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ANL/EVS-24/19

Verification of RESRAD-OFFSITE Code Version 4

Environmental Science Division

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ANL/EVS-24/19

Verification of RESRAD-OFFSITE Code Version 4

by
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October 2024

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1 INTRODUCTION

1.1 OVERVIEW

This report documents the verification of RESRAD-OFFSITE Version 4.0 and describes, where necessary, the verification of the following:

- The data comprising the standard dose and risk coefficient libraries in the RESRAD database files Master_dcf_ICRP07.mdb and Master_dcf_2k.mdb.

- The extraction and transfer of the data from the selected database file to the computational code by the RESRAD-OFFSITE 4.0 interface, ResOWin.exe.

- The different processes that are modeled by the main computational code in RESRAD-OFFSITE 4.0, ResOMain.exe.

- The data displayed in the graphical and text reports.

Many verifications were performed as part of the quality assurance quality control program associated with the development and release of RESRAD-OFFSITE 4.0, namely,

- developer testing,
- internal independent testing, and
- release testing.

Some were also performed in response to questions from users regarding the performance of the code. The main text of the report focuses on summarizing a subset of those tests, both independent and developer tests that verified the computations performed by the code. The verifications included in this report served as the basis for the development of the release tests of the computational executables and provided the quantitative results to be compared with the code output.

The input and output interfaces and the data transfers between the various executables of the code were tested while performing the verification testing. They were tested intentionally during release testing.

This report also provides some basic information to help in understanding the activities that were verified. The report

- outlines the components of RESRAD-OFFSITE 4.0 and the interconnections between these components,

- outlines the processes modeled by the computational code,

- provides summary figures and tables to offer confirmation of the verification of the computational components of the code,

- reproduces the verifiers' reports, if available, in individual appendices,
- refers to the previous verification report (Yu et al. 2011) for more details about some of the verifications, and
- reproduces the test cases and the testers' reports from the release testing in individual appendices, when possible.

1.2 COMPONENTS OF RESRAD-OFFSITE 4.0

RESRAD-OFFSITE 4.0 consists of eight executables and one compiled html help file and accesses data from two database files and a number of ASCII and binary data files. While Appendix 1 describes the components and interconnections in greater detail, this section focuses on the aspects of the components from the perspective of verification.

Executables:

- ResOwin.exe is the main interface. It performs the following verifiable tasks:
  - Accepts inputs and writes them in a format that can be read by the computational code ResOCalc.exe.
  - Queries the appropriate database file to extract the relevant dose and risk coefficients.
  - Writes the dose and risk coefficients to a number of files.
- ResOCalc.exe is the main computational code. It performs the following verifiable computations and tasks:
  - Reads the input and data files and writes the inputs, dose factors, and risk factors to text reports.
  - Computes the following:
    - Temporal variation of the thickness and mixing of the primary contamination.
    - Temporal variation of radioactivity in the primary contamination
      - ◊ under a number of conceptualizations of the primary contamination and
      - ◊ under a number of transfer mechanisms.
    - Temporal variation of the releases from the primary contamination
      - ◊ under a number of conceptualizations of the primary contamination and
      - ◊ under a number of transfer mechanisms.
    - Atmospheric transport of
      - ◊ all (respirable and non-respirable) particulates,
      - ◊ respirable particulates, and
      - ◊ ^{3}H and ^{14}C in vapor or gaseous form.
    - Atmospheric transport of radon and three of its progeny and the radiological transformations that occur during transport.
    - Groundwater transport of

            - ◊ a temporal flux input at the upgradient face of the transport zone, to determine the
                - – temporal flux out of the zone and
                - – temporal concentration in pore water at the end of the zone,
            - ◊ a temporal pulse input distributed over a length of the transport zone, to determine the
                - – temporal flux out of the zone and
                - – temporal concentration in pore water at the end of the zone,
            - ◊ an instantaneous pulse input distributed over a length of the transport zone, to determine the
                - – temporal flux out of the zone and
                - – temporal concentration in pore water at the end of the zone.
        - ▪ Groundwater transport from a submerged source.
        - ▪ Transfer of material eroded from the primary contamination to the offsite locations (farmed lands and the surface water body).
        - ▪ Accumulation in the farmed lands.
        - ▪ Accumulation in the surface water body.
        - ▪ Temporal variation of the concentration of radionuclides in plants.
        - ▪ Temporal variation of the concentration of radionuclides in meat.
        - ▪ Temporal variation of the concentration of radionuclides in milk.
        - ▪ Temporal variation of the concentration of radionuclides in aquatic food.
        - ▪ Dose and risk from external radiation from the primary contamination and from the accumulation in the farmed lands.
        - ▪ Dose and risk from the inhalation of respirable particulates while on the primary contamination and on the farmed lands.
        - ▪ Dose and risk from the ingestion of plant foods.
        - ▪ Dose and risk from the ingestion of meat.
        - ▪ Dose and risk from the ingestion of milk.
        - ▪ Dose and risk from the ingestion of water.
        - ▪ Dose and risk from the ingestion of aquatic food.
        - ▪ Dose and risk from the incidental ingestion of soil.
        - ▪ Dose and risk from the inhalation of radon isotopes and three of their progeny.
        - ▪ Additional models for ^{3}H and ^{14}C.
    - o Writes the doses, risks, concentrations, and other intermediate output.

- GrphCnv5.exe
    - o Reads the binary output of ResOCalc.exe and writes text outputs of doses, risks, and concentrations for use by the plotting program.

- WResPlot.exe
    - o Reads the text files created by GrphCnv5.exe or by GrphCnvP.exe and displays temporal plots of dose, risk, and concentration.
    - o Outputs the data used to generate the selected plot.

- LHSRO.exe
- CorRegRO.exe
- GrphCnvP.exe
    - Reads the binary output of ResOCalc.exe and writes text outputs of doses, risks, and concentrations for each probabilistic realization for use by the plotting program.
- ResDCF.exe

Database files:

- Master_dcf_2k.mdb
- Master_dcf_ICRP07.mdb

2 VERIFICATION OF THE PRIMARY CONTAMINATION FORMULATIONS

The primary contamination formulations in Version 2.5 of RESRAD-OFFSITE were verified in Chapter 2 of NUREG/CR-7038 (Yu et al. 2011). The leaching release formulation in Version 2.5 is retained in Version 4.0 as the "RESRAD-ONSITE exponential release" option. But the underlying coding was modified to allow the first-order leach rate to vary with time and model transport within the primary contamination. Thus, three representative cases from that verification, Cases 1, 3, and 4, were reverified using the output of the candidate version of RESRAD-OFFSITE 4.0 prior to its release. The inputs that were changed from the defaults/placeholders of the code are listed in Table 2.1.

Table 2.1 Inputs Used in Verification of RESRAD-ONSITE Exponential Release Model

<table>
<tr><th>Inputs ↓</th><th>Case →</th><th>1</th><th>3</th><th>4</th></tr>
<tr><td>Transformation data</td><td></td><td>ICRP-38</td><td>ICRP-38</td><td>ICRP-38</td></tr>
<tr><td>Number of calculation time points</td><td></td><td>1024</td><td colspan="2">1024</td></tr>
<tr><td>Largest reporting time, y</td><td></td><td>994</td><td colspan="2">994</td></tr>
<tr><td>Thickness of cover, m</td><td></td><td>(0)[a]</td><td colspan="2">0.3</td></tr>
<tr><td>Thickness of primary contamination, m</td><td></td><td>(2)</td><td colspan="2">1</td></tr>
<tr><td>Nominal erosion rate of cover, m y^{-1}[b]</td><td></td><td>n a[c]</td><td colspan="2">0.001</td></tr>
<tr><td>Nominal erosion rate of primary contamination, m y^{-1}[b]</td><td></td><td>0.01</td><td colspan="2">0</td></tr>
<tr><td>Rainfall and runoff factor</td><td></td><td>(160)</td><td colspan="2">7.58929</td></tr>
<tr><td>Slope length steepness factor</td><td></td><td>3.49</td><td colspan="2">2</td></tr>
<tr><td>Cover and management factor</td><td></td><td>0.3</td><td colspan="2">1</td></tr>
<tr><td>Soil erodibility factor in cover, tons acre^{-1}</td><td></td><td>n a</td><td colspan="2">0.470588</td></tr>
<tr><td>Soil erodibility factor in primary contamination, tons acre^{-1}</td><td></td><td>(0.4)</td><td colspan="2">0</td></tr>
<tr><td>Dry bulk density of cover, g (cm)$^{-3}$</td><td></td><td>n a</td><td colspan="2">1.6</td></tr>
<tr><td>Dry bulk density of unsaturated zone, g (cm)$^{-3}$</td><td></td><td>1.7</td><td colspan="2">1.7</td></tr>
<tr><td>Thickness of ^{14}C evasion layer, m</td><td></td><td>n a</td><td>n a</td><td>0.5</td></tr>
<tr><td>^{14}C evasion flux rate s^{-1}</td><td></td><td>n a</td><td>n a</td><td>6.338 10^{-8}</td></tr>
</table>

[a] Values in parenthesis are the default/placeholder values of RESRAD-OFFSITE.

[b] The erosion rates computed using other inputs are used in the verification; the nominal erosion rate is for information only.

[c] n a = not applicable.

2.1 FORMULATIONS FOR CLEAR COVER, CONTAMINATED MIXING LAYER, AND UNDISTURBED PRIMARY CONTAMINATION

The expressions used to calculate the erosion rate of the primary contamination and the temporal variation of the thickness of the unmixed portion of the primary contamination are verified in Figure 2.1 for Case 1, which involves an eroding primary contamination with no cover. The same equations are verified in Figure 2.2 for Cases 3 and 4, which involve an eroding cover that is initially thicker than the mixing layer. The expressions used to compute the volume fraction of material from the primary contamination that are in the mixing layer are verified in Figure 2.3 for Cases 3 and 4, which involve an eroding cover that is initially thicker than the mixing layer.

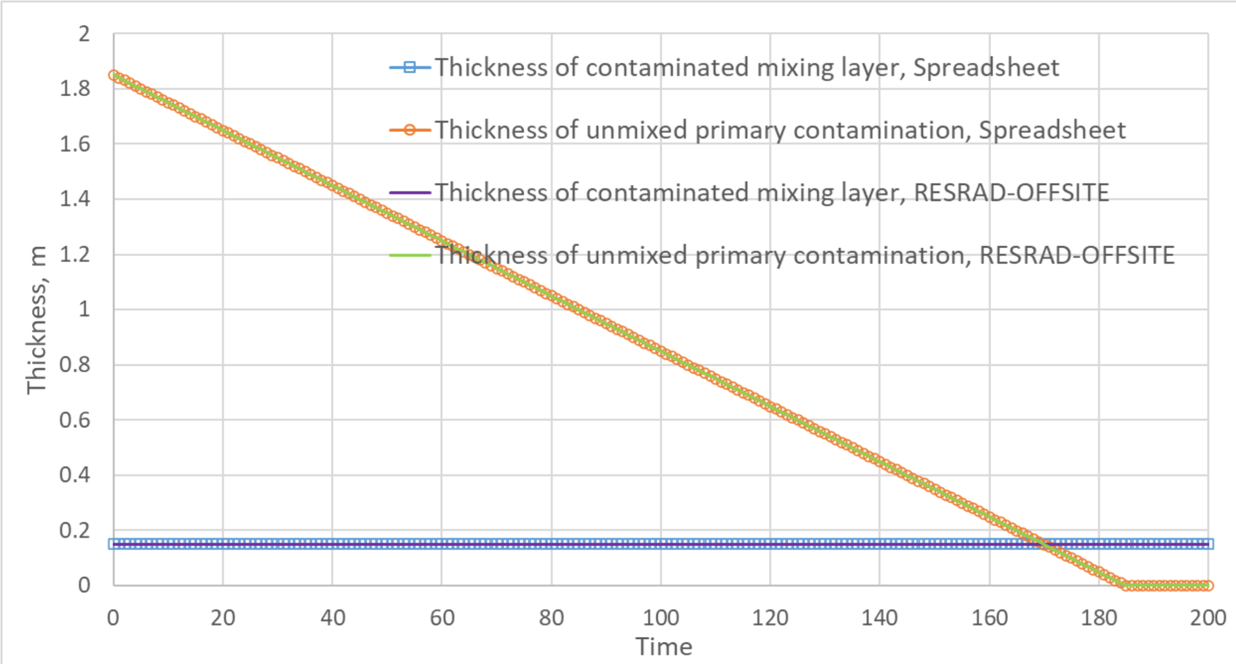

Figure 2.1 Temporal Variation of Thicknesses of Contaminated Mixing Layer and Unmixed Primary Contamination When There Is No Cover above an Eroding Primary Contamination

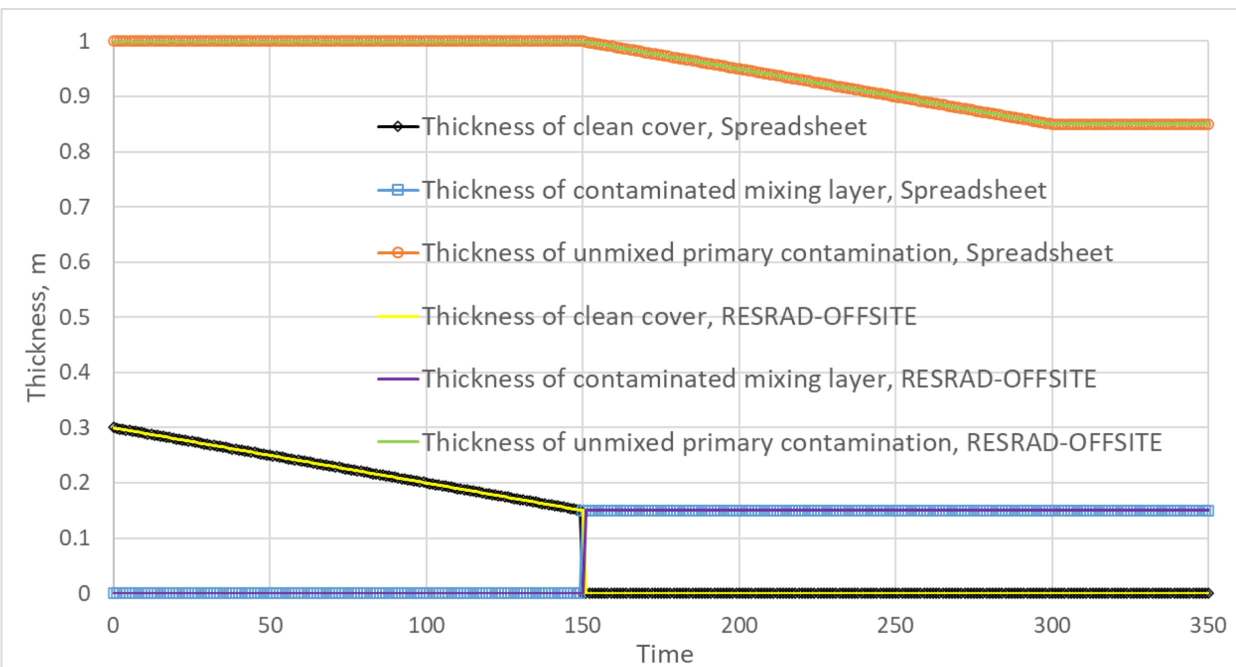

Figure 2.2 Temporal Variation of Thicknesses of Clean Cover, Contaminated Mixing Layer and Unmixed Primary Contamination When There Is an Eroding Cover above a Non-eroding Primary Contamination

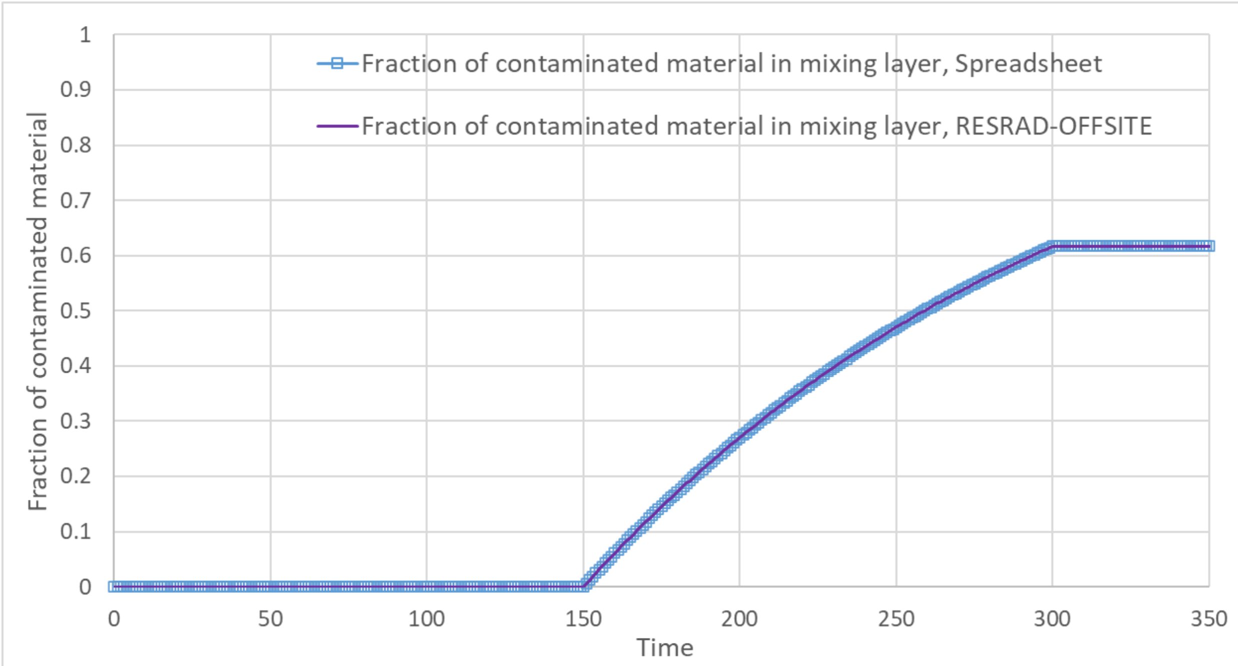

Figure 2.3 Temporal Variation of the Volume Fraction of Material from Primary Contamination in the Mixing Layer When There Is an Eroding Cover above a Non-eroding Primary Contamination

2.2 CONCENTRATION OF RADIONUCLIDES IN THE PRIMARY CONTAMINATION FOR THE “RESRAD-ONSITE EXPONENTIAL RELEASE” OPTION

The expressions used to compute the radionuclide concentration in the soil under the “RESRAD-ONSITE exponential release” option are verified in Figure 2.4 through Figure 2.11. Figure 2.10 and Figure 2.11 also verify the functionality to model time-varying removal rates, which was added post-Version 2.5, in this case for the evasion rate.

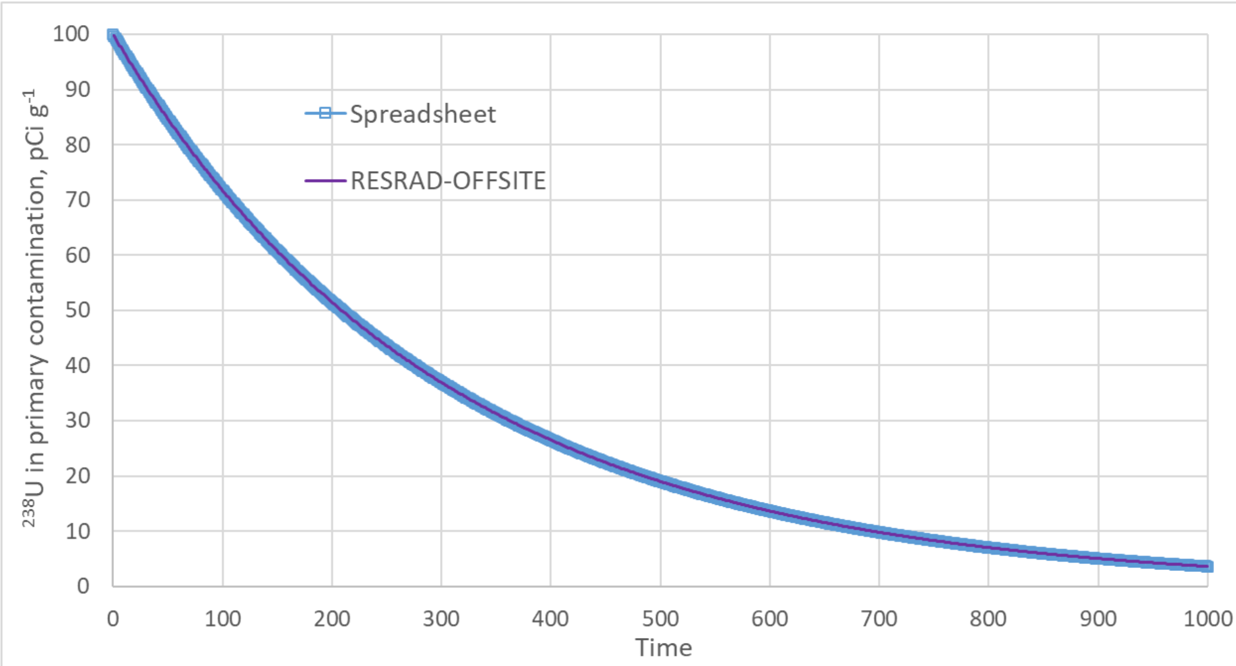

Figure 2.4 Temporal Variation of Concentration of ^{238}U in the Primary Contamination Due to Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Decay

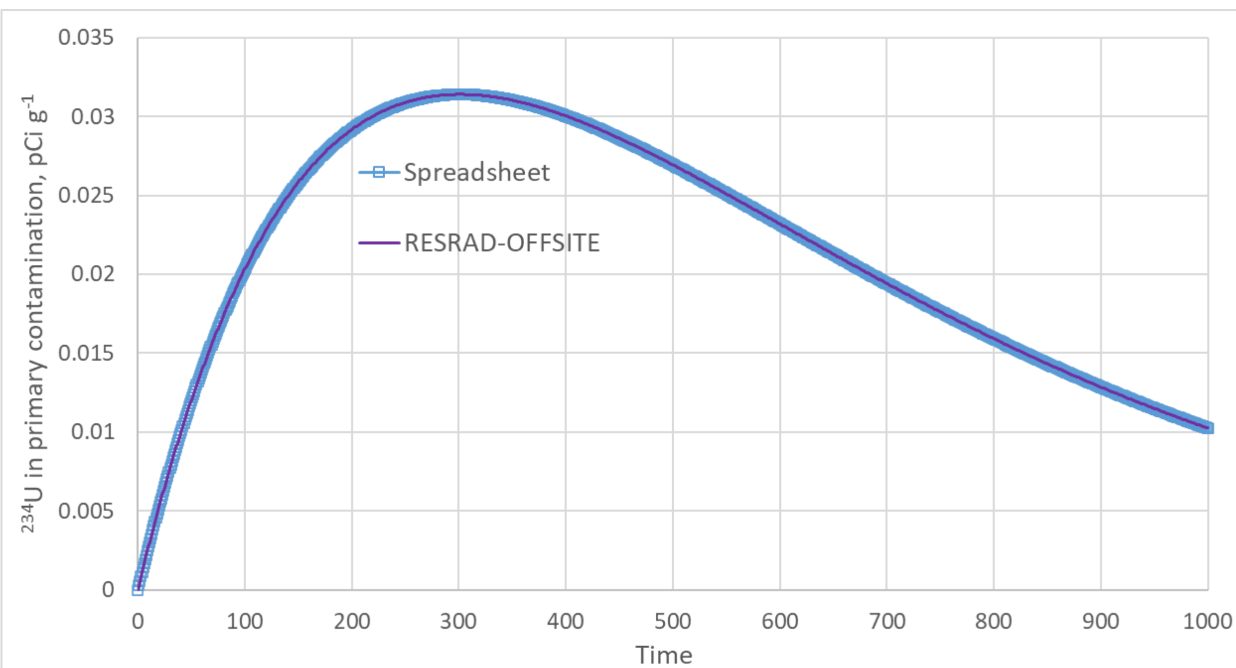

Figure 2.5 Temporal Variation of Concentration of ^{234}U, Derived from ^{238}U, in the Primary Contamination Due to Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

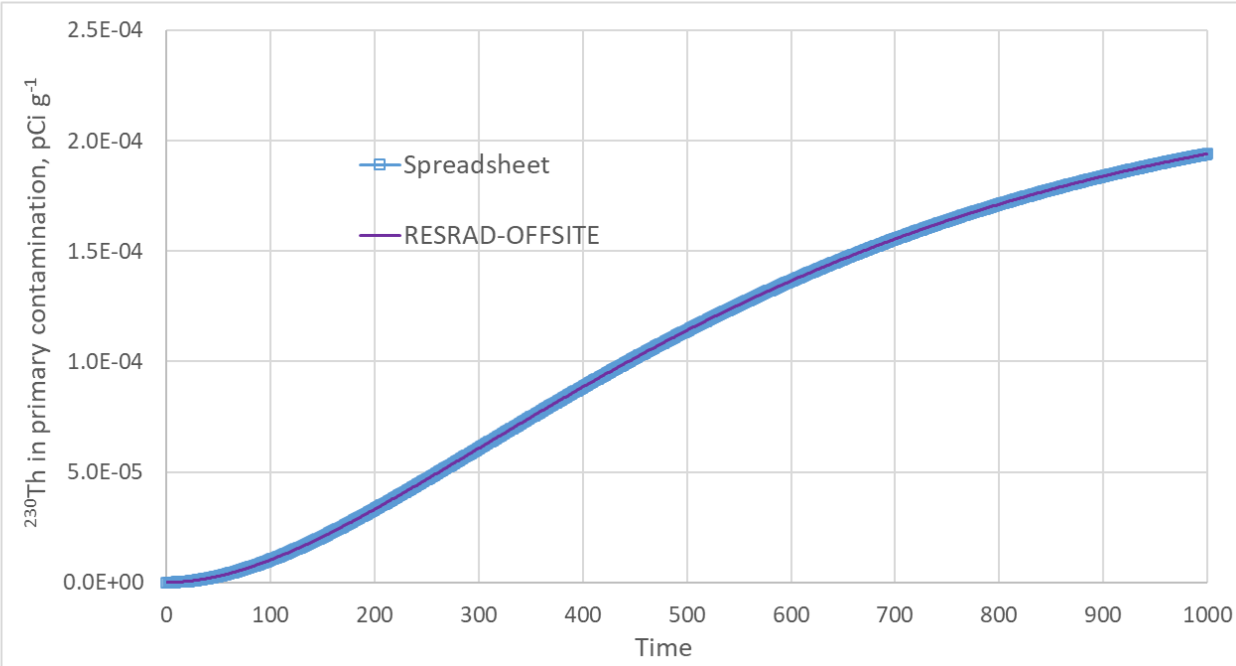

Figure 2.6 Temporal Variation of Concentration of ^{230}Th, Derived from ^{238}U, in the Primary Contamination Due to Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

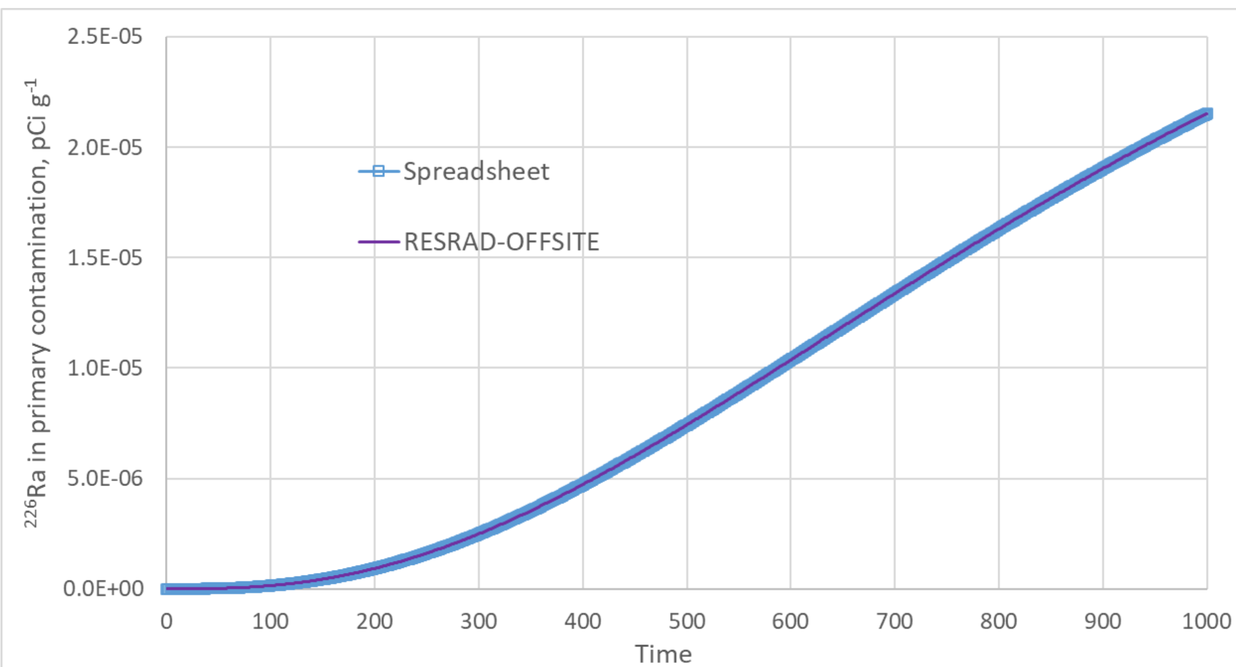

Figure 2.7 Temporal Variation of Concentration of ^{226}Ra, Derived from ^{238}U, in the Primary Contamination Due to Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

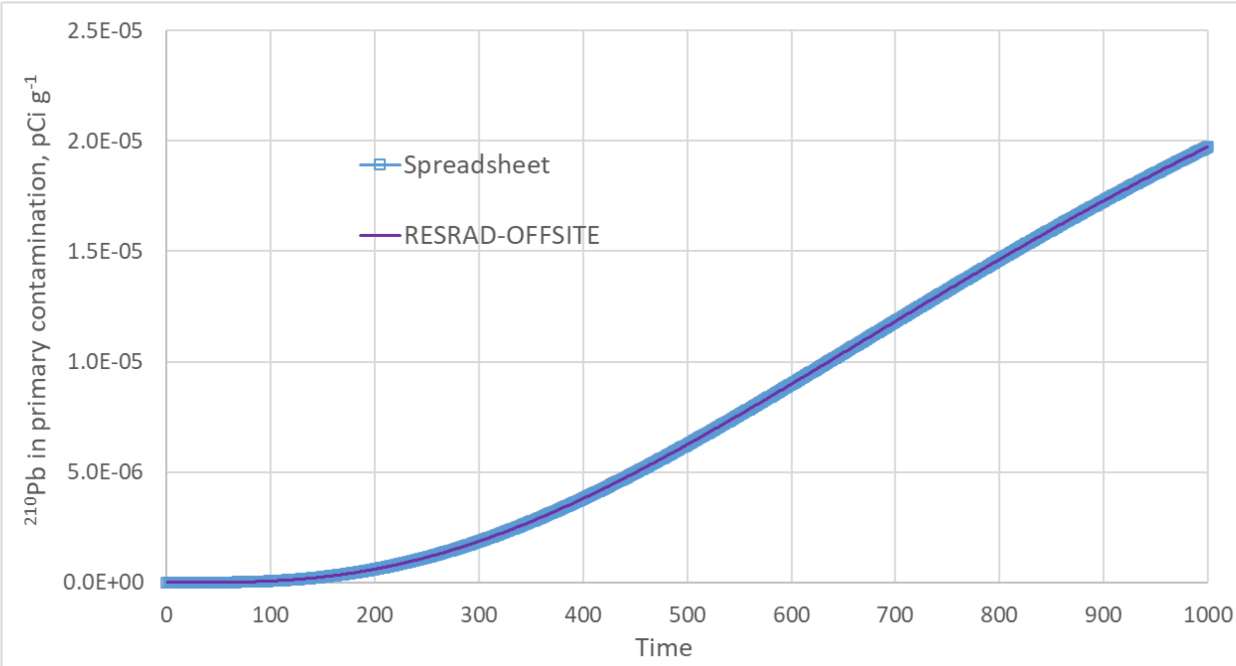

Figure 2.8 Temporal Variation of Concentration of ^{210}Pb, Derived from ^{238}U, in the Primary Contamination Due to Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

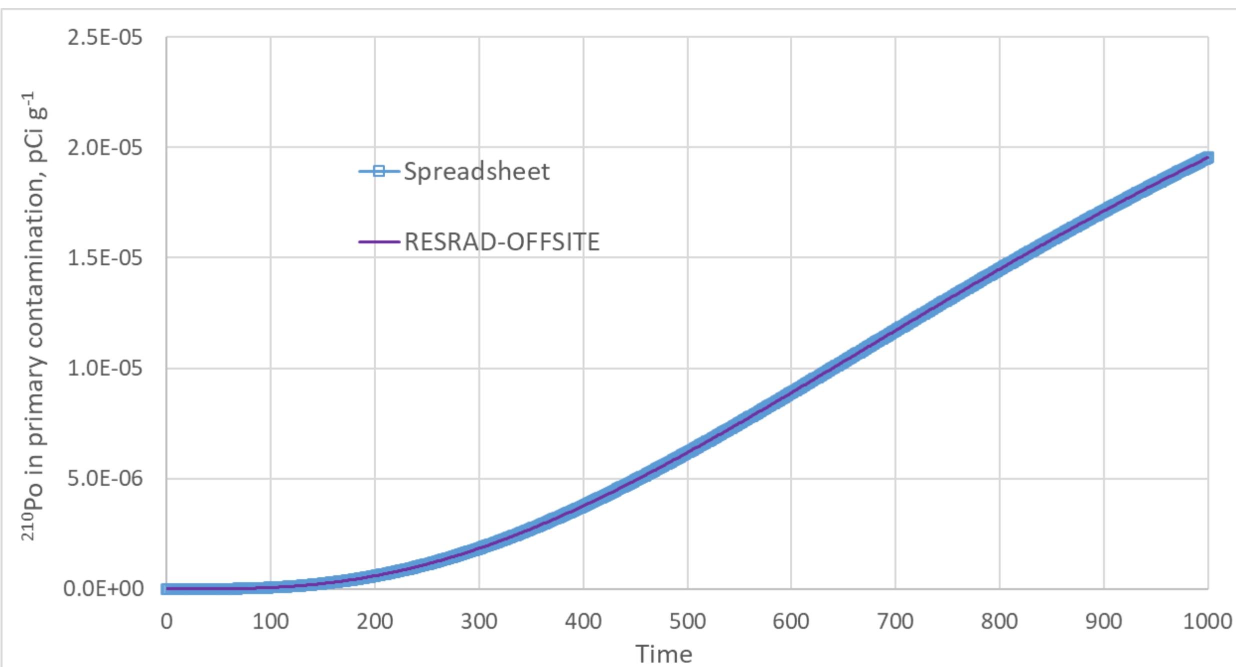

Figure 2.9 Temporal Variation of Concentration of ^{210}Po, Derived from ^{238}U, in the Primary Contamination Due to Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

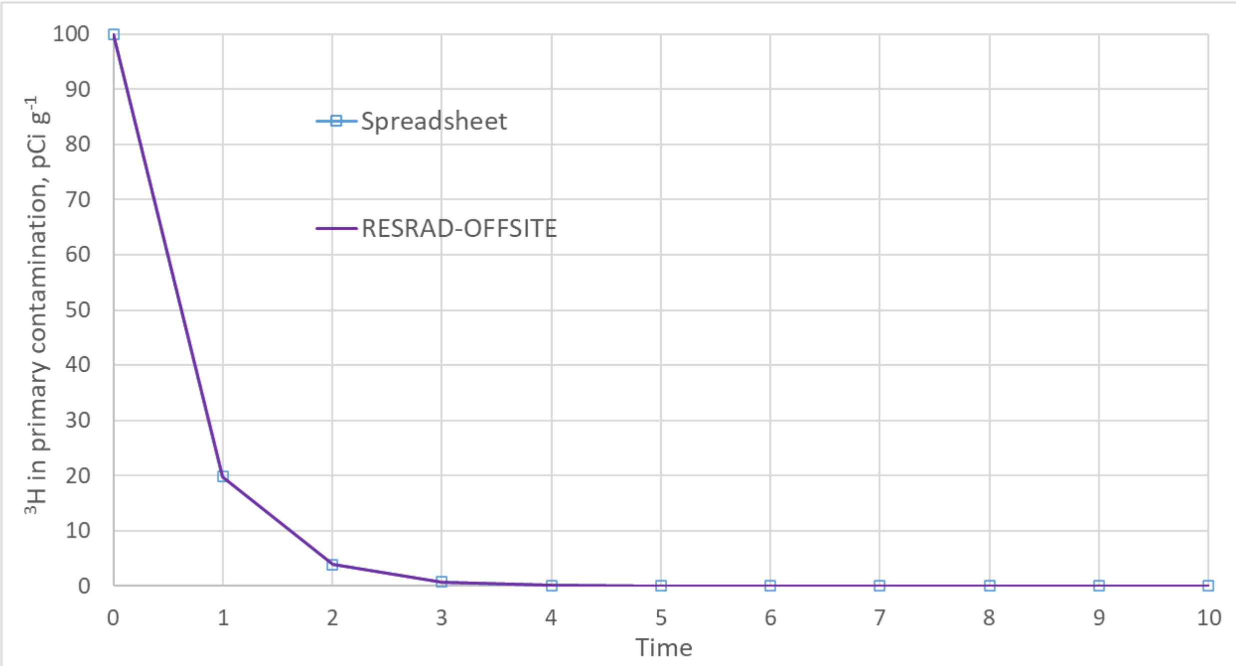

Figure 2.10 Temporal Variation of Concentration of ^{3}H in the Primary Contamination Due to Evapotranspiration, Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

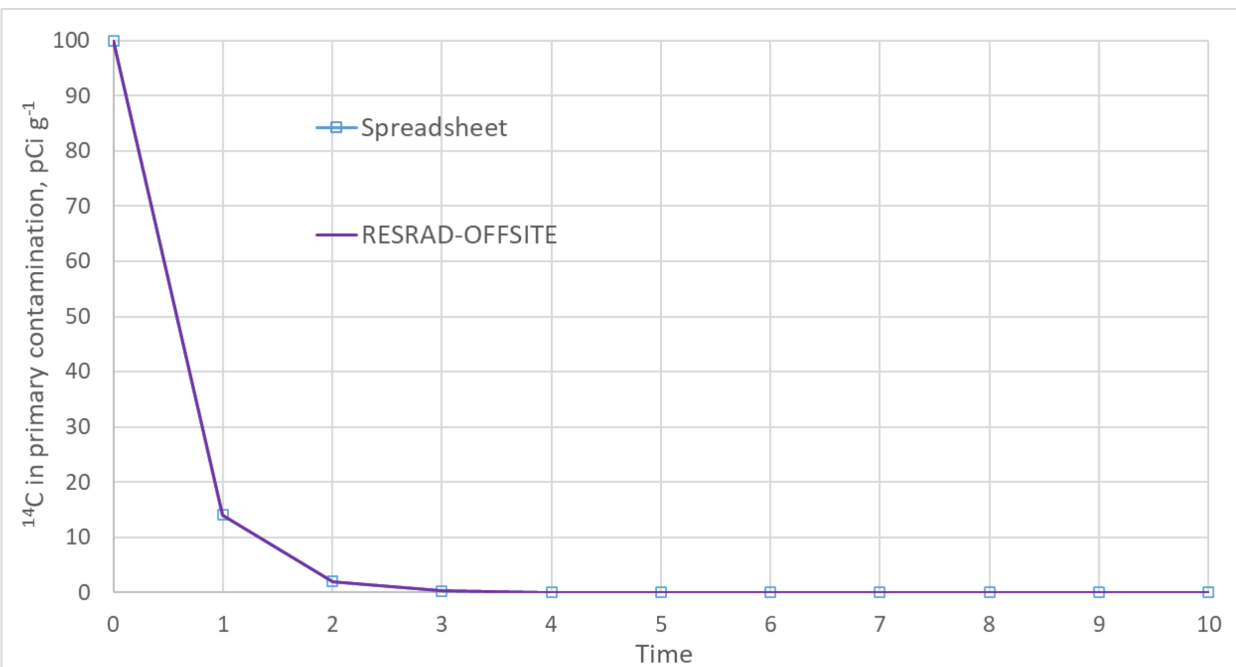

Figure 2.11 Temporal Variation of Concentration of ^{14}C in the Primary Contamination Due to Evasion, Leaching under the RESRAD-ONSITE Exponential Release Option and Radiological Transformations

2.3 RELEASE OF RADIONUCLIDES TO INFILTRATION UNDER THE "RESRAD-ONSITE EXPONENTIAL RELEASE" OPTION

The expressions used to compute the release of radionuclides under the "RESRAD-ONSITE exponential release" option are verified in Figure 2.12 through Figure 2.17.

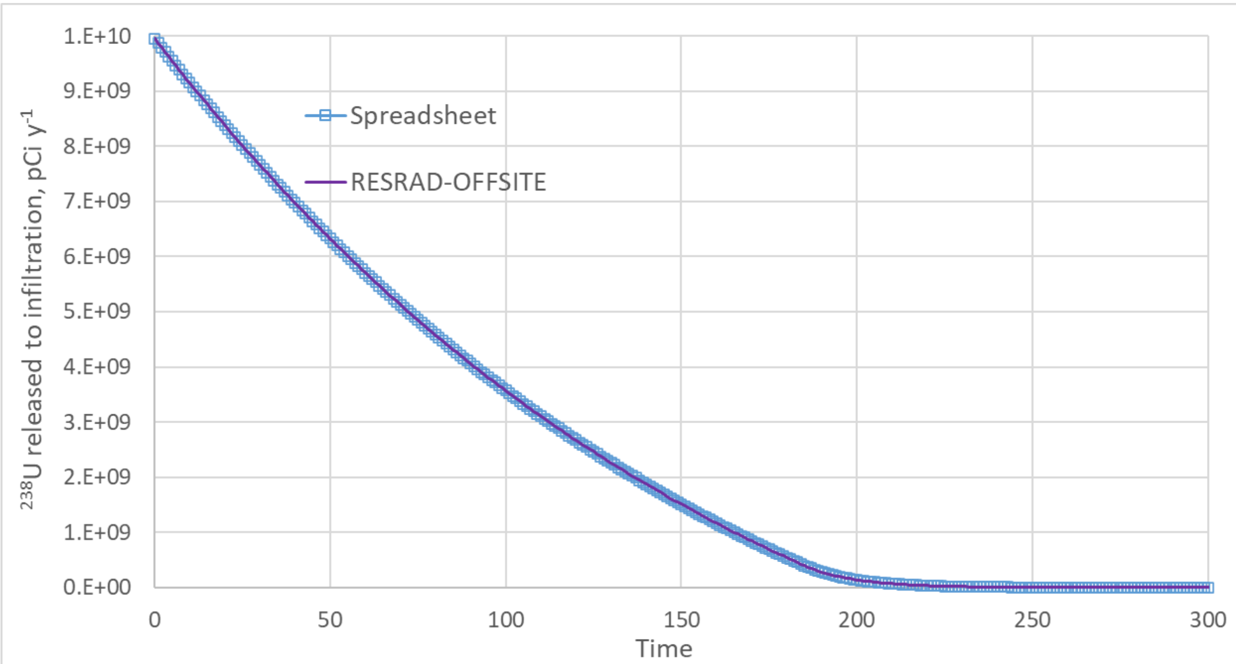

Figure 2.12 Temporal Variation of the Release of ^{238}U to Infiltration at the Bottom of the Primary Contamination under the RESRAD-ONSITE Exponential Release Option

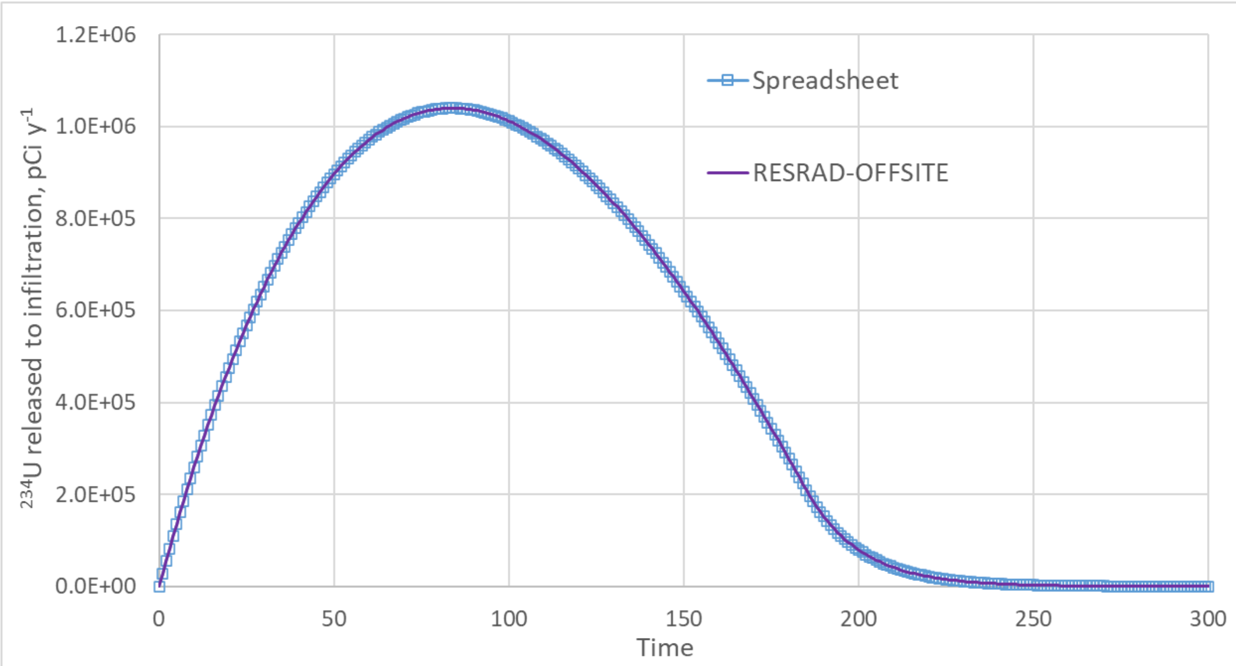

Figure 2.13 Temporal Variation of the Release of ^{234}U to Infiltration at the Bottom of the Primary Contamination under the RESRAD-ONSITE Exponential Release Option

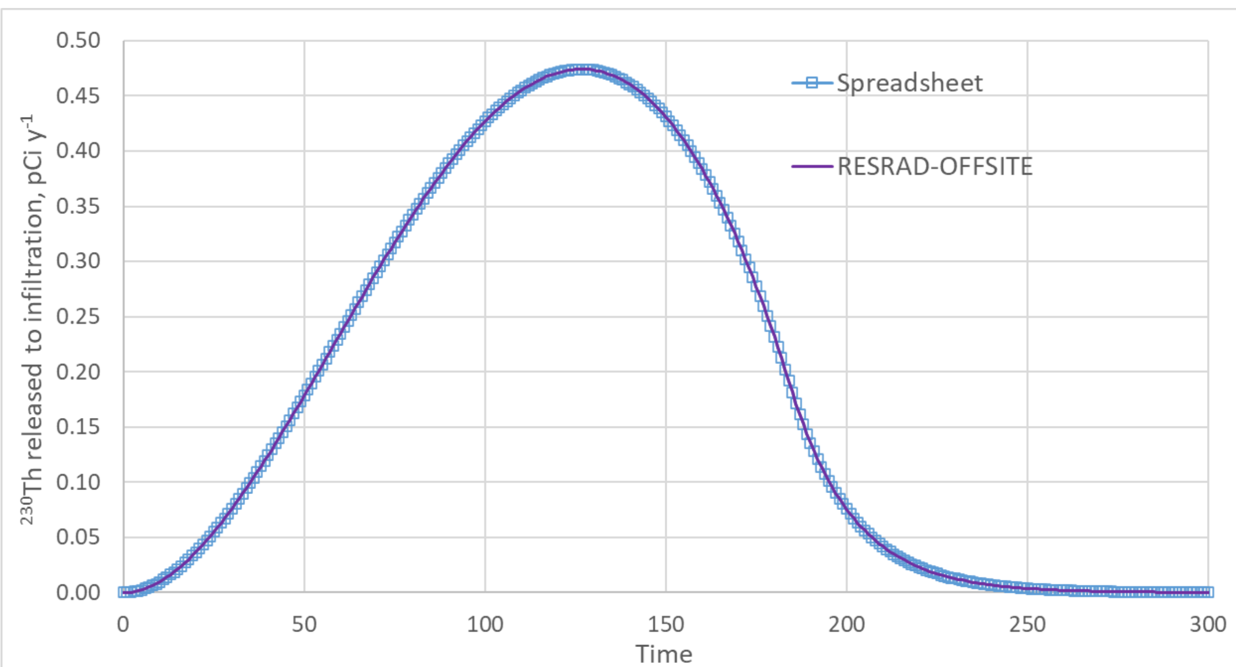

Figure 2.14 Temporal Variation of the Release of ^{230}Th to Infiltration at the Bottom of the Primary Contamination under the RESRAD-ONSITE Exponential Release Option

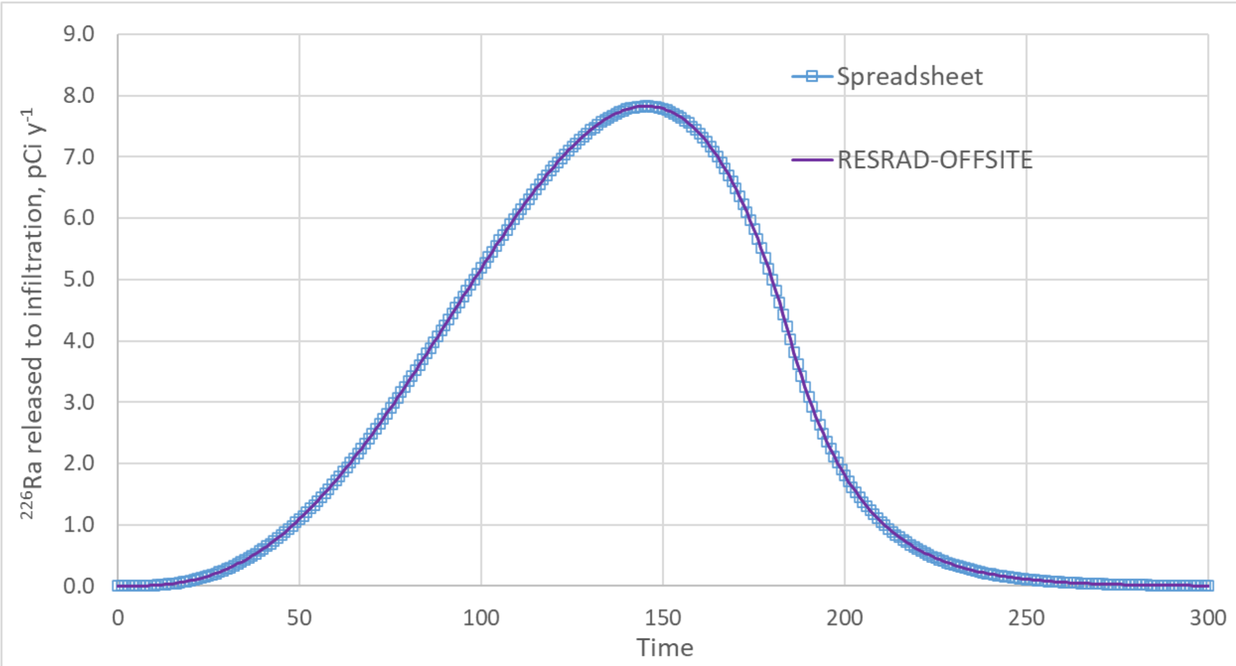

Figure 2.15 Temporal Variation of the Release of ^{226}Ra to Infiltration at the Bottom of the Primary Contamination under the RESRAD-ONSITE Exponential Release Option

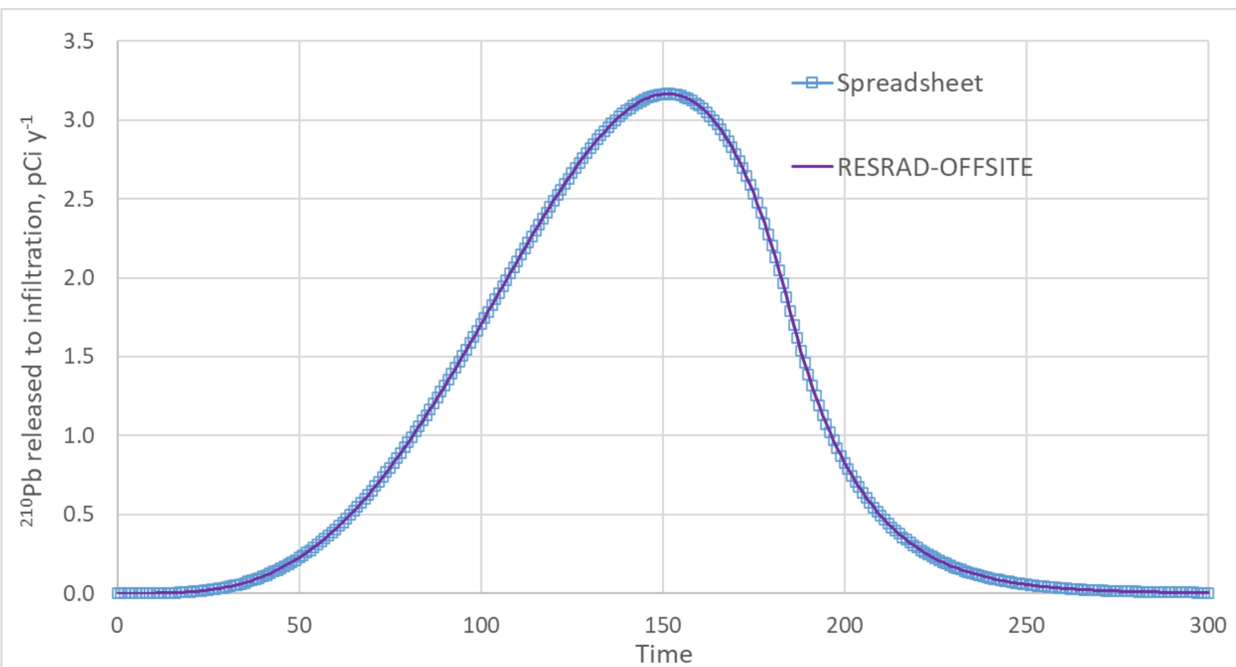

Figure 2.16 Temporal Variation of the Release of ^{210}Pb to Infiltration at the Bottom of the Primary Contamination under the RESRAD-ONSITE Exponential Release Option

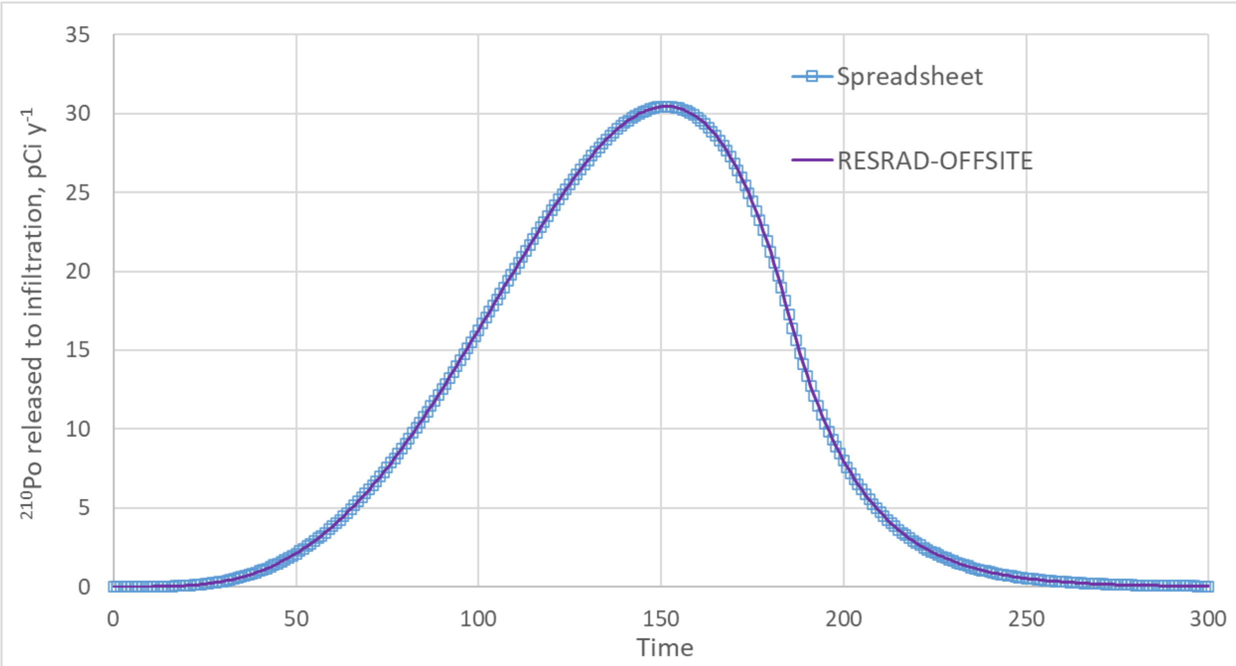

Figure 2.17 Temporal Variation of the Release of ^{210}Po to Infiltration at the Bottom of the Primary Contamination under the RESRAD-ONSITE Exponential Release Option

2.4 RELEASE OF RADIONUCLIDES IN PARTICULATES TO THE ATMOSPHERE UNDER THE "RESRAD-ONSITE EXPONENTIAL RELEASE" OPTION

The release of radionuclides associated with the release of particulates to the atmosphere was verified as described in Appendix 2. The expressions used to calculate the release of ^{90}Sr in particulates to the atmosphere are verified in Figure 2.18 for two cases:

- The sum of the initial thicknesses of the cover, 0.05 m, and the primary contamination, 0.1 m, is equal to the thickness of the mixing layer, 0.15 m;
- The sum of the initial thicknesses of the cover, 0.05 m, and the primary contamination, 1.2 m, is greater than the thickness of the mixing layer, 0.15 m.

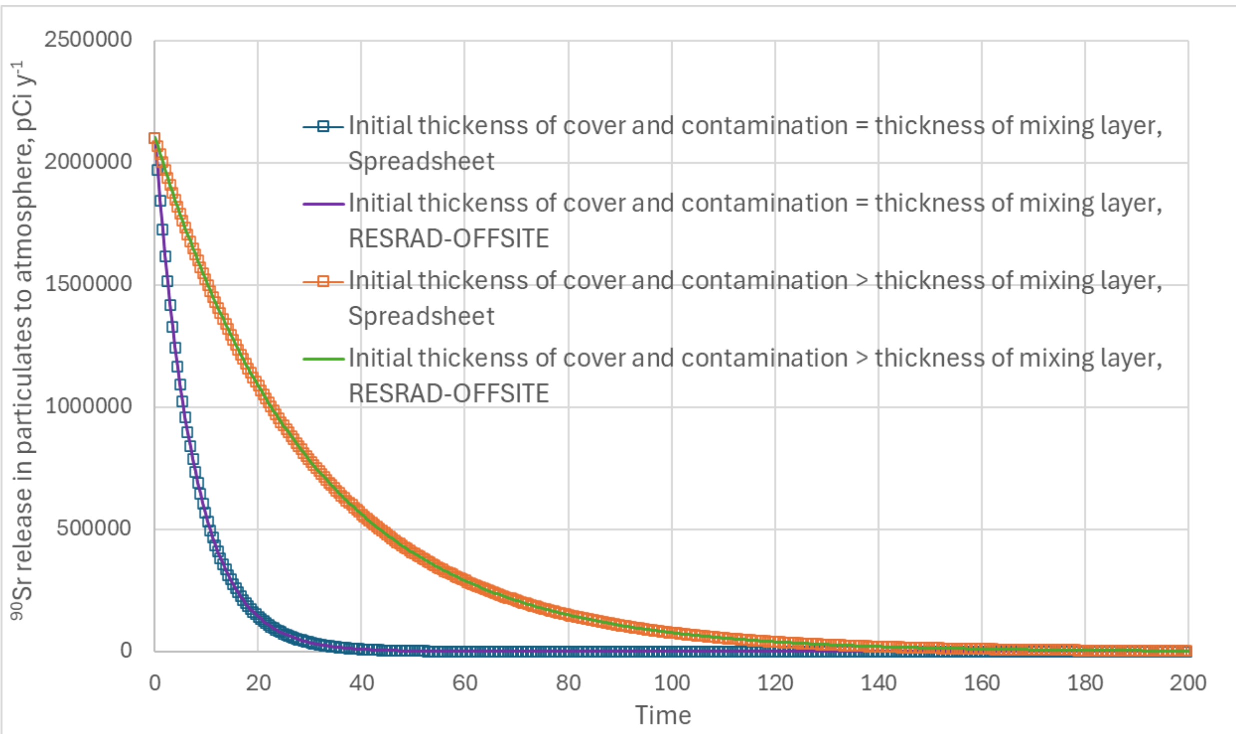

Figure 2.18 Temporal Variation of the Release of ^{90}Sr in Particulates to the Atmosphere

2.5 RELEASE OF RADIONUCLIDES IN PARTICULATES BY EROSION TO RUNOFF UNDER THE “RESRAD-ONSITE EXPONENTIAL RELEASE” OPTION

The release of radionuclides in particulates that are eroded and carried away by runoff was verified as described in Appendix 3. The expressions used to calculate the release of ^{90}Sr in particulates to runoff are verified in Figure 2.19 for two cases.

- The sum of the initial thicknesses of the cover, 0.05 m, and the primary contamination, 0.1 m, is equal to the thickness of the mixing layer, 0.15 m;
- The sum of the initial thicknesses of the cover, 0.05 m, and the primary contamination, 1.2 m, is greater than the thickness of the mixing layer, 0.15 m.

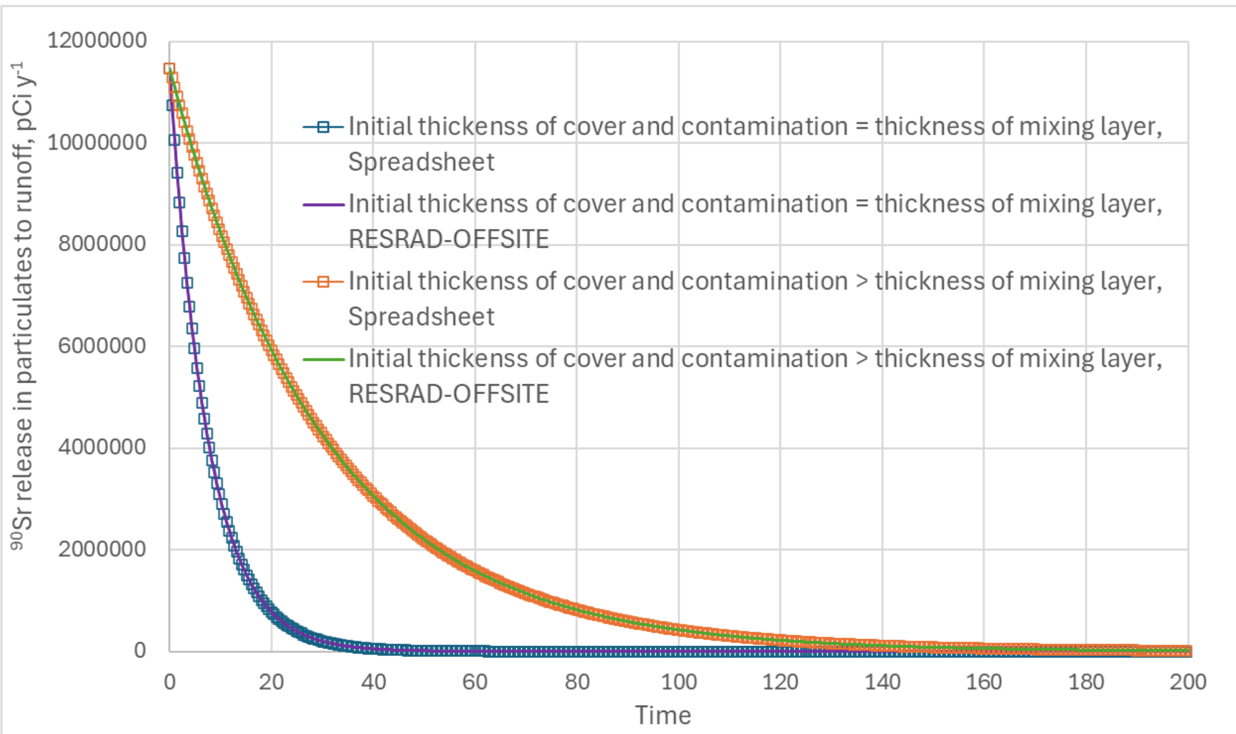

Figure 2.19 Temporal Variation of the Release of ^{90}Sr in Particulates Eroded and Carried Away by Runoff

The verification performed in this chapter provided the basis for the release testing of the primary contamination.

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3 VERIFICATION OF GROUNDWATER TRANSPORT FORMULATIONS

The longitudinal groundwater transport formulations in Version 2.5 of RESRAD-OFFSITE were verified in Chapter 3 of NUREG/CR-7038 (Yu et al. 2011). The basic longitudinal groundwater transport formulations in Version 2.5 are retained in Version 4.0 and applied to the contaminated layer in addition to the uncontaminated layers in the unsaturated and saturated groundwater transport layers. These groundwater transport formulations were reverified prior to release of Version 4.0 and are discussed in this section. The verification performed in this chapter provided the basis for the release testing of the groundwater transport.

3.1 GROUNDWATER TRANSPORT OF A TEMPORALLY DISTRIBUTED FLUX INPUT ACROSS THE UPGRADIENT SURFACE OF THE TRANSPORT ZONE

The formulations were verified for four different radionuclide transport velocities for eight radionuclides to cover a wide range of conditions. The inputs used to model the transport velocities in the transport zone are show in Table 3.1. The computed radionuclide transport velocities and dispersion coefficients are shown in Table 3.2. The half-life of the radionuclide is an argument of the formulation. The eight radionuclides in Table 3.3 were selected because they cover a wide range of half-lives. The formulations were verified using two triangular input fluxes as described in Chapter 3 of NUREG/CR-7038 (Yu et al. 2011) using the RESRAD-OFFSITE feature allowing overriding the internal release model and specifying the desired triangular fluxes instead.

Table 3.1 Inputs Used to Model the Radionuclide Transport Velocities and the Associated Dispersion Coefficients in the Unsaturated Zone for the Verification of Transport of Flux Inputs

	Case 1	Case 2		Case 3	Case 4
Characteristic			Value		
Precipitation rate, m y^{-1}			(1)[a,b]		
Runoff coefficient			(0.2)		
Irrigation applied per year, m			(0.2)		
Evapotranspiration coefficient			(0.5)		
Transport distance, m			(4)		
Saturated hydraulic conductivity, m y^{-1}			(10)		
Parameter b of Clapp-Hornberger equation			(5.3)		
Field capacity			(0.3)		
Total porosity			(0.4)		
Effective porosity			(0.2)		
Dry bulk density, g $(cm)^{-3}$			(1.5)		
Distribution coefficient, $(cm)^3$ g^{-1}	0	1		10	100
Time horizon, y	4	20		200	2000
Longitudinal dispersivity, m			(0.1)		
Number of calculation time points			(128)		

[a] Values in parenthesis are the default/placeholder values of RESRAD-OFFSITE.

[b] Values in the central column apply to all four cases.

Table 3.2 Radionuclide Transport Velocities and Dispersion Coefficients Used in Verification of Transport of Flux Inputs

	Case 1	Case 2	Case 3	Case 4
Computed Characteristic		Computed Value		
Darcy velocity, m y^{-1}		0.5[a]		
Saturation ratio		0.8023		
Total moisture content		0.3209		
Effective moisture content		0.1605		
Retardation factor	1	5.674	47.74	468.4
Advective contaminant transport velocity, m y^{-1}	3.116	0.5492	0.06527	0.006652
Dispersion coefficient of contaminant, m^2 y^{-1}	0.3116	0.0549	0.00653	0.000665
Advective travel time, y	1.28	7.28	61.3	601

[a] Values in the central column apply to all four cases.

Table 3.3 ICRP-38 Half-lives of Radionuclides Used in the Verification of Groundwater Transport

Radionuclide	^{60}Co	^{3}H	^{90}Sr	^{137}Cs	^{63}Ni	^{226}Ra	^{14}C	^{238}U
Half-life, y	5.271	12.35	29.12	30	96	1600	5730	4.468×10^{9}

The verification of the longitudinal transport of the flux inputs of the eight radionuclides at the upgradient surface are illustrated in Figure 3.1 through Figure 3.4 for the four cases. The advective velocity and the dispersion coefficient for these cases are in Table 3.2. As seen in Figure 3.1, the loss due to radiological transformations is not sufficient to make a noticeable shift in the time of the peaks of the curves at the high transport velocity and dispersion of Case 1. But the effect of the loss is reflected in the progressive lowering of the peak in the eight plots in the figure. The forward shift of the time of the peak of the ^{60}Co curve in Figure 3.2, due to the increasing loss from radiological transformations over time, is noticeable at the transport velocity and dispersion of Case 2. The forward shifts of the times of the peaks in the ^{60}Co and ^{3}H curves in Figure 3.3, due to the increasing loss from radiological transformations over time, are noticeable at the transport velocity and dispersion of Case 3.

There is very good agreement between the spreadsheet calculated transfer rates and the transfer rates output by RESRAD-OFFSITE for the four longer-lived radionuclides ^{238}U, ^{14}C, ^{226}Ra, and ^{63}Ni at the transport velocity and dispersion of Case 4. There is very good agreement between the spreadsheet calculated transfer rates and the transfer rates output by RESRAD-OFFSITE for the two radionuclides with half-lives that are approximately one twenty-fifth of the width of the peak with no decay, ^{137}Cs and ^{90}Sr, over most of the time range. But the spreadsheet calculated curves in Figure 3.4 are smooth at and near the initial part, while the RESRAD-OFFSITE curves are sharp and lag the spreadsheet curves initially. The formulations implemented in RESRAD-OFFSITE are truncated at four "dispersion standard deviations," $\sqrt{\frac{2\theta_a D t}{\theta_c + K_d \rho_b}}$, on either side of the advective travel distance to ensure the accuracy of the final results by using only the precise digits of intermediate quantities. This was not implemented in the spreadsheet calculations, leading to smoother curves initially, but also to some negative results initially, too. Negative results can occur when the imprecise digits of the intermediate calculations influence the final results. Thus, the need to truncate in the coding.

There are significant differences between the spreadsheet calculated curves and the RESRAD-OFFSITE curves for ^{3}H and for ^{60}Co, radionuclides with half-lives that are less than one-sixtieth of the width of the undecayed peak. This too is due to the truncation discussed in the previous paragraph. As seen from Figure 3.4, the rates at which these radionuclides exit the transport zone for these short-lived radionuclides diminished by nine and sixteen orders of magnitude over the large travel time in the transport zone. Thus, this truncation is not expected to have a practical impact on the conclusions derived from the output of RESRAD-OFFSITE.

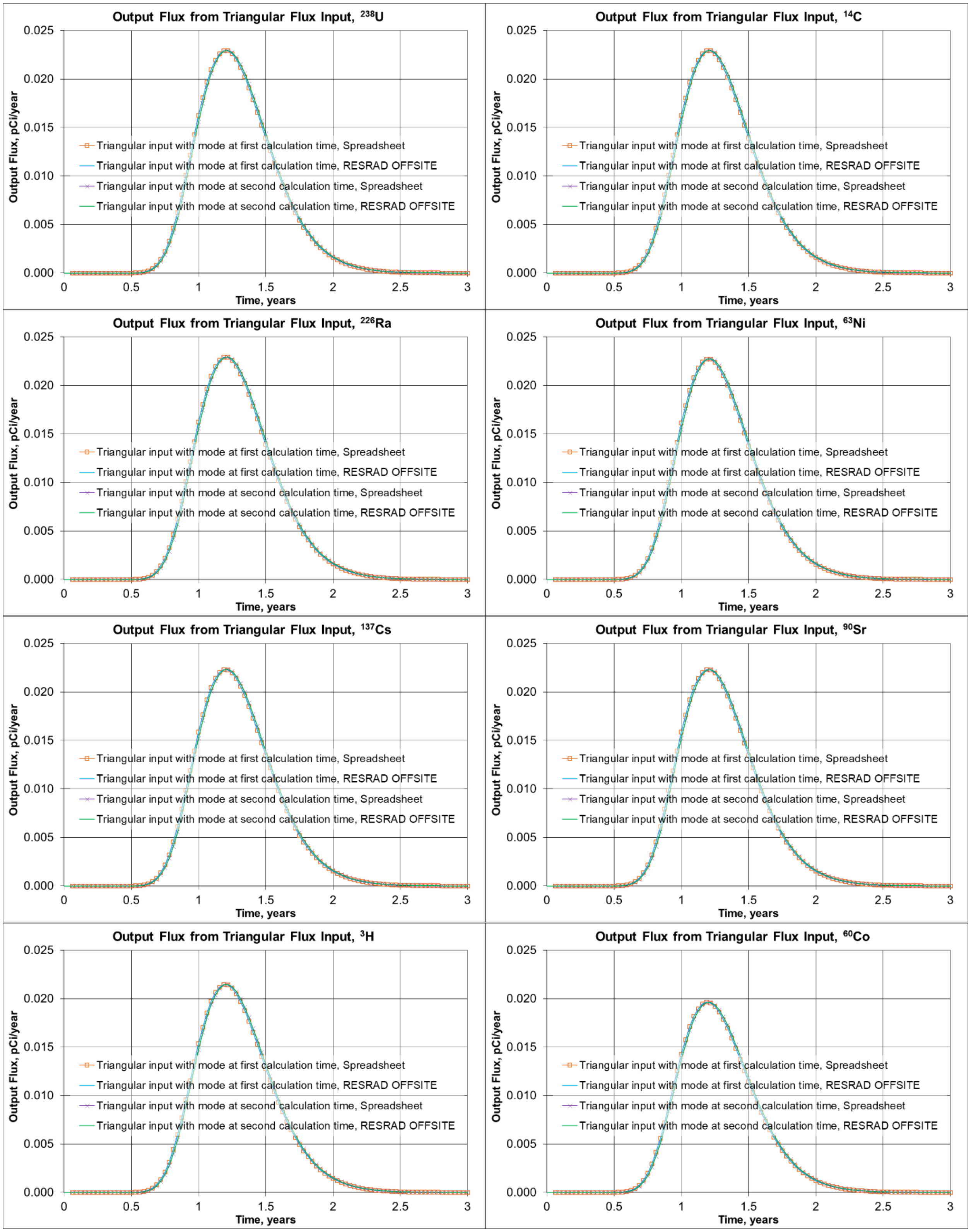

Figure 3.1 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Triangular Input Fluxes of the Same Radionuclides at the Upgradient Surface of the Transport Zone, Case 1

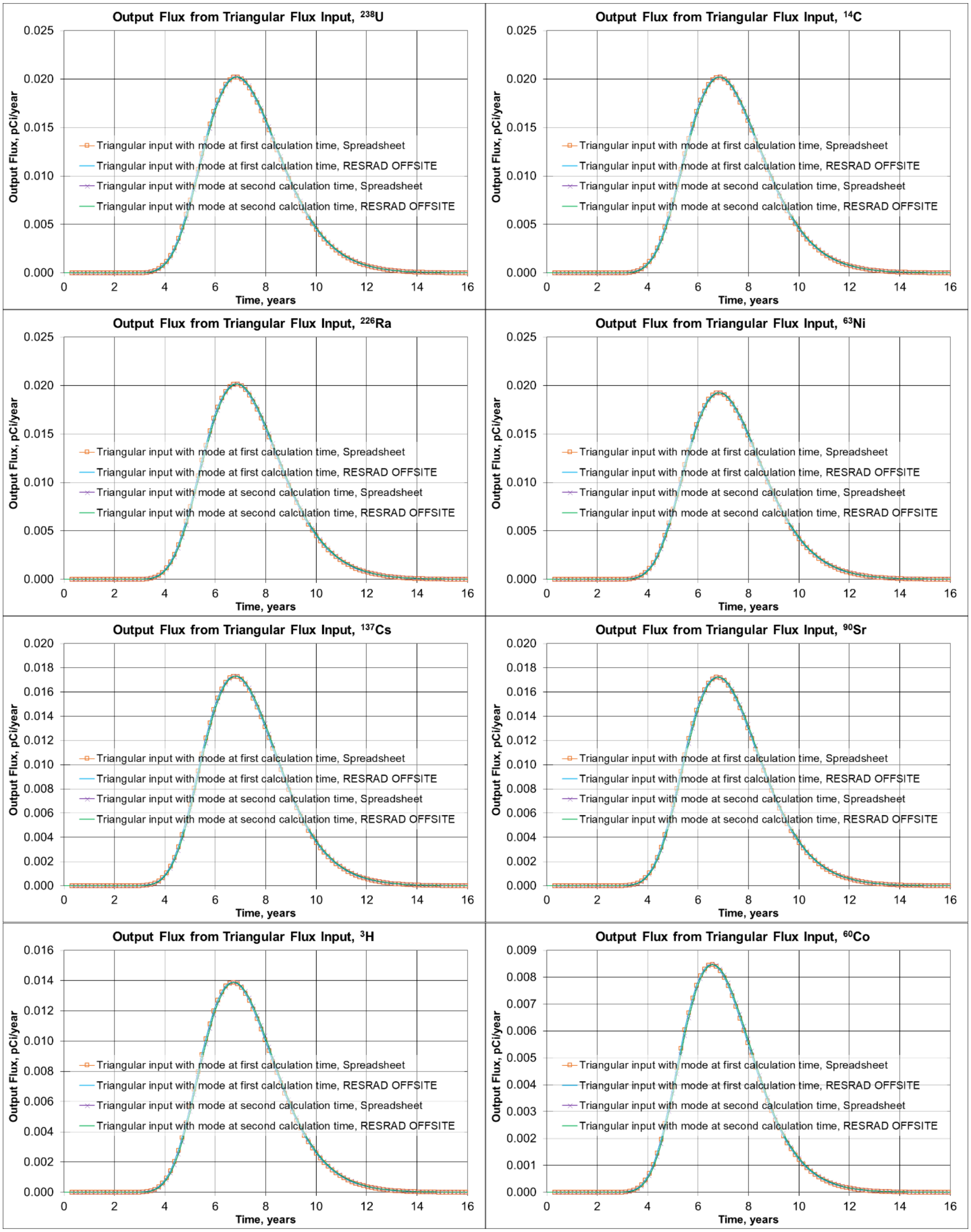

Figure 3.2 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Triangular Input Fluxes of the Same Radionuclides at the Upgradient Surface of the Transport Zone, Case 2

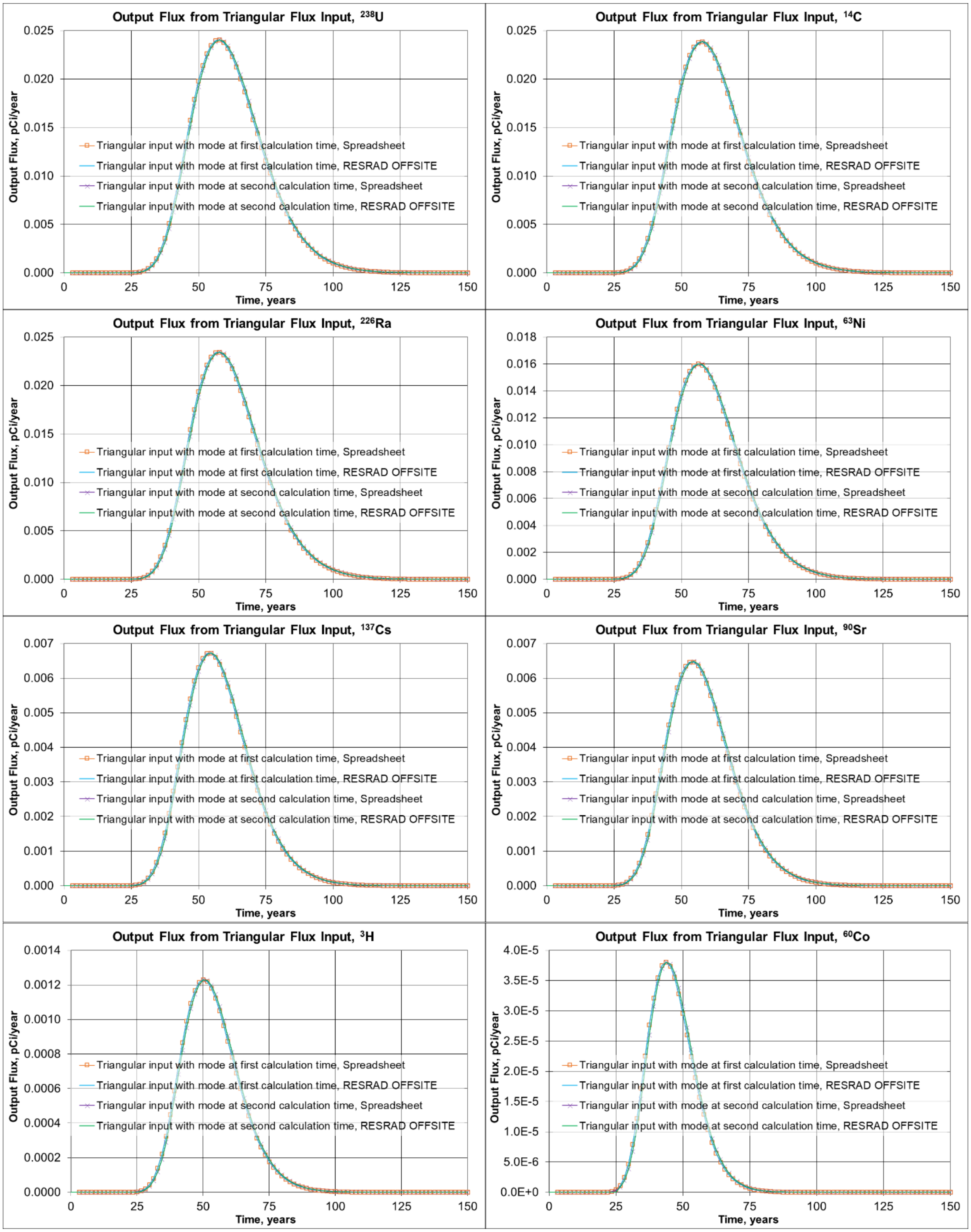

Figure 3.3 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Triangular Input Fluxes of the Same Radionuclides at the Upgradient Surface of the Transport Zone, Case 3

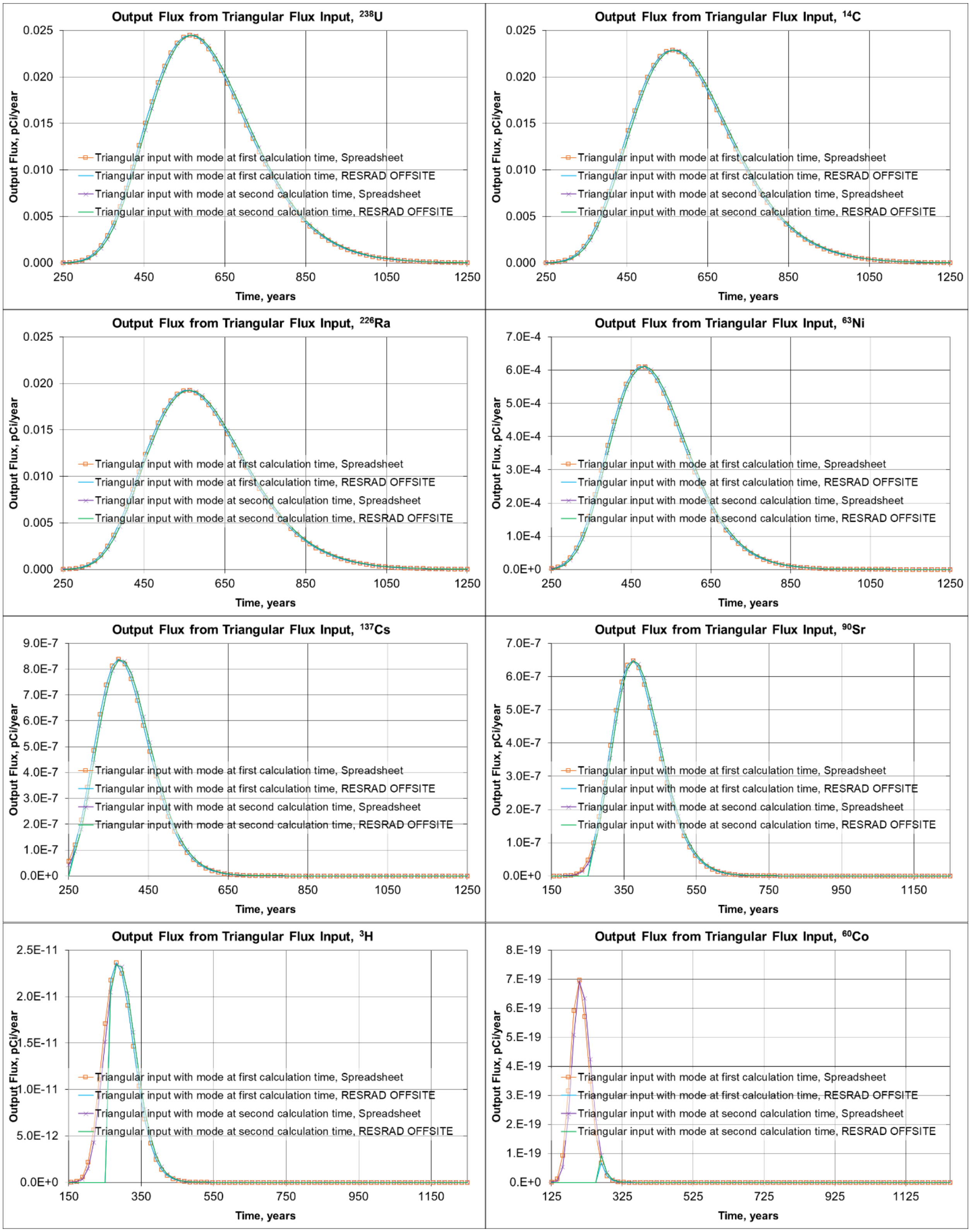

Figure 3.4 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Triangular Input Fluxes of the Same Radionuclides at the Upgradient Surface of the Transport Zone, Case 4

3.2 GROUNDWATER TRANSPORT OF A PULSE INPUT THAT IS DISTRIBUTED BOTH OVER TIME AND OVER A LENGTH OF THE TRANSPORT ZONE

The formulations were verified for three different radionuclide transport velocities for eight radionuclides to cover a wide range of conditions. The inputs used to model the transport velocities in the transport zone are shown in Table 3.4. The computed radionuclide transport velocities and dispersion coefficients are shown in Table 3.5. The eight radionuclides in Table 3.3 were used in this verification to cover a wide range of half-lives. The formulations were verified using two triangular input fluxes, as described in Chapter 3 of NUREG/CR-7038 (Yu et al. 2011), using the RESRAD-OFFSITE feature allowing overriding the internal release model and specifying the desired triangular pulses instead.

Table 3.4 Inputs Used to Model the Radionuclide Transport Velocities and the Associated Dispersion Coefficients in the Saturated Zone for the Verification of Transport of Temporally Distributed Pulse Inputs

	Case 1	Case 2	Case 3
Characteristic		Value	
Length of primary contamination, m		(100)[a, b]	
Width of primary contamination, m		(100)	
Saturated hydraulic conductivity, m y^{-1}		500	
Hydraulic gradient		(0.02)	
Precipitation rate, m y^{-1}		(1)	
Runoff coefficient		(0.2)	
Irrigation applied per year, m		(0.2)	
Evapotranspiration coefficient		(0.5)	
Total porosity		(0.4)	
Effective porosity		(0.2)	
Dry bulk density, g $(cm)^{-3}$		(1.5)	
Longitudinal dispersivity, m		20	
Lateral horizontal dispersivity, m		3	
Lateral vertical dispersivity, m		0.15	
Distribution coefficient, $(cm)^3$ g^{-1}	0	1	10
Time horizon, y	32	128	1024
Number of calculation time points		128	
Inputs for surface water body, used to verify the flux output:			
Distance from downgradient edge of contamination, m		800	
Distance from plume centerline to right edge, m		-150	
Distance from plume centerline to left edge, m		150	
Depth of aquifer intercepted, m		(5)	
Inputs for well, used to verify the concentration output:			
Distance from downgradient edge of contamination, m		800	
Distance from plume centerline, m		(0)	
Well pumping rate, m^3 y^{-1}		5100	
Depth of aquifer intercepted, m		5	

[a] Values in parenthesis are the default/placeholder values of RESRAD-OFFSITE.

[b] Single values in the central column apply to all three cases.

Table 3.5 Radionuclide Transport Velocities and Dispersion Coefficients Used in Verification of Transport of Pulse Inputs

Characteristic	Case 1	Case 2	Case 3
		Value	
Average transport distance, m		850[a]	
Darcy Velocity, m y^{-1}		10	
Infiltration rate, m y^{-1}		0.5	
Depth of penetration of the pulse input into the saturated zone, m		5	
Retardation factor	1	4.75	38.5
Contaminant transport velocity, m y^{-1}	50	10.53	1.299
Longitudinal dispersion coefficient of contaminant, m^2 y^{-1}	1000	210.6	25.97
Lateral horizontal dispersion coefficient of contaminant, m^2 y^{-1}	150	31.58	3.896
Lateral vertical dispersion coefficient of contaminant, m^2 y^{-1}	7.5	1.579	0.1948
Advective travel time, y	16-18	76–85.5	616-693
Time to peak output for ^{238}U, y	15.8	75.3	610
Time to peak output for ^{14}C, y	15.8	75.2	608
Time to peak output for ^{226}Ra, y	15.8	75.1	603
Time to peak output for ^{63}Ni, y	15.8	73.4	513
Time to peak output for ^{137}Cs, y	15.6	69.8	402
Time to peak output for ^{90}Sr, y	15.6	69.6	399
Time to peak output for ^{3}H, y	15.2	63.7	300
Time to peak output for ^{60}Co, y	14.5	54.3	212
Width of aquifer intercepted by well, m		51	

[a] Single values in the central column apply to all three cases.

The verifications of the longitudinal transport of a pulse input, distributed over a length of the transport zone, of the eight radionuclides are illustrated in Figure 3.5 through Figure 3.10 for the three cases. There are two figures for each case, one shows the verification of the rate at which the radionuclide exits the zone and the other shows the verification of the concentration in well water at the downgradient edge of the zone.

As can be seen in Figure 3.5 and Figure 3.6, these formulations for transport, capable of modeling the loss due to radiological transformations during advective-dispersive transport, show a noticeable shift in the times of the peaks of the curves for the two radionuclides with short half-lives, even at the high transport velocity and dispersion of Case 1. The loss is also reflected in the progressive lowering of the peak with decreasing half-life of the radionuclides in the eight plots in the figures. There is very good agreement between the spreadsheet calculations and the RESRAD-OFFSITE calculations for all 8 radionuclides in this case.

The forward shift of the time of the peak of the curves in Figure 3.7 and Figure 3.8, due to the increasing loss from radiological transformations over time, is noticeable for four of the eight radionuclides at the intermediate transport velocity and dispersion of Case 2. There is very good agreement between the spreadsheet calculations and the RESRAD-OFFSITE calculations for all eight radionuclides in this case, too.

There is very good agreement between the spreadsheet calculations and the RESRAD-OFFSITE calculations for four of the radionuclides, good agreement between the calculations for two of the radionuclides, and significant differences for two of the radionuclides at the low transport velocity and dispersion of Case 3, Figure 3.9 and Figure 3.10. This is similar to the observations at the low transport velocity and dispersion of Case 4 for the flux input in Section 3.1 and occurs for the same reason. As seen in Figure 3.9 and Figure 3.10, peaks for these short-lived radionuclides diminish by ten and seventeen orders of magnitude over the large travel time in the transport zone. Thus, this truncation is not expected to have a practical impact on the conclusions derived from the output of RESRAD-OFFSITE.

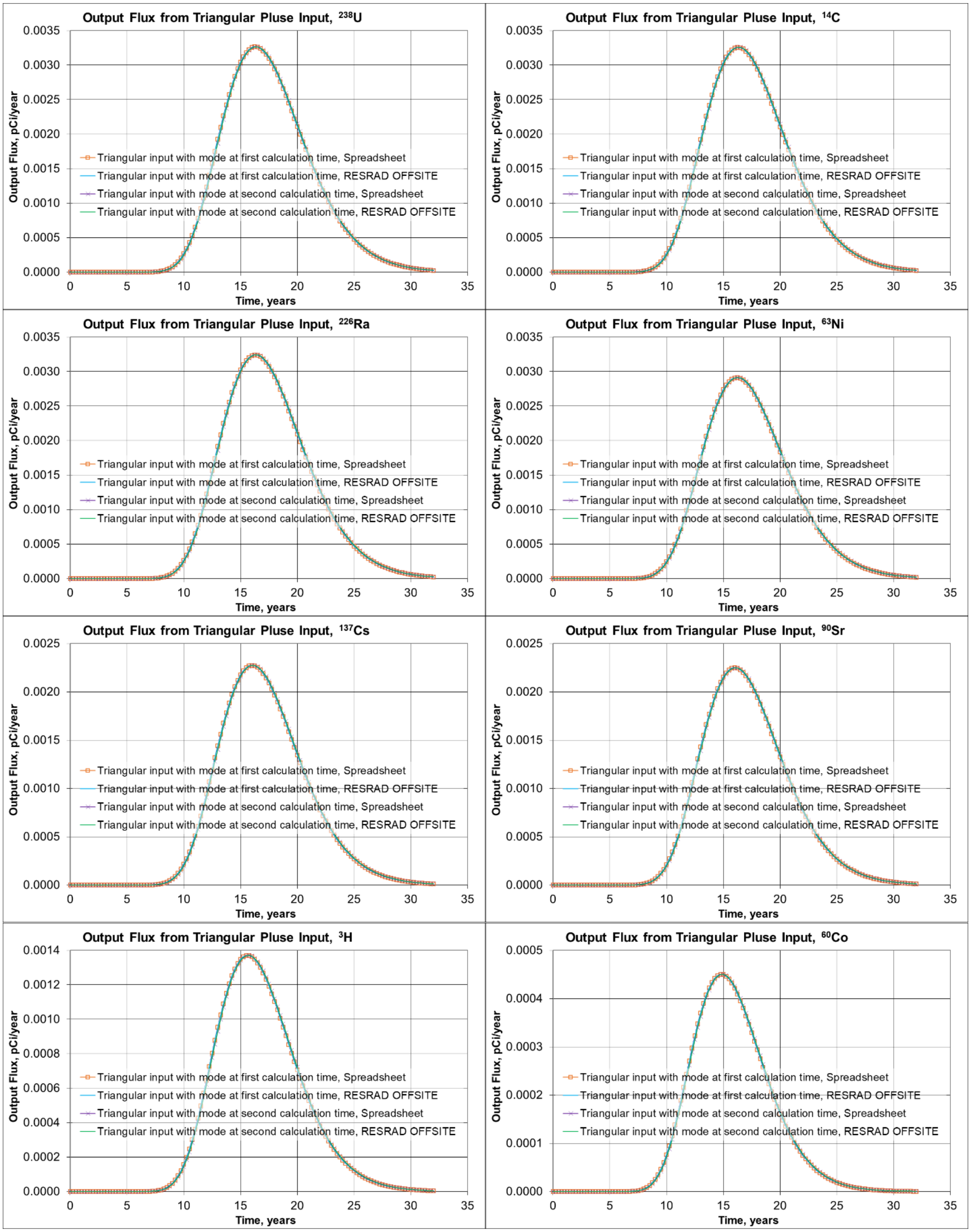

Figure 3.5 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Temporally Triangular Input Pulses of the Same Radionuclides Uniformly Distributed over an Upgradient Length of the Transport Zone, Case 1

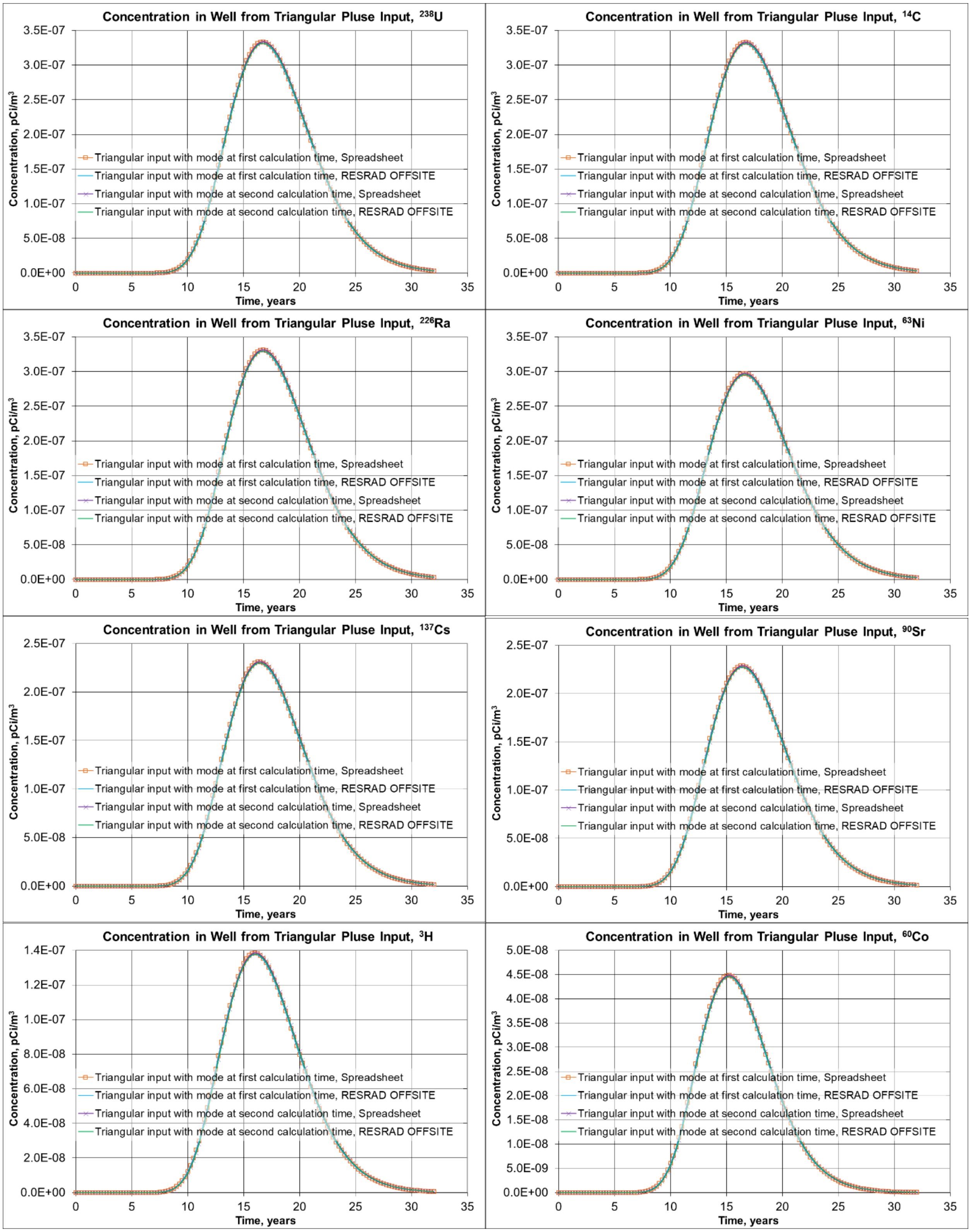

Figure 3.6 Temporal Variations of the Concentration of Radionuclides in Well Water Due to Temporally Triangular Input Pulses of the Same Radionuclides Uniformly Distributed over an Upgradient Length of the Transport Zone, Case 1

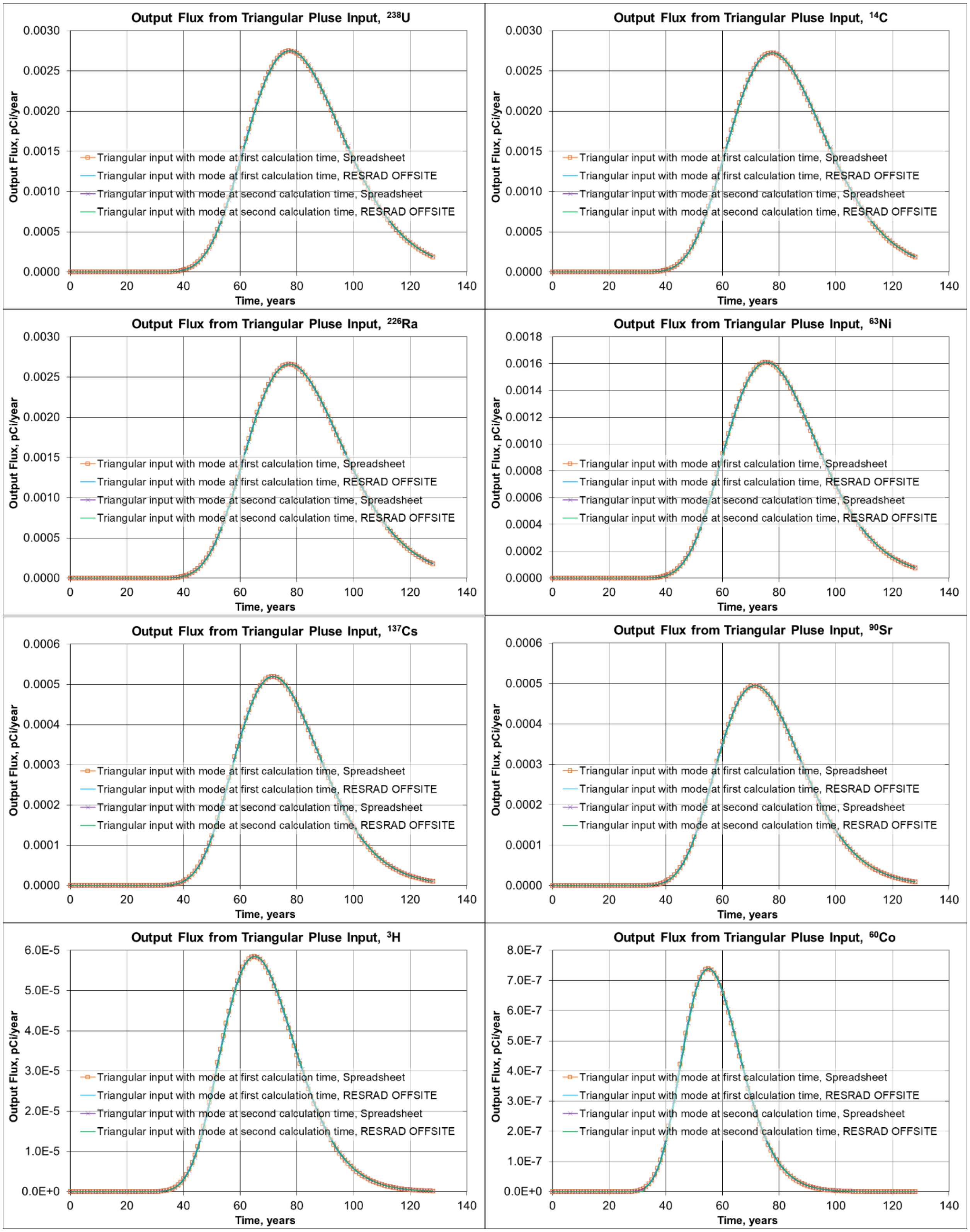

Figure 3.7 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Temporally Triangular Input Pulses of the Same Radionuclides Uniformly Distributed over an Upgradient Length of the Transport Zone, Case 2

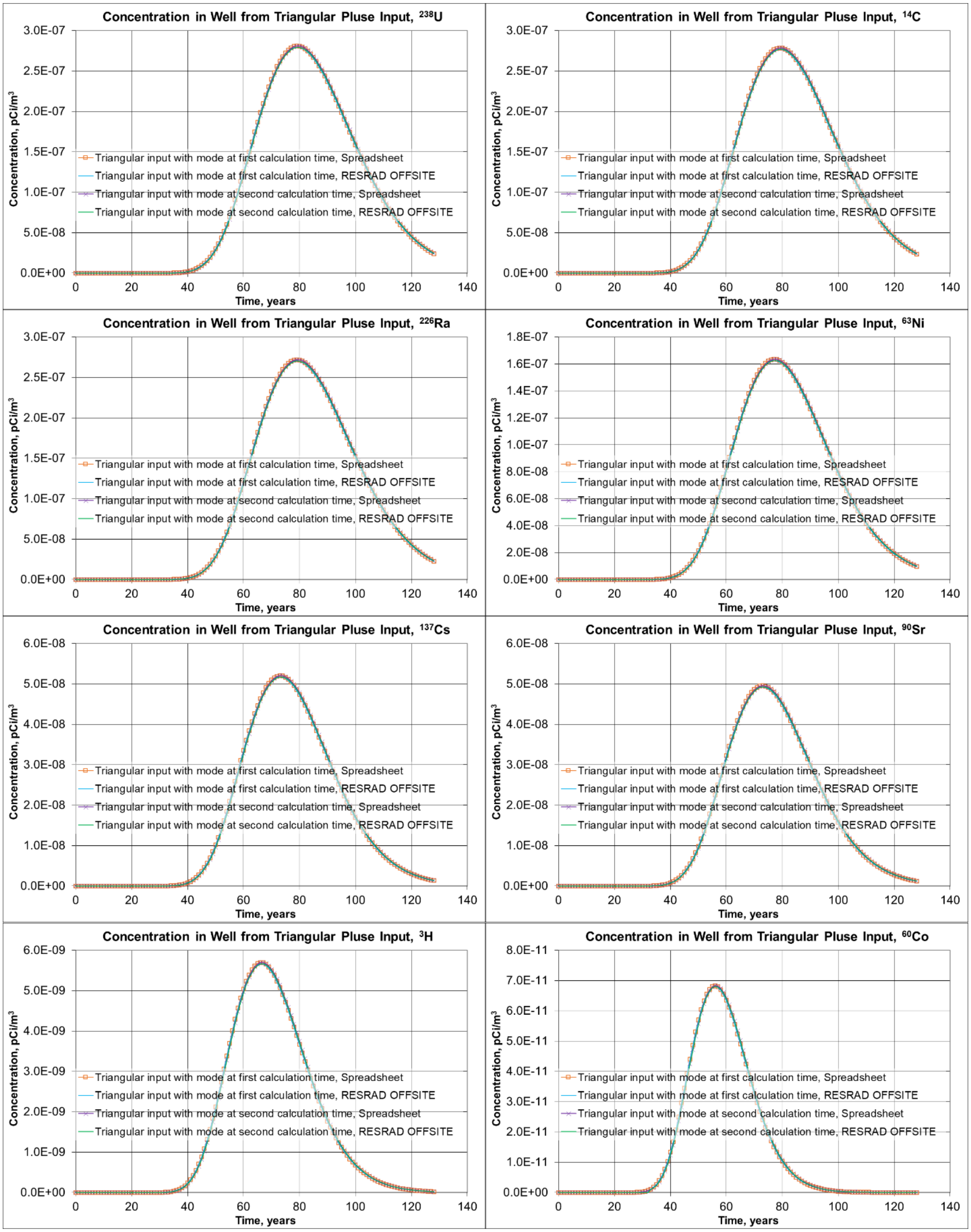

Figure 3.8 Temporal Variations of the Concentration of Radionuclides in Well Water Due to Temporally Triangular Input Pulses of the Same Radionuclides Uniformly Distributed over an Upgradient Length of the Transport Zone, Case 2

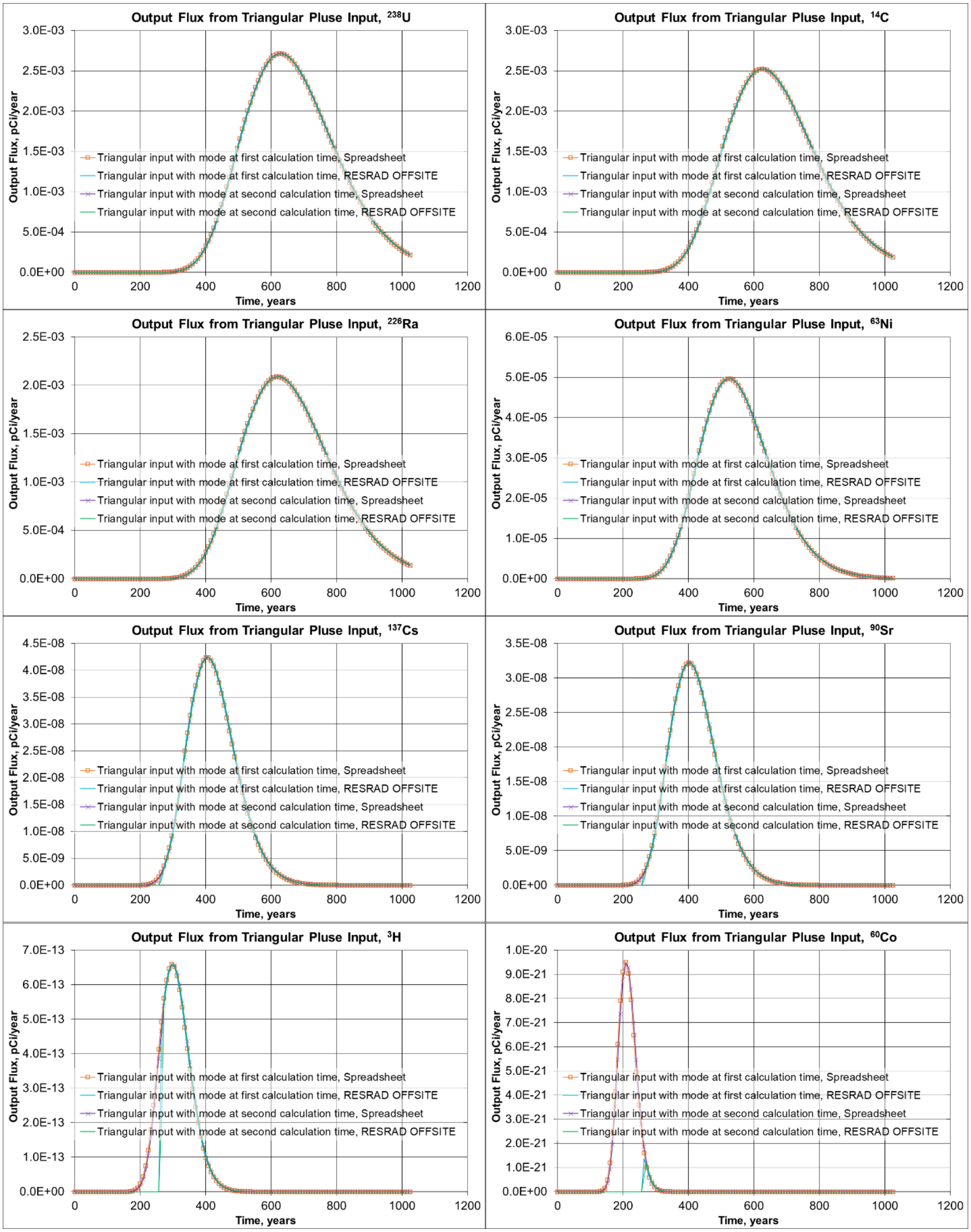

Figure 3.9 Temporal Variations of the Rates at which Radionuclides Exit a Transport Zone following Temporally Triangular Input Pulses of the Same Radionuclides Uniformly Distributed over an Upgradient Length of the Transport Zone, Case 3

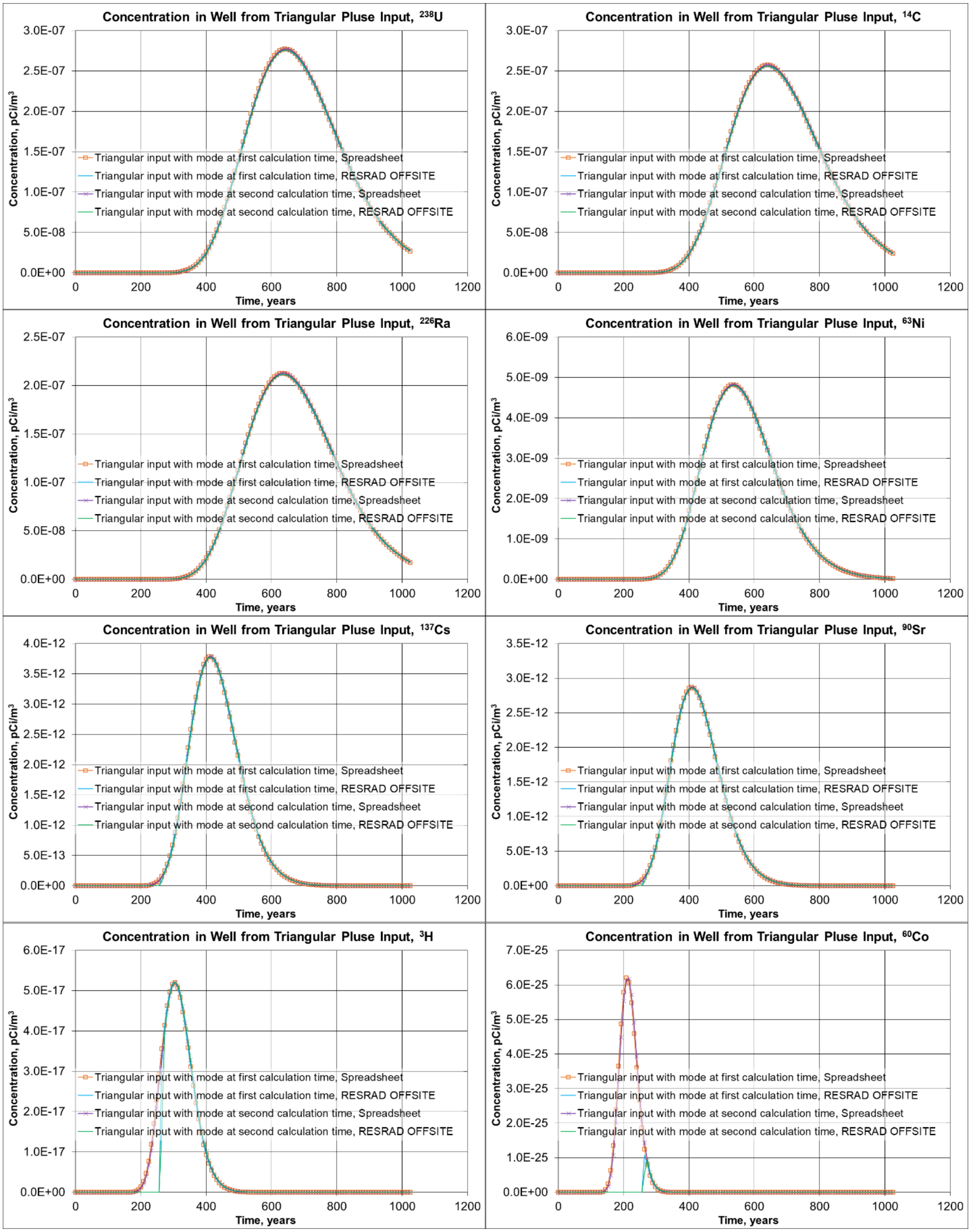

Figure 3.10 Temporal Variations of the Concentration of Radionuclides in Well Water Due to Temporally Triangular Input Pulses of the Same Radionuclides Uniformly Distributed over an Upgradient Length of the Transport Zone, Case 3

4 VERIFICATION OF ATMOSPHERIC TRANSPORT FORMULATIONS

The atmospheric transport formulations in Version 2.5 of RESRAD-OFFSITE were verified in Chapter 4 of NUREG/CR-7038 (Yu et al. 2011). These formulations are used in RESRAD-OFFSITE Version 4.0 to compute atmospheric transport to all offsite locations other than the watershed of the surface water body. A formulation capable of modeling atmospheric transport to receptor locations that overlap the primary contamination was added to RESRAD-OFFSITE in Version 4.0. These formulations are verified for RESRAD-OFFSITE 4.0 in Appendix 4 and are summarized in the second subsection that follows.

4.1 χ/Q AT OFFSITE LOCATIONS THAT DO NOT OVERLAP THE PRIMARY CONTAMINATION

The verification of the ratio of the concentration in air at the offsite location to the rate of release to the atmosphere, χ/Q or chi over Q, at five different locations, each under different atmospheric condition, is summarized in Figure 4.1. None of these five offsite locations overlap the primary contamination from which the particles containing the radionuclides are released.

4.2 DEPLETED SOURCE STRENGTH WITH DISTANCE OF ATMOSPHERIC TRANSPORT

The verifications of the depleted source strength, the fraction of the released material remaining in the plume, at distances ranging from 0 to 3000 m of transport distance are summarized in Figure 4.2 for depletion by dry deposition and in Figure 4.3 for depletion by wet deposition. Some of the locations overlap the primary contamination while others are outside the primary contamination. Each figure shows five curves, showing the verification at five different atmospheric conditions.

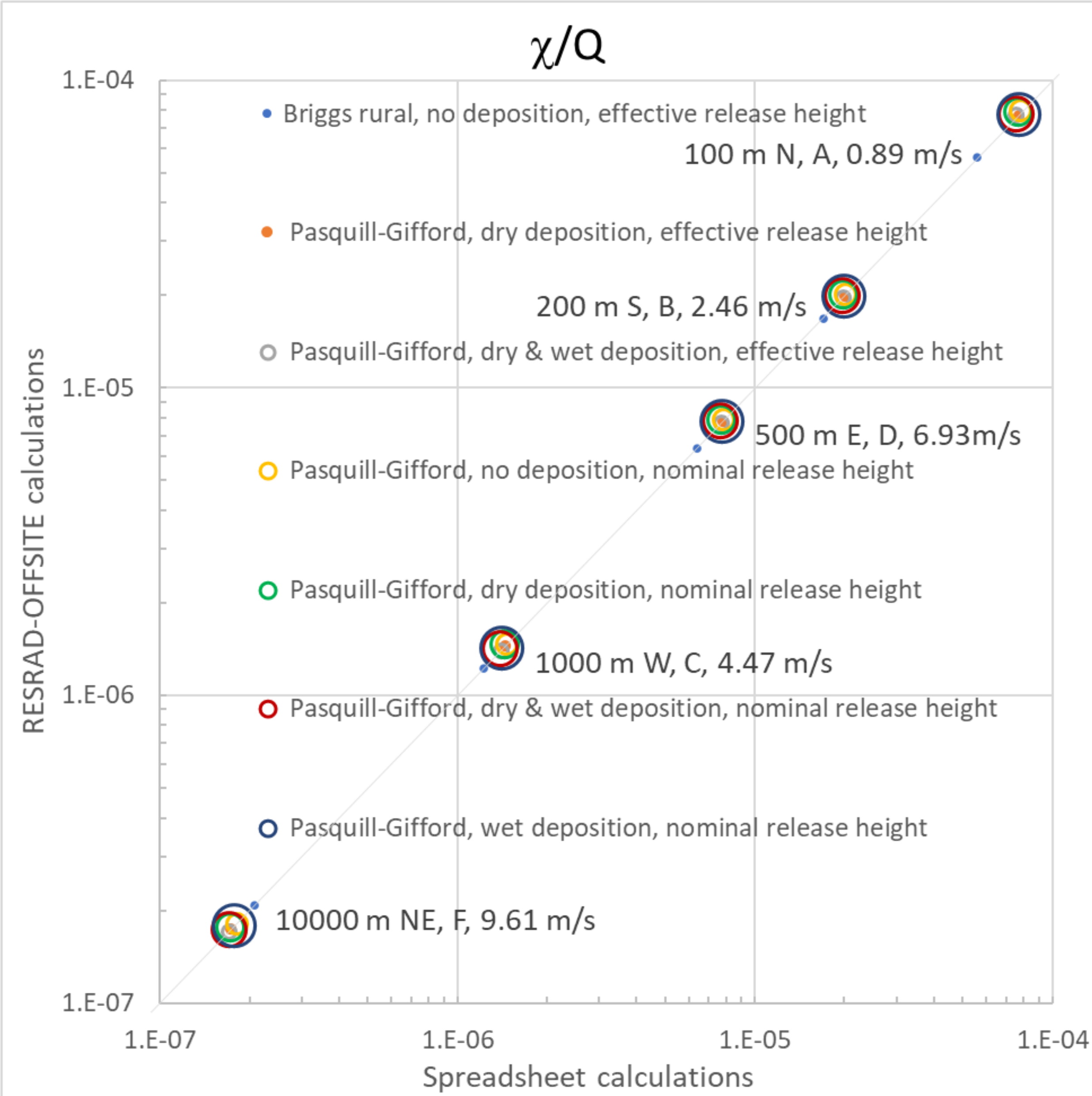

Figure 4.1 Summary of Chi over Q, (χ/Q), the Concentration to Release Ratio, under Different Conditions at Different Locations

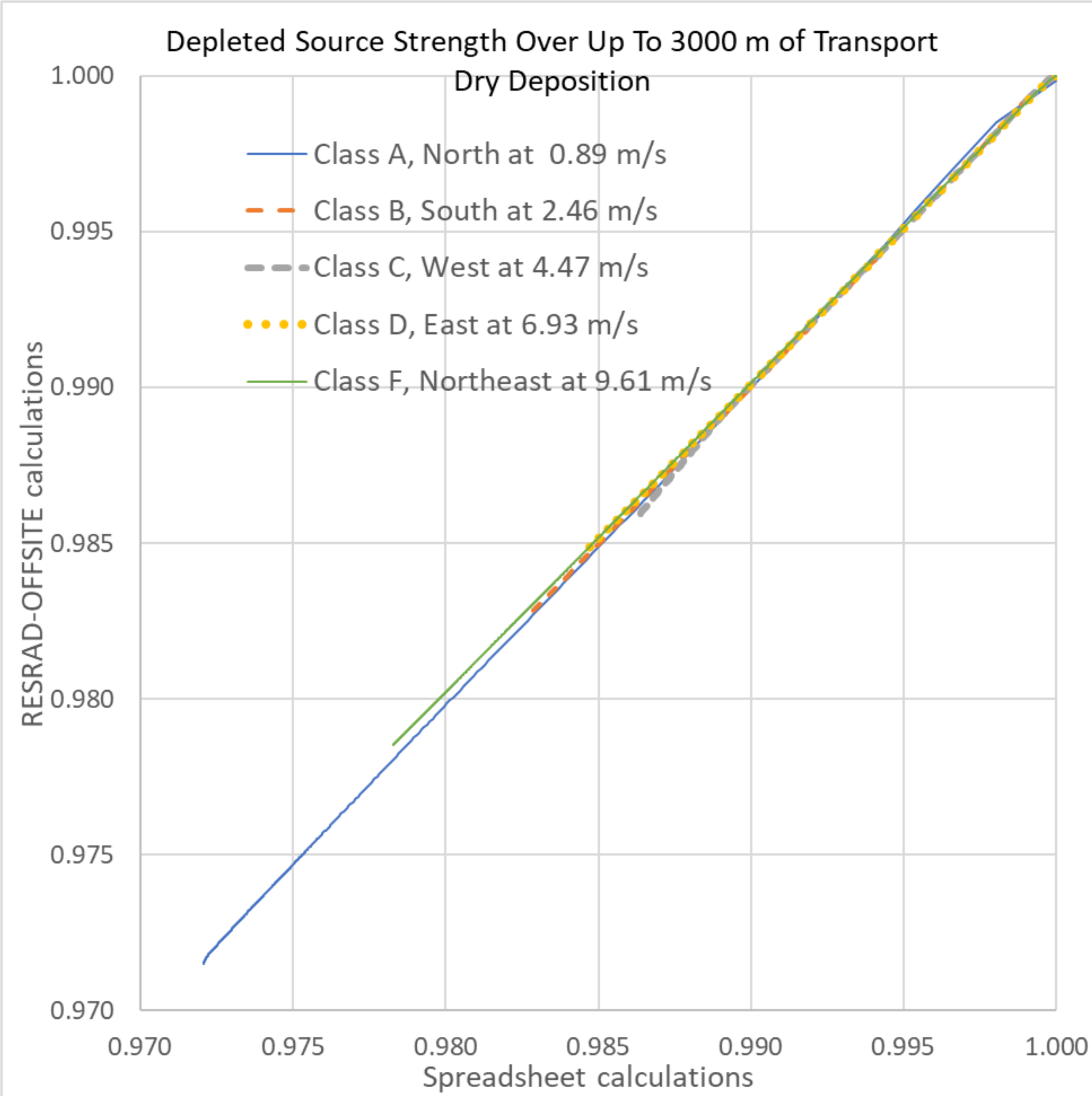

Figure 4.2 Depleted Source Strength over Distances of 0 to 3000 m under Different Conditions with Dry Deposition

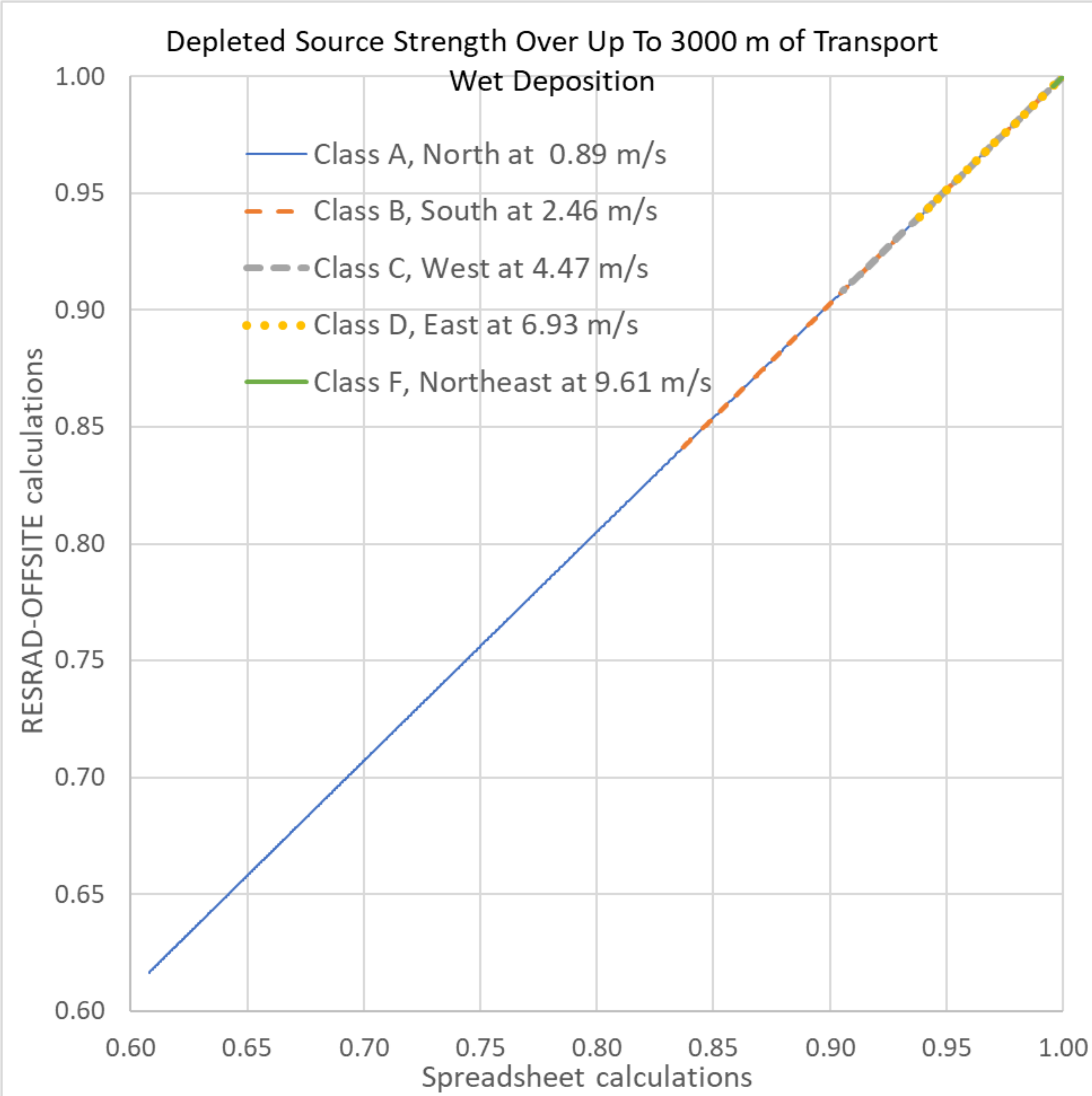

Figure 4.3 Depleted Source Strength Over Distances of 0 to 3000 m under Different Conditions with Wet Deposition

The verification performed in this chapter provided the basis for the release testing of the atmospheric transport.

5 VERIFICATION OF ACCUMULATION AT OFFSITE LOCATIONS

The formulations for the accumulation at offsite locations in Version 2.5 of RESRAD-OFFSITE were verified in Chapter 5 of NUREG/CR-7038 (Yu et al. 2011). The formulation in RESRAD-OFFSITE Version 4.0 for the accumulation in land-based offsite locations includes input of radionuclides that deposit from particles carried by runoff. The surface water body accumulation model was updated in RESRAD-OFFSITE 4.0. The verification performed in this chapter provided the basis for the release testing of the accumulation at offsite locations.

5.1 ACCUMULATION IN SURFACE WATER BODY

The pre-release verification of the new surface water body model in Version 4 of the code is described in Appendix 5 and is summarized in this sub-section. Figure 5.1 and Figure 5.2 illustrate the verification of the concentration of ^{99}Tc in surface water resulting from the influx of ^{99}Tc by all four transport pathways included in the new model:

- Deposition of material eroded from the primary contamination carried by runoff.
- Deposition of airborne material on the surface water body.
- Washout of airborne material that was deposited on the catchment/watershed.
- ^{99}Tc leached from the primary contamination by infiltration to groundwater that is intercepted by the surface water body.

The influx with groundwater dominates in Figure 5.1. Figure 5.2 shows the verification when the other three transport pathways make an appriciable contribution. Figure 5.3 illustrates the verification of the concentration of ^{234}U in surface water resulting from the influx of ^{234}U by the first three transport pathways. Figure 5.4 shows the verification of the concentration of ^{90}Sr in surface water that was carried out as part of the verification of dose from the ingestion pathways.

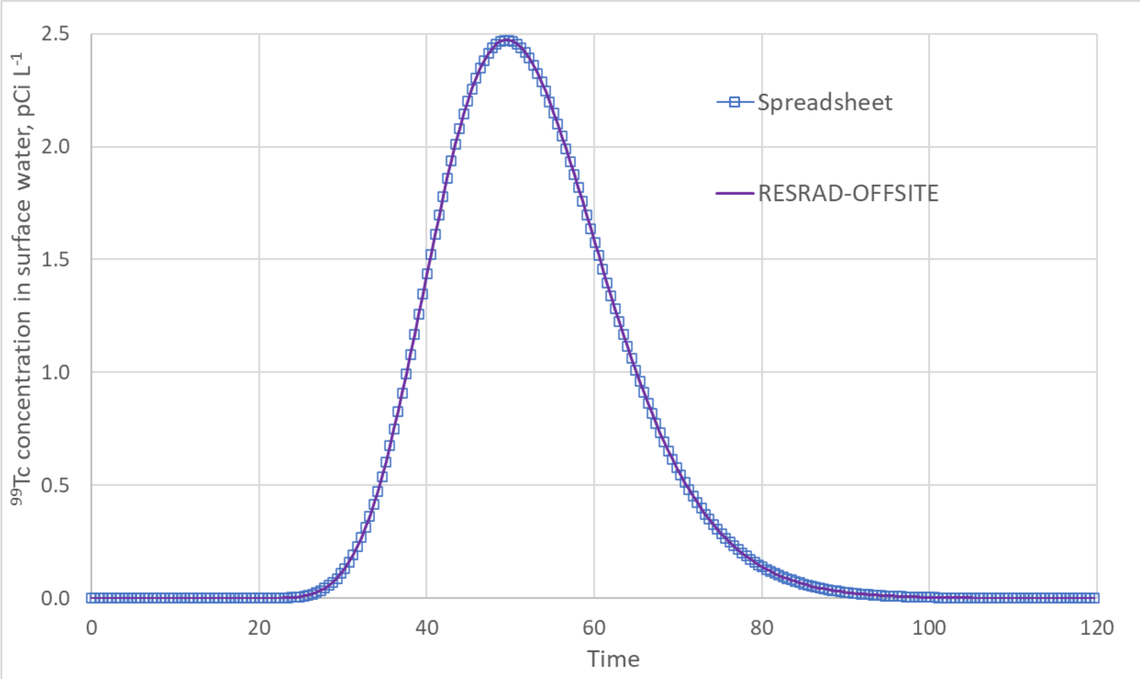

Figure 5.1 Temporal Variation of the Concentration of ^{99}Tc in Surface Water Primarily Due to Influx of ^{99}Tc Carried by Groundwater Infiltrating through Primary Contamination and Flowing into the Surface Water Body

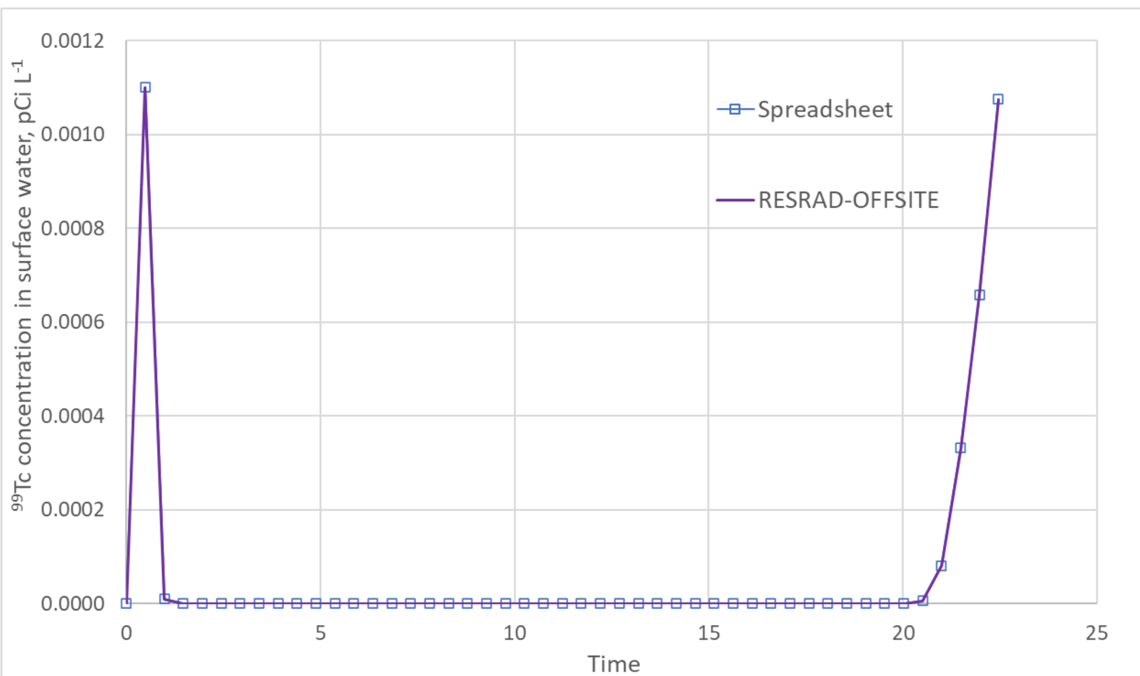

Figure 5.2 Temporal Variation of the Concentration of ^{99}Tc in Surface Water Due to Influx of ^{99}Tc Carried by Eroded Material into the Surface Water Body, Atmospheric Deposition on the Surface Water Body, and Washout of Atmospheric Deposition on the Catchment and by Groundwater, before the Groundwater Contribution Dominates

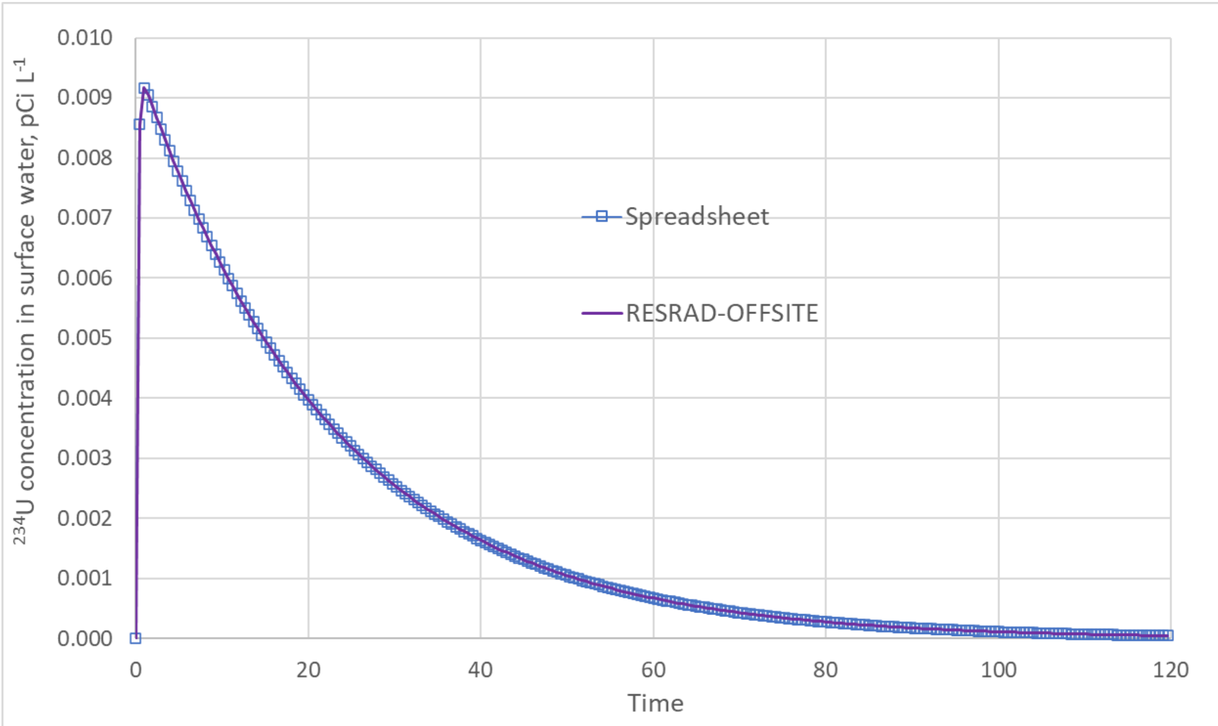

Figure 5.3 Temporal Variation of the Concentration of ^{234}U in Surface Water Due to Influx of ^{234}U Carried by Eroded Material into the Surface Water Body, Atmospheric Deposition on the Surface Water Body, and Washout of Atmospheric Deposition on the Catchment

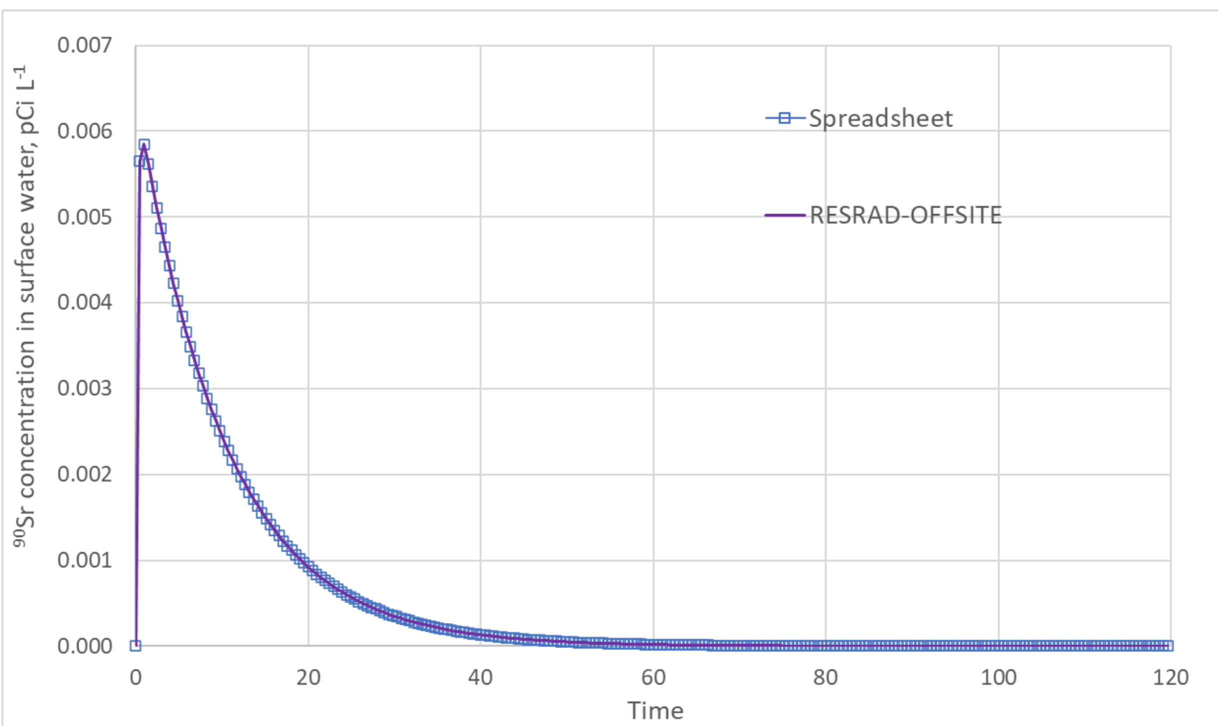

Figure 5.4 Temporal Variation of the Concentration of ^{90}Sr in Surface Water

5.2 ACCUMULATION IN OFFSITE SOILS

The pre-release verification of the accumulation model for offsite soils in Version 4 of the code is described in Appendix 6 and is summarized below.

- Figure 5.5 illustrates the verification of the concentration of four radionuclides in soil, each at different offsite locations, resulting from the influx of radionuclides by all three transport pathways:
  - Deposition of material eroded from the primary contamination carried by runoff.
  - Deposition of airborne material.
  - Irrigation with water from the well and or the surface water body.

- Figure 5.6 shows the verification of the concentration of ^{14}C in soil at an offsite location due to each of the three radionuclide transport pathways listed above.

- Figure 5.7 shows the verification of the concentration of ^{90}Sr in soil at four offsite locations from the influx of ^{90}Sr by all three transport pathways listed above. This was part of the verification of the dose from the ingestion pathways.

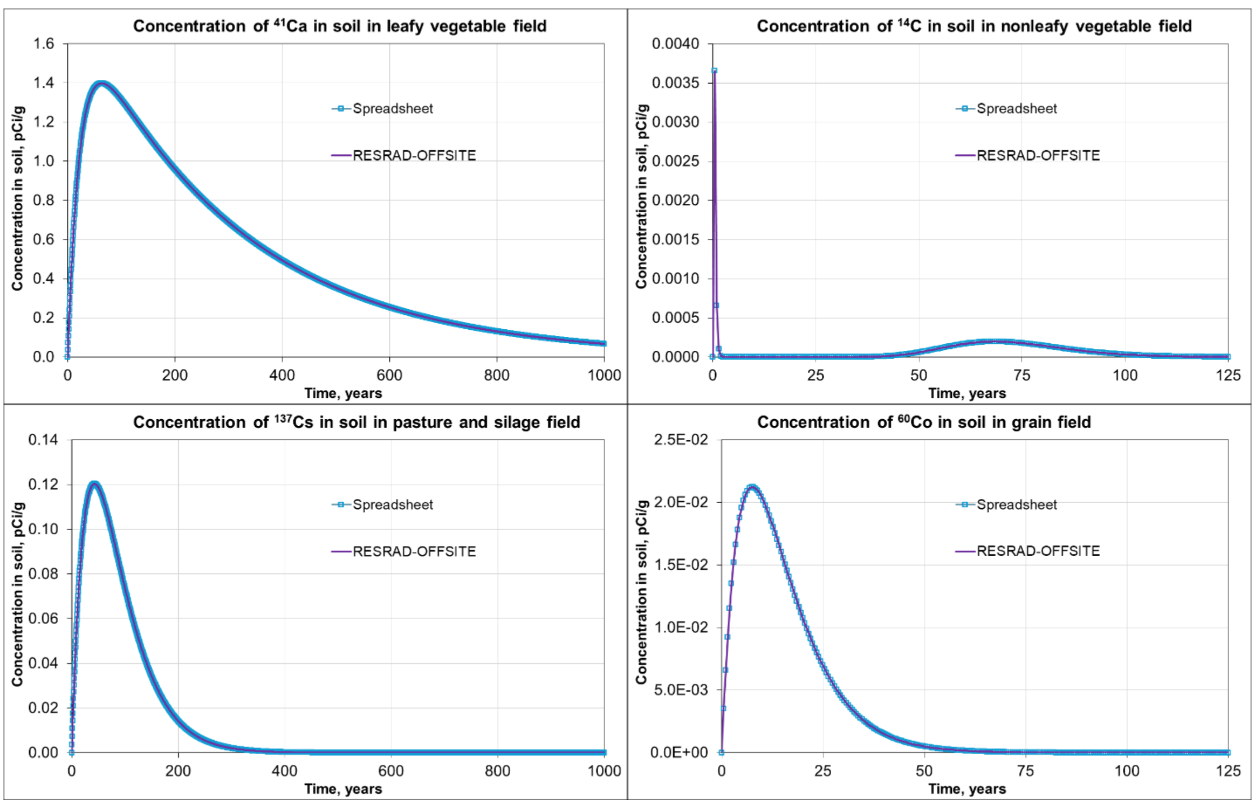

Figure 5.5 Temporal Variation of Concentration of Radionuclides in Offsite Soils

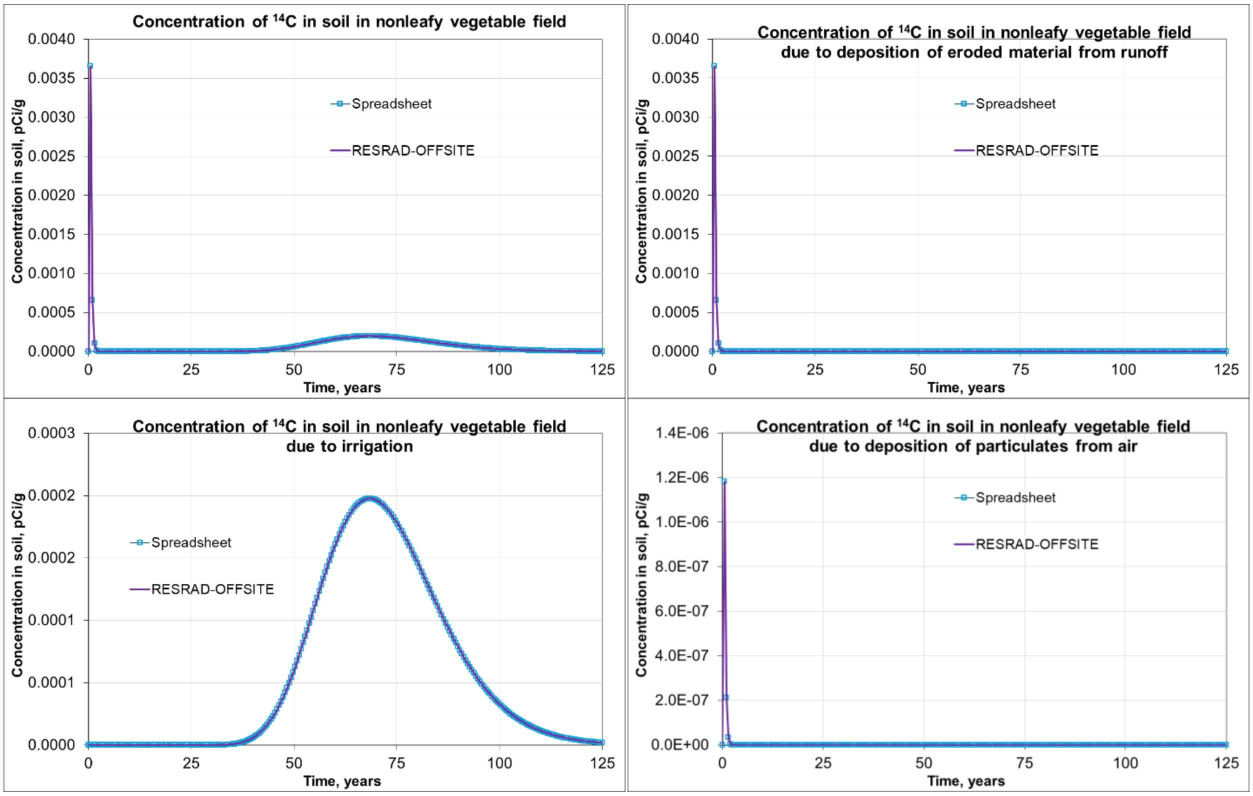

Figure 5.6 Temporal Variation of ^{14}C Concentration in Offsite Soil Due to the Three Different Radionuclide Transport Pathways

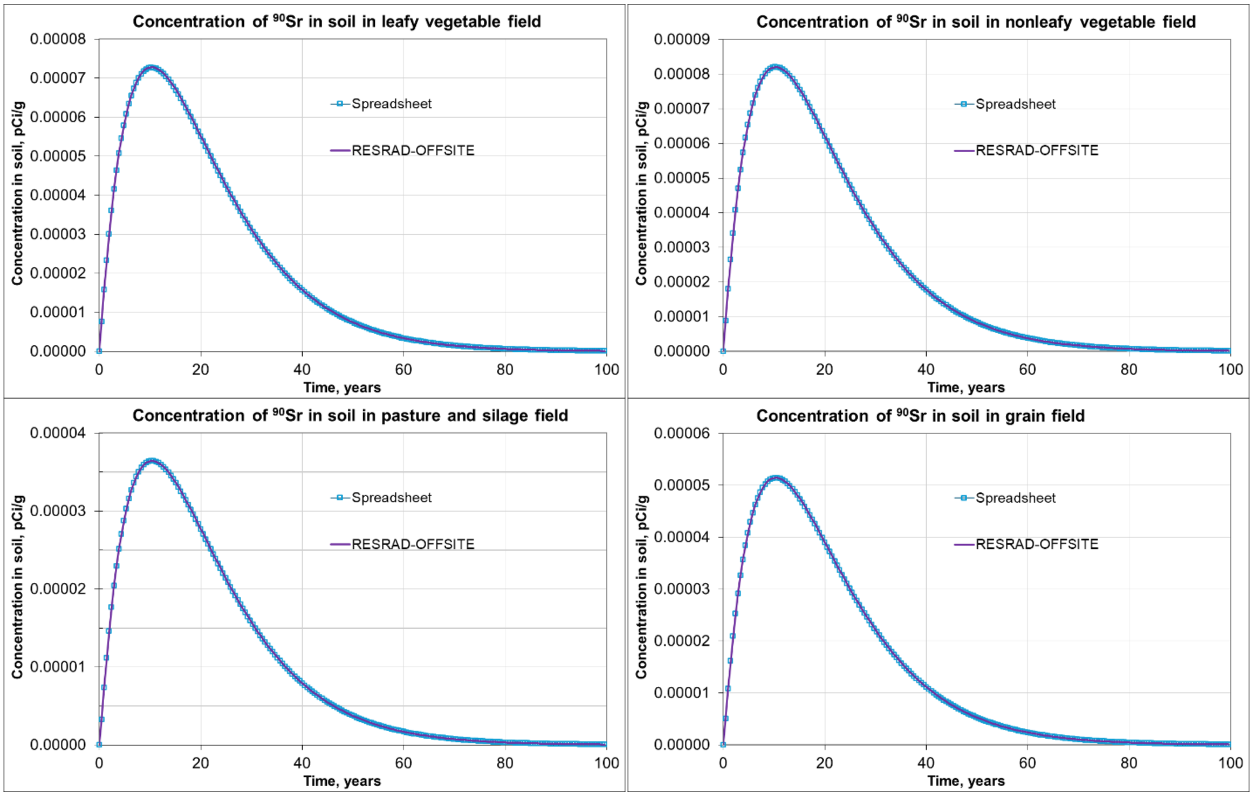

Figure 5.7 Temporal Variation of Concentration of ^{90}Sr in Soil at Four Different Offsite Locations

6 VERIFICATION OF TRANSFER AND ACCUMULATION IN PLANT FOOD, ANIMAL FEED, MEAT, MILK, AND AQUATIC FOOD

The concentration of ^{90}Sr in food ingested by the receptor and in animal feed was verified during the pre-release verification of the dose from the ingestion pathways. This was performed as outlined in Chapter 5 of NUREG/CR-7038 (Yu et al. 2011).

- The verification of concentration of ^{90}Sr in plant food and in animal feed at the time of harvest is shown in Figure 6.1.
- The radionuclides are transferred to different parts of the plant by three transport pathways:
    - Foliar interception of particulates followed, if necessary, by translocation to the part that is ingested.
    - Foliar interception of irrigation water followed, if necessary, by translocation to the part that is ingested.
    - Root uptake from accumulation in the agricultural land.
- In this case, the concentrations in the leaf are dominated by the sum of the two foliar interception transport pathways, while the concentrations in the other parts of the plant are dominated by root uptake from accumulation in soil. This leads to the two different temporal profiles seen in Figure 6.1.

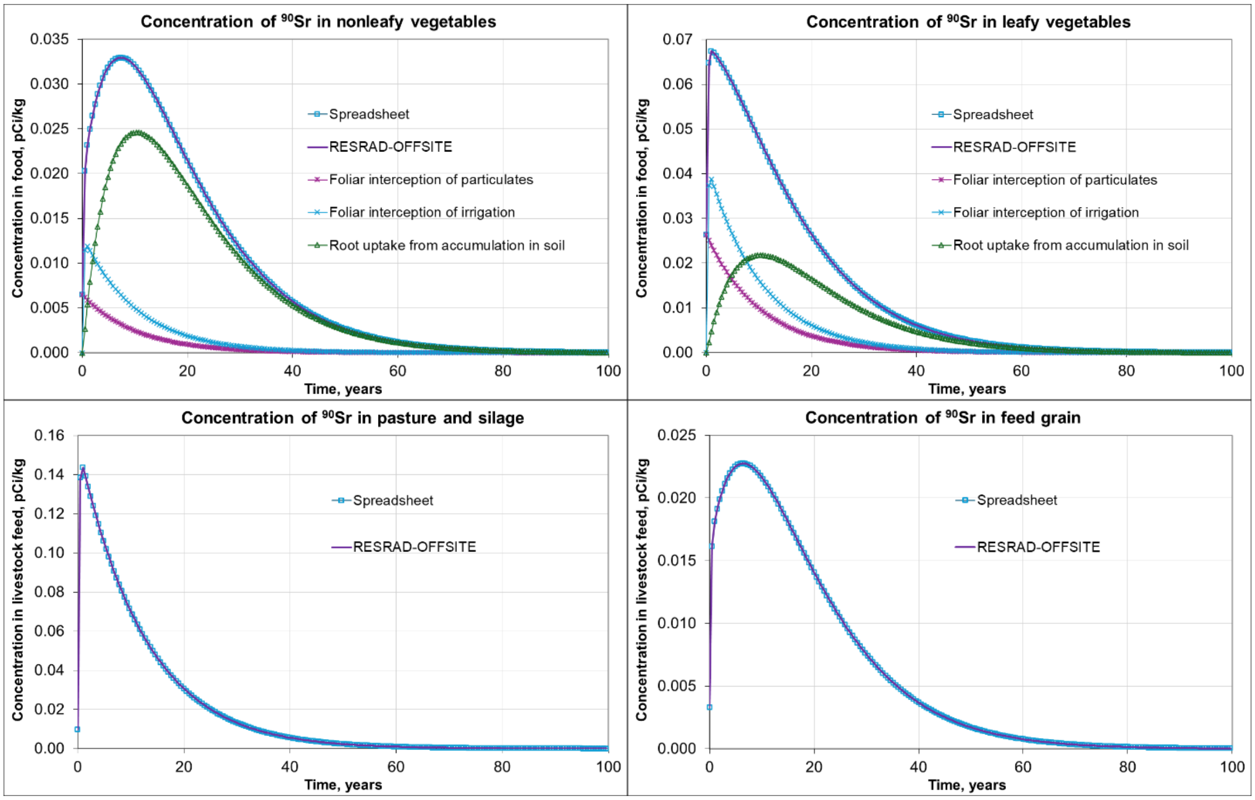

Figure 6.1 Temporal Concentration of ^{90}Sr in Plant Food and Animal Feed

The verification of concentration of ^{90}Sr in meat and milk at the time of harvest is shown in Figure 6.2.

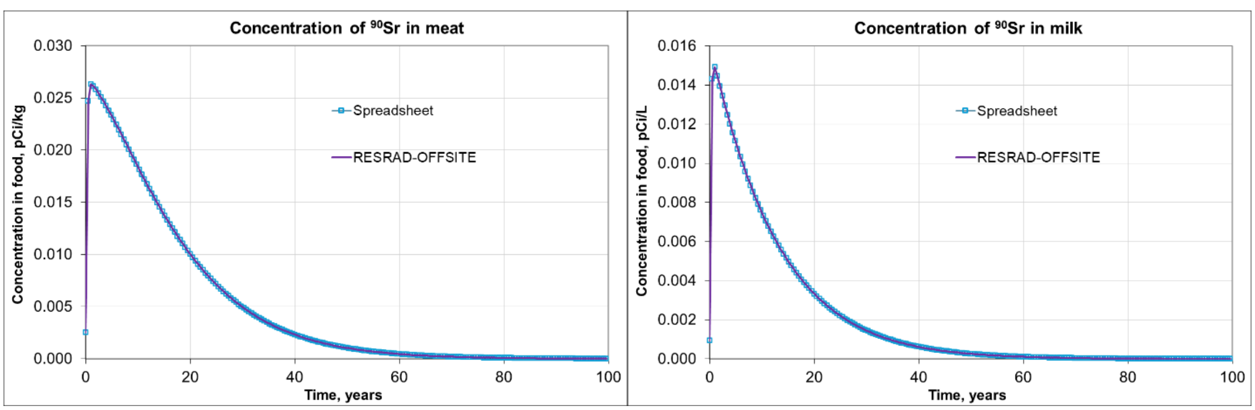

Figure 6.2 Temporal Concentration of ^{90}Sr in Meat and Milk

The verification of the concentration of ^{90}Sr in fish, crustacea, and mollusks at the time of harvest is shown in Figure 6.3.

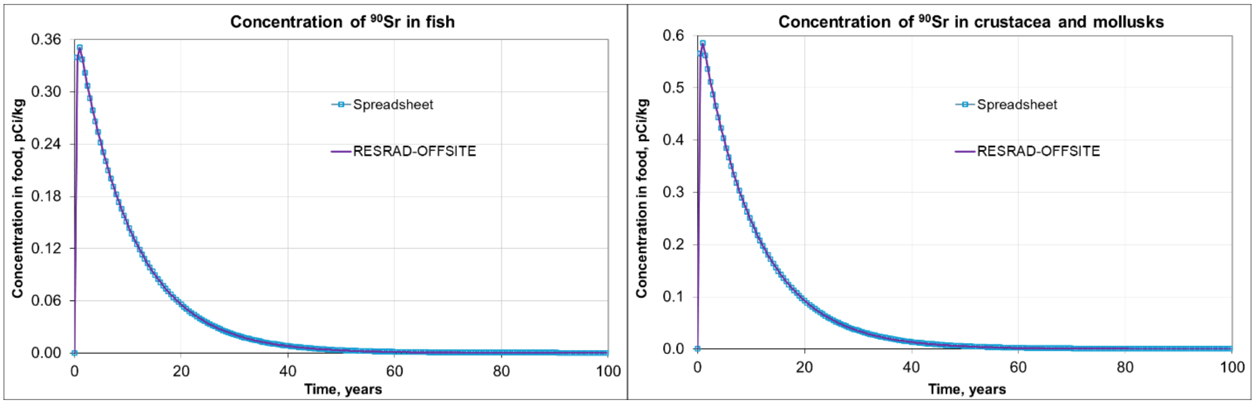

Figure 6.3 Temporal Concentration of ^{90}Sr in Fish, Crustacea, and Mollusks

The verification performed in this chapter and the next provided the basis for the release testing of the concentrations in vegetables, livestock feed, meat, and milk.

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7 VERIFICATION OF RADIOLOGICAL DOSE FROM THE INGESTION PATHWAYS

The pre-release verification of the dose from the ingestion pathways and the incidental soil ingestion pathway of Version 4.0 of RESRAD-OFFSITE are described in Appendix 7 and Appendix 8 respectively. The verification of the ingestion pathways, summarized below, provided the basis for the release testing of the ingestion pathways.

- Figure 7.1 shows the verification of the ^{90}Sr dose from the five ingestion sub-pathways.
- Figure 7.2 shows the verification of the dose from the soil ingestion pathway.

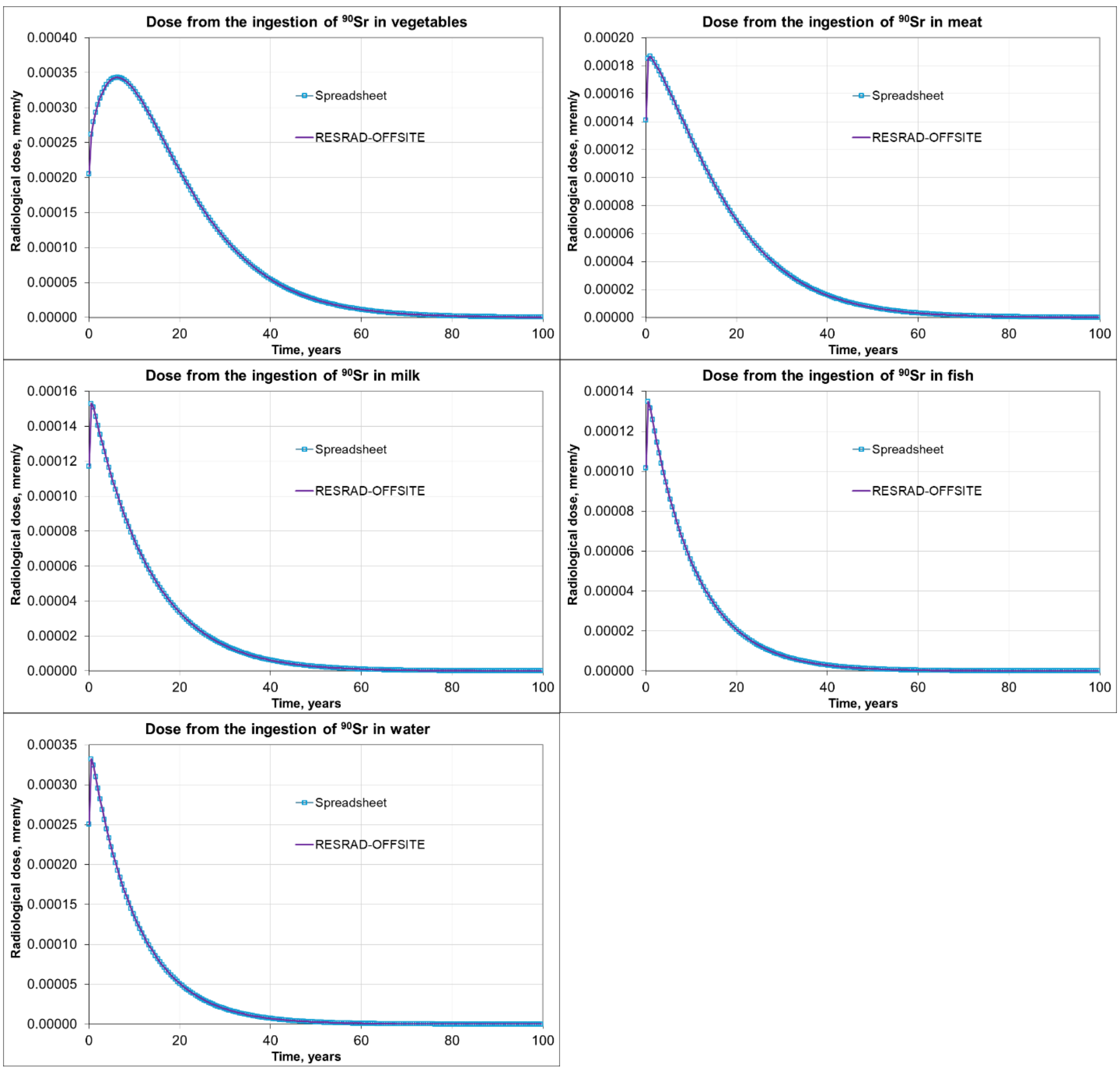


Figure 7.1 Temporal Variation of Dose from the Ingestion of ^{90}Sr in Food and Water

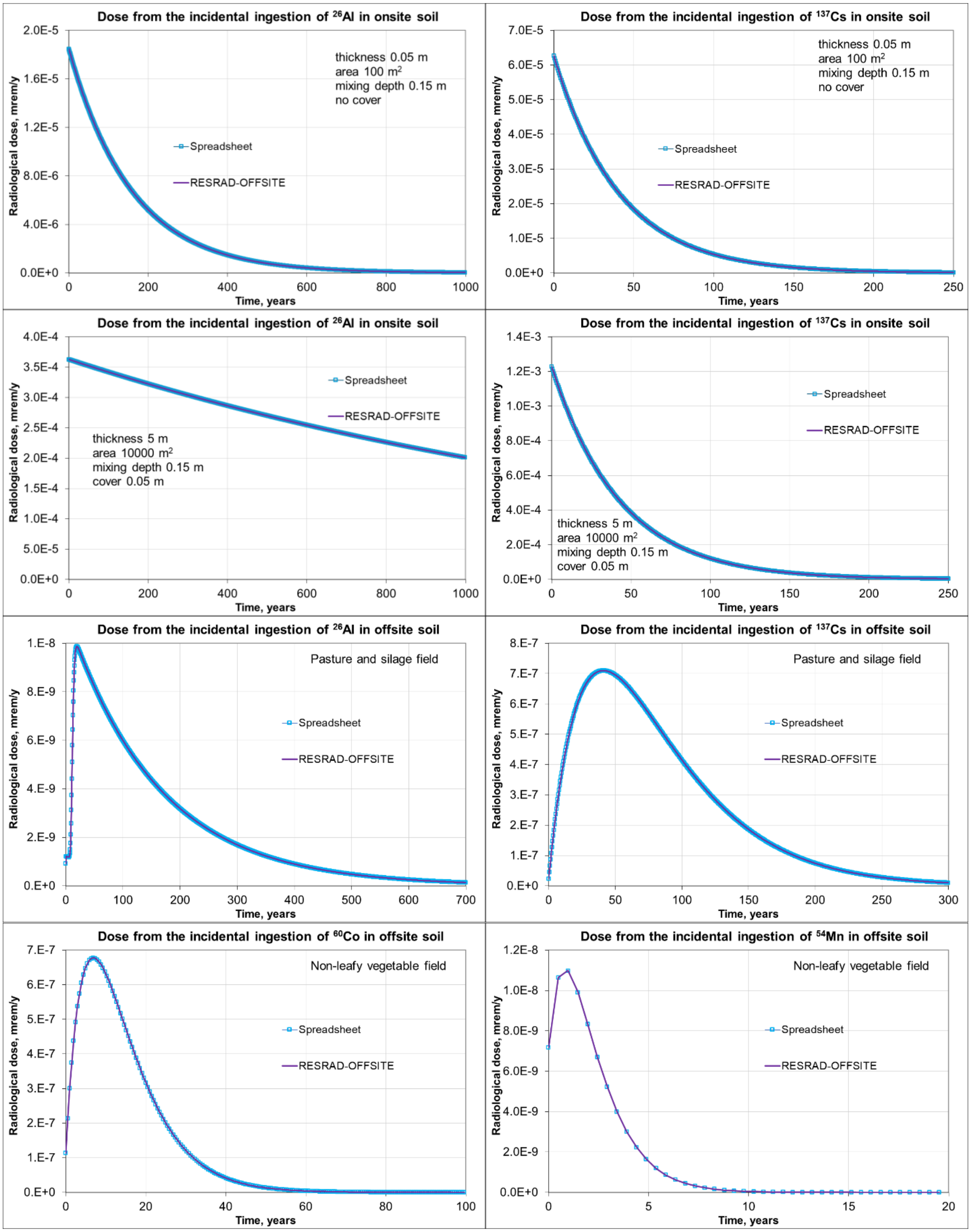


Figure 7.2 Temporal Variation of Dose from the Incidental Ingestion of Soil at Onsite and Offsite Locations

8 VERIFICATION OF RADIOLOGICAL DOSE FROM INHALATION OF RESPIRABLE PARTICULATES

The pre-release verification of the dose from the inhalation pathway of Version 4.0 of RESRAD-OFFSITE is described in Appendix 9 and is summarized below.

- Figure 8.1 shows the verification of the ^{26}Al inhalation dose at four receptor locations.
- Figure 8.2 shows the verification of the ^{137}Cs inhalation dose at four receptor locations.

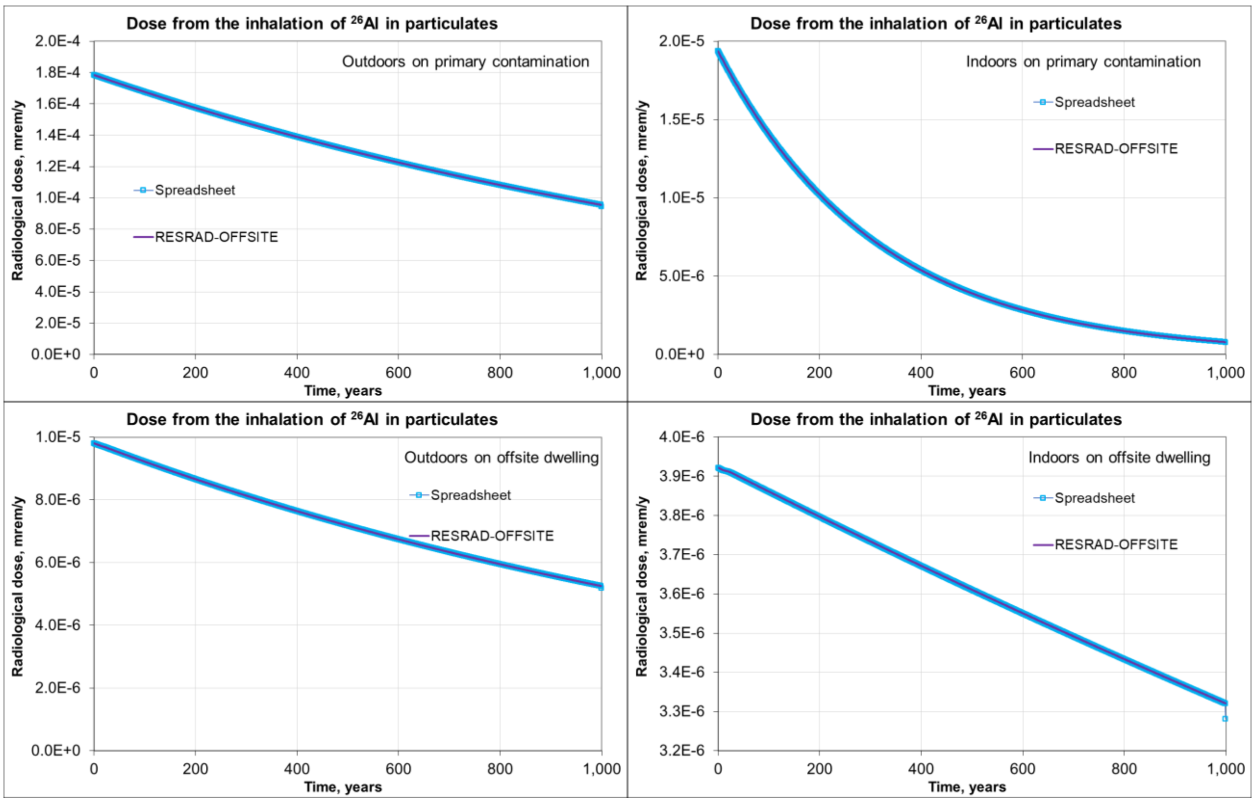


Figure 8.1 Temporal Variation of Dose from the Inhalation of ^{26}Al in Particulates

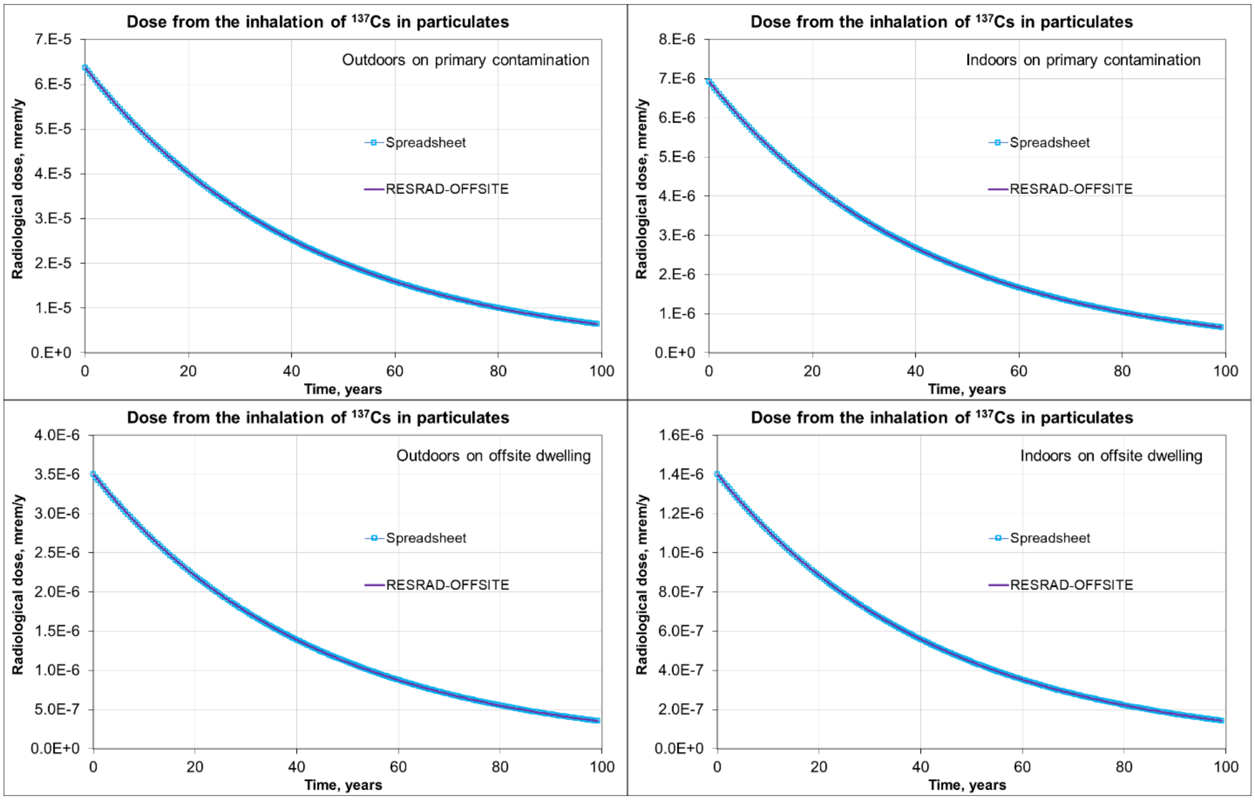


Figure 8.2 Temporal Variation of Dose from the Inhalation of ^{137}Cs in Particulates

The verification performed in this chapter provided the basis for the release testing of the inhalation pathway.

9 VERIFICATION OF RADIOLOGICAL DOSE FROM EXTERNAL RADIATION FROM OFFSITE SOILS

The pre-release verification of the dose from the external radiation pathway of Version 4.0 of RESRAD-OFFSITE is described in Appendix 10. The verification of the external radiation dose from ^{26}Al, ^{137}Cs, ^{60}Co, and ^{54}Mn in soil at offsite locations is illustrated in Figure 9.1. The verification of the external radiation dose from the primary contamination is shown in Table 9.1. The verification performed in this chapter provided the basis for the release testing of the external radiation pathway.

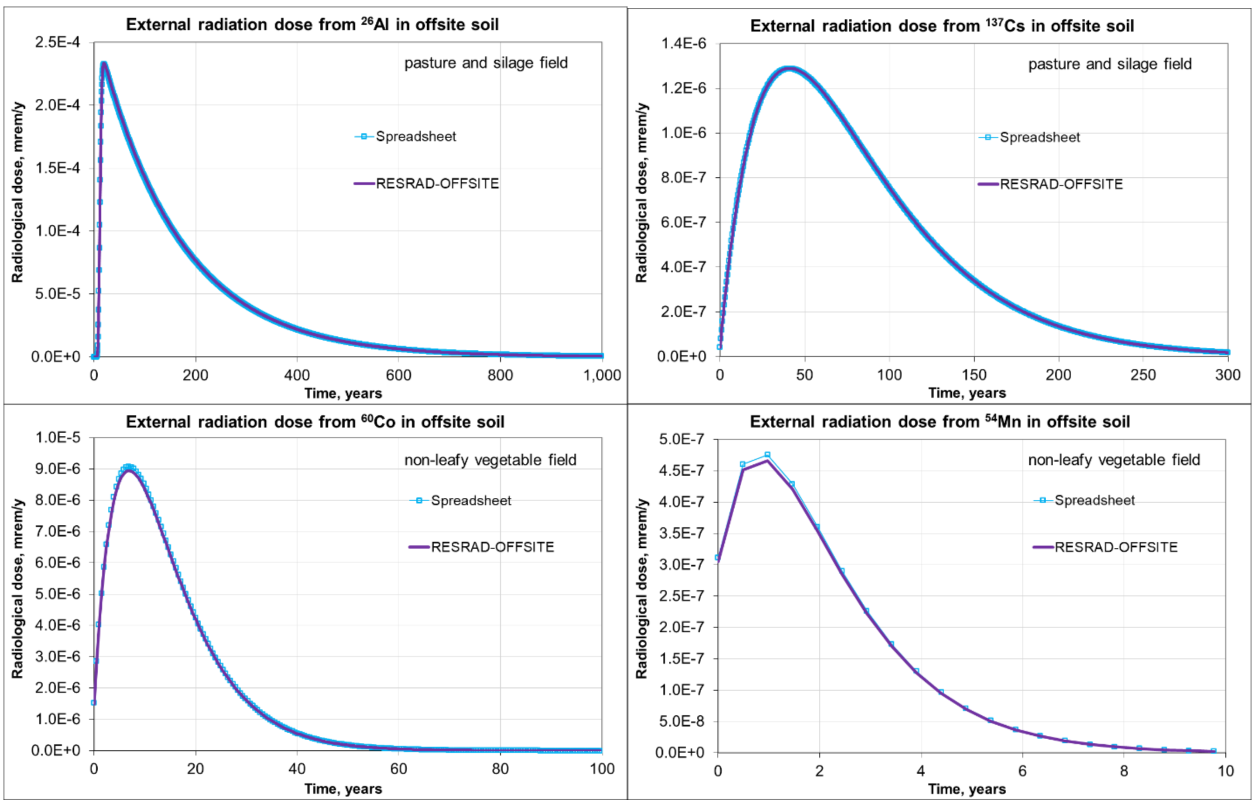


Figure 9.1 Temporal Variation of External Radiation Dose from the Accumulation of Radionuclides at the Offsite Locations

Table 9.1 Comparison of External Radiation Dose to Onsite Receptor

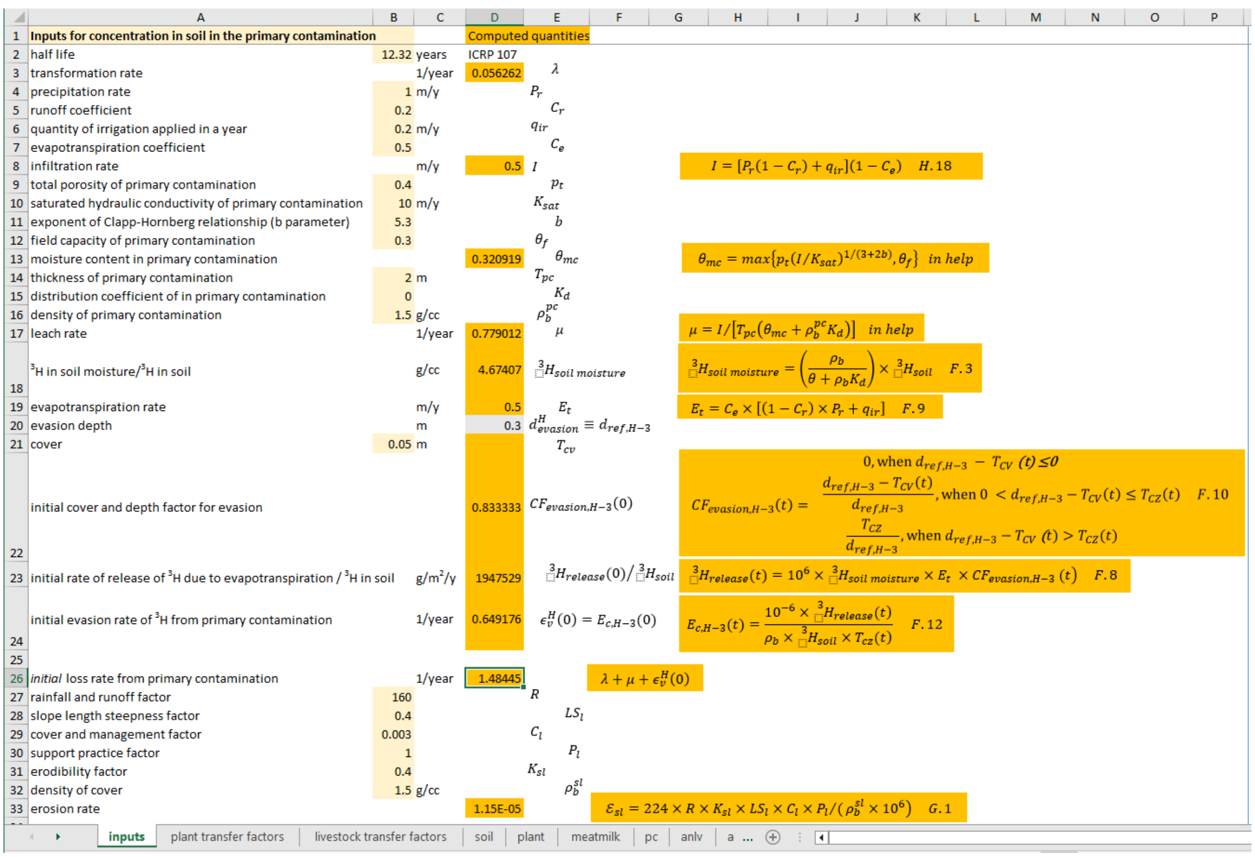
	Source area = 1000000 m^2 Source thickness = 50 cm		Source radius = 100 m^2 Source thickness = 5 cm	
	Time integrated dose during the first year, mrem		Time integrated dose during the first year, mrem	
Radionuclide	RESRAD-OFFSITE	Calculated	RESRAD-OFFSITE	Calculated
^{26}Al	17.3	17.3	5.82	5.92
^{57}Co	0.331	0.326	0.187	0.184
^{60}Co	15.1	15.2	5.20	5.20
^{137}Cs	3.37	3.37	1.32	1.31
^{54}Mn	3.57	3.54	1.34	1.32
^{234}U	4.01E-04	4.02E-04	2.71E-04	2.86E-04
^{235}U	0.757	0.757	0.390	0.385

10 VERIFICATION OF ADDITIONAL MODELS FOR TRITIATED WATER

The pre-release verification of the formulations to model the movement and exposure from ^3H in the form of tritiated water in addition to the movement and exposure from ^3H in particulates is documented in this chapter. The verification performed in this chapter provided the basis for the release testing of the special models for tritium, ^3H.

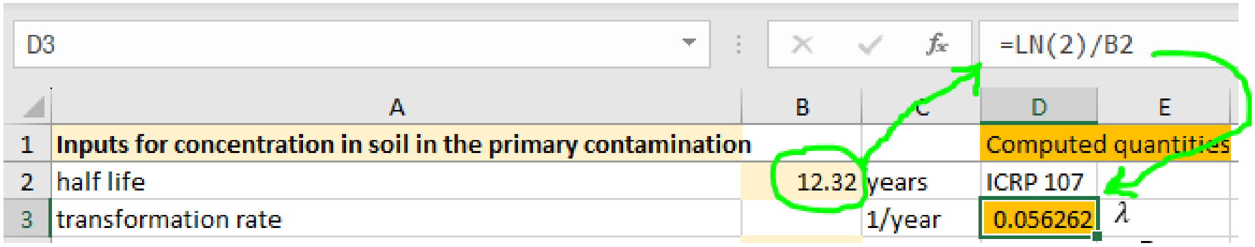
10.1 TEMPORAL CONCENTRATION IN PRIMARY CONTAMINATION

The calculation of the concentration of ^3H in the primary contamination has an additional term to model the release of tritiated water vapor from the primary contamination due to evapotranspiration. The spreadsheet calculations of the initial loss/removal rate of ^3H from the primary contamination and the erosion rate, in the tab "inputs," are outlined in Figure 10.1. The calculations of the three components of this loss rate, the radiological transformation rate, the leach rate under the RESRAD-ONSITE exponential release model, and the initial evasion rate are detailed in Figure 10.2, Figure 10.3, and Figure 10.4, respectively.



	A	B	C	D	E	Formula
1	Inputs for concentration in soil in the primary contamination			Computed quantities		
2	half life	12.32	years	ICRP 107		
3	transformation rate		1/year	0.056262	λ	
4	precipitation rate	1	m/y		P_r	
5	runoff coefficient	0.2			C_r	
6	quantity of irrigation applied in a year	0.2	m/y		q_{ir}	
7	evapotranspiration coefficient	0.5			C_e	
8	infiltration rate		m/y	0.5	I	$I = [P_r(1-C_r)+q_{ir}](1-C_e)$ H.18
9	total porosity of primary contamination	0.4			p_t	
10	saturated hydraulic conductivity of primary contamination	10	m/y		K_{sat}	
11	exponent of Clapp-Hornberg relationship (b parameter)	5.3			b	
12	field capacity of primary contamination	0.3			θ_f	
13	moisture content in primary contamination			0.320919	θ_{mc}	$\theta_{mc} = max\{p_t(I/K_{sat})^{1/(3+2b)}, \theta_f\}$ in help
14	thickness of primary contamination	2	m		T_{pc}	
15	distribution coefficient of in primary contamination	0			K_d	
16	density of primary contamination	1.5	g/cc		ρ_b^{pc}	
17	leach rate		1/year	0.779012	μ	$\mu = I/[T_{pc}(\theta_{mc}+\rho_b^{pc}K_d)]$ in help
18	^3H in soil moisture/^3H in soil		g/cc	4.67407	$^3H_{soil\ moisture}$	$^3H_{soil\ moisture} = \left(\frac{\rho_b}{\theta+\rho_b K_d}\right) \times {}^3H_{soil}$ F.3
19	evapotranspiration rate		m/y	0.5	E_t	$E_t = C_e \times [(1-C_r)\times P_r + q_{ir}]$ F.9
20	evasion depth		m	0.3	$d^H_{evasion} \equiv d_{ref,H-3}$	
21	cover	0.05	m		T_{cv}	
22	initial cover and depth factor for evasion			0.833333	$CF_{evasion,H-3}(0)$	$CF_{evasion,H-3}(t) = \begin{cases} 0, \text{when } d_{ref,H-3} - T_{CV}(t) \le 0 \\ \frac{d_{ref,H-3}-T_{CV}(t)}{d_{ref,H-3}}, \text{when } 0 < d_{ref,H-3} - T_{CV}(t) \le T_{CZ}(t) \\ \frac{T_{CZ}}{d_{ref,H-3}}, \text{when } d_{ref,H-3} - T_{CV}(t) > T_{CZ}(t) \end{cases}$ F.10
23	initial rate of release of ^3H due to evapotranspiration / ^3H in soil		g/m²/y	1947529	$^3H_{release}(0)/{}^3H_{soil}$	$^3H_{release}(t) = 10^6 \times {}^3H_{soil\ moisture} \times E_t \times CF_{evasion,H-3}(t)$ F.8
24	initial evasion rate of ^3H from primary contamination		1/year	0.649176	$\epsilon^H_v(0) = E_{c,H-3}(0)$	$E_{c,H-3}(t) = \frac{10^{-6} \times {}^3H_{release}(t)}{\rho_b \times {}^3H_{soil} \times T_{cz}(t)}$ F.12
25						
26	*initial* loss rate from primary contamination		1/year	1.48445		$\lambda + \mu + \epsilon^H_v(0)$
27	rainfall and runoff factor	160			R	
28	slope length steepness factor	0.4			LS_l	
29	cover and management factor	0.003			C_l	
30	support practice factor	1			P_l	
31	erodibility factor	0.4			K_{sl}	
32	density of cover	1.5	g/cc		ρ_b^{sl}	
33	erosion rate			1.15E-05		$\mathcal{E}_{sl} = 224 \times R \times K_{sl} \times LS_l \times C_l \times P_l/(\rho_b^{sl} \times 10^6)$ G.1

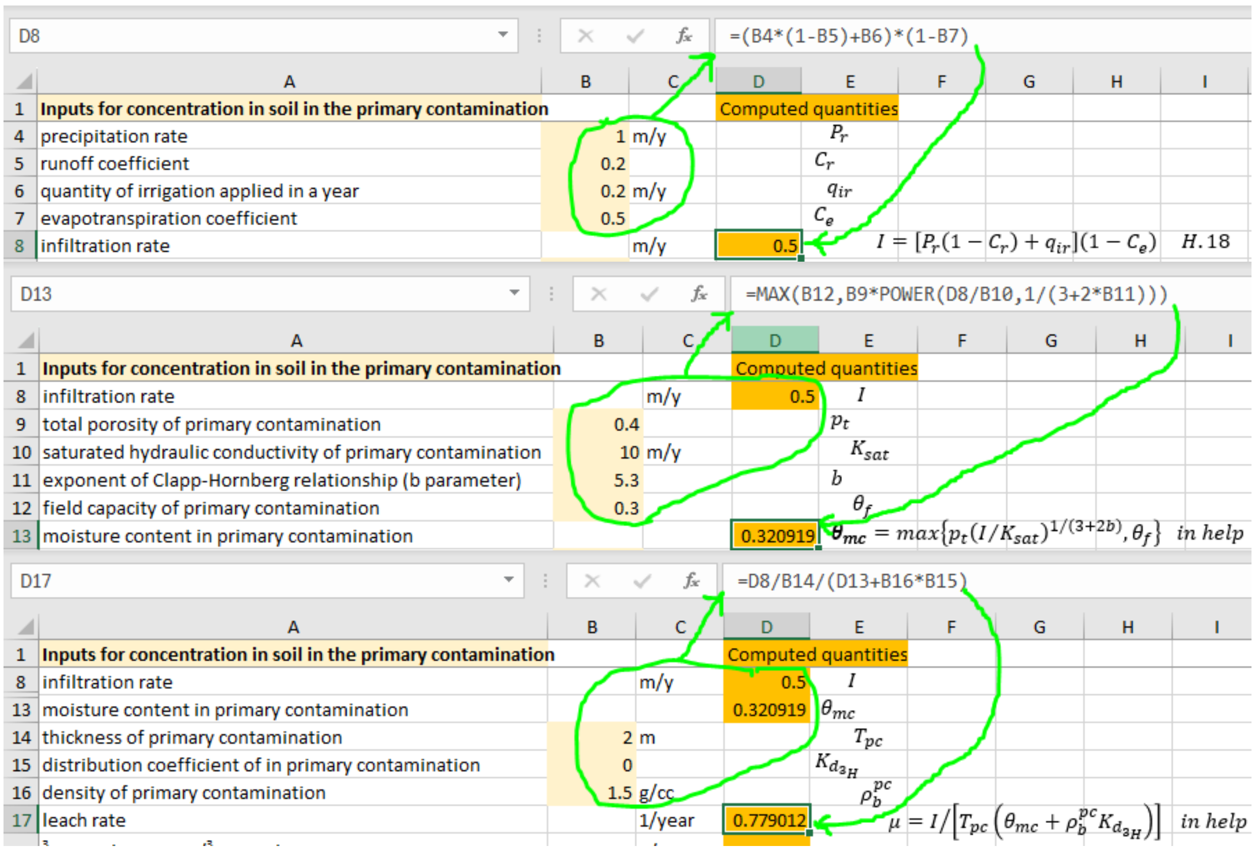
Figure 10.1 Screen Shot of Spreadsheet Calculations of the Initial Loss/Removal Rate of ^3H and the Erosion Rate



D3 =LN(2)/B2

	A	B	C	D	E
1	Inputs for concentration in soil in the primary contamination			Computed quantities	
2	half life	12.32	years	ICRP 107	
3	transformation rate		1/year	0.056262	λ

Figure 10.2 Screen Shot of Calculation of the Radiological Transformation Rate of ^{3}H Using the ICRP-107 Half-life



D8 =(B4*(1-B5)+B6)*(1-B7)

	A	B	C	D	E	F	G	H	I
1	Inputs for concentration in soil in the primary contamination			Computed quantities					
4	precipitation rate	1	m/y		P_r				
5	runoff coefficient	0.2			C_r				
6	quantity of irrigation applied in a year	0.2	m/y		q_{ir}				
7	evapotranspiration coefficient	0.5			C_e				
8	infiltration rate		m/y	0.5	$I = [P_r(1-C_r)+q_{ir}](1-C_e)$			$H.18$	

D13 =MAX(B12,B9*POWER(D8/B10,1/(3+2*B11)))

	A	B	C	D	E	F	G	H	I
1	Inputs for concentration in soil in the primary contamination			Computed quantities					
8	infiltration rate		m/y	0.5	I				
9	total porosity of primary contamination	0.4			p_t				
10	saturated hydraulic conductivity of primary contamination	10	m/y		K_{sat}				
11	exponent of Clapp-Hornberg relationship (b parameter)	5.3			b				
12	field capacity of primary contamination	0.3			θ_f				
13	moisture content in primary contamination			0.320919	$\theta_{mc} = max\{p_t(I/K_{sat})^{1/(3+2b)}, \theta_f\}$				*in help*

D17 =D8/B14/(D13+B16*B15)

	A	B	C	D	E	F	G	H	I
1	Inputs for concentration in soil in the primary contamination			Computed quantities					
8	infiltration rate		m/y	0.5	I				
13	moisture content in primary contamination			0.320919	θ_{mc}				
14	thickness of primary contamination	2	m		T_{pc}				
15	distribution coefficient of in primary contamination	0			Kd_{3_H}				
16	density of primary contamination	1.5	g/cc		ρ_b^{pc}				
17	leach rate		1/year	0.779012	$\mu = I/\left[T_{pc}\left(\theta_{mc} + \rho_b^{pc} Kd_{3_H}\right)\right]$				*in help*

Figure 10.3 Screen Shots of Estimation of the Leach Rate of ^{3}H under the RESRAD-ONSITE Exponential Release Option

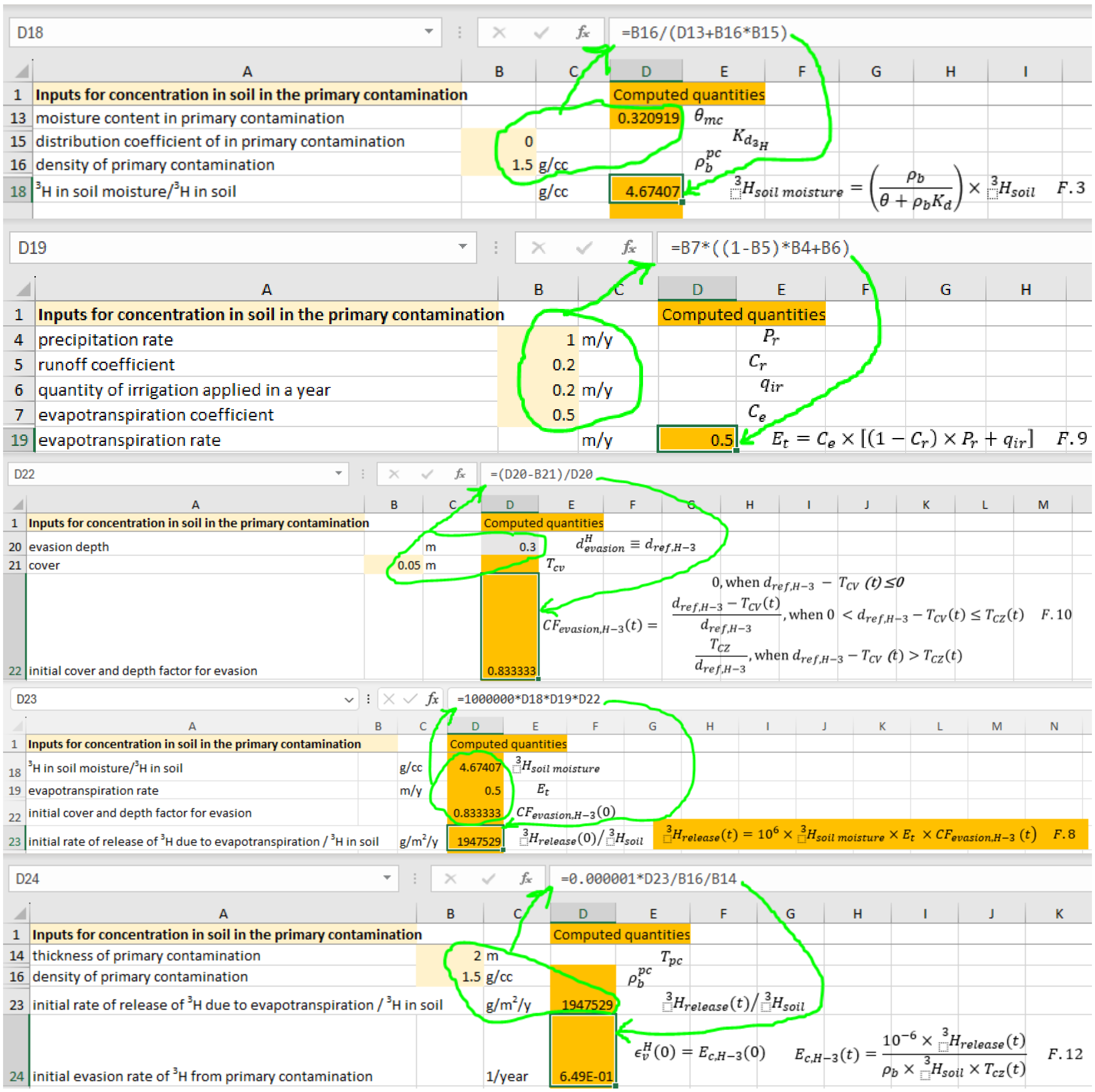


Figure 10.4 Screen Shot of Calculation of the Initial Evasion Rate of ^{3}H from the Primary Contamination

The calculation of the rate at which the cover above the primary contamination erodes is shown in Figure 10.5. This erosion rate is used to compute the time-dependent thickness of the cover and the time dependence of the fraction of the evasion depth that is contaminated. The computation of the concentration of ^{3}H remaining in the primary contamination at a specific time, 3/16 year, is shown in Figure 10.6; this figure also shows the verification of the concentrations at four different times. Figure 10.7 illustrates the verification of the temporal concentration of ^{3}H remaining in the primary contamination.

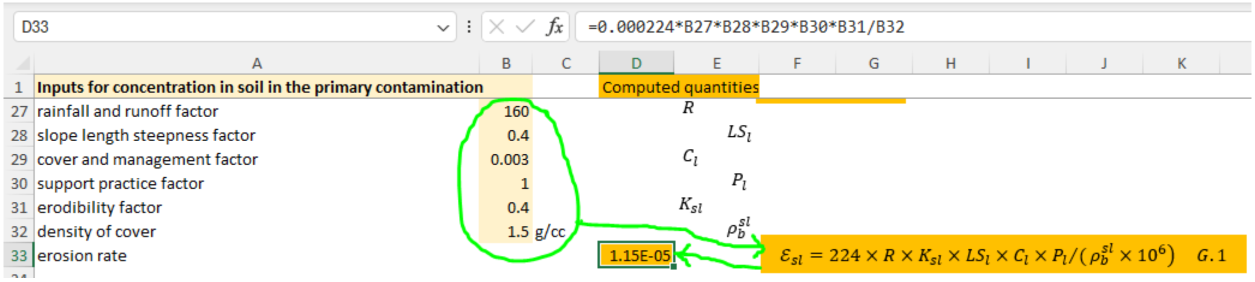


Figure 10.5 Screen Shot of Calculation of the Erosion Rate of the Cover above the Primary Contamination

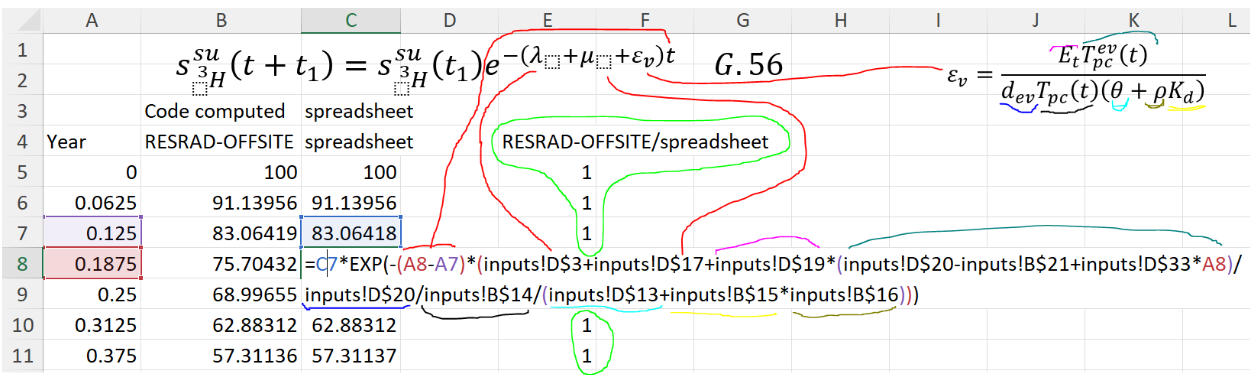


Figure 10.6 Screen Shot of Calculation of the Concentration of ^{3}H Remaining in the Primary Contamination

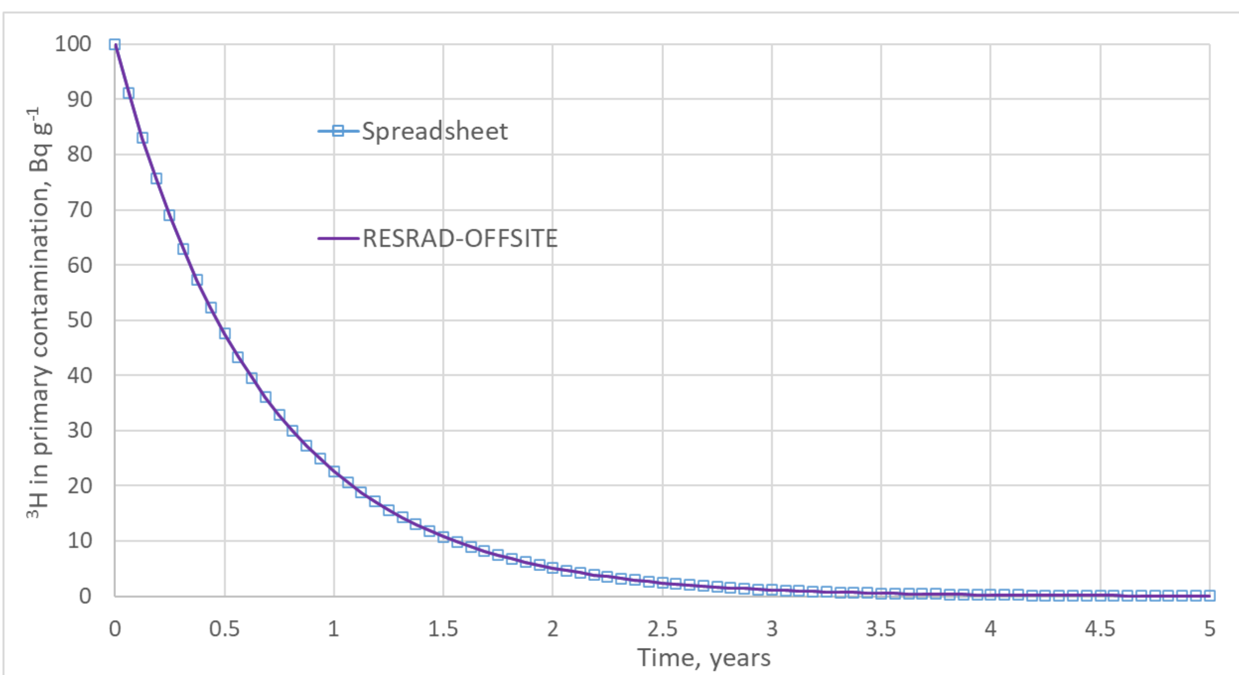


Figure 10.7 Temporal Variation of the Concentration of ^{3}H Remaining in the Primary Contamination

10.2 CONCENTRATION IN PLANT

The movement of tritiated water from soil through the roots is modeled as being the same as the movement of water from soil. The calculation of the equivalent root transfer factor is illustrated in Figure 10.8.

B7 | f_x =B5/(B4+B6*B5)*B3

	A	B	C	D	E	F	G
1	**Inputs for concentration in plant**			Computed quantities			
2		nonleafy vegetables, fruit and grain	leafy vegetables	pasture and silage	livestock feed grain		
3	mass fraction of water in plants	0.8	0.8	0.8	0.8		H_2O_{plant}
4	moisture content of soil	0.3	0.3	0.3	0.3		θ_{mc}
5	dry bulk density of soil	1.5	1.5	1.5	1.5	g/cc	ρ_b
6	distribution coefficient	0	0	0	0	cc/g	K_d
7	root transfer factor	4	4	4	4	^{3}H from root uptake	
8	$rtf_{^3H}$	$rtf_{^3H} = \frac{^3H_{soil\ moisture}(t)H_2O_{plant}}{^3H_{soil}(t)} = \frac{\rho}{\theta + \rho K_d} H_2O_{plant}$				in a gram of plant /	
9						^{3}H in a gram of soil	

Figure 10.8 Screen Shot of Calculation of Root Transfer Factor of ^{3}H for Each Plant Type

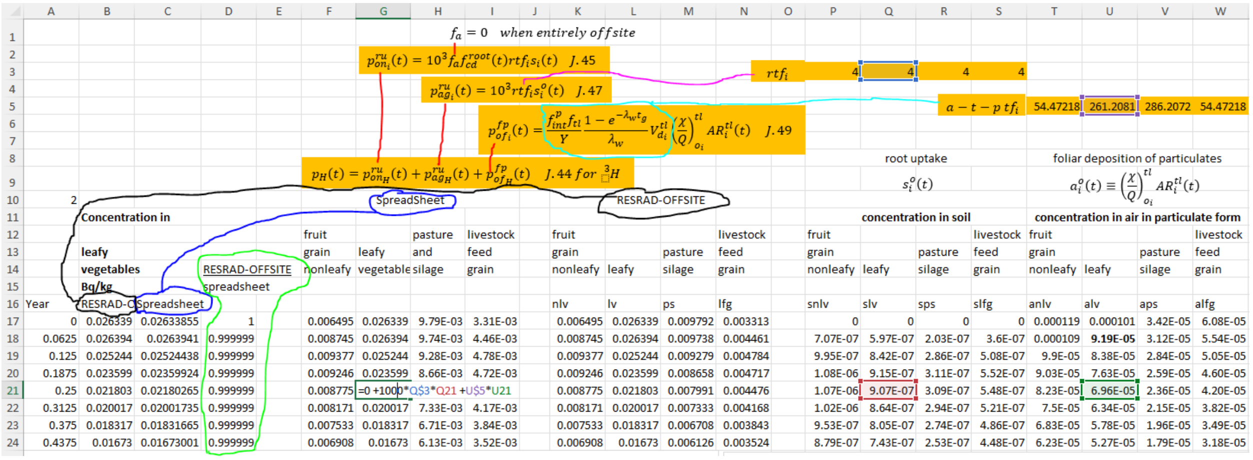
The ^{3}H in plant from the foliar deposition of particles containing it are modeled in the same manner as for the other radionuclides. The computation of the air-to-plant concentration ratios that are used in this model are in shown in Figure 10.9.

B18 | f_x =B12*B15/B13*(1-EXP(-B14*B16))/B16*$B17*3600*24*365.25

	A	B	C	D	E	F	G
1	**Inputs for concentration in plant**			Computed quantities			
2		nonleafy vegetables, fruit and grain	leafy vegetables	pasture and silage	livestock feed grain		
10							
11	mixing depth	0.15	0.15	0.15	0.15	m	
12	Foliar interception factor for dust	0.25	0.25	0.25	0.25		f^p_{int}
13	wet weight crop yield	0.7	1.5	1.1	0.7	kg/m^2	Y
14	duration of growing season	0.17	0.25	0.08	0.17	y	t_g
15	foliage to food translocation factor	0.1	1	1	0.1		f_{tl}
16	weathering constant	20	20	20	20	1/y	λ_w
17	deposition velocity of particulates	0.001				m/s	
18	air-to-plant transfer factor	54.5	261.2	286.2	54.5	^{3}H from foliar	
19	$a-t-p\,tf$	$a-t-p\,tf = \frac{f^p_{int} f_{tl}}{Y} \frac{1-e^{-\lambda_w t_g}}{\lambda_w} V^{tl}_{d_i}$ part of J.49				deposition in a kg of	
20						plant /	
21						^{3}H in a m^3 of air	

Figure 10.9 Screen Shot of Calculation of Air-to-Plant Concentration Ratios, which Are Used to Model Foliar Deposition

The calculation of the concentration of ^{3}H in plant at a specific time, 0.25 years, and the verification of the code calculated value at that time and at six other times around it, are shown in Figure 10.10. The concentrations of ^{3}H in the soil and in air used in these calculations were obtained for RESRAD-OFFSITE output. The calculation of concentration in offsite soils was verified in Section 5.2. The component calculations for the concentration in air were verified in Sections 2.4 and 4.1. The verification of the temporal concentration of ^{3}H in plant is shown in Figure 10.11. The figure on the left shows the verification when the concentration is high, while the figure on the right shows the verification during early times when the concentration is orders of magnitude lower and is mainly due to foliar deposition.



Year	Concentration in leafy vegetables Bq/kg RESRAD-O	Spreadsheet	RESRAD-OFFSITE / spreadsheet	fruit grain nonleafy	leafy vegetable	pasture and silage	livestock feed grain	nlv	lv	ps	lfg	snlv	slv	sps	slfg	anlv	alv	aps	alfg
0	0.026339	0.02633855	1	0.006495	0.026339	9.79E-03	3.31E-03	0.006495	0.026339	0.009792	0.003313	0	0	0	0	0.000119	0.000101	3.42E-05	6.08E-05
0.0625	0.026394	0.0263941	0.999999	0.008745	0.026394	9.74E-03	4.46E-03	0.008745	0.026394	0.009738	0.004461	7.07E-07	5.97E-07	2.03E-07	3.6E-07	0.000109	9.19E-05	3.12E-05	5.54E-05
0.125	0.025244	0.02524438	0.999999	0.009377	0.025244	9.28E-03	4.78E-03	0.009377	0.025244	0.009279	0.004784	9.95E-07	8.42E-07	2.86E-07	5.08E-07	9.9E-05	8.38E-05	2.84E-05	5.05E-05
0.1875	0.023599	0.02359924	0.999999	0.009246	0.023599	8.66E-03	4.72E-03	0.009246	0.023599	0.008658	0.004717	1.08E-06	9.15E-07	3.11E-07	5.52E-07	9.03E-05	7.63E-05	2.59E-05	4.60E-05
0.25	0.021803	0.02180265	0.999999	0.008775	=0 +1000*Q$3*Q21 +U$5*U21			0.008775	0.021803	0.007991	0.004476	1.07E-06	9.07E-07	3.09E-07	5.48E-07	8.23E-05	6.96E-05	2.36E-05	4.20E-05
0.3125	0.020017	0.02001735	0.999999	0.008171	0.020017	7.33E-03	4.17E-03	0.008171	0.020017	0.007333	0.004168	1.02E-06	8.64E-07	2.94E-07	5.21E-07	7.5E-05	6.34E-05	2.15E-05	3.82E-05
0.375	0.018317	0.01831665	0.999999	0.007533	0.018317	6.71E-03	3.84E-03	0.007533	0.018317	0.006708	0.003843	9.53E-07	8.05E-07	2.74E-07	4.86E-07	6.83E-05	5.78E-05	1.96E-05	3.49E-05
0.4375	0.01673	0.01673001	0.999999	0.006908	0.01673	6.13E-03	3.52E-03	0.006908	0.01673	0.006126	0.003524	8.79E-07	7.43E-07	2.53E-07	4.48E-07	6.23E-05	5.27E-05	1.79E-05	3.18E-05

Figure 10.10 Screen Shot of Calculation and Verification of Concentration of ^{3}H in Plants

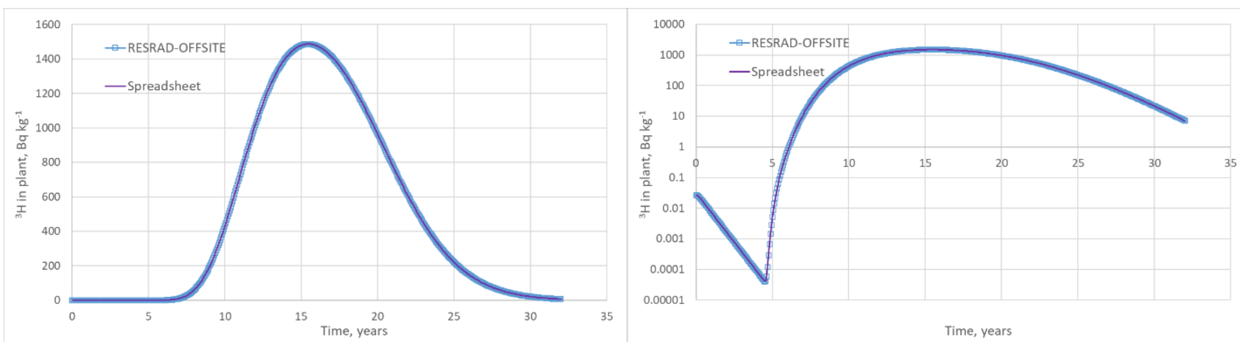


Figure 10.11 Verification of Temporal Concentration of ^{3}H in Plant

10.3 CONCENTRATION IN MEAT AND MILK

The transfer of ^{3}H ingested by the livestock to milk and meat is modeled as being the same as the transfer of H_2O to meat and milk, both as water and in the feed that is ingested by the livestock. The calculation of the intake to the concentration in meat factor and intake to the concentration in milk factor for ^{3}H are shown in Figure 10.12. The use of these factors to compute the concentrations of ^{3}H in meat and milk from livestock water, pasture and silage, feed grain, and the soils associated with the livestock feeds is illustrated in Figure 10.13. The verification of the temporal concentrations of ^{3}H in milk and meat are shown in Figure 10.14 and Figure 10.15, respectively. The plots on the left of both figures show the verification when the concentration is high, while the plots on the right of both figures show the verification during early times when the concentration is orders of magnitude lower and is mainly due to foliar deposition.

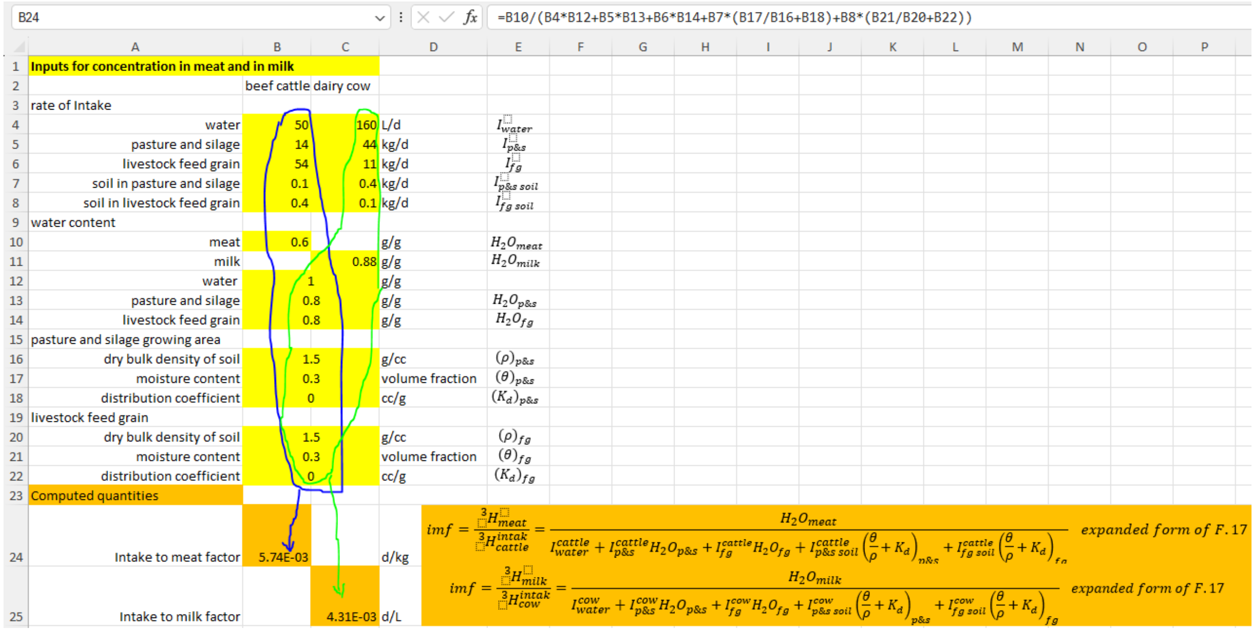


Figure 10.12 Screen Shot of Calculation of Intake to Concentration in Meat and Intake to Concentration in Milk Factors for ^{3}H

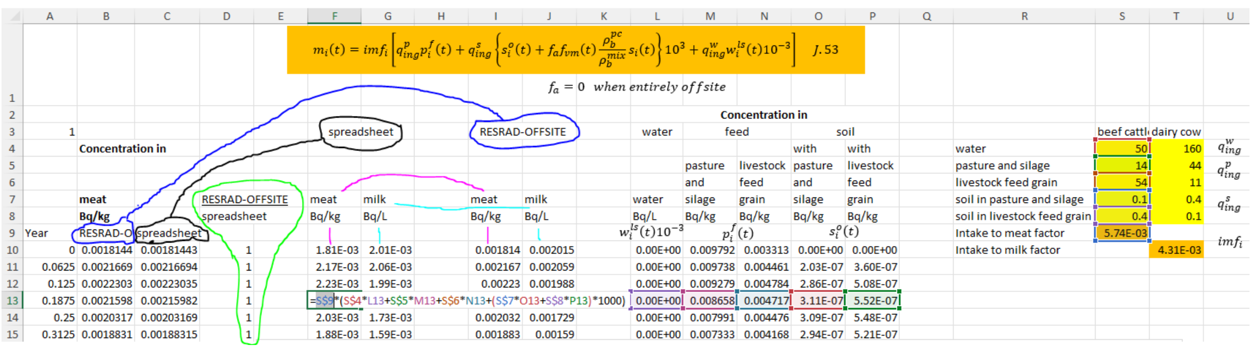


Figure 10.13 Screen Shot of Calculation and Verification of Concentration of ^{3}H in Milk and Meat

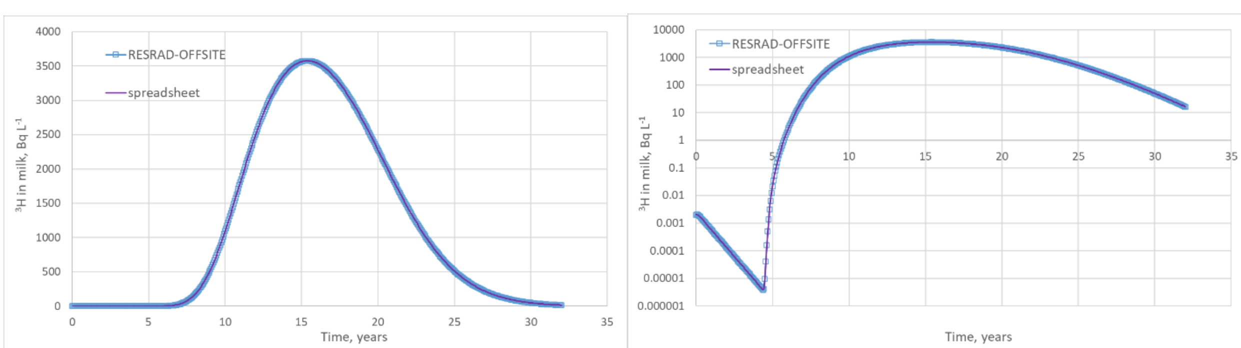


Figure 10.14 Verification of Temporal Concentration of ^{3}H in Milk

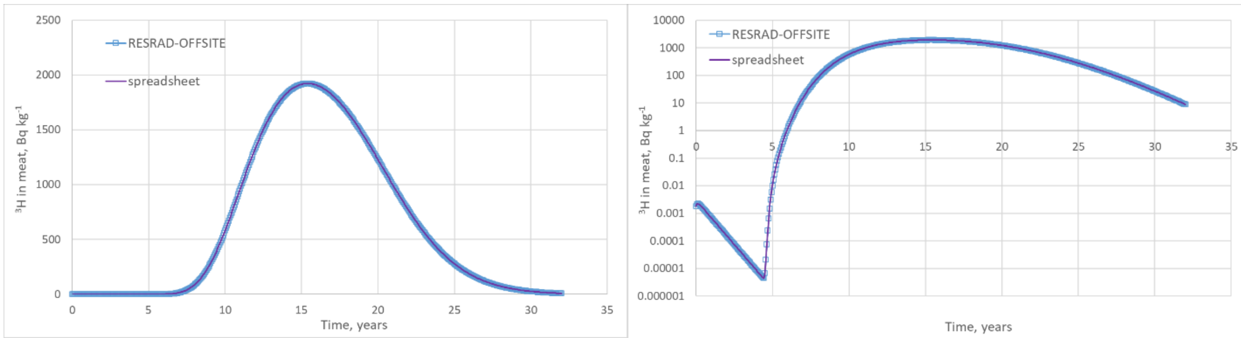


Figure 10.15 Verification of Temporal Concentration of ^{3}H in Meat

10.4 INHALATION

The ^{3}H inhalation dose in RESRAD-OFFSITE 4.0 is modeled as being from the inhalation of tritiated water. The evapotranspiration of tritiated water is modeled as paralleling that of regular water. The spreadsheet computations of the infiltration rate, the evapotranspiration rate, and the moisture content in soil are illustrated in Figure 10.16. These computed values are used in the spreadsheet computation of the rate of evasion of water from the evasion depth, as shown in Figure 10.17.The spreadsheet calculation of the cover and depth factor for the evasion of ^{3}H is in Figure 10.18. The calculation of the concentration of ^{3}H in the air above the primary contamination per unit concentration of ^{3}H in the primary contamination is illustrated in Figure 10.19. This was found to be within the bounds computed by the spreadsheet in Figure 10.20.

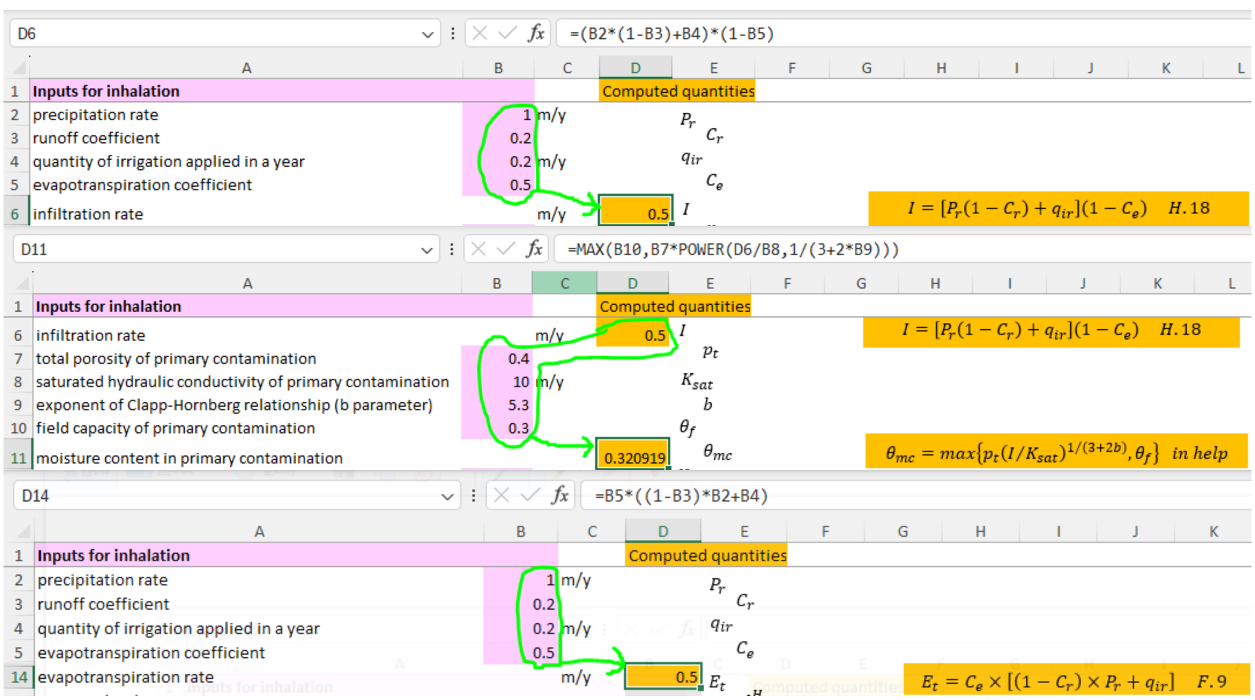


Figure 10.16 Screen Shots of Spreadsheet Computations of Infiltration Rate and Moisture Content in Soil and Evapotranspiration Rate

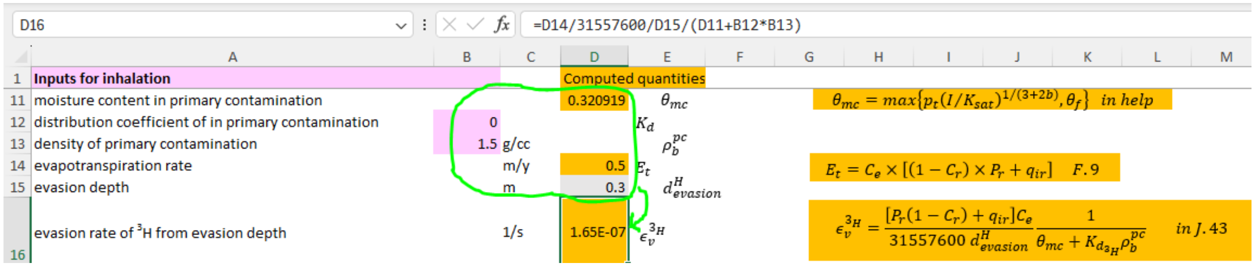


Figure 10.17 Screen Shot of Spreadsheet Calculation of Evasion Rate of ³H from the Entire Evasion Depth

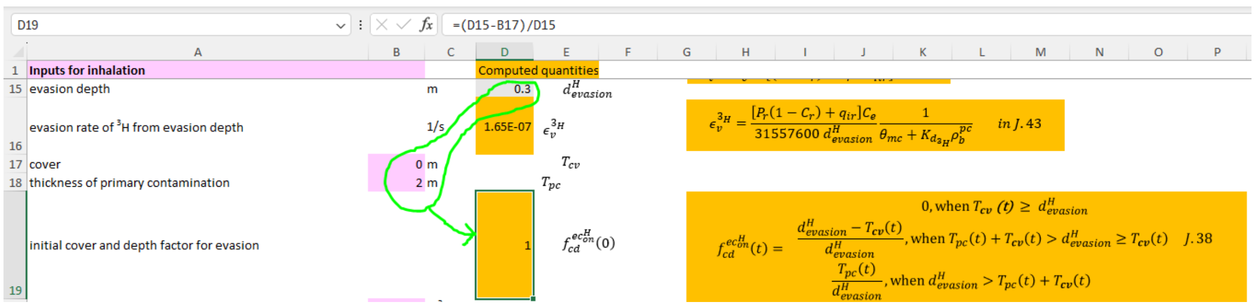


Figure 10.18 Screen Shot of the Calculation of the Cover and Depth Factor for the Evasion of Water

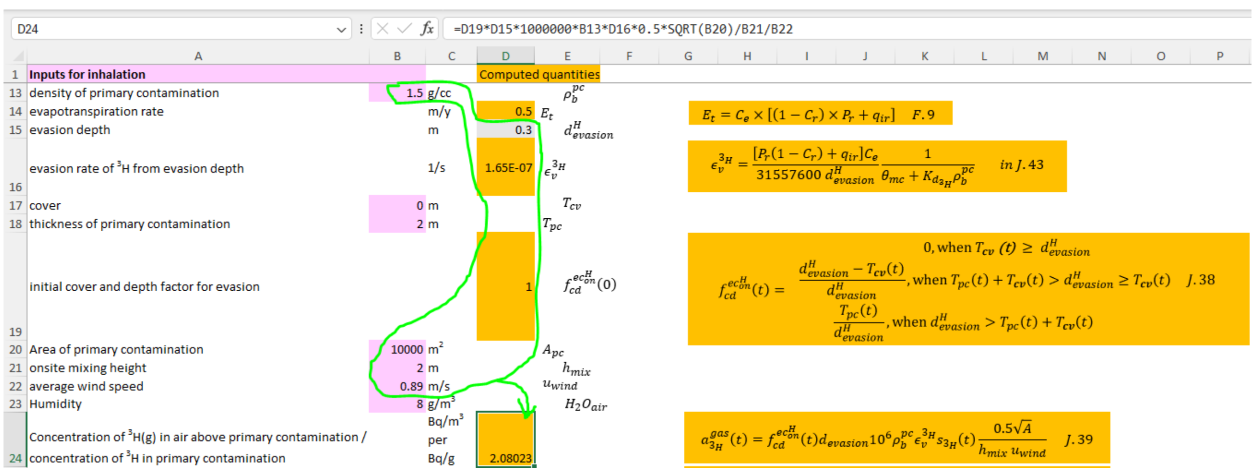


Figure 10.19 Screen Shot of the Calculation of the Ratio of the Concentration of ³H in the Air above and in the Soil in the Primary Contamination

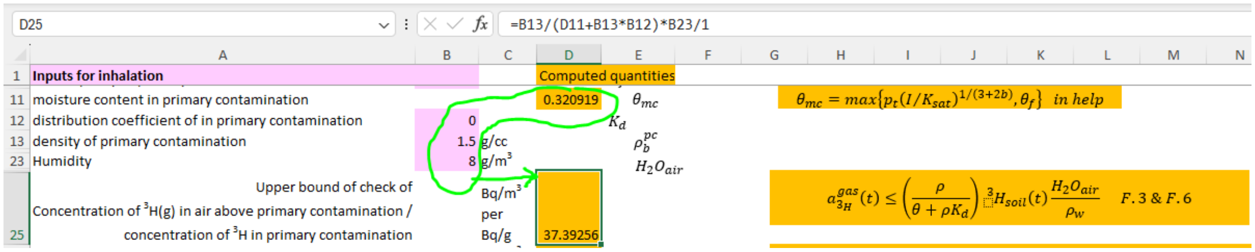


Figure 10.20 Screen Shot of the Calculation of the Upper Bound for the Ratio of the Concentration of ^{3}H in the Air above and in the Soil in the Primary Contamination

Figure 10.21 shows the spreadsheet computation of the rate of release of ^{3}H by evapotranspiration from the primary contamination per unit concentration in the primary contamination. The computation of the annual time-integrated concentration of ^{3}H in the primary contamination using the trapezoidal approximation is illustrated in Figure 10.22. The instantaneous concentration in the primary contamination was verified in Section 2.2. As illustrated in Figure 10.23, the annual time-integrated concentration of ^{3}H in the air above the primary contamination was computed by multiplying the annual time-integrated concentration in soil by the ratio calculated in Figure 10.19. Figure 10.24 shows the computation of the annual time-integrated concentration of ^{3}H in the air at offsite locations as the product of three quantities: the annual time-integrated concentration in soil, the rate of release per unit concentration in the primary contamination calculated in Figure 10.21, and the chi over Q, $\left(\frac{\chi}{Q}\right)_{offsite}^{gas}$, for transport of a gas from the primary contamination to the offsite location. The chi over Qs were verified in Section 4.1.

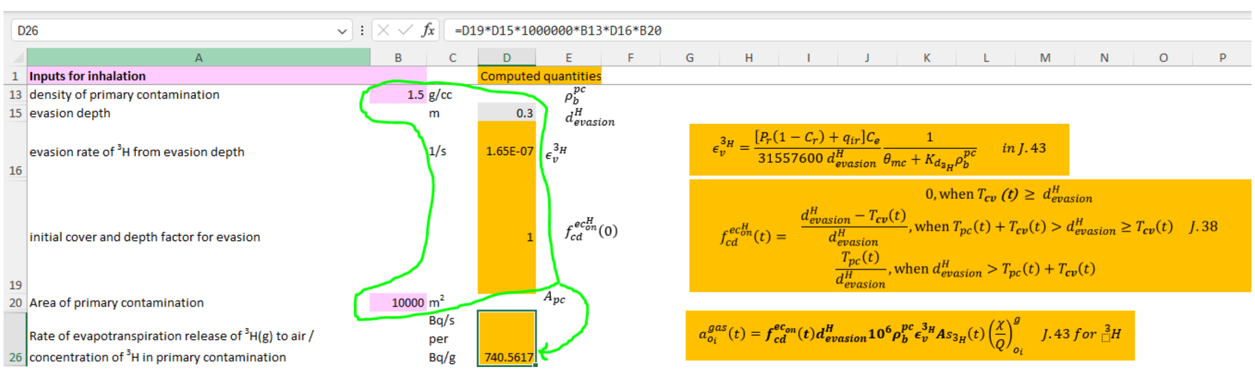


Figure 10.21 Screen Shot of the Calculation of the Release Rate of ^{3}H per Unit Concentration in the Primary Contamination

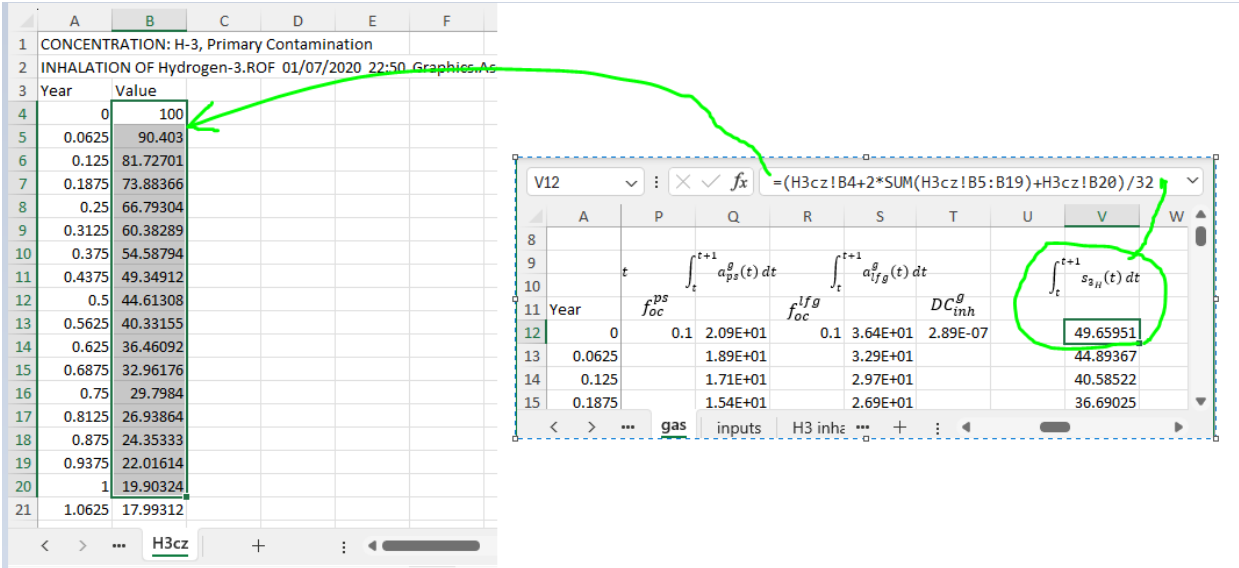


Figure 10.22 Screen Shot of Time Integration of the Concentration in the Primary Contamination over a Year Using the Trapezoidal Approximation

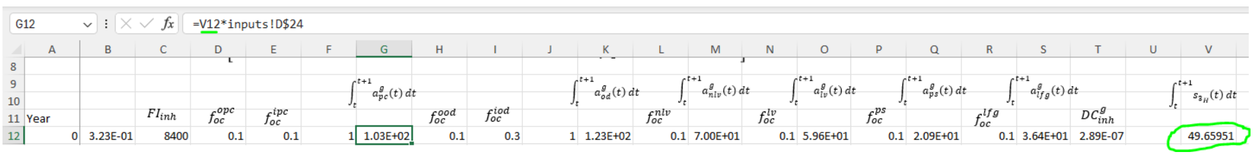


Figure 10.23 Screen Shot of Computation of the Time-Integrated Concentration in the Air above the Primary Contamination over the First Year

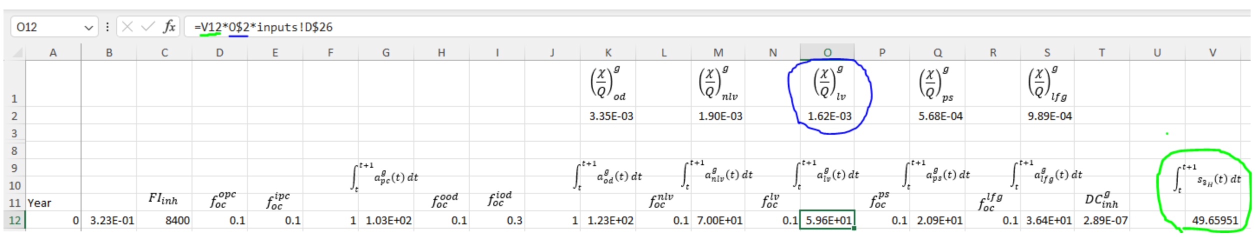
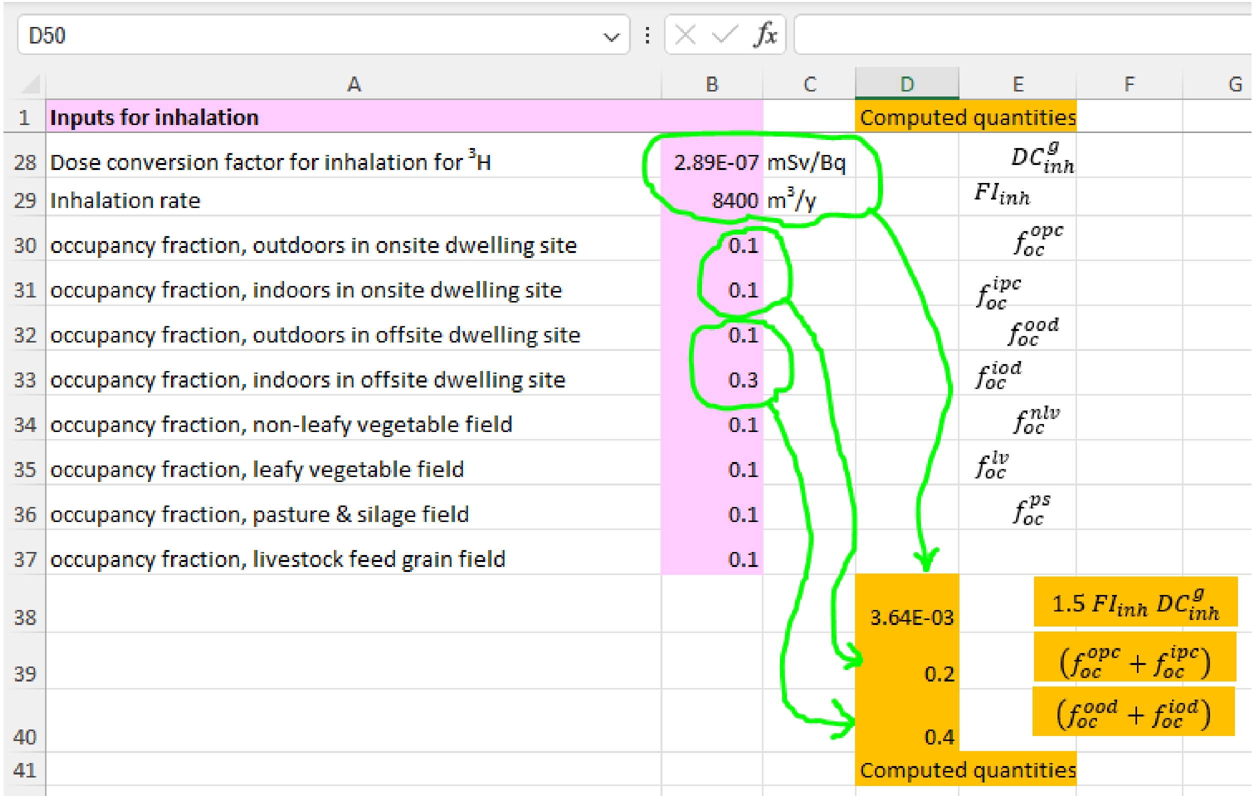


Figure 10.24 Screen Shot of Computation of the Time-Integrated Concentration in the Air at an Offsite Location over the First Year

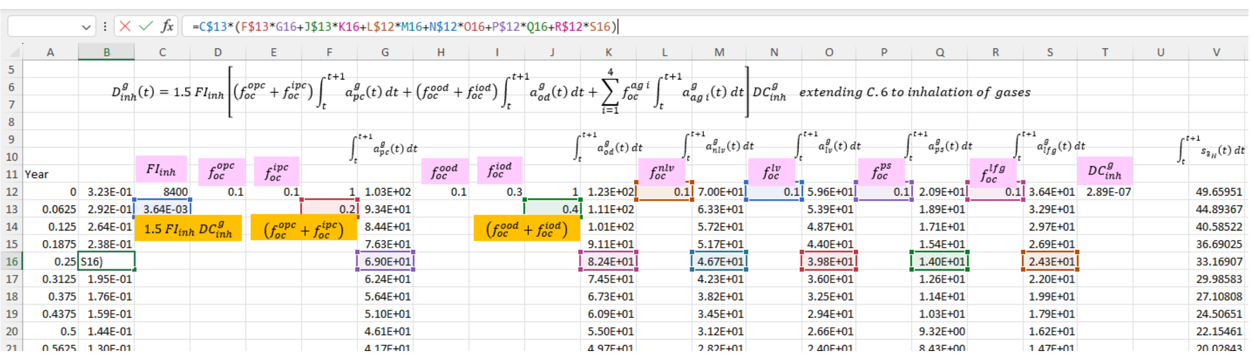
The aggregation of the inputs to compute the dose from inhalation, the dose conversion factor, the inhalation rate, and the indoor and outdoor occupancies in the onsite and offsite dwellings is shown in Figure 10.25. The calculation of the annual time-integrated ^{3}H inhalation dose while the receptor is at the various locations is shown in Figure 10.26 for a specific time interval of 1 year beginning at 0.25 years. Figure 10.27 verifies the RESRAD-OFFSITE 4.0 ^{3}H inhalation dose over the time horizon where that dose is significant.



D50

	A	B	C	D	E	F	G
1	**Inputs for inhalation**			Computed quantities			
28	Dose conversion factor for inhalation for ^{3}H	2.89E-07	mSv/Bq		DC^g_{inh}		
29	Inhalation rate	8400	m^3/y		FI_{inh}		
30	occupancy fraction, outdoors in onsite dwelling site	0.1			f^{opc}_{oc}		
31	occupancy fraction, indoors in onsite dwelling site	0.1			f^{ipc}_{oc}		
32	occupancy fraction, outdoors in offsite dwelling site	0.1			f^{ood}_{oc}		
33	occupancy fraction, indoors in offsite dwelling site	0.3			f^{iod}_{oc}		
34	occupancy fraction, non-leafy vegetable field	0.1			f^{nlv}_{oc}		
35	occupancy fraction, leafy vegetable field	0.1			f^{lv}_{oc}		
36	occupancy fraction, pasture & silage field	0.1			f^{ps}_{oc}		
37	occupancy fraction, livestock feed grain field	0.1					
38				3.64E-03		$1.5\, FI_{inh}\, DC^g_{inh}$	
39				0.2		$(f^{opc}_{oc} + f^{ipc}_{oc})$	
40				0.4		$(f^{ood}_{oc} + f^{iod}_{oc})$	
41				Computed quantities			

Figure 10.25 Screen Shot of the Aggregation of Inhalation Dose Pathway Inputs



=C$13*(F$13*G16+J$13*K16+L$12*M16+N$12*O16+P$12*Q16+R$12*S16)

$$D^g_{inh}(t) = 1.5\, FI_{inh}\left[(f^{opc}_{oc} + f^{ipc}_{oc})\int_t^{t+1} a^g_{pc}(t)\,dt + (f^{ood}_{oc} + f^{iod}_{oc})\int_t^{t+1} a^g_{od}(t)\,dt + \sum_{i=1}^{4} f^{ag\,i}_{oc}\int_t^{t+1} a^g_{ag\,i}(t)\,dt\right] DC^g_{inh}$$ *extending C.6 to inhalation of gases*

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
10							$\int_t^{t+1} a^g_{pc}(t)\,dt$				$\int_t^{t+1} a^g_{od}(t)\,dt$		$\int_t^{t+1} a^g_{nlv}(t)\,dt$		$\int_t^{t+1} a^g_{lv}(t)\,dt$		$\int_t^{t+1} a^g_{ps}(t)\,dt$		$\int_t^{t+1} a^g_{lfg}(t)\,dt$			$\int_t^{t+1} s_{3_H}(t)\,dt$
11	Year		FI_{inh}	f^{opc}_{oc}	f^{ipc}_{oc}			f^{ood}_{oc}	f^{iod}_{oc}			f^{nlv}_{oc}		f^{lv}_{oc}		f^{ps}_{oc}		f^{lfg}_{oc}		DC^g_{inh}		
12	0	3.23E-01	8400	0.1	0.1	1	1.03E+02	0.1	0.3	1	1.23E+02	0.1	7.00E+01	0.1	5.96E+01	0.1	2.09E+01	0.1	3.64E+01	2.89E-07		49.65951
13	0.0625	2.92E-01	3.64E-03			0.2	9.34E+01			0.4	1.11E+02		6.33E+01		5.39E+01		1.89E+01		3.29E+01			44.89367
14	0.125	2.64E-01	$1.5\, FI_{inh}\, DC^g_{inh}$		$(f^{opc}_{oc} + f^{ipc}_{oc})$		8.44E+01		$(f^{ood}_{oc} + f^{iod}_{oc})$		1.01E+02		5.72E+01		4.87E+01		1.71E+01		2.97E+01			40.58522
15	0.1875	2.38E-01					7.63E+01				9.11E+01		5.17E+01		4.40E+01		1.54E+01		2.69E+01			36.69025
16	0.25	S16)					6.90E+01				8.24E+01		4.67E+01		3.98E+01		1.40E+01		2.43E+01			33.16907
17	0.3125	1.95E-01					6.24E+01				7.45E+01		4.23E+01		3.60E+01		1.26E+01		2.20E+01			29.98583
18	0.375	1.76E-01					5.64E+01				6.73E+01		3.82E+01		3.25E+01		1.14E+01		1.99E+01			27.10808
19	0.4375	1.59E-01					5.10E+01				6.09E+01		3.45E+01		2.94E+01		1.03E+01		1.79E+01			24.50651
20	0.5	1.44E-01					4.61E+01				5.50E+01		3.12E+01		2.66E+01		9.32E+00		1.62E+01			22.15461
21	0.5625	1.30E-01					4.17E+01				4.97E+01		2.82E+01		2.40E+01		8.43E+00		1.47E+01			20.02843

Figure 10.26 Screen Shot of Spreadsheet Calculation of the Annual Time-Integrated ^{3}H Inhalation Dose Beginning at 0.25 years

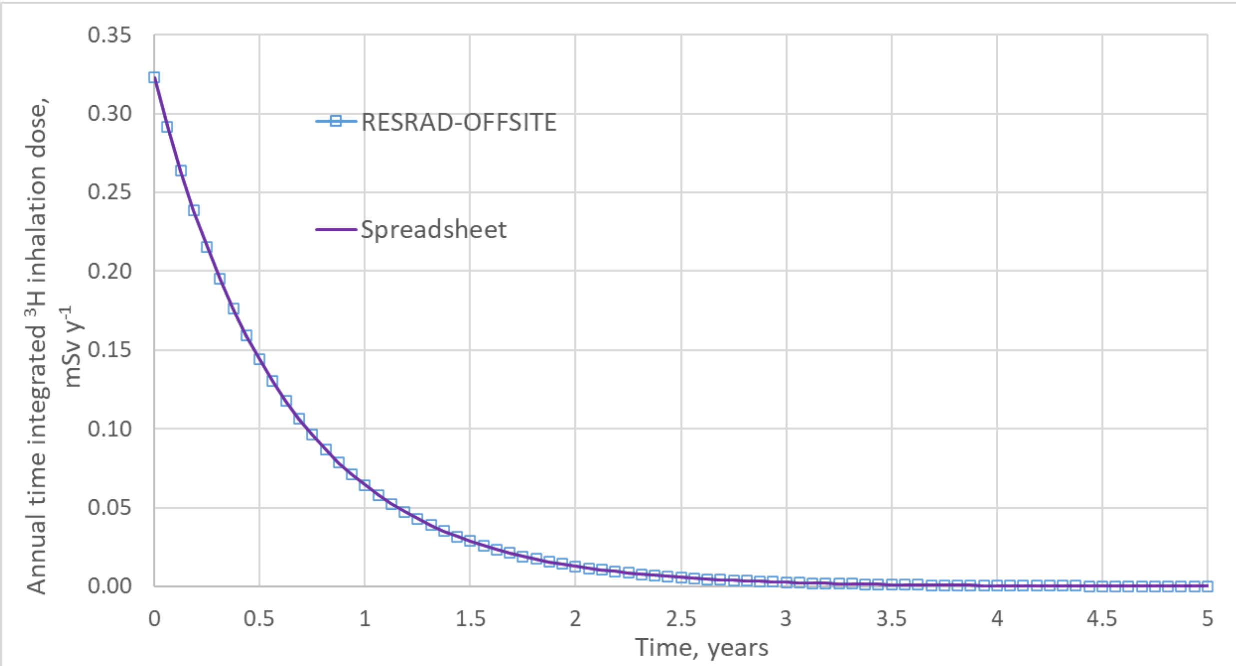


Figure 10.27 Verification of the Annual Time-Integrated ^{3}H Inhalation Dose

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11 VERIFICATION OF ADDITIONAL MODELS FOR ^{14}C

The pre-release verification of the formulations to model the movement and exposure from ^{14}C in the form of carbon dioxide ($^{14}CO_2$) in addition to the movement and exposure from ^{14}C in particulates is documented in this chapter. The verification performed in this chapter provided the basis for the release testing of the special models for ^{14}C.

11.1 TEMPORAL CONCENTRATION IN PRIMARY CONTAMINATION

The calculation of the concentration of ^{14}C in the primary contamination has an additional term to model the evasion of $^{14}CO_2$ out of the primary contamination. The spreadsheet calculations of the initial loss/removal rate of ^{14}C from the primary contamination and the erosion rate, in the tab "inputs," are outlined in Figure 11.1. The calculations of the three components of this loss rate, the radiological transformation rate, the leach rate under the RESRAD-ONSITE exponential release model, and the initial evasion rate are detailed in Figure 11.2, Figure 11.3, and Figure 11.4, respectively.

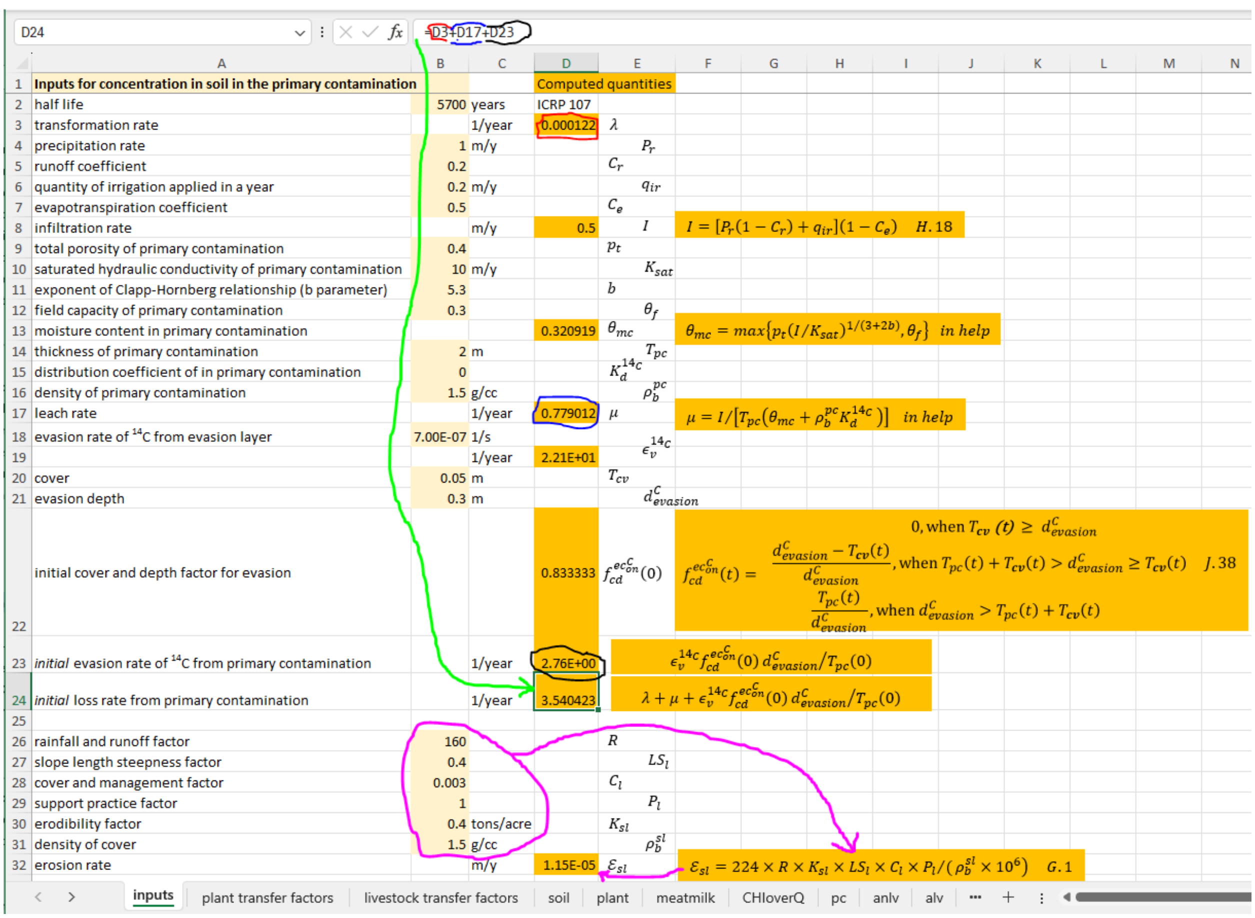


Figure 11.1 Screen Shot of Spreadsheet Calculations of the Initial Loss/Removal Rate of ^{14}C from the Primary Contamination and the Erosion Rate of the Primary Contamination

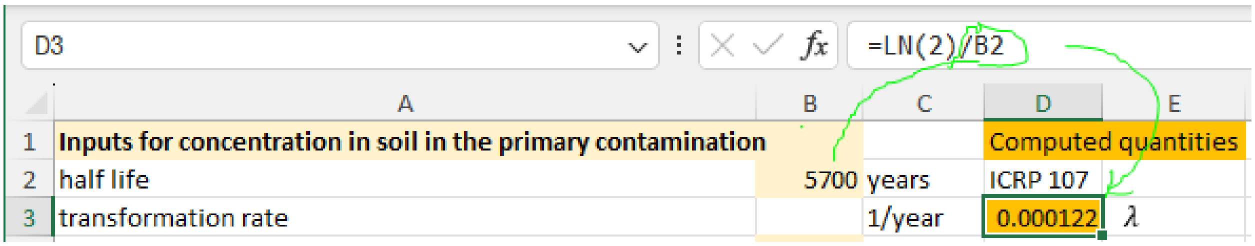


Figure 11.2 Screen Shot of Calculation of the Radiological Transformation Rate of ^{14}C Using the ICRP-107 Half-life

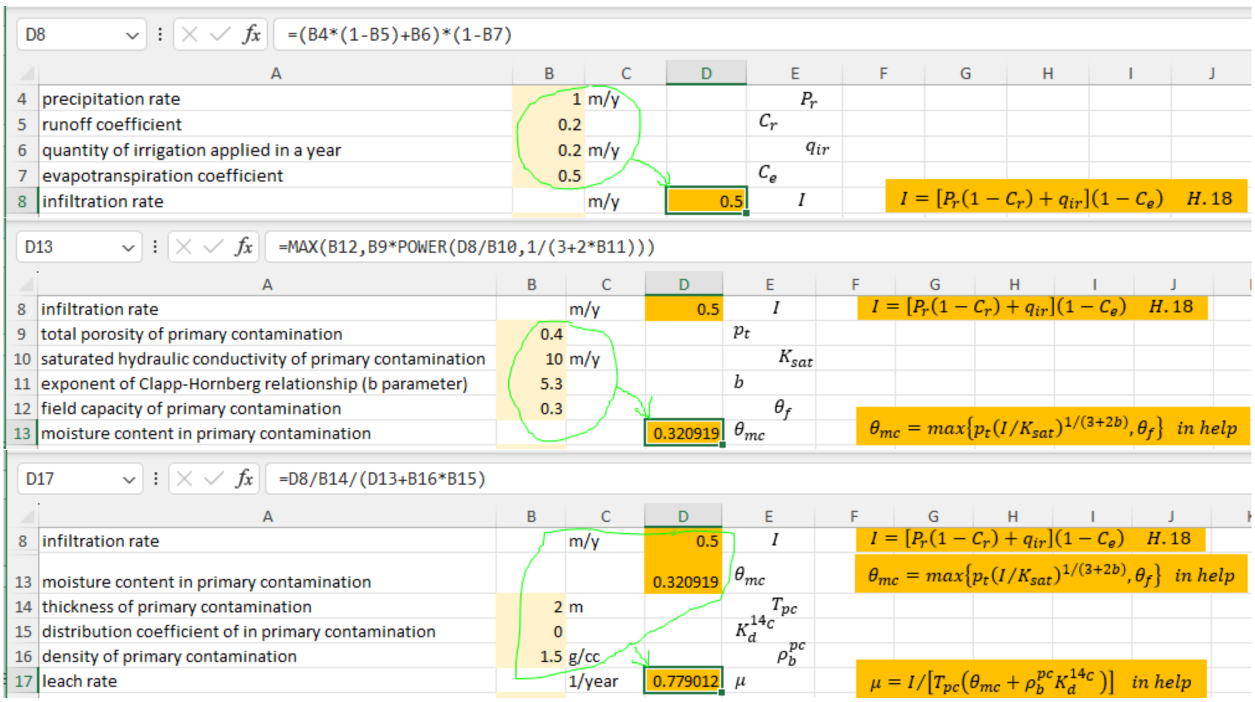


Figure 11.3 Screen Shots of Estimation of the Leach Rate of ^{14}C under the RESRAD-ONSITE Exponential Release Option

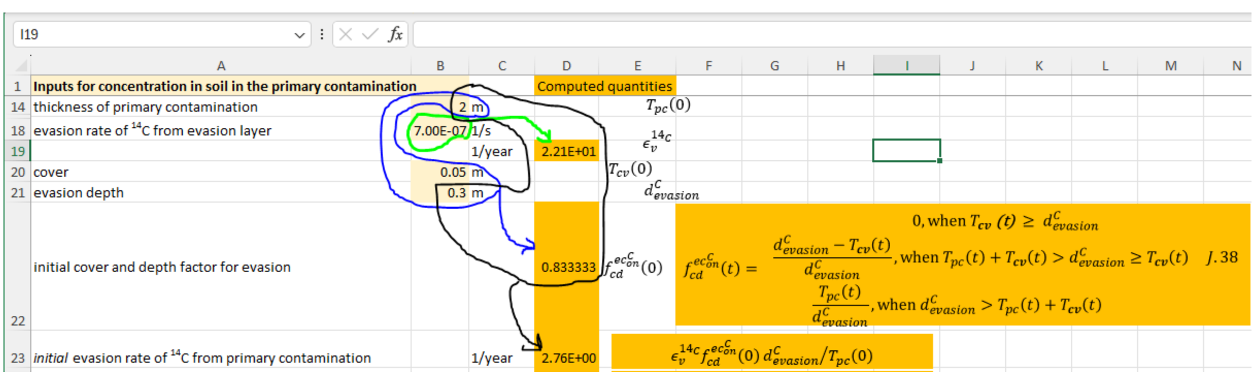


Figure 11.4 Screen Shot of Calculation of the Initial Evasion Rate of ^{14}C from the Primary Contamination

Figure 11.5 illustrates the calculation of the initial rate of loss of ^{14}C from the primary contamination. The calculation of the rate at which the cover above the primary contamination erodes is shown in Figure 11.6. This erosion rate is used to compute the time-dependent thickness of the cover and the time dependence of the fraction of the evasion depth that is contaminated. The computation of the concentration of ^{14}C remaining in the primary contamination at a specific time, 3/16 year, is shown in Figure 11.7; this figure also shows the verification of the concentrations at five different times. Figure 11.8 illustrates the verification of the temporal concentration of ^{14}C remaining in the primary contamination.

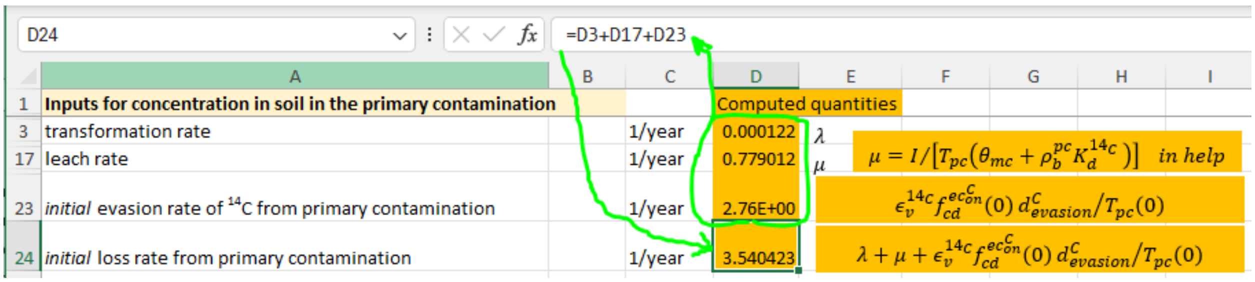


Figure 11.5 Screen Shot of Calculation of the Initial Rate of Removal of ^{14}C from the Primary Contamination Due to Evasion, Radiological Transformations, and Leaching under the RESRAD-ONSITE Exponential Release Option

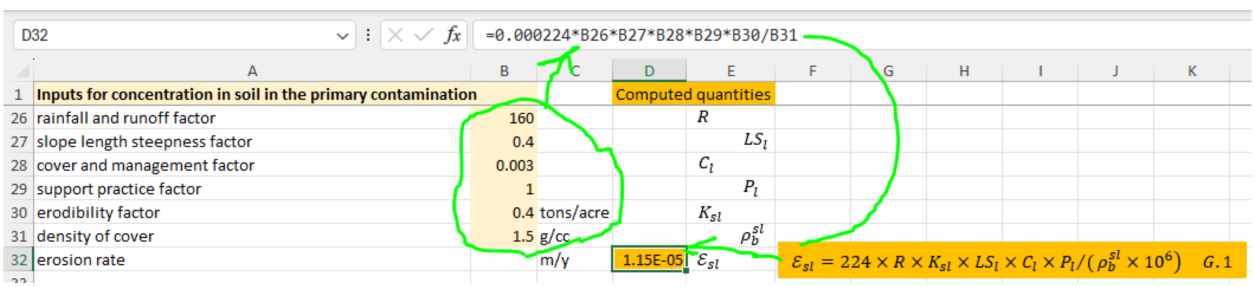


Figure 11.6 Screen Shot of Calculation of the Erosion Rate of the Cover above the Primary Contamination

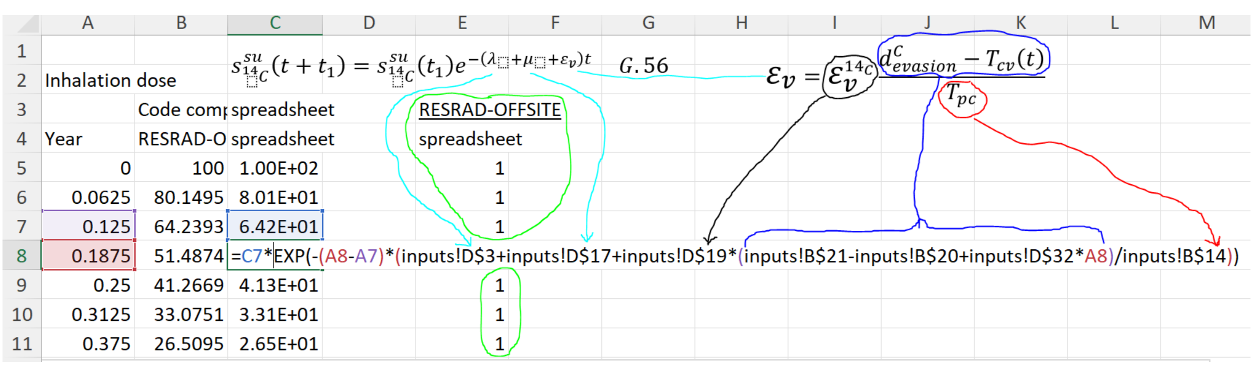


Figure 11.7 Screen Shot of Calculation of the Concentration of ^{14}C Remaining in the Primary Contamination at a Specific Time

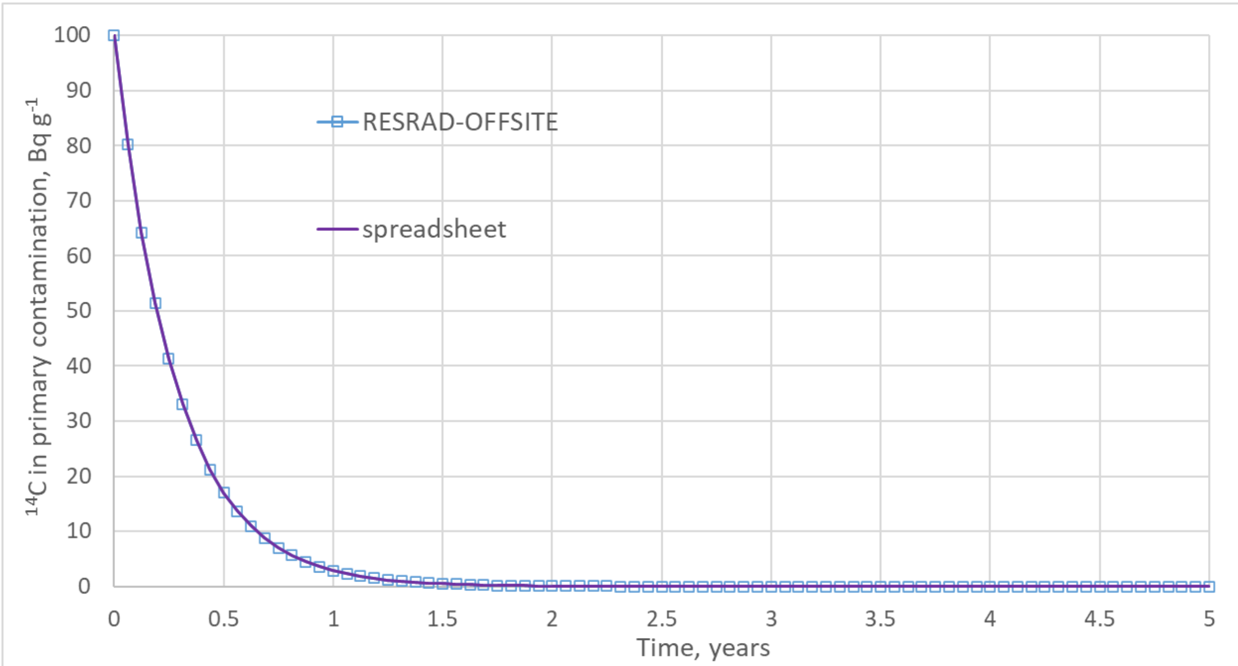
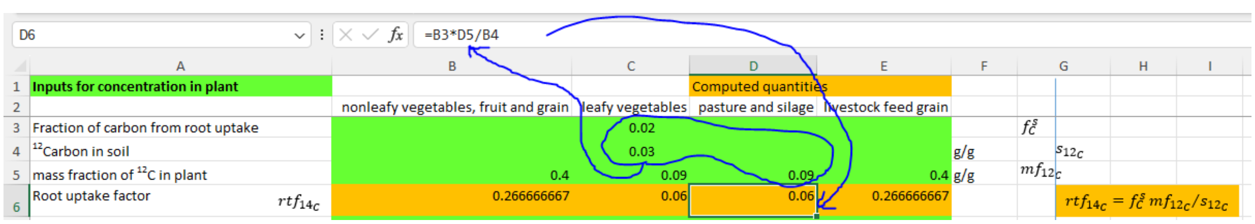


Figure 11.8 Verification of the Temporal Variation of the Concentration of ^{14}C Remaining in the Primary Contamination

11.2 CONCENTRATION IN PLANT

The movement of ^{14}C from the soil to plant by root uptake and from air by photosynthesis are modeled as being the same as the movement of stable carbon. The computation of the soil-to-plant root uptake transfer factor for ^{14}C, based on the fraction of root uptake-derived carbon in the plant, is shown in Figure 11.9.



D6 | =B3*D5/B4

	A	B	C	D	E	F	G
1	Inputs for concentration in plant			Computed quantities			
2		nonleafy vegetables, fruit and grain	leafy vegetables	pasture and silage	livestock feed grain		
3	Fraction of carbon from root uptake		0.02				f_C^s
4	^{12}Carbon in soil		0.03			g/g	s_{12_C}
5	mass fraction of ^{12}C in plant	0.4	0.09	0.09	0.4	g/g	mf_{12_C}
6	Root uptake factor rtf_{14_C}	0.266666667	0.06	0.06	0.266666667		$rtf_{14_C} = f_C^s\, mf_{12_C}/s_{12_C}$

Figure 11.9 Screen Shot of Calculation of Root Transfer Factor of ^{14}C for Each Plant Type

The ^{14}C in plants from the foliar uptake of $^{14}CO_2$ followed by photosynthesis is modeled using air-to-plant concentration ratios when the agricultural fields are not collocated with the primary contamination. The calculation of the air-to-plant concentration ratio is shown in Figure 11.10. The ^{14}C in plants from the foliar uptake of $^{14}CO_2$ and photosynthesis is modeled using the soil-to-air-to-plant concentration ratios for contamination in the agricultural fields. The calculation of the soil-to-air-to-plant concentration ratio is shown in Figure 11.11. The calculation of the cover and depth factor for photosynthesis from secondary contamination at the offsite location is shown in Figure 11.12.

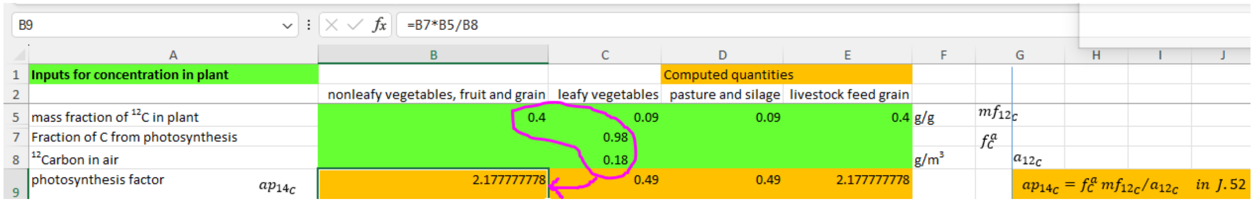


Figure 11.10 Screen Shot of Calculation of Air-to-Plant Concentration Ratios which Are Used to Model Photosynthesis following Atmospheric Transport

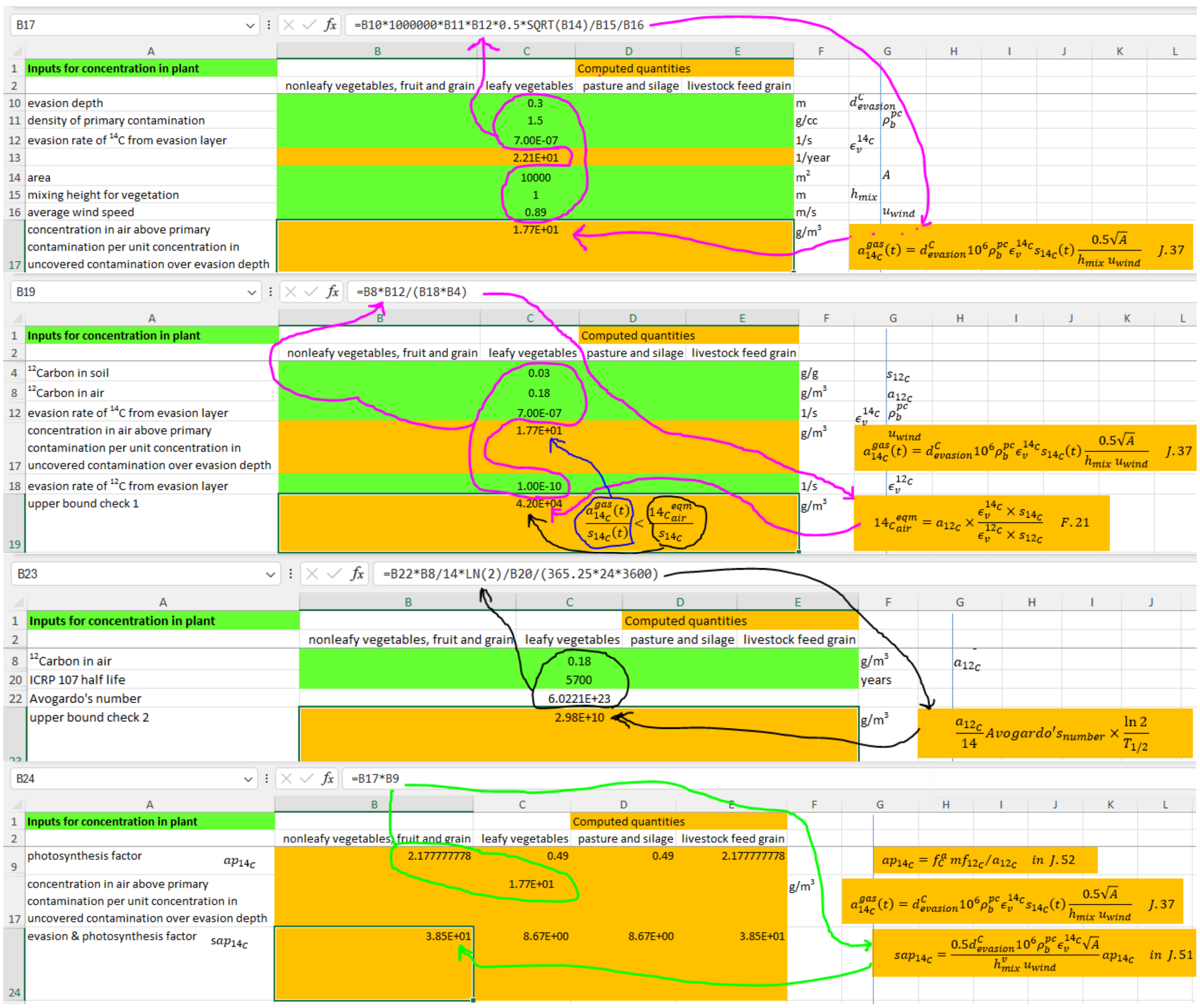


Figure 11.11 Screen Shots of Calculation of Soil-to-Air-to-Plant Concentration Ratios which Are Used to Model Photosynthesis from Contaminated Soil in the Farmed Areas

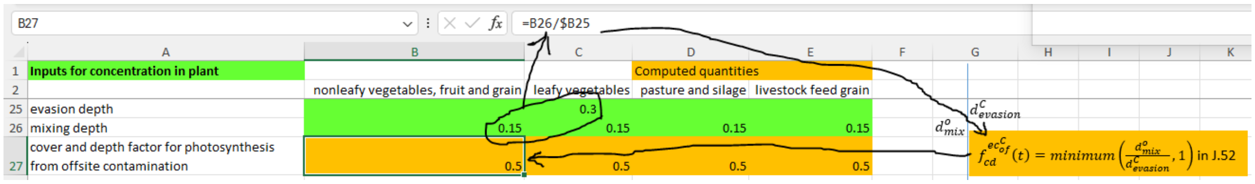


Figure 11.12 Screen Shot of Calculation of Cover and Depth Factor for Photosynthesis Resulting from Secondary Contamination in the Offsite Location

The ^{14}C in plants from the foliar deposition of particles containing it is modeled in the same manner as for the other radionuclides. The computation of the air-to-plant concentration ratios that are used in this model are in shown in Figure 11.13.

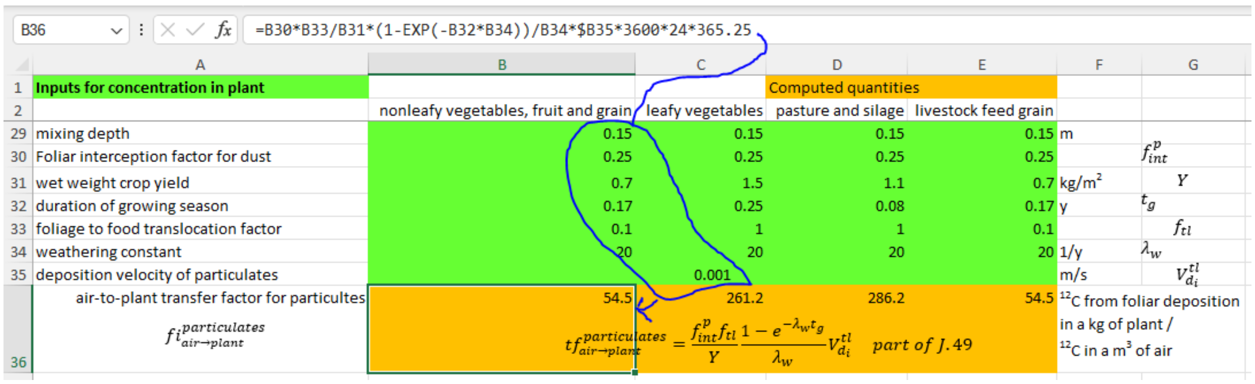


Figure 11.13 Screen Shot of Calculation of Air-to-Plant Concentration Ratios which Are Used to Model Foliar Deposition of particulates

The calculation of the concentration of ^{14}C in plants (fruit, grain, and leafy vegetables) at a specific time, 0.25 years, and the verification of the code calculated value at that time are shown in Figure 11.14. The concentration to release ratios, $\left(\frac{\chi}{Q}\right)_{offsite}^{gas}$, for transport of a gas from the primary contamination to the offsite locations and the concentrations of ^{14}C in the soil and in air used in these calculations were obtained for RESRAD-OFFSITE output. The chi over Q ratios were verified in Section 4.1. The calculation of the concentration in offsite soils was verified in Section 5.2. The component calculations for the concentration of particulates in air were verified in Sections 2.4 and 4.1. The verification of the temporal concentration of ^{14}C in plants (pasture and silage) is shown in Figure 11.15. The figure on the left shows the verification when the concentration is high, while the figure on the right shows the verification during later times when the concentration is orders of magnitude lower.

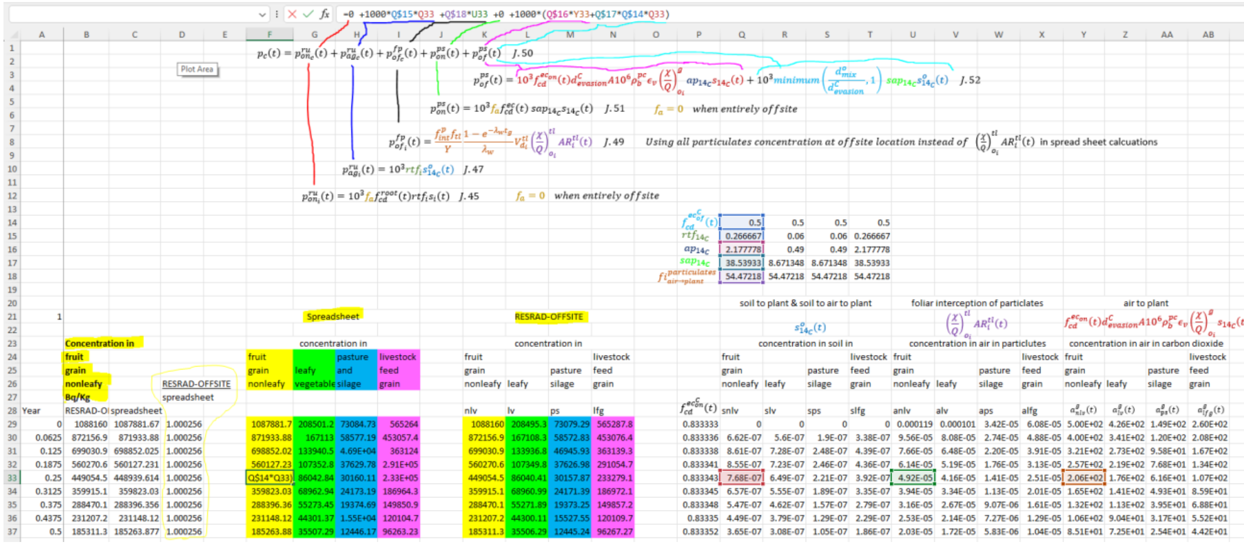


Figure 11.14 Screen Shot of Calculation and Verification of Concentration of ^{14}C in Plants

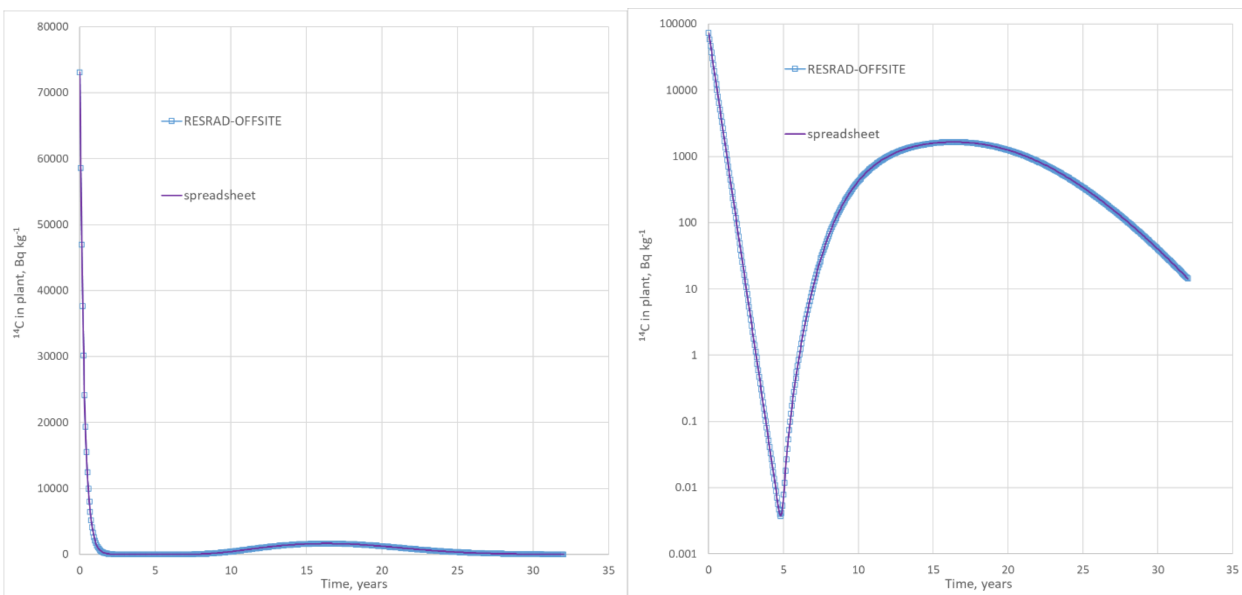
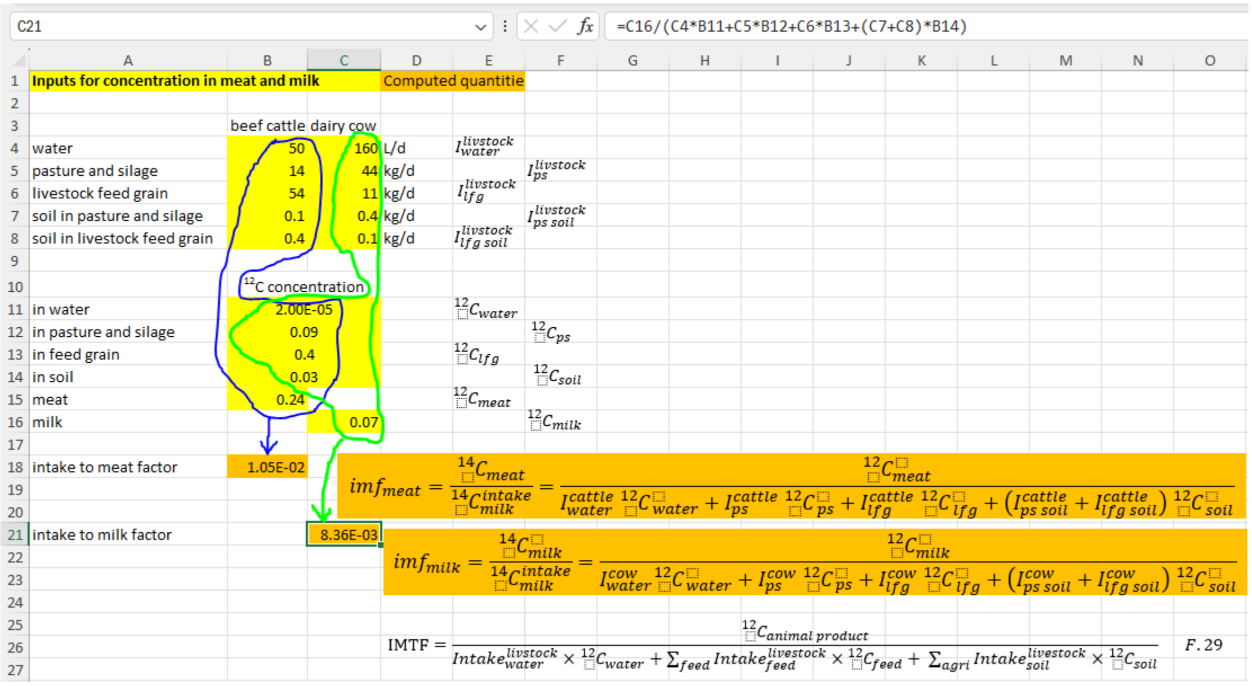


Figure 11.15 Verification of Temporal Variation of ^{14}C Concentration in Plants

11.3 CONCENTRATION IN MEAT AND MILK

The transfer of ^{14}C ingested by the livestock to milk and meat is modeled as being the same as the transfer of stable ^{12}C that is ingested by the livestock to meat and milk. The calculations of the intake to concentration in meat factor and the intake to concentration in milk factor for ^{14}C are shown in Figure 11.16. The use of these factors to compute the concentrations of ^{14}C in meat and milk from livestock water, pasture and silage, feed grain, and the soil associated with the livestock feeds is illustrated in Figure 11.17. The verification of the temporal concentrations of ^{14}C in milk and meat are shown in Figure 11.18 and Figure 11.19, respectively.

The plots on the left of both figures show the verification when the concentration is high, while the plots on the right of both figures show the verification during early times when the concentration is orders of magnitude lower and is mainly due to foliar deposition.



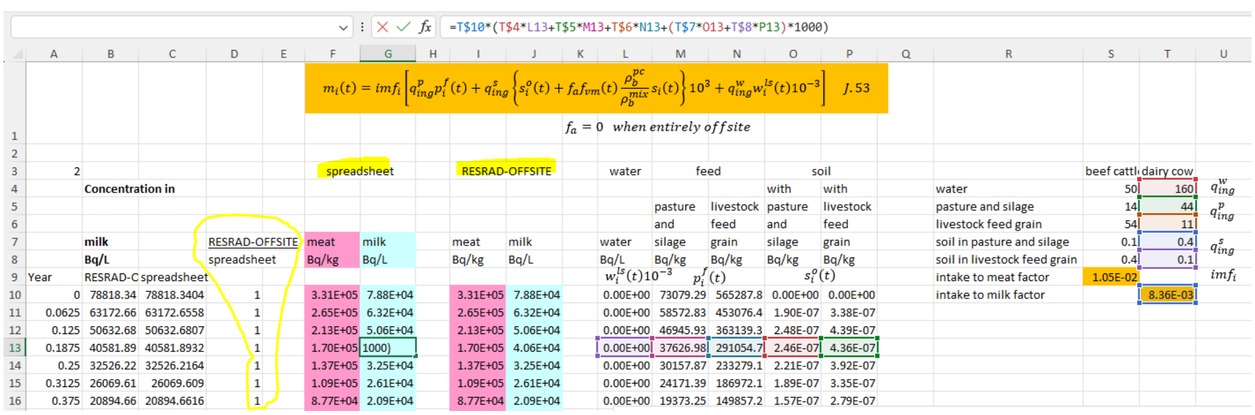
	A	B	C	D	E	F
1	Inputs for concentration in meat and milk			Computed quantitie		
2						
3		beef cattle	dairy cow			
4	water	50	160	L/d	$I^{livstock}_{water}$	
5	pasture and silage	14	44	kg/d		$I^{livstock}_{ps}$
6	livestock feed grain	54	11	kg/d	$I^{livstock}_{lfg}$	
7	soil in pasture and silage	0.1	0.4	kg/d		$I^{livstock}_{ps\ soil}$
8	soil in livestock feed grain	0.4	0.1	kg/d	$I^{livstock}_{lfg\ soil}$	
9						
10		^{12}C concentration				
11	in water	2.00E-05			$^{12}C_{water}$	
12	in pasture and silage	0.09				$^{12}C_{ps}$
13	in feed grain	0.4			$^{12}C_{lfg}$	
14	in soil	0.03				$^{12}C_{soil}$
15	meat	0.24			$^{12}C_{meat}$	
16	milk		0.07			$^{12}C_{milk}$
17						
18	intake to meat factor	1.05E-02				
19						
20						
21	intake to milk factor		8.36E-03			

$$imf_{meat} = \frac{^{14}C_{meat}}{^{14}C^{intake}_{milk}} = \frac{^{12}C_{meat}}{I^{cattle}_{water}\,^{12}C_{water} + I^{cattle}_{ps}\,^{12}C_{ps} + I^{cattle}_{lfg}\,^{12}C_{lfg} + (I^{cattle}_{ps\ soil} + I^{cattle}_{lfg\ soil})\,^{12}C_{soil}}$$

$$imf_{milk} = \frac{^{14}C_{milk}}{^{14}C^{intake}_{milk}} = \frac{^{12}C_{milk}}{I^{cow}_{water}\,^{12}C_{water} + I^{cow}_{ps}\,^{12}C_{ps} + I^{cow}_{lfg}\,^{12}C_{lfg} + (I^{cow}_{ps\ soil} + I^{cow}_{lfg\ soil})\,^{12}C_{soil}}$$

$$\mathrm{IMTF} = \frac{^{12}C_{animal\ product}}{Intake^{livestock}_{water} \times {}^{12}C_{water} + \Sigma_{feed}\, Intake^{livestock}_{feed} \times {}^{12}C_{feed} + \Sigma_{agri}\, Intake^{livestock}_{soil} \times {}^{12}C_{soil}} \quad F.29$$

Figure 11.16 Screen Shot of Intake to Concentration in Meat and Intake to Concentration in Milk Factors for ^{14}C



$$m_i(t) = imf_i\left[q^p_{ing}p^f_i(t) + q^s_{ing}\left\{s^o_i(t) + f_a f_{vm}(t)\frac{\rho^{pc}_b}{\rho^{mix}_b}s_i(t)\right\}10^3 + q^w_{ing}w^{ls}_i(t)10^{-3}\right] \quad J.53$$

$f_a = 0$ when entirely offsite

	A	B	C	D	F	G	I	J	L	M	N	O	P
3	2				spreadsheet		RESRAD-OFFSITE		water	feed		soil	
4		Concentration in										with	with
5										pasture	livestock	pasture	livestock
6										and	feed	and	feed
7		milk		RESRAD-OFFSITE	meat	milk	meat	milk	water	silage	grain	silage	grain
8		Bq/L		spreadsheet	Bq/kg	Bq/L	Bq/kg	Bq/L	Bq/L	Bq/kg	Bq/kg	Bq/kg	Bq/kg
9	Year	RESRAD-C	spreadsheet						$w^{ls}_i(t)10^{-3}$	$p^f_i(t)$		$s^o_i(t)$	
10	0	78818.34	78818.3404	1	3.31E+05	7.88E+04	3.31E+05	7.88E+04	0.00E+00	73079.29	565287.8	0.00E+00	0.00E+00
11	0.0625	63172.66	63172.6558	1	2.65E+05	6.32E+04	2.65E+05	6.32E+04	0.00E+00	58572.83	453076.4	1.90E-07	3.38E-07
12	0.125	50632.68	50632.6807	1	2.13E+05	5.06E+04	2.13E+05	5.06E+04	0.00E+00	46945.93	363139.3	2.48E-07	4.39E-07
13	0.1875	40581.89	40581.8932	1	1.70E+05	1000)	1.70E+05	4.06E+04	0.00E+00	37626.98	291054.7	2.46E-07	4.36E-07
14	0.25	32526.22	32526.2164	1	1.37E+05	3.25E+04	1.37E+05	3.25E+04	0.00E+00	30157.87	233279.1	2.21E-07	3.92E-07
15	0.3125	26069.61	26069.609	1	1.09E+05	2.61E+04	1.09E+05	2.61E+04	0.00E+00	24171.39	186972.1	1.89E-07	3.35E-07
16	0.375	20894.66	20894.6616	1	8.77E+04	2.09E+04	8.77E+04	2.09E+04	0.00E+00	19373.25	149857.2	1.57E-07	2.79E-07

	R	S	T	U
3		beef cattl	dairy cow	
4	water	50	160	q^w_{ing}
5	pasture and silage	14	44	q^p_{ing}
6	livestock feed grain	54	11	
7	soil in pasture and silage	0.1	0.4	q^s_{ing}
8	soil in livestock feed grain	0.4	0.1	
9	intake to meat factor	1.05E-02		imf_i
10	intake to milk factor		8.36E-03	

Figure 11.17 Screen Shot of Calculation and Verification of ^{14}C in Meat and Milk

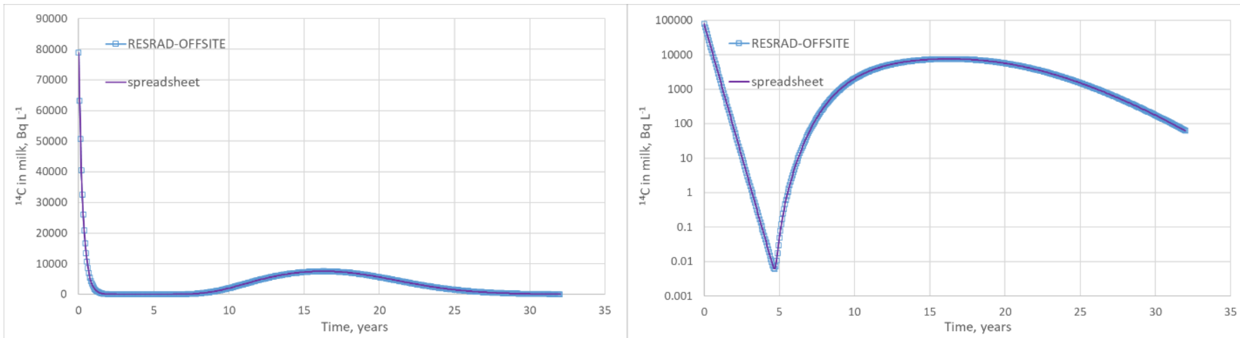


Figure 11.18 Verification of Temporal Concentration of ^{14}C in Milk

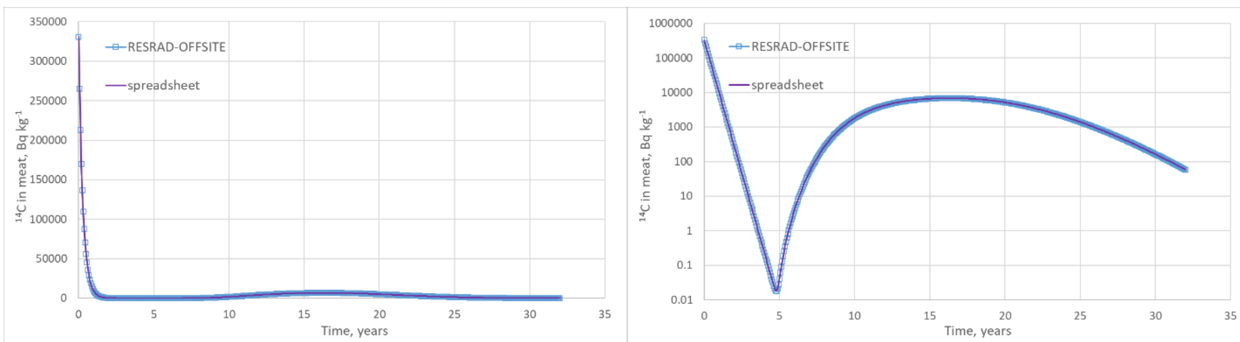


Figure 11.19 Verification of Temporal Concentration of ^{14}C in Meat

11.4 INHALATION

The ^{14}C inhalation dose in RESRAD-OFFSITE 4.0 is modeled as being from the inhalation of both ^{14}C in respirable particles and $^{14}CO_2$. The calculation of the inhalation dose from the ^{14}C in respirable particles is shown in Figure 11.20. The calculation of the concentration of ^{14}C in the air above the primary contamination per unit concentration and the calculation of the rate of release of ^{14}C per unit concentration of ^{14}C in the primary contamination are shown in Figure 11.21. The calculation of the time-integrated concentration of ^{14}C in the air above the primary contamination over a period of a year beginning at 0.25 years is shown in Figure 11.22. The calculation of the time-integrated concentration of ^{14}C in the air above the offsite dwelling location over a period of a year beginning at 0.25 years is shown in Figure 11.23. The calculation of the inhalation dose from inhaling $^{14}CO_2$ is shown in Figure 11.24. The computation of the ^{14}C inhalation dose from both the respirable particles and carbon dioxide is shown in Figure 11.25. The temporal variation of the ^{14}C inhalation dose is verified in Figure 11.26.

`=C$9*(F$9*G12+J$9*K12+L$8*M12+N$8*O12+P$8*Q12+R$8*S12)`

$$D_{inh}^{rp}(t) = FI_{inh}\left[\left(f_{oc}^{opc} + f_{oc}^{ipc}F_{du}\right)\int_t^{t+1} a_{pc}^{rp}(t)\,dt + \left(f_{oc}^{ood} + f_{oc}^{iod}F_{du}\right)\int_t^{t+1} a_{od}^{rp}(t)\,dt + \sum_{i=1}^{4} f_{oc}^{ag\,i}\int_t^{t+1} a_{ag\,i}^{rp}(t)\,dt\right] DC_{inh}^{rp} \quad recasting\ C.6$$

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
5			DC_{inh}^{rp}	6.15E-06			$\int_t^{t+1} a_{pc}^{rp}(t)\,dt$				$\int_t^{t+1} a_{od}^{rp}(t)\,dt$		$\int_t^{t+1} a_{nlv}^{rp}(t)\,dt$		$\int_t^{t+1} a_{lv}^{rp}(t)\,dt$		$\int_t^{t+1} a_{ps}^{rp}(t)\,dt$		$\int_t^{t+1} a_{ifg}^{rp}(t)\,dt$
7	Year		FI_{inh}	f_{oc}^{opc}	f_{oc}^{ipc}	F_{du}		f_{oc}^{ood}	f_{oc}^{iod}	F_{du}		f_{oc}^{nlv}		f_{oc}^{lv}		f_{oc}^{ps}		f_{oc}^{ifg}	
8	0	7.61E-06	8400	0.1	0.1	0.4	8.47E-04	0.1	0.3	0.4	7.82E-05	0.1	4.32E-05	0.1	3.65E-05	0.1	1.24E-05	0.1	2.2E-05
9	0.0625	5.89E-06	5.17E-02			0.14	6.56E-04			0.22	6.06E-05		3.35E-05		2.83E-05		9.6E-06		1.71E-05
10	0.125	4.56E-06	$1.5\ FI_{inh}\ DC_{inh}^{rp}$		$\left(f_{oc}^{opc} + f_{oc}^{ipc}F_{du}\right)$		5.08E-04	$\left(f_{oc}^{ood} + f_{oc}^{iod}F_{du}\right)$			4.69E-05		2.59E-05		2.19E-05		7.43E-06		1.32E-05
11	0.1875	3.53E-06					3.93E-04				3.63E-05		2.01E-05		1.7E-05		5.76E-06		1.02E-05
12	0.25	S12)					3.04E-04				2.81E-05		1.55E-05		1.31E-05		4.46E-06		7.92E-06
13	0.3125	2.12E-06					2.36E-04				2.18E-05		1.2E-05		1.02E-05		3.45E-06		6.13E-06
14	0.375	1.64E-06					1.83E-04				1.69E-05		9.31E-06		7.87E-06		2.67E-06		4.75E-06
15	0.4375	1.27E-06					1.41E-04				1.31E-05		7.21E-06		6.1E-06		2.07E-06		3.68E-06
16	0.5	9.83E-07					1.09E-04				1.01E-05		5.58E-06		4.72E-06		1.6E-06		2.85E-06

Figure 11.20 Screen Shot of Computation of Inhalation Dose from ^{14}C in Respirable Particulates

	A	B	C	D and following
1	**Inputs for concentration in plant**			
2		primary contamination		
3	^{12}Carbon in soil	0.03	g/g	s_{12C}
4	^{12}Carbon in air	0.18	g/m^3	a_{12C}
5	evasion depth	0.3	m	$d_{evasion}^{C}$
6	density of primary contamination	1.5	g/cc	ρ_b^{pc}
7	evasion rate of ^{14}C from evasion layer	7.00E-07	1/s	ϵ_v^{14C}
8		2.21E+01	1/year	
9	area	10000	m^2	A
10	mixing height for vegetation	2	m	h_{mix}
11	average wind speed	0.89	m/s	u_{wind}
12	concentration in air above primary contamination per unit concentration in uncovered contamination over evasion depth	8.85E+00	g/m^3	$a_{14C}^{gas}(t) = d_{evasion}^{C}10^6\rho_b^{pc}\epsilon_v^{14C}s_{14C}(t)\dfrac{0.5\sqrt{A}}{h_{mix}\,u_{wind}}$ J.37
13	evasion rate of ^{12}C from evasion layer	1.00E-10	1/s	
14	upper bound check 1	4.20E+04 $\dfrac{a_{14C}^{gas}(t)}{s_{14C}(t)} < \dfrac{14C_{air}^{eqm}}{s_{14C}}$	g/m^3	$14C_{air}^{eqm} = a_{12C} \times \dfrac{\epsilon_v^{14C} \times s_{14C}}{\epsilon_v^{12C} \times s_{12C}}$ F.21
15	ICRP 107 half life	5700	years	
16	transformation rate	0.000121605	1/year	λ
17	Avogardo's number	6.0221E+23		
18	upper bound check 2	2.98E+10	g/m^3	$\dfrac{a_{12C}}{14}Avogardo's_{number} \times \dfrac{\ln 2}{T_{1/2}}$
19	cover	0	m	$T_{cv}(0)$
20	thickness of primary contamination	2	m	$T_{pc}(0)$
21	cover	0	m	
22	evasion depth	0.3	m	
23	initial cover and depth factor for evasion	1	$f_{cd}^{ec_{on}^{C}}(0)$	$f_{cd}^{ec_{on}^{C}}(t) = \begin{cases} 0, \text{when } T_{cv}(t) \geq d_{evasion}^{C} \\ \dfrac{d_{evasion}^{C} - T_{cv}(t)}{d_{evasion}^{C}}, \text{when } T_{pc}(t) + T_{cv}(t) > d_{evasion}^{C} \geq T_{cv}(t) \\ \dfrac{T_{pc}(t)}{d_{evasion}^{C}}, \text{when } d_{evasion}^{C} > T_{pc}(t) + T_{cv}(t) \end{cases}$ J.38
24	concentration of ^{14}C in air above primary contamination per unit concentration in primary contamination	8.85E+00	g/m^3	$a_{pc}^{14CO_2}(0)$; $a_{pc}^{14CO_2}(t) = f_{cd}^{ec_{on}^{C}}(t)\ a_{14C}^{gas}(t)$
25	rate of release of ^{14}C per unit concentration in primary contamination	3.15E+03	g/s	$a_{o_i}^{14CO_2}(t) \Big/ \left(s_{14C}(t)\left(\dfrac{\chi}{Q}\right)_{o_i}^{g}\right)$; $a_{o_i}^{14CO_2}(t) = f_{cd}^{ec_{on}}(t)d_{evasion}^{C}10^6\rho_b^{pc}\epsilon_v^{C}A s_{14C}(t)\left(\dfrac{\chi}{Q}\right)_{o_i}^{g}$ J.43 for ^{14}C

Figure 11.21 Screen Shot of Calculation of the Concentration of ^{14}C in Air above the Primary Contamination per Unit Concentration in the Primary Contamination and the Rate of Release of ^{14}C per Unit Concentration in Primary Contamination

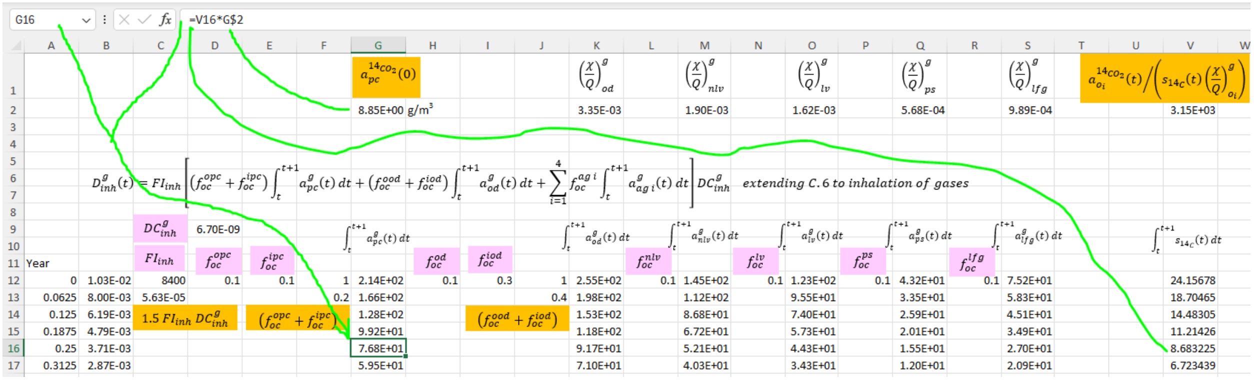


Figure 11.22 Screen Shot of the Calculation of the Annual Time-Integrated Concentration of ^{14}C in Air above the Primary Contamination at 0.25 Years

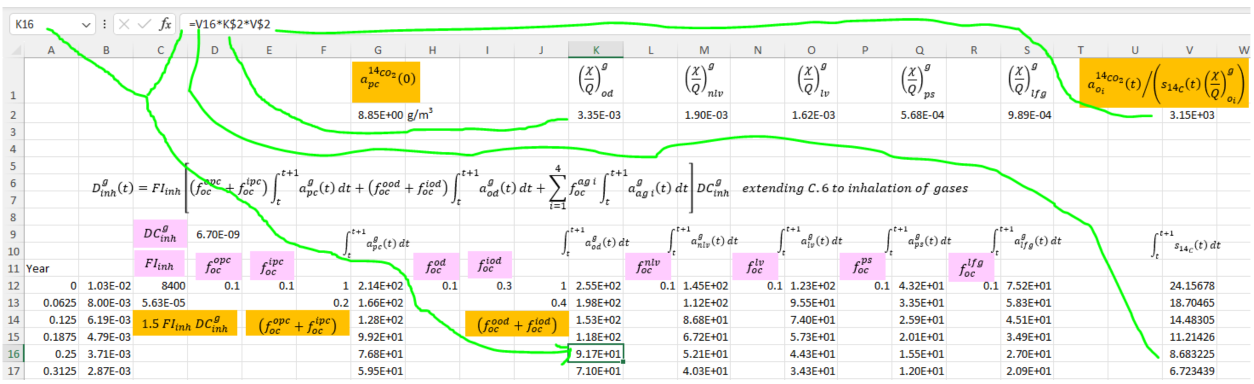


Figure 11.23 Screen Shot of the Calculation of the Annual Time-Integrated Concentration of ^{14}C in Air above the Offsite Dwelling Site at 0.25 Years

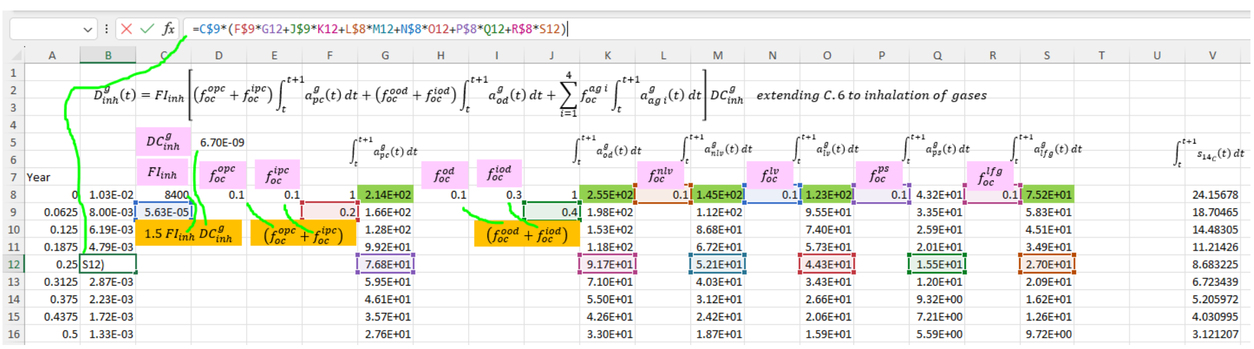


Figure 11.24 Screen Shot of Computation of Inhalation Dose from the Inhalation of $^{14}CO_2$

	A	B	C	D	E	F	G	H
1	Inhalation dose							
2					RESRAD-OFFSITE		gas	particulate
3	Year	RESRAD-OFFSITE	spreadsheet		Spreadsheet			
4	0	1.03E-02	=G4+H4		1.00		1.03E-02	7.61E-06
5	0.0625	8.00E-03	8.00E-03		1.00		8.00E-03	5.89E-06
6	0.125	6.20E-03	6.20E-03		1.00		6.19E-03	4.56E-06
7	0.1875	4.80E-03	4.80E-03		1.00		4.79E-03	3.53E-06
8	0.25	3.71E-03	3.71E-03		1.00		3.71E-03	2.73E-06
9	0.3125	2.88E-03	2.88E-03		1.00		2.87E-03	2.12E-06
10	0.375	2.23E-03	2.23E-03		1.00		2.23E-03	1.64E-06
11	0.4375	1.72E-03	1.72E-03		1.00		1.72E-03	1.27E-06
12	0.5	1.34E-03	1.34E-03		1.00		1.33E-03	9.83E-07

Figure 11.25 Screen Shot of the Calculation of the ^{14}C Inhalation Dose from Respirable Particles and Carbon Dioxide

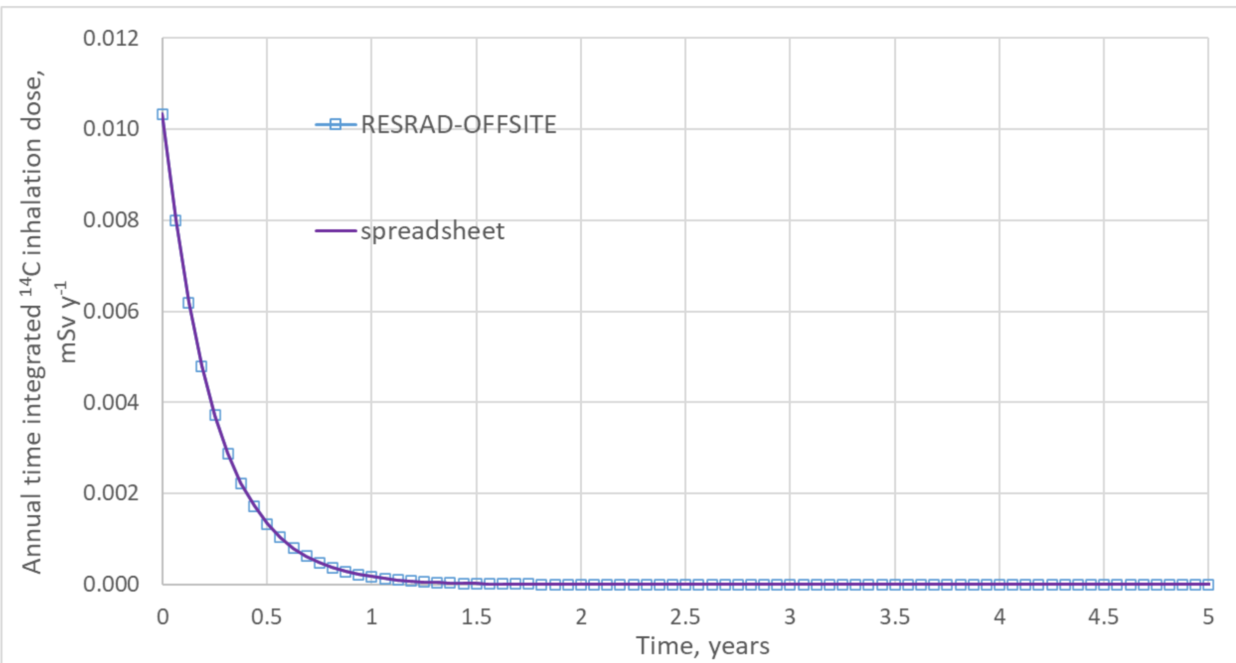


Figure 11.26 Verification of the Temporal Variation of the ^{14}C Inhalation Dose

APPENDIX 1: COMPONENTS OF RESRAD-OFFSITE VERSION 4.0

1.1 MAIN USER INTERFACE, RESOWIN.EXE

Purpose of ResOwin.exe: This is the main interface of RESRAD-OFFSITE which pops up when the code is launched. It is used to perform the following:

1. To activate the exposure pathways, to input the site-specific values, to make choices to define the scenario being analyzed, and to write this information to the input files to be used by some of the other executables.
2. To specify the radionuclide transformation data and associated inputs to be used for the analysis and to generate the transformation chain data for the computational code.
3. To select the dose and slope factor library to be used for the analysis and to write the dose and risk factor library files for the computational code.
4. To specify sensitivity analysis on inputs.
5. To specify probabilistic/uncertainty analysis and to specify relationships between input variables.
6. To facilitate the computation of area factors using the probabilistic analysis feature with relationships.
7. To launch the appropriate FORTRAN executables to perform deterministic, sensitivity, and probabilistic/uncertainty analyses.
8. To view the text output.
9. To launch the deterministic graphics viewer.
10. To view the probabilistic/uncertainty graphics.
11. To view help information about any input or option in the interface.
12. To view pdf files of the User's Manual, the user's guide to the code.
13. To launch the dose conversion factor editor.

Data Files Read by ResOwin.exe:

1. RESRADOF.INI is an ASCII file that contains the user preferences for the appearance of the interface and the names of the directories that contain the dose conversion factor files, the meteorological files, and the input files. The interface will create this file if it is missing. It will also rewrite this file every time the code is exited to reflect current user preferences.
2. VARIABOF.inf is an ASCII file that contains for each variable, the active pathway codes, the bounds, the default value, the FORTRAN name, the descriptive name and units, the name of the primary form the variable resides in, and the RESRAD default distribution.
3. NewICRP38.idx is an ASCII file that contains the radionuclide transformation data in International Commission on Radiological Protection Pub. 38 (ICRP-38) (ICRP 1983) and the RESRAD default distribution coefficients for each radionuclide.
4. ICRP-07.NDX is an ASCII file that contains the radionuclide transformation data in International Commission on Radiological Protection Pub. 1047 (ICRP-107) (ICRP 2008).

5. ICRP-07_Kd.NDX is an ASCII file that contains the RESRAD default distribution coefficients for the radionuclides in ICRP-107.
6. NucDist.inf is an ASCII file that contains the RESRAD default probabilistic distributions for radionuclide-dependent properties.
7. The DCF database files Master_dcf_2k.mdb and Master_dcf_ICRP07.mdb contain the dose conversion factors, slope factors, and transfer factors for the ICRP-38 and ICRP-107 radionuclides, respectively.
8. Current.lib is an ASCII file created by the interface, and it contains the dose and risk factors from the currently selected library. It is rewritten every time the dose or slope factor library is changed in the Title form.
9. Default.lib is an ASCII file created by the interface that contains the dose and risk factors from the current default library. It is rewritten every time a dose or slope factor library change in the Title form necessitates a new default library.
10. MyFonts.dat is an ASCII file containing information about the fonts and the printer driver installed on the computer. It is generated by the code if it is missing. It should be regenerated if the fonts installed on the computer are changed.
11. Message.fil is a single-line text file indicating the computation being performed in the FORTRAN executables.
12. *Input file name*.NID.CSV is a comma-separated values file containing all the radionuclide-independent inputs in the input file currently in the interface.
13. *Input file name*.NDP.CSV is a comma-separated values file containing all the radionuclide-dependent inputs in the input file currently in the interface.

Pdf Files Available from ResOwin.exe:

1. UsersGuide.pdf, Volume 2 of the User's Manual for RESRAD-OFFSITE code Version 4 is accessible via the Help menu.
2. UsersManual.pdf, Volume 1 of the User's Manual for RESRAD-OFFSITE code Version 4 is accessible via the Help menu.
3. MapGuideRO.pdf describes how to use the map interface and is accessible via a button on the map interface.
4. GWFlowlineRO.pdf describes how to input a curved flow path in the map interface and is accessible via a button on the trace groundwater path view of the map interface.
5. AreaFactors.pdf describes the procedure for computing area factors.

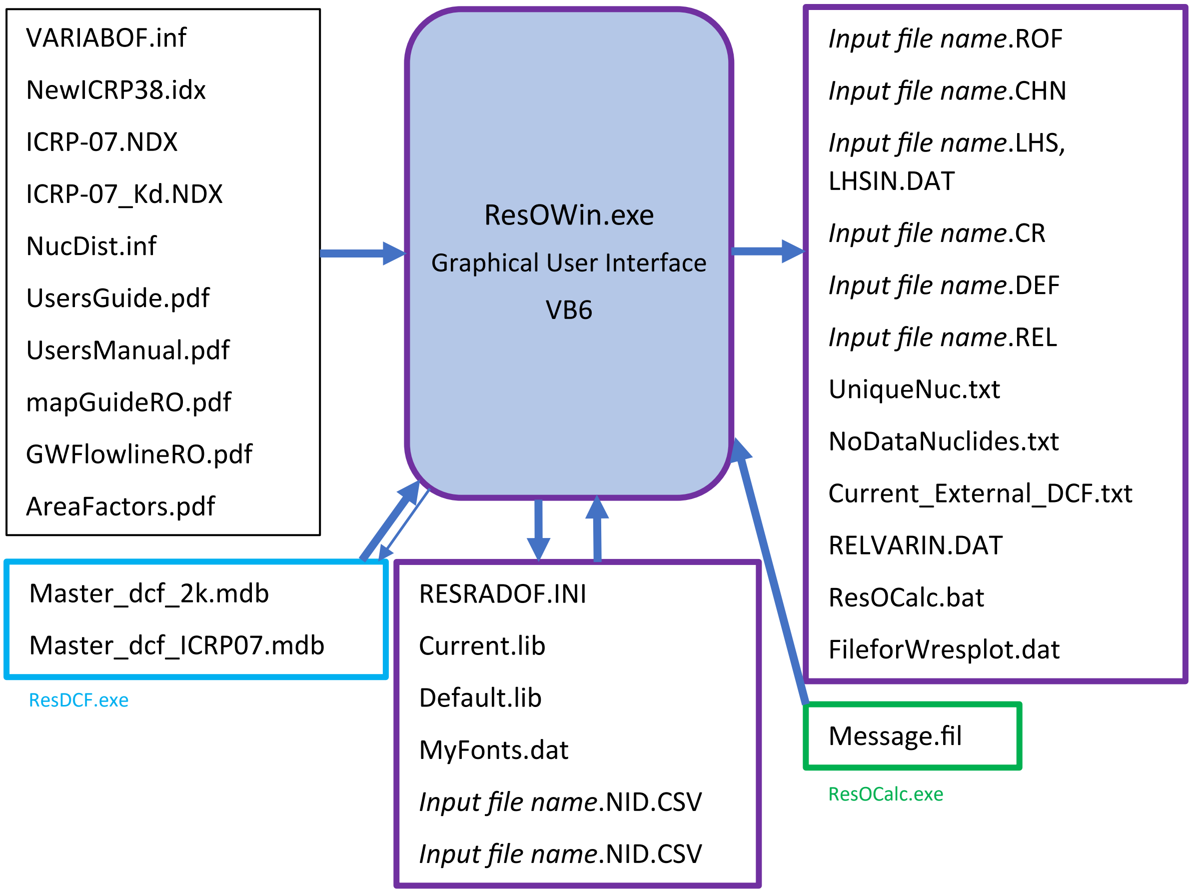
Data Files Written by ResOwin.exe:

1. RESRADOF.INI is an ASCII file that contains the user preferences for the appearance of the interface and the names of the directories that contain the dose conversion factor files, the meteorological files, and the input files. The interface will create this file if it is missing. It will also rewrite this file every time the code is exited to reflect the current user preferences.
2. *Input file name*.ROF is an ASCII file containing the values for all the input variables used in RESRAD-OFFSITE to define the scenario.

3. *Input file name*.CHN is an ASCII file containing the transformation chain data for the radionuclides in the scenario being analyzed.
4. *Input file name*.LHS is an ASCII file containing the probabilistic/uncertainty distributions for the variables selected for probabilistic/uncertainty analyses in the scenario being analyzed.
5. *Input file name*.CR is an ASCII file specifying the probabilistic/uncertainty outputs that are to be subjected to linear regression analysis with the variables selected for probabilistic/uncertainty analyses in the scenario being analyzed.
6. *Input file name*.DEF is an ASCII file containing the default values for all the variables used in RESRAD-OFFSITE to define the scenario. This file is deleted when the computational code completes its calculations.
7. *Input file name*.REL is an ASCII file containing any relationships between variables, with variables selected for probabilistic/uncertainty analysis being among the “independent” variables.
8. *Input file name*.NID.CSV is a comma-separated values file containing externally formatted values for all the radionuclide-independent inputs in the input file currently in the interface.
9. *Input file name*.NDP.CSV is a comma-separated values file containing externally formatted values for all the radionuclide-dependent inputs in the input file currently in the interface.
10. Current.lib is an ASCII file that contains the dose and risk factors from the currently selected library. It is rewritten every time the dose or slope factor library is changed in the Title form.
11. Default.lib is an ASCII file that contains the dose and risk factors from the current default library. It is rewritten every time a dose or slope factor library change in the Title form necessitates a new default library.
12. UniqueNuc.txt is a text file containing the number and names of all the radionuclides in the transformation chain of the radionuclides in the current input file.
13. NoDataNuclides.txt is a text file containing a list of radionuclides missing one or more dose or slope factor.
14. Current_External_DCF.txt is a text file containing the default external exposures dose factors, the scenario-specific external exposure dose and slope factors, and the fitting factors for all the radionuclides in the current input file.
15. MyFonts.dat is an ASCII file containing information about the fonts and the printer driver installed on the computer. It is generated by the code if it is missing. It should be regenerated if the fonts installed on the computer are changed.
16. RELVARIN.DAT is an ASCII file containing the description of the dependent related variables, the relationship between the variables, and the sample values of the dependent related variables.
17. FileforWresplot.dat contains the names of the graphics file and the input file.

Batch File Written by ResOwin.exe:

1. ResOCalc.bat is the set of instructions for executing the FORTRAN executables necessary to perform the calculations for the current input file.



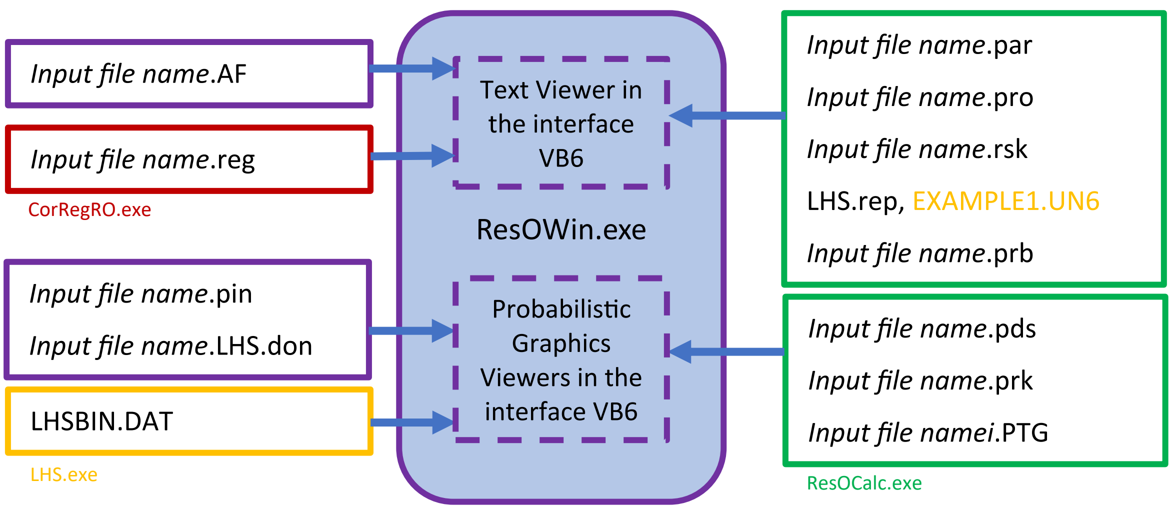
Data Transfer Diagram for ResOWin.exe

Text Reports Read and Displayed in the Text Viewer within ResOWin:

1. SUMMARY.REP or *Input file name*.par contains the table of contents and the text of the main report consisting of the input echo, dose attributed to the initially present radionuclides, soil guideline, and run time information.
2. INTRISK.REP or *Input file name*.rsk contains the table of contents and the text of the intake and risk report.
3. DAUDOSE.REP or *Input file name*.pro contains the table of contents and the text of the dose attributed to the radionuclides at the location and time of exposure report.
4. MCSUMMAR.REP or *Input file name*.prb contains the table of contents and the probabilistic text report.
5. LHS.REP or *Input file name*.smp contains the probabilistic sampling report of LHS.exe, EXAMPLE1.UN6, with a table of content added to it.
6. Regression.REP or *Input file name*.reg contains the regression coefficient of the dependent variables sorted in the order of importance.
7. AreaFactorText.REP or *Input file name*.AF contains tables of the area factors for each radionuclide in file executed under generate area factors option.

Data Files Read and Displayed in the Probabilistic Graphics Viewers within ResOWin:

1. *Input file name*.LHS.don, identical to *Input file name*.LHS , is an ASCII file containing the probabilistic/uncertainty distributions for the variables selected for probabilistic/uncertainty analyses in the scenario being analyzed. This file is created after the input variables have been sampled to indicate that the sampling has been performed.
2. *Input file name*.pin, identical to LHSBIN.DAT, is an ASCII file containing the sample values for each variable selected for probabilistic/uncertainty analysis. This file is created after the input variables have been sampled to indicate that the sampling has been performed.
3. *Input file name*.rel is an ASCII file containing any relationships between variables, with variables selected for probabilistic/uncertainty analysis being among the “independent” variables and the sample values for any related variables.
4. *Input file name*.pds, identical to UNCPEAK.ASC, is an ASCII file containing the peak doses and the times of the peak doses (grand total, total for each pathway, and total for each radionuclide) for each probabilistic simulation.
5. *Input file name*.prk, identical to UNCPEAKR.ASC, is an ASCII file containing the peak risks (grand total, total for each pathway, and total for each radionuclide) for each probabilistic simulation.
6. *Input file namei*.PTG, where *i* is any number from 1 to the number of repetitions, is an ASCII file containing the probabilistic temporal graphics data.



Data Transfer Diagram for the Text and Probabilistic Graphics Viewers in ResOWin.exe

1.2 MAIN COMPUTATIONAL CODE, RESOCALC.EXE

Purpose of ResOCalc.exe: This is the main computational executable of RESRAD-OFFSITE which computes the dose, risk, and concentration for deterministic, sensitivity, and probabilistic/uncertainty runs.

Description of ResOCalc.exe: This computational executable reads the data files; performs a sequence of computations to calculate the concentration in environmental media, radiological dose, and excess cancer risk to a single receptor; and outputs the results to a number of text and binary files. The executable repeats the sequence of calculations for sensitivity and probabilistic/uncertainty simulations after changing the values of the variables selected for sensitivity or probabilistic/uncertainty analysis.

This computational code does the following in sequence:

1. Reads the dimensions for dynamically allocatable variables from the DB Name list part of the input file; use these to allocate the variables just before the call to the subroutine that uses the variables.
2. Reads from Current_External_DCF.txt the external exposure dose (default and current) and slope (current) factors and fitting factors for all the radionuclides in the current input file.
3. Reads the default values and the scenario-specific values of the inputs from the default (*.DEF) and the input (*.ROF) files.
4. Reads from the chain file (*.CHN) the radionuclide transformation data.
5. Performs the calculations that need to be done only once for an input file; these are the calculations that do not need to be repeated for different calculation times nor for sensitivity nor probabilistic runs.
6. For probabilistic runs, reads the probabilistic distributions and the probabilistic sample values for each variable selected for probabilistic/uncertainty analysis. Also reads in sample values for any related variables.
7. For sensitivity runs, sets the current sensitivity analysis input to the appropriate value. Resets previous sensitivity analysis input to base value.
8. Performs the calculations that need to be done once for a deterministic run and once for each sensitivity or probabilistic/uncertainty simulation.
9. Computes or reads the activity in and the releases from the primary contamination for each computation time.
10. Performs atmospheric transport calculations for each computation time.
11. Performs groundwater transport calculations to compute the concentration in well water and input rate to a surface water body at each computation time; or reads the concentration in well water.
12. Computes or reads the concentration in the surface water at each computation time.
13. Computes the concentrations in the agricultural areas, in plant, meat, and milk at each computation time.
14. Computes dose and risk from each of the nine exposure pathways and finds the peak dose.
15. Writes text reports.
16. For runs that include both sensitivity analysis and probabilistic/uncertainty analysis, sets the last sensitivity analysis input to its base value.
17. Determines the statistics for the probabilistic dose and risk.

Data Files Read by ResOCalc.exe:

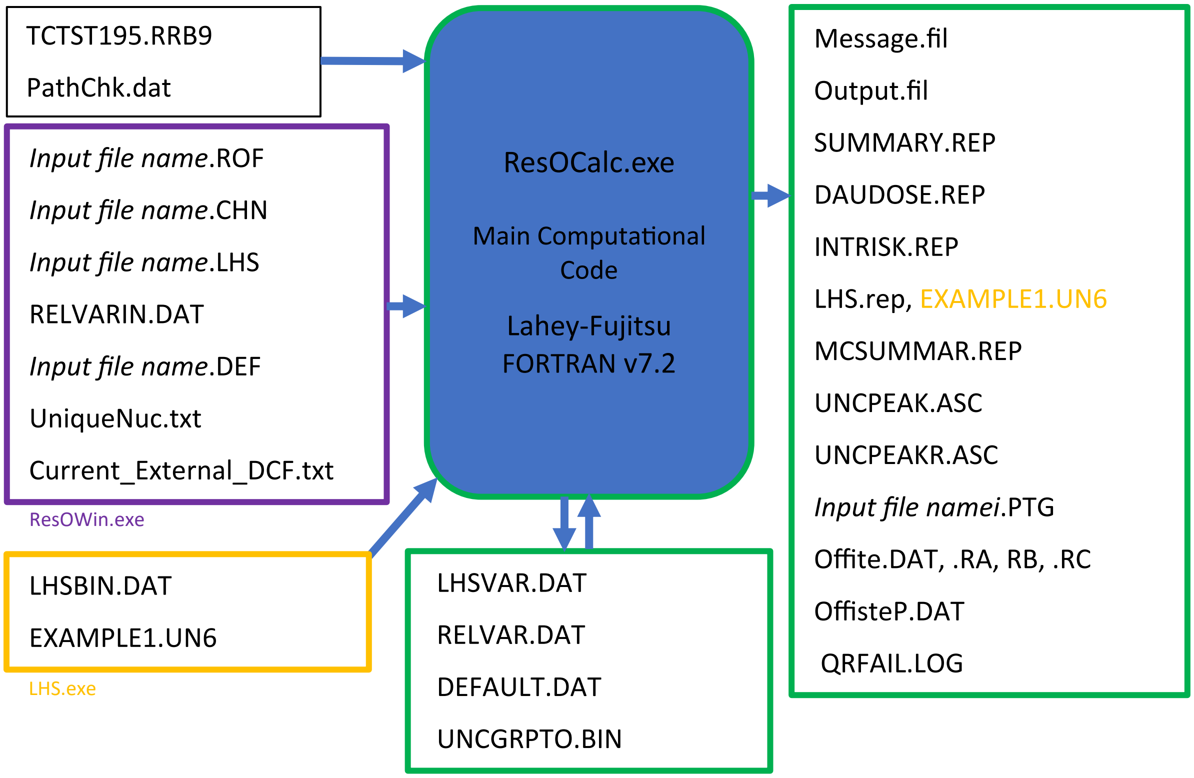
1. *Input file name*.ROF is an ASCII file containing the values for all the input variables used in RESRAD-OFFSITE to define the scenario.
2. *Input file name*.CHN is an ASCII file containing the transformation chain data for the radionuclides in the scenario being analyzed.
3. *Input file name*.LHS is an ASCII file containing the probabilistic/uncertainty distributions for the variables selected for probabilistic/uncertainty analyses in the scenario being analyzed.
4. LHSBIN.DAT is an ASCII file containing the sample values for each variable selected for probabilistic/uncertainty analysis.
5. RELVARIN.DAT (*Input file name*.REL) is an ASCII file containing any relationships between variables, with variables selected for probabilistic/uncertainty analysis being among the "independent" variables and the sample values for any related variables.
6. *Input file name*.DEF is an ASCII file containing the default values for all the variables used in RESRAD-OFFSITE to define the scenario. This file is deleted when the computational code completes its calculations.
7. UniqueNuc.txt is a text file containing the number and names of all the radionuclides in the transformation chain of the radionuclides in the current input file.
8. Current_External_DCF.txt is a text file containing the default external exposures dose factors, the scenario-specific external exposure dose and slope factors, and the fitting factors for all the radionuclides in the transformation chain of the radionuclides in the current input file.
9. TCTST195.RRB is a binary file containing area factor information for seven different thicknesses of cover, six different thicknesses of contamination, twelve different radii, and 23 different levels of gamma energies.
10. pathchk.dat is a text file containing active pathway codes for the inputs as listed in the order they appear in Default.inc and thus in the input echo.
11. DEFAULT.dat an ASCII file listing the default values of the inputs in name lists for each form.
12. UNCGRPTO.BIN is a binary file containing the total dose at each graphic time point for each probabilistic simulation.
13. WSCONC.DAT is a user-created text file containing the concentrations of the radionuclides in the water in the surface water body.
14. WWCONC.DAT is a user-created test file containing the concentrations of the radionuclides in well water.

Files Written by ResOCalc.exe:

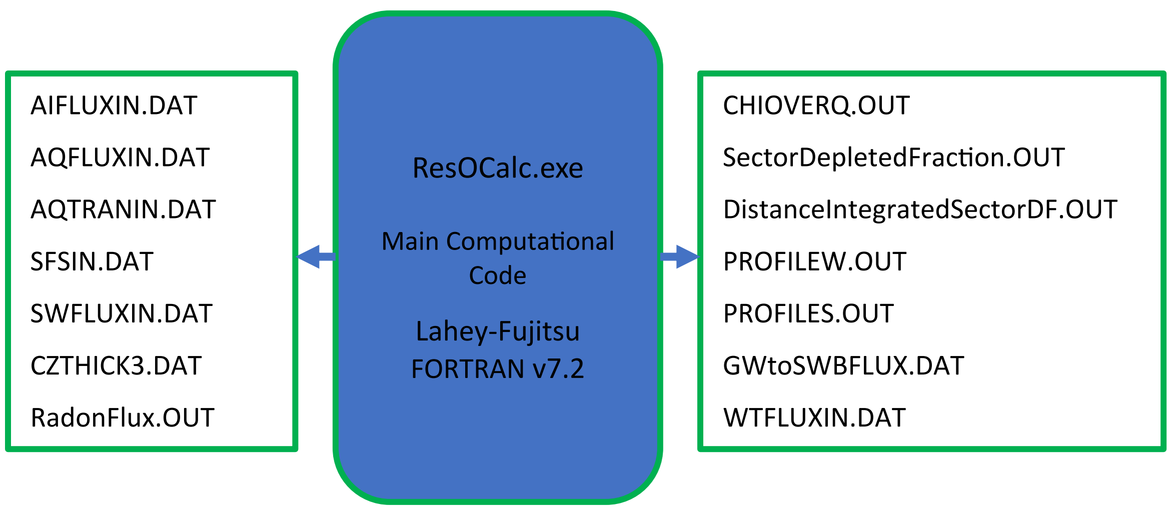
1. Output.fil, a text file listing the progress of the computational code as it works its way sequentially through the calls.
2. DEFAULT.dat is an ASCII file listing the default values of the inputs in name lists for each form.

3. SUMMARY.OUT, containing the text of the main report consisting of the input echo, dose attributed to the initially present radionuclides, soil guideline, etc., is appended to SUMMARY.REP, which initially contains the table of contents to the report.
4. INTRISK.OUT, containing the text of the intake and risk report, is appended to INTRISK.REP, which initially contains the table of contents of the report.
5. DAUDOSE.OUT, containing the text of the dose attributed to the radionuclides at the location and time of the exposure report, is appended to DAUDOSE.REP, which initially contains the table of contents of the report.
6. MCSUMMAR.OUT, containing the probabilistic text report, is appended to MCSUMMAR.REP, which initially contains the table of contents of the report.
7. LHS.REP contains the probabilistic sampling report of LHS.exe.
8. UNCPEAK.ASC is an ASCII file containing the peak doses and the time of the peak doses (grand total, total for each pathway, and total for each radionuclide) for each probabilistic simulation.
9. UNCPEAKR.ASC is an ASCII file containing the peak risks (grand total, total for each pathway, and total for each radionuclide) for each probabilistic simulation.
10. UNCGRPTO.BIN is a binary file containing the total dose at each graphic time point for each probabilistic simulation.
11. *Input file namei*.PTG, where *i* is any number from 1 to the number of repetitions, is an ASCII file containing the probabilistic temporal graphics data.
12. LHSVAR.DAT is an ASCII file containing the probabilistic sample values for the current probabilistic simulation.
13. RELVAR.DAT is an ASCII file containing the sample values of the dependent related variables for the current probabilistic simulation.
14. OFFSITE.DAT is a binary file containing information about the current run including the number of radionuclides, the parent and progeny pointers, the number of environmental media, the number of reporting and calculation times, units.
15. Offsite.RA, Offsite.RB, and Offsite.RC are binary files containing risk, dose, and concentration, respectively, at graphical times for the deterministic simulation, for each sensitivity simulation, and for each probabilistic simulation.
16. Message.fil a single-line text file indicating the computation being performed.
17. CHIOVERQ.OUT is an ASCII file containing the atmospheric concentrations to release (chi/Q) ratios for each radionuclide at the different offsite exposure locations.
18. SectorDepletedFraction.OUT is an ASCII file which has 17 columns of data; the first is the distance from the point release, and the next 16 contain the depleted source strengths at the distances in the first column in each of the 16 sectors, expressed as fractions of the release. The 16 columns are in the order N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, and NNW.
19. DistanceIntegratedSectorDF.OUT is an ASCII file which has 17 columns of data; the first is the distance from the point release, and the next 16 contain the integrals of the depleted source strengths over the distance in the first column in each of the 16 sectors. The 16 columns are in the order N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, and NNW.

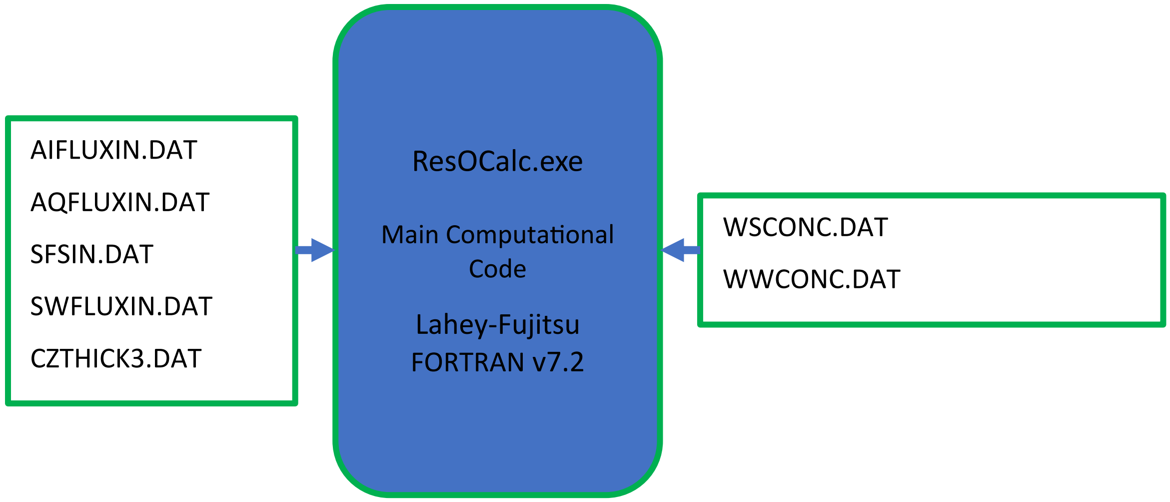
20. PROFILEW.OUT is an ASCII file containing data on the horizontal and vertical concentration profiles of each radionuclide in the aquifer in the plane containing the well.
21. PROFILES.OUT is an ASCII file containing data on the horizontal and vertical concentration profiles of each radionuclide in the aquifer in the plane containing the surface water body.
22. QRFAIL.LOG is an ASCII file listing information about groundwater transport calculations that reached the upper limit of numerical integration points before achieving the user-specified convergence criterion.
23. RadonFlux.OUT is an ASCII file listing the release rates of the radon isotopes (g) from the primary contamination and from the accumulations in offsite locations.
24. Summary.REP is the main text report with a table of content, consisting of the input echo, dose attributed to the initially present radionuclides, soil guideline, etc. The other text reports, INTRISK.REP, DAUDOSE.REP, and MCSUMMAR.REP, are created in a similar fashion by adding tables of contents to the corresponding OUT files.
25. AIFLUXIN.DAT is an ASCII file listing the release, attached to particulates, to the atmosphere from the surface layer, in pCi/yr.
26. AQFLUXIN.DAT is an ASCII file listing the release, in the aqueous phase, to water at the downgradient edge of the primary contamination, in pCi/year.
27. AQTRANIN.DAT is an ASCII file listing the transfer to infiltration or gradual injection in the part of the primary contamination that is above the water table, in pCi/yr, and the instantaneous injection in the part of the primary contamination that is above the water table, in pCi.
28. GWtoSWBFLUX.DAT is the transfer, in aqueous phase, from the aquifer to the surface water body, in pCi/year.
29. SFSIN.DAT is the concentration in the primary contamination, in pCi/g, averaged over the primary contamination. Currently includes the release immune form for all transfer options and the release susceptible form for the rate-controlled and the equilibrium dissolution transfer mechanisms, but not the aqueous or adsorbed phases of the radionuclides in transit in the primary contamination.
30. WTFLUXIN.DAT is the transfer, in aqueous phase, across the water table to the aquifer, in pCi/yr.
31. SWFLUXIN.DAT is the release, in eroded material, to surface runoff from the surface layer, in pCi/yr. It includes the mass of material eroded from the primary contamination and the surface layer, in g/yr, the mass of suspended sediment in the surface water body, in g, and the mass of bottom sediment on which the radionuclides are in adsorption-desorption equilibrium with the water in the surface water body.
32. CZTHICK3.DAT contains columns listing the calculation times in years, the concentration of the radionuclides in the surface mixing layer of the soil as a fraction of the concentration in the physically undisturbed primary contamination, the thickness of the clean cover in meters, the thickness of the contaminated mixing layer in meters, and the thickness of the physically undisturbed (unmixed) thickness of the primary contamination.



Data Transfer Diagram for ResOCalc.exe



Intermediate Data Diagram for ResOCalc.exe



Overriding User Data Input Diagram for ResOCalc.exe

1.3 DETERMINISTIC GRAPHICS DATA CONVERTER, GRPHCNV5.EXE

Purpose of GrphCnv5.exe: This FORTRAN executable reads the dose, risk, and concentration from the RESRAD-OFFSITE binary output files and writes the ASCII deterministic and sensitivity graphics data file, GRAPHICS.ASC, that will be read by WResPlot.exe.

Description of GrphCnv5.exe: This is a small, simple code that reads the data in the four files listed below and writes the dose, concentration, and risk data to an ASCII file in a format that can easily be used by the deterministic graphics executable WResPlot.exe.

Files Read by GrphCnv5.exe:

1. Offsite.dat is a binary file containing information about the current run including the number of radionuclides, the parent and progeny pointers, the number of environmental media, the number of reporting and calculation times, units.
2. Offsite.RA, Offsite.RB, and Offsite.RC are binary files containing risk, dose, and concentration, respectively, at graphical times for the deterministic simulation, for each sensitivity simulation, and for each probabilistic simulation.

Files Written by GrphCnv5.exe:

1. GRAPHICS.ASC is an ASCII file containing the dose, concentration, and risk data in a format that can be used by WResPlot.exe.

1.4 DETERMINISTIC GRAPHICS VIEWER, WRESPLOT.EXE

Purpose of WResPlot,exe: This executable displays the deterministic and sensitivity output (dose, risk, or concentration) of the RESRAD-OFFSITE (and the RESRAD-ONSITE) code in graphical form.

Data Files Read by WRESPLOT.exe:

1. FileforWresplot.dat to read the name of the graphics file.
2. VARIABOF.INF to read in the description of the variables for use when sensitivity analysis is performed.
3. GRAPHICS.ASC, *Input file name*.grp is an ASCII file containing the dose, concentration, and risk data.

APPENDIX 2: VERIFICATION OF AIR RELEASE FROM THE SURFACE MIXING LAYER

The spreadsheet calculations of the air release of particulates from the surface layer at the primary contamination are performed for ^{90}Sr using the equations described in G.15 of Appendix G of the RESRAD-OFFSITE Manual. First, the concentration in the mixing layer using Equation G.67 is calculated, and after that, the air release is calculated using Equation G.69. Releases associated with both respirable and total particulates can be calculated. Special models are used for gaseous/vapor releases of tritium (^{3}H) as water vapor, ^{14}C as carbon dioxide, and radon (^{220}Rn and ^{222}Rn). Verification of special radionuclides is done separately. The spreadsheet calculations are compared with the code output file AIFLUXIN.DAT.

Table A2.1 lists parameters used in calculating air release rate from the surface layer.

Table A2.1 Parameters Used in Air Release Calculations

Radionuclide and Radionuclide-Specific Parameters	**^{90}Sr**
Half-life (yr)	29.12
Cut-off half-life (d)	30
Primary Contamination and Cover Parameters	
Rainfall and runoff factor (/yr)	160
Dry bulk density (g/cm^3)	1.5
Soil erodibility factor	0.4
Slope-length-steepness factor	0.4
Cover and management	0.003
Support practice factor	1
Depth of soil mixing layer (m)	0.15
Deposition velocity of all particulates (to compute atmospheric release) (m/s)	0.001
Mass loading of all particulates (g/m^3)	0.0001
Primary contamination thickness (m)	Case 1 – 0.1 Case 2 – 1.2
Cover thickness (m)	0.05
Area of primary contamination (m^2)	10000

The comparison is done for two thicknesses of primary contamination (two input files used are air release comp sr90.rof and air release comp case2.rof). Figure A2.1 shows the Case 1 comparison of the calculated air release rate using an EXCEL spreadsheet with the air release rate from the code. The detailed comparison is in the EXCEL spreadsheet (air-release-case1.xlsx). Figure A2.2 shows the Case 2 comparison of the calculated air release rate using an EXCEL spreadsheet with the air release rate from the code (air-release-case2.xlsx). The spreadsheets can be used for comparing results for other cover and primary contamination thicknesses. The EXCEL spreadsheet calculations in general match the code output.

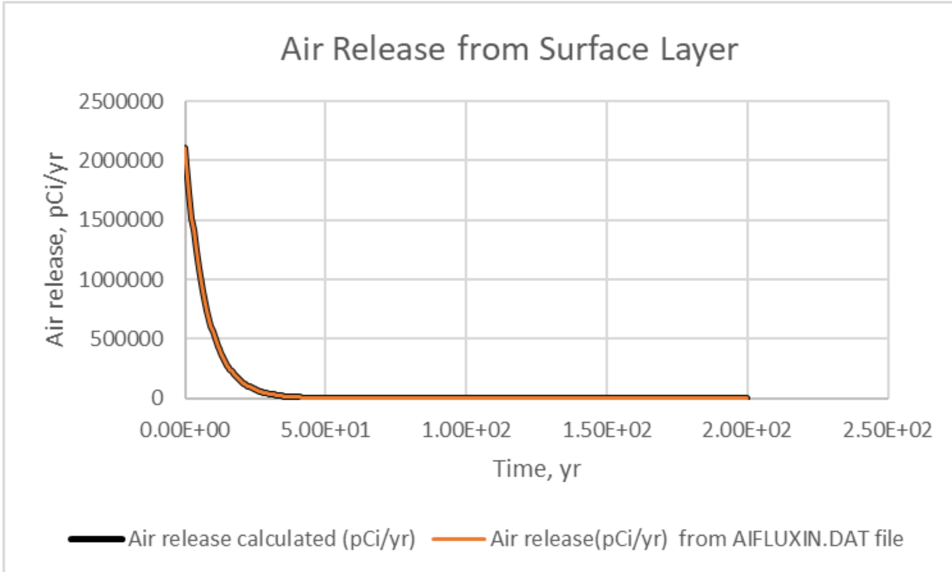


Figure A2.1 Air Release to Atmosphere from the Surface Layer (Case 1)

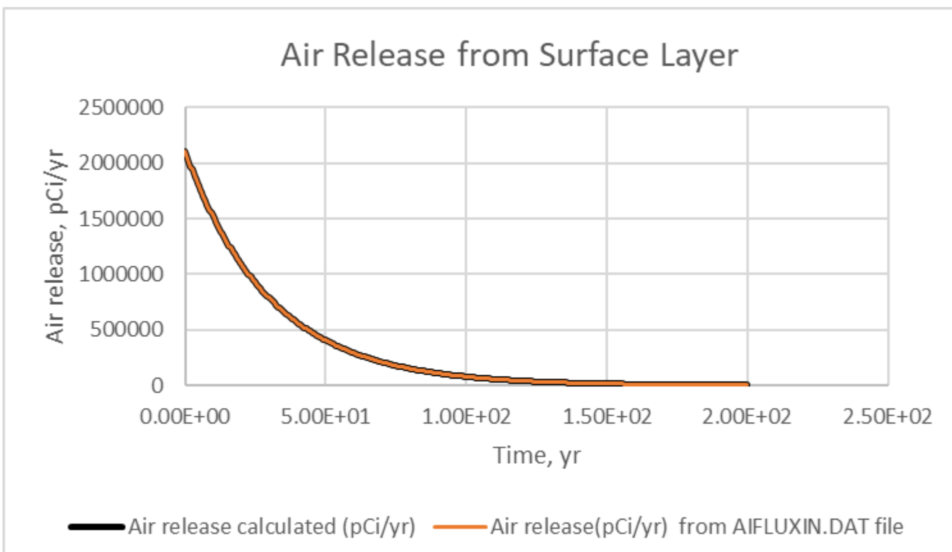


Figure A2.2 Air Release to Atmosphere from the Surface Layer (Case 2)

APPENDIX 3: VERIFICATION OF EROSION RELEASE FROM PRIMARY CONTAMINATION

The spreadsheet calculations of the erosion release of particulates from the primary contamination are performed for ^{90}Sr using the equations described in the Appendix G of the RESRAD-OFFSITE Manual. First, the eroded material rate is calculated using Equations G.24 and G.25, and after that, the erosion rate is calculated using Equation G.68. The two input files used are erosion release comp case1.rof and erosion release comp case2.rof. The spreadsheet calculations are compared with the code output file SWFLUXIN.DAT.

Table A3.1 lists the parameters used in calculating the air release rate from the surface layer.

Table A3.1 Parameters Used in Erosion Release Calculations

Radionuclide and Radionuclide-Specific Parameters	**^{90}Sr**
Half-life (yr)	29.12
Cut-off half-life (d)	30
Primary Contamination and Cover Parameters	
Rainfall and runoff factor (/yr)	160
Dry bulk density (g/cm^3)	1.5
Soil erodibility factor	0.4
Slope-length-steepness factor	0.4
Cover and management	0.003
Support practice factor	1
Depth of soil mixing layer (m)	0.15
Primary contamination thickness (m)	Case 1 – 0.1 Case 2 – 1.2
Cover thickness (m)	0.05
Area of primary contamination (m^2)	10000

Figure A3.1 shows the comparison of the calculated erosion rate for Case 1 using an EXCEL spreadsheet with the erosion rate from the code. The detailed comparison is in the EXCEL spreadsheet "erosion-release-case1.xlsx." Figure A3.2 shows the comparison of the calculated erosion rate for Case 2 using an EXCEL spreadsheet with the erosion rate from the code. The detailed comparison is in the EXCEL spreadsheet "erosion-release-case2.xlsx." The spreadsheets can be used for comparing the results for other cover and primary contamination thicknesses. The EXCEL spreadsheet calculations in general match the code output.

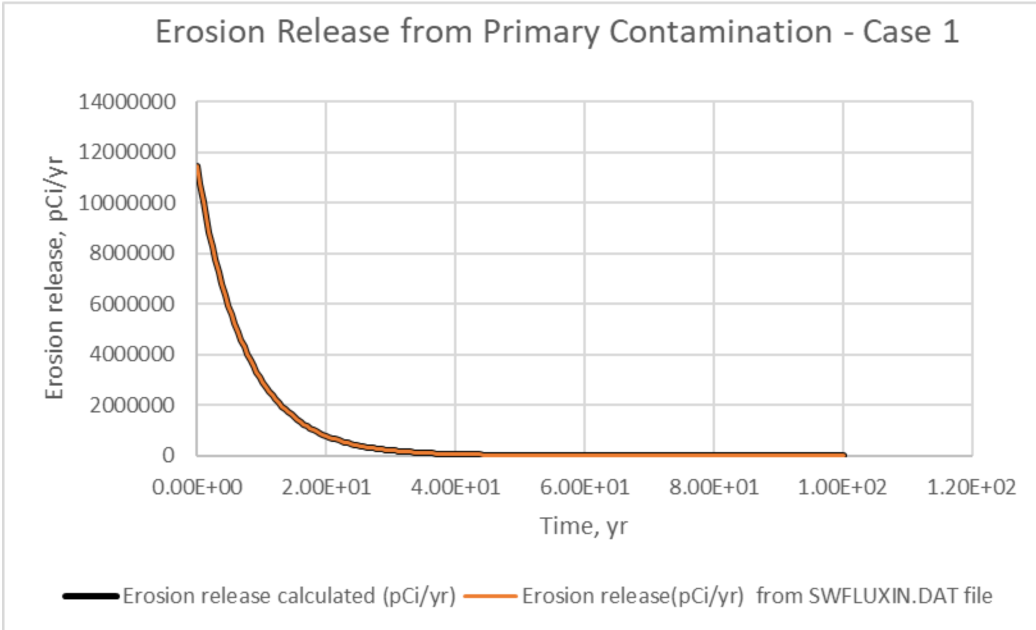


Figure A3.1 Erosion Release from Primary Contamination – Case 1

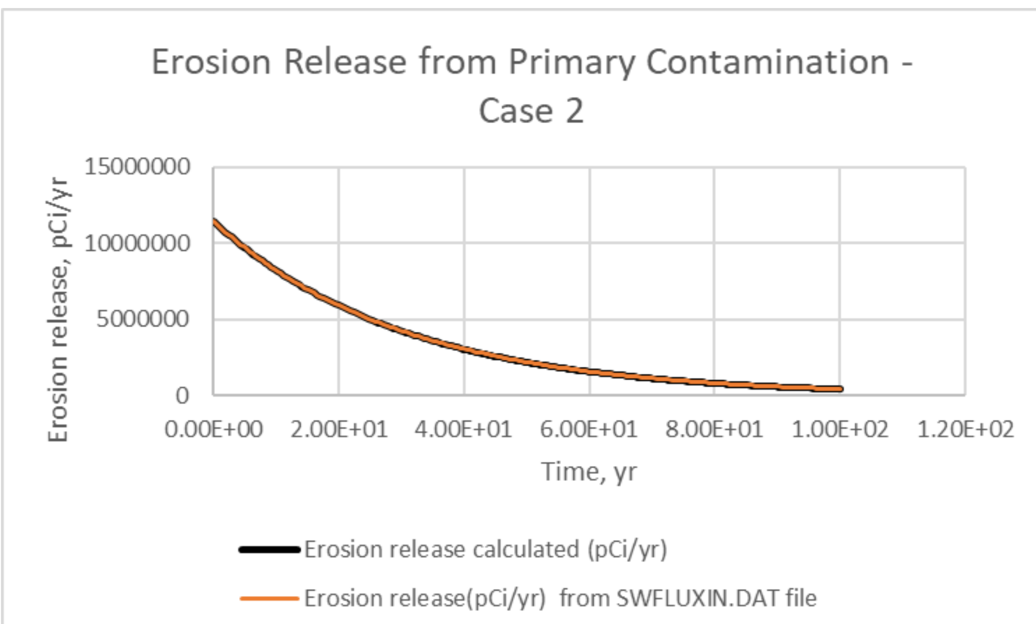


Figure A3.2 Erosion Release from Primary Contamination – Case 2

APPENDIX 4: VERIFICATION OF ATMOSPHERIC TRANSPORT MODEL

The atmospheric transport model used in RESRAD-OFFSITE is a Gaussian plume dispersion model based on an area source release. As a radioactive plume travels downwind, its radionuclide content decreases due to deposition on the ground. The model considers two deposition mechanisms, dry and wet, to account for radionuclide depletion from the plume.

The earlier versions of the code (before Version 4.0) computed the concentration in the air above the offsite receptor and accumulation locations that did not overlap with the primary contamination. A formulation to compute the deposition on a catchment that could potentially overlap the primary contamination was added to Version 4. Details of the model are presented in Appendix I of the RESRAD-OFFSITE User's Manual Yu et al. (2020).

The RESRAD-OFFSITE V&V report (Yu et al. 2011) verified the earlier model. Six input files (air dispersion run1.rof, air dispersion run2.rof, … air dispersion run6.rof) are created based on the information in the V&V report and are run with the new version. Table A4.1 shows the site layout and atmospheric transport parameters used in air dispersion calculations. The results in Tables 4-2 and 4-3 in the V&V report are compared with Version 4 results. Table A4.2 and Table A4.3 show the comparison of the old spreadsheet calculations, old code results, and Version 4 results for CHIOVERQ (normalized air concentration). Version 4 results are taken from the CHIOVERQ.OUT file created after each run in the directory where RESRAD-OFFSITE code is installed. There is practically no difference in the spreadsheet calculations and Version 4 results.

Table A4.1 Site Layout and Atmospheric Transport Parameters Used in Point-to-Point Air Dispersion Calculations

Receptor Area	Distance, m	Direction	Elevation, m	Directional Frequency	Stability Category	Wind Speed (m/s)
Fruit grain non-leafy vegetable plot	100	North	0	0.05	A	0.89
Leafy vegetables plot	200	South	5	0.1	B	2.46
Pasture, silage growing area	500	East	10	0.25	D	6.93
Grain field	1000	West	15	0.2	C	4.47
Dwelling site	10000	Northeast	20	0.4	F	9.61

Note: Elevation is only used with plume rise.

Note that only wet deposition was not checked in the V&V report. A new spreadsheet incorporating RESRAD-OFFSITE Manual Appendix I equations is made to calculate the normalized air concentration for different stability classes. The spreadsheet includes both Pasquill-Gifford and Briggs dispersion models but only includes wet deposition. A separate RESRAD-OFFSITE input file (air dispersion run7) is used. Table A4.4 compares the spreadsheet calculations with RESRAD-OFFSITE Version 4 results with no deposition for both Pasquill-Gifford and Briggs dispersion models and wet deposition only with the Pasquill-Gifford dispersion model.

Table A4.2 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m^3) in V&V Report (with Plume Rise) with RESRAD-OFFSITE Version 4

	Values from V&V Report Table 4-2			
	Spreadsheet	Spreadsheet x Directional Frequency	Previous OFFSITE	OFFSITE Version 4
Run 1 - Briggs Rural Dispersion Coefficients, no dry or wet deposition				
Fruit grain non-leafy vegetable plot	1.12E-03	5.60E-05	5.68E-05	5.60E-05
Leafy vegetables plot	1.70E-04	1.70E-05	1.69E-05	1.69E-05
Pasture, silage growing area	2.55E-05	6.38E-06	6.39E-06	6.38E-06
Grain field	6.14E-06	1.23E-06	1.23E-06	1.23E-06
Dwelling site	5.22E-07	2.09E-07	2.09E-07	2.09E-07
Run 2 - Pasquill-Gifford dispersion coefficient with dry deposition, no wet deposition				
Fruit grain non-leafy vegetable plot	1.54E-03	7.69E-05	7.81E-05	7.69E-05
Leafy vegetables plot	2.00E-04	2.00E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.34E-07	1.74E-07	1.74E-07	1.74E-07
Run 3 - Pasquill-Gifford dispersion coefficient with dry deposition and wet deposition				
Fruit grain non-leafy vegetable plot	1.51E-03	7.56E-05	7.68E-05	7.56E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.71E-06	7.70E-06
Grain field	7.02E-06	1.40E-06	1.40E-06	1.40E-06
Dwelling site	4.27E-07	1.71E-07	1.71E-07	1.72E-07

Note: The spreadsheet calculations do not include the directional wind frequency.

Table A4.3 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m^3) in V&V Report (without Plume Rise) with Version 4

	Values from V&V Report Table 4-3			
	Spreadsheet	Spreadsheet x directional frequency	Previous OFFSITE	OFFSITE Version 4
Run 4 - Pasquill-Gifford rural dispersion coefficients, no dry or wet deposition				
Fruit grain non-leafy vegetable plot	1.57E-03	7.86E-05	7.94E-05	7.86E-05
Leafy vegetables plot	2.02E-04	2.02E-05	2.01E-05	2.00E-05
Pasture, silage growing area	3.14E-05	7.86E-06	7.87E-06	7.86E-06
Grain field	7.34E-06	1.47E-06	1.47E-06	1.47E-06
Dwelling site	4.52E-07	1.81E-07	1.81E-07	1.81E-07
Run 5 - Pasquill-Gifford dispersion coefficient with dry deposition, no wet deposition				
Fruit grain non-leafy vegetable plot	1.55E-03	7.73E-05	7.81E-05	7.73E-05
Leafy vegetables plot	2.01E-04	2.01E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.36E-07	1.74E-07	1.74E-07	1.74E-07
Run 6 - Pasquill-Gifford dispersion coefficient with dry deposition and wet deposition				
Fruit grain non-leafy vegetable plot	1.52E-03	7.61E-05	7.68E-05	7.60E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.72E-06	7.70E-06
Grain field	7.03E-06	1.41E-06	1.40E-06	1.40E-06
Dwelling site	4.29E-07	1.72E-07	1.72E-07	1.72E-07

Table A4.4 Comparison of RESRAD-OFFSITE (Version 4) Normalized Air Concentration with New Spreadsheet Calculations

	New Spreadsheet	Spreadsheet x Directional Frequency	Version 4.0
Run 1 - Briggs rural dispersion coefficients, no dry or wet deposition			
Fruit grain non-leafy vegetable plot	1.12E-03	5.60E-05	5.60E-05
Leafy vegetables plot	1.69E-04	1.69E-05	1.69E-05
Pasture, silage growing area	2.55E-05	6.38E-06	6.38E-06
Grain field	6.14E-06	1.23E-06	1.23E-06
Dwelling site	5.21E-07	2.09E-07	2.09E-07
Run 4 - Pasquill-Gifford rural dispersion coefficients, no dry or wet deposition			
Fruit grain non-leafy vegetable plot	1.57E-03	7.86E-05	7.86E-05
Leafy vegetables plot	2.02E-04	2.02E-05	2.00E-05
Pasture, silage growing area	3.14E-05	7.85E-06	7.86E-06
Grain field	7.34E-06	1.47E-06	1.47E-06
Dwelling site	4.52E-07	1.81E-07	1.81E-07
Run 7 - Pasquill-Gifford dispersion coefficient with wet deposition			
Fruit grain non-leafy vegetable plot	1.55E-03	7.73E-05	7.73E-05
Leafy vegetables plot	2.00E-04	2.00E-05	1.98E-05
Pasture, silage growing area	3.11E-05	7.77E-06	7.77E-06
Grain field	7.10E-06	1.42E-06	1.42E-06
Dwelling site	4.45E-07	1.78E-07	1.78E-07

The code outputs the intermediate results of the atmospheric transport calculations of the deposition in the catchment to the SectorDepletedFraction.OUT file. The file includes the distance from the point release and the depleted source strength in the 16 sectors at the distance in the first column, expressed as fraction of the release. The values in this file are compared with the EXCEL spreadsheet calculations for both wet and dry deposition by considering wet and dry deposition individually. Table A4.5 and Table A4.6 compare the RESRAD-OFFSITE source depletion due to dry and wet deposition, respectively, at few select distances from the spreadsheet calculations. Differences of less than 1 percent are observed in all stability classes. The full comparison is in the EXCEL spreadsheet wet and dry depleted fraction comparison.xlsx.

Table A4.5 Comparison of RESRAD-OFFSITE Deposition Depletion Due to Dry Deposition with Spreadsheet Calculations

	Depleted Fraction from the Code (Dry Deposition - Run 5)					Depleted Fraction Due to Dry Deposition Calculated Using Spreadsheet				
Distances (m)	North - A (0.89 m/s)	Northeast -F (9.61 m/s)	East - D (6.93 m/s)	South - B (2.46 m/s)	West - C (4.47 m/s)	A (0.89 m/s)	F (9.61 m/s)	D (6.93 m/s)	B (2.46 m/s)	C (4.47 m/s)
2.03E+01	9.93E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	9.93E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01
5.22E+01	9.88E-01	9.98E-01	9.97E-01	9.95E-01	9.97E-01	9.88E-01	9.98E-01	9.97E-01	9.95E-01	9.97E-01
1.01E+02	9.84E-01	9.96E-01	9.96E-01	9.93E-01	9.95E-01	9.84E-01	9.96E-01	9.96E-01	9.93E-01	9.95E-01
2.00E+02	9.79E-01	9.94E-01	9.94E-01	9.91E-01	9.93E-01	9.79E-01	9.94E-01	9.94E-01	9.91E-01	9.93E-01
5.02E+02	9.75E-01	9.90E-01	9.92E-01	9.88E-01	9.91E-01	9.75E-01	9.90E-01	9.92E-01	9.88E-01	9.91E-01
1.00E+03	9.73E-01	9.86E-01	9.89E-01	9.86E-01	9.89E-01	9.73E-01	9.86E-01	9.89E-01	9.86E-01	9.89E-01
1.50E+03	9.72E-01	9.83E-01	9.88E-01	9.85E-01	9.88E-01	9.73E-01	9.83E-01	9.88E-01	9.85E-01	9.88E-01
2.00E+03	9.72E-01	9.81E-01	9.87E-01	9.84E-01	9.87E-01	9.72E-01	9.81E-01	9.86E-01	9.84E-01	9.87E-01

Table A4.6 Comparison of RESRAD-OFFSITE Depletion Due to Wet Deposition with Spreadsheet Calculations

	Depleted Fraction from the Code (Wet Deposition - Run 5)					Depleted Fraction Due to Wet Deposition Calculated Using Spreadsheet				
Distances (m)	North - A (0.89 m/s)	Northeast -F (9.61 m/s)	East - D (6.93 m/s)	South - B (2.46 m/s)	West - C (4.47 m/s)	A (0.89 m/s)	B (2.46 m/s)	C (4.47 m/s)	D (6.93 m/s)	F (9.61 m/s)
2.03E+01	9.97E-01	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.97E-01	9.99E-01	9.99E-01	1.00E+00	1.00E+00
5.22E+01	9.91E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	9.91E-01	9.97E-01	9.98E-01	9.99E-01	1.00E+00
1.01E+02	9.83E-01	1.00E+00	9.98E-01	9.94E-01	9.97E-01	9.83E-01	9.94E-01	9.97E-01	9.98E-01	1.00E+00
2.00E+02	9.67E-01	1.00E+00	9.96E-01	9.88E-01	9.93E-01	9.66E-01	9.88E-01	9.93E-01	9.96E-01	1.00E+00
5.02E+02	9.20E-01	9.99E-01	9.89E-01	9.70E-01	9.83E-01	9.18E-01	9.69E-01	9.83E-01	9.89E-01	9.99E-01
1.00E+03	8.46E-01	9.98E-01	9.79E-01	9.41E-01	9.67E-01	8.42E-01	9.40E-01	9.66E-01	9.78E-01	9.98E-01
1.50E+03	7.79E-01	9.98E-01	9.68E-01	9.14E-01	9.51E-01	7.73E-01	9.11E-01	9.50E-01	9.68E-01	9.98E-01
2.00E+03	7.16E-01	9.97E-01	9.58E-01	8.86E-01	9.36E-01	7.10E-01	8.83E-01	9.34E-01	9.57E-01	9.97E-01

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APPENDIX 5: VERIFICATION OF SURFACE WATER MODEL

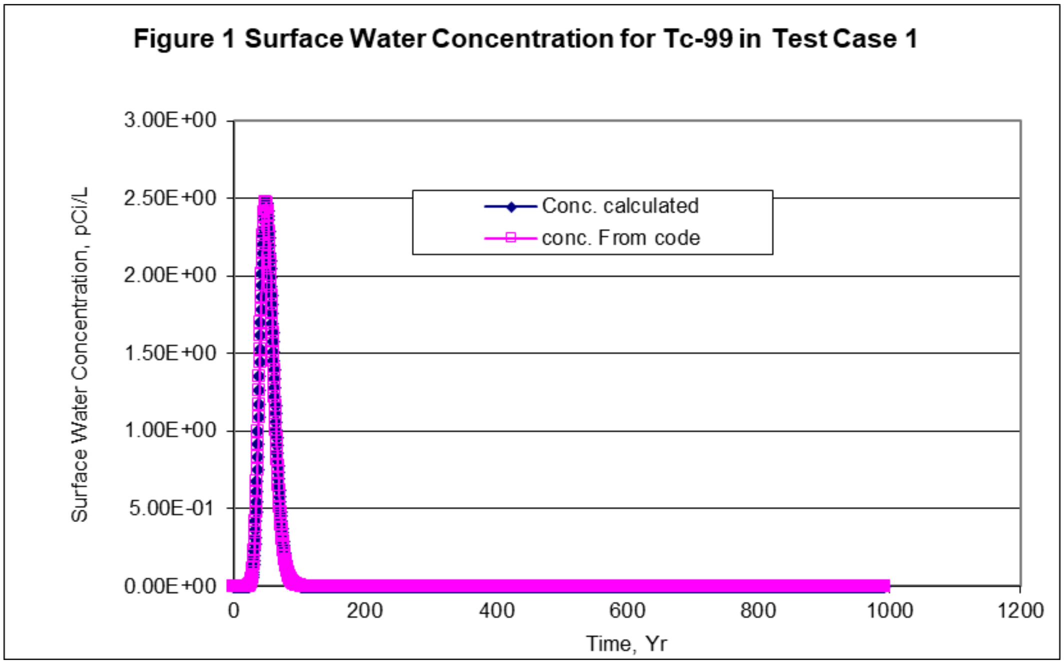
A limited verification of the surface water body model in RESRAD-OFFSITE code is performed for ^{99}Tc and ^{238}U contamination. The water concentration in the surface water body for the principal radionuclide from an EXCEL spreadsheet calculation is compared with the code surface water concentration.

Verification is done all four modes of entry of radionuclides into the surface water body: (1) influx of dissolved radionuclides in the water intercepted from the aquifer; (2) influx of radionuclides adsorbed on soil eroded from the primary contamination; (3) influx of radionuclides transported by air, then deposited on the catchment, and ultimately washed out into the surface water body; and (4) influx of radionuclides transported by air and deposited on the surface water body.

The code considers four ways of removal of radionuclides from the surface water body: (1) loss of radionuclides, both dissolved in the water and adsorbed on the suspended sediments, in the stream outflow; (2) loss of radionuclides, both dissolved in the water and adsorbed on the suspended sediments, in the water extracted for use; (3) loss of radionuclides dissolved in the water that seeps into the aquifer; and (4) loss of radionuclides adsorbed on the deeper layers of the sediments that are assumed to be isolated from the water by the recently buried sediments. The surface water body is modeled as being continuously mixed throughout the year. The radionuclides dissolved in the water are modeled as being in adsorption-desorption equilibrium with the radionuclides in the suspended sediment and the radionuclides in the recent bottom sediments. The equations in Section J.2 (Yu et al. 2020) are used in the EXCEL spreadsheet for calculations.

For comparing surface water concentration from the influx of dissolved radionuclides in the water intercepted from the aquifer, the rate at which radionuclide enters the surface water body with the water that is intercepted from the aquifer is taken from the code (GWtoSWFLUX.DAT). For comparing surface water concentration from the influx of radionuclides adsorbed on soil eroded from the primary contamination, the release in eroded material to surface runoff from the surface layer is taken from the code (SWFLUXIN.DAT). For comparing the surface water concentration from the influx of radionuclides transported by air, then deposited on the catchment, and ultimately washed out into the surface water body, the rate at which radionuclide is deposited over the catchment is taken from the code (SectorDepletedFraction.OUT). For comparing the surface water concentration from the influx of radionuclides transported by air and deposited on the surface water body, the release rate of radionuclide particulates in air from primary contamination was taken from the code (AIRFLUXIN.DAT).

The RESRAD-ONSITE exponential release model is used. Test 1 is at all default parameter values except cover = 5 cm, primary contamination zone thickness = 15 cm. Figure 1 shows the surface water concentration for ^{99}Tc in Test Case 1.



In Test 2, cover = 0 cm, settling velocity of sediment = 0.01 cm/s, density of bottom sediment = 1.2 gm/cm^3, volume of surface water body = 100,000 m^3. Figure 2 shows the surface water concentration for ^{99}Tc in Test Case 2. The surface water concentration from the spreadsheet calculations matches the code results, as shown in Figure 1 and Figure 2. The same calculations were repeated with ^{234}U. The results are shown in Figure 3 and Figure 4 for Test Case 1 and Test Case 2, respectively.

RESRAD-OFFSITE input files used in the surface water model are: SURF-WATER-CHECK-TC99-TEST1.ROF, SURF-WATER-CHECK-TC99-TEST2.ROF, SURF-WATER-CHECK-U234-TEST1.ROF, and SURF-WATER-CHECK-U234-TEST2.ROF, and the EXCEL spreadsheets that show the calculations are: "surface water conc verification-Tc99-test1.xlsx," "surface water conc verification-Tc99-test2.xlsx," "surface water conc verification-U234-test1.xlsx," and "surface water conc verification-U234-test2.xlsx."

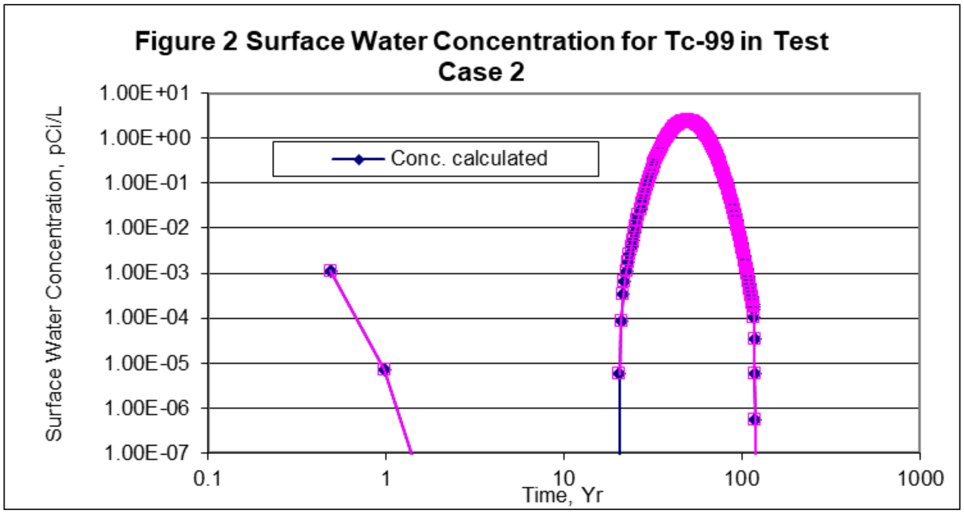
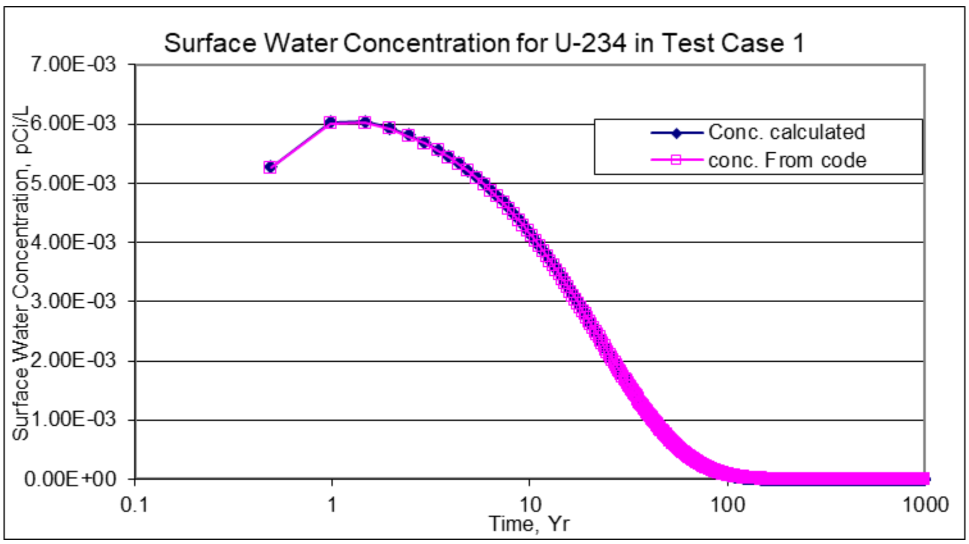


Figure 2 Surface Water Concentration for Tc-99 in Test Case 2



Surface Water Concentration for U-234 in Test Case 1

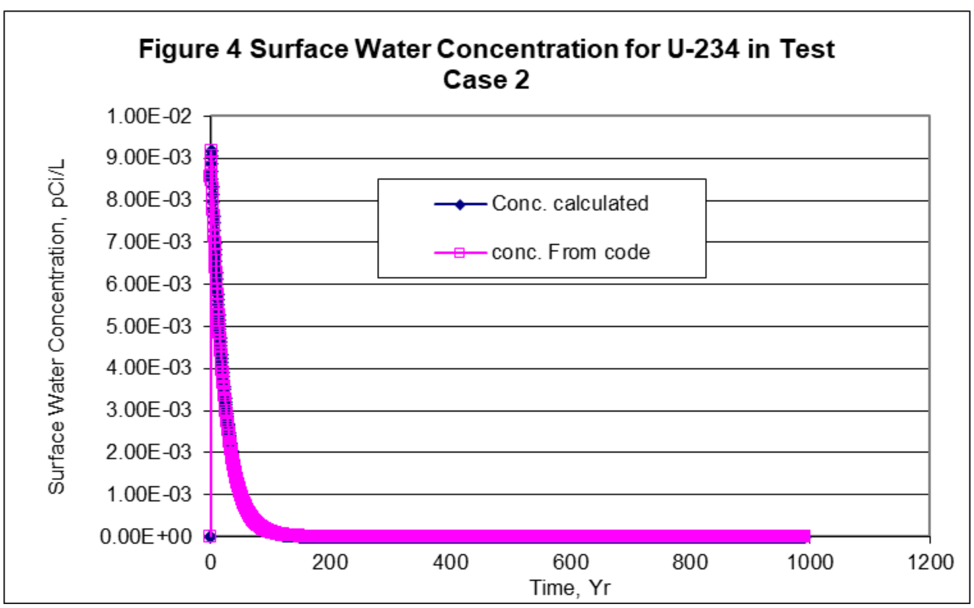


Figure 4 Surface Water Concentration for U-234 in Test Case 2

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APPENDIX 6: VERIFICATION OF ACCUMULATION IN OFFSITE SURFACE SOIL

A limited verification of the accumulation in offsite surface soil in the RESRAD-OFFSITE code is performed. The radionuclide concentration in the surface soil for the principal radionuclide from the EXCEL spreadsheet calculation is compared with the code's surface soil concentration.

The code models the influx of radionuclides from the primary contamination in the surface soil layer at the offsite locations by three mechanisms: irrigation with contaminated water from the well or from the surface water body, deposition of contaminated particulates following atmospheric transport, and deposition of eroded material transported by runoff. At offsite locations, it considers mixing of the surface layer, erosion of the surface layer, linear adsorption-desorption partitioning between the solid and aqueous phases of the surface layer, and radiological transformations of each radionuclide and its parent radionuclides.

Verification is accomplished for all three modes of entry of radionuclides into the surface soil for non-leafy vegetable field with ^{14}C. Different radionuclides (^{137}Cs for pasture and silage field, ^{41}Ca for leafy vegetable field, and ^{60}Co for grain field) were used to verify offsite soil concentrations at different offsite locations. For ^{14}C, ^{137}Cs, and ^{60}Co surface water was used for irrigation and ^{41}Ca groundwater was used for irrigation. The equations in Appendix J (Yu et al. 2020) were used in an EXCEL spreadsheet for the calculations.

For comparing offsite soil concentrations from the influx of radionuclides adsorbed on soil eroded from the primary contamination, the release in eroded material to surface runoff from the surface layer is taken from the code (SWFLUXIN.DAT). For comparing the offsite soil concentrations from the deposition of particulates containing radionuclides from the atmosphere, the concentration in air at an offsite location is taken from the code. For comparing the offsite soil concentration from irrigation, the irrigation water concentration is taken from the code.

RESRAD-ONSITE exponential release model is used. Table A6.1 shows some of the input parameters used in RESRAD-OFFSITE code run.

Table A6.1 Input Parameters Used in RESRAD-OFFSITE Code Run

Parameters	Values
Deposition velocity (m/s)	0.001
Storage time (d)	0
Precipitation rate (m/yr)	1
Sediment delivery to offsite location	1
Radionuclide Parameters	
^{14}C half-life, yr	5730
^{14}C distribution coefficient (cm^3/g)	0
^{41}Ca half-life (yr)	140000
^{41}Ca distribution coefficient (cm^3/g)	50
^{60}Co half-life (yr)	5.271
^{60}Co distribution coefficient (cm^3/g)	1000
^{137}Cs half-life (yr)	30
^{137}Cs distribution coefficient (cm^3/g)	4600
Offsite Soil Parameters in Different Agricultural Areas	
Fraction of area directly over primary contamination	0
Irrigation applied (m/yr)	0.2
Evapotranspiration coefficient	0.5
Runoff coefficient	0.2
Mixing depth (m)	0.15
Volumetric water content	0.3
Dry bulk density (g/cm^3)	1.5
Soil erodibility factor	0.4
Slope-length-steepness factor	0.4
Cover and management	0.003
Support practice factor	1
Duration of growing season for fruit, grain, and leafy vegetables (yr)	0.17
Duration of growing season for leafy vegetables (yr)	0.25
Duration of growing season for pasture and grass (yr)	0.08
Duration of growing season for grain (yr)	0.17
Weathering removal constant for all plant types (per yr)	20
Foliar interception factor for irrigation for all plant types[a]	0.25
Foliar interception factor for dust for all plant types	0.25

[a] For ^{14}C, the foliar interception factor for irrigation = 0.

The EXCEL spreadsheet calculations are in the following files:

soil conc accumulation in leafy field-Ca-41.xlsx,
soil conc accumulation in pasture field-Cs-137.xlsx,
soil conc accumulation in grain field-Co-60.xlsx, and
soil conc accumulation in nonleafy field-C-14.xlsx.

The seven RESRAD-OFFSITE input files used in the verification were: offsite-accumulation-test1.rof, offsite-accumulation-test2.rof, offsite-accumulation-Test3.rof, offsite-accumulation-Test4.rof, offsite-accumulation-Test4-air-dep-only.rof, offsite-accumulation-Test4-erosion-only.rof, and offsite-accumulation-Test4-surface-water-only.rof.

Figure A6.1 shows the comparison of ^{41}Ca soil concentration in leafy vegetable field. The "offsite-accumulation-test1.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in leafy field-Ca-41.xlsx" spreadsheet.

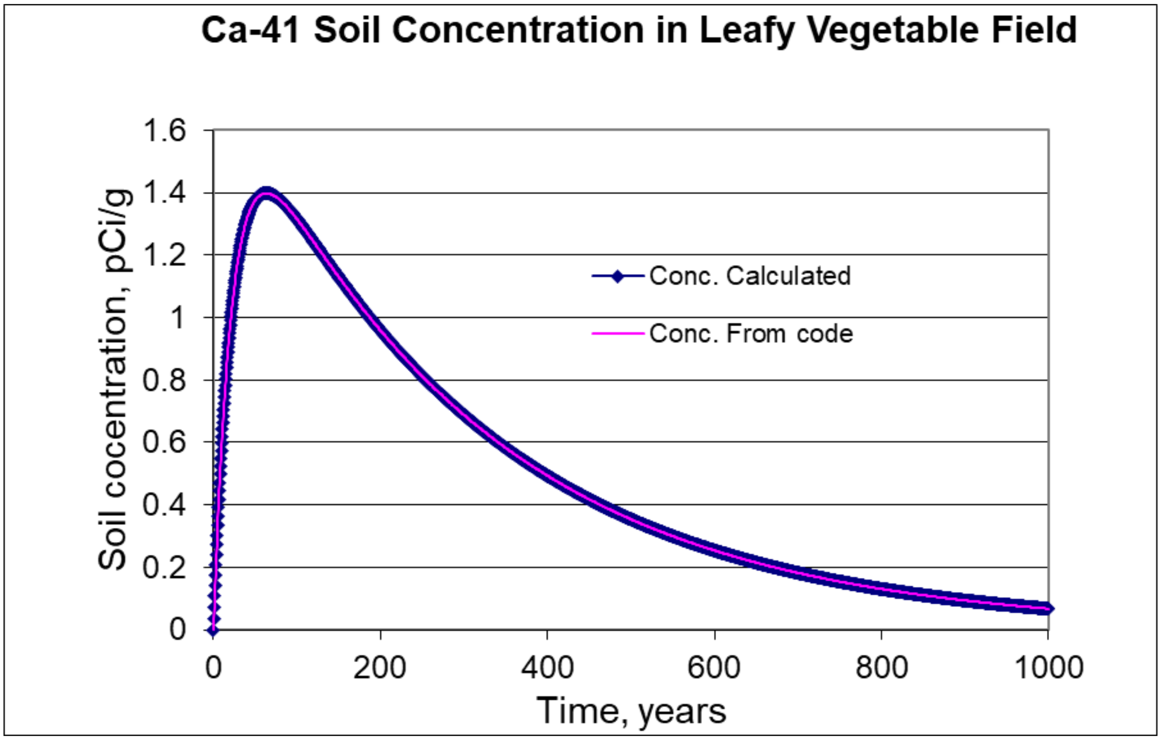


Figure A6.1 Ca-41 Soil Concentration in Leafy Vegetable Field

Figure A6.2 shows the comparison of ^{137}Cs soil concentration in the pasture and silage field. The "offsite-accumulation-test2.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in pasture field-Cs-137.xlsx" spreadsheet.

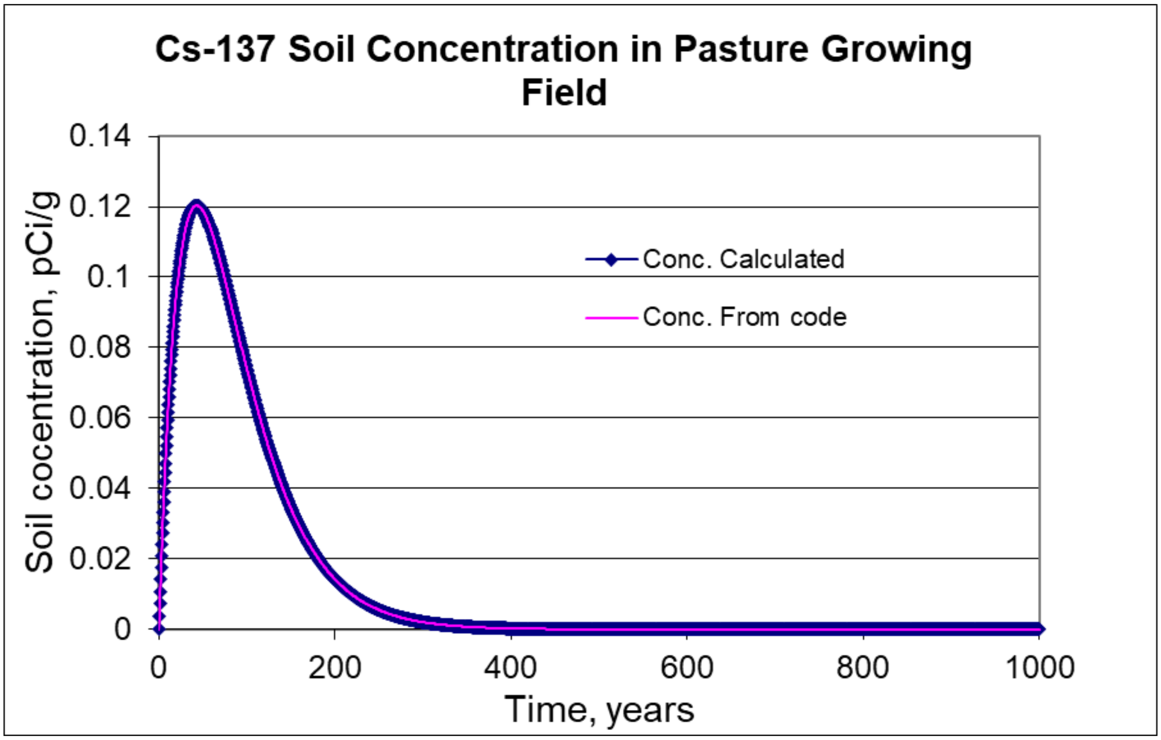


Figure A6.2 ^{137}Cs Soil Concentration in Pasture and Silage Field

Figure A6.3 shows the comparison of ^{60}Co soil concentration in a grain field. The "offsite-accumulation-test3.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in grain field-Co-60.xlsx" spreadsheet.

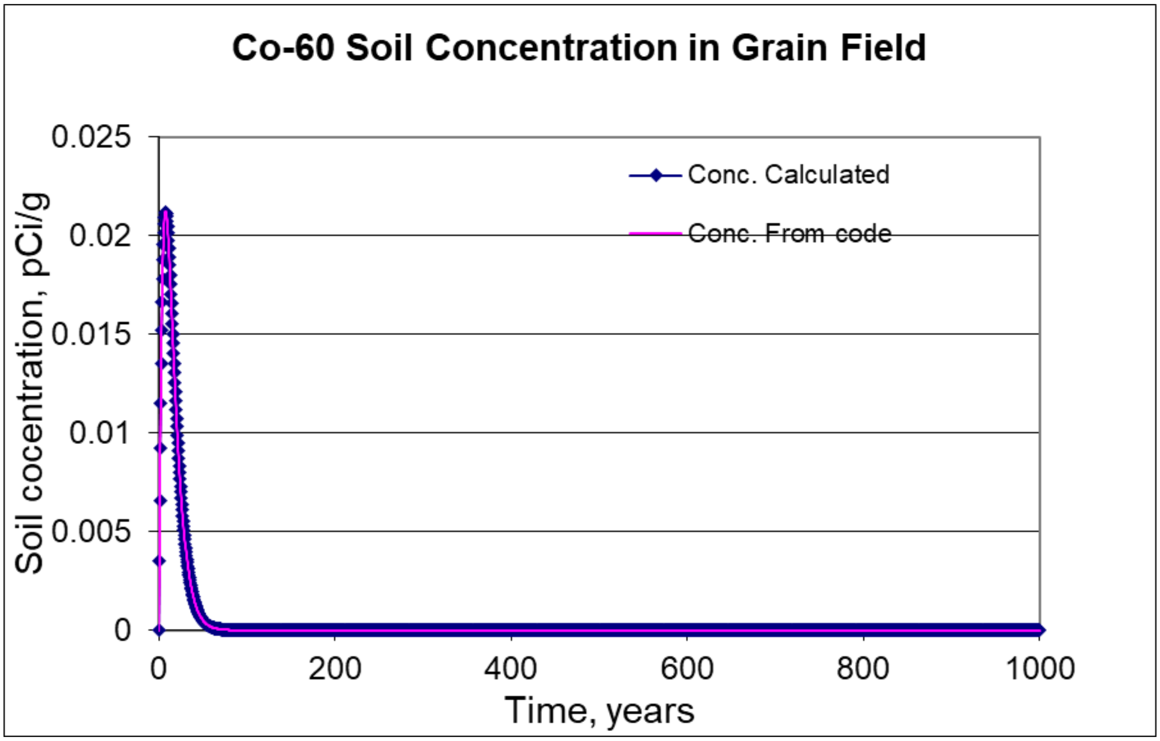


Figure A6.3 ^{60}Co Soil Concentration in Grain Field

Figure A6.4 shows the comparison of ^{14}C soil concentration in a nonleafy vegetables field. The “offsite-accumulation-test4.rof” RESRAD-OFFSITE file is used, and the calculations are in the “soil conc accumulation in nonleafy vegetable field-C-14.xlsx” spreadsheet.

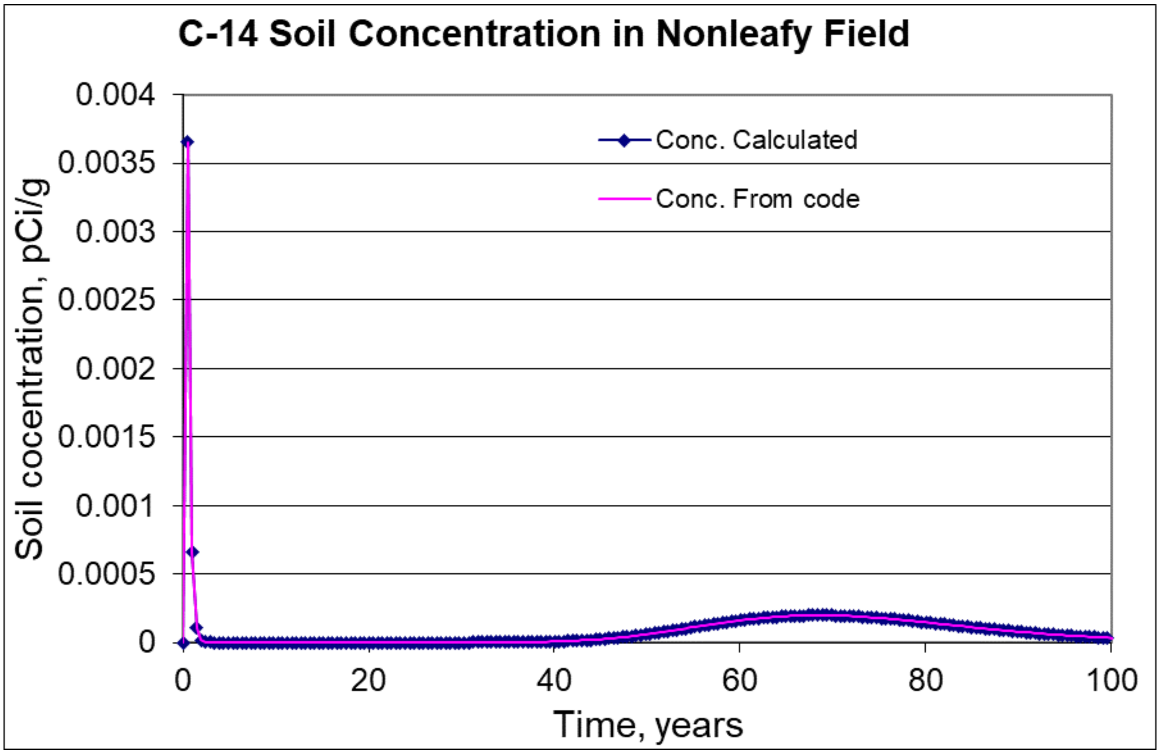


Figure A6.4 ^{14}C Soil Concentration in Fruit, Grain, and Nonleafy Vegetables Field

Figure A6.5 shows the comparison of ^{14}C soil concentration in a nonleafy vegetables field from erosion in the primary contaminated area. The "offsite-accumulation-test4-erosion-only.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in nonleafy vegetable field-C-14.xlsx" spreadsheet.

Figure A6.6 shows the comparison of ^{14}C soil concentration in a nonleafy vegetables field from air particulate deposition. The "offsite-accumulation-test4-air-dep-only.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in nonleafy vegetable field-C-14.xlsx" spreadsheet.

Figure A6.7 shows the comparison of ^{14}C soil concentration in a nonleafy vegetables field from irrigation with contaminated surface water. The "offsite-accumulation-test4-surface water only.rof" RESRAD-OFFSITE file is used, and the calculations are in the "soil conc accumulation in nonleafy vegetable field-C-14.xlsx" spreadsheet.

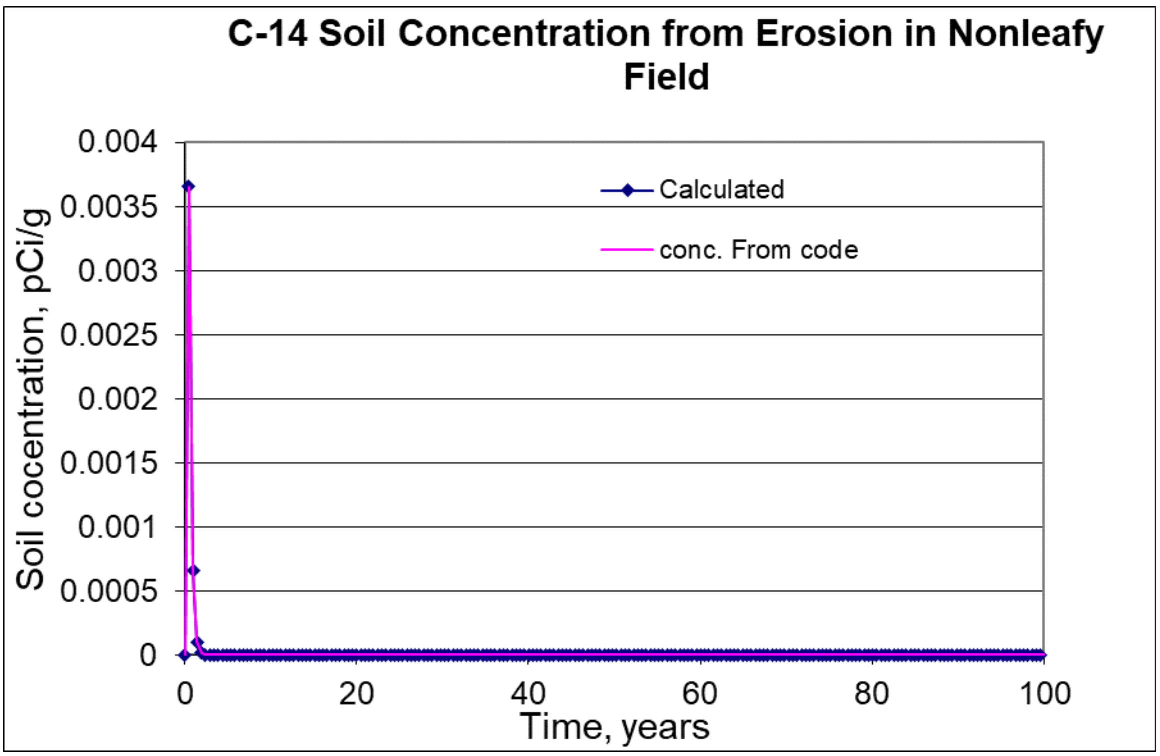


Figure A6.5 ^{14}C Soil Concentration in Fruit, Grain, and Nonleafy Vegetables Field from Erosion

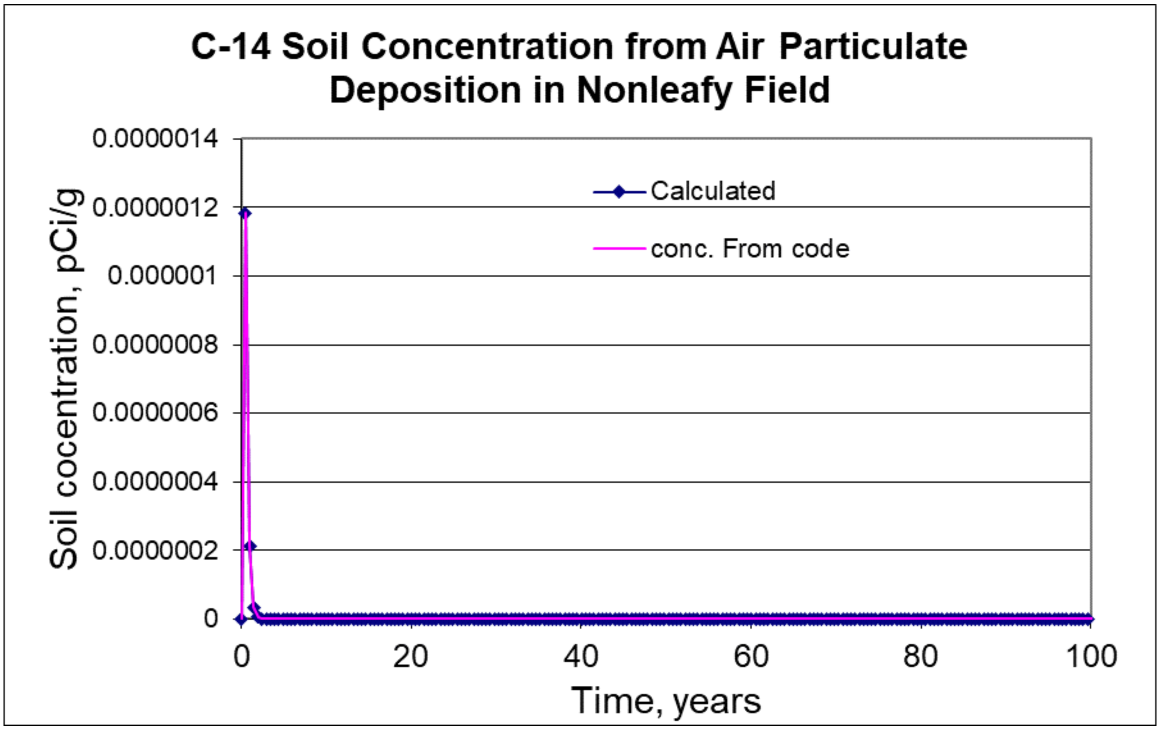


Figure A6.6 ^{14}C Soil Concentration in Fruit, Grain, and Nonleafy Vegetables Field from Air Particulate Deposition

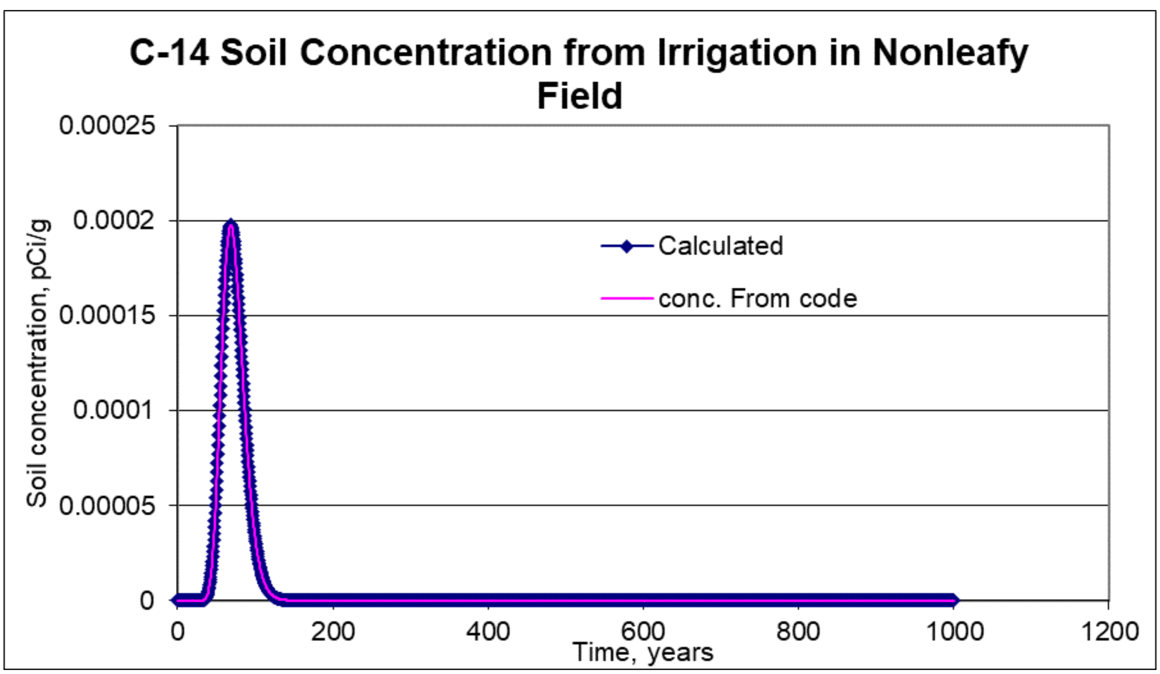


Figure A6.7 ^{14}C Soil Concentration in Fruit, Grain, and Nonleafy Vegetables Field from Irrigation

APPENDIX 7: VERIFICATION OF PLANT, MEAT, MILK, AND AQUATIC FOOD CONCENTRATIONS AND INGESTION PATHWAY DOSES

Verification of the accumulation of radionuclides in plants, meat, milk, and aquatic foods in RESRAD-OFFSITE code is performed for ^{90}Sr. The concentrations along with intake rates and ingestion dose coefficient are used to calculate pathway doses.

The code models the root uptake from the primary and secondary contaminations, the foliar interception of particulates released from the primary contamination but not from the secondary contamination, foliar interception of contaminated irrigation water, translocation of the radionuclides intercepted by the foliage to the edible part of the plant, and losses due to weathering. The code models two classes of vegetables (leafy and fruit, grain, and nonleafy) and two classes of animal feed (grain and pasture and silage).

The code computes the concentrations of the radionuclides in meat and milk using transfer factors that are in essence ratios of the concentrations to the intake rates. It models the intake of radionuclides from ingesting livestock feed and water and the incidental ingestion of soil with the feed.

The code computes the concentrations of the radionuclides in two classes of aquatic food—fish and crustaceans—using transfer factors or bioaccumulation factors. These factors are simply the ratios of the concentrations in the aquatic food to the concentrations in the water where the fish lived.

The formulations as described in Appendix J (J.4, J.5, and J.6) of RESRAD-OFFSITE Manual (Yu et al. 2020) were used in the EXCEL spreadsheet for calculating food concentrations (plant-meat-milk-aquatic-food-conc-verification-comprehensive-sr90.xlsx). The spreadsheet results are compared with the concentrations available in the deterministic graphics.

The formulations as described in Section 4.4 of the RESRAD-OFFSITE Manual (Yu et al. 2020) were used in the EXCEL spreadsheet for calculating the ingestion pathway dose from food and water.

The RESRAD-OFFSITE exponential release model is used. It is assumed surface water is used for human consumption, animal intake, and irrigation. The eroded material from primary contamination by runoff is deposited in the surface water body. The site layout, atmospheric parameters, and surface water body parameters are kept at code defaults. Table 1 lists other parameters used in calculating plant, meat, milk, and aquatic food concentrations and pathway doses.

Table 1 Parameters Used in Food Concentrations and Ingestion Pathway Dose Calculations

Radionuclide and Radionuclide Specific Parameters	**^{90}Sr**
Half-life (yr)	29.12
Cut-off half-life (d)	30
Distribution coefficient (cm^3/g)	30
Plant root uptake transfer factor (pCi/kg per pCi/kg)	0.3
Meat transfer factor (pCi/kg per pCi/d)	0.008
Milk transfer factor (pCi/L per pCi/d)	0.002
Fish bioaccumulation factor (pCi/kg per pCi/L)	60
Crustacea bioaccumulation factor	100
General Parameters	**Values**
Deposition velocity of all particulates (m/s)	0.001
Storage time (d)	0
Precipitation rate (m/yr)	1
Depth of soil mixing layer (m)	0.15
Contaminated zone thickness (m)	
Cover thickness (m)	
Dry bulk density of contaminated zone and cover (g/cm^3)	1.5
Soil erodibility factor for contaminated zone and cover	0.4
Slope-length-steepness factor	0.4
Cover and management	0.003
Support practice factor	1
Irrigation applied (m/yr)	0.2
Evapotranspiration coefficient	0.5
Runoff coefficient	0.2
Offsite Soil Parameters in Different Agricultural Areas	
Fraction of area directly over primary contamination	0
Irrigation applied (m/yr)	0.2
Evapotranspiration coefficient	0.5
Runoff coefficient	0.2
Mixing depth (m)	0.15
Volumetric water content	0.3
Dry bulk density (g/cm^3)	1.5
Soil erodibility factor	0.4
Slope-length-steepness factor	0.4
Cover and management	0.003
Support practice factor	1

Table 1 (Cont.)

Plant Accumulation Parameters	
Wet crop yield for fruit, grain, and leafy vegetables (kg/m^2)	0.7
Wet crop yield for leafy vegetables (kg/m^2)	1.5
Wet crop yield for pasture and silage (kg/m^2)	1.1
Wet crop yield for grain (kg/m^2)	0.7
Foliage to food transfer coefficient for fruit, grain, and leafy vegetables	0.1
Foliage to food transfer coefficient for leafy vegetables	1.0
Foliage to food transfer coefficient for pasture and grass	1.0
Foliage to food transfer coefficient for grain	0.1
Duration of growing season for fruit, grain, and leafy vegetables (yr)	0.17
Duration of growing season for leafy vegetables (yr)	0.25
Duration of growing season for pasture and grass (yr)	0.08
Duration of growing season for grain (yr)	0.17
Weathering removal constant for all plant types (per yr)	20
Foliar interception factor for irrigation for all plant types	0.25
Foliar interception factor for dust for all plant types	0.25
Meat and Milk Cow Intake Parameters	
Beef cattle water intake (L/d)	50
Dairy cow water intake (L/d)	160
Beef cattle pasture intake (kg/d)	14
Dairy cow pasture intake (kg/d)	44
Beef cattle grain intake (kg/d)	54
Dairy cow grain intake (kg/d)	11
Beef cattle soil intake from pasture and silage (kg/d)	0.1
Dairy cow soil intake from pasture and silage (kg/d)	0.4
Beef cattle soil intake from grain (kg/d)	0.4
Dairy cow soil intake from grain (kg/d)	0.1
Dose Coefficient	
Ingestion dose coefficient (mrem/pCi)	0.0001136
Human Consumption Parameters	
Drinking water (L/yr)	510
Fish intake (kg/yr)	5.4
Crustacea intake (kg/yr)	0.9
Non-leafy vegetable intake	160
Leafy vegetable intake	14
Meat intake (kg/yr)	63
Milk intake (L/yr)	92
Soil intake (g/yr)	36.5
Fraction from Affected Area	
CF drinking water	1
CF fish	0.5
CF crustacea	0.5
CF non-leafy	0.5
CF meat	1
CF milk	1

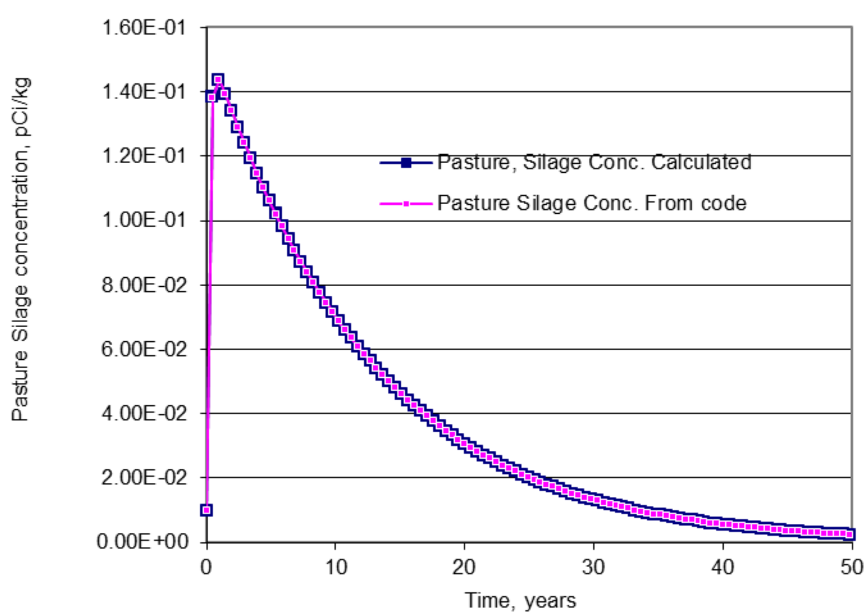
Separate EXCEL spreadsheets for calculating surface water concentration and accumulation in different offsite agricultural areas were created for ^{90}Sr contamination and were used in this verification. The surface water model and the accumulation in offsite locations were verified separately.

Plant Concentration Comparisons

For calculating plant concentrations, it is assumed plants are grown in agricultural areas that are not on primary contamination. The soil concentration in agricultural areas is taken from spreadsheets “soil conc accumulation in nonleafy field-Sr-90.xlsx,” “soil conc accumulation in leafy field-Sr-90.xlsx,” “soil conc accumulation in pasture field-Sr-90.xlsx,” and “soil conc accumulation in grain field-Sr-90.xlsx” in the “Soil accumulation in agricultural areas” subfolder; surface water concentration is taken from the spreadsheet “surface water conc verification-sr90.xlsx” in the “surface water concentration calculations” subfolder. The other inputs used in the EXCEL spreadsheet include the release rate to air from primary contamination (AIRFLUXIN.DAT), erosion release (SWFLUX.DAT), and CHIOVERQ files (intermediate results generated in the code).

Figures 1-4 show the comparison of the calculated plant concentrations using the EXCEL spreadsheet in four different types of plants with the concentrations from the code. The detailed comparison is in the EXCEL spreadsheet “plant-meat-milk-aquatic-food-conc-verification-comprehensive-sr90.xlsx” under the “plant food concentration” worksheet. The EXCEL spreadsheet calculations in general match the code output.

Figure 1 Sr-90 Concentration in Pasture and Silage



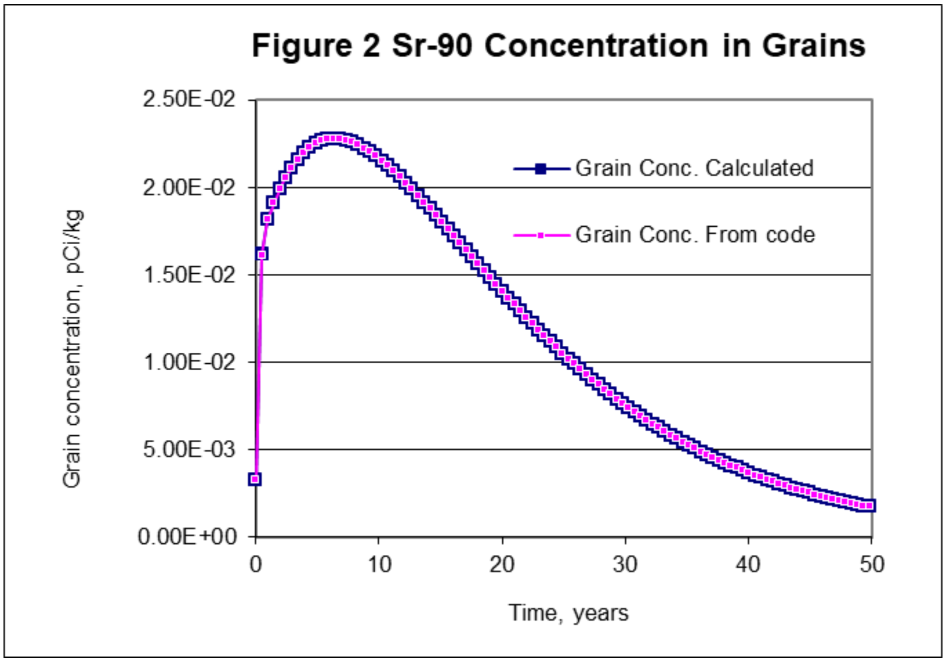


Figure 2 Sr-90 Concentration in Grains
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Grain concentration, pCi/kg
Grain Conc. Calculated
Grain Conc. From code
0
10
20
30
40
50
Time, years

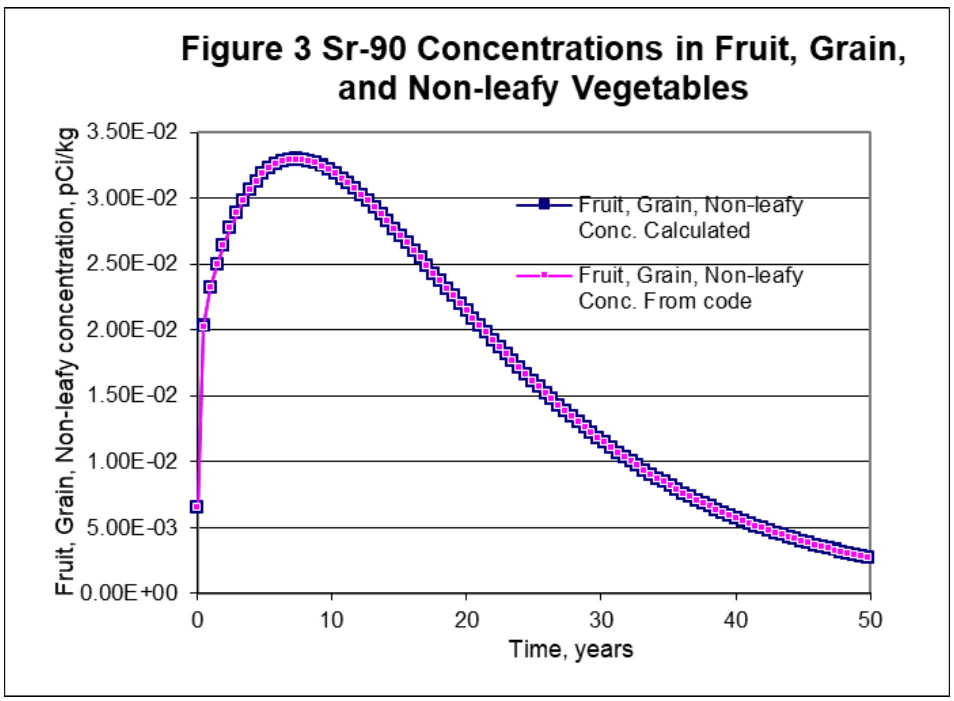
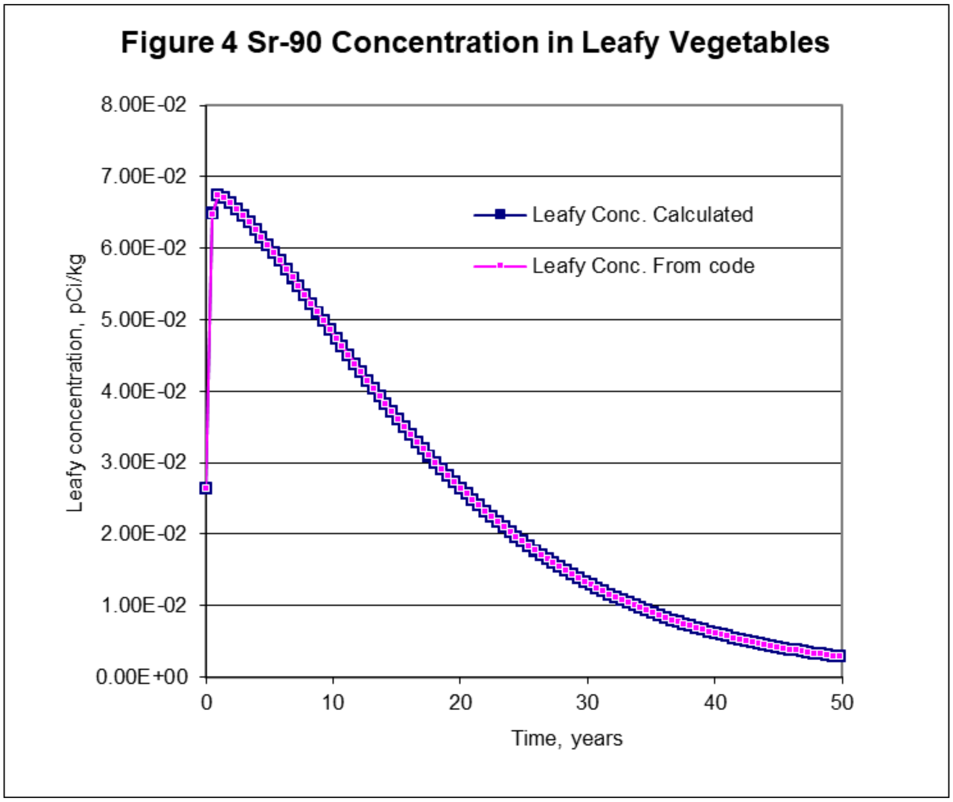


Figure 3 Sr-90 Concentrations in Fruit, Grain, and Non-leafy Vegetables
3.50E-02
3.00E-02
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Fruit, Grain, Non-leafy concentration, pCi/kg
Fruit, Grain, Non-leafy Conc. Calculated
Fruit, Grain, Non-leafy Conc. From code
0
10
20
30
40
50
Time, years



Meat and Milk Concentrations Comparison

For calculating meat and milk concentrations, the soil concentration in the livestock feed areas is taken from spreadsheets “soil conc accumulation in pasture field-Sr-90.xlsx” and “soil conc accumulation in grain field-Sr-90.xlsx” in the “Soil accumulation in agricultural areas” subfolder; surface water concentration is taken from the spreadsheet “surface water conc verification-sr90.xlsx” in the “surface water concentration calculations” subfolder; and the pasture and grain concentration is taken from the “plant food concentration” worksheet. The calculated meat and milk concentrations are in the “meat and milk concentration” worksheet in the “plant-meat-milk-aquatic-food-conc-verification-comprehensive-sr90.xlsx” EXCEL spreadsheet.

Figures 5 and 6 compare the calculated meat and milk concentrations using the EXCEL spreadsheet with the concentrations from the code. The detailed comparison is in the EXCEL spreadsheet “plant-meat-milk-aquatic-food-conc-verification-comprehensive-sr90.xlsx” under the “meat and milk concentration” worksheet. The EXCEL spreadsheet calculations in general match the code output.

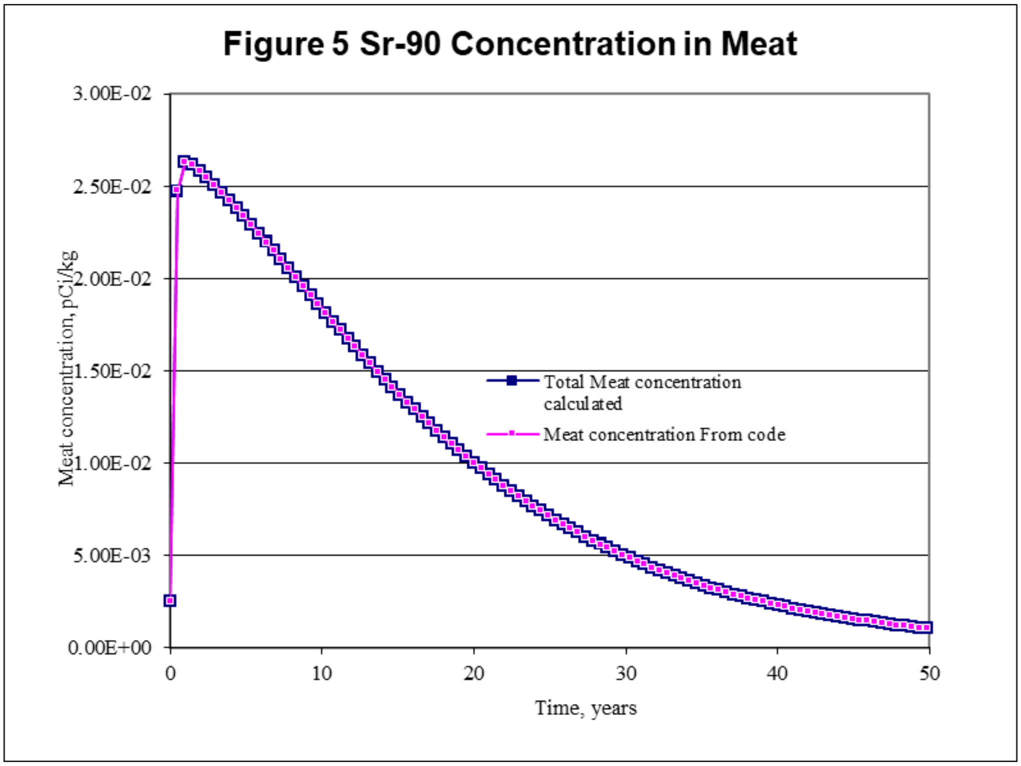


Figure 5 Sr-90 Concentration in Meat
3.00E-02
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Meat concentration, pCi/kg
0
10
20
30
40
50
Time, years
Total Meat concentration calculated
Meat concentration From code

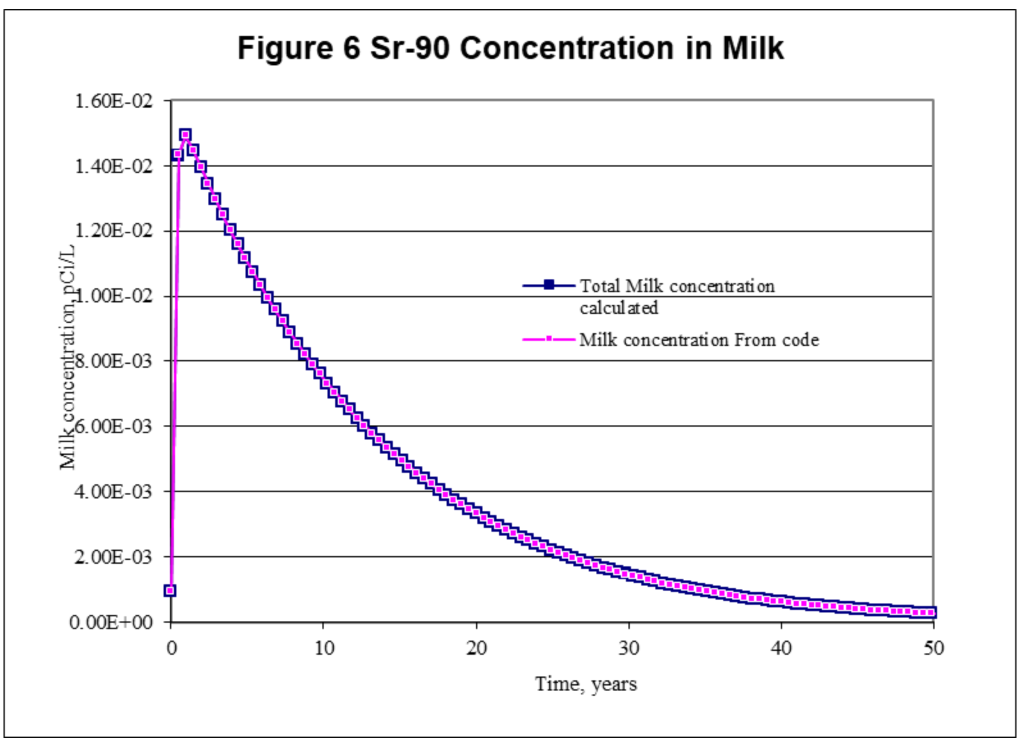


Figure 6 Sr-90 Concentration in Milk
1.60E-02
1.40E-02
1.20E-02
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
Milk concentration, pCi/L
0
10
20
30
40
50
Time, years
Total Milk concentration calculated
Milk concentration From code

Aquatic Food Concentrations Comparison

For calculating aquatic food (fish and crustacea) concentrations, the surface water concentration is taken from the spreadsheet "surface water conc verification-sr90.xlsx" in the "surface water concentration calculations" subfolder. The calculated fish and crustacean concentrations are in the "aquatic food concentration" worksheet in the "plant-meat-milk-aquatic-food-conc-verification-comprehensive-sr90.xlsx" EXCEL spreadsheet.

Figure 7 Sr-90 Concentration in Fish

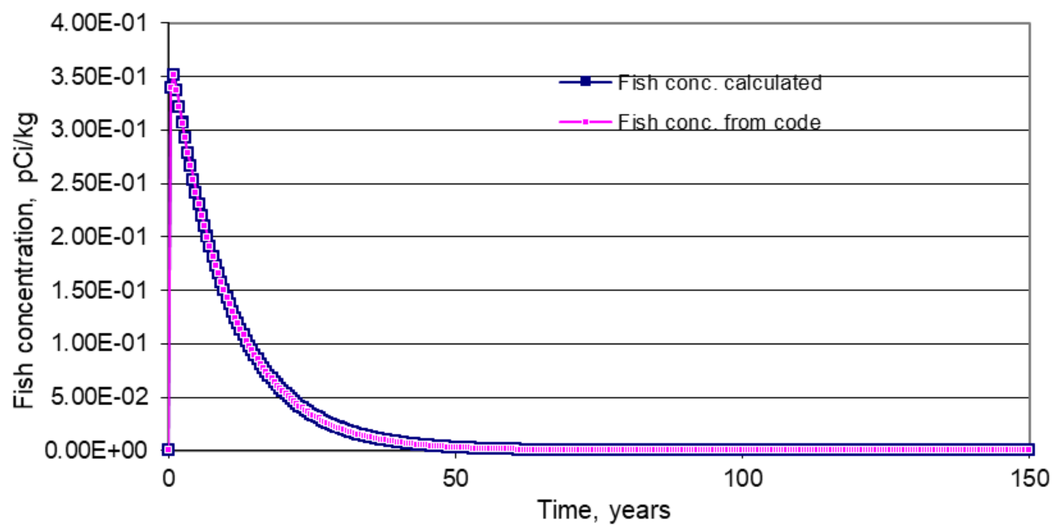
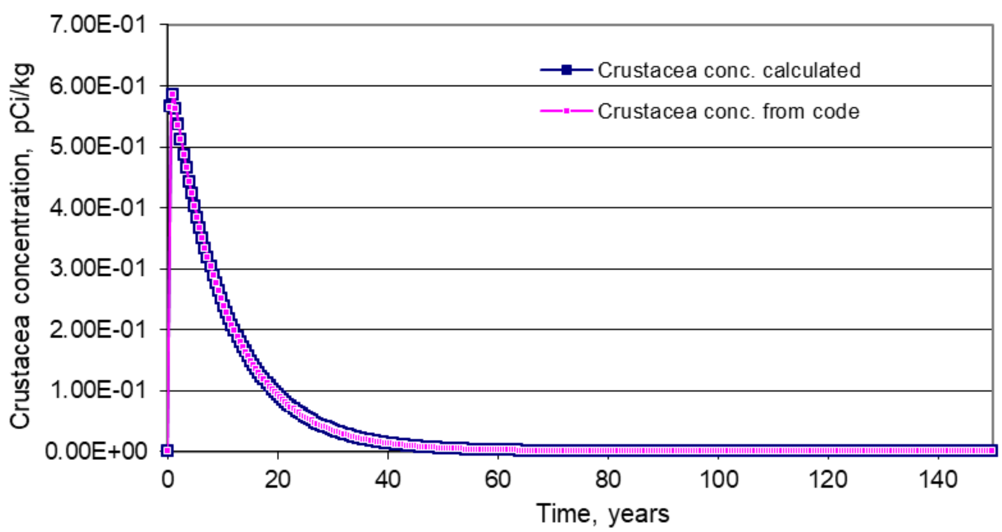


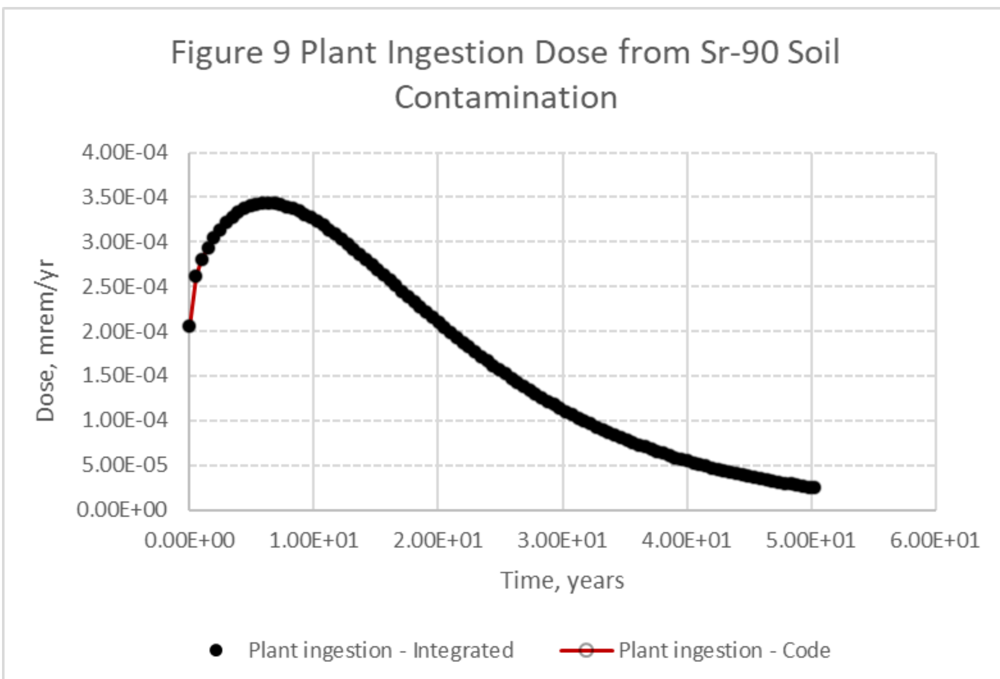
Figure 8 Sr-90 Concentration in Crustacean



Ingestion Pathway Doses from Food and Water

For calculating the ingestion pathway dose from food and water, the surface water concentration is taken from the spreadsheet "surface water conc verification-sr90.xlsx" in the "surface water concentration calculations" subfolder. The plant food concentrations are taken from the "plant food concentration" worksheet; the meat and milk concentrations are taken from the "meat and milk concentration" worksheet; and the aquatic food concentrations are taken from the "aquatic food concentration" worksheet. The calculated ingestion pathway doses are in the "ingestion pathway doses" worksheet in the "plant-meat-milk-aquatic-food-conc-verification-comprehensive-sr90.xlsx" EXCEL spreadsheet.

The instantaneous dose rates calculated at the calculation time points are used to calculate the time-integrated dose over a period of 1 year, as described in Appendixes E.1 and E.2 of the RESRAD-OFFSITE Manual (Yu et al. 2020), and compared with the code results. Figures 9-13 compare the EXCEL spreadsheet integrated dose with the code results from different foods and water ingestion.



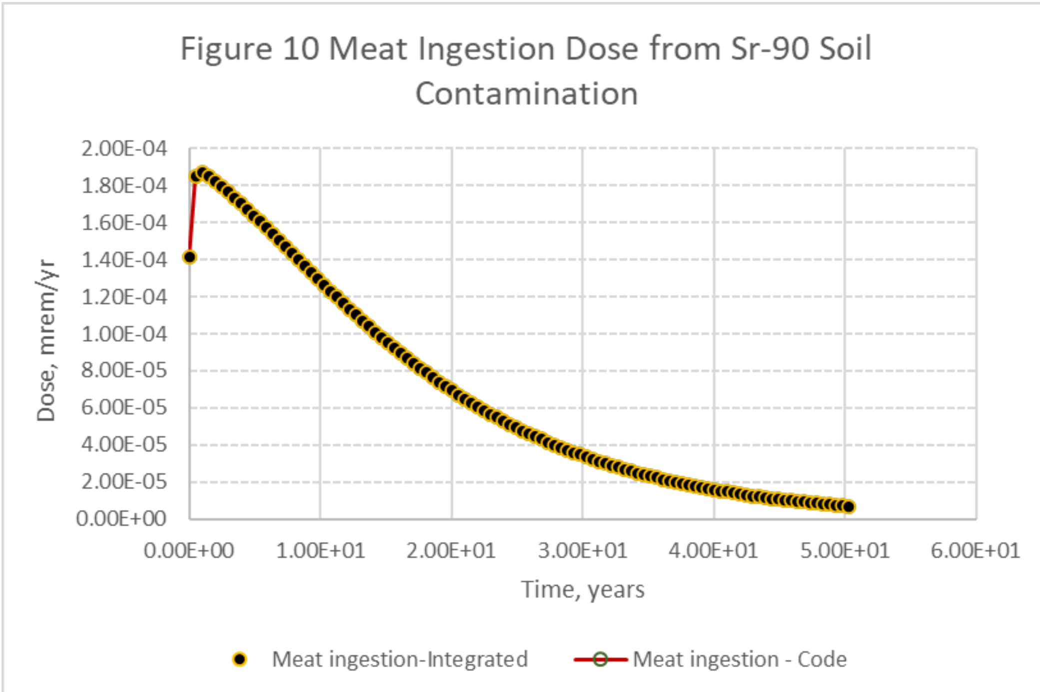


Figure 10 Meat Ingestion Dose from Sr-90 Soil Contamination
Dose, mrem/yr
2.00E-04
1.80E-04
1.60E-04
1.40E-04
1.20E-04
1.00E-04
8.00E-05
6.00E-05
4.00E-05
2.00E-05
0.00E+00
0.00E+00
1.00E+01
2.00E+01
3.00E+01
4.00E+01
5.00E+01
6.00E+01
Time, years
Meat ingestion-Integrated
Meat ingestion - Code

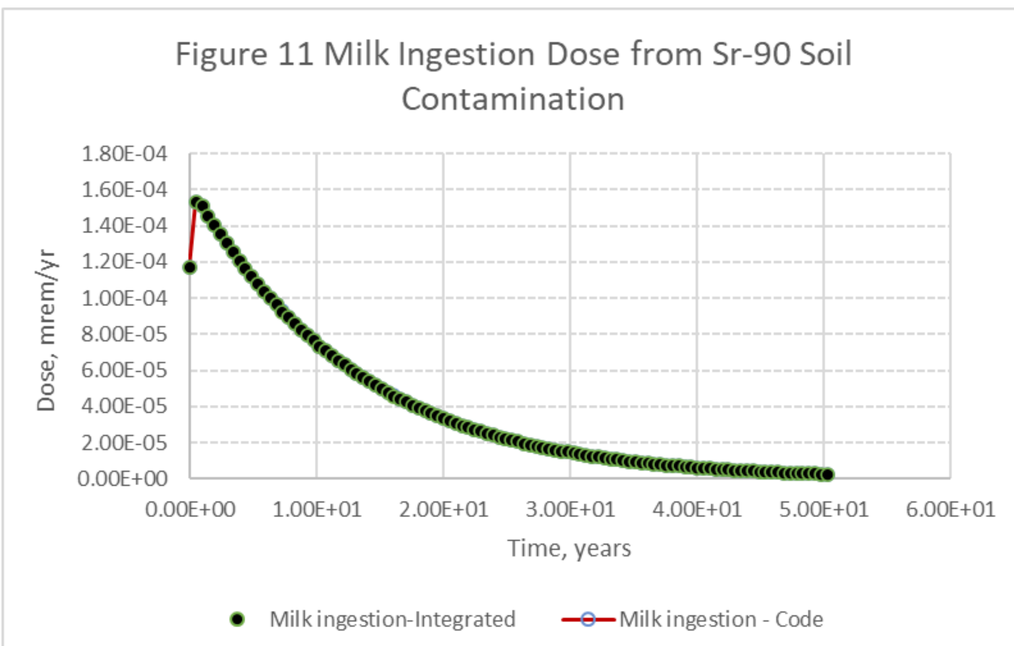


Figure 11 Milk Ingestion Dose from Sr-90 Soil Contamination
Dose, mrem/yr
1.80E-04
1.60E-04
1.40E-04
1.20E-04
1.00E-04
8.00E-05
6.00E-05
4.00E-05
2.00E-05
0.00E+00
0.00E+00
1.00E+01
2.00E+01
3.00E+01
4.00E+01
5.00E+01
6.00E+01
Time, years
Milk ingestion-Integrated
Milk ingestion - Code

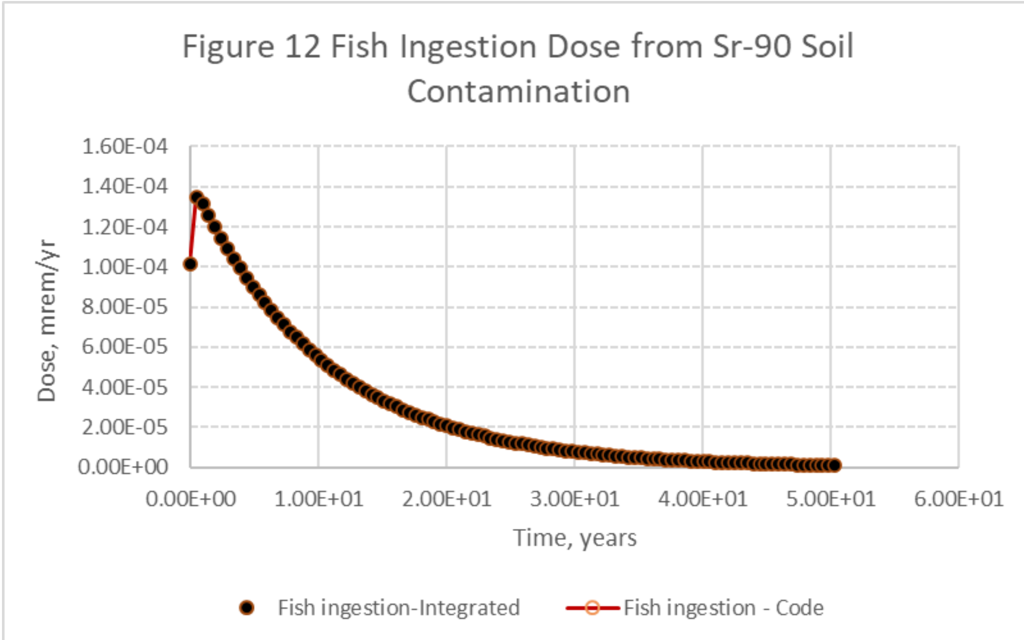


Figure 12 Fish Ingestion Dose from Sr-90 Soil Contamination
Dose, mrem/yr
1.60E-04
1.40E-04
1.20E-04
1.00E-04
8.00E-05
6.00E-05
4.00E-05
2.00E-05
0.00E+00
0.00E+00
1.00E+01
2.00E+01
3.00E+01
4.00E+01
5.00E+01
6.00E+01
Time, years
Fish ingestion-Integrated
Fish ingestion - Code

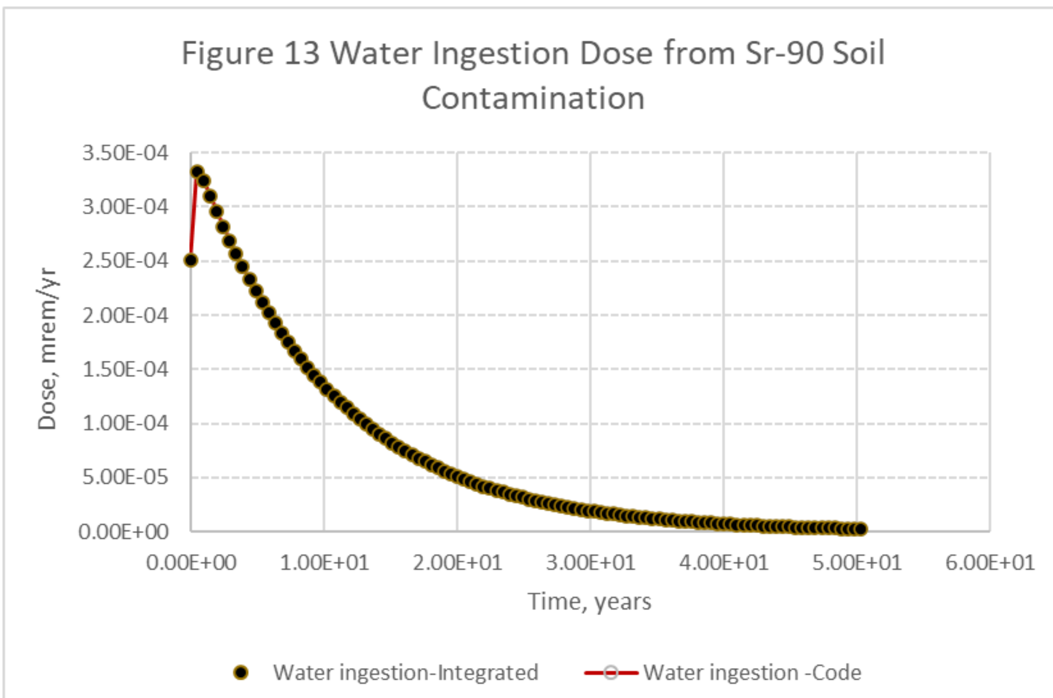


Figure 13 Water Ingestion Dose from Sr-90 Soil Contamination
Dose, mrem/yr
3.50E-04
3.00E-04
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
0.00E+00
1.00E+01
2.00E+01
3.00E+01
4.00E+01
5.00E+01
6.00E+01
Time, years
Water ingestion-Integrated
Water ingestion -Code

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APPENDIX 8: VERIFICATION OF SOIL INGESTION PATHWAY DOSE

RESRAD-OFFSITE computes the exposure from the incidental ingestion of soil by summing the product of the dose conversion factor or slope factor for the radionuclide from the chosen dose factor library, the incidental ingestion rate of the soil, the fraction of time spent at the onsite or offsite location, and the concentration of the radionuclide in the soil at the onsite or offsite location. For the onsite location, if the area is less than 1000 m^2, an area factor correction (ratio of contaminated area/1,000) is applied.

For verifying soil ingestion pathway doses, four test cases are used. In all four test cases, the ICRP-38 nuclide database and FGR-11 internal dose library are used. Table A8.1 lists some of the parameters that are different from the code defaults used in the dose calculations. For two test cases, the receptor was outside on the primary contaminated area, and for the other two test cases, the receptor was in different agriculture fields. Table A8.1 also lists the input files used in different runs.

Soil Ingestion When Receptor Is on Primary Contamination

For verifying the dose when the receptor was on the primary contamination, two test cases (soil-ingestion-1.rof and soil-ingestion-2.rof) were used. The receptor was placed outside on the primary contamination, and the contaminated area, thickness, and cover thickness were varied. Table A8.1 lists the parameters used in the run that are different from the code defaults. Only the soil ingestion pathway was kept active in the run, and the soil ingestion pathway dose for two radionuclides with varying half-lives was noted from the graphic interface. The graphic interface results for the soil ingestion pathway doses were compared with the calculated dose from the EXCEL spreadsheet results.

For EXCEL spreadsheet calculations, the primary contamination soil concentration was taken from the code (graphic interface) and the surface layer concentration was calculated. The surface layer concentration along with the area factor, occupancy factor, soil ingestion rate, and ingestion dose coefficients were used to calculate the soil ingestion dose. The detailed calculations are in two EXCEL spreadsheets (soil-ingestion-pathway-onsite-receptor-case1 and soil-ingestion-pathway-onsite-receptor-case2). Figures A8.1-A8.4 compare the calculated soil ingestion dose with the soil ingestion dose from the code.

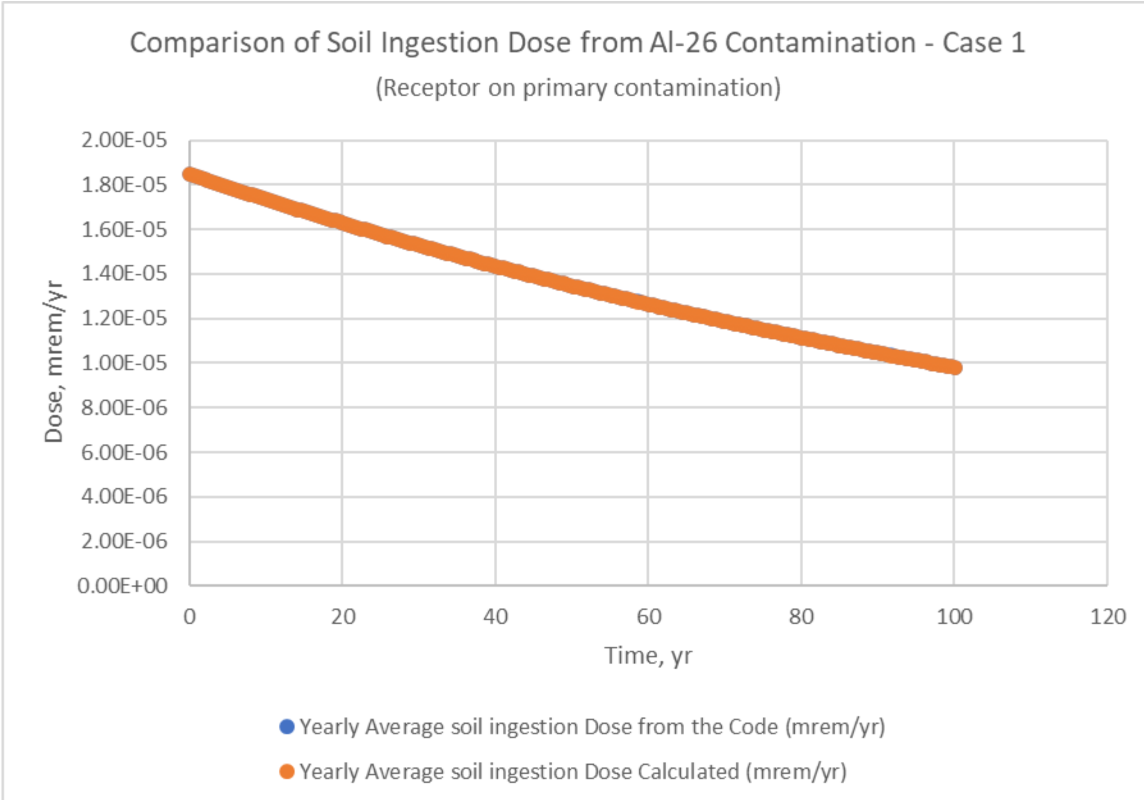

Figure A8.1 Soil Ingestion Dose Comparison for ^{26}Al Contamination – Case 1

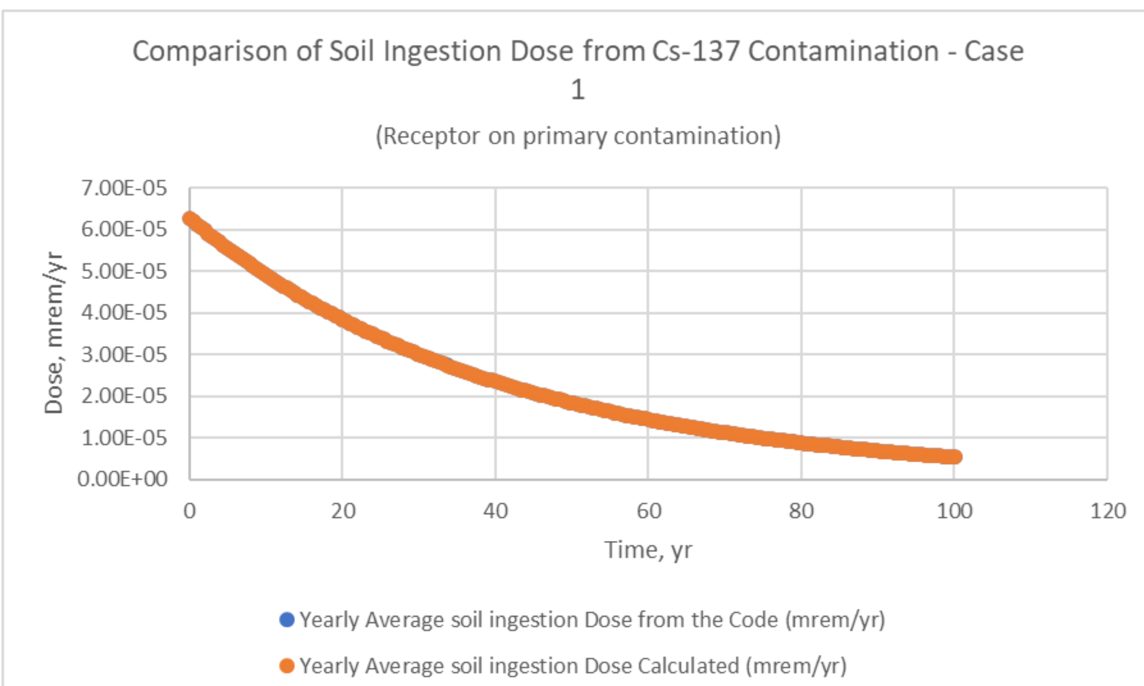

Figure A8.2 Soil Ingestion Dose Comparison for ^{137}Cs Contamination – Case 1

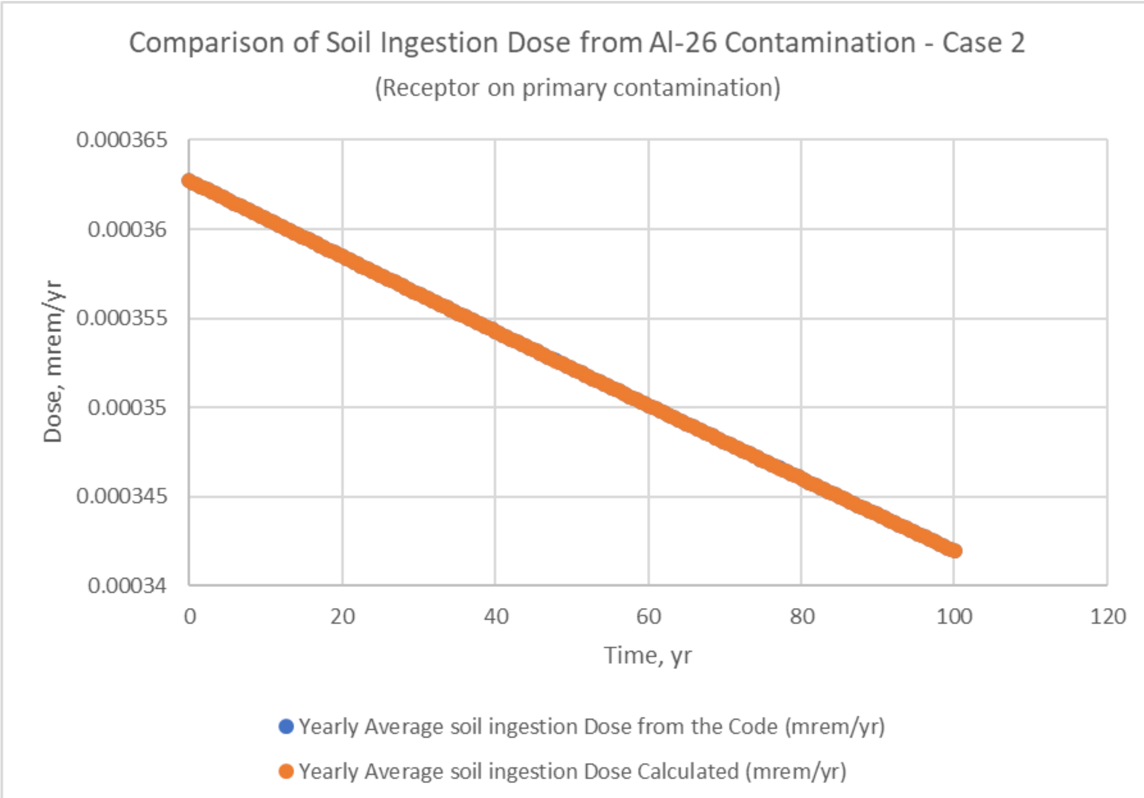

Figure A8.3 Soil Ingestion Dose Comparison for ^{26}Al Contamination – Case 2

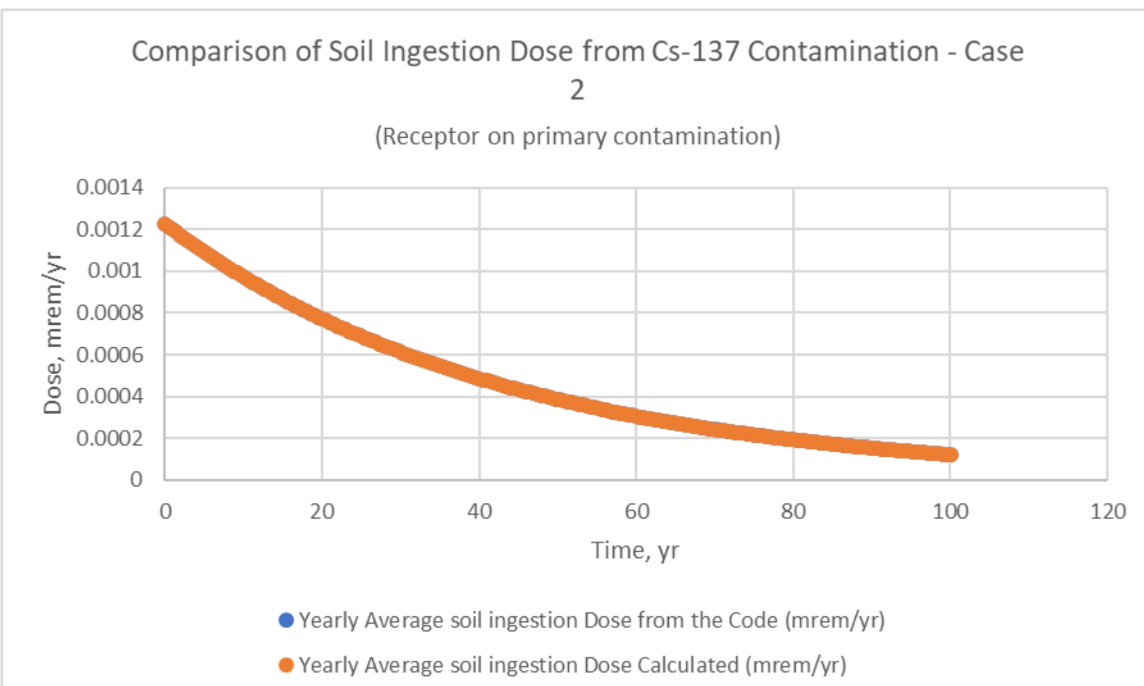

Figure A8.4 Soil Ingestion Dose Comparison for ^{137}Cs Contamination – Case 2

Soil Ingestion When Receptor Is Offsite

For verifying dose when the receptor was offsite, two test cases (soil-ingestion-3.rof and soil-ingestion-4.rof) were used. In Case 3, the receptor was placed outside in the pasture and silage field, and in Case 4, the receptor was placed outside in the non-leafy agricultural area. Table A8.1 lists the parameters used in the run that are different from the code defaults. Only the soil ingestion pathway was kept active in the run, and the soil ingestion pathway dose for two radionuclides with varying half-lives was noted from the graphic interface. The graphic interface results for inhalation pathway doses were compared with the calculated dose from the EXCEL spreadsheet results.

For EXCEL spreadsheet calculations, the soil concentration in agricultural areas was taken from the code (graphic interface). The soil concentration in agricultural areas along with the occupancy factor, soil ingestion rate, and ingestion dose coefficients were used to calculate the soil ingestion dose. The detailed calculations are in the EXCEL spreadsheets (soil-ingestion-pathway-offsite-receptor). Figures A8.5-A8.8 compare the calculated soil ingestion dose with the soil ingestion dose from the code.

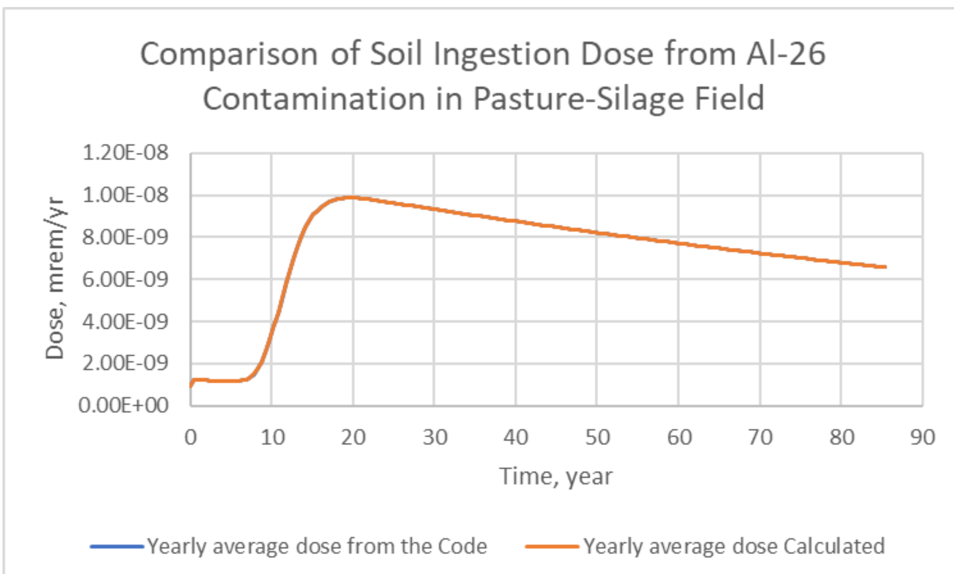

Figure A8.5 Soil Ingestion Dose Comparison for ^{26}Al Contamination – Case 3

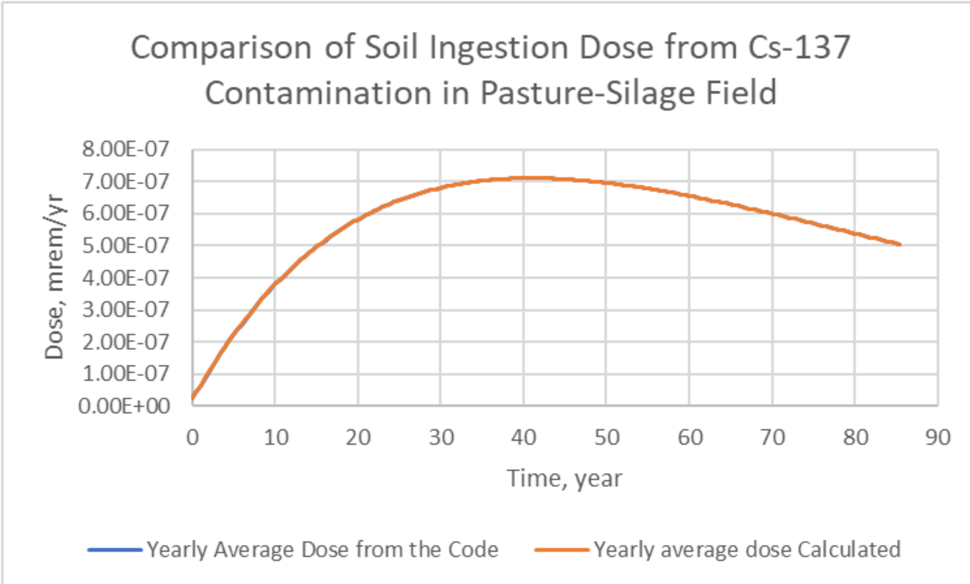

Figure A8.6 Soil Ingestion Dose Comparison for ^{137}Cs Contamination – Case 3

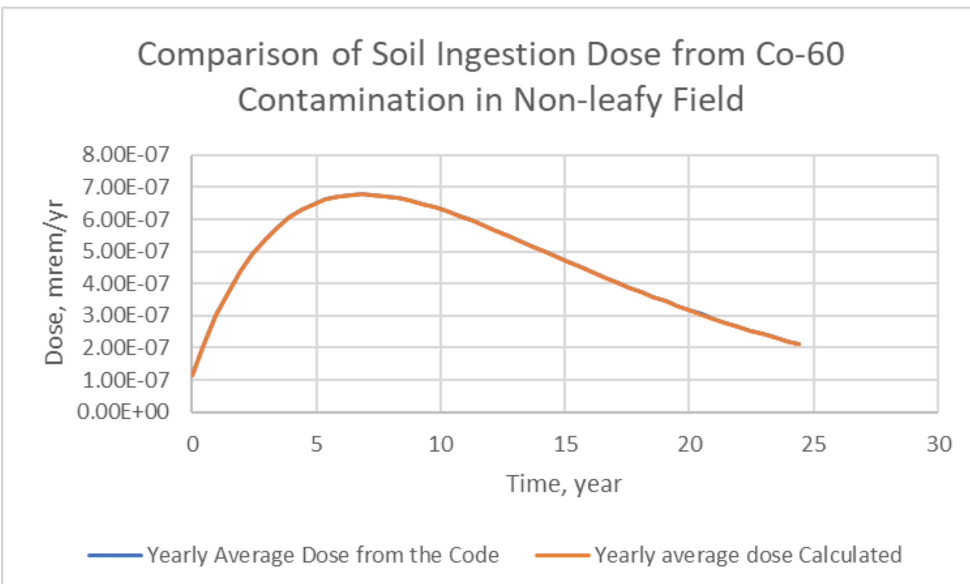

Figure A8.7 Soil Ingestion Dose Comparison for ^{60}Co Contamination – Case 4

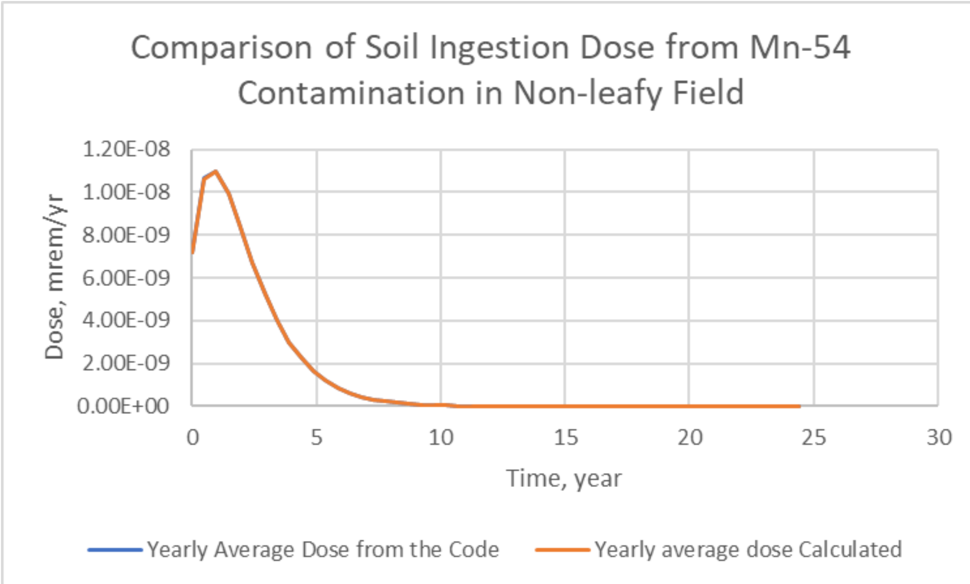

Figure A8.8 Soil Ingestion Dose Comparison for ^{54}Mn Contamination – Case 4

Table A8.1 Parameters Used in Different Test Cases That Are Different from Code Defaults

Test Case	Receptor Occupancy & Location	Radionuclides Selected	PC Parameters	Cover Parameters	Sediment Deliver Ratio	RESRAD-OFFSITE Input File
1	100% outside on PC	^{26}Al and ^{137}Cs	Area = 100 m^2, thickness = 0.05 m, density = 1.6 g/cm^3	None	None	soil-ingestion-1.rof
2	100% outside on PC	^{26}Al and ^{137}Cs	Thickness = 0.5 m, density = 1.6 g/cm^3	Thickness = 0.05 m	None	soil-ingestion-2.rof
3	100% time in pasture field (1450 m away from PC)	^{26}Al and ^{137}Cs	Thickness = 0.05 m, density = 1.6 g/cm^3	None	100% to pasture field	soil-ingestion-3.rof
4	100% time in non-leafy field (Code default location)	^{60}Co and ^{54}Mn	Thickness = 0.05 m, density = 1.6 g/cm^3,	None	100% to non-leafy field	soil-ingestion-4.rof

Note: ^{26}Al Kd was changed from default to 1000 cm^3/g in the contaminated zone in Test Cases 1-3.

APPENDIX 9: VERIFICATION OF PARTICULATE INHALATION PATHWAY DOSE

The code calculates the inhalation pathway dose/risk from the primary contamination and the secondary contamination for indoor and outdoor receptors. The inhalation pathway dose is the product of dose conversion factor or slope factor for the radionuclide from the chosen dose factor library, an occupancy and indoor filtration factor to account for the time spent at the location and for the filtration of dust by any building components while indoors, the inhalation rate, and the concentration of the radionuclide in air at the exposure location.

The concentration of radionuclides in the air above the primary contamination depends on the mass loading of particulates in the air above the primary contamination, the concentration of radionuclides in the surface soil, and the area factor that accounts for uncontaminated dust from outside the primary contamination. For calculating the area factor, it is assumed a very large area is contaminated. The concentration of radionuclides attached to respirable particulates in the air above the primary contamination is the product of the respirable fraction of particulates and the total air concentration.

The concentration of radionuclides in air at an offsite location has two components. The first is the concentration of radionuclides attached to particulates released from the primary contamination and transported by air to the offsite location. The second is the concentration of radionuclides attached to particulates that are re-suspended from the accumulation at the offsite location.

For verifying inhalation pathway doses, four test cases are used. In all four test cases, the ICRP-107 nuclide database and the DCFPAK3.02 adult internal dose library are used. Table A9.1 list the parameters that are different from the code defaults used in dose calculations. For two test cases, the receptor was outside on the primary contaminated area, and for other two test cases, the receptor was on the dwelling site. Table A9.1 also lists input files used in different runs.

Table A9.1 Parameters That Are Different from Code Defaults in the Test Cases

Test Case	Receptor Occupancy & Location	Radionuclides Selected	Primary Contamination Parameters	Cover Parameters	RESRAD-OFFSITE Input File
1	100% outside on PC	^{26}Al and ^{137}Cs	Area = 1000000 m^2, thickness = 0.5 m, density = 1.6 g/cm^3	None	inhalation-1.rof
2	100% inside on PC	^{26}Al and ^{137}Cs	Area = 100 m^2, thickness = 0.1 m, density = 1.6 g/cm^3	Thickness = 0.05 m	inhalation -2.rof
3	100% time outside on the dwelling site	^{26}Al and ^{137}Cs	Thickness = 0.5 m, density = 1.6 g/cm^3	None	inhalation -3.rof
4	100% time inside on the dwelling site	^{26}Al and ^{137}Cs	None	None	inhalation -4.rof

Inhalation Dose When Receptor Is on Primary Contamination

For verifying dose when the receptor was on the primary contamination, two test cases (inhalation-1.rof and inhalation-2.rof) were used. The receptor was placed outside/inside on the primary contamination, and the contaminated area, thickness, and cover thickness were varied. Table A9.1 lists the parameters used in the run that are different from the code defaults. Only the inhalation pathway was kept active in the run, and the inhalation pathway dose for two radionuclides with varying half-lives was noted from the graphic interface. The graphic interface results for the inhalation pathway doses were compared with the calculated dose from the EXCEL spreadsheet results.

For EXCEL spreadsheet calculations, the primary contamination soil concentration was taken from the code (graphic interface) and the surface layer concentration and air concentration above the primary contamination were calculated. The air concentration along with the respirable fraction, area factor, occupancy factor, inhalation rate, and inhalation dose coefficients were used to calculate the inhalation pathway dose. The detailed calculations are in two EXCEL spreadsheets ("inhalation-pathway-onsite-receptor-case1" and "inhalation-pathway-onsite-receptor-case2"). Figures A91-A9.4 compare the calculated inhalation pathway dose with the inhalation pathway dose from the code.

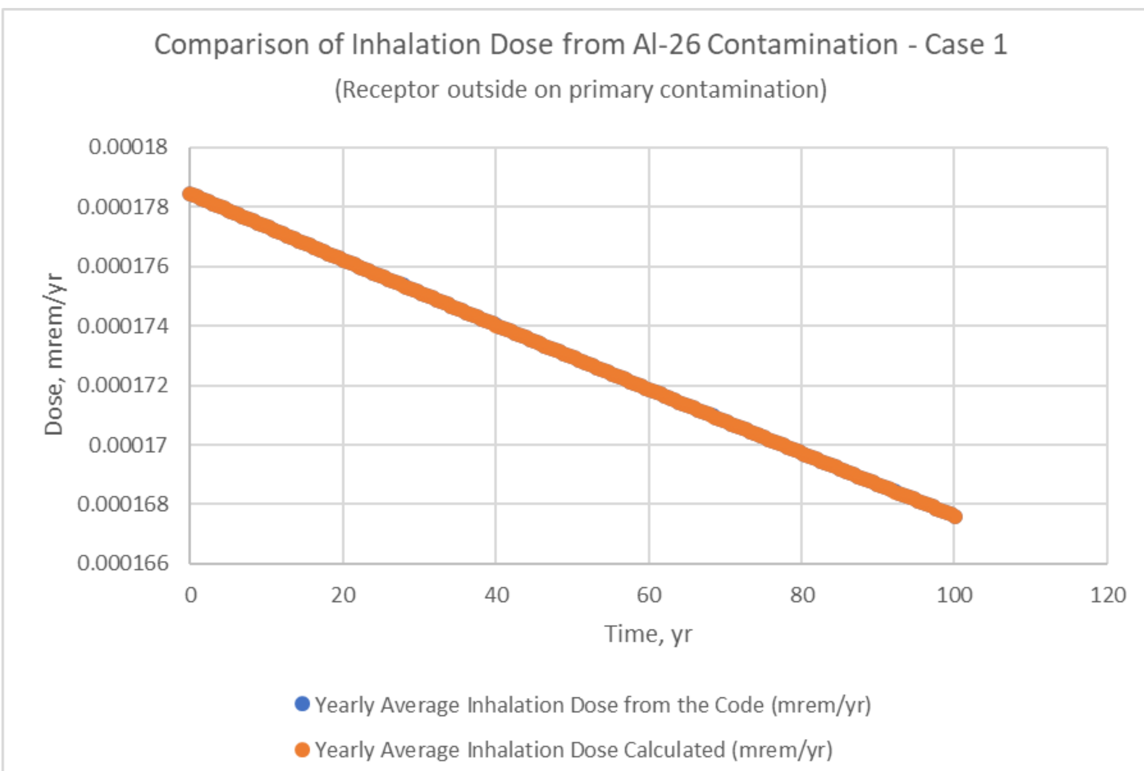

Figure A9.1 Inhalation Dose Comparison for ^{26}Al Contamination – Case 1

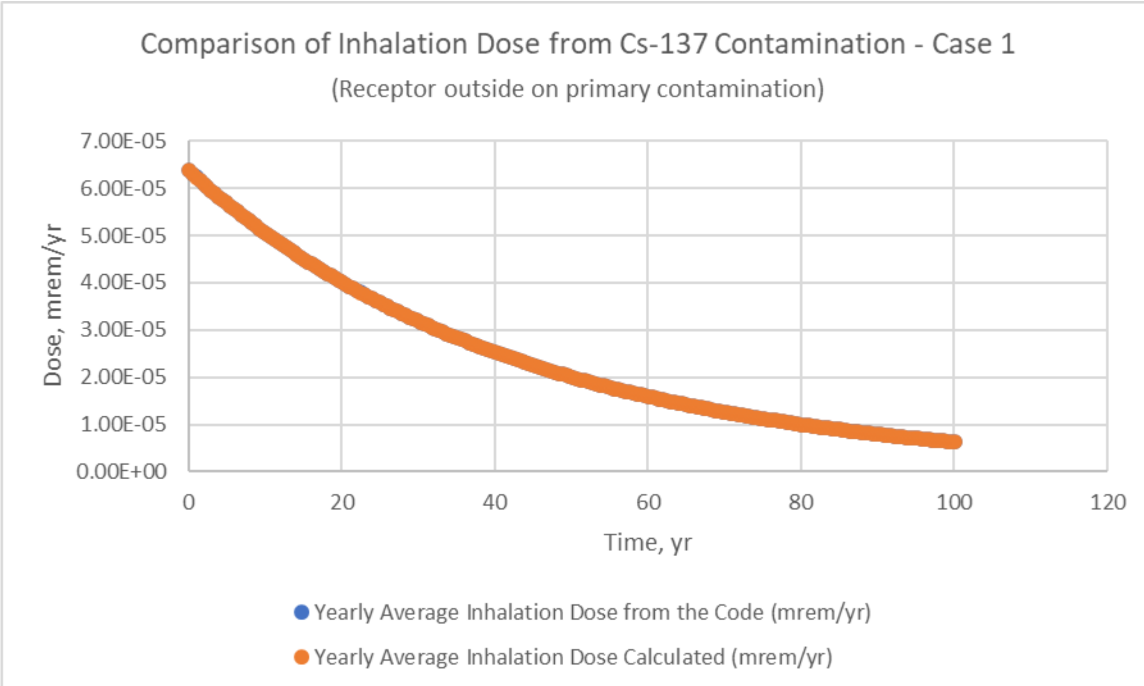

Figure A9.2 Inhalation Dose Comparison for ^{137}Cs Contamination – Case 1

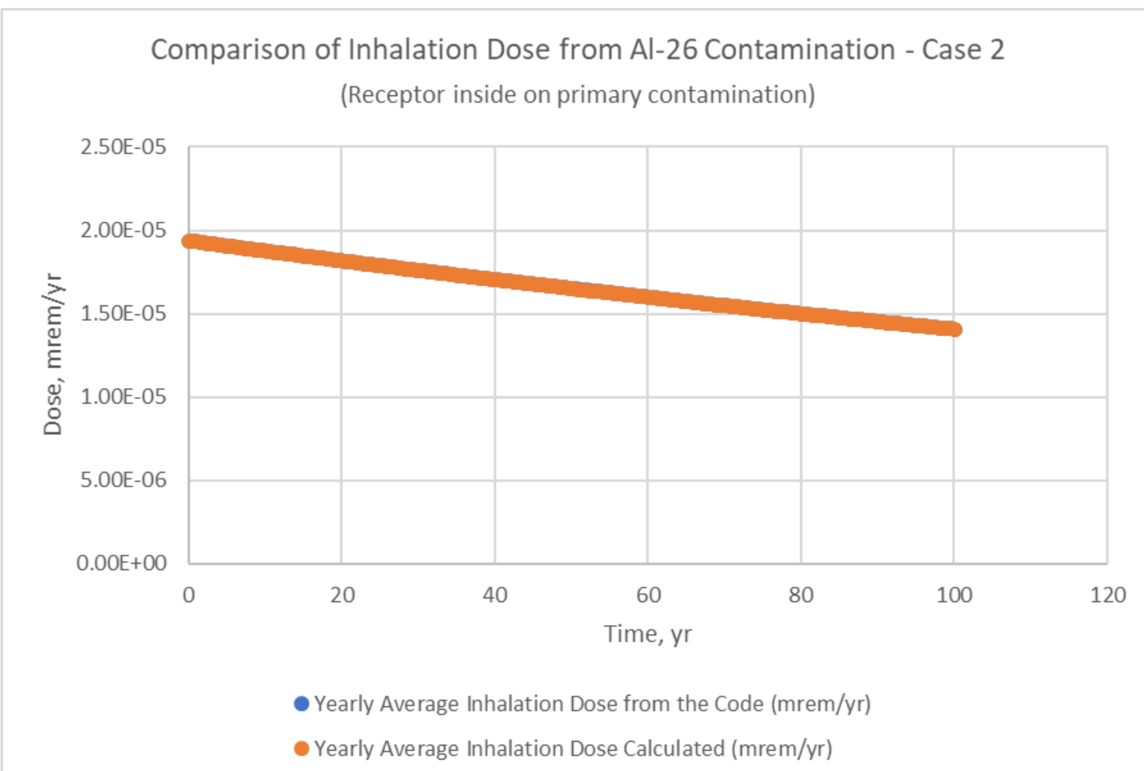

Figure A9.3 Inhalation Dose Comparison for ^{26}Al Contamination – Case 2

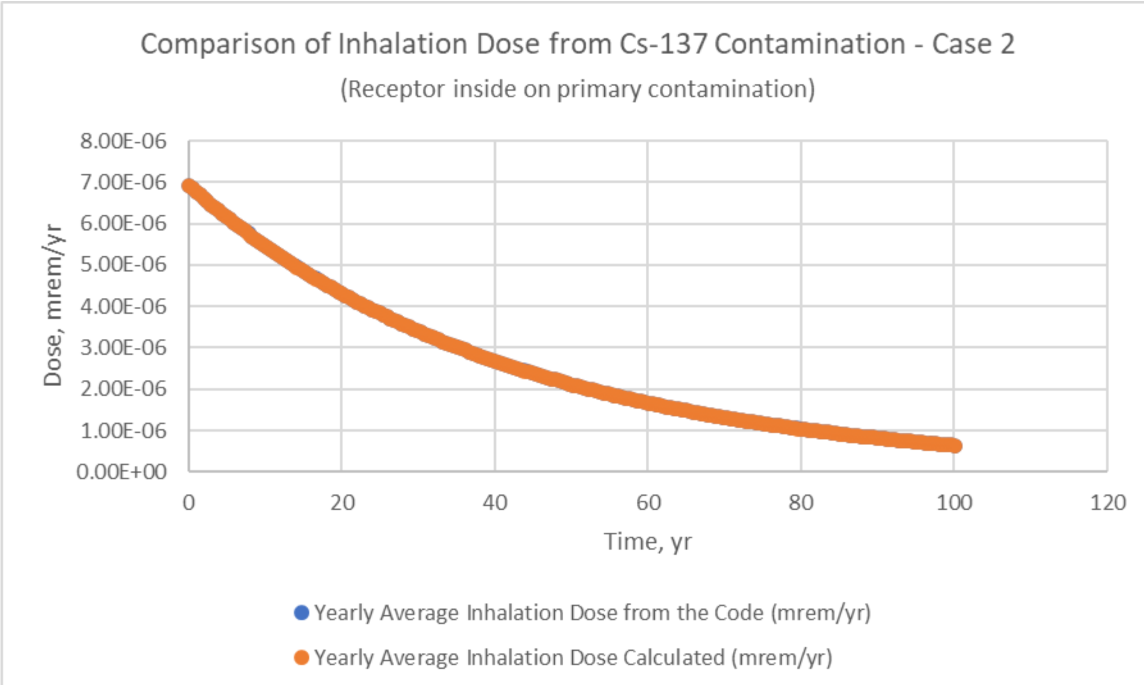

Figure A9.4 Inhalation Dose Comparison for ^{137}Cs Contamination – Case 2

Inhalation Dose When Receptor Is offsite

For verifying dose when the receptor was offsite, two test cases (inhalation-3.rof and inhalation-4.rof) were used. In Case 3, the receptor was placed outside on the dwelling site, and in Case 4, the receptor was placed inside on the dwelling site. Table A9.1 lists the parameters used in the run that are different from the code defaults. Only the inhalation pathway was kept active in the run, and the inhalation pathway dose for two radionuclides with varying half-lives was noted from the graphic interface. The graphic interface results for the inhalation pathway doses were compared with the calculated dose from the EXCEL spreadsheet results.

In the EXCEL spreadsheet, the air concentration at the offsite location was calculated for both components. The concentration of radionuclides attached to particulates released from the primary contamination and transported by air to the offsite location was calculated from the release rate of the radionuclides from the primary contamination and CHIOVERQ. CHIOVERQ was taken from the code (from the CHIOVERQ.OUT file generated after the run in the code's root directory), and the air release rate from the primary contamination was calculated. For calculating the air release rate from the primary contamination, first, the surface layer concentration was calculated. For calculating the surface layer concentration, the primary contamination concentration was taken from the graphic interface.

The concentration of radionuclides attached to particulates that are re-suspended from the accumulation at the offsite location was calculated from the offsite soil concentration and the mass loading of particulates at the offsite location. The offsite location soil concentration was taken from the code (graphical interface).

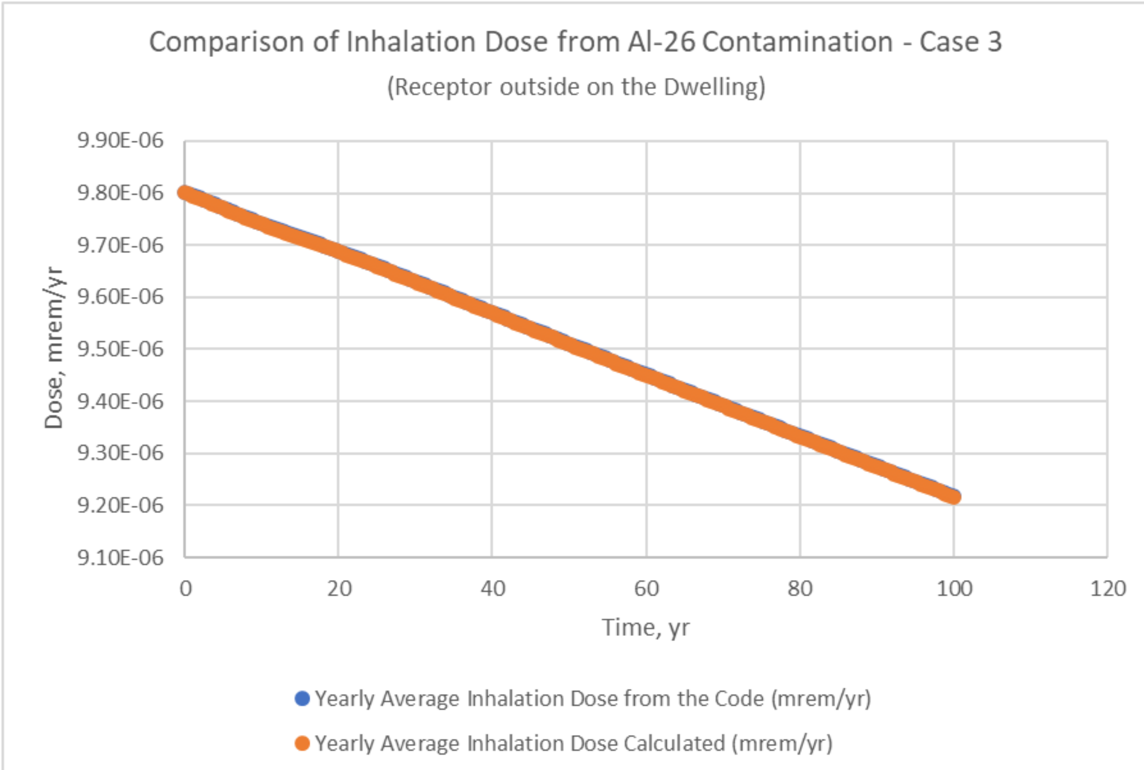

Figure A9.5 Inhalation Dose Comparison for Al-26 Contamination – Case 3

The air concentration at the offsite location along with the respirable fraction, occupancy factor, inhalation rate, and inhalation dose coefficients were used to calculate the inhalation pathway dose. The code dose results were taken from the graphic interface. The detailed calculations are in the EXCEL spreadsheets (inhalation-pathway-offsite-receptor).
Figures A9.5-A9.8 compare the calculated inhalation dose with the inhalation dose from the code.

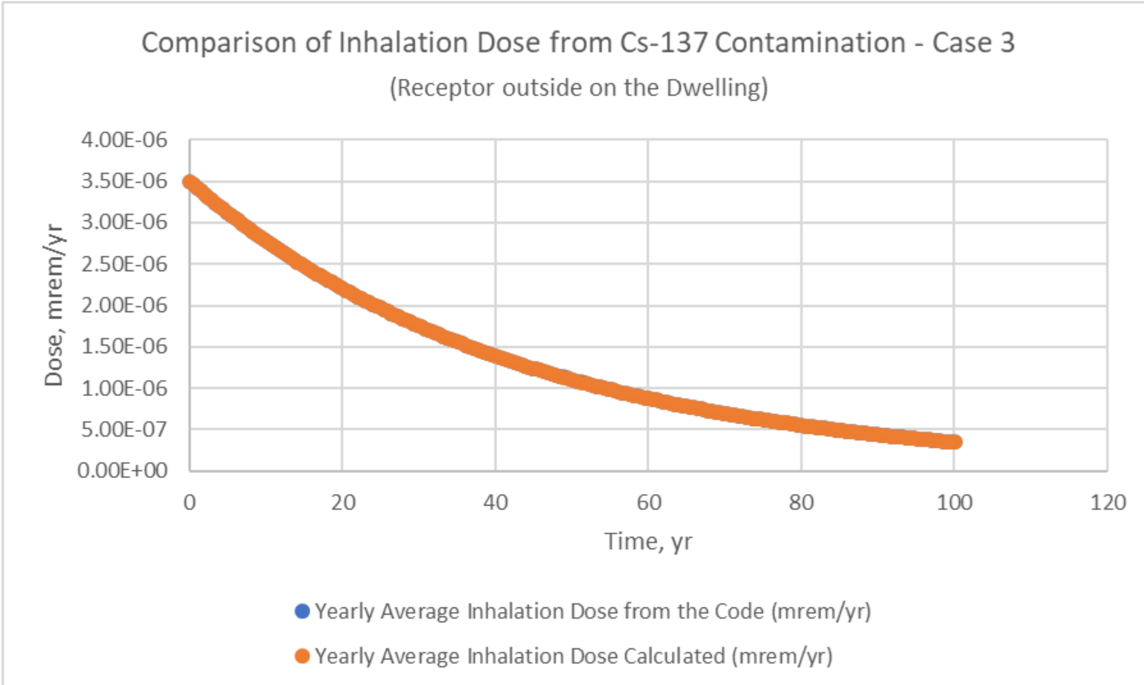

Figure A9.6 Inhalation Dose Comparison for ^{137}Cs Contamination – Case 3

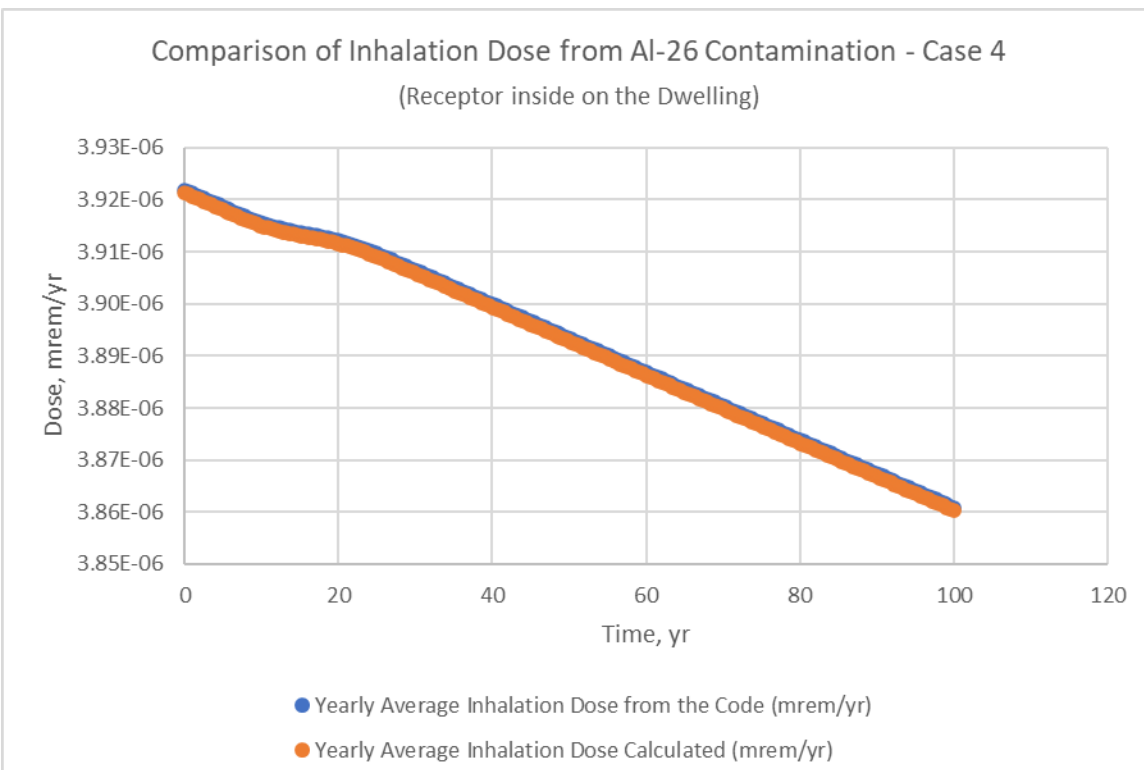

Figure A9.7 Inhalation Dose Comparison for ^{26}Al Contamination – Case 4

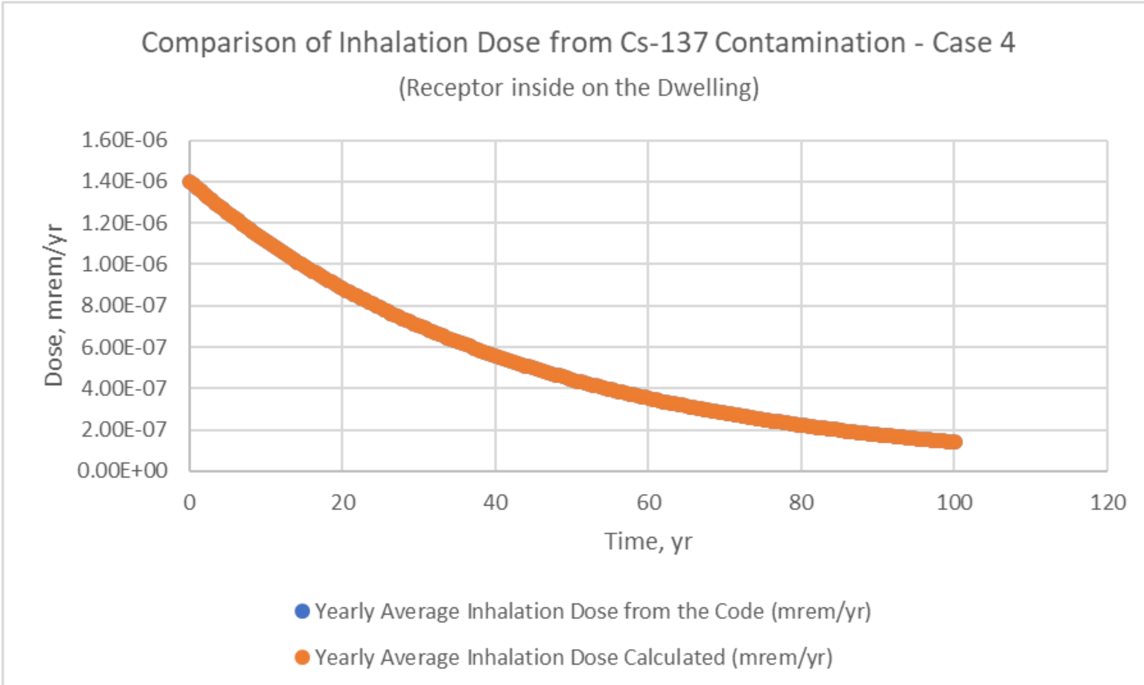

Figure A9.8 Inhalation Dose Comparison for ^{137}Cs Contamination – Case 4

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APPENDIX 10: VERIFICATION OF EXTERNAL MODEL AND EXTERNAL EXPOSURE PATHWAY DOSE

RESRAD-OFFSITE calculates the external pathway dose/risk from the primary contamination and secondary contamination for indoor and outdoor receptors. The exposure for each of the situations is computed as the product of the following:

- The dose conversion factor or slope factor for external radiation, for a volume source of infinite thickness and infinite area, from the chosen dose factor library ([mrem/yr]/[pCi/g] or [risk/yr]/[pCi/g]);

- The concentration of the radionuclide in the soil (pCi/g);

- An occupancy and indoor shielding factor to account for the time spent at the location and for the shielding from any building components while indoors;

- A cover and depth factor to account for the finite thickness of the contamination and for any intervening clean cover between the contamination and the receptor; and

- An area and shape factor to account for the finite area and shape of the contaminated soil and for the position (location) of the receptor in relation to the contaminated area.

All the above factors, with the exception of the occupancy factor, depend on the radionuclide. The shape of the primary contamination can be specified to be circular or polygonal. The location of the onsite and offsite dwellings in relation to the primary contamination can also be specified. The offsite areas (dwelling and agricultural areas) are assumed to be circular, with the receptor located at the center of the circle, when calculating the exposure from external radiation.

For verifying the external model and the external exposure pathway doses, four test cases are used. In all four test cases, the ICRP-38 nuclide database and the FGR-12 external exposure dose library are used.

External dose from Primary Contamination

For verifying the dose from primary contamination, two test cases (external-1.rof and external-2.rof) were used. The receptor was placed outside on the primary contamination, and the contaminated area and thickness were varied. The yearly average external pathway dose for seven radionuclides with varying half-lives was estimated with the RESRAD-OFFSITE code and compared with the calculated dose at time zero. For calculations, the dose was taken from the ANL/EAD/TM-84 (Kamboj et al. 1998) report and was corrected for decay. The code results were taken from the summary report. Table A10.1 shows the comparison. The dose results obtained with the code match (less than 1% difference) the calculated results.

Table A10.1 Comparison of External Exposure Pathway Dose for Onsite Receptor

				Source area = 1000000 m^2, thickness = 50 cm			Source radius = 100 m^2, thickness = 5 cm		
Radionuclide	Half-life, yr	Decay Constant (/yr)	Yearly Average Concentration, pCi/g	Yearly Dose (Code), mrem/yr	Calculated, mrem/yr	ANL/EAD/TM-84, mrem/yr	Yearly Dose (Code), mrem/yr	Calculated, mrem/yr	ANL/EAD/TM-84, mrem/yr
^{26}Al	7.16E+05	9.68E-07	1.00E+00	1.73E+01	1.73E+01	1.73E+01	5.82E+00	5.92E+00	5.92E+00
^{57}Co	7.42E-01	9.35E-01	6.50E-01	3.31E-01	3.26E-01	5.01E-01	1.87E-01	1.84E-01	2.83E-01
^{60}Co	5.27E+00	1.32E-01	9.37E-01	1.51E+01	1.52E+01	1.62E+01	5.20E+00	5.20E+00	5.55E+00
^{137}Cs	3.00E+01	2.31E-02	9.89E-01	3.37E+00	3.37E+00	3.41E+00	1.32E+00	1.31E+00	1.33E+00
^{54}Mn	8.56E-01	8.10E-01	6.85E-01	3.57E+00	3.54E+00	5.16E+00	1.34E+00	1.32E+00	1.93E+00
^{234}U	2.45E+05	2.83E-06	1.00E+00	4.01E-04	4.02E-04	4.02E-04	2.71E-04	2.86E-04	2.86E-04
^{235}U	7.04E+08	9.85E-10	1.00E+00	7.57E-01	7.57E-01	7.57E-01	3.90E-01	3.85E-01	3.85E-01

Note: Used high Kd in contaminated zone (at least 1000 cm^3/g), very less erosion (support practice factor = 0.001).
The code results are taken from the summary report (page 44) at time zero after the run.
The dose results in ANL/EAD/TM-84 are at time zero for the instantaneous dose (do not account for yearly average).
The calculated results correct ANL/EAD/TM-84 results for the yearly average dose.

External Dose from Secondary Contamination

For comparing the external dose from the secondary contamination, two test cases (external-3.rof and external-4.rof) were developed. In both test cases, the secondary contaminated areas were very far, so there was no direct external exposure. In one case, the receptor was located 100% of the time in the pasture and silage field (external-3.rof), and in the other case, the receptor was located 100% of the time in the non-leafy vegetable field (external-4.rof). Only the external exposure pathway was active. The code-generated external pathway dose from the graphical interface was compared with the calculated dose. For calculating dose, the soil concentration in the agricultural field was taken from the code and the depth-cover-factor and area-shape factors were taken from the ANL/EAD/TM-84 report for different radionuclides. Figures A10.1-A10.4 compare the results. The detailed calculations are in the external-exposure-pathway.xlsx spreadsheet.

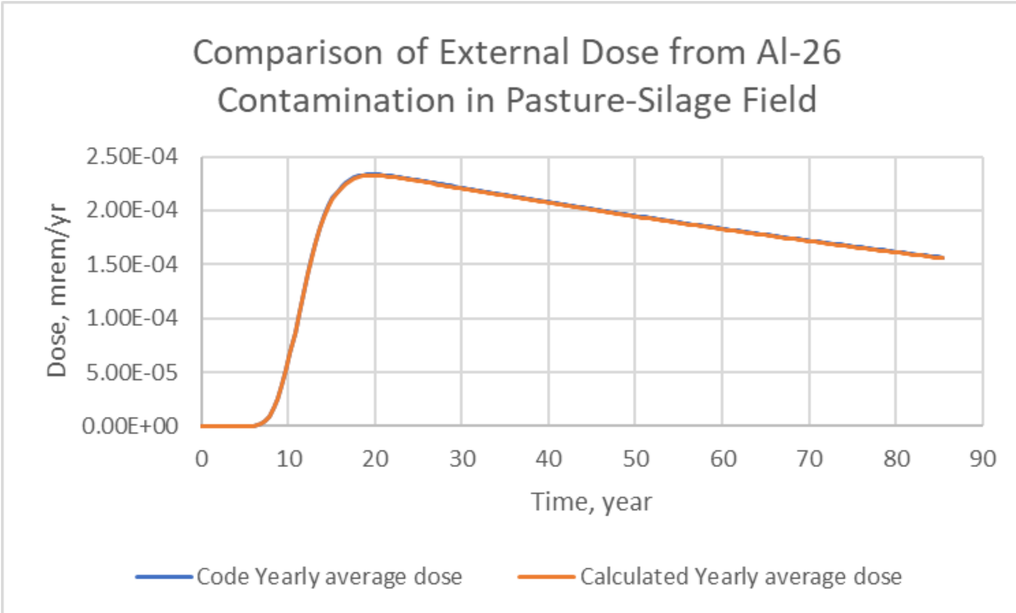


Figure A10.1 External Dose from ^{26}Al Contamination in Pasture and Silage Field

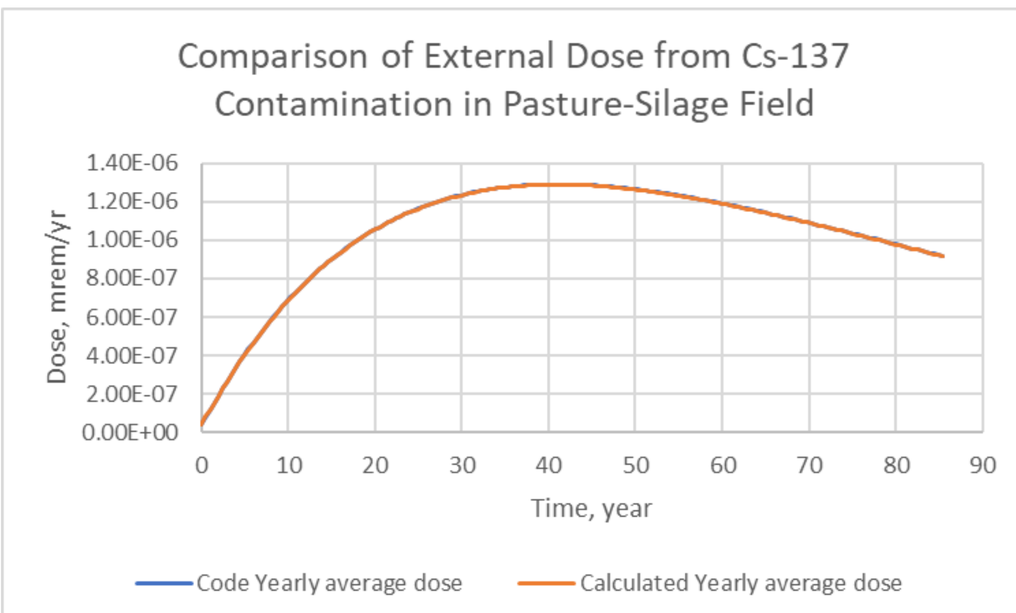


Figure A10.2 External Dose from ^{137}Cs Contamination in Pasture and Silage Field

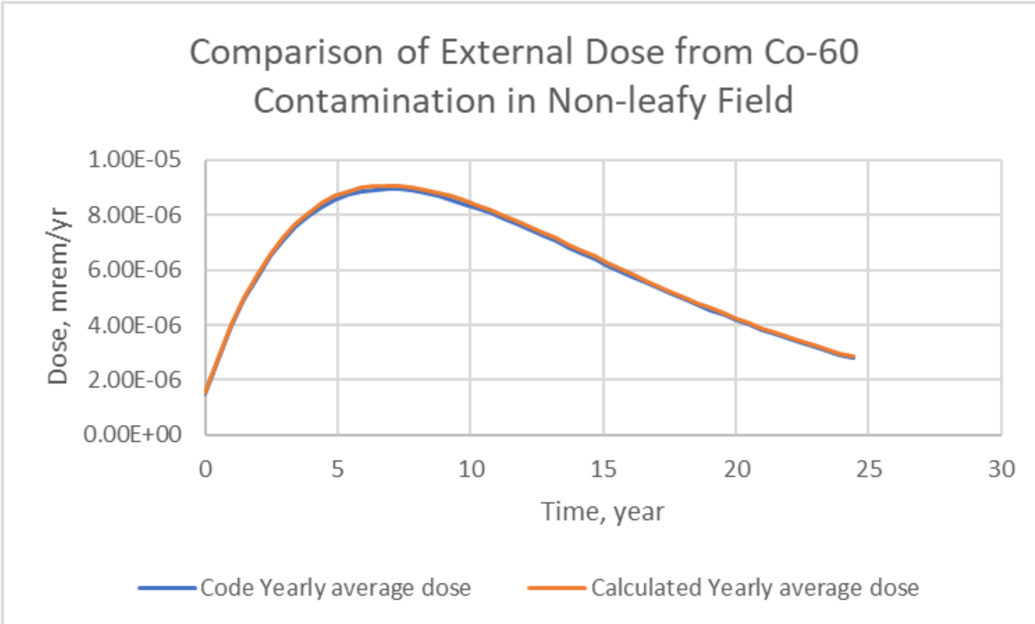


Figure A10.3 External Dose from ^{60}Co Contamination in Non-leafy Vegetable Field

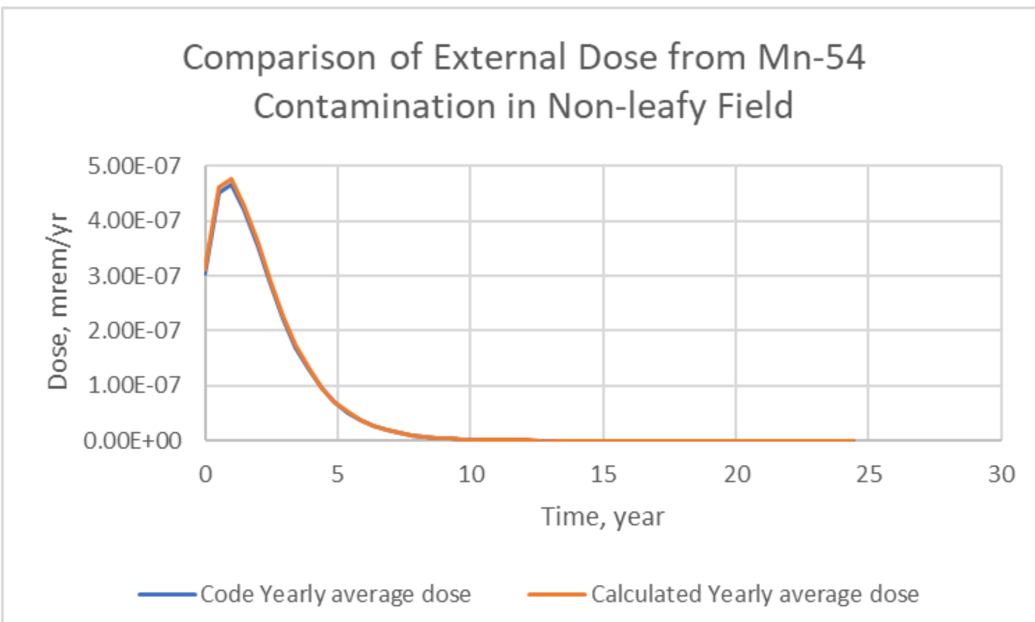


Figure A10.4 External Dose from ^{54}Mn Contamination in Non-leafy Vegetable Field

APPENDIX 11: TEST CASES FOR RELEASE TESTING OF RESRAD-OFFSITE VERSION 4.0

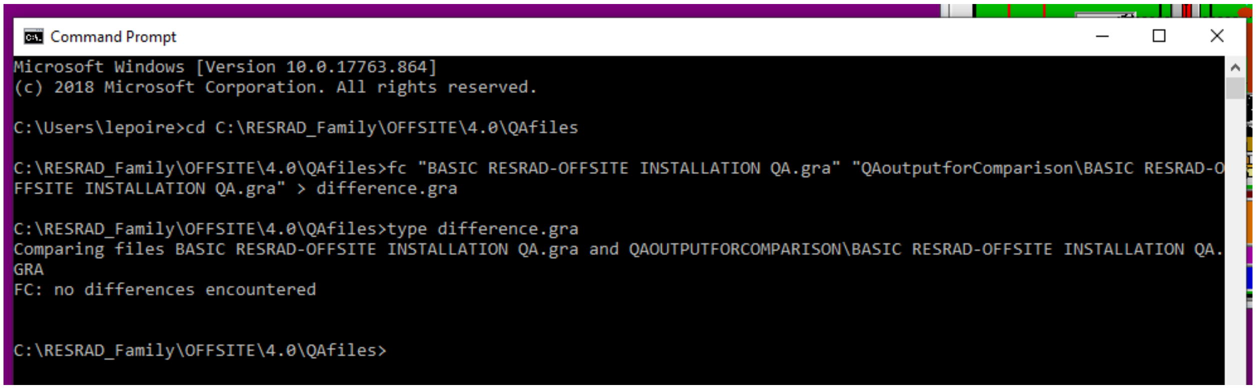
The test cases were copied from the test case, quality control, and quality assurance document. The testers were to perform the test as stipulated in the document. These test cases are reproduced here without editing to retain the text in the test case document in order to maintain authenticity.

11.1 TEST CASE 001

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-001
Test Summary	Test installation and operation on various operating systems
Created By/Date	DJL 8/22/2019
Test Objective	Test installation and operation on various operating systems
Procedure	Install and run software on the range of operating systems the version is designed for. Note and document any issues. Specifically test for font installation.

Steps:

- Install
- Look at ReadMe
- Launch code
- Run QA file, BASIC RESRAD-OFFSITE INSTALLATION QA.ROF (up one folder level, then in the QAFiles folder. Make sure folder is the one just installed.)
- Open graphics, report, look at font
- Do file comparison in DOS (fc like below) or equivalent for a set of output result files.



Required Data

Expected Results Successful installations. Should see only expected differences (e.g., date and time in reports)

11.2 TEST CASE 002

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-002
Test Summary	Tests OFFSITE Nuclide Decay and Ingrowth
Created By/Date	DJL 11/14/2019
Test Objective	Test features of OFFSITE Nuclide Decay and Ingrowth
Procedure	Run case 1, compare to expected results below, consult Verification report and V&V folder: 'NRC7038_Source Term'
Required Data	VROFF_Case1.ROF
Expected Results	Verification of RESRAD-OFFSITE Verification Report, Table 2.10 (below)

Table 2-10 Comparison of the RESRAD-OFFSITE Results and the Spreadsheet Results for the Concentration of Nuclide in the Unmixed Portion of the Primary Contamination for Case I Concerning U-238 and Its Progenies, with Notable Disagreement Highlighted

	U-238		U-234		Th-230		Ra-226		Pb-210		Po-210	
Time (yr)	RESRAD-OFFSITE	Spread-sheet	RESRAD-OFFSITE	Spread-sheet	RESRAD-OFFSITE	Spread-sheet	RESRAD-OFFSITE	Spread-sheet	RESRAD-OFFSITE	Spread-sheet	RESRAD-OFFSITE	Spread-sheet
0	100	100	0	0	0	0	0	0	0	0	0	0
1	9.97E+01	9.97E+01	2.83E-04	2.83E-04	1.27E-09	1.27E-09	1.84E-13	1.84E-13	1.40E-15	1.40E-15	3.71E-16	4.01E-16
2	9.93E+01	9.93E+01	5.63E-04	5.63E-04	5.08E-09	5.08E-09	1.47E-12	1.47E-12	2.25E-14	2.25E-14	9.98E-15	1.00E-14
3	9.90E+01	9.90E+01	8.42E-04	8.42E-04	1.14E-08	1.14E-08	4.94E-12	4.94E-12	1.13E-13	1.13E-13	6.21E-14	6.22E-14
4	9.87E+01	9.87E+01	1.12E-03	1.12E-03	2.02E-08	2.02E-08	1.17E-11	1.17E-11	3.54E-13	3.54E-13	2.21E-13	2.21E-13
5	9.84E+01	9.84E+01	1.39E-03	1.39E-03	3.15E-08	3.15E-08	2.28E-11	2.28E-11	8.58E-13	8.58E-13	5.80E-13	5.80E-13
50	8.47E+01	8.47E+01	1.20E-02	1.20E-02	2.86E-06	2.86E-06	2.05E-08	2.05E-08	6.04E-09	6.04E-09	5.76E-09	5.76E-09
75	7.80E+01	7.80E+01	1.66E-02	1.66E-02	6.09E-06	6.09E-06	6.52E-08	6.52E-08	2.56E-08	2.56E-08	2.47E-08	2.47E-08
100	7.18E+01	7.18E+01	2.03E-02	2.03E-02	1.03E-05	1.03E-05	1.46E-07	1.46E-07	6.84E-08	6.84E-08	6.66E-08	6.66E-08
125	6.60E+01	6.60E+01	2.34E-02	2.34E-02	1.52E-05	1.52E-05	2.69E-07	2.69E-07	1.43E-07	1.43E-07	1.39E-07	1.39E-07
150	6.08E+01	6.08E+01	2.58E-02	2.58E-02	2.07E-05	2.07E-05	4.38E-07	4.38E-07	2.54E-07	2.54E-07	2.49E-07	2.49E-07
175	5.59E+01	5.59E+01	2.77E-02	2.77E-02	2.68E-05	2.68E-05	6.57E-07	6.57E-07	4.08E-07	4.08E-07	4.01E-07	4.01E-07
200	5.15E+01	5.15E+01	2.92E-02	2.92E-02	3.32E-05	3.32E-05	9.26E-07	9.26E-07	6.07E-07	6.07E-07	5.97E-07	5.97E-07
225	4.74E+01	4.74E+01	3.02E-02	3.02E-02	3.98E-05	3.98E-05	1.25E-06	1.25E-06	8.53E-07	8.53E-07	8.40E-07	8.40E-07
250	4.36E+01	4.36E+01	3.09E-02	3.09E-02	4.67E-05	4.67E-05	1.61E-06	1.61E-06	1.15E-06	1.15E-06	1.13E-06	1.13E-06
275	4.01E+01	4.01E+01	3.13E-02	3.13E-02	5.37E-05	5.37E-05	2.03E-06	2.03E-06	1.48E-06	1.48E-06	1.46E-06	1.46E-06
300	3.69E+01	3.69E+01	3.14E-02	3.14E-02	6.07E-05	6.07E-05	2.49E-06	2.49E-06	1.87E-06	1.87E-06	1.84E-06	1.84E-06
350	3.13E+01	3.13E+01	3.10E-02	3.10E-02	7.48E-05	7.48E-05	3.54E-06	3.54E-06	2.76E-06	2.76E-06	2.73E-06	2.73E-06
400	2.65E+01	2.65E+01	3.00E-02	3.00E-02	8.85E-05	8.85E-05	4.73E-06	4.73E-06	3.81E-06	3.81E-06	3.76E-06	3.76E-06
450	2.25E+01	2.25E+01	2.86E-02	2.86E-02	1.02E-04	1.02E-04	6.04E-06	6.04E-06	4.98E-06	4.98E-06	4.92E-06	4.92E-06
500	1.90E+01	1.90E+01	2.69E-02	2.69E-02	1.14E-04	1.14E-04	7.43E-06	7.43E-06	6.25E-06	6.25E-06	6.18E-06	6.18E-06
550	1.61E+01	1.61E+01	2.51E-02	2.51E-02	1.26E-04	1.26E-04	8.88E-06	8.88E-06	7.60E-06	7.60E-06	7.51E-06	7.51E-06
600	1.36E+01	1.36E+01	2.32E-02	2.32E-02	1.37E-04	1.37E-04	1.04E-05	1.04E-05	8.99E-06	8.99E-06	8.89E-06	8.89E-06
650	1.16E+01	1.16E+01	2.13E-02	2.13E-02	1.46E-04	1.46E-04	1.19E-05	1.19E-05	1.04E-05	1.04E-05	1.03E-05	1.03E-05
700	9.79E+00	9.79E+00	1.94E-02	1.94E-02	1.56E-04	1.56E-04	1.34E-05	1.34E-05	1.18E-05	1.18E-05	1.17E-05	1.17E-05
750	8.30E+00	8.30E+00	1.76E-02	1.76E-02	1.64E-04	1.64E-04	1.49E-05	1.49E-05	1.32E-05	1.32E-05	1.31E-05	1.31E-05
800	7.03E+00	7.03E+00	1.59E-02	1.59E-02	1.71E-04	1.71E-04	1.63E-05	1.63E-05	1.46E-05	1.46E-05	1.45E-05	1.45E-05
850	5.95E+00	5.95E+00	1.43E-02	1.43E-02	1.78E-04	1.78E-04	1.77E-05	1.77E-05	1.60E-05	1.60E-05	1.58E-05	1.58E-05
900	5.04E+00	5.04E+00	1.28E-02	1.28E-02	1.84E-04	1.84E-04	1.90E-05	1.90E-05	1.73E-05	1.73E-05	1.71E-05	1.71E-05
950	4.27E+00	4.27E+00	1.15E-02	1.15E-02	1.89E-04	1.89E-04	2.03E-05	2.03E-05	1.85E-05	1.85E-05	1.84E-05	1.84E-05
1000	3.62E+00	3.62E+00	1.02E-02	1.02E-02	1.94E-04	1.94E-04	2.15E-05	2.15E-05	1.97E-05	1.97E-05	1.95E-05	1.95E-05

11.3 TEST CASE 003-001

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-003-001
Test Summary	Tests OFFSITE Source Term Mixing Concentration
Created By/Date	DJL 7/29/2019
Test Objective	Test features of OFFSITE Source Term Mixing Concentration
Procedure	Run case 2, compare with expected results, consult Verification report and V&V folder: 'NRC7038_Source Term'
Required Data	VROFF_Case2.ROF
Expected Results	**Verification of RESRAD-OFFSITE Table 2.5 (below)**

Table 2-5 Comparison of the RESRAD-OFFSITE Results and the Spreadsheet Results for the Modification Factor for the Concentration of Nuclides in the Mixing Zone for Case II Concerning Cs-137, with Notable Disagreement Highlighted

Time (yr)	RESRAD-OFFSITE	Spreadsheet
349	0	0
350	0	1.510E-07
351	6.644E-03	6.645E-03
352	1.324E-02	1.324E-02
353	1.980E-02	1.980E-02
354	2.631E-02	2.631E-02
355	3.278E-02	3.278E-02
375	1.535E-01	1.535E-01
400	2.835E-01	2.835E-01
425	3.935E-01	3.935E-01
450	4.866E-01	4.866E-01
475	5.654E-01	5.654E-01
500	6.321E-01	6.321E-01
525	6.886E-01	6.886E-01
550	7.364E-01	7.364E-01
575	7.769E-01	7.769E-01
600	8.111E-01	8.111E-01
625	8.401E-01	8.401E-01
650	8.647E-01	8.647E-01
675	8.854E-01	8.854E-01
700	9.030E-01	9.030E-01
725	9.179E-01	9.179E-01
750	9.305E-01	9.305E-01
775	9.412E-01	9.412E-01
800	9.502E-01	9.502E-01
825	9.579E-01	9.579E-01
850	9.643E-01	9.643E-01
851	9.579E-01	9.579E-01
852	9.516E-01	9.516E-01
853	9.452E-01	9.452E-01
854	9.389E-01	9.390E-01
855	9.327E-01	9.327E-01
875	8.163E-01	8.163E-01
900	6.910E-01	6.910E-01
925	5.849E-01	5.849E-01
950	4.951E-01	4.951E-01
1000	3.548E-01	3.548E-01

11.4 TEST CASE 003-002

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-003-002
Test Summary	Tests OFFSITE Source Term Mixing Concentration
Created By/Date	DJL 7/29/2019
Test Objective	Test features of OFFSITE Source Term Mixing Concentration
Procedure	Run case 3, compare with expected results, consult Verification report and V&V folder: 'NRC7038_Source Term'
Required Data	VROFF_Case3.ROF
Expected Results	Verification of RESRAD-OFFSITE Table 2.6 (below)

Table 2-6 Comparison of the RESRAD-OFFSITE Results and the Spreadsheet Results for the Modification Factor for the Concentration of Nuclides in the Mixing Zone for Case III Concerning H-3, with Notable Disagreement Highlighted

Time (yr)	RESRAD-OFFSITE	Spreadsheet
149	0	0
150	0	6.066E-08
151	6.231E-03	6.232E-03
152	1.243E-02	1.243E-02
153	1.859E-02	1.859E-02
154	2.471E-02	2.471E-02
155	3.080E-02	3.080E-02
160	6.071E-02	6.071E-02
165	8.975E-02	8.975E-02
170	1.179E-01	1.179E-01
175	1.453E-01	1.453E-01
180	1.719E-01	1.719E-01
185	1.977E-01	1.977E-01
190	2.227E-01	2.227E-01
200	2.705E-01	2.705E-01
210	3.156E-01	3.156E-01
220	3.579E-01	3.579E-01
230	3.978E-01	3.978E-01
240	4.353E-01	4.353E-01
250	4.705E-01	4.705E-01
260	5.036E-01	5.036E-01
270	5.347E-01	5.347E-01
280	5.638E-01	5.638E-01
290	5.913E-01	5.913E-01
300	6.170E-01	6.170E-01
350	6.170E-01	6.170E-01
400	6.170E-01	6.170E-01
500	6.170E-01	6.170E-01
600	6.170E-01	6.170E-01
700	6.170E-01	6.170E-01
800	6.170E-01	6.170E-01
900	6.170E-01	6.170E-01
1000	6.170E-01	6.170E-01

11.5 TEST CASE 003-003

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-003-003
Test Summary	Tests OFFSITE Source Term Mixing Concentration
Created By/Date	DJL 7/29/2019
Test Objective	Test features of OFFSITE Source Term Mixing Concentration
Procedure	Run case 8, compare with expected results, consult Verification report and V&V folder: 'NRC7038_Source Term'
Required Data	VROFF_Case8.ROF

Expected Results Verification of RESRAD-OFFSITE Table 2.8 (below)

Table 2-8 Comparison of the RESRAD-OFFSITE Results and the Spreadsheet Results for the Modification Factor for the Concentration of Nuclides in the Mixing Zone for Case VIII Concerning Ra-226, with Notable Disagreement Highlighted

Time (yr)	RESRAD-OFFSITE	Spreadsheet
99	0	0
100	0	2.491E-07
101	4.404E-03	4.404E-03
102	8.790E-03	8.790E-03
103	1.316E-02	1.316E-02
104	1.751E-02	1.751E-02
105	2.185E-02	2.185E-02
125	1.051E-01	1.051E-01
150	2.004E-01	2.004E-01
175	2.865E-01	2.865E-01
200	3.640E-01	3.640E-01
225	4.338E-01	4.338E-01
250	4.964E-01	4.964E-01
275	5.524E-01	5.524E-01
325	6.256E-01	6.256E-01
375	6.679E-01	6.679E-01
425	7.055E-01	7.055E-01
475	7.391E-01	7.391E-01
525	7.689E-01	7.689E-01
575	7.954E-01	7.954E-01
625	8.189E-01	8.189E-01
675	8.398E-01	8.398E-01
725	8.583E-01	8.583E-01
775	8.747E-01	8.747E-01
825	8.892E-01	8.892E-01
875	9.021E-01	9.021E-01
899	9.077E-01	9.077E-01
900	9.080E-01	9.080E-01
901	9.057E-01	9.057E-01
925	8.530E-01	8.530E-01
950	8.013E-01	8.013E-01
975	7.527E-01	7.527E-01
1000	7.071E-01	7.071E-01

11.6 TEST CASE 005

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-005
Test Summary	Tests OFFSITE Source Term Leaching
Created By/Date	DJL 7/29/2019
Test Objective	Test features of OFFSITE Source Term Leaching
Procedure	Run cases 1; compare with expected results, consult Verification report and V&V folder: 'NRC7038_Source