,4-trichlorobenzene (46%), 1,3-dichlorobenzene(48%), 1,4-dichlorobenzene (49%), 2,4-dimethylphenol (49%), 4-chloroanaline (49%), hexachlorobutadiene (48%), hexachlorocyclopentadiene (41%), hexachloroethane (47%), nitrobenzene (49%), and pentachlorophenol (41%) are outside the QC range. Third-party validation qualified all results for these analytes in SDG KP0123 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the SVOA, MSD recoveries 2,4-dimethylphenol (47%), 4-chloroanaline (45%), and pentachlorophenol (41%) are outside the QC range. Third-party validation qualified all results for these analytes in SDG KP0123 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the SVOA, a surrogate recovery in sample J1PX96 is outside the QC range. Third-party validation qualified the associated analytes (2,4-dichlorophenol, 2,4,6-trichlorophenol, 2,4,5-trichlorophenol, pentachlorophenol, bis(2-chloroethyl)ether, bis(2-chloroisopropyl)ether, bis(2-chloroethoxy)methane, 4-chlorophenyl phenyl ether, and 4-bromophenyl phenyl ether) as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the SVOA, a surrogate recovery in sample J1PX99 is outside the QC range. Third-party validation qualified the associated analytes (2-chlorophenol, 2,4-dichlorophenol, and

4-chloro-3-methyl phenol) as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the SVOA, the relative percent difference (RPD) calculation for pentachlorophenol (53%) is above the QC range. Third-party validation qualified all pentachlorophenol result in SDG KP0123 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the Method 300.0 anions analysis, holding times were exceeded by more than twice the specified holding time for nitrate, nitrite, and orthophosphate. The nondetected results for these analytes are discussed above in the Major Deficiencies section. Third-party validation qualified the detected results for these analytes as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the Method 300.0 analysis, the holding time was exceeded by less than twice the specified holding time for sulfide. Third-party validation qualified all sulfide results in SDG KP0123 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the pH analysis, the holding time was exceeded. Third-party validation qualified all pH results in SDG KP0123 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the TPH-dx analysis, an MS recovery (152%) is above the QC range. Third-party validation qualified the associated sample (J1PX99 and J1PXC0) results as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the TPH-dx analysis, no MS, MSD, or LCS was prepared for the motor oil range results. Third-party validation qualified all of the motor oil range results in SDG KP0123 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the TPH-Dx analysis, the RPD calculated for TPH-Dx are outside the QC limits. Third-party validation qualified all TPH-Dx results in SDG KP0123 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recovery for antimony (42%) is outside the QC limits. Third-party validation qualified all antimony results in SDG KP0123 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the LCS recoveries for aluminum (153%), antimony (47.2%), and silicon (269%) are outside the QC limits. Third-party validation qualified all associated data as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the PCB analysis, the MS recovery for aroclor-1260 (513%) is above the QC range. Third-party validation qualified all aroclor-1260 data in SDG KP0123 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the isotopic uranium and curium-242 analyses, no LCS was prepared for uranium-235 or curium-242. Third-party validation qualified all uranium-235 and curium-242 results in SDG KP0123 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the tritium and carbon-14 analysis, no MS was prepared for these analytes. Third-party validation qualified all tritium and carbon-14 results in SDG KP0123 as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the VOA, the MS (27%) and MSD (12%) recoveries for methylene chloride are outside the QC limits. Third-party validation qualified all methylene chloride results, except for J1PXC2, as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the VOA, the MS (174%) and MSD (167%) recoveries for tetrachloroethane are outside the QC limits. Third-party validation qualified all tetrachloroethane results, except for J1PXC2, as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the VOA, the RPD calculated for methylene chloride (80%) is outside the QC range. Third-party validation qualified all methylene chloride results, except for J1PXC2, as estimated with "J" flags. Estimated data are usable for decision-making purposes.

In the VOA, a surrogate recovery in sample J1PX99 is outside the QC range. Third-party validation qualified the methylene chloride result in J1PX99 as estimated with a "J" flag. Estimated data are usable for decision-making purposes.

