PHILOTECHNICS

Fort Mims Facility
Decontamination and Decommissioning Project

Final RESRAD Modeling In Support of Release for Unrestricted Use

Follow-up Report NO. 1: Soil Samples Nov 2011

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1.0 Executive Summary

This document describes the dose modeling and radiological criteria for license termination of the Fort Mims facility. Activities performed at the site to remove residual radioactive material have been completed. Over 200 soil samples were collected on site and analyzed for ^{3}H (tritium) and ^{14}C. All tritium samples were well below the default screening values presented in NUREG 1757 Volume 1, Appendix B. RESRAD was used to estimate the radiation dose that a future occupant of the site would be likely to receive from residual radioactivity.

10 CFR 20.1402 states, in part, "A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA)."

The RESRAD model described in this report demonstrates that, if the entire site were contaminated with the maximum concentration of ^{14}C and ^{3}H measured on site, the maximum predicted annual dose to a member of the critical group is 6.9 millirem.

Based on these findings, the requirements for release for unrestricted use have been met.

2.0 The Fort Mims Property RESRAD Model

RESRAD Version 6.5 was used to predict the average annual dose to workers at the site from residual radioactivity from present time to 1000 years in the future. This section discusses the site location and physical dimensions, surrounding area, surface and subsurface soil characteristics, hydrology, climate, and zoning. Site-specific parameters are used to make the RESRAD model as realistic as possible.

RESRAD models were initially generated in 2010, based on available data at the time, for the Fort Mims Site. After reviewing the initial RESRAD report, the U.S. NRC (NRC), expressed the need for Sigma to better characterize the extent of contamination, the characteristics of the unsaturated zone, including soil, and possible ground water contamination. In response to those concerns, In October 2011 three additional holes were bored: one under the former

septic tank location, and the other two at the locations exhibiting the highest concentration of C-14 within previously-collected soil samples. The dual purpose of this sampling event was to determine the extent of contamination and to determine site-specific soil characteristics. A geologist was contracted to bore holes until resistance was encountered, indicating bedrock had been reached. The geologist then provided boring logs in conjunction with the project and assisted in the determination of the appropriate values to assign to RESRAD model soil parameters.

2.1 Site and Surrounding Area

The site is located at 11542 Fort Mims Drive, Maryland Heights, Missouri. The area of the site is 12,000 m^2. The immediate surrounding area is zoned industrial and commercial. The nearest residential area is approximately 800 m due south. A drainage pond is across the street. A county park with lake suitable for fishing and recreation is 4 km west; the Missouri River is 4 km northwest.

2.2 Soil Contamination

The soil is contaminated with varying concentrations of ^{14}C and ^{3}H. Across multiple sampling events a total of 208 soil samples have been collected and analyzed to measure the concentration of those radionuclides throughout the property. The measured average concentrations were 5.1 pCi/g of ^{3}H and 42.7 pCi.g of ^{14}C. Detectable contamination was measured two meters below the surface but is not uniform; radionuclide concentration decreases with increasing depth. The measured maximum concentrations of each radionuclide were 42.5 pCi/g of ^{3}H and 1290 pCi/g of ^{14}C. The 1290 pCi/g value was located above a footing of the preexisting building, just under the preexisting exhaust stack . No evidence of contamination of the concrete footing was found. Tom Spencer, RSO, explained the anomalous 1290 pCi/g hot spot to the NRC during their site visit on September 15, 2011.The building slab and footings were removed in 2010. The next highest concentration of ^{14}C was 483 pCi/g. Sigma Aldrich opted to use that value within the RESRAD model, assuming that ^{14}C concentration of 483 pCi/g was uniform throughout the contaminated zone to a depth of 4 meters.

Previous RESRAD models for the Fort Mims site were based on sampling that terminated at 2 meters depth. Based on feedback from the NRC, we returned to the site on October 25, 2011 better characterize the soil on-site by obtaining core samples down to bedrock. The purpose was twofold: to determine the maximum depth to which soil contamination penetrated, and to better define soil types and input parameters for the RESRAD model. Schreiber & Yonley

Associates of Ellisville, Missouri was selected as the geological consultant and driller to obtain samples and identify soil types.

Soil samples were analyzed by Teledyne Brown Engineering of Knoxville, Tennessee for ^{3}H and ^{14}C. ^{3}H concentration was consistently very low (lower than the 42.5 pCi/g maximum concentration previously measured). ^{14}C analysis proved difficult because the soil was not of uniform consistency. Laboratory personnel, in an effort to preserve ^{3}H in the soil, ran three separate analyses on each sample without drying them; all results differed from one another and quality control (QC) checks failed to confirm the results. After discussion with Philotechnics and Sigma-Aldrich, the laboratory then thoroughly dried and ground samples to get a more accurate representation of the ^{14}C concentration. Those analyses passed QC checks and are used in this final RESRAD model. ^{14}C contamination extends to 4 meters below grade.

2.3 Soil Characteristics

Surface and subsurface soils are a combination of clayey silt loam, silty clay, and clayey silt. Available documentation indicates an aquifer is at least 140 feet (47 meters) below the ground surface. Limestone, which defines the beginning of the saturated zone, is 33 feet (10 meters) below grade.

The RESRAD model assumes uniform soil contamination at the maximum concentration measured exists to a depth of three meters—the contaminated zone. Uncertainty analyses were run on the thickness of the contaminated zone and the thickness of the unsaturated zone. These are described in Section 3.0.

2.4 Hydrology

There is no cover layer over the contamination.

Site-specific soil parameters were provided by a licensed geologist as follows:

Soil Type	Density	Total Porosity (P_t)	Effective Porosity	Field Capacity	Hydraulic Conductivity (k_{sat})	b Parameter
Contaminated Zone	1.75	0.55	0.18	0.4	3.1	10.4*
Unsaturated Zone	1.75	0.55	0.18	0.4	3.1	10.4*
Saturated Zone	3.7	0.5	0.36	0.2*	315	10.4

A licensed geologist and two hydrogeologists were consulted in an effort to determine the distribution coefficient (K_d), also known as "partition coefficient", for both carbon and hydrogen in all zones. None was able to provide a value.

The Distribution coefficient was conservatively set to a value of 0 for ^{3}H and a value of 1 for ^{14}C (RESRAD Users Guide) The RESRAD User's Manual lists values of K_d of carbon between 1 and 20 for the soil types present, and 70 for organic matter. A value of zero means the radionuclide does not diffuse. Because the extent of vertical contamination was limited to 4 meters below grade and groundwater was not detected down to the bedrock layer, contamination of ground water was determined to be extremely unlikely.

2.5 Climate

Average wind speed is 4.8 $m\text{-}s^{-1}$ (National Oceanic and Atmospheric Administration http://www.ncdc.noaa.gov/oa/climate/online/ccd/avgwind.html) Average annual precipitation is 1 m (National Oceanic and Atmospheric Administration http://www.crh.noaa.gov/lsx/climate/COU/annual_rainfall.php)

2.6 Specific Modeling for ^{14}C

^{14}C behaves differently from other radionuclides in soil; therefore RESRAD contains a module that is specific to ^{14}C. Default parameters were used.

2.7 Occupancy Scenario and Exposure Pathways

RESRAD provides the user with a number of canned but editable occupancy scenarios. For the Fort Mims site, the "Industrial Worker" scenario was selected. In this case, the site remains as a commercial/industrial use area and commercial business is conducted on the site. All exposure pathways associated with working on the property are considered.

AEL/AED-4, "User's Manual for RESRAD Version 6", Tables 2.2 and 2.3 are reproduced below.

Pathways to be Considered for Resident Farmer, Suburban Resident, Industrial Worker, and Recreationist Scenarios (Table 2.2)

Pathway	Resident Farmer	Suburban Resident	Industrial Worker	Recreationist
External gamma exposure	Yes	Yes	Yes	Yes
Inhalation of dust	Yes	Yes	Yes	Yes
Radon Inhalation*	Yes	Yes	Yes	Yes
Ingestion of plant foods	Yes	Yes	No	No
Ingestion of meat	Yes	No	No	Yes
Ingestion of milk	Yes	No	No	No
Ingestion of fish	Yes	No	No	Yes
Ingestion of soil	Yes	Yes	Yes	Yes
Ingestion of water	Yes	No	No/Yes**	No

*Radon is not a contaminant of concern; this parameter is turned OFF.

**While the RESRAD default is OFF, this pathway is turned ON because EPA's industrial worker guidance assumes water is consumed from an onsite well.

Comparison of Key Default Parameters Used in the Resident Farmer, Suburban Resident, Industrial Worker, and Recreationist Scenarios (Table 2.3)

Parameter	Unit	Resident Farmer	Suburban Resident	Industrial Worker	Recreationist
Exposure duration	yr	30	30	**25**	30
Inhalation rate	m^3/yr	8400	8400	**11,400**	14,000
Fraction of time indoors	-	.50	.50	**.17**	-
Fraction of time outdoors	-	.25	.25	**.06**	.006
Contaminated Fractions of food					
Plant food	-	.50	.10	-	-
Milk	-	1	-	-	-
Meat	-	1	-	-	1
Aquatic food	-	.50	-	-	.50
Soil ingestion	g/yr	36.5	36.5	**36.5**	36.5
Drinking water intake	L/yr	510	510*	**510***	-

*EPA guidelines assume drinking water intake of 1.4 L/day

2.8 Site-Specific Parameters

The following table describes the parameters that were changed from the default value and the reason for the change.

Parameter	Default Value	Actual Value	Reason
Area of Contaminated Zone, m^2	10,000	12,000	Actual size
Thickness of contaminated zone, m	2	3	Sampling data
Contaminated zone hydraulic conductivity	10	3.1	Licensed geologist
Contaminated zone b parameter	5.3	10.4	RESRAD User's Manual based on soil type
Average annual wind speed, m/s	2	4.3	NOAA published data
Unsaturated zone thickness, m	4	3	Actual site data
Saturated zone total porosity	0.4	0.5	Licensed geologist
Saturated zone effective porosity	0.2	0.36	Licensed geologist
Saturated zone hydraulic conductivity	100	315	Licensed geologist
Distribution Coefficient for ^{14}C	0	1	RESRAD User's Manual
Inhalation rate, m^3/yr	8400	11,400	RESRAD User's Manual
Exposure duration, yr	30	25	RESRAD User's Manual
Fraction of time spent indoors	0.5	0.17	RESRAD User's Manual
Fraction of time spent outdoors (on site)	0.25	0.06	RESRAD User's Manual

2.9 Dose Calculations

NUREG 1757, "Consolidated NMSS Decommissioning Guidance," contains default Screening Values, based on 25 mrem/year, for several radionuclides in soil. Licensees have the option of using the Screening Values without further justification or deriving site-specific release limits using RESRAD. The table below is provided to compare Screening Values with site-specific limits established for this project.

	NUREG 1757 Screening Value, pCi/g	**RESRAD 10 mrem/yr, pCi/g**	**RESRAD 25 mrem/yr, pCi/g**	**MAX Value on site, pCi/g**	**AVG Value on site, pCi/g***
^{3}H	110	1.06E+05	2.65E+05	42.5	5.1
^{14}C	12	744	1861	483	44.7

* AVG value based on analysis results of 208 soil samples.

RESRAD calculated the maximum dose to a worker of 6.5 mrem/year. This analysis clearly indicates the Fort Mims site is acceptable for unrestricted release from radiological control.

3.0 Sensitivity Analyses

The RESRAD model depends on the setting of parameters that could significantly alter the projected dose to a future or current occupant of the site. ^{14}C and ^{3}H are both low energy beta emitters, so external radiation exposure is negligible. Because food is not grown on site, internal dose for contaminated foodstuffs is not considered. The largest variation in individual dose prediction is dependent on whether or not contaminated water is ingested.

Sensitivity analyses were run separately on the following site parameters:

- Distribution Coefficient of carbon in the Contaminated Zone;
- Distribution Coefficient of carbon in the Unsaturated Zone;
- Distribution Coefficient of carbon in the Saturated Zone;
- Thickness of the Contaminated Zone;
- Thickness of the Unsaturated Zone;
- ^{12}C Concentration in Local Soil;
- ^{12}C Concentration in Local Water;
- ^{12}C Evasion Flux Rate in Soil;
- ^{14}C Evasion Flux Rate in Soil;
- Thickness of the Evasion Layer

Sensitivity analyses results are included as appendices to this report.

