140875

Date Submitted: 05/21/08 Originator: J. M. Capron Phone: 372-9227	**WASTE SITE RECLASSIFICATION FORM** Operable Unit(s): 100-FR-1 Waste Site Code: 100-F-46 Type of Reclassification Action: Closed Out ☐ Interim Closed Out ☐ No Action ☒ RCRA Postclosure ☐ Rejected ☐ Consolidated ☐	Control Number: 2008-021

This form documents agreement among parties listed authorizing classification of the subject unit as Closed Out, Interim Closed Out, No Action, RCRA Postclosure, Rejected, or Consolidated. This form also authorizes backfill of the waste management unit, if appropriate, for Closed Out and Interim Closed Out units. Final removal from the NPL of No Action and Closed Out waste management units will occur at a future date.

Description of current waste site condition:

The 100-F-46 french drain consisted of a 1.5 to 3 m (5 to 10 ft) long, vertically buried, gravel-filled pipe that was approximately 1 m (3 ft) in diameter. Also included in this waste site was a 5 cm (2-in.) cast-iron pipeline that drained condensate from the 119-F Stack Sampling Building into the 100-F-46 french drain. Confirmatory sampling of this site has been performed in accordance with remedial action objectives and goals established by the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100 DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Remaining Sites *ROD)*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington. The selected action involved: (1) evaluating the site using available process information, (2) demonstrating through confirmatory sampling that cleanup goals have been achieved, and (3) proposing the site for reclassification to No Action.

Basis for reclassification:

In accordance with this evaluation, the confirmatory sampling results support a reclassification of this site to No Action. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the Remaining Sites ROD. The results of confirmatory sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow-zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of groundwater and the Columbia River. Site contamination did not extend into the deep-zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required. The basis for reclassification is described in detail in the *Remaining Sites Verification Package for the 100-F-46, 119-F Stack Sampling French Drain* (attached).

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.

R. F. Guercia DOE Federal Project Director (printed)	Signature	6/10/08 Date
N/A Ecology Project Manager (printed)	Signature	Date
R. A. Lobos EPA Project Manager (printed)	Signature	8-6-08 Date

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-46, 119-F STACK SAMPLING FRENCH DRAIN

Attachment to Waste Site Reclassification Form 2008-021

April 2008

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-46, 119-F STACK SAMPLING FRENCH DRAIN

EXECUTIVE SUMMARY

The 100-F-46 Stack Sampling french drain consisted of a 1.5 to 3 m (5 to 10 ft) long vertically buried gravel-filled pipe approximately 1 m (3 ft) in diameter. The upper portion of the pipe extended a few inches above grade (GE 1962, 1965). Also included in this waste site is the 5 cm (2-in.) cast-iron pipeline that drained condensate from the 119-F Stack Sampling Building into the 100-F-46 french drain.

The 100-F-46 french drain was located near the 105-F Reactor between the inlet and exhaust air ducts/tunnels associated with the 117-F Filter Building (132-F-5 waste site). Both the 100-F-46 french drain and the condensate pipeline are presumed to have been removed during decommissioning and demolition of the 117-F Filter Building (132-F-5) and associated air tunnels in 1983 (UNI 1983a). These structures were decontaminated, removed to a depth of 1 m (3 ft) below grade, and backfilled to grade. Uncertainty remained as to the disposition of the french drain and condensate pipe within the 100-F-46 waste site; therefore, a work instruction was prepared for confirmatory sampling.

Confirmatory sampling at the 100-F-46 french drain site was performed on November 29, 2007. A test pit was excavated to approximately 4.5 m (15 ft) depth, with no indication of either the french drain or the associated cast iron condensate pipeline. Confirmatory samples were collected from the excavator bucket of material that was taken from the bottom of the test pit. The 100-F-46 waste site was then backfilled.

One sample and one duplicate were collected based on site contaminants of potential concern (COPCs). Samples were analyzed by gamma energy analysis, and for gross alpha, gross beta, tritium, carbon-14, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, total petroleum hydrocarbons, inductively coupled metals, mercury, and hexavalent chromium in accordance with the confirmatory work instruction. A summary of the cleanup evaluation for the soil results compared against the applicable criteria is presented in Table ES-1. The results of the confirmatory sampling are used to make reclassification decisions for the 100-F-46 waste site in accordance with the TPA-MP-14 (DOE-RL 2007) procedure.

In accordance with this evaluation, the confirmatory sampling results support a reclassification of this site to No Action. The current site conditions achieve the remedial action objectives and the corresponding remedial action goals established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site* (Remaining Sites ROD) (EPA 1999). The results of confirmatory sampling show that residual contaminant concentrations do not preclude any future uses (as bounded by the rural-residential scenario) and allow for unrestricted use of shallow-zone soils (i.e., surface to 4.6 m [15 ft] deep). The results also demonstrate that residual contaminant concentrations are protective of

groundwater and the Columbia River. Site contamination did not extend into the deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

Table ES-1. Summary of Remedial Action Goals for the 100-F-46 Stack Sampling French Drain. (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.	The maximum all-pathways dose rate calculated by RESRAD is 0.30 mrem/yr over 1,000 years.	Yes
Direct Exposure Nonradionuclides	Attain individual COC/COPC RAGs.	All individual COC/COPC concentrations are below the direct exposure criteria.	Yes
Risk Requirements Nonradionuclides	Attain a hazard quotient of <1 for all individual noncarcinogens.	All individual hazard quotients are <1.	Yes
	Attain a cumulative hazard quotient of <1 for noncarcinogens.	The cumulative hazard quotient (3.6×10^{-3}) is <1.	
	Attain an excess cancer risk of $<1 \times 10^{-6}$ for individual carcinogens.	The excess cancer risk values for individual carcinogens are $<1 \times 10^{-6}$.	
	Attain a total excess cancer risk of $<1 \times 10^{-5}$ for carcinogens.	The total excess cancer risk value (2.8×10^{-7}) is $<1 \times 10^{-5}$.	
Groundwater/River Protection – Radionuclides	Attain single COC/COPC groundwater and river protection RAGs.	Tritium (the only detected radionuclide COC/COPC) is predicted to reach groundwater at a peak concentration of 4,900 pCi/L in the 1,000 years of the RESRAD model run, which is less than the MCL of 20,000 pCi/L. Therefore, groundwater and river protection RAGs are attained.	Yes
	Attain national primary drinking water regulations:[a] 4 mrem/yr (beta/gamma) dose rate to target receptor/organs.	Because the only detected radionuclide COC/COPC is predicted to reach groundwater at concentrations below the groundwater protection RAG, it was not necessary to perform the calculation of cumulative organ specific dose via the groundwater (and river) pathway to determine that the 4 mrem/yr drinking water dose limit is met.	
	Meet drinking water standards for alpha emitters: the more stringent of 15 pCi/L MCL or 1/25th of the derived concentration guide from DOE Order 5400.5.[b]	No alpha-emitting radionuclide COC/COPCs were detected.	
	Meet total uranium standard of 21.2 pCi/L.[c]	Uranium was not identified as a COC/COPC for this site.	

Table ES-1. Summary of Remedial Action Goals for the 100-F-46 Stack Sampling French Drain. (2 Pages)

Regulatory Requirement	Remedial Action Goals	Results	Remedial Action Objectives Attained?
Groundwater/River Protection – Nonradionuclides	Attain individual nonradionuclide groundwater and river cleanup requirements.	All the groundwater and river RAGs have been attained.	Yes

[a] "National Primary Drinking Water Regulations" (40 *Code of Federal Regulations* 141).
[b] *Radiation Protection of the Public and Environment* (DOE Order 5400.5).
[c] Based on the isotopic distribution of uranium in the 100 Areas, 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).

COC = contaminant of concern
COPC = contaminant of potential concern
MCL = maximum contaminant level
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose assessment model)

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999), based on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of potential concern and other constituents. Screening levels were not exceeded, with the exception of antimony, boron, manganese, and vanadium. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. It is believed that the presence of these constituents does not pose a risk to ecological receptors because concentrations of antimony, manganese, and vanadium are below site background levels, and boron concentrations are consistent with those seen elsewhere at the Hanford Site (no established background value is available for boron). A more complete quantitative ecological risk assessment will be presented in the baseline risk assessment for the river corridor portion of the Hanford Site and will be used to support the final closeout decision for this site.

REMAINING SITES VERIFICATION PACKAGE FOR THE 100-F-46, 119-F STACK SAMPLING FRENCH DRAIN

STATEMENT OF PROTECTIVENESS

The 100-F-46, 119-F Stack Sampling french drain, site confirmatory sample results demonstrate that the site achieves the remedial action objectives and remedial action goals (RAGs) established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP) (DOE-RL 2005b) and the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units* (Remaining Sites ROD) (EPA 1999). These results show that residual soil concentrations support future land uses that can be represented (or bounded) by a rural-residential scenario. The results also demonstrate that residual contaminant concentrations support unrestricted future use of shallow-zone soil (i.e., surface to 4.6 m [15 ft]) and that contaminant levels remaining in the soil are protective of groundwater and the Columbia River. Site contamination did not extend into the deep zone soils; therefore, institutional controls to prevent uncontrolled drilling or excavation into the deep zone are not required.

Soil cleanup levels were established in the Remaining Sites ROD (EPA 1999), based on a limited ecological risk assessment. Although not required by the Remaining Sites ROD, a comparison against ecological risk screening levels has been made for the site contaminants of potential concern and other constituents. Screening levels were not exceeded with the exception of antimony, boron, manganese, and vanadium. Exceedance of screening values does not necessarily indicate the existence of risk to ecological receptors. It is believed that the presence of these constituents does not pose a risk to ecological receptors because concentrations of antimony, manganese, and vanadium are below site background levels, and boron concentrations are consistent with those seen elsewhere at the Hanford Site (no established background value is available for boron). A more complete quantitative ecological risk assessment will be presented in the baseline risk assessment for the river corridor portion of the Hanford Site and will be used to support the final closeout decision for this site.

GENERAL SITE INFORMATION AND BACKGROUND

The 100-F-46 french drain site consisted of a 1.5 to 3 m (5 to 10 ft) long, vertically buried, gravel-filled pipe approximately 1 m (3 ft) in diameter. The upper portion of this pipe extended a few inches above grade (GE 1962, 1965). Also included in this site is the 5 cm (2-in.) cast-iron pipeline that drained condensate from the 119-F Stack Sampling Building to the 100-F-46 french drain.

The 100-F-46 french drain (Figure 1) was located near the 105-F Reactor in the 100-FR-1 Operable Unit of the Hanford Site between the inlet and exhaust air ducts/tunnels associated with the 117-F Filter Building (132-F-5 waste site). The location is about 50 m (164 ft) northwest of the west wall of the 105-F Reactor interim safe storage structure at Washington State Plane coordinates E 580378.9, N 147617.4 (Figure 2). The influent end of the pipeline was located at coordinates E 580382.2, N 147614.2. Figure 3 is the french drain and pipeline location map.

The 100-F-46 french drain was associated with the 116-F Reactor Stack (132-F-4 waste site) and 119-F Stack Sampling Building. The reactor stack (132-F-4 waste site) exhaust gases were sampled by pulling moist stack off gases through a steam-heated pipe to the 119-F Stack Sampling Building where the gas stream was sampled. This building was a small structure on a concrete pad on the north side of the reactor stack (UNI 1985) (Figures 4 through 6). The condensate then drained via a 5 cm (2-in.) cast-iron pipeline into the 100-F-46 french drain.

In 1983, the 117-F Filter Building (132-F-5 waste site) and associated air tunnels were decontaminated and removed to approximately 1 m (3-ft) below grade. The remainder of the site structures were characterized, decontaminated, demolished in situ, and backfilled to grade (UNI 1983a). The 135-F-5 site was determined to meet remedial action objectives using Allowable Residual Contamination Level methodology (UNI 1983b) and reclassified to No Action (BHI 2003). The 100-F-46 french drain and condensate pipeline were likely removed in 1983 since they were located between the 117-F Filter Building (132-F-5 waste site) air tunnels. The french drain is clearly visible in a photograph during the demolition of 117-F (Figure 7). The features (concrete posts and lid) of the french drain are not visible in the post-demolition photograph of the same area (Figure 8). Additional site photographs are included in Appendix A.

CONFIRMATORY SAMPLING ACTIVITIES

Confirmatory sampling of the 100-F-46 site was performed on November 29, 2007, in accordance with *Work Instruction for Confirmatory Sampling of the 100-F-46 French Drain* (WCH 2007b), to determine whether the french drain and condensate pipe still existed and to collect data to determine if the RAGs had been met. RAGs are the specific numeric goals against which the cleanup verification data are evaluated to demonstrate attainment of the remedial action objectives for the site. The following subsections provide additional discussion of the information used to develop the confirmatory sampling design. The results of confirmatory sampling are also summarized to support the No Action decision for the site.

Nonintrusive Investigation Results

A formal site visit was not conducted at the 100-F-46 french drain site. Global positioning system (GPS) coordinates of the french drain site were available, and current field conditions were already known. In addition, the french drain was not visible in a photograph taken in 1993, nor was it located during a field walkdown in 2005. A geophysical survey was not performed at the 100-F-46 french drain site since the location was identified by Washington State Plane coordinates E 580378.9, N 147617.4.

Figure 1. 100-F-46 Site Location Map.

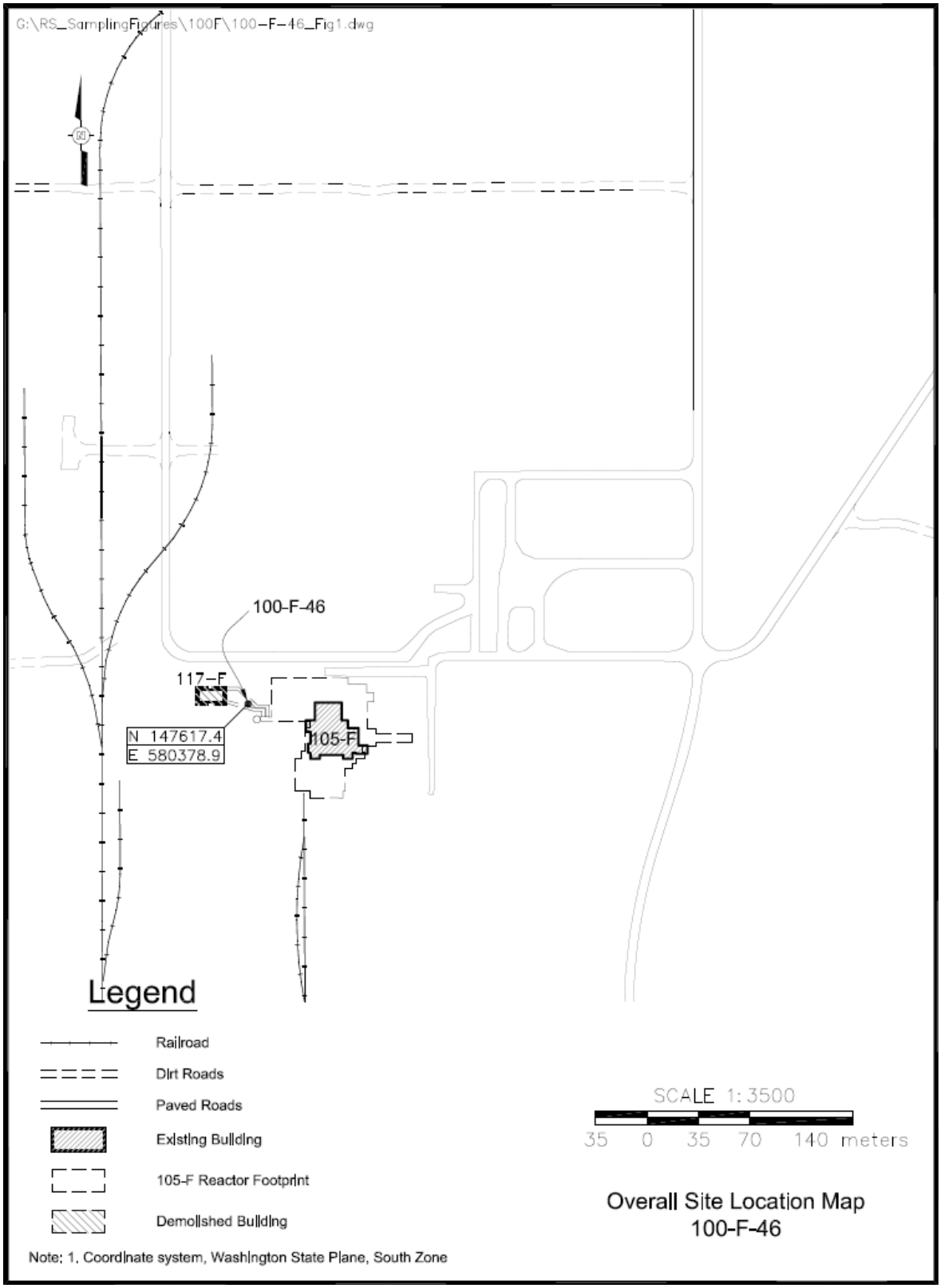


Figure 2. 100-F-46 French Drain Test Pit Location.