SDG KP0125

This SDG comprises one soil sample (J1PXC3) from the 316-3 waste site. This sample was analyzed for gross alpha, gross beta, gamma emitting analytes, isotopic uranium, americium-241, curium-241, isotopic plutonium, nickel-63, carbon-14, tritium, VOA, SVOA, PCBs, TPH-Dx, PAHs, ICP metals, mercury, cyanide, anions (by Method 300.0 and 353.2), and pH and mercury. Minor deficiencies are as follows:

In the isotopic plutonium analysis, the final plating solution was split to allow other analysis resulting in a low tracer yield. However, this discrepancy is explained by the reduced solution volume and does not indicate any problems with the analytical methodology or equipment. The data are usable for decision-making purposes.

In the isotopic uranium and curium-242 analyses, no LCS was prepared for uranium-235 or curium-242. These data may be considered estimated. Estimated data are usable for decision-making purposes.

In the tritium and carbon-14 analysis, no MS was prepared for these analytes. These data may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOA, 30 of 128 MS/MSD recoveries are outside the QC limits with several that were unrecoverable. The laboratory determined that these results are due to matrix interference and do not indicate a problem with the analytical system. The associated LCS results are acceptable. These data may be considered estimated. Estimated data are usable for decision-making purposes.

In the PAH analysis, the MS recovery for acenaphthylene (46%) is outside the QC limits. Acenaphthylene data for sample J1PCX3 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recovery for antimony (128%) is outside the QC limits. This may suggest a high bias in the antimony results. Results for antimony may be considered estimated. High biased or estimated data are usable for decision-making purposes.

In the Method 300.0 anions analysis, holding times were exceeded by more than twice the specified holding time for nitrate, nitrite, and orthophosphate. The nondetected results for these analytes are discussed above in the Major Deficiencies section. The detected results for these analytes may be considered estimated. Estimated data are usable for decision-making purposes.

In the Method 300.0 analysis, the holding time was exceeded by less than twice the specified holding time for sulfide. All sulfide results may be considered estimated. Estimated data are usable for decision-making purposes.

In the pH analysis, the holding time was exceeded. All pH results may be considered estimated with "J" flags. Estimated data are usable for decision-making purposes.

SDG KP0127

This SDG comprises one soil samples (J1PXC4) from the 316-3 waste site. This sample was analyzed for gross alpha, gross beta, gamma emitting analytes, isotopic uranium, americium-241, curium-241, isotopic plutonium, nickel-63, carbon-14, tritium, VOA, SVOA, PCBs, TPH-Dx, PAHs, ICP metals, mercury, cyanide, anions (by Method 300.0 and 353.2), and pH and mercury. Minor deficiencies are as follows:

In the isotopic plutonium analysis, the final plating solution was split to allow other analysis resulting in a low tracer yield. However, this discrepancy is explained by the reduced solution volume and does not indicate any problems with the analytical methodology or equipment. The data are usable for decision-making purposes.

In the isotopic uranium and curium-242 analyses, no LCS was prepared for uranium-235 or curium-242. These data may be considered estimated. Estimated data are usable for decision-making purposes.

In the tritium and carbon-14 analysis, no MS was prepared for these analytes. These data may be considered estimated. Estimated data are usable for decision-making purposes.

In the VOA, surrogate recoveries and many MS/MSD recoveries for sample J1PXC4 are above the QC range. These results suggest a high bias in the VOA sample data for J1PXC4. All VOA data for sample J1PXC4 may be considered estimated. High biased or estimated data are usable for decision-making purposes.

In the SVOA, eight MS/MSD recoveries are below the QC limits as are the surrogates associated with these results. The LCS results are all within QC limits. The laboratory has determined that these results are due to matrix interference. These data may be considered estimated. Estimated data are usable for decision-making purposes.

In the SVOA, RPDs calculated between the MS and MSD for 2,4-dinitrophenol (42%), 3,3'-dichlorbenzidine(68%), and 4-chloroanaline (63%), are above the QC limit (30%). Elevated RPDs in environmental samples are generally attributed to natural heterogeneities in the sample matrix. Results for these analytes may be considered estimated. Estimated data are usable for decision-making purposes.