4.0 Conclusion

The model described in this report includes a great deal of conservatism. For example, the maximum soil concentration measured was used throughout the site, to a depth of 4 meters. That level of contamination was only found in one sample very near the surface (0.2 m). Radioactivity concentrations in soil show an overall decrease with increasing depth. The average concentration of 14C in soil is 42.7 pCi/g, which is less than 10 percent of the value used.

The Kd values selected, which primarily affect the drinking water pathway dose, are also conservative, as described above. The drinking water pathway

is turned on in accordance with NUREG 1757 and EPA recommendations. This is conservative because most, if not all, industrial sites in the U.S. obtain drinking water from public utilities. The drinking water pathway in this RESRAD model is the only appreciable source of radiation dose to a future worker.

Even with these conservative assumptions, the maximum projected dose to a worker on the property is projected to be less than 7 mrem. Actual doses are expected to be much lower.

5.0 References

5.1 10 CFR 20, Standards for Protection Against Radiation

5.2 NUREG 1757, Consolidated NMSS Decommissioning Guidance

5.3 EPA402-R-99-004B, Understanding Variation in Partition Coefficient, K_d, Values; Volume II: Review of Geochemistry and Available Kd Values for Cadmium, Cesium, Chromium, Lead, Plutonium, Radon, Strontium, Thorium, Tritium (^3H), and Uranium

5.4 Data Collection Handbook to Support Modeling Impact of Radioactive Materials in Soil; Yu, et al, DOE, 1993

5.5 ANL/EAD-4, User's Manual for RESRAD Version

Appendix A

Resrad Model

Summary : Sigma Aldrich Site-Specific Model Feb 2012
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\SIGMA_ALDRICH_FEB_2012 IND_WKR.RAD

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Part I: Mixture Sums and Single Radionuclide Guidelines

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

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	C-14 (Source: FGR 12)	1.345E-05	1.345E-05	DCF1(1)
A-1	H-3 (Source: FGR 12)	0.000E+00	0.000E+00	DCF1(2)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	C-14(p) (Class: ORGANIC)	2.090E-06	2.090E-06	DCF2(1)
B-1	C-14(g) (Class: CO2)	2.350E-08	2.350E-08	C14GInhDCF
B-1	H-3	6.400E-08	6.400E-08	DCF2(2)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	C-14	2.090E-06	2.090E-06	DCF3(1)
D-1	H-3	6.400E-08	6.400E-08	DCF3(2)
D-34	Food transfer factors:			
D-34	C-14 , plant/soil concentration ratio, dimensionless	5.500E+00	5.500E+00	RTF(1,1)
D-34	C-14 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.100E-02	3.100E-02	RTF(1,2)
D-34	C-14 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,3)
D-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(2,1)
D-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(2,2)
D-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(2,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	C-14 , fish	5.000E+04	5.000E+04	BIOFAC(1,1)
D-5	C-14 , crustacea and mollusks	9.100E+03	9.100E+03	BIOFAC(1,2)
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC(2,1)
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(2,2)

#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.

Summary : Sigma Aldrich Site-Specific Model Feb 2012
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\SIGMA_ALDRICH_FEB_2012 IND_WKR.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)	1.200E+04	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	4.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	1.000E+01	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	1.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(9)
R011	Times for calculations (yr)	not used	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): C-14	4.830E+02	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): H-3	4.250E+01	0.000E+00	---	S1(2)
R012	Concentration in groundwater (pCi/L): C-14	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---	W1(2)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.200E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	5.000E+01	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	1.040E+01	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	4.300E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	8.000E+00	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-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)	3.700E+00	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	4.200E-01	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	3.730E-01	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	3.150E+02	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	0.000E+00	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---	MODEL

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	1	1	---	NS
R015	Unsat. zone 1, thickness (m)	6.000E+00	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	1.750E+00	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	5.500E-01	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	1.800E-01	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	4.000E-01	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	1.040E+01	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	3.100E+00	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for C-14				
R016	Contaminated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.771E-02	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for H-3				
R016	Contaminated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	1.000E+00	0.000E+00	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.771E-02	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R017	Inhalation rate (m**3/yr)	1.140E+04	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	1.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	2.500E+01	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	1.700E-01	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	6.000E-02	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

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

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	2.000E-05	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	3.000E-02	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	2.000E-02	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	9.800E-01	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	3.000E-01	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	7.000E-07	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	1.000E-10	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	8.000E-01	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	2.000E-01	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	128	---	---	NPTS

Site-Specific Parameter Summary (continued)

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

Summary of Pathway Selections

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

Summary : Sigma Aldrich Site-Specific Model Feb 2012
File : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\SIGMA_ALDRICH_FEB_2012 IND_WKR.RAD

Contaminated Zone Dimensions		Initial Soil Concentrations, pCi/g	
Area:	12000.00 square meters	C-14	4.830E+02
Thickness:	4.00 meters	H-3	4.250E+01
Cover Depth:	0.00 meters		

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 2.500E+01 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	5.809E+00	6.602E+00	6.803E+00	6.834E+00	6.819E+00	2.293E-06	1.765E-23	0.000E+00
M(t):	2.323E-01	2.641E-01	2.721E-01	2.734E-01	2.728E-01	9.171E-08	7.062E-25	0.000E+00

Maximum TDOSE(t): 6.943E+00 mrem/yr at t = 16.96 ± 0.03 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.696E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	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.
C-14	1.917E-16	0.0000	1.003E-14	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.423E-15	0.0000
H-3	0.000E+00	0.0000	3.380E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.797E-07	0.0000
Total	1.917E-16	0.0000	3.380E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.797E-07	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 = 1.696E+01 years

Water Dependent Pathways

Radio-Nuclide	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.
C-14	6.863E+00	0.9885	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.863E+00	0.9885
H-3	7.979E-02	0.0115	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.982E-02	0.0115
Total	6.943E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.943E+00	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	1.142E-03	0.0002	5.972E-02	0.0103	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.475E-03	0.0015
H-3	0.000E+00	0.0000	8.774E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.283E-05	0.0000
Total	1.142E-03	0.0002	6.060E-02	0.0104	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.497E-03	0.0015

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

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	5.707E+00	0.9824	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.776E+00	0.9944
H-3	3.171E-02	0.0055	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.261E-02	0.0056
Total	5.738E+00	0.9879	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.809E+00	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	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.
C-14	2.030E-04	0.0000	1.062E-02	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.507E-03	0.0002
H-3	0.000E+00	0.0000	7.244E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.885E-05	0.0000
Total	2.030E-04	0.0000	1.134E-02	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.525E-03	0.0002

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

Water Dependent Pathways

Radio-	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.
C-14	6.536E+00	0.9900	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.548E+00	0.9919
H-3	5.300E-02	0.0080	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.374E-02	0.0081
Total	6.589E+00	0.9980	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.602E+00	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	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.
C-14	6.399E-06	0.0000	3.347E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.749E-05	0.0000
H-3	0.000E+00	0.0000	4.937E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.285E-05	0.0000
Total	6.399E-06	0.0000	8.283E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.034E-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 = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	6.721E+00	0.9879	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.721E+00	0.9880
H-3	8.123E-02	0.0119	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.174E-02	0.0120
Total	6.802E+00	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.803E+00	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	3.467E-11	0.0000	1.814E-09	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.574E-10	0.0000
H-3	0.000E+00	0.0000	1.289E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.353E-06	0.0000
Total	3.467E-11	0.0000	1.289E-04	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.354E-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 = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
C-14	6.734E+00	0.9853	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.734E+00	0.9853
H-3	1.002E-01	0.0147	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.003E-01	0.0147
Total	6.834E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.834E+00	1.0000

*Sum of all water independent and dependent pathways.

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

Water Independent Pathways (Inhalation excludes radon)

Radio-	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.
C-14	2.487E-26	0.0000	1.301E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.846E-25	0.0000
H-3	0.000E+00	0.0000	2.751E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.158E-08	0.0000
Total	2.487E-26	0.0000	2.751E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.158E-08	0.0000

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

Water Dependent Pathways

Radio-	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.
C-14	6.777E+00	0.9939	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.777E+00	0.9939
H-3	4.149E-02	0.0061	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.150E-02	0.0061
Total	6.819E+00	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.819E+00	1.0000

*Sum of all water independent and dependent pathways.

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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	0.000E+00	0.0000	3.499E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.106E-14	0.0000
Total	0.000E+00	0.0000	3.499E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.106E-14	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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	2.293E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.293E-06	1.0000
Total	2.293E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.293E-06	1.0000

*Sum of all water independent and dependent pathways.

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-	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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
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-	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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
H-3	1.765E-23	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.765E-23	1.0000
Total	1.765E-23	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.765E-23	1.0000

*Sum of all water independent and dependent pathways.

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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
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.
C-14	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
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

*Sum of all water independent and dependent pathways.

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

Parent (i)	Product (j)	Thread Fraction	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g) 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	1.196E-02	1.356E-02	1.392E-02	1.394E-02	1.403E-02	3.837E-35	0.000E+00	0.000E+00
H-3	H-3	1.000E+00	7.673E-04	1.265E-03	1.923E-03	2.361E-03	9.764E-04	5.395E-08	4.154E-25	0.000E+00

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

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	2.091E+03	1.844E+03	1.797E+03	1.793E+03	1.782E+03	*4.455E+12	*4.455E+12	*4.455E+12
H-3	3.258E+04	1.977E+04	1.300E+04	1.059E+04	2.561E+04	4.634E+08	*9.597E+15	*9.597E+15

*At specific activity limit

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 = 16.96 ± 0.03 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
C-14	4.830E+02	16.97 ± 0.03	1.421E-02	1.759E+03	1.421E-02	1.759E+03
H-3	4.250E+01	7.97 ± 0.02	2.406E-03	1.039E+04	1.878E-03	1.331E+04

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

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	5.776E+00	6.548E+00	6.721E+00	6.734E+00	6.777E+00	0.000E+00	0.000E+00	0.000E+00
H-3	H-3	1.000E+00	3.261E-02	5.374E-02	8.174E-02	1.003E-01	4.150E-02	2.293E-06	1.765E-23	0.000E+00

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

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	1.000E+02	3.000E+02	1.000E+03
C-14	C-14	1.000E+00	4.830E+02	8.586E+01	2.707E+00	1.467E-05	1.052E-20	0.000E+00	0.000E+00	0.000E+00
H-3	H-3	1.000E+00	4.250E+01	3.509E+01	2.391E+01	6.241E+00	1.332E-01	1.695E-07	8.722E-25	0.000E+00