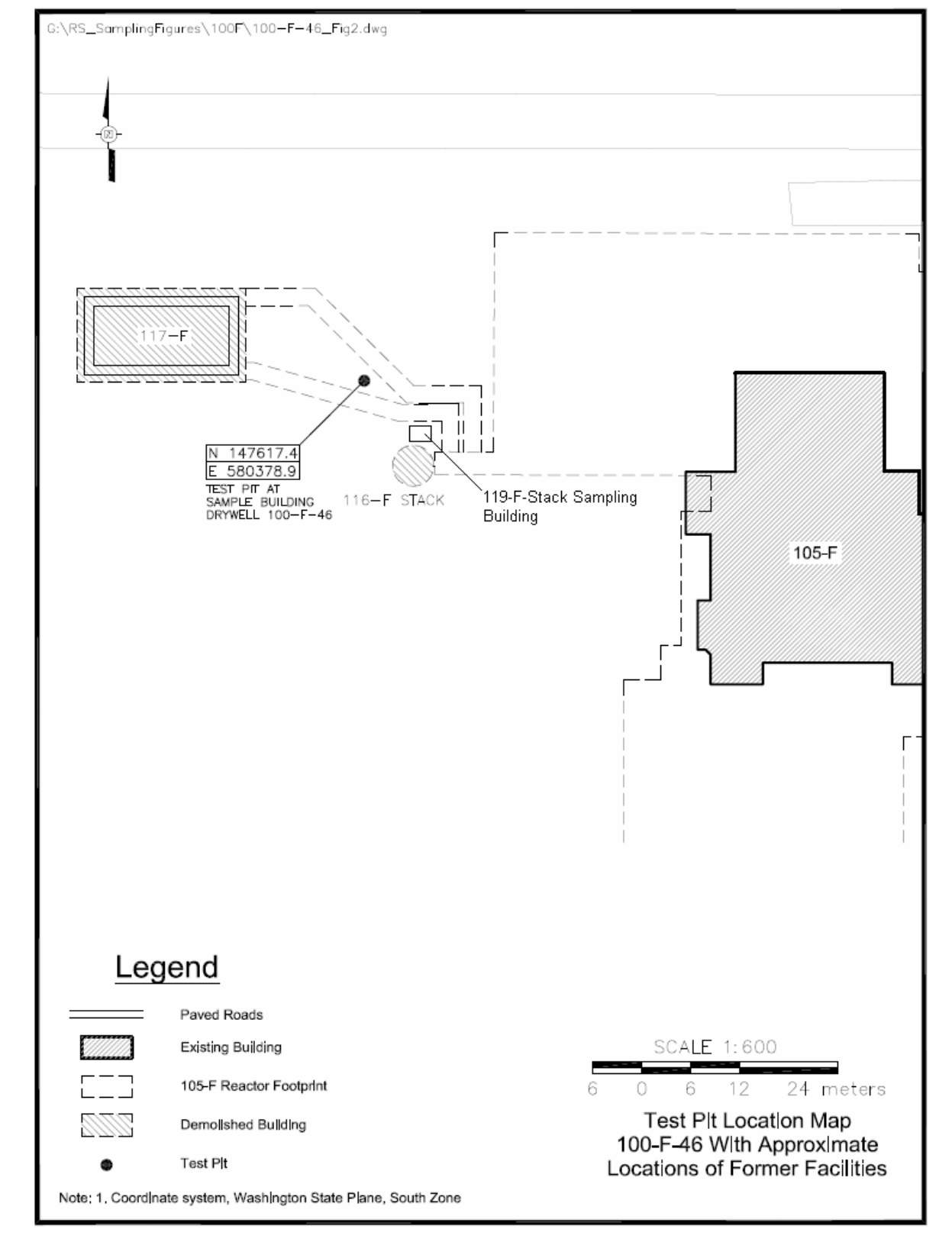


Figure 3. French Drain and Pipeline Location Map.

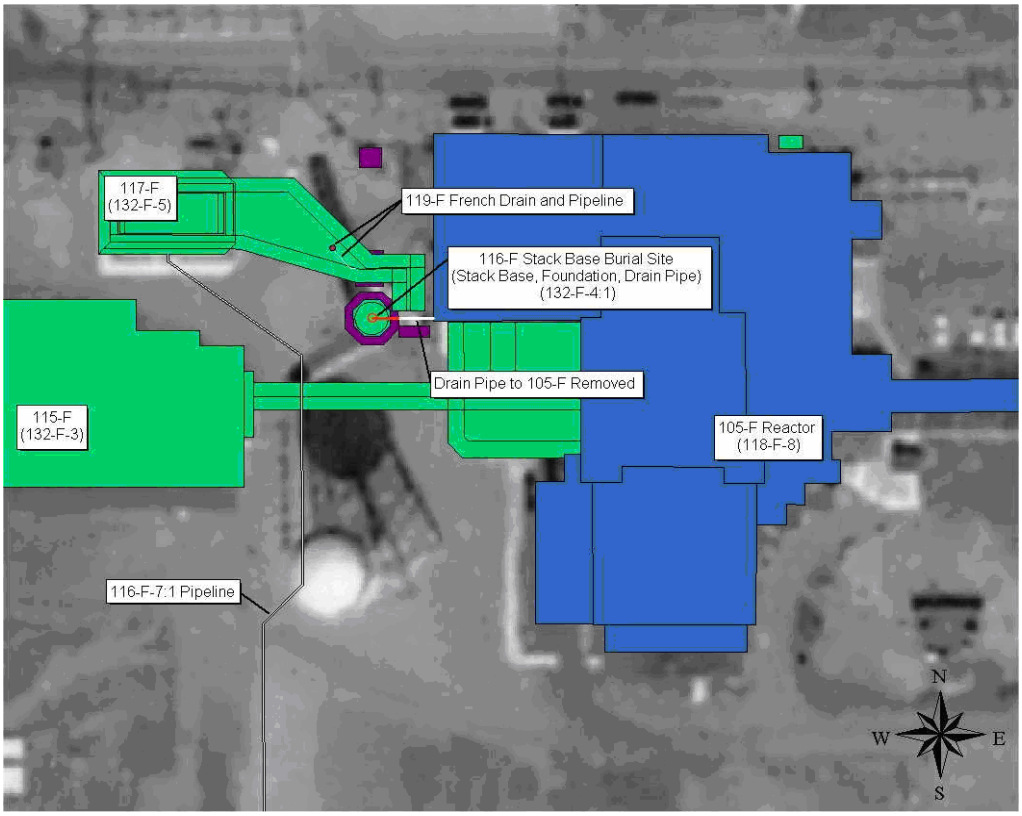


Figure 4. Aerial Photograph Showing the 119-F Stack Sampling Building Adjacent to Stack (July 12, 1965).

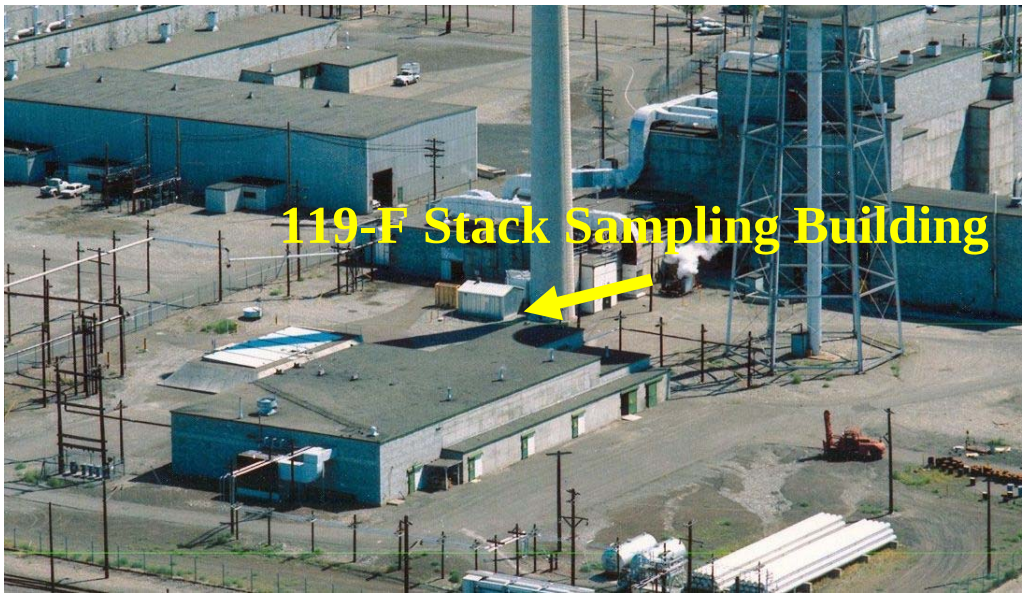


Figure 5. Closeup View of the 119-F Stack Sampling Building (August 12, 1960).

Figure 6. Aerial Photograph After the 119-F Stack Sampling Building Removed.

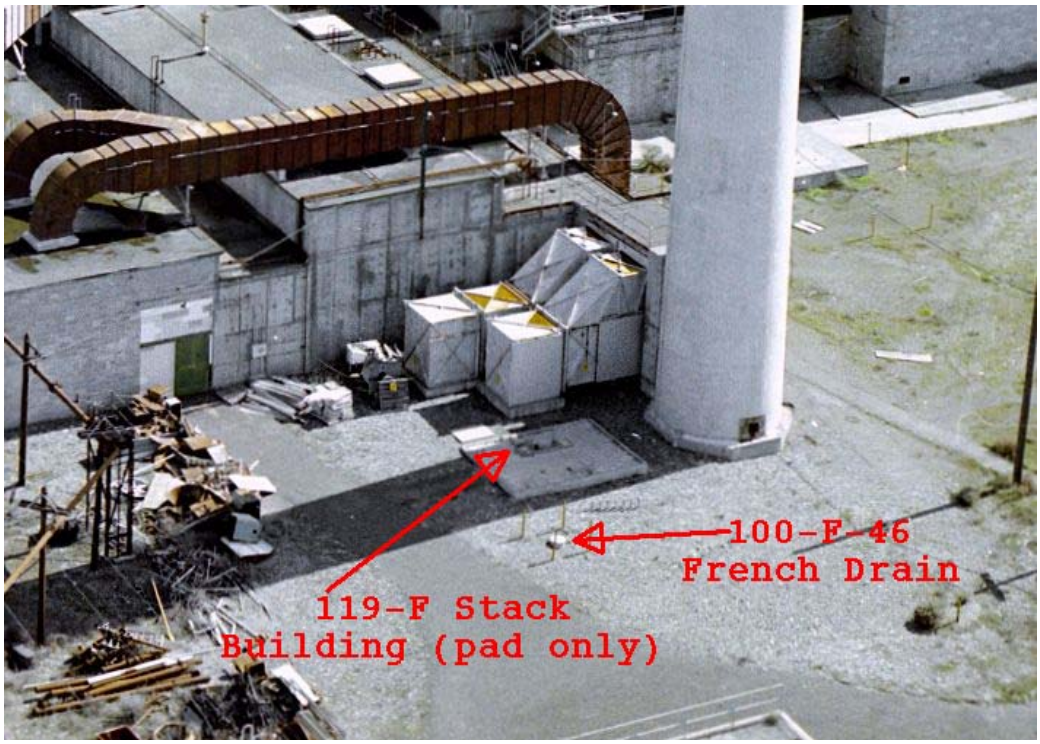


Figure 7. Closeup View of the 119-F Building Pad and French Drain (Surrounded by Concrete Posts) (July 25, 1983).

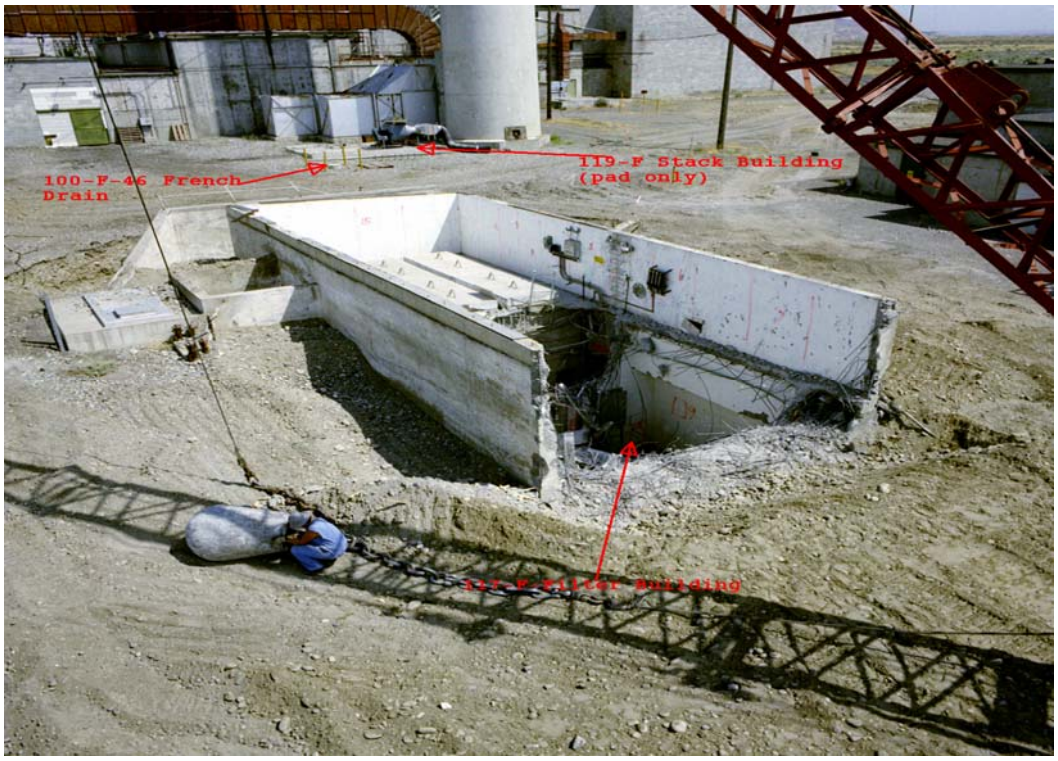


Figure 8. The 119-F Building Pad Following Demolition of the 117-F Building and Reactor Stack (September 23, 1983).