In the PCB analysis, the surrogate tetrachloro-meta-xylene recovered outside the QC range at 48%. The laboratory notes that this surrogate is more volatile than the target analytes (PCBs) and that the other surrogate is less volatile and within the QC range. The laboratory, therefore, concludes that the low recovery of tetrachloro-meta-xylene is a result of the concentration of the sample extract. The PCB data for sample J1PXC4 may be considered estimated. Estimated data are usable for decision-making purposes.

In the TPH-Dx analysis, the laboratory notes that the chromatogram does not have the characteristic pattern associated with either diesel range or motor oil range hydrocarbons, but is likely due to a heavier fuel oil. The diesel range and motor oil range results may be considered estimated. Estimated data are usable for decision-making purposes.

In the TPH-Dx analysis, the diesel range MS (13%) is outside the QC range. However, the MSD and LCS results are within the QC range. This result is likely due to heterogeneities in the native sample matrix from which the MS was prepared. There is no impact on the field sample data. The data are usable for decision-making purposes.

In the PAH analysis, several MS/MSD recoveries are outside the QC range. The sample contained numerous target and nontarget analytes and required a five-fold dilution to perform the analysis. The discrepancies in the MS/MSD recoveries are due to interferences from these analytes. The PAH data for sample J1PXC4 may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recovery for antimony (30.5%) is outside the QC limits. Results for antimony may be considered estimated. Estimated data are usable for decision-making purposes.

In the Method 300.0 anions analysis, holding times were exceeded by more than twice the specified holding time for nitrate, nitrite, and orthophosphate. The nondetected results for these

analytes are discussed above in the Major Deficiencies section. The detected results for these analytes may be considered estimated. Estimated data are usable for decision-making purposes.

In the Method 300.0 analysis, the holding time was exceeded by less than twice the specified holding time for sulfide. All sulfide results may be considered estimated. Estimated data are usable for decision-making purposes.

In the pH analysis, the holding time was exceeded. All pH results may be considered estimated with "J" flags. Estimated data are usable for decision-making purposes.

SDG KP0134

This SDG comprises four soil samples (J1PXC5 through J1PXC8) from the 316-3 waste site. These samples were analyzed for gross alpha, gross beta, gamma emitting analytes, isotopic uranium, americium-241, curium-241, isotopic plutonium, nickel-63, carbon-14, tritium, VOA, SVOA, PCBs, TPH-Dx, PAHs, ICP metals, mercury, cyanide, anions (by Method 300.0 and 353.2), and pH and mercury. Minor deficiencies are as follows:

In the isotopic plutonium analysis, the final plating solution was split to allow other analysis resulting in a low tracer yield. However, this discrepancy is explained by the reduced solution volume and does not indicate any problems with the analytical methodology or equipment. The data are usable for decision-making purposes.

In the isotopic uranium and curium-242 analyses, no LCS was prepared for uranium-235 or curium-242. These data may be considered estimated. Estimated data are usable for decision-making purposes.

In the tritium and carbon-14 analysis, no MS was prepared for these analytes. These data may be considered estimated. Estimated data are usable for decision-making purposes.

In the VOA, numerous surrogate, and MS/MSD recoveries were outside the QC range. The sample matrix consisted of black charcoal like substance. The laboratory reanalyzed these samples with similar results. Discrepancies in these recoveries are likely due to matrix interference by the charcoal. All VOA results for SDG KP0134 may be considered estimated. Estimated data are usable for decision-making purposes.

In the VOA, the LCS recoveries for 1,2-dichloroethane (136%) and acetone (241%) are above the QC range. This suggests a high bias in the field sample data for these analytes. However, these analytes were not detected in the field samples. Therefore, there is no impact to the field sample data. The data are usable for decision-making purposes.

In the SVOA, two of five surrogate recoveries in sample J1PXC5 are outside the QC range. The SVOA results for sample J1PXC5 maybe considered estimated. Estimated data are usable for decision-making purposes.