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

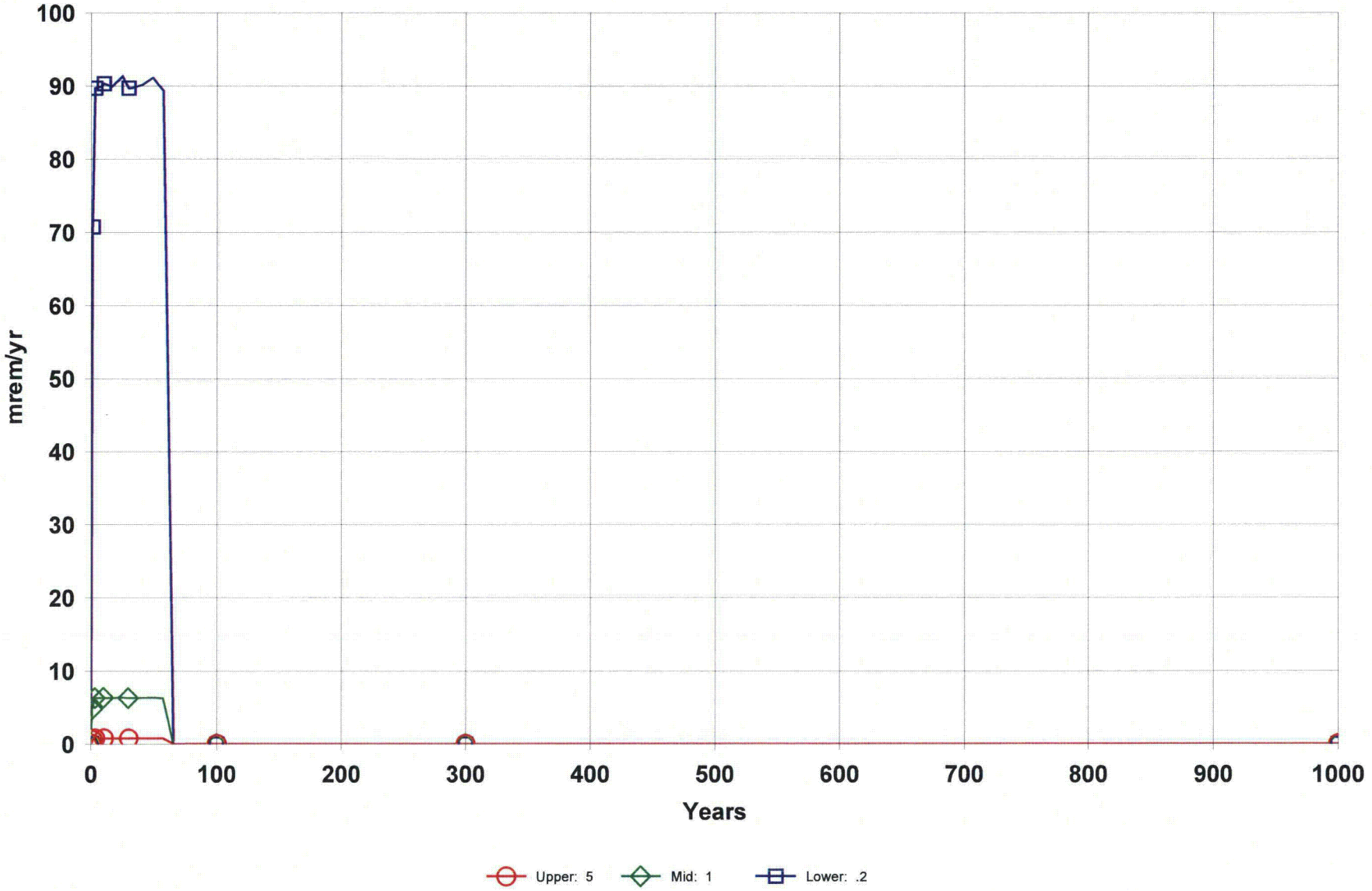
RESCALC.EXE execution time = 0.86 seconds

Appendix B

Sensitivity Analyses

- Distribution Coefficient of carbon in the Contaminated Zone;
- Distribution Coefficient of carbon in the Unsaturated Zone;
- Distribution Coefficient of carbon in the Saturated Zone;
- Thickness of the Contaminated Zone;
- Thickness of the Unsaturated Zone;
- ^{12}C Concentration in Local Soil;
- ^{12}C Concentration in Local Water;
- ^{12}C Evasion Flux Rate in Soil;
- ^{14}C Evasion Flux Rate in Soil;
- Thickness of the Evasion Layer

DOSE: C-14, All Pathways Summed With SA on C-14 Contaminated Zone Distribution Coefficient



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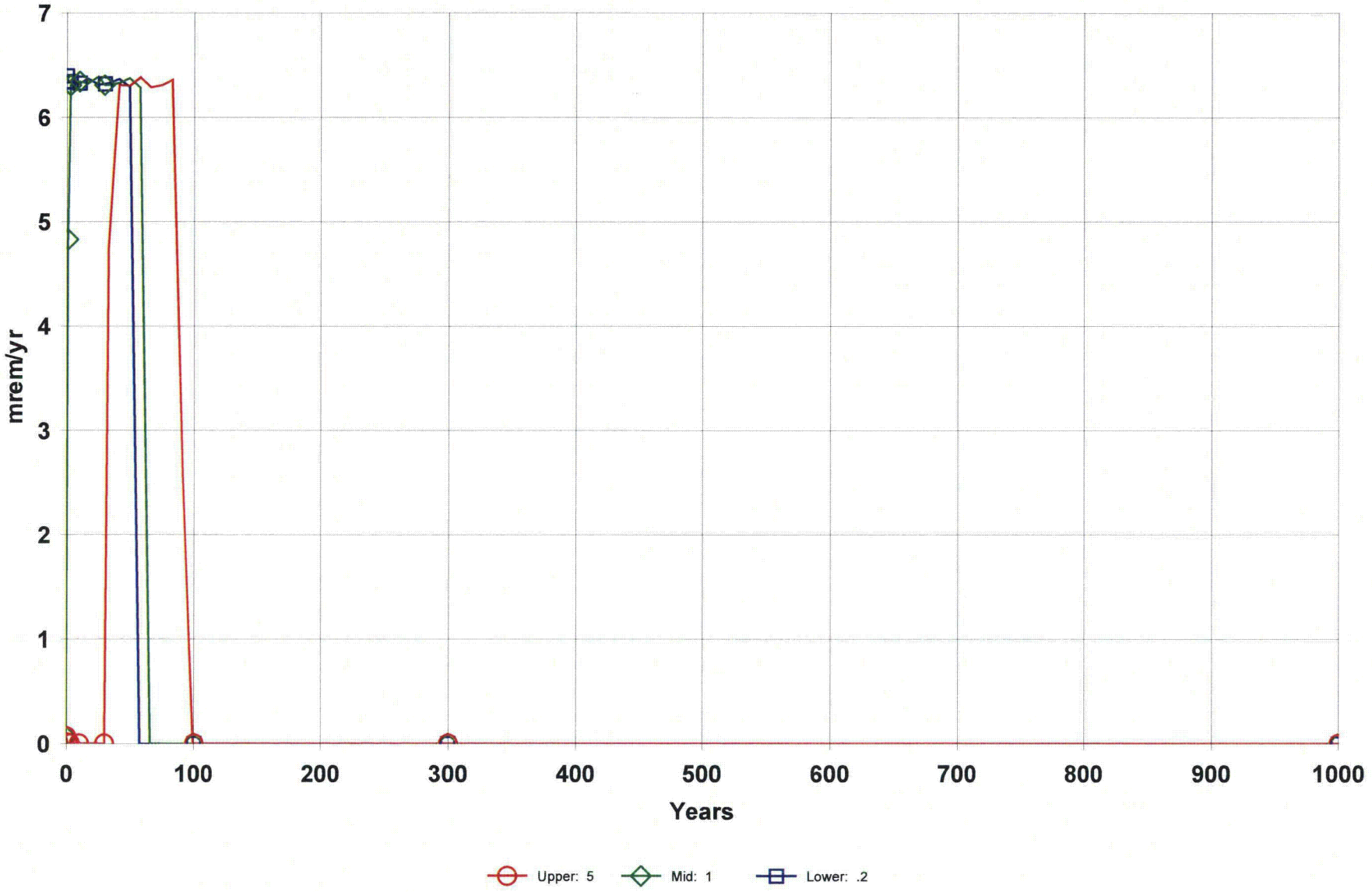
DOSE: C-14, All Pathways Summed With SA on C-14 Unsaturated Zone Distribution Coefficient



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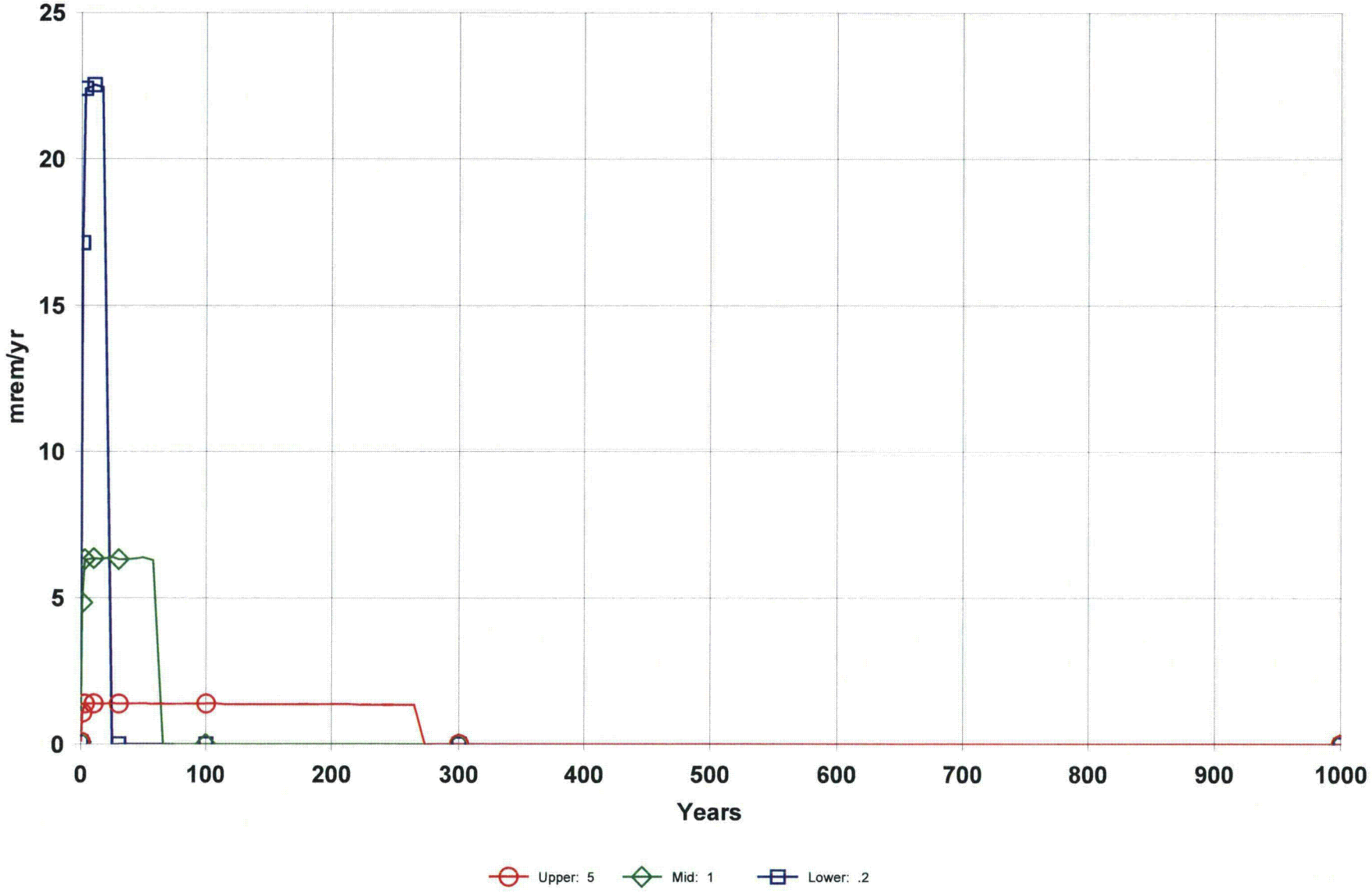
DOSE: C-14, All Pathways Summed With SA on C-14 Saturated Zone Distribution Coefficient