Contaminants of Potential Concern

Contaminants of potential concern (COPCs) for the 100-F-46 waste site were developed from information contained in the Waste Information Data System (WIDS) report (WCH 2007b). Past processes pulled exhaust gases from the 116-F Reactor Stack (132-F-4 waste site) through the 119-F Stack Sampling Building where they were sampled. Residual condensate then drained through the cast iron pipeline to the 100-F-46 french drain. The COPCs are tritium, carbon-14, strontium-90, cobalt-60, cesium-137, europium-152, and plutonium-239/240. Based on further evaluation of contaminants potentially discharged to the 100-F-46 french drain, europium-154, europium-155, the expanded list of inductively coupled plasma metals, mercury, hexavalent chromium, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, (PAHs), and total petroleum hydrocarbons (TPH) were added as COPCs.

Confirmatory Sampling

Confirmatory sampling activities at 100-F-46 site were performed on November 29, 2007, (Figures 9 through 11) with details recorded in the field logbook (WCH 2007a). Miscellaneous concrete and pipe debris were encountered during excavation; however, no traces of the 100-F-46 french drain or associated condensate pipe were found. The location of the former french drain is well established, and this location is known to be between the intake and exhaust ducts for the 117-F Filter Building (Figure 2). Excavation at the established location of the former french drain located the exhaust ducts (Figure 12), confirming that excavation was performed at the correct location. It is reasonable to conclude that the 100-F-46 french drain was removed during previous decommissioning and demolition activities in the area. Confirmatory samples of material from the bottom of the excavation at 4.6 m (15 ft) were collected from the bucket of the excavator.

Radiological field screening was conducted during the confirmatory sampling activities at the 100-F-46 french drain. Field screening was used to guide the excavation to quickly assess the presence and level of contamination. Field screening at the site included using hand-held sodium iodide (NaI) detectors. No radiation was detected above background levels.

Confirmatory Sampling Design

The confirmatory sampling design for the 100-F-46 french drain was developed per the *100 Area Remedial Action Sampling and Analysis Plan* (DOE-RL 2005a). The site consisted of a 1 m (3 ft) diameter french drain and an associated 5 cm (2-in.) cast-iron condensate line that went from the 119-F Sampling Stack Building to the 100-F-46 french drain. The primary objective of sampling was to determine if constituents associated with the former 100-F-46 french drain present an adverse risk to human health or the environment and to evaluate if the site meets the remedial action goals specified in the Remaining Sites ROD (EPA 1999).

Figure 9. 100-F-46 Waste Site Prior to Excavation.

Figure 10. Excavation of the 100-F-46 Waste Site.

Figure 11. Confirmatory Sampling Activity at the 100-F-46 Excavation.

Figure 12. Intake and Exhaust Ducts to the 119-F Stack Filter Building During the 100-F-46 Excavation.

Confirmatory Sampling Results

Confirmatory samples were analyzed using analytical methods approved by the U.S. Environmental Protection Agency. The laboratory-reported data results for all constituents are stored in the Environmental Remediation System (ENRE) project-specific database prior to submission for archival in the Hanford Environmental Information System (HEIS) site-wide database and are summarized in Appendix B.

Comparisons of the confirmatory sampling data results for analytes with the shallow zone RAGs are summarized in Table 1. Contaminants of potential concern that were not detected by laboratory analysis are excluded from consideration. Calculated cleanup levels are not presented in the *Cleanup Levels and Risk Calculations Database* (Ecology 2005) under *Washington Administrative Code* (WAC) 173-340-740(3) for aluminum, calcium, iron, magnesium, potassium, silicon, and sodium; therefore, these constituents are not considered site COPCs. Potassium-40, radium-226, radium-228, thorium-228, and thorium-232 were detected in samples collected at the site, but are not considered within the following table, as these isotopes are not related to the operational history of the site and were detected below background levels (based on an assumption of secular equilibrium, the background activities for radium-228 and thorium-228 are equal to the statistical background activity of 1.32 pCi/g for thorium-232 provided in DOE-RL [1996]).

Table 2 summarizes samples collected, total depth, and required list of COPCs to be analyzed. Isotopic-Plutonium analysis was inadvertently requested in addition to gross alpha analysis. Data results from the Isotopic-Plutonium analysis were less than detectable and are included in Appendix B Data Tables.

DATA EVALUATION

Evaluation of the test pit data results listed in Table 1 indicates that all COPCs meet the direct exposure RAGS. One contaminant (tritium) exceeded the soil lookup value for groundwater and river protection. Analysis of the primary sample resulted in a tritium concentration of 33.8 pCi/g. Tritium was not detected in the duplicate sample. RESidual RADioactivity (RESRAD) modeling (ANL 2005) was used to predict maximum dose rate, excess lifetime cancer risk, and impact on groundwater and the river from residual tritium concentrations (DOE-RL 2005). A maximum radionuclide dose of 0.30 mrem/yr was predicted to occur in the present year (2008) corresponding to a carcinogenic risk of 1.22×10^{-6}. Both dose and risk are predicted to decline over time due to radioactive decay. The RESRAD calculations are provided in Appendix C.

Table 1. Comparison of Maximum Contaminant Concentrations to Action Levels for the 100-F-46 French Drain Test Pit Confirmatory Sampling Event. (2 Pages)

COCs/COPCs	Maximum Result (pCi/g)	Generic Site Lookup Values[a] (pCi/g)			Does the Maximum Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Shallow Zone Lookup Value	Groundwater Protection Lookup Value	River Protection Lookup Value		
Tritium	33.8	510	15.8	106.8	Yes	Yes[b]
COCs/COPCs	**Maximum Result (mg/kg)**	**Remedial Action Goals[a] (mg/kg)**			**Does the Maximum Result Exceed RAGs?**	**Does the Result Pass RESRAD Modeling?**
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Antimony	1.20 (<BG)	32	5[c]	5[c]	No	--
Arsenic	1.9 (<BG)	20	20	20	No	--
Barium	57.7 (<BG)	5,600	132[c]	224	No	--
Beryllium	0.51 (<BG)	10.4[d]	1.51[c]	1.51[c]	No	--
Boron[e]	3.9	16,000	320	--[f]	No	--
Chromium (total)	8.5 (<BG)	80,000	18.5[c]	18.5[c]	No	--
Cobalt	5.2 (<BG)	1,600	32	--[f]	No	--
Copper	12.0 (<BG)	2,960	59.2	22.0[c]	No	--
Hexavalent chromium[e]	0.28	2.1[d]	4.8	2	No	--
Lead	5.5 (<BG)	353	10.2[c]	10.2[c]	No	--
Manganese	245 (<BG)	11,200	512[c]	512[c]	No	--
Molybdenum[e]	0.86	400	8	--[f]	No	--
Nickel	9.0 (<BG)	1,600	19.1[c]	27.4	No	--
Silver	0.38 (<BG)	400	8	0.73[c]	No	--
Vanadium	34.2 (<BG)	560	85.1[c]	--[f]	No	--
Zinc	30.6 (<BG)	24,000	480	67.8[c]	No	--
Aroclor-1260	0.0048	0.5	0.017[g]	0.017[g]	No	--
Benzo(a)anthracene	0.0039	1.37[h]	0.015[g]	0.015[g]	No	--
Benzo(a)pyrene	0.0029	0.137[h]	0.015[g]	0.015[g]	No	--
Benzo(b)fluoranthene	0.003	1.37[h]	0.015[g]	0.015[g]	No	--

Table 1. Comparison of Maximum Contaminant Concentrations to Action Levels for the 100-F-46 French Drain Test Pit Confirmatory Sampling Event. (2 Pages)

COCs/COPCs	Maximum Result (mg/kg)	Remedial Action Goals[a] (mg/kg)			Does the Maximum Result Exceed RAGs?	Does the Result Pass RESRAD Modeling?
		Direct Exposure	Soil Cleanup Level for Groundwater Protection	Soil Cleanup Level for River Protection		
Benzo(k)fluoranthene	0.0076	1.37[h]	0.015[g]	0.015[g]	No	--
Benzo(ghi)perylene	0.0042	2400	48	192	No	--
Indeno(1,2,3-cd)pyrene	0.01	1.37	0.33[g]	0.33[g]	No	--

[a] Lookup values and RAGs obtained from the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (DOE-RL 2005b) or calculated per WAC-173-340-720, WAC-173-340-730, and WAC-173-340-740, Method B, 1996, unless otherwise noted.
[b] Site-specific RESRAD evaluation determined that the mass of contamination was insufficient to cause the direct exposure limitation of 15 mrem/yr or RAGs for groundwater and river protection to be exceeded.
[c] Where cleanup levels are less than background, cleanup levels default to background (WAC 173-340-700[4][d], 1996 and DOE-RL 2005b).
[d] Carcinogenic cleanup level calculated based on the inhalation exposure pathway (WAC 173-340-750[) (1996) and an airborne particulate mass-loading rate of 0.0001 g/m^3 (WDOH 1997).
[e] No Hanford Site-specific or Washington State background value available.
[f] No cleanup level is available from the *Cleanup Levels and Risk Calculations (CLARC) Database* (Ecology 2005), and no bioconcentration factor or ambient water quality criteria values are available to calculate cleanup levels (WAC 173-340-730(3)(a)(iii), 1996 [Method B for surface waters]).
[g] Where cleanup levels are less than RDLs, cleanup levels default to RDLs (WAC 173-340-707(2)) (1996).
[h] Cleanup level calculated with updated toxicity values using the appropriate formulas from WAC 173-340-740 (Ecology 1996). Updated toxicity values are available from the EPA Integrated Risk Information System (IRIS) at < http://www.epa.gov/iris > or from the Risk Assessment Information System database of the Oak Ridge National Laboratory (ORNL) on the Internet at < http://risk.lsd.ornl.gov >.

-- = not applicable
BG = background
COC = contaminant of concern
COPC = contaminant of potential concern
RAG = remedial action goal
RESRAD = RESidual RADioactivity (dose assessment model)
WAC = *Washington Administrative Code*

Table 2. 100-F-46 Sample Summary.

Sample Location	Sample Media	HEIS Number	Coordinate Locations	Depth	Sample Analysis
Test pit	Soil	J16355	N 147617.4 E 580378.9	4 m	GEA, C-14, H-3, isotopic plutonium, gross alpha, gross beta, ICP metals, mercury, hexavalent chromium, PCBs, PAH, TPH
	Duplicate soil	J16356			
Equipment blank	Associated with J16355 and J16356	J16357	NA	NA	ICP metals[a], mercury

[a] See also field logbook EL-1601-2, pp. 2-3 (WCH 2007a).

GEA = gamma energy analysis
HEIS = Hanford Environmental Information System
ICP = inductively coupled plasma
NA = not applicable
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
TPH = total petroleum hydrocarbon

The vadose zone beneath the 100-F-46 excavation is approximately 12.4 m (40.7 ft) thick. The RESRAD model predicted that tritium from the 100-F-46 french drain site will reach groundwater (or the river) within the 1,000 years of the evaluation at a peak activity of 4,900 pCi/L, which is below the maximum contaminant level of 20,000 pCi/L. Therefore, residual activities of tritium are protective of groundwater. The only pathway for contamination to reach the Columbia River is via groundwater migration, so this contaminant activity is also protective of the river.

Assessment of the risk requirements for the 100-F-46 french drain site is determined by calculation of the hazard quotient and carcinogenic (excess cancer) risk values for nonradionuclides. These calculations are located in Appendix C. The requirements include an individual hazard quotient of less than 1.0, a cumulative hazard quotient of less than 1.0, an individual contaminant carcinogenic risk of less than 1×10^{-6}, and a cumulative excess carcinogenic risk of less than 1×10^{-5}. These risk values were conservatively calculated for the entire 100-F-46 french drain site using the highest values. Risk values were not calculated for constituents that were not detected or were detected at concentrations below Hanford Site or Washington State background values. The calculations indicated that all individual hazard quotients for noncarcinogenic constituents are less than 1.0. The cumulative hazard quotient for the 100-F-46 waste site is 3.6×10^{-3}. All individual cumulative carcinogenic risk values are less than 1×10^{-6}. The cumulative carcinogenic risk value is 2.8×10^{-7}. Therefore, nonradionuclide risk requirements are met.

DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the verification sampling approach and resulting analytical data with the sampling and data quality requirements specified by the project objectives and performance specifications. The DQA for the 100-F-46 french drain site established that the data are of the right type, quality, and quantity to support site verification decisions within specified error tolerances. All analytical data were found to be acceptable for decision-making purposes. The evaluation verified that the sample design was sufficient for the purpose of clean site verification. The detailed DQA is presented in Appendix D.

SUMMARY FOR NO ACTION DECISION

The 100-F-46 french drain site has been confirmed to have been previously removed. Confirmatory sampling demonstrates that residual contamination meets the cleanup criteria specified in the Remaining Sites ROD (EPA 1999) and the RDR/RAWP (DOE-RL 2005b). Accordingly, a No Action reclassification is supported for the 100-F-46 french drain site. The site does not have a deep zone or residual contaminant concentrations that would require any institutional controls.

REFERENCES

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

ANL, 2007, *RESRAD for Windows*, Version 6.4, Argonne National Laboratory, Environmental Assessment Division, Argonne, Illinois.

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.

BHI, 2003, Waste Site Reclassification Form 2003-29, and Attachment *Waste Site Evaluation for 132-F-5, 117-F Filter Building*, Bechtel Hanford, Inc., Richland, Washington.

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

DOE-RL, 1996, *Hanford Site Background: Part 2, Soil Background for Radionuclides*, DOE/RL-96-12, Rev.0, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2005a, *100 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-96-22, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2005b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2007, *Tri-Party Agreement Handbook Management Procedures*, RL-TPA-90-0001, Guideline Number TPA-MP-14, "Maintenance of the Waste Information Data System (WIDS)," Rev. 1, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

Ecology, 2005, *Cleanup Levels and Risk Calculations (CLARC) Database*, Washington State Department of Ecology, Olympia, Washington, available at: < http://www.ecy.wa.gov >.

EPA, 1999, *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 100-DR-2, 100-FR-1, 100-FR-2, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington*, U.S. Environmental Protection Agency, Region 10, Seattle, Washington.

GE, 1962, *Civil Plan – Outside Lines, Water Supply and Drains*, H-1-19812, Sheet 1, Rev. 5, General Electric Company, Richland, Washington.

GE, 1965, *Plot Plan – 117-F Filter Building*, H-1-19803, Rev. 3, General Electric Company, Richland, Washington.

UNI, 1983a, *Final Closeout Report for the 117-F Filter Building*, UNI-2692, UNC Nuclear Industries, Richland, Washington.

UNI, 1983b, *Radiological Characterization Activities Resulting in the Unrestricted Release of the 117-F Filter Building*, UNI-2674, UNC Nuclear Industries, Richland, Washington.

UNI, 1985, *ARCL Calculations for Decommissioning the 116-F Stack*, UNI-3492, UNC Nuclear Industries, Richland, Washington.

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

WCH, 2007a, *Miscellaneous Sampling*, Logbook EL-1601-2, pp. 2-3, and 13, Washington Closure Hanford, Richland, Washington.

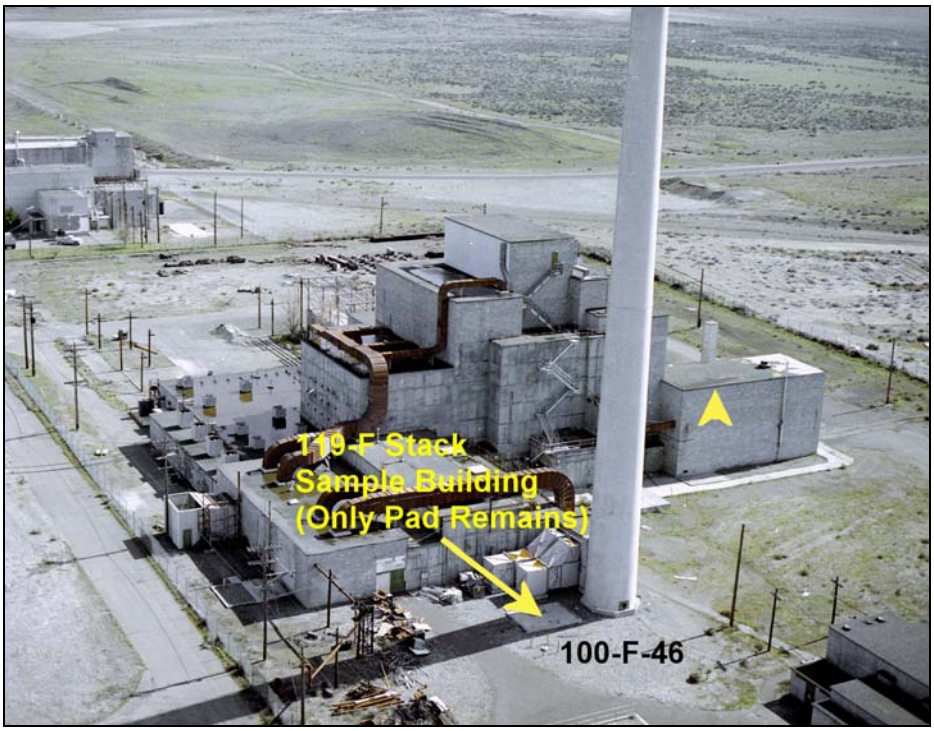
WCH, 2007b, *Work Instruction for Confirmatory Sampling of the 100-F-46, 119-F Stack Sampling French Drain*, 0100F-WI-G0044, Rev. 0, Washington Closure Hanford, Richland, Washington.

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

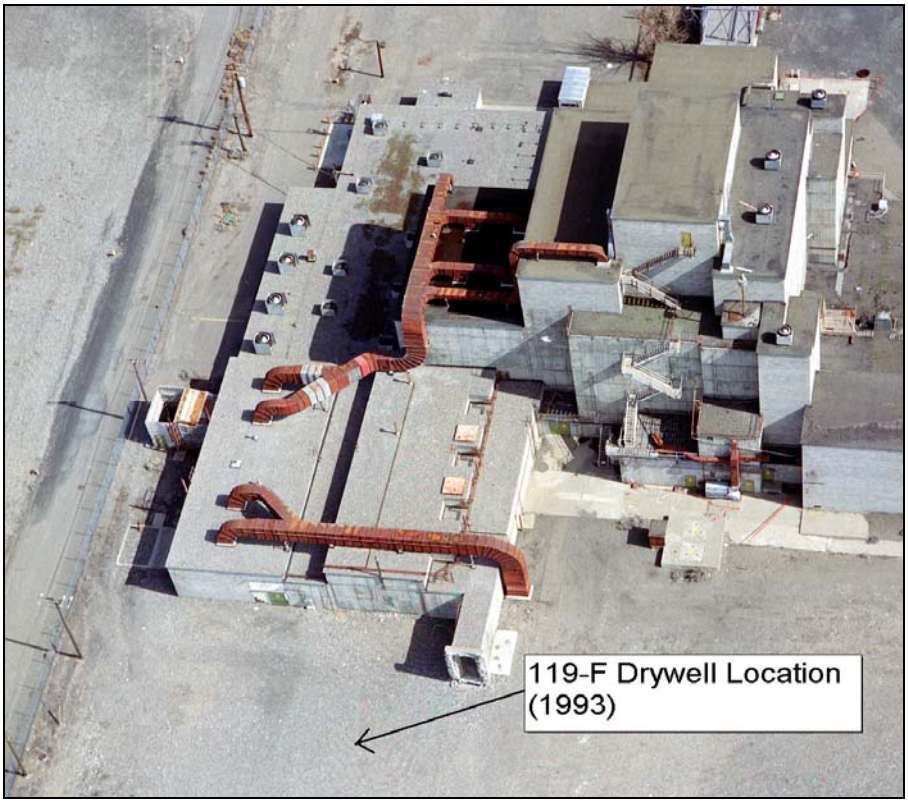
APPENDIX A

100-F-46 SITE PHOTOGRAPHS

View of the 119-F-Stack Sample Building Site. Only the Concrete Pad Remains. Photograph from 1983.



View of the 119-F-Stack Sample Building Site With the Concrete Pad Removed. Photograph from 1993.



Prior to Excavation of the 100-F-46 French Drain Location.

100-F-46
Prior to starting excavation

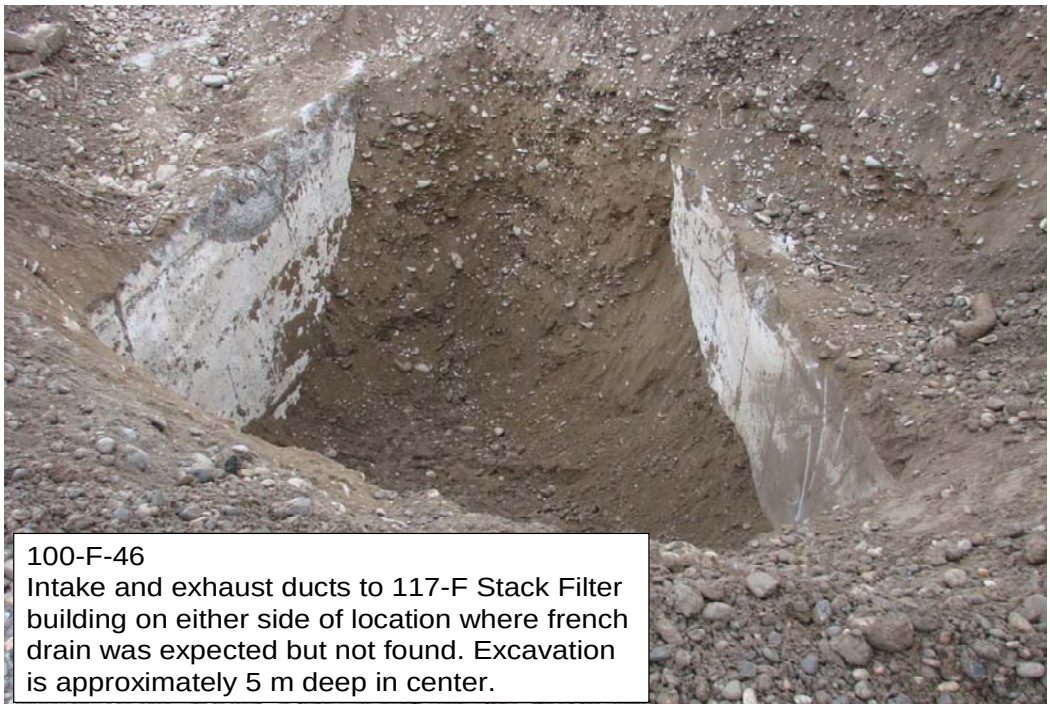
Radiological and Industrial Hygiene Field Screening in Progress at the 100-F-46 French Drain Location.

100-F-46
Screening stock pile for radiological contamination and volatile organic compounds. Note shallow excavation depth – approximately 6 inches per lift.

Another View of the 100-F-46 French Drain Excavation.

Radiological and Industrial Hygiene Technicians Continue Field Screening of Material Removed from the 100-F-46 French Drain Excavation.

Intake and Exhaust Ducts to 117-F Stack Filter Building Encountered During Excavation of the 100-F-46 French Drain Location.



100-F-46
Intake and exhaust ducts to 117-F Stack Filter building on either side of location where french drain was expected but not found. Excavation is approximately 5 m deep in center.

Soil Sample Collection from the Excavator Bucket from the 100-F-46 French Drain Excavation.

100-F-46
Collecting sample material from excavator bucket.

APPENDIX B

100-F-46 CONFIRMATORY DATA TABLES

Table B-1. 100-F-46 Radionuclide Data Results.

Sample Location	HEIS Number	Sample Date	Americium-241 (GEA)			Carbon-14			Cesium-137			Cobalt-60			Europium-152		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Test Pit 1	J16355	11/29/07	0.147	U	0.147	0.136	U	3.400	0.020	U	0.020	0.021	U	0.021	0.059	U	0.059
Duplicate	J16356	11/29/07	0.344	U	0.344	1.000	U	3.250	0.035	U	0.035	0.039	U	0.039	0.095	U	0.095

Sample Location	HEIS Number	Sample Date	Europium-154			Europium-155			Plutonium-238			Plutonium-239/240			Potassium-40		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Test Pit 1	J16355	11/29/07	0.071	U	0.071	0.075	U	0.075	0.0	U	0.291	0.030	U	0.232	15.700		0.191
Duplicate	J16356	11/29/07	0.139	U	0.139	0.110	U	0.110	0.1	U	0.274	0.036	U	0.274	14.600		0.494

Sample Location	HEIS Number	Sample Date	Radium-226			Radium-228			Thorium-228 GEA			Thorium-232 GEA			Tritium		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Test Pit 1	J16355	11/29/07	0.526		0.040	0.678		0.087	0.660		0.030	0.678		0.087	33.800		7.510
Duplicate	J16356	11/29/07	0.491		0.081	0.886		0.152	0.826		0.077	0.886		0.152	0.058	U	7.520

Sample Location	HEIS Number	Sample Date	Uranium-235 GEA			Uranium-238 GEA			Gross alpha			Gross beta		
			pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA	pCi/g	Q	MDA
Test Pit 1	J16355	11/29/07	0.11	U	0.11	2.4	U	2.38	9.6		8.00	20.9		5.33
Duplicate	J16356	11/29/07	0.17	U	0.17	4.9	U	4.86	15.7		8.39	17.4		5.61

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

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

B = blank contamination (organic compounds)
C = blank contamination (inorganic compounds)
D = diluted
I = interference during analysis
J = estimate value
ND = not detected
U = undetected

GEA = Gamma Energy Analysis
HEIS = Hanford Environmental Information System
MDA = Minimum Detectable Activity
PQL = Practical Quantitation Limit
TPH = Total Petroleum Hydrocarbons
QUAL = qualifier

Table B-2. 100-F-46 Inorganic Data Results.

Sample Location	HEIS Number	Sample Date	Aluminum			Antimony			Arsenic			Barium			Beryllium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1	J16355	11/29/07	5420		11.2	1.20		0.84	1.6		1.4	52.6	C	0.28	0.51		0.14
Duplicate	J16356	11/29/07	5820		11.4	0.86	U	0.86	1.9		1.4	57.7	C	0.29	0.51		0.14
Equip Blank	J16357	11/29/07	45		3.7	0.28	U	0.28	0.5	U	0.5	1.4	C	0.09	0.05	U	0.05

Sample Location	HEIS Number	Sample Date	Boron			Cadmium			Calcium			Chromium			Hexavalent Chromium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1	J16355	11/29/07	3.5		1.4	0.14	U	0.14	6240	C	11.2	7.7		0.56	0.2	U	0.21
Duplicate	J16356	11/29/07	3.9		1.4	0.14	U	0.14	6550	C	11.4	8.5		0.57	0.28		0.21
Equip Blank	J16357	11/29/07	0.5	U	0.5	0.05	U	0.05	23.6	C	3.7	0.2		0.18			

Sample Location	HEIS Number	Sample Date	Cobalt			Copper			Iron			Lead			Magnesium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1	J16355	11/29/07	4.9		0.56	11.7		0.56	13000	C	12.6	5.2	C	0.84	3810	C	7
Duplicate	J16356	11/29/07	5.2		0.57	12.0		0.57	15200	C	12.9	5.5	C	0.86	4130	C	7.1
Equip Blank	J16357	11/29/07	0.2		0.18	0.3		0.18	95	C	4.1	0.5	C	0.28	9	C	2.3

Sample Location	HEIS Number	Sample Date	Manganese			Mercury			Molybdenum			Nickel			Potassium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1	J16355	11/29/07	221		0.11	0.01	U	0.01	0.84	U	0.84	8.7		0.56	844		11.2
Duplicate	J16356	11/29/07	245		0.11	0.01	U	0.01	0.86		0.86	9.0		0.57	907		11.4
Equip Blank	J16357	11/29/07	4		0.04	0.01	U	0.01	0.28	U	0.28	0.2	U	0.18	23		3.7

Sample Location	HEIS Number	Sample Date	Selenium			Silicon			Silver			Sodium			Vanadium		
			mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1	J16355	11/29/07	1.7	U	1.7	2470		11.2	0.28	U	0.28	211	C	5.6	30.0		0.39
Duplicate	J16356	11/29/07	1.7	U	1.7	1750		11.4	0.38		0.29	203	C	5.7	34.2		0.40
Equip Blank	J16357	11/29/07	0.6	U	0.6	64		3.7	0.09	U	0.09	13	C	1.8	0.2		0.13

Sample Location	HEIS Number	Sample Date	Zinc			TPH		
			mg/kg	Q	PQL	mg/kg	Q	PQL
Test Pit 1	J16355	11/29/07	28.4		1.70	142.0	U	142.00
Duplicate	J16356	11/29/07	30.6		1.70	141.0	U	141.00
Equip Blank	J16357	11/29/07	1.9		0.55			

Table B-3. 100-F-46 Inorganic Data Results.

Constituents	J16355 Test Pit 1 Sample Date 11/29/07			J16356 Duplicate of J16355 Sample Date 11/29/07		
	µg/kg	Q	PQL	µg/kg	Q	PQL
Polychlorinated Biphenyls						
Aroclor-1016	14	U	14	14	U	14
Aroclor-1221	14	U	14	14	U	14
Aroclor-1232	14	U	14	14	U	14
Aroclor-1242	14	U	14	14	U	14
Aroclor-1248	14	U	14	14	U	14
Aroclor-1254	14	U	14	14	U	14
Aroclor-1260	14	U	14	4.8	J	14
Polyaromatic Hydrocarbons						
Acenaphthene	35.6	U	35.6	35.5	U	35.5
Acenaphthylene	35.6	U	35.6	35.5	U	35.5
Anthracene	3.56	U	3.56	3.55	U	3.55
Benzo(a)anthracene	3.3	J	3.56	3.9		3.55
Benzo(a)pyrene	2.9	J	3.56	1.5	J	3.55
Benzo(b)fluoranthene	3	J	3.56	1.3	J	3.55
Benzo(ghi)perylene	3.56	U	3.56	4.2		3.55
Benzo(k)fluoranthene	1.6	J	3.56	7.6		3.55
Chrysene	3.56	U	3.56	3.55	U	3.55
Dibenz[a,h]anthracene	3.56	U	3.56	3.55	U	3.55
Fluoranthene	3.56	U	3.56	3.55	U	3.55
Fluorene	3.56	U	3.56	3.55	U	3.55
Indeno(1,2,3-cd)pyrene	10		3.56	3.55	U	3.55
Naphthalene	35.6	U	35.6	35.5	U	35.5
Phenanthrene	3.56	U	3.56	3.55	U	3.55
Pyrene	3.56	U	3.56	3.55	U	3.55

APPENDIX C

100-F-46 CALCULATION BRIEFS

APPENDIX C

CALCULATION BRIEFS

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. These calculations have been prepared in accordance with ENG-1, *Engineering Services*, ENG-1-4.5, "Project Calculation," Washington Closure Hanford, Richland, Washington. The following calculations are provided in this appendix:

100-F-46 Hazard Quotient and Carcinogenic Risk Calculations, Calculation No. 0100F-CA-V0347, Rev. 0.

100-F-46 French Drain Soils Confirmatory Sampling RESRAD Calculation Brief, Calculation No. 0100F-CA-V0346, Rev. 0.

DISCLAIMER FOR CALCULATIONS

The calculation that is provided in this appendix has been generated to document compliance with established cleanup levels. This calculation should be used in conjunction with other relevant documents in the administrative record.

Acrobat 8.0

CALCULATION COVER SHEET

Project Title: 100-F-Field Remediation **Job No. 14655**

Area: 100-F

Discipline: Environmental *Calculation No: 0100F-CA-V0347

Subject: 100-F-46 Hazard Quotient and Carcinogenic Risk Calculatons

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	4	C.R. Martinez	L. D. Habel	N/A	J. M. Capron	03/19/08

SUMMARY OF REVISION

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

Washington Closure Hanford CALCULATION SHEET

Originator:	C. R. Martinez	Date:	3/19/08	Calc. No.:	0100F-CA-V0347	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	L. D. Habel	Date:	3/19/08
Subject:	100-F-46 Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 1 of 3	

PURPOSE:

Provide documentation to support the calculation of the hazard quotient (HQ) and carcinogenic (excess cancer) risk values for the 100-F-46 french drain site remedial action. In accordance with the remedial action goals (RAGs) in the remedial design report/remedial action work plan (RDR/RAWP) (DOE-RL 2005), 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, 2005, *Remedial Design Report/Remedial Action Work Plan for the 100 Areas,* DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

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

3) WCH, 2008, *Remaining Sites Verification Package for 100-F-46, 119-F Stack Sampling French Drain*, Attachment to Waste Site Reclassification Form 2008-021, March 2008, Washington Closure Hanford, Richland, Washington.

SOLUTION:

1) Calculate an HQ for each noncarcinogenic constituent detected above background and compare it to the individual HQ of <1.0 (DOE-RL 2005).

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

3) Calculate an excess cancer risk value for each carcinogenic constituent detected above background and compare it to the individual excess cancer risk criterion of $<1 \times 10^{-6}$ (DOE-RL 2005).

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

Washington Closure Hanford CALCULATION SHEET

Originator:	C. R. Martinez	Date:	3/19/08	Calc. No.:	0100F-CA-V0347	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	L. D. Habel	Date:	3/19/08
Subject:	100-F-46 Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 2 of 3	

METHODOLOGY:

HQ and carcinogenic risk calculations were calculated for the entire 100-F-46 french drain site using the higher value for each analyte from the primary and duplicate samples. Boron, hexavalent chromium, molybdenum, Aroclor-1260, and a number of semivolatile organic compounds required the HQ and risk calculations because these COPCs were detected and a Washington State or Hanford Site background value either is not available, or is not applicable. All other site nonradionuclide COPCs were not detected or were quantified below background levels. An example of the HQ and risk calculations is presented below:

1) For example, the maximum result for molybdenum (0.86 mg/kg), divided by the noncarcinogenic RAG value of 400 mg/kg (calculated in accordance with the noncarcinogenic toxic effects WAC 173-340-740[3]), is 2.2×10^{-3}. Comparing this value, and all other individual values, to the requirement of <1.0, this criterion is met.

2) After the HQ calculations are completed for the appropriate analytes, the cumulative HQ is obtained by summing the individual values. (To avoid errors due to intermediate rounding, the individual HQ values prior to rounding are used for this calculation.) The sum of the HQ values is 3.6×10^{-3}. Comparing this values to the requirement of <1.0, this criterion is met.

3) To calculate the excess cancer risk, the maximum statistical value is divided by the carcinogenic RAG value, then, multiplied by 1×10^{-6}. For example, the maximum value for hexavalent chromium is 0.28 mg/kg; divided by 2.1 mg/kg, and multiplied as indicated, is 1.3×10^{-7}. 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 is obtained by summing the individual values. The sum of the excess cancer risk values is 2.8×10^{-7}. Comparing this value to the requirement of $<1 \times 10^{-5}$, this criterion is met.

RESULTS:

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

Table 1 shows the results of the calculation.

Washington Closure Hanford		CALCULATION SHEET					
Originator:	C. R. Martinez	Date:	3/19/08	Calc. No.:	0100F-CA-V0347	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	L. D. Habel	Date:	3/19/08
Subject:	100-F-46 Hazard Quotient and Carcinogenic Risk Calculations					Sheet No. 3 of 3	

Table 1. Hazard Quotient and Excess Cancer Risk Results for the 100-F-46 French Drain Site.

Contaminants of Potential Concern	Maximum Value[a] (mg/kg)	Noncarcinogen RAG[b] (mg/kg)	Hazard Quotient	Carcinogen RAG[b] (mg/kg)	Carcinogen Risk
Metals					
Boron	3.9	16,000	2.4E-04	--	--
Chromium, hexavalent[c]	0.28	240	1.2E-03	2.1	1.3E-07
Molybdenum	0.86	400	2.2E-03	--	--
Semivolatiles					
Benzo(a)anthracene	0.0039	--	--	0.137	2.8E-08
Benzo(a)pyrene	0.0029	--	--	0.137	2.1E-08
Benzo(b)fluoranthene	0.003	--	--	0.137	2.2E-08
Benzo(k)fluoranthene	0.0076	--	--	0.137	5.5E-08
Benzo(ghi)perylene	0.0042	2,400	1.8E-06	--	--
Indeno(1,2,3-cd) pyrene	0.01	--	--	1.37	7.3E-09
Polychlorinated Biphenyls					
Aroclor-1260	0.0048	--	--	0.5	9.6E-09
Totals					
Cumulative Hazard Quotient:			**3.6E-03**		
Cumulative Excess Cancer Risk:					**2.8E-07**

Notes:
RAG = remedial action goal
-- = not applicable
[a] = From Table 1, WCH 2008
[b] = Value obtained from *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.

CONCLUSION:

This calculation demonstrates that the 100-F-46 french drain site meets the requirements for the hazard quotients and carcinogenic (excess cancer) risk as identified in the RDR/RAWP (DOE-RL 2005).

Acrobat 8.0

CALCULATION COVER SHEET

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

Area: 100-F

Discipline: Environmental *Calculation No: 0100F-CA-V0346

Subject: 100-F-46 French Drain Soils Confirmatory Sampling RESRAD Calc Brief

Computer Program: RESRAD Program No: Version 6.4

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 - 1 pg Attm. 2 - 18 pg Attm. 3 - 21 pg Attm. 4 - 10 pg Total – 55 pages	S. W. Clark	H. M. Sulloway	N/A	J. D. Fancher	3/13/08

SUMMARY OF REVISION

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

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	3/1/08	Calc. No.:	0100F-CA-V0346	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	3/6/08
Subject:	100-F-46 French Drain Confirmatory Sampling RESRAD Calculation Brief					Sheet No.	1 of 4

PURPOSE:

Calculate the soil and groundwater concentrations, dose, and risk contributions over a period of 1,000 years from the maximum activities of radionuclides in the soil analyses at the 100-F-46 French Drain soils confirmatory sampling site.

GIVEN/REFERENCES:

1) Confirmatory sampling data from *Remaining Sites Verification Package for the 100-F-46, 119-F Stack Sampling French Drain*, (100-F-46 RSVP) attachment to Waste Site Reclassification Form (WSFR) 2008-021, Washington Closure Hanford, Richland, Washington.
2) *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (RDR/RAWP), DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.
3) For the purpose of these RESRAD calculations, the only radioactive contaminant of concern (COC) established in the 100-F-46 RSVP is tritium.
4) The nonradionuclide COCs are discussed in the 100-F-46 RSVP. All nonradionuclide remedial action goals (RAGs) are met for direct exposure and protection of groundwater and the river.
5) RESidual RADioactivity (RESRAD) computer code, version 6.4, to calculate compliance with residual radioactivity guidelines, developed for the U.S. Department of Energy by the Environmental Assessment Division of Argonne National Laboratory, Argonne, Illinois.
6) Sample design from the *Work Instruction for Confirmatory Sampling of the 100-F-46 French Drain*, Work Instruction No. 0100F-WI-G0044, Rev. 0, Washington Closure Hanford, Richland, Washington.
7) Groundwater elevation from *Hanford Groundwater Monitoring for Fiscal Year 2006,* PNNL-16346, Pacific Northwest National Laboratory, Richland, Washington.

SOLUTION:

1) A single RESRAD run was performed for the 100-F-46 French Drain soils confirmatory sampling analysis. Table 1 shows the elevations (NAVD88) and thickness of each soil horizon. Attachment 1 shows representative dimensions of soil horizons and contaminant pathways considered for dose, risk, and groundwater protection. Input factors for each run are shown in the "Summary" section of the RESRAD "Mixture Sums and Single Radionuclide Guidelines" printouts in the Attachments to this Calculation Summary. For the purposes of this RESRAD evaluation, an area of 100 m^2 (1,076 ft^2) was conveniently selected for the waste site, although the WIDS description for the 100-F-46 site states that the french drain was only 0.91 m (3 ft) in diameter.

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	3/11/08	Calc. No.:	0100F-CA-V0346	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	3/11/08
Subject:	100-F-46 French Drain Confirmatory Sampling RESRAD Calculation Brief					Sheet No.	2 of 4

Table 1. Waste Site Dimensions for RESRAD Modeling

Parameter	Units	OB/BCL
Contaminated Zone Dimensions		
Cover Depth	m	0
Area of Contaminated Zone (CZ)	m^2	100
Length Parallel to Aquifer Flow	m	10
Elevations of Vadose Zone Horizons		
Elevation: Surface	m	126.4
Elevation: Groundwater	m	114.0
Thickness: Contaminated Zone	m	12.4
Thickness: Unsaturated Zone	m	0

2) The year where 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 2008) for the only COC (tritium). For the water pathways (i.e. drinking water and food ingestion) the peak year for tritium is also at year zero (year 2008).

METHODOLOGY:

1) Runs of RESRAD version 6.4 were completed for the 100-F-46 French Drain soils confirmatory sampling analysis in Table 2. RESRAD numerical output reports for dose, risk, and concentration are presented in the Attachments to this calculation summary.

Table 2. Maximum Radionuclide Activities from the 100-F-46 French Drain Soils Confirmatory Sampling Analysis

COC	Confirmatory Sampling Soils Analysis
Radionuclide Activity (pCi/g)	
Tritium (H-3)	33.8

RESULTS:

1) Radionuclide "All Pathways" Dose Rate

The "all pathways" (maximum) dose rates are shown in Table 3. The maximum all pathways dose rate for the 100-F-46 French Drain soils confirmatory sampling analysis is 0.30 mrem/yr at year zero (2008).

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	3/11/08	Calc. No.:	0100F-CA-V0346	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	3/11/08
Subject:	100-F-46 French Drain Confirmatory Sampling RESRAD Calculation Brief					Sheet No.	3 of 4

Table 3. All Pathways Dose Rate (mrem/yr)

RESRAD Run	Vadose Zone Horizons	"All Pathways" Dose Contributions in mrem/yr at Each Time Slice (yr)								
		0	1	2	4	10	30	100	300	1000
Confirmatory Sampling Soil	All	3.00E-01	2.39E-01	1.56E-01	6.65E-02	5.15E-03	1.00E-06	8.69E-20	0	0

2) Radionuclide Excess Lifetime Cancer Risk

The radionuclide excess lifetime cancer risk (ELCR) results are shown in Table 4. The maximum ELCR for the 100-F-46 French Drain soils confirmatory sampling analysis is 1.22×10^{-6} at year zero (2008).

Table 4. Radionuclide Excess Lifetime Cancer Risk

RESRAD Run	Vadose Zone Horizons	Excess Cancer Risk at Each Time Slice (yr)								
		0	1	2	4	10	30	100	300	1000
Confirmatory Sampling Soil	All	1.22E-06	1.32E-06	8.62E-07	3.67E-07	2.84E-08	5.52E-12	4.75E-25	0	0

3) Radionuclide Groundwater Protection

The radionuclide concentrations in groundwater calculated by the RESRAD model are summarized in Table 5. Tritium is predicted to reach groundwater in the 1,000 years of the RESRAD model evaluation (at a concentration of 4,900 pCi/L, which is below the MCL of 20,000 pCi/L). Because tritium is the only COC, calculation of cumulative organ specific dose via the groundwater (and river) pathway was not necessary to determine that the 4 mrem/yr drinking water dose limitation is met. The comparison to drinking water standards (MCL) calculation brief was also not necessary to be performed.

Table 5. Predicted Groundwater (Well Water/Drinking Water) Concentrations

Radio-nuclides	RESRAD Run	Groundwater Concentrations in pCi/L at Each Time Slice (yr)									RAGs, pCi/L
		0	1	2	4	10	30	100	300	1000	
Tritium	Confirmatory Sampling Soil	0	4.90E+03	3.20E+03	1.37E+03	1.06E+02	2.06E-02	1.80E-15	0	0	20,000

RAGs = Remedial action goals from the 100 Area RDR/RAWP

CONCLUSIONS:

- The "all pathways" (maximum) dose rates are shown in Table 3. The maximum all pathways dose rate from the 100-F-46 French Drain soils confirmatory sampling analysis is 0.30m/yr at year zero (2008).

- The radionuclide excess lifetime cancer risk (ELCR) results are shown in Table 4. The maximum ELCR for the 100-F-46 French Drain soils confirmatory sampling analysis 1.22×10^{-6} at year zero (2008).

Washington Closure Hanford CALCULATION SHEET

Originator:	S. W. Clark	Date:	3/11/08	Calc. No.:	0100F-CA-V0346	Rev.:	0
Project:	100-F Field Remediation	Job No:	14655	Checked:	H. M. Sulloway	Date:	3/11/08
Subject:	100-F-46 French Drain Confirmatory Sampling RESRAD Calculation Brief					Sheet No.	4 of 4

- The dominant pathway for the RESRAD evaluations dose rate for the 100-F-46 French Drain soils confirmatory sampling analysis is water ingestion due to tritium.

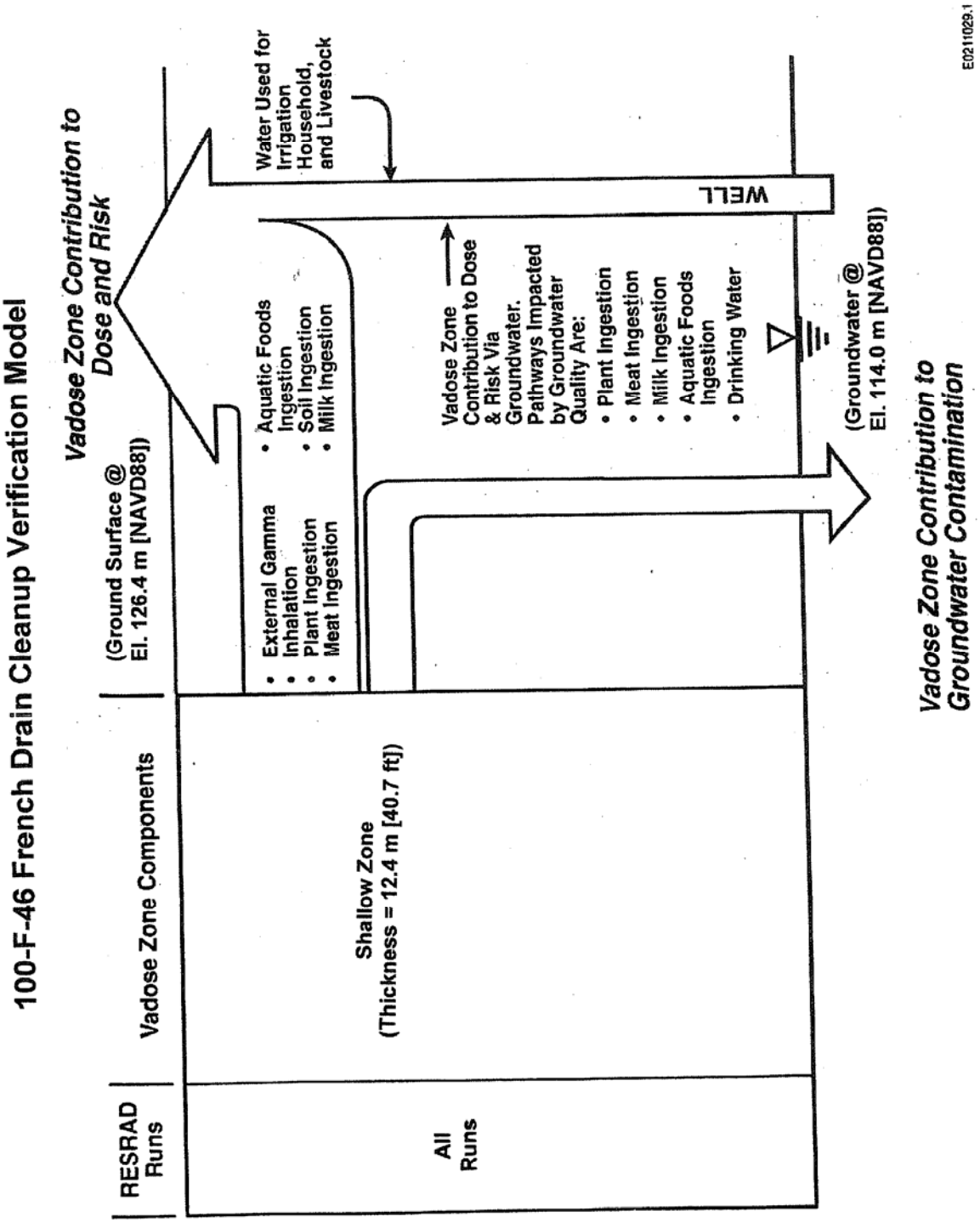
- None of the site COCs are projected to exceed remedial action goals (RAGs).

- Tritium is predicted to reach groundwater in the 1,000 years of the RESRAD model evaluation at a concentration of 4,900 pCi/L which is below the MCL (20,000 pCi/L). Because only one radionuclide is predicted to reach groundwater it was not necessary to perform the calculation of cumulative organ specific dose via the groundwater (and river) pathway to determine that the 4 mrem/yr drinking water dose limitation is met.

ATTACHMENTS:

1. Graphic showing 100-F-46 Cleanup Verification Model (1 page)
2. RESRAD Output: 100-F-46 French Drain Soils Confirmatory Sampling Analysis – Mixture Sums and Single Radionuclide Guidelines (18 pages)
3. RESRAD Output: 100-F-46 French Drain Soils Confirmatory Sampling Analysis – Intake Quantities and Health Risk Factors (21 pages)
4. RESRAD Output: 100-F-46 French Drain Soils Confirmatory Sampling Analysis – Concentration of Radionuclides, (10 pages)

ATTACHMENT 1



Attachment 1 Sheet No. 1 of 1
Originators: S. W. Clark Date 3/14/06
Chk'd By: H. M. Sulloway Date 3/14/06
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

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1RESRAD, Version 6.4      T« Limit = 180 days        03/10/2008  13:54  Page   1
 Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
 File    : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

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Attachment 2 Sheet No. 1 of 18
Originator: S. W. Clark Date 3/11/08
Chk'd By: H. M. Sulloway Date 3/11/08
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 2
Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

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

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	H-3 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(1)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	H-3	6.400E-08	6.400E-08	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	H-3	6.400E-08	6.400E-08	DCF3(1)
D-34	Food transfer factors:			
D-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(1,1)
D-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,2)
D-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC(1,1)
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(1,2)

#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 2 Sheet No. 2 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
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ATTACHMENT 2

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 3
Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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)	1.000E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.240E+01	2.000E+00	---	THICKO
R011	Length parallel to aquifer flow (m)	1.000E+01	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	2.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	4.000E+00	1.000E+01	---	T(4)
R011	Times for calculations (yr)	1.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	3.000E+01	1.000E+02	---	T(6)
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): H-3	3.380E+01	0.000E+00	---	S1(1)
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---	W1(1)
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)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.000E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	1.500E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	2.500E+02	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	3.400E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	9.100E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.600E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	7.600E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	2.000E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---	WAREA
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	2.500E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	1.500E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	5.530E+03	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	1.250E-03	2.000E-02	---	HGWT
R014	Saturated zone b parameter	4.050E+00	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	4.600E+00	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	2.500E+02	2.500E+02	---	UW
R015	Number of unsaturated zone strata	0	1	---	NS

Attachment 2 Sheet No. 3 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 4
Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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 H-3				
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCC(1)
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.327E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R017	Inhalation rate (m**3/yr)	7.300E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-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	8.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	6.000E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.000E-01	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)
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)	7.300E+01	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	7.300E+02	5.100E+02	---	DWI

Attachment 2 Sheet No. 4 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 5
Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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-01	FPLANT
R018	Contamination fraction of meat	-1	-1	0.500E-02	FMEAT
R018	Contamination fraction of milk	-1	-1	0.500E-02	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
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):				

Attachment 2 Sheet No. 5 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 6
Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
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	64	---	---	NPTS
TITL	Maximum number of integration points for dose	5	---	---	LYMAX
TITL	Maximum number of integration points for risk	9	---	---	KYMAX

Summary of Pathway Selections

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

Attachment 2 Sheet No. 6 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

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1RESRAD, Version 6.4      T« Limit = 180 days        03/10/2008  13:54  Page   7
 Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
 File    : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

      Contaminated Zone Dimensions            Initial Soil Concentrations, pCi/g
      ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ            ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
        Area:     100.00 square meters              H-3        3.380E+01
   Thickness:      12.40 meters
 Cover Depth:       0.00 meters
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)
                    ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
    t (years):  0.000E+00  1.000E+00  2.000E+00  4.000E+00  1.000E+01  3.000E+01  1.000E+02  3.000E+02  1.000E+03
     TDOSE(t):  2.993E-01  2.390E-01  1.560E-01  6.653E-02  5.149E-03  1.003E-06  8.694E-20  0.000E+00  0.000E+00
         M(t):  1.995E-02  1.593E-02  1.040E-02  4.435E-03  3.432E-04  6.684E-08  5.796E-21  0.000E+00  0.000E+00
0Maximum TDOSE(t):  2.993E-01 mrem/yr   at t = 0.000E+00 years
```

Attachment 2 Sheet No. 7 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 8
Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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-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.
H-3	0.000E+00	0.0000	2.400E-03	0.0080	0.000E+00	0.0000	6.633E-02	0.2216	8.682E-04	0.0029	1.440E-03	0.0048	1.028E-05	0.0000
Total	0.000E+00	0.0000	2.400E-03	0.0080	0.000E+00	0.0000	6.633E-02	0.2216	8.682E-04	0.0029	1.440E-03	0.0048	1.028E-05	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-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.
H-3	2.217E-01	0.7408	1.224E-05	0.0000	0.000E+00	0.0000	6.300E-03	0.0210	4.500E-05	0.0002	1.606E-04	0.0005	2.993E-01	1.0000
Total	2.217E-01	0.7408	1.224E-05	0.0000	0.000E+00	0.0000	6.300E-03	0.0210	4.500E-05	0.0002	1.606E-04	0.0005	2.993E-01	1.0000

*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 8 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

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1RESRAD, Version 6.4      T« Limit = 180 days        03/10/2008  13:54  Page   9
 Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
 File    : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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
0                                   Water Independent Pathways (Inhalation excludes radon)
0            Ground          Inhalation          Radon           Plant           Meat            Milk            Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 H-3     0.000E+00 0.0000 1.567E-03 0.0066 0.000E+00 0.0000 4.336E-02 0.1815 5.705E-04 0.0024 9.442E-04 0.0040 6.714E-06 0.0000
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 Total   0.000E+00 0.0000 1.567E-03 0.0066 0.000E+00 0.0000 4.336E-02 0.1815 5.705E-04 0.0024 9.442E-04 0.0040 6.714E-06 0.0000
0
                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years
0                                     Water Dependent Pathways
0             Water            Fish            Radon           Plant           Meat            Milk          All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 H-3     1.867E-01 0.7814 1.055E-05 0.0000 0.000E+00 0.0000 5.586E-03 0.0234 4.771E-05 0.0002 1.450E-04 0.0006 2.390E-01 1.0000
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 Total   1.867E-01 0.7814 1.055E-05 0.0000 0.000E+00 0.0000 5.586E-03 0.0234 4.771E-05 0.0002 1.450E-04 0.0006 2.390E-01 1.0000
0*Sum of all water independent and dependent pathways.
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Attachment 2 Sheet No. 9 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 10
Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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 = 2.000E+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.
H-3	0.000E+00	0.0000	1.023E-03	0.0066	0.000E+00	0.0000	2.831E-02	0.1814	3.724E-04	0.0024	6.164E-04	0.0040	4.383E-06	0.0000
Total	0.000E+00	0.0000	1.023E-03	0.0066	0.000E+00	0.0000	2.831E-02	0.1814	3.724E-04	0.0024	6.164E-04	0.0040	4.383E-06	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 = 2.000E+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.
H-3	1.219E-01	0.7814	6.888E-06	0.0000	0.000E+00	0.0000	3.648E-03	0.0234	3.116E-05	0.0002	9.466E-05	0.0006	1.560E-01	1.0000
Total	1.219E-01	0.7814	6.888E-06	0.0000	0.000E+00	0.0000	3.648E-03	0.0234	3.116E-05	0.0002	9.466E-05	0.0006	1.560E-01	1.0000

*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 10 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 11
Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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 = 4.000E+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.
H-3	0.000E+00	0.0000	4.358E-04	0.0066	0.000E+00	0.0000	1.206E-02	0.1813	1.587E-04	0.0024	2.626E-04	0.0039	1.868E-06	0.0000
Total	0.000E+00	0.0000	4.358E-04	0.0066	0.000E+00	0.0000	1.206E-02	0.1813	1.587E-04	0.0024	2.626E-04	0.0039	1.868E-06	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 = 4.000E+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.
H-3	5.200E-02	0.7816	2.937E-06	0.0000	0.000E+00	0.0000	1.555E-03	0.0234	1.329E-05	0.0002	4.036E-05	0.0006	6.653E-02	1.0000
Total	5.200E-02	0.7816	2.937E-06	0.0000	0.000E+00	0.0000	1.555E-03	0.0234	1.329E-05	0.0002	4.036E-05	0.0006	6.653E-02	1.0000

*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 11 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

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1RESRAD, Version 6.4      T« Limit = 180 days        03/10/2008  13:54  Page  12
 Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
 File    : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 H-3     0.000E+00 0.0000 3.367E-05 0.0065 0.000E+00 0.0000 9.318E-04 0.1810 1.226E-05 0.0024 2.029E-05 0.0039 1.443E-07 0.0000
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 Total   0.000E+00 0.0000 3.367E-05 0.0065 0.000E+00 0.0000 9.318E-04 0.1810 1.226E-05 0.0024 2.029E-05 0.0039 1.443E-07 0.0000
0
                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                  As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years
0                                          Water Dependent Pathways
0             Water             Fish            Radon           Plant           Meat            Milk          All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 H-3     4.026E-03 0.7819 2.274E-07 0.0000 0.000E+00 0.0000 1.204E-04 0.0234 1.029E-06 0.0002 3.125E-06 0.0006 5.149E-03 1.0000
 ßßßßßßß ßßßßßßßßß ßßßßßß ßßßßßßßßß ßßßßßß ßßßßßßßßß ßßßßßß ßßßßßßßßß ßßßßßß ßßßßßßßßß ßßßßßß ßßßßßßßßß ßßßßßß ßßßßßßßßß ßßßßßß
 Total   4.026E-03 0.7819 2.274E-07 0.0000 0.000E+00 0.0000 1.204E-04 0.0234 1.029E-06 0.0002 3.125E-06 0.0006 5.149E-03 1.0000
0*Sum of all water independent and dependent pathways.
```

Attachment 2 Sheet No. 12 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

```
1RESRAD, Version 6.4      T« Limit = 180 days        03/10/2008  13:54  Page  13
 Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
 File    : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0                                   Water Independent Pathways (Inhalation excludes radon)
0          Ground          Inhalation          Radon           Plant           Meat            Milk            Soil
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 H-3     0.000E+00 0.0000 6.516E-09 0.0065 0.000E+00 0.0000 1.804E-07 0.1799 2.373E-09 0.0024 3.928E-09 0.0039 2.792E-11 0.0000
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 Total   0.000E+00 0.0000 6.516E-09 0.0065 0.000E+00 0.0000 1.804E-07 0.1799 2.373E-09 0.0024 3.928E-09 0.0039 2.792E-11 0.0000
0
                    Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                 As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years
0                                     Water Dependent Pathways
0           Water            Fish            Radon           Plant           Meat            Milk          All Pathways*
 Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
 Nuclide  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.  mrem/yr  fract.
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
 H-3     7.851E-07 0.7830 4.434E-11 0.0000 0.000E+00 0.0000 2.349E-08 0.0234 2.006E-10 0.0002 6.095E-10 0.0006 1.003E-06 1.0000
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
 Total   7.851E-07 0.7830 4.434E-11 0.0000 0.000E+00 0.0000 2.349E-08 0.0234 2.006E-10 0.0002 6.095E-10 0.0006 1.003E-06 1.0000
0*Sum of all water independent and dependent pathways.
```

Attachment 2 Sheet No. 13 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 14
Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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-	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.
H-3	0.000E+00	0.0000	5.529E-22	0.0064	0.000E+00	0.0000	1.531E-20	0.1761	2.015E-22	0.0023	3.334E-22	0.0038	2.369E-24	0.0000
Total	0.000E+00	0.0000	5.529E-22	0.0064	0.000E+00	0.0000	1.531E-20	0.1761	2.015E-22	0.0023	3.334E-22	0.0038	2.369E-24	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
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.
H-3	6.842E-20	0.7870	3.865E-24	0.0000	0.000E+00	0.0000	2.047E-21	0.0235	1.749E-23	0.0002	5.312E-23	0.0006	8.694E-20	1.0000
Total	6.842E-20	0.7870	3.865E-24	0.0000	0.000E+00	0.0000	2.047E-21	0.0235	1.749E-23	0.0002	5.312E-23	0.0006	8.694E-20	1.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 14 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 15
Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 15 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 16
Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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-	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.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

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-	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.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

0*Sum of all water independent and dependent pathways.

Attachment 2 Sheet No. 16 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

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1RESRAD, Version 6.4      T« Limit = 180 days        03/10/2008  13:54  Page  17
 Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
 File    : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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 2.000E+00 4.000E+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 ÄÄÄÄÄÄÄÄÄÄ
 H-3         H-3        1.000E+00  8.855E-03 7.070E-03 4.617E-03 1.968E-04 1.523E-04 2.966E-08 2.572E-21 0.000E+00 0.000E+00
 íííííííííí 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   2.000E+00   4.000E+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  ÄÄÄÄÄÄÄÄÄÄ
 H-3        1.694E+03  2.122E+03  3.249E+03  7.621E+03  9.847E+04  5.057E+08 *9.597E+15 *9.597E+15 *9.597E+15
 íííííííí    íííííííííí  íííííííííí  íííííííííí  íííííííííí  íííííííííí  íííííííííí  íííííííííí  íííííííííí  íííííííííí
 *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
0Nuclide  Initial      tmin       DSR(i,tmin) G(i,tmin) DSR(i,tmax) G(i,tmax)
   (i)    (pCi/g)     (years)                  (pCi/g)              (pCi/g)
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 H-3     3.380E+01    0.000E+00      8.855E-03  1.694E+03  8.855E-03  1.694E+03
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Attachment 2 Sheet No. 17 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 2

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1RESRAD, Version 6.4      T« Limit = 180 days        03/10/2008  13:54  Page  18
 Summary : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
 File    : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

                                  Individual Nuclide Dose Summed Over All Pathways
                                    Parent Nuclide and Branch Fraction Indicated
ONuclide Parent   THF(i)                                          DOSE(j,t), mrem/yr
   (j)     (i)             t= 0.000E+00 1.000E+00 2.000E+00 4.000E+00 1.000E+01 3.000E+01 1.000E+02 3.000E+02 1.000E+03
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ    ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 H-3     H-3     1.000E+00    2.993E-01 2.390E-01 1.560E-01 6.653E-02 5.149E-03 1.003E-06 8.694E-20 0.000E+00 0.000E+00
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ    ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ
 THF(i) is the thread fraction of the parent nuclide.


                                     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 2.000E+00 4.000E+00 1.000E+01 3.000E+01 1.000E+02 3.000E+02 1.000E+03
 ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄ    ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 H-3     H-3     1.000E+00    3.380E+01 2.207E+01 1.441E+01 6.138E+00 4.742E-01 9.184E-05 7.807E-18 0.000E+00 0.000E+00
 ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍ    ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ
 THF(i) is the thread fraction of the parent nuclide.
ORESCALC.EXE execution time =    9.12 seconds
```

Attachment 2 Sheet No. 18 of 18
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

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1RESRAD, Version 6.4      T« Limit = 180 days        03/10/2008  13:54  Page   1
 Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
 File    : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

                     Table of Contents
                     ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
   Part III: Intake Quantities and Health Risk Factors
   ÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ

 Cancer Risk Slope Factors ..............................    2
 Risk Slope and ETFG for the Ground Pathway ..............    3
 Amount of Intake Quantities and Excess Cancer Risks
      Time= 0.000E+00 ....................................    4
      Time= 1.000E+00 ....................................    6
      Time= 2.000E+00 ....................................    8
      Time= 4.000E+00 ....................................   10
      Time= 1.000E+01 ....................................   12
      Time= 3.000E+01 ....................................   14
      Time= 1.000E+02 ....................................   16
      Time= 3.000E+02 ....................................   18
      Time= 1.000E+03 ....................................   20
```

Attachment 3 Sheet No. 1 of 21
Originator: S. W. Clark Date 3/11/08
Chk'd By: H. M. Sulloway Date 3/14/08
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 2
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Cancer Risk Slope Factors Summary Table
Risk Library: HEAST 2001 Morbidity

0 Menu	Parameter	Current Value	Base Case*	Parameter Name
Sf-1	Ground external radiation slope factors, 1/yr per (pCi/g):			
Sf-1	H-3	0.00E+00	0.00E+00	SLPF(1,1)
Sf-2	Inhalation, slope factors, 1/(pCi):			
Sf-2	H-3	1.99E-13	1.99E-13	SLPF(1,2)
Sf-3	Food ingestion, slope factors, 1/(pCi):			
Sf-3	H-3	1.44E-13	1.44E-13	SLPF(1,3)
Sf-3	Water ingestion, slope factors, 1/(pCi):			
Sf-3	H-3	1.12E-13	1.12E-13	SLPF(1,4)
Sf-3	Soil ingestion, slope factors, 1/(pCi):			
Sf-3	H-3	2.20E-13	2.20E-13	SLPF(1,5)

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Attachment 3 Sheet No. 2 of 21
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ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 3
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Risk Slope and Environmental Transport Factors for the Ground Pathway

ONuclide (i)	Slope(i)*	ETFG(i,t) At Time in Years (dimensionless)								
	t=	0.000E+00	1.000E+00	2.000E+00	4.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	0.000E+00	6.780E-01	6.780E-01	6.780E-01	6.780E-01	6.780E-01	6.780E-01	6.780E-01	6.780E-01	6.780E-01

* - Units are 1/yr per (pCi/g) at infinite depth and area. Multiplication by ETFG(i,t) converts to site conditions.

Attachment 3 Sheet No. 3 of 21
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ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 4
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 0.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
H-3	4.606E+04	1.257E+06	1.570E+04	2.650E+04	1.974E+02	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.300E+06

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	2.209E-08	0.0181	4.391E-07	0.3604	5.627E-09	0.0046	9.404E-09	0.0077	1.046E-10	0.0001
Total	0.000E+00	0.0000	2.209E-08	0.0181	4.391E-07	0.3604	5.627E-09	0.0046	9.404E-09	0.0077	1.046E-10	0.0001

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	7.136E-07	0.5857	5.182E-11	0.0000	2.744E-08	0.0225	2.344E-10	0.0002	7.122E-10	0.0006	1.218E-06	1.0000
Total	7.136E-07	0.5857	5.182E-11	0.0000	2.744E-08	0.0225	2.344E-10	0.0002	7.122E-10	0.0006	1.218E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	2.209E-08	0.0181	0.000E+00	0.0000	4.391E-07	0.3604	5.627E-09	0.0046	9.404E-09	0.0077	1.046E-10	0.0001
Total	0.000E+00	0.0000	2.209E-08	0.0181	0.000E+00	0.0000	4.391E-07	0.3604	5.627E-09	0.0046	9.404E-09	0.0077	1.046E-10	0.0001

Attachment 3 Sheet No. 4 of 21
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ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 5
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 0.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	7.136E-07	0.5857	5.182E-11	0.0000	0.000E+00	0.0000	2.744E-08	0.0225	2.344E-10	0.0002	7.122E-10	0.0006	1.218E-06	1.0000
Total	7.136E-07	0.5857	5.182E-11	0.0000	0.000E+00	0.0000	2.744E-08	0.0225	2.344E-10	0.0002	7.122E-10	0.0006	1.218E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 5 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
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ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 6
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
H-3	3.007E+04	8.323E+05	1.095E+04	1.812E+04	1.289E+02	3.583E+06	2.024E+02	1.072E+05	9.155E+02	2.782E+03	4.556E+06

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	1.442E-08	0.0109	2.887E-07	0.2188	3.799E-09	0.0029	6.287E-09	0.0048	6.830E-11	0.0001
Total	0.000E+00	0.0000	1.442E-08	0.0109	2.887E-07	0.2188	3.799E-09	0.0029	6.287E-09	0.0048	6.830E-11	0.0001

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	9.676E-07	0.7333	7.027E-11	0.0001	3.721E-08	0.0282	3.179E-10	0.0002	9.657E-10	0.0007	1.319E-06	1.0000
Total	9.676E-07	0.7333	7.027E-11	0.0001	3.721E-08	0.0282	3.179E-10	0.0002	9.657E-10	0.0007	1.319E-06	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years
Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	1.442E-08	0.0109	0.000E+00	0.0000	2.887E-07	0.2188	3.799E-09	0.0029	6.287E-09	0.0048	6.830E-11	0.0001
Total	0.000E+00	0.0000	1.442E-08	0.0109	0.000E+00	0.0000	2.887E-07	0.2188	3.799E-09	0.0029	6.287E-09	0.0048	6.830E-11	0.0001

Attachment 3 Sheet No. 6 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
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ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 7
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	9.676E-07	0.7333	7.027E-11	0.0001	0.000E+00	0.0000	3.721E-08	0.0282	3.179E-10	0.0002	9.657E-10	0.0007	1.319E-06	1.0000
Total	9.676E-07	0.7333	7.027E-11	0.0001	0.000E+00	0.0000	3.721E-08	0.0282	3.179E-10	0.0002	9.657E-10	0.0007	1.319E-06	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 7 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
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ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 8
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 2.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
H-3	1.963E+04	5.433E+05	7.148E+03	1.183E+04	8.413E+01	2.340E+06	1.322E+02	7.000E+04	5.979E+02	1.817E+03	2.975E+06

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 2.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	9.410E-09	0.0109	1.885E-07	0.2188	2.480E-09	0.0029	4.104E-09	0.0048	4.458E-11	0.0001
Total	0.000E+00	0.0000	9.410E-09	0.0109	1.885E-07	0.2188	2.480E-09	0.0029	4.104E-09	0.0048	4.458E-11	0.0001

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 2.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	6.318E-07	0.7334	4.588E-11	0.0001	2.430E-08	0.0282	2.076E-10	0.0002	6.306E-10	0.0007	8.615E-07	1.0000
Total	6.318E-07	0.7334	4.588E-11	0.0001	2.430E-08	0.0282	2.076E-10	0.0002	6.306E-10	0.0007	8.615E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 2.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	9.410E-09	0.0109	0.000E+00	0.0000	1.885E-07	0.2188	2.480E-09	0.0029	4.104E-09	0.0048	4.458E-11	0.0001
Total	0.000E+00	0.0000	9.410E-09	0.0109	0.000E+00	0.0000	1.885E-07	0.2188	2.480E-09	0.0029	4.104E-09	0.0048	4.458E-11	0.0001

Attachment 3 Sheet No. 8 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
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ATTACHMENT 3

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Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 2.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	6.318E-07	0.7334	4.588E-11	0.0001	0.000E+00	0.0000	2.430E-08	0.0282	2.076E-10	0.0002	6.306E-10	0.0007	8.615E-07	1.0000
Total	6.318E-07	0.7334	4.588E-11	0.0001	0.000E+00	0.0000	2.430E-08	0.0282	2.076E-10	0.0002	6.306E-10	0.0007	8.615E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 9 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 10
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 4.000E+00 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
H-3	8.365E+03	2.315E+05	3.046E+03	5.041E+03	3.585E+01	9.979E+05	5.636E+01	2.985E+04	2.550E+02	7.746E+02	1.268E+06

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 4.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	4.009E-09	0.0109	8.028E-08	0.2186	1.056E-09	0.0029	1.748E-09	0.0048	1.899E-11	0.0001
Total	0.000E+00	0.0000	4.009E-09	0.0109	8.028E-08	0.2186	1.056E-09	0.0029	1.748E-09	0.0048	1.899E-11	0.0001

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 4.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	2.694E-07	0.7335	1.956E-11	0.0001	1.036E-08	0.0282	8.849E-11	0.0002	2.688E-10	0.0007	3.672E-07	1.0000
Total	2.694E-07	0.7335	1.956E-11	0.0001	1.036E-08	0.0282	8.849E-11	0.0002	2.688E-10	0.0007	3.672E-07	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 4.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	4.009E-09	0.0109	0.000E+00	0.0000	8.028E-08	0.2186	1.056E-09	0.0029	1.748E-09	0.0048	1.899E-11	0.0001
Total	0.000E+00	0.0000	4.009E-09	0.0109	0.000E+00	0.0000	8.028E-08	0.2186	1.056E-09	0.0029	1.748E-09	0.0048	1.899E-11	0.0001

Attachment 3 Sheet No. 10 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 11
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 4.000E+00 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	2.694E-07	0.7335	1.956E-11	0.0001	0.000E+00	0.0000	1.036E-08	0.0282	8.849E-11	0.0002	2.688E-10	0.0007	3.672E-07	1.0000
Total	2.694E-07	0.7335	1.956E-11	0.0001	0.000E+00	0.0000	1.036E-08	0.0282	8.849E-11	0.0002	2.688E-10	0.0007	3.672E-07	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 11 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 12
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+01 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
H-3	6.463E+02	1.789E+04	2.353E+02	3.895E+02	2.770E+00	7.727E+04	4.364E+00	2.311E+03	1.974E+01	5.998E+01	9.818E+04

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	3.095E-10	0.0109	6.199E-09	0.2183	8.156E-11	0.0029	1.350E-10	0.0048	1.466E-12	0.0001
Total	0.000E+00	0.0000	3.095E-10	0.0109	6.199E-09	0.2183	8.156E-11	0.0029	1.350E-10	0.0048	1.466E-12	0.0001

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	2.084E-08	0.7339	1.514E-12	0.0001	8.016E-10	0.0282	6.847E-12	0.0002	2.080E-11	0.0007	2.840E-08	1.0000
Total	2.084E-08	0.7339	1.514E-12	0.0001	8.016E-10	0.0282	6.847E-12	0.0002	2.080E-11	0.0007	2.840E-08	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	3.095E-10	0.0109	0.000E+00	0.0000	6.199E-09	0.2183	8.156E-11	0.0029	1.350E-10	0.0048	1.466E-12	0.0001
Total	0.000E+00	0.0000	3.095E-10	0.0109	0.000E+00	0.0000	6.199E-09	0.2183	8.156E-11	0.0029	1.350E-10	0.0048	1.466E-12	0.0001

Attachment 3 Sheet No. 12 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 13
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	2.084E-08	0.7339	1.514E-12	0.0001	0.000E+00	0.0000	8.016E-10	0.0282	6.847E-12	0.0002	2.080E-11	0.0007	2.840E-08	1.0000
Total	2.084E-08	0.7339	1.514E-12	0.0001	0.000E+00	0.0000	8.016E-10	0.0282	6.847E-12	0.0002	2.080E-11	0.0007	2.840E-08	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 13 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 14
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+01 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
H-3	1.252E-01	3.464E+00	4.559E-02	7.544E-02	5.363E-04	1.508E+01	8.516E-04	4.510E-01	3.853E-03	1.170E-02	1.913E+01

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	5.980E-14	0.0108	1.198E-12	0.2170	1.576E-14	0.0029	2.608E-14	0.0047	2.833E-16	0.0001
Total	0.000E+00	0.0000	5.980E-14	0.0108	1.198E-12	0.2170	1.576E-14	0.0029	2.608E-14	0.0047	2.833E-16	0.0001

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	4.058E-12	0.7352	2.947E-16	0.0001	1.561E-13	0.0283	1.333E-15	0.0002	4.050E-15	0.0007	5.519E-12	1.0000
Total	4.058E-12	0.7352	2.947E-16	0.0001	1.561E-13	0.0283	1.333E-15	0.0002	4.050E-15	0.0007	5.519E-12	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	5.980E-14	0.0108	0.000E+00	0.0000	1.198E-12	0.2170	1.576E-14	0.0029	2.608E-14	0.0047	2.833E-16	0.0001
Total	0.000E+00	0.0000	5.980E-14	0.0108	0.000E+00	0.0000	1.198E-12	0.2170	1.576E-14	0.0029	2.608E-14	0.0047	2.833E-16	0.0001

Attachment 3 Sheet No. 14 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 15
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+01 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Radio- Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	4.058E-12	0.7352	2.947E-16	0.0001	0.000E+00	0.0000	1.561E-13	0.0283	1.333E-15	0.0002	4.050E-15	0.0007	5.519E-12	1.0000
Total	4.058E-12	0.7352	2.947E-16	0.0001	0.000E+00	0.0000	1.561E-13	0.0283	1.333E-15	0.0002	4.050E-15	0.0007	5.519E-12	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 15 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 16
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+02 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
H-3	1.064E-14	2.945E-13	3.878E-15	6.416E-15	4.559E-17	1.316E-12	7.435E-17	3.938E-14	3.365E-16	1.022E-15	1.662E-12

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	5.039E-27	0.0106	1.010E-25	0.2126	1.325E-27	0.0028	2.197E-27	0.0046	2.246E-29	0.0000
Total	0.000E+00	0.0000	5.039E-27	0.0106	1.010E-25	0.2126	1.325E-27	0.0028	2.197E-27	0.0046	2.246E-29	0.0000

0

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	3.514E-25	0.7398	2.399E-29	0.0001	1.351E-26	0.0285	1.120E-28	0.0002	3.442E-28	0.0007	4.750E-25	1.0000
Total	3.514E-25	0.7398	2.399E-29	0.0001	1.351E-26	0.0285	1.120E-28	0.0002	3.442E-28	0.0007	4.750E-25	1.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

0

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

0 Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	5.039E-27	0.0106	0.000E+00	0.0000	1.010E-25	0.2126	1.325E-27	0.0028	2.197E-27	0.0046	2.246E-29	0.0000
Total	0.000E+00	0.0000	5.039E-27	0.0106	0.000E+00	0.0000	1.010E-25	0.2126	1.325E-27	0.0028	2.197E-27	0.0046	2.246E-29	0.0000

Attachment 3 Sheet No. 16 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 17
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+02 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	3.514E-25	0.7398	2.399E-29	0.0001	0.000E+00	0.0000	1.351E-26	0.0285	1.120E-28	0.0002	3.442E-28	0.0007	4.750E-25	1.0000
Total	3.514E-25	0.7398	2.399E-29	0.0001	0.000E+00	0.0000	1.351E-26	0.0285	1.120E-28	0.0002	3.442E-28	0.0007	4.750E-25	1.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 17 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 18
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 3.000E+02 years

Radio-Nuclide	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					Total
	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Ingestion*
H-3	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	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Plant		Meat		Milk		All Pathways**	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Attachment 3 Sheet No. 18 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

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1RESRAD, Version 6.4      T« Limit = 180 days        03/10/2008  13:54  Page  19
 Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
 File    : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

                Total Excess Cancer Risk CNRS(i,p,t)*** for  Initially Existent Radionuclides (i) and Pathways (p)
                                      and Fraction of Total Risk at t= 3.000E+02 years

                                                Water Dependent Pathways

            Water           Fish            Radon           Plant           Meat            Milk            All pathways
Radio-  ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ
Nuclide    risk    fract.     risk    fract.     risk    fract.     risk    fract.     risk    fract.     risk    fract.     risk    fract.
ÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄ
H-3     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
ÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍ
Total   0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000  0.000E+00 0.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides
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Attachment 3 Sheet No. 19 of 21
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 20
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Amount of Intake Quantities QINT(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As pCi/yr at t= 1.000E+03 years

	Water Independent Pathways (Inhalation w/o radon)					Water Dependent Pathways					
Radio-Nuclide	Inhalation	Plant	Meat	Milk	Soil	Water	Fish	Plant	Meat	Milk	Total Ingestion*
H-3	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	0.000E+00	0.000E+00

* Sum of all ingestion pathways, i.e. water independent plant, meat, milk, soil
and water-dependent water, fish, plant, meat, milk pathways

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Plant		Meat		Milk		Soil	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Excess Cancer Risks CNRS(i,p,t) for Individual Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

	Water		Fish		Plant		Meat		Milk		All Pathways**	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

** Sum of water independent ground, inhalation, plant, meat, milk, soil
and water dependent water, fish, plant, meat, milk pathways

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Attachment 3 Sheet No. 20 of 21
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Chk'd By: H. M. Sulloway Date
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ATTACHMENT 3

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 21
Intrisk : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Total Excess Cancer Risk CNRS(i,p,t)*** for Initially Existent Radionuclides (i) and Pathways (p)
and Fraction of Total Risk at t= 1.000E+03 years

Water Dependent Pathways

	Water		Fish		Radon		Plant		Meat		Milk		All pathways	
Radio-Nuclide	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.	risk	fract.
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

***CNRSI(i,p,t) includes contribution from decay daughter radionuclides

Attachment 3 Sheet No. 21 of 21
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ATTACHMENT 4

1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 1
Concent : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

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Originator: S. W. Clark Date 3/11/08
Chk'd By: H. M. Sulloway Date 3/11/08
Calc. No. 0100F-CA-V0346 Rev. No. 0

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1RESRAD, Version 6.4 T« Limit = 180 days 03/10/2008 13:54 Page 2
Concent : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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
H-3	3.380E+01	3.380E+01	2.611E-04	0.000E+00	0.000E+00

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

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of H-3 in soil moisture = 2.792E+02 pCi/ml
Concentration of gaseous H-3 in air = 5.258E+00 pCi/m**3

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
H-3	0.000E+00	2.231E+05	2.231E+05	2.231E+05	2.231E+05	8.724E+04	5.299E+04	0.000E+00	0.000E+00

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

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

Attachment 4 Sheet No. 2 of 10
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
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Concent : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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
H-3	2.207E+01	2.207E+01	1.705E-04	4.904E+03	1.951E+01

*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 H-3 in soil moisture = 1.823E+02 pCi/ml
Concentration of gaseous H-3 in air = 3.433E+00 pCi/m**3

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
H-3	4.909E+03	1.666E+05	1.731E+05	1.654E+05	1.618E+05	6.592E+04	4.181E+04	1.965E+01	1.965E+01

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

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

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Chk'd By: H. M. Sulloway Date
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Concent : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

Concentration of radionuclides in environmental media
at t = 2.000E+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
H-3	1.441E+01	1.441E+01	1.113E-04	3.202E+03	1.274E+01

*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 H-3 in soil moisture = 1.190E+02 pCi/ml
Concentration of gaseous H-3 in air = 2.241E+00 pCi/m**3

Concentration of radionuclides in foodstuff media
at t = 2.000E+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
H-3	3.206E+03	1.087E+05	1.130E+05	1.080E+05	1.056E+05	4.303E+04	2.729E+04	1.283E+01	1.283E+01

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

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

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Chk'd By: H. M. Sulloway Date
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 Concent : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
 File    : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

      Concentration of radionuclides in environmental media
                  at t = 4.000E+00 years

          Contaminat-  Surface   Air Par-     Well      Surface
           ted Zone     Soil*    ticulate     Water      Water
 Radio-   ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 Nuclide     pCi/g      pCi/g    pCi/m**3     pCi/L      pCi/L
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 H-3       6.138E+00  6.138E+00  4.741E-05  1.366E+03  5.433E+00
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 *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 H-3 in soil moisture =  5.070E+01 pCi/ml
 Concentration of gaseous H-3 in air   =  9.549E-01 pCi/m**3


                          Concentration of radionuclides in foodstuff media
                                      at t = 4.000E+00 years*

          Drinking   Nonleafy     Leafy     Fodder     Fodder      Meat       Milk       Fish    Crustacea
            Water    Vegetable  Vegetable    Meat       Milk
 Radio-   ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 Nuclide     pCi/L      pCi/kg     pCi/kg     pCi/kg     pCi/kg     pCi/kg     pCi/L     pCi/kg     pCi/kg
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 H-3       1.367E+03  4.634E+04  4.815E+04  4.602E+04  4.501E+04  1.834E+04  1.163E+04  5.472E+00  5.472E+00
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 *Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
  For livestock fodder, consumption time is t minus meat or milk storage time.

  Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters,
  i.e. using parameters appearing in the input screen when the pathways are active.
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Originator: S. W. Clark Date
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Concent : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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
H-3	4.742E-01	4.742E-01	3.663E-06	1.057E+02	4.207E-01

*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 H-3 in soil moisture = 3.917E+00 pCi/ml
Concentration of gaseous H-3 in air = 7.378E-02 pCi/m**3

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
H-3	1.058E+02	3.581E+03	3.722E+03	3.556E+03	3.478E+03	1.417E+03	8.990E+02	4.237E-01	4.237E-01

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

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

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Concent : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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
H-3	9.184E-05	9.184E-05	7.094E-10	2.063E-02	8.209E-05

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

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of H-3 in soil moisture = 7.585E-04 pCi/ml
Concentration of gaseous H-3 in air = 1.429E-05 pCi/m**3

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
H-3	2.065E-02	6.941E-01	7.216E-01	6.891E-01	6.740E-01	2.747E-01	1.743E-01	8.268E-05	8.268E-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.

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1RESRAD, Version 6.4      T« Limit = 180 days        03/10/2008  13:54  Page   8
 Concent : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
 File    : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

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

          Contaminat-  Surface   Air Par-     Well      Surface
           ted Zone     Soil*    ticulate     Water      Water
 Radio-   ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 Nuclide     pCi/g      pCi/g    pCi/m**3     pCi/L      pCi/L
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 H-3       7.807E-18  7.807E-18  6.030E-23  1.801E-15  7.167E-18
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 *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 H-3 in soil moisture =  6.448E-17 pCi/ml
 Concentration of gaseous H-3 in air   =  1.214E-18 pCi/m**3


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

          Drinking   Nonleafy     Leafy     Fodder     Fodder      Meat       Milk       Fish     Crustacea
            Water    Vegetable  Vegetable    Meat       Milk
 Radio-   ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 Nuclide     pCi/L      pCi/kg     pCi/kg     pCi/kg     pCi/kg     pCi/kg      pCi/L      pCi/kg     pCi/kg
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 H-3       1.803E-15  5.919E-14  6.160E-14  5.871E-14  5.740E-14  2.341E-14  1.488E-14  7.218E-18  7.218E-18
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 *Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
  For livestock fodder, consumption time is t minus meat or milk storage time.

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

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Originator: S. W. Clark Date
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Concent : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
File : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.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
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

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

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

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
H-3	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

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

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

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 Concent : 100-F-46 French Drain Confirmatory Sampling Soils Analysis
 File    : C:\PROGRAM FILES\RESRAD_FAMILY\RESRAD\100-F-46_FRENCH DRAIN_TRITIUM.RAD

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

          Contaminat-  Surface   Air Par-     Well      Surface
           ted Zone     Soil*    ticulate     Water      Water
 Radio-   ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 Nuclide     pCi/g      pCi/g    pCi/m**3     pCi/L      pCi/L
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 H-3       0.000E+00  0.000E+00  0.000E+00  0.000E+00  0.000E+00
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 *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 H-3 in soil moisture =  0.000E+00 pCi/ml
 Concentration of gaseous H-3 in air   =  0.000E+00 pCi/m**3


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

          Drinking   Nonleafy     Leafy     Fodder     Fodder      Meat       Milk       Fish    Crustacea
            Water    Vegetable  Vegetable    Meat       Milk
 Radio-   ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 Nuclide     pCi/L      pCi/kg     pCi/kg     pCi/kg     pCi/kg     pCi/kg      pCi/L      pCi/kg     pCi/kg
 ÄÄÄÄÄÄÄ  ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ ÄÄÄÄÄÄÄÄÄÄ
 H-3       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
 ÍÍÍÍÍÍÍ  ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ ÍÍÍÍÍÍÍÍÍÍ
 *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 4 Sheet No. 10 of 10
Originator: S. W. Clark Date
Chk'd By: H. M. Sulloway Date
Calc. No. 0100F-CA-V0346 Rev. No. 0

APPENDIX D

100-F-46 DATA QUALITY ASSESSMENT

CONFIRMATORY SAMPLING DATA QUALITY ASSESSMENT

A data quality assessment (DQA) was performed to compare the confirmatory sampling approach and resulting analytical data with the sampling and data requirements specified in the site-specific sample designs (WCH 2007, DOE-RL 2005b). This DQA was performed in accordance with site-specific data quality objectives found in the *100 Area Remedial Action Sampling and Analysis Plan* (SAP) (DOE-RL 2005a).

To ensure quality data, the SAP data assurance requirements and the data validation procedures for chemical and radiochemical analysis (BHI 2000a, 2000b) 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., evaluate against cleanup criteria to support a no action or remedial action decision). The DQA completes the data life cycle (i.e., planning, implementation, and assessment) that was initiated by the data quality objectives process (EPA 2000).

A review of the sample design (WCH 2007), the field logbook (WCH 2008), and applicable analytical data packages has been performed as part of this DQA. All samples were collected and analyzed per the sample design. In addition, Toxicity Characteristic Leachate Procedure (TCLP) metals analysis was performed on the confirmatory samples collected at the 100-F-46 waste site. TCLP analytical results are requested for waste characterization purposes and do not support No Action or Remedial Action decisions for waste sites. This DQA limited the data review for the 100-F-46 confirmatory sampling to the data required per the sample design. Confirmatory sample data collected at the 100-F-46 waste site were provided by the laboratory in sample delivery group (SDG) K1037. SDG K1037 was submitted for third-party validation. No major deficiencies were identified in the analytical data set. Minor deficiencies are discussed below.

SDG K1037

This SDG comprises a field duplicate pair (J16355/J16356) sampled from the base of the excavation at the 100-F-46 waste site and sample J16357 (equipment blank). These samples were analyzed for inductively coupled plasma (ICP) metals and mercury. In addition, the field duplicate pair (J16355/J16356) was analyzed for hexavalent chromium, polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCBs), gross alpha and gross beta by proportional counting, carbon-14, tritium, isotopic plutonium, and by gamma spectroscopy. SDG K1037 was submitted for formal third-party validation. No major deficiencies were identified in SDG K1037. Minor deficiencies found in SDG K1037 are as follows:

No matrix spike (MS) analysis was performed for tritium or for carbon-14. Third-party validation qualified all tritium and carbon-14 results as estimated and flagged with a “J” designation. The data are useable for decision-making purposes.

For the mercury analysis, the holding time of 28 days was exceeded by less than twice the limit, and all mercury results were qualified as estimates and flagged “J” by third-party validation.

Estimated data are useable for decision-making purposes.

In the ICP metals analysis, the lead result for sample J16357 (the equipment blank) is of similar magnitude as the method blank result, and is qualified by third-party validation as an undetected estimate with a "UJ" flag, due to method blank contamination. The data are useable for decision-making purposes.

Also in the ICP metals analysis, the matrix spike (MS) recoveries for four ICP metals (aluminum, iron, manganese, and silicon) are out of acceptance criteria. For these analytes, the spiking concentration is insignificant compared to the native concentration in the sample from which the MS was prepared. Therefore, the deficiency in the MS result is a reflection of the analytical variability of the native concentration rather than a measure of the recovery from the sample. To confirm quantitation, post-digestion spikes (PDSs) and serial dilutions were prepared for all three analytes with acceptable results.

In the PAH analysis, the matrix spike duplicate (MSD) and laboratory control sample (LCS) recoveries for benzo(a)pyrene are outside the acceptance criteria, at 142% and 141%, respectively. The benzo(a)pyrene results were qualified as estimates and flagged "J" by third-party validation. Estimated data are useable for decision-making purposes.

FIELD QUALITY ASSURANCE/QUALITY CONTROL

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

Field quality assurance/quality control (QA/QC) measures are used to assess potential sources of error and cross contamination of samples that could bias results. Field QA/QC samples, listed in the field logbook (WCH 2008), are the 100-F-46 sample primary and duplicate (J16355/J16356). The main and QA/QC sample results are presented in Appendix C.

Field duplicate samples are collected to provide a relative measure of the degree of local heterogeneity in the sampling medium, unlike laboratory duplicates that are used to evaluate precision in the analytical process. The field duplicates are evaluated by comparison of the RPD of the duplicate samples for each contaminant of concern. The results of the field duplicate RPD calculation were reported in the final validation package for SDG K1037, and are summarized below.

Radionuclides

None of the RPDs calculated for the field QA/QC samples radionuclide results exceeded the acceptance criteria of 30%. The data are useable for decision-making purposes.

Nonradionuclides

The RPD calculated for selenium was 34%, which exceeded the acceptance criteria of 30%. An elevated RPD such as this in the analysis of environmental soil samples is largely attributed to heterogeneities in the soil matrix and only in small part attributed to precision and accuracy issues at the laboratory. The data are useable for decision-making purposes.

An overall visual inspection of all of the data is also performed. No additional major or minor deficiencies were noted. The data are useable for decision-making purposes.

SUMMARY

Limited, random, or sample matrix-specific influenced batch QC issues such as those discussed above are a potential for any analysis. The number and types seen in these data sets are within expectations for the matrix types and analyses performed. The DQA review of the 100-F-46 confirmatory 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 100-F-46 waste site concludes that the data are of the right type, quality, and quantity to support the intended use. The confirmatory sample analytical data are stored in the ENRE Environmental Restoration database prior to being submitted for inclusion in the HEIS Hanford Environmental Information System database. The confirmatory sample analytical data are also summarized in Appendix B.

REFERENCES

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

BHI, 2000b, *Data Validation Procedure for Radiochemical Analysis*, BHI-01433, Rev. 0, Bechtel Hanford, Inc., Richland, Washington.

DOE-RL, 2005a, *100 Area Remedial Action Sampling and Analysis Plan*, DOE/RL-96-22, Rev. 4, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

DOE-RL, 2005b, *Remedial Design Report/Remedial Action Work Plan for the 100 Area*, DOE/RL-96-17, Rev. 5, U.S. Department of Energy, Richland Operations Office, Richland, Washington.

EPA, 2000, *Guidance for Data Quality Assessment*, EPA QA/G-9, QA00 Update, U.S. Environmental Protection Agency, Office of Environmental Information, Washington, D.C.

WCH, 2007, *Work Instruction for Confirmatory Sampling of the 100-F-46, 119-F Stack Sampling French Drain*, 0100F-WI-G0044, Rev. 0, Washington Closure Hanford, Richland, Washington.

WCH, 2008, *Miscellaneous Sampling*, Logbook EL-1601-2, pp. 2-3 and 13, Washington Closure Hanford, Richland, Washington.