In the SVOA, the LCS recovery for 2,4-dinitrophenol (11%) is outside the QC limits. Results for phenols can be erratic. All 2,4-dintirophenol results for SDG KP0134 may be considered estimated. Estimated data are usable for decision-making purposes.

In the PCB analysis, the surrogate tetrachloro-meta-xylene recovered outside the QC range at 47% in sample J1PXC8. The laboratory notes that this surrogate is more volatile than the target analytes (PCBs) and that the other surrogate is less volatile and within the QC range. The laboratory, therefore, concludes that the low recovery of tetrachloro-meta-xylene is a result of the concentration of the sample extract. The PCB data for sample J1PXC8 may be considered estimated. Estimated data are usable for decision-making purposes.

In the PCB analysis, due to a laboratory error the MS/MSD, were not spiked. All PCB results in SDG KP0134 may be considered estimated. Estimated data are usable for decision-making purposes.

In the TPH-Dx analysis, the laboratory notes that the chromatogram for sample J1PCX5 does not have the characteristic pattern associated with either diesel range or motor oil range hydrocarbons, but is likely due to a heavier fuel oil. The diesel range and motor oil range results may be considered estimated. Estimated data are usable for decision-making purposes.

In the PAH analysis, the MSD recovery for acenaphthylene (141%) is outside the QC range. This result suggests a high bias in the field sample data for acenaphthylene. Data in SDG KP0134 for acenaphthylene may be considered estimated. High biased or estimated data are usable for decision-making purposes.

In the ICP metals analysis, the MS recovery for antimony (30.4%) is outside the QC limits. Results for antimony may be considered estimated. Estimated data are usable for decision-making purposes.

In the ICP metals analysis, the RPDs calculated for molybdenum (37.3%) and mercury (45.7%) are outside the QC limits. Molybdenum and mercury results in SDG KP0134 may be considered estimated. Estimated data are usable for decision-making purposes.

In the Method 300.0 anions analysis, holding times were exceeded by more than twice the specified holding time for nitrate, nitrite, and orthophosphate. The nondetected results for these analytes are discussed above in the Major Deficiencies section. The detected results for these analytes may be considered estimated. Estimated data are usable for decision-making purposes.

In the Method 300.0 analysis, the holding time was exceeded by less than twice the specified holding time for sulfide. All sulfide results may be considered estimated. Estimated data are usable for decision-making purposes.

In the pH analysis, the holding time was exceeded. All pH results may be considered estimated with "J" flags. Estimated data are usable for decision-making purposes.

Summary

Limited, random, or sample matrix-specific influenced batch QC issues, such as those discussed above, are a potential for any analysis. The number and types seen in the data set are within expectations for the matrix types and analyses performed. The DQA review of the 316-3 waste site investigative sampling data found that the analytical results are accurate within the standard errors associated with the analytical methods, sampling, and sample handling. The DQA review for 316-3 waste site concludes that the reviewed data are of the right type, quality, and quantity to support the intended use. The analytical data were found acceptable for decision-making purposes. The investigative sample analytical data are stored in the Environmental Restoration project-specific database prior to being submitted for inclusion in the Environmental Information System database. The investigative sample analytical data are also summarized in Appendix B.

REFERENCES

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

DOE-RL, 2011, *300 Area Remedial Action Sampling and Analysis Plan,* DOE/RL-2001-48, Rev. 3, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

WCH, 2012a, *Hanford 300-FF-2 Operable Unit 300 Area Industrial Complex D4/ISS Closure 316-3 Waste Site Subsurface Investigation Plan,* PLN-0012, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH, 2012b, *300-FF-2, 340 Ramp Dailies, 316-3 Disposal Trenches – Test Pits*, Logbook EL-1663-03, pp. 52-100, Washington Closure Hanford, Richland, Washington.

WCH, 2012c, *D4 Waste Site Miscellaneous Sampling*, Logbook EL-1663-04, pp. 1-15, Washington Closure Hanford, Richland, Washington.