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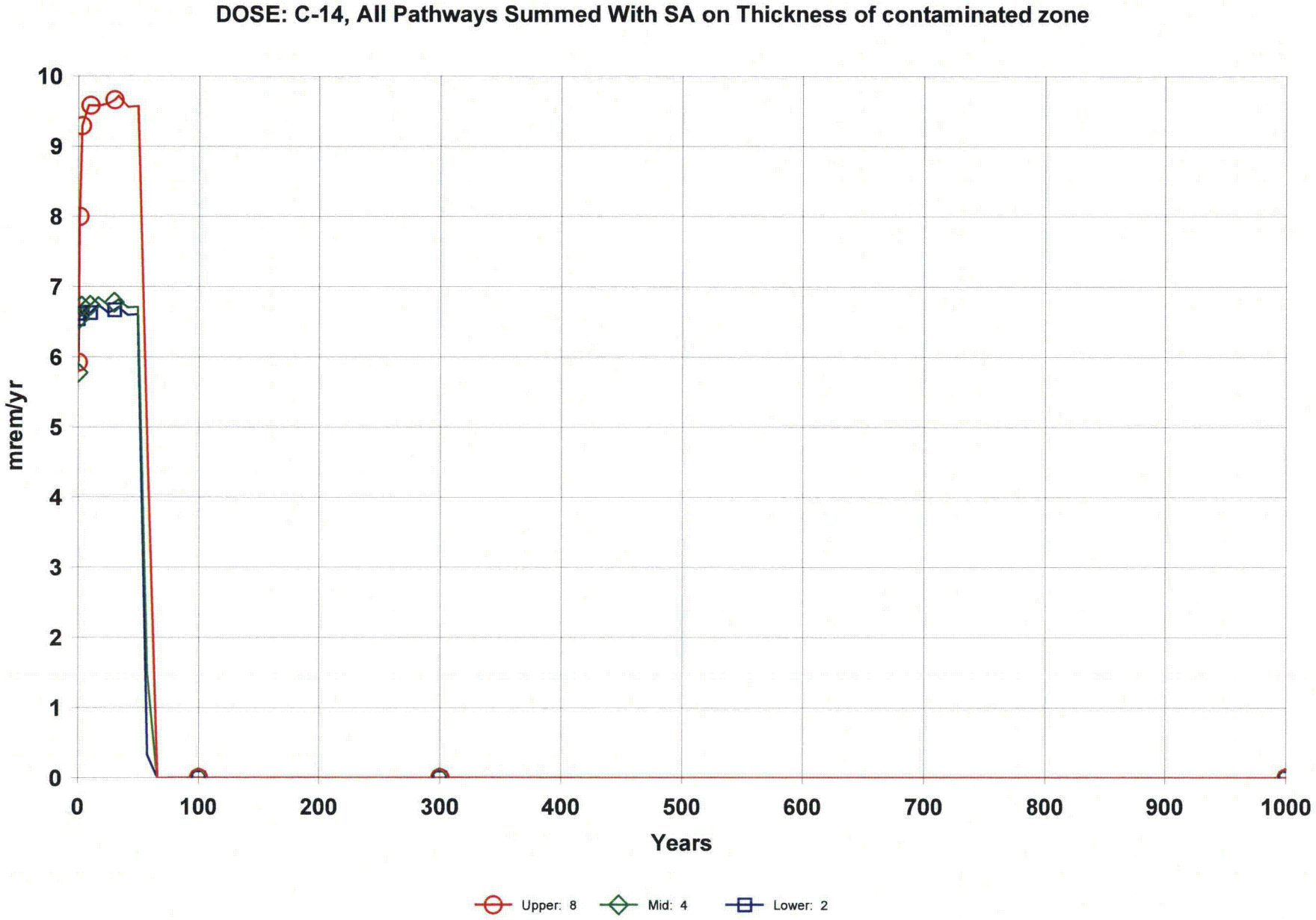

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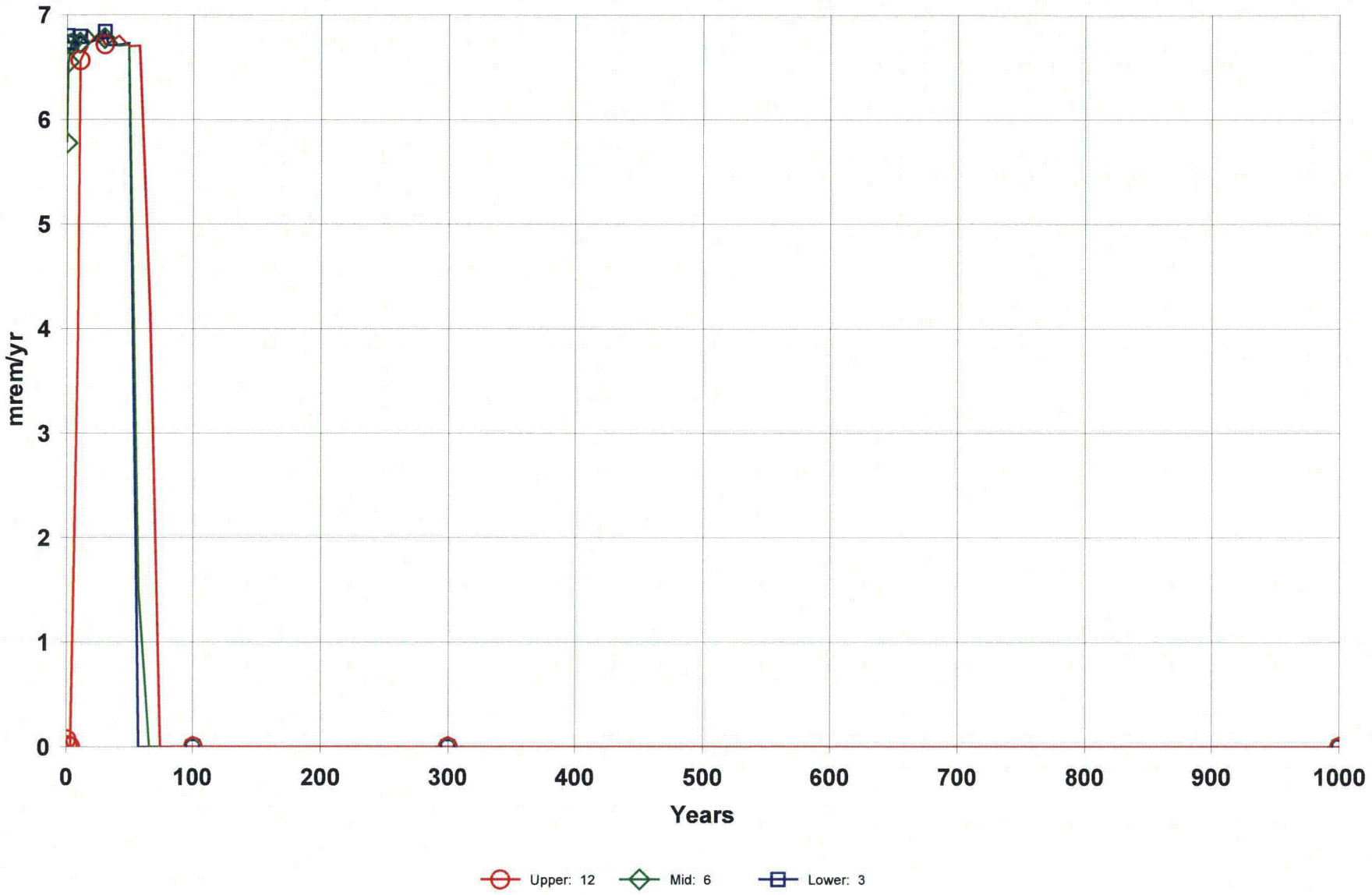
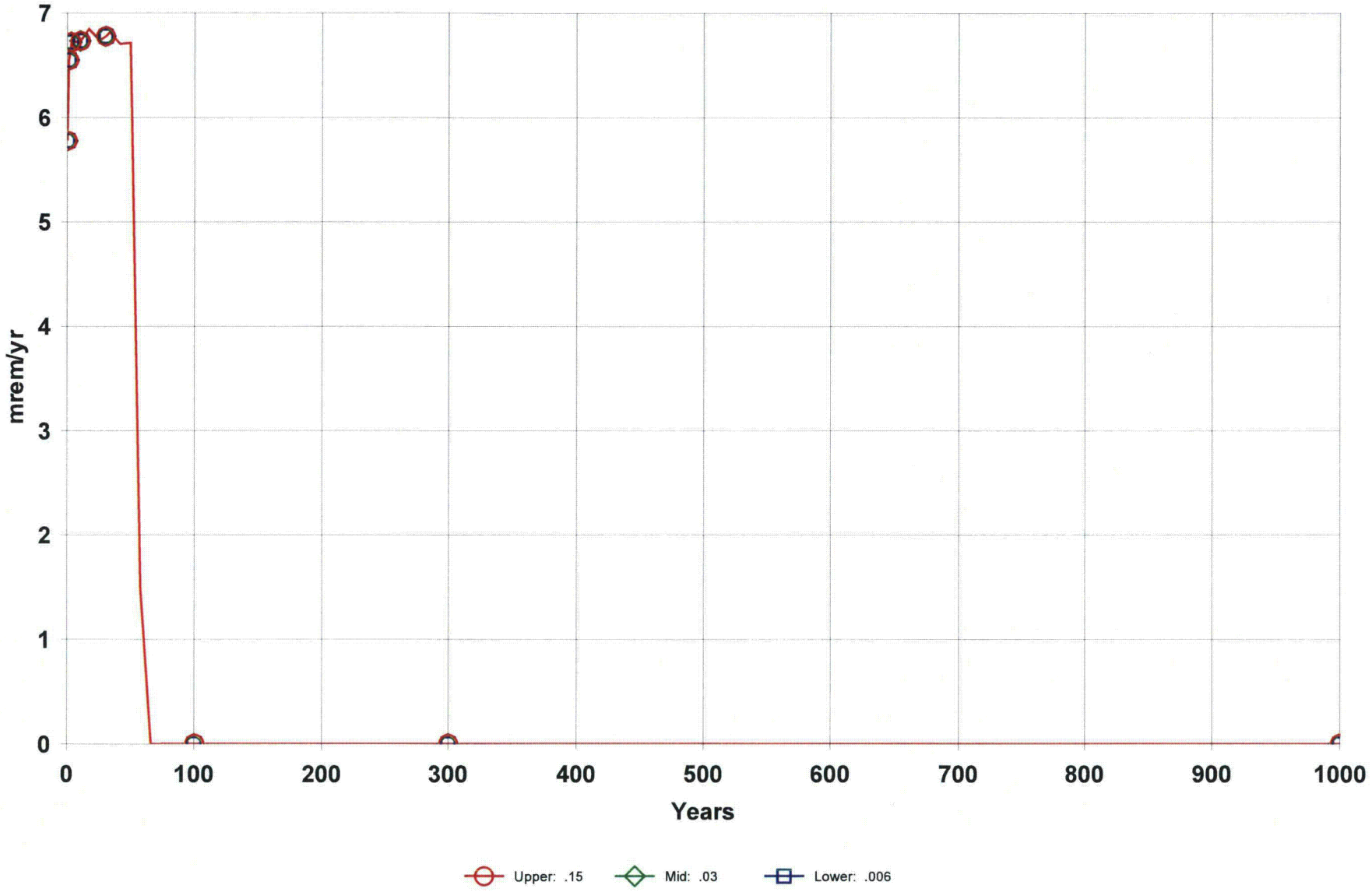


C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\SIGMA_ALDRICH_FEB_2012 IND_WKR.RAD 02/04/2012 17:22 GRAPHICS.ASC Includes All Pathways

DOSE: C-14, All Pathways Summed With SA on C-12 concentration in contaminated soil



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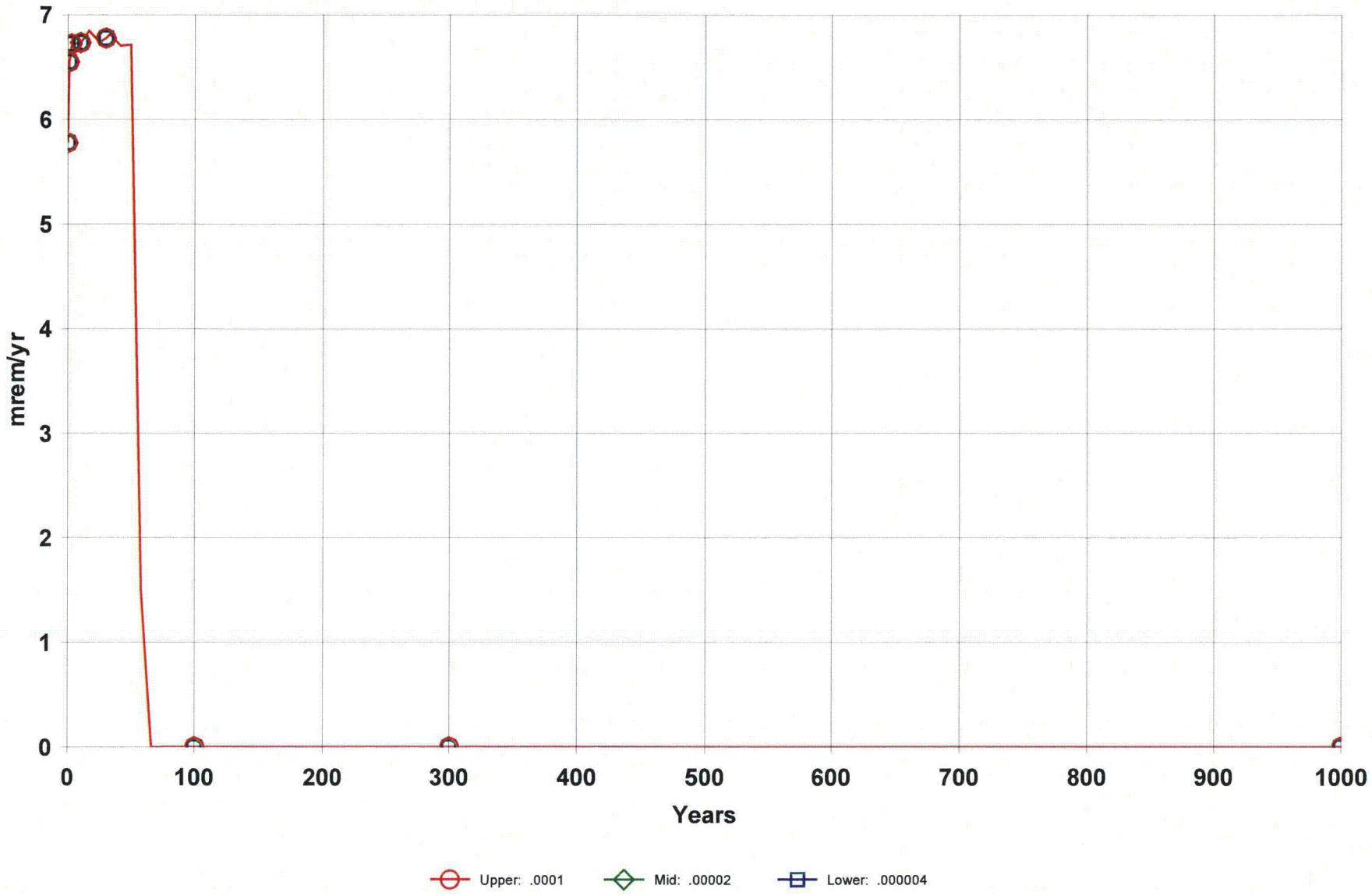
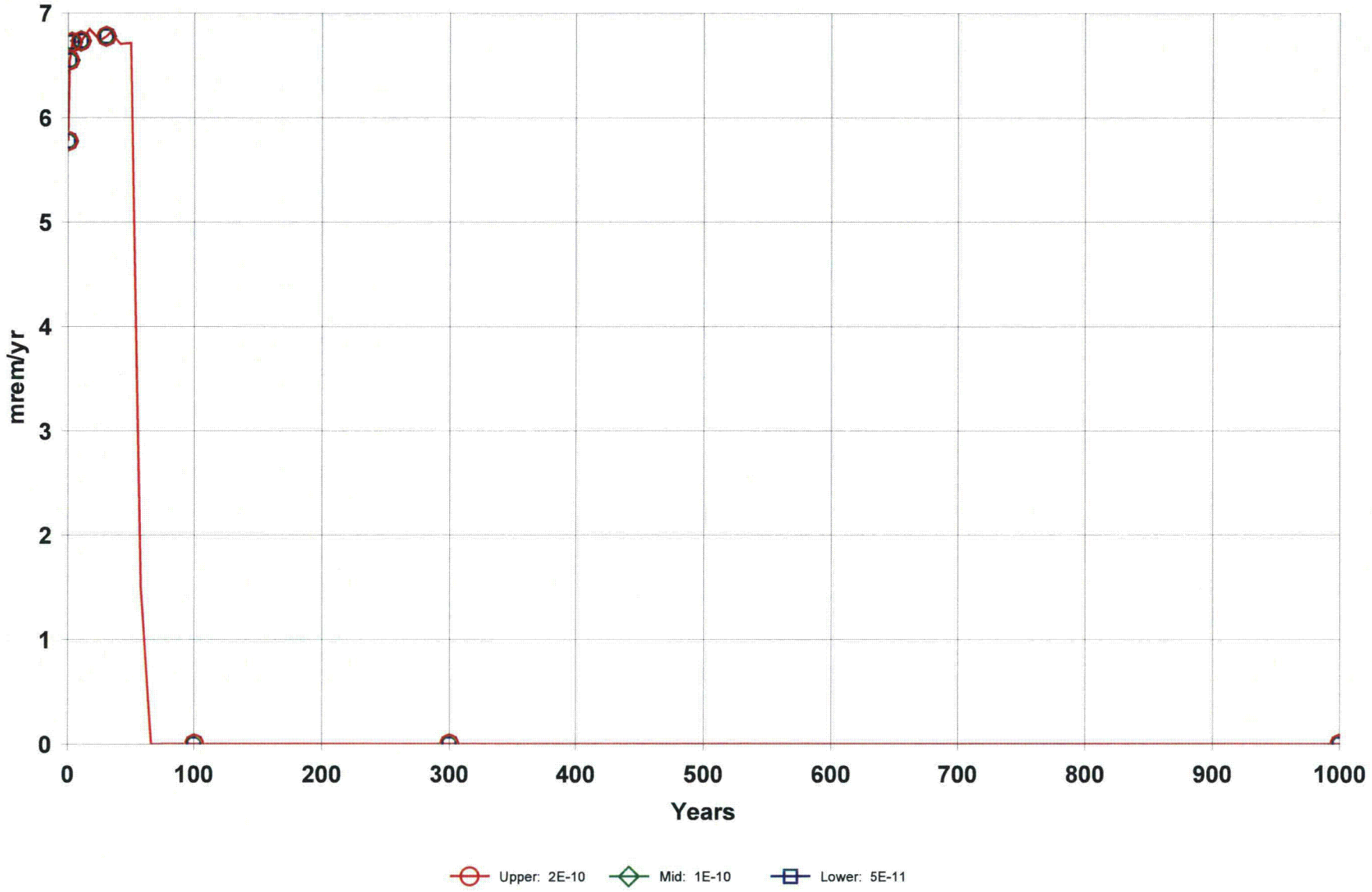


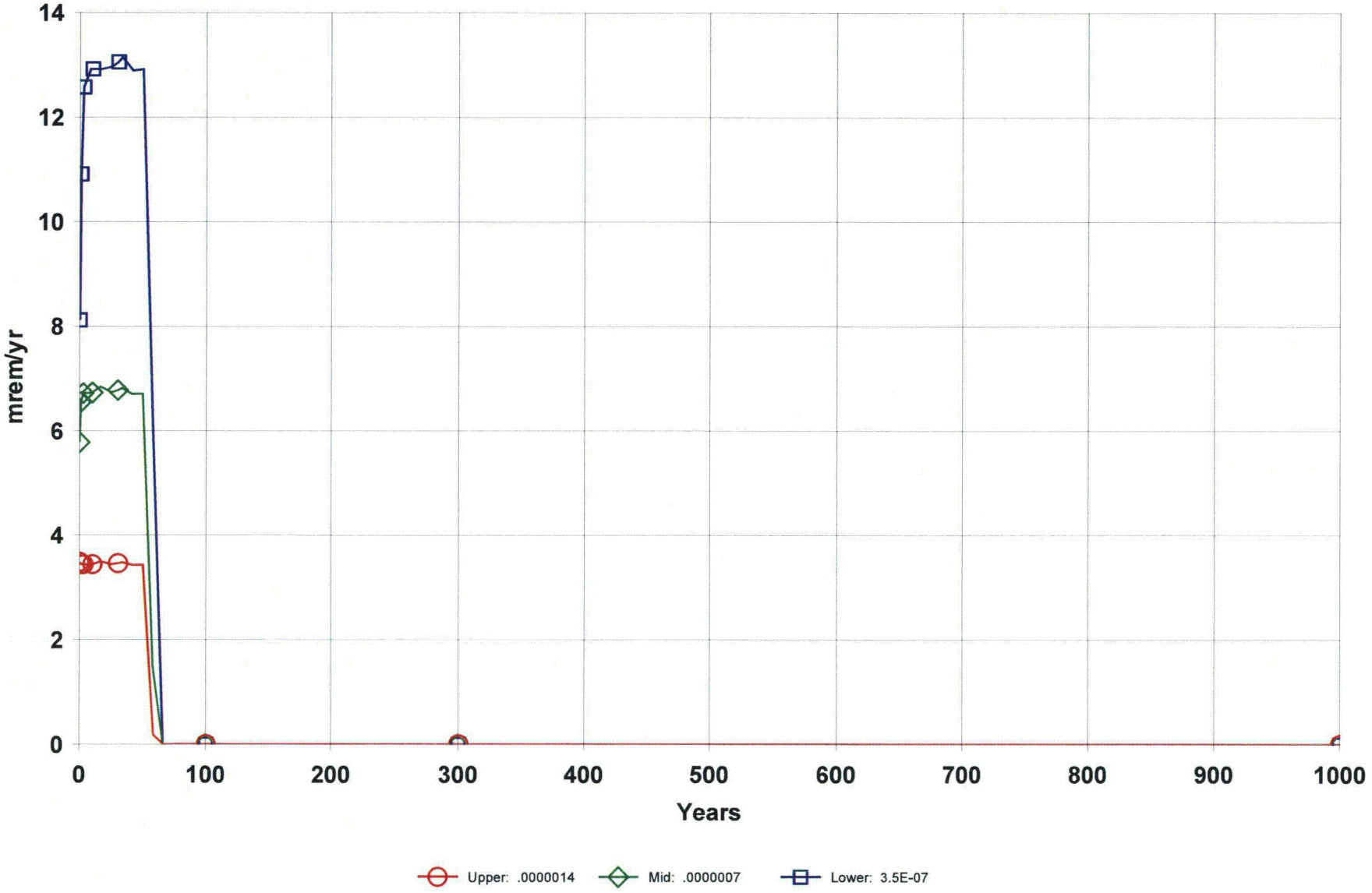
C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\SIGMA_ALDRICH_FEB_2012 IND_WKR.RAD 02/05/2012 07:34 GRAPHICS.ASC Includes All Pathways

DOSE: C-14, All Pathways Summed With SA on C-12 evasion flux rate from soil



C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\SIGMA_ALDRICH_FEB_2012 IND_WKR.RAD 02/05/2012 14:32 GRAPHICS.ASC Includes All Pathways

DOSE: C-14, All Pathways Summed With SA on C-14 evasion flux rate from soil



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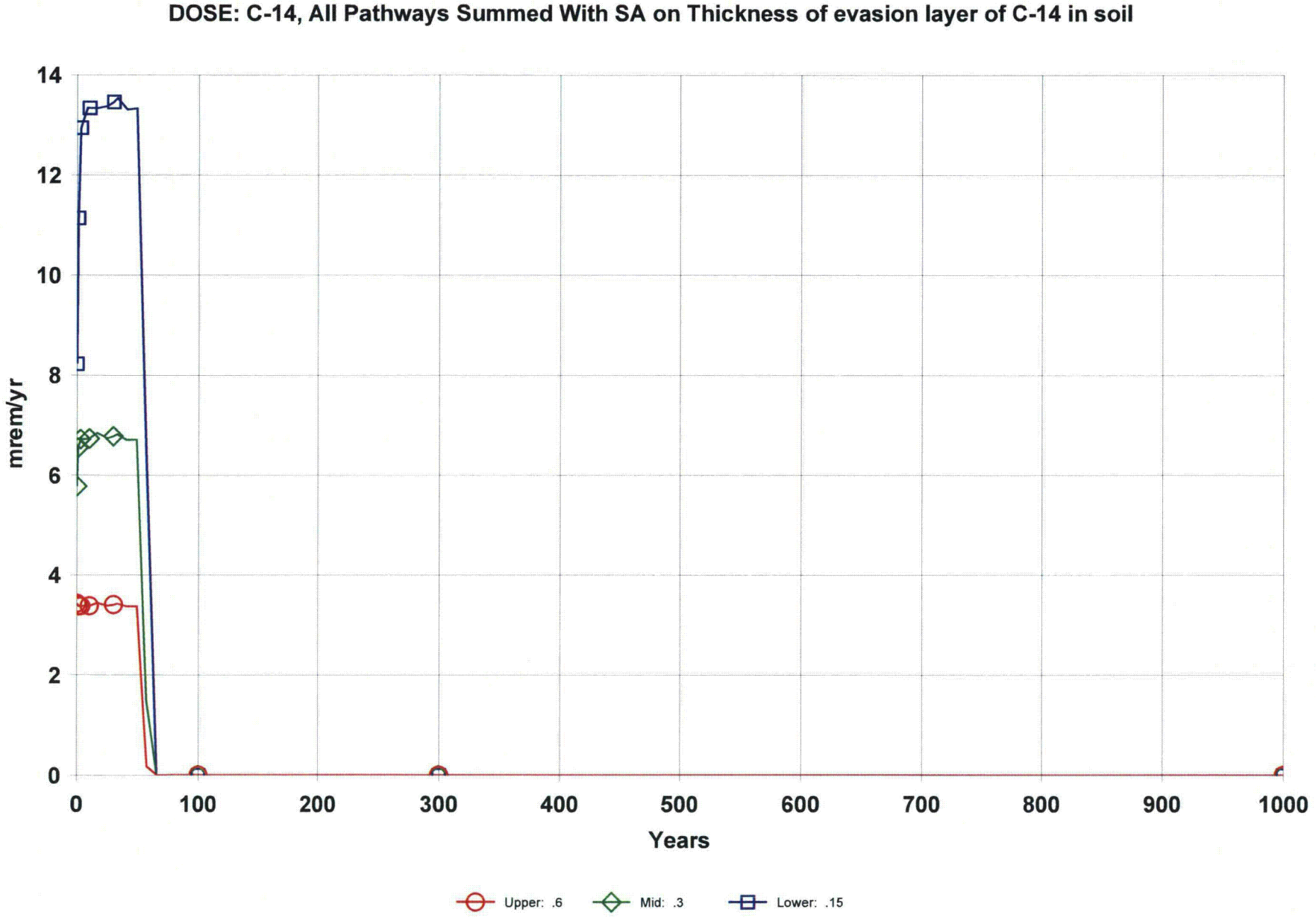

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Appendix C

Additional Soil Sample Locations


15'
BH 03
12'
BH 02
Start of
Fenceline
52'
BH 01
24'
12'
6'
MSD Manhole
11542 Fort Mims Dr, Maryland Heights, MO 6
© 2011 Europa Technologies
© 2011 Google
Google
Imagery Date: 9/1/2011
38°42'08.25"N 90°25'28.06"W elev 159 m
Eye alt 243 m

Appendix D

Additional Soil Sample Analyses Results

TELEDYNE
BROWN ENGINEERING, INC.
A Teledyne Technologies Company
2508 Quality Lane
Knoxville, TN 37931-3133
865-690-6819

REVISED
Dec. 29, 2011

Glen Marshall, CHP
Philotechnics
201 Renovare Blvd

Oak Ridge, TN 37831-4489

Report of Analysis/Certificate of Conformance

12/29/2011

LIMS #:	L48308
Project ID#:	PH001-3EREGGM-06
Received:	10/27/2011
Delivery Date:	11/26/2011
P.O.#:	PO-0000881
Release #:	
SDG#:	

This is to certify that Teledyne Brown Engineering - Environmental Services located at 2508 Quality Lane, Knoxville, Tennessee, 37931, has analyzed, tested and documented samples, as received by the laboratory, as specified in the applicable purchase order.

This also certifies that requirements of applicable codes, standards and specifications have been fully met and that any quality assurance documentation which verified conformance to the purchase order is on file and may be examined upon request.

I hereby certify that the above statements are true and correct.

Keith Jeter
Operations Manager

Cross Reference Table

Client ID	Laboratory ID	Station ID (if applicable)
FMF-DSP 3	L48308-1	3
FMF-DSP 3	L48308-2	3
FMF-DSP 3	L48308-3	3
FMF-DSP 3	L48308-4	3
FMF-DSP 3	L48308-5	3
FMF-DSP 2	L48308-6	2
FMF-DSP 2	L48308-7	2
FMF-DSP 2	L48308-8	2

TELEDYNE
BROWN ENGINEERING, INC.
A Teledyne Technologies Company
2508 Quality Lane
Knoxville, TN 37931-3133
865-690-6819

REVISED
Dec. 29, 2011

Cross Reference Table

Client ID	Laboratory ID	Station ID (if applicable)
FMF-DSP 2	L48308-9	2
FMF-DSP 2	L48308-10	2
FMF-DSP 1	L48308-11	1
FMF-DSP 1	L48308-12	1
FMF-DSP 1	L48308-13	1
FMF-DSP 1	L48308-14	1
FMF-DSP 1	L48308-15	1

TELEDYNE
BROWN ENGINEERING, INC.
A Teledyne Technologies Company

Case Narrative

12/29/2011 13:32

L48308

PH001-3EREGGM-06

Philotechnics

All sample were anlyzed three times and the results were inconsistent. The sample matrix was difficult to homogenize and the samples could not be dried and ground without loss of the tritium. Difference in results can probably be attributed to the nonhomogeneity of the sample. The same problem was reflected in the QC sample results. The duplicate analysis for first rerun for C-14 and for the original analysis and first rerun for tritium exceeded internal reproducibility limits. The laboratory control sample result for the first rerun for C-14 was slightly high at 136.1%. All blanks for all runs were acceptable.

Revision:
Samples were dried and ground and analyzved for C-14 (dry basis). All QC was acceptable. Analysis data is designated as R3.

Report of Analysis

12/29/11 13:30

L48308

Philotechnics

PH001-3EREGGM-06

TELEDYNE BROWN ENGINEERING, INC.
A Teledyne Technologies Company

REVISED
Dec. 29, 2011

Sample ID: **FMF-DSP 3** Collect Start: 10/25/2011 09:41 Matrix: Soil (S)
Station: 3 Collect Stop: 10/25/2011 09:42 Volume:
Description: 3 meters Receive Date: 10/27/2011 % Moisture: 19.05
LIMS Number: L48308-1

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	**6.30E+00**	1.55E+00		pCi/g		2.51	g wet		11/30/11	5	M	+
C-14	2003	<		**4.63E+00**	pCi/g	R1	2.3155	g wet		12/02/11	5	M	U
C-14	2003	**2.75E+00**	1.43E+00		pCi/g	R2	2.2593	g wet		12/10/11	5	M	+
C-14	2003	<		**2.14E+00**	pCi/g	R3	1.44	g dry		12/23/11	20	M	U
H-3	2003	<		**3.99E+00**	pCi/g		2.51	g wet		11/30/11	5	M	U
H-3	2003	<		**5.19E+00**	pCi/g	R1	2.3155	g wet		12/02/11	5	M	U
H-3	2003	**5.24E+00**	2.82E+00		pCi/g	R2	2.2593	g wet		12/10/11	5	M	+

Sample ID: **FMF-DSP 3** Collect Start: 10/25/2011 09:47 Matrix: Soil (S)
Station: 3 Collect Stop: 10/25/2011 09:48 Volume:
Description: 4 meters Receive Date: 10/27/2011 % Moisture: 18.75
LIMS Number: L48308-2

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	**8.96E+00**	1.88E+00		pCi/g		2.17	g wet		11/30/11	5	M	+
C-14	2003	<		**4.35E+00**	pCi/g	R1	2.4637	g wet		12/02/11	5	M	U
C-14	2003	<		**2.15E+00**	pCi/g	R2	2.1559	g wet		12/10/11	5	M	U
C-14	2003	<		**1.63E+00**	pCi/g	R3	1.89	g dry		12/23/11	20	M	U
H-3	2003	<		**4.62E+00**	pCi/g		2.17	g wet		11/30/11	5	M	U
H-3	2003	<		**4.88E+00**	pCi/g	R1	2.4637	g wet		12/02/11	5	M	U
H-3	2003	<		**4.07E+00**	pCi/g	R2	2.1559	g wet		12/10/11	5	M	U

Flag Values
U = Compound/Analyte not detected (< MDC) or less than 3 sigma
\+ = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
High = Activity concentration exceeds customer reporting value
Spec = MDC exceeds customer technical specification
L = Low recovery
H = High recovery

Bolded text indicates reportable value.

No = Peak not identified in gamma spectrum
Yes = Peak identified in gamma spectrum

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MDC - Minimum Detectable Concentration

Report of Analysis

12/29/11 13:30

L48308

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PH001-3EREGGM-06

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A Teledyne Technologies Company

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Dec. 29, 2011

Glen Marshall, CHP

Sample ID: **FMF-DSP 3** | Collect Start: 10/25/2011 09:50 | Matrix: Soil (S)
Station: 3 | Collect Stop: 10/25/2011 09:51 | Volume:
Description: 5 meters | Receive Date: 10/27/2011 | % Moisture: 19.00
LIMS Number: L48308-3

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	**5.15E+01**	3.35E+00		pCi/g		2.24	g wet		11/30/11	5	M	+
C-14	2003	**6.34E+01**	5.06E+00		pCi/g	R1	2.0152	g wet		12/02/11	5	M	+
C-14	2003	**3.71E+00**	1.28E+00		pCi/g	R2	2.6971	g wet		12/10/11	5	M	+
C-14	2003	<		**1.27E+00**	pCi/g	R3	2.43	g dry		12/23/11	20	M	U
H-3	2003	**5.82E+01**	5.89E+00		pCi/g		2.24	g wet		11/30/11	5	M	+
H-3	2003	<		**5.96E+00**	pCi/g	R1	2.0152	g wet		12/02/11	5	M	U
H-3	2003	<		**3.25E+00**	pCi/g	R2	2.6971	g wet		12/10/11	5	M	U

Sample ID: **FMF-DSP 3** | Collect Start: 10/25/2011 09:54 | Matrix: Soil (S)
Station: 3 | Collect Stop: 10/25/2011 09:55 | Volume:
Description: 8 meters | Receive Date: 10/27/2011 | % Moisture: 17.89
LIMS Number: L48308-4

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	<		**2.24E+00**	pCi/g		2.16	g wet		11/30/11	5	M	U
C-14	2003	**8.11E+00**	2.90E+00		pCi/g	R1	2.4855	g wet		12/02/11	5	M	+
C-14	2003	<		**1.70E+00**	pCi/g	R2	2.7335	g wet		12/10/11	5	M	U
C-14	2003	<		**1.34E+00**	pCi/g	R3	2.3	g dry		12/23/11	20	M	U
H-3	2003	<		**4.64E+00**	pCi/g		2.16	g wet		11/30/11	5	M	U
H-3	2003	<		**4.83E+00**	pCi/g	R1	2.4855	g wet		12/02/11	5	M	U
H-3	2003	<		**3.21E+00**	pCi/g	R2	2.7335	g wet		12/10/11	5	M	U

Flag Values
U = Compound/Analyte not detected (< MDC) or less than 3 sigma
\+ = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
High = Activity concentration exceeds customer reporting value
Spec = MDC exceeds customer technical specification
L = Low recovery
H = High recovery

Bolded text indicates reportable value.

No = Peak not identified in gamma spectrum
Yes = Peak identified in gamma spectrum

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MDC - Minimum Detectable Concentration

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Sample ID: **FMF-DSP 3** Collect Start: 10/25/2011 10:27 Matrix: Soil (S)
Station: 3 Collect Stop: 10/25/2011 10:28 Volume:
Description: 12 meters Receive Date: 10/27/2011 % Moisture: 20.92
LIMS Number: L48308-5

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	<		**2.29E+00**	pCi/g		2.11	g wet		11/30/11	5	M	U
C-14	2003	<		**4.67E+00**	pCi/g	R1	2.2969	g wet		12/02/11	5	M	U
C-14	2003	<		**1.90E+00**	pCi/g	R2	2.438	g wet		12/10/11	5	M	U
C-14	2003	<		**1.41E+00**	pCi/g	R3	2.19	g dry		12/23/11	20	M	U
H-3	2003	**2.22E+02**	1.14E+01		pCi/g		2.11	g wet		11/30/11	5	M	+
H-3	2003	<		**5.23E+00**	pCi/g	R1	2.2969	g wet		12/02/11	5	M	U
H-3	2003	**5.54E+00**	2.67E+00		pCi/g	R2	2.438	g wet		12/10/11	5	M	+

Sample ID: **FMF-DSP 2** Collect Start: 10/25/2011 13:20 Matrix: Soil (S)
Station: 2 Collect Stop: 10/25/2011 13:21 Volume:
Description: 3 meters Receive Date: 10/27/2011 % Moisture: 21.50
LIMS Number: L48308-6

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	<		**2.32E+00**	pCi/g		2.09	g wet		11/30/11	5	M	U
C-14	2003	**6.31E+01**	4.52E+00		pCi/g	R1	2.3659	g wet		12/02/11	5	M	+
C-14	2003	<		**1.90E+00**	pCi/g	R2	2.4446	g wet		12/10/11	5	M	U
C-14	2003	<		**1.67E+00**	pCi/g	R3	1.85	g dry		12/23/11	20	M	U
H-3	2003	**1.10E+01**	3.29E+00		pCi/g		2.09	g wet		11/30/11	5	M	+
H-3	2003	<		**5.08E+00**	pCi/g	R1	2.3659	g wet		12/02/11	5	M	U
H-3	2003	**4.10E+00**	2.55E+00		pCi/g	R2	2.4446	g wet		12/10/11	5	M	+

Flag Values
U = Compound/Analyte not detected (< MDC) or less than 3 sigma
\+ = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
High = Activity concentration exceeds customer reporting value
Spec = MDC exceeds customer technical specification
L = Low recovery
H = High recovery

Bolded text indicates reportable value.

No = Peak not identified in gamma spectrum
Yes = Peak identified in gamma spectrum

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MDC - Minimum Detectable Concentration

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Sample ID: **FMF-DSP 2** Collect Start: 10/25/2011 13:34 Matrix: Soil (S)
Station: 2 Collect Stop: 10/25/2011 13:35 Volume:
Description: 4 meters Receive Date: 10/27/2011 % Moisture: 20.24
LIMS Number: L48308-7

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	<		**2.08E+00**	pCi/g		2.33	g wet		11/30/11	5	M	U
C-14	2003	<		**4.27E+00**	pCi/g	R1	2.5085	g wet		12/02/11	5	M	U
C-14	2003	**9.17E+00**	1.82E+00		pCi/g	R2	2.2036	g wet		12/10/11	5	M	+
C-14	2003	<		**1.70E+00**	pCi/g	R3	1.81	g dry		12/23/11	20	M	U
H-3	2003	<		**4.30E+00**	pCi/g		2.33	g wet		11/30/11	5	M	U
H-3	2003	<		**4.79E+00**	pCi/g	R1	2.5085	g wet		12/02/11	5	M	U
H-3	2003	**1.04E+02**	7.40E+00		pCi/g	R2	2.2036	g wet		12/10/11	5	M	+

Sample ID: **FMF-DSP 2** Collect Start: 10/25/2011 13:41 Matrix: Soil (S)
Station: 2 Collect Stop: 10/25/2011 13:42 Volume:
Description: 5 meters Receive Date: 10/27/2011 % Moisture: 17.90
LIMS Number: L48308-8

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	<		**1.88E+00**	pCi/g		2.58	g wet		11/30/11	5	M	U
C-14	2003	<		**4.77E+00**	pCi/g	R1	2.2468	g wet		12/02/11	5	M	U
C-14	2003	<		**1.88E+00**	pCi/g	R2	2.4606	g wet		12/10/11	5	M	U
C-14	2003	<		**1.92E+00**	pCi/g	R3	1.61	g dry		12/23/11	20	M	U
H-3	2003	<		**3.88E+00**	pCi/g		2.58	g wet		11/30/11	5	M	U
H-3	2003	**3.16E+02**	1.28E+01		pCi/g	R1	2.2468	g wet		12/02/11	5	M	+
H-3	2003	<		**3.56E+00**	pCi/g	R2	2.4606	g wet		12/10/11	5	M	U

Flag Values
U = Compound/Analyte not detected (< MDC) or less than 3 sigma
\+ = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
High = Activity concentration exceeds customer reporting value
Spec = MDC exceeds customer technical specification
L = Low recovery
H = High recovery

Bolded text indicates reportable value.

No = Peak not identified in gamma spectrum
Yes = Peak identified in gamma spectrum

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Sample ID: **FMF-DSP 2** | Collect Start: 10/25/2011 14:00 | Matrix: Soil (S)
Station: 2 | Collect Stop: 10/25/2011 14:01 | Volume:
Description: 8 meters | Receive Date: 10/27/2011 | % Moisture: 12.24
LIMS Number: L48308-9

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	<		**2.23E+00**	pCi/g		2.17	g wet		11/30/11	5	M	U
C-14	2003	<		**3.91E+00**	pCi/g	R1	2.7403	g wet		12/02/11	5	M	U
C-14	2003	<		**1.90E+00**	pCi/g	R2	2.439	g wet		12/10/11	5	M	U
C-14	2003	<		**1.47E+00**	pCi/g	R3	2.1	g dry		12/23/11	20	M	U
H-3	2003	<		**4.62E+00**	pCi/g		2.17	g wet		11/30/11	5	M	U
H-3	2003	**9.34E+00**	3.29E+00		pCi/g	R1	2.7403	g wet		12/02/11	5	M	+
H-3	2003	<		**3.59E+00**	pCi/g	R2	2.439	g wet		12/10/11	5	M	U

Sample ID: **FMF-DSP 2** | Collect Start: 10/25/2011 14:15 | Matrix: Soil (S)
Station: 2 | Collect Stop: 10/25/2011 14:16 | Volume:
Description: 10 meters | Receive Date: 10/27/2011 | % Moisture: 10.68
LIMS Number: L48308-10

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	<		**1.94E+00**	pCi/g		2.49	g wet		11/30/11	5	M	U
C-14	2003	**1.13E+02**	5.07E+00		pCi/g	R1	2.724	g wet		12/02/11	5	M	+
C-14	2003	<		**1.87E+00**	pCi/g	R2	2.4836	g wet		12/10/11	5	M	U
C-14	2003	<		**1.83E+00**	pCi/g	R3	1.69	g dry		12/23/11	20	M	U
H-3	2003	<		**4.02E+00**	pCi/g		2.49	g wet		11/30/11	5	M	U
H-3	2003	**2.97E+02**	1.13E+01		pCi/g	R1	2.724	g wet		12/02/11	5	M	+
H-3	2003	<		**3.53E+00**	pCi/g	R2	2.4836	g wet		12/10/11	5	M	U

Flag Values
U = Compound/Analyte not detected (< MDC) or less than 3 sigma
\+ = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
High = Activity concentration exceeds customer reporting value
Spec = MDC exceeds customer technical specification
L = Low recovery
H = High recovery

Bolded text indicates reportable value.

No = Peak not identified in gamma spectrum
Yes = Peak identified in gamma spectrum

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MDC - Minimum Detectable Concentration

Report of Analysis

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Sample ID: **FMF-DSP 1** | Collect Start: 10/25/2011 15:30 | Matrix: Soil (S)
Station: 1 | Collect Stop: 10/25/2011 15:31 | Volume:
Description: 3 meters | Receive Date: 10/27/2011 | % Moisture: 19.35
LIMS Number: L48308-11

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	**9.43E+00**	1.91E+00		pCi/g		2.17	g wet		11/30/11	5	M	+
C-14	2003	<		**4.37E+00**	pCi/g	R1	2.4496	g wet		12/02/11	5	M	U
C-14	2003	**8.71E+00**	1.68E+00		pCi/g	R2	2.4247	g wet		12/10/11	5	M	+
C-14	2003	**1.46E+01**	1.45E+00		pCi/g	R3	1.8	g dry		12/23/11	20	M	+
H-3	2003	<		**4.62E+00**	pCi/g		2.17	g wet		11/30/11	5	M	U
H-3	2003	**1.38E+02**	8.40E+00		pCi/g	R1	2.4496	g wet		12/02/11	5	M	+
H-3	2003	<		**3.61E+00**	pCi/g	R2	2.4247	g wet		12/10/11	5	M	U

Sample ID: **FMF-DSP 1** | Collect Start: 10/25/2011 15:38 | Matrix: Soil (S)
Station: 1 | Collect Stop: 10/25/2011 15:39 | Volume:
Description: 4 meters | Receive Date: 10/27/2011 | % Moisture: 18.77
LIMS Number: L48308-12

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	**1.10E+01**	1.89E+00		pCi/g		2.32	g wet		11/30/11	5	M	+
C-14	2003	**1.25E+01**	3.25E+00		pCi/g	R1	2.3047	g wet		12/02/11	5	M	+
C-14	2003	**1.29E+01**	2.11E+00		pCi/g	R2	2.0507	g wet		12/10/11	5	M	+
C-14	2003	**1.46E+01**	1.41E+00		pCi/g	R3	1.86	g dry		12/23/11	20	M	+
H-3	2003	<		**4.32E+00**	pCi/g		2.32	g wet		11/30/11	5	M	U
H-3	2003	<		**5.21E+00**	pCi/g	R1	2.3047	g wet		12/02/11	5	M	U
H-3	2003	<		**4.27E+00**	pCi/g	R2	2.0507	g wet		12/10/11	5	M	U

Flag Values
U = Compound/Analyte not detected (< MDC) or less than 3 sigma
\+ = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
High = *Activity concentration exceeds customer reporting value*
Spec = MDC exceeds customer technical specification
L = Low recovery
H = High recovery

Bolded text indicates reportable value.

No = Peak not identified in gamma spectrum
Yes = Peak identified in gamma spectrum

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MDC - Minimum Detectable Concentration

Report of Analysis

12/29/11 13:30

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Sample ID: **FMF-DSP 1** Collect Start: 10/25/2011 15:47 Matrix: Soil (S)
Station: 1 Collect Stop: 10/25/2011 15:48 Volume:
Description: 5 meters Receive Date: 10/27/2011 % Moisture: 19.83
LIMS Number: L48308-13

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	**4.44E+00**	1.54E+00		pCi/g		2.33	g wet		11/30/11	5	M	+
C-14	2003	**1.39E+01**	3.13E+00		pCi/g	R1	2.4483	g wet		12/02/11	5	M	+
C-14	2003	<		**2.19E+00**	pCi/g	R2	2.1134	g wet		12/10/11	5	M	U
C-14	2003	<		**2.14E+00**	pCi/g	R3	1.74	g dry		12/23/11	20	M	U
H-3	2003	<		**4.30E+00**	pCi/g		2.33	g wet		11/30/11	5	M	U
H-3	2003	**9.40E+01**	7.14E+00		pCi/g	R1	2.4483	g wet		12/02/11	5	M	+
H-3	2003	<		**4.15E+00**	pCi/g	R2	2.1134	g wet		12/10/11	5	M	U

Sample ID: **FMF-DSP 1** Collect Start: 10/25/2011 16:07 Matrix: Soil (S)
Station: 1 Collect Stop: 10/25/2011 16:08 Volume:
Description: 8 meters Receive Date: 10/27/2011 % Moisture: 8.03
LIMS Number: L48308-14

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	**4.20E+00**	1.50E+00		pCi/g		2.39	g wet		11/30/11	5	M	+
C-14	2003	<		**4.35E+00**	pCi/g	R1	2.4614	g wet		12/02/11	5	M	U
C-14	2003	<		**1.60E+00**	pCi/g	R2	2.8965	g wet		12/10/11	5	M	U
C-14	2003	<		**1.37E+00**	pCi/g	R3	2.25	g dry		12/23/11	20	M	U
H-3	2003	<		**4.19E+00**	pCi/g		2.39	g wet		11/30/11	5	M	U
H-3	2003	<		**4.88E+00**	pCi/g	R1	2.4614	g wet		12/02/11	5	M	U
H-3	2003	<		**3.03E+00**	pCi/g	R2	2.8965	g wet		12/10/11	5	M	U

Flag Values
U = Compound/Analyte not detected (< MDC) or less than 3 sigma
\+ = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
High = Activity concentration exceeds customer reporting value
Spec = MDC exceeds customer technical specification
L = Low recovery
H = High recovery

Bolded text indicates reportable value.

No = Peak not identified in gamma spectrum
Yes = Peak identified in gamma spectrum

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Sample ID: **FMF-DSP 1**
Station: 1
Description: 10 meters
LIMS Number: L48308-15

Collect Start: 10/25/2011 16:17
Collect Stop: 10/25/2011 16:18
Receive Date: 10/27/2011

Matrix: Soil (S)
Volume:
% Moisture: 9.78

Radionuclide	SOP#	Activity Conc	Uncertainty 2 Sigma	MDC	Units	Run #	Aliquot Volume	Aliquot Units	Reference Date	Count Date	Count Time	Count Units	Flag Values
C-14	2003	**5.40E+00**	1.44E+00		pCi/g		2.64	g wet		11/30/11	5	M	+
C-14	2003	**1.68E+02**	5.89E+00		pCi/g	R1	2.7757	g wet		12/02/11	5	M	+
C-14	2003	**6.32E+00**	1.71E+00		pCi/g	R2	2.148	g wet		12/10/11	5	M	+
C-14	2003	<		**1.81E+00**	pCi/g	R3	2.06	g dry		12/23/11	20	M	U
H-3	2003	<		**3.79E+00**	pCi/g		2.64	g wet		11/30/11	5	M	U
H-3	2003	<		**4.33E+00**	pCi/g	R1	2.7757	g wet		12/02/11	5	M	U
H-3	2003	<		**4.08E+00**	pCi/g	R2	2.148	g wet		12/10/11	5	M	U

Flag Values
U = Compound/Analyte not detected (< MDC) or less than 3 sigma
\+ = Activity concentration exceeds MDC and 3 sigma; peak identified(gamma only)
U* = Compound/Analyte not detected. Peak not identified, but forced activity concentration exceeds MDC and 3 sigma
High = Activity concentration exceeds customer reporting value
Spec = MDC exceeds customer technical specification
L = Low recovery
H = High recovery

Bolded text indicates reportable value.

No = Peak not identified in gamma spectrum
Yes = Peak identified in gamma spectrum

**** Unless otherwise noted, the analytical results reported are related only to the samples tested in the condition they are received by the laboratory.

MDC - Minimum Detectable Concentration

TELEDYNE
BROWN ENGINEERING, INC.
A Teledyne Technologies Company

Case Narrative

12/29/2011 13:32

L48308

PH001-3EREGGM-06

Philotechnics

All sample were anlyzed three times and the results were inconsistent. The sample matrix was difficult to homogenize and the samples could not be dried and ground without loss of the tritium. Difference in results can probably be attributed to the nonhomogeneity of the sample. The same problem was reflected in the QC sample results. The duplicate analysis for first rerun for C-14 and for the original analysis and first rerun for tritium exceeded internal reproducibility limits. The laboratory control sample result for the first rerun for C-14 was slightly high at 136.1%. All blanks for all runs were acceptable.

Revision:
Samples were dried and ground and analyzved for C-14 (dry basis). All QC was acceptable. Analysis data is designated as R3.

TELEDYNE BROWN ENGINEERING
A Teledyne Technologies Company

Analysis Request Chain of Custody

L48308
WH13B

Client name: **Philotechnics**
Client address: **201 Renovare Blvd**
Oak Ridge, TN 37830
Phone Number **865-285-3018**
Fax Number: **865-220-0686**
Contact: **Glenn Marshall**

um-around-time: 30 days
urchase order: 881

LIMS #:
Variance Report:
(for lab use)

Project Number: 5789

) Number (for lab use)	Client Sample ID	Description	Station	Collection Date/Time Start		Collection Date/Time Stop		Volume	Units	Matrix or type	Analysis Request
	FMF-DSP 3	3 Meters	3	25-Oct-11	9:41	25-Oct-11	9:42	500	ml	soil	H-3, C-14
	FMF-DSP 3	4 Meters	3	25-Oct-11	9:47	25-Oct-11	9:48	500	ml	soil	H-3, C-14
	FMF-DSP 3	5 Meters	3	25-Oct-11	9:50	25-Oct-11	9:51	500	ml	soil	H-3, C-14
	FMF-DSP 3	8 Meters	3	25-Oct-11	9:54	25-Oct-11	9:55	500	ml	soil	H-3, C-14
	FMF-DSP 3	12 Meters	3	25-Oct-11	10:27	25-Oct-11	10:28	500	ml	soil	H-3, C-14
	FMF-DSP 2	3 Meters	2	25-Oct-11	13:20	25-Oct-11	13:21	500	ml	soil	H-3, C-14
	FMF-DSP 2	4 Meters	2	25-Oct-11	13:34	25-Oct-11	13:35	500	ml	soil	H-3, C-14
	FMF-DSP 2	5 Meters	2	25-Oct-11	13:41	25-Oct-11	13:42	500	ml	soil	H-3, C-14
	FMF-DSP 2	8 Meters	2	25-Oct-11	14:00	25-Oct-11	14:01	500	ml	soil	H-3, C-14
	FMF-DSP 2	10 Meters	2	25-Oct-11	14:15	25-Oct-11	14:16	500	ml	soil	H-3, C-14
	FMF-DSP 1	3 Meters	1	25-Oct-11	15:30	25-Oct-11	15:31	500	ml	soil	H-3, C-14
	FMF-DSP 1	4 Meters	1	25-Oct-11	15:38	25-Oct-11	15:39	500	ml	soil	H-3, C-14
	FMF-DSP 1	5 Meters	1	25-Oct-11	15:47	25-Oct-11	15:48	500	ml	soil	H-3, C-14
	FMF-DSP 1	8 Meters	1	25-Oct-11	16:07	25-Oct-11	16:08	500	ml	soil	H-3, C-14
	FMF-DSP 1	10 Meters	1	25-Oct-11	16:17	25-Oct-11	16:18	500	ml	soil	H-3, C-14

Special Instructions:

Relinquished by:	Date:	Relinquished by:	Date:	Relinquished by:	Date:
Received by:	Date:	Received by:	Date:	Received by:	Date:

Relinquished by: [signature] Date: 10/27/11
Received by: [signature] Date: 10/27/11 10:00

10/31/11 10:26

SR #: SR29473

Teledyne Brown Engineering
Sample Receipt Verification/Variance Report

Client: Philotechnics

Project #: PH001-3EREGGM-06

LIMS #L48308

Initiated By: JSIMMONS
Init Date: 10/31/11 Receive Date: 10/31/11

Notification of Variance

Person Notified: Contacted By:

Notify Date:

Notify Method:

Notify Comment:

Client Response

Person Responding:

Response Date:

Response Method:

Response Comment

	Criteria	Yes	No	NA	Comment
1	Shipping container custody seals present and intact.			NA	
2	Sample container custody seals present and intact.			NA	
3	Sample containers received in good condition	Y			
4	Chain of custody received with samples	Y			
5	All samples listed on chain of custody received	Y			
6	Sample container labels present and legible.	Y			
7	Information on container labels correspond with chain of custody	Y			
8	Sample(s) properly preserved and in appropriate container(s)			NA	
9	Other (Describe)			NA	
For Hazardous Materials Only:					
10	Paperwork shows TBE and shippers name, address and phone number			NA	
11	Paperwork shows sample quantity information			NA	

Appendix E

Soil Types

SCHREIBER & YONLEY ASSOCIATES
ENVIRONMENTAL ENGINEERS

16252 Westwoods Business Park Drive
Ellisville, Missouri 63021
636-256-7200/ Fax: 636-256-7202
www.perma-fix/sya.com

LOG OF TEST BORING

Client:	Sigma - Radiochem	Project No:	110218	Boring / Well No.	BH 01
Project:	Soil Sampling Assessment			Page No.	1 of 3
Location:	11542 Fort Mims Dr.; Maryland Heights, MO			Start Date:	10/25/11
Surface Elevation:		Top of Casing Elevation:	N/A	Completion Date:	10/25/11
Drilling Contractor:	PSC			Sample Method:	Continuous Sampler
Drill Rig:	CME 55				5'x4" Sampler
Water Encountered ? :	Yes	Total Boring Depth:	50'	Hole Diameter:	8"
Initial Water Level:	~33'	Surface Casing Depth:	NA	Inspector (s):	Doug Abeln
Static Water Level:		Well Depth:	NA	Company:	Schreiber, Yonley & Associates

Depth BGS (ft.)	Sample Interval	N	Rec. % RQD	PID Units	Description of Materials/Remarks	Moisture	Soil Class	Graphic Log	Well Diag.
1					0-6" Limestone gravel				
2	Run 1 0-5'		60%	N/A	Silty clay loam; med. Stiff; moist, brown		CL		
3									
4					Clay loam, med. stiff, moist, brown		CL		
5									
6									
7	Run 2 5'-10'		0%						
8									
9									
10									
11					Silty clay; med. stiff; moist; lt. brown; somewhat plastic				
12	Run 3 10'-15'		20%				CL		
13									
14									
15									
16					Silty clay; med. stiff; moist; lt. brown				
17	Run 4 15'-20'		100%				CL		
18									
19									
20									

Notes:

SCHREIBER & YONLEY ASSOCIATES
ENVIRONMENTAL ENGINEERS

16252 Westwoods Business Park Drive
Ellisville, Missouri 63021
636-256-7200/ Fax: 636-256-7202
www.perma-fix/sya.com

LOG OF TEST BORING

Client:	Sigma - Radiochem	Project No:	110218	Boring / Well No.	BH 02
Project:	Soil Sampling Assessment			Page No.	1 of 2
Location:	11542 Fort Mims Dr.; Maryland Heights, MO			Start Date:	10/25/11
Surface Elevation:		Top of Casing Elevation:	N/A	Completion Date:	10/25/11
Drilling Contractor:	PSC			Sample Method:	Continuous Sampler
Drill Rig:	CME 55				5'x4" Sampler
Water Encountered ? :	No	Total Boring Depth:	33.5'	Hole Diameter:	8"
Initial Water Level:		Surface Casing Depth:	NA	Inspector (s):	Doug Abeln
Static Water Level:		Well Depth:	NA	Company:	Schreiber, Yonley & Associates

Depth BGS (ft.)	Sample Interval	N	Rec. % RQD	PID Units	Description of Materials/Remarks	Moisture	Soil Class	Graphic Log	Well Diag.
1					Silty loam; med. dense; dry; crumbly; brown-lt. brown mottled; some orange material				
2	Run 1		53%	N/A					
3	0-5'						ML		
4									
5									
6					Clayey silt; med. stiff; moist at 9'; brown				
7	Run 2		100%						
8	5'-10'						ML		
9									
10									
11					Clayey silt; med. stiff; moist; brown				
12	Run 3		100%				ML		
13	10'-15'								
14									
15									
16					Clayey silt; med. stiff; moist; brown		ML		
17	Run 4		100%		Clayey silt; stiff; dry; brown-lt. brown mottled		ML		
18	15'-20'								
19									
20									

Notes:

SCHREIBER & YONLEY ASSOCIATES
ENVIRONMENTAL ENGINEERS

16252 Westwoods Business Park Drive
Ellisville, Missouri 63021
636-256-7200/ Fax: 636-256-7202
www.perma-fix/sya.com

LOG OF TEST BORING

Client:	Sigma - Radiochem	Project No:	110218	Boring / Well No.	BH 03
Project:	Soil Sampling Assessment				Page No. 1 of 2
Location:	11542 Fort Mims Dr.; Maryland Heights, MO			Start Date:	10/25/11
Surface Elevation:		Top of Casing Elevation:	N/A	Completion Date:	10/25/11
Drilling Contractor:	PSC			Sample Method:	Continuous Sampler
Drill Rig:	CME 55				5'x4" Sampler
Water Encountered ? :	No	Total Boring Depth:	33'	Hole Diameter:	8"
Initial Water Level:		Surface Casing Depth:	NA	Inspector (s):	Doug Abeln
Static Water Level:		Well Depth:	NA	Company:	Schreiber, Yonley & Associates

Depth BGS (ft.)	Sample Interval	N	Rec. % RQD	PID Units	Description of Materials/Remarks	Moisture	Soil Class	Graphic Log	Well Diag.
1					Clayey silt loam; med. stiff; crumbly; dry; brown				
2	Run 1		50%	N/A					
3	0-5'						ML		
4									
5									
6					Silty clay; stiff; moist; brown-lt. brown mottled				
7	Run 2		100%						
8	5'-10'						ML		
9									
10									
11					Silty clay; stiff; moist; brown				
12	Run 3		100%				ML		
13	10'-15'								
14									
15									
16					Silty clay; stiff; moist; brown				
17	Run 4		100%				ML		
18	15'-20'								
19					Silty clay; stiff; dry; brown-lt. brown mottled		ML		
20									

Notes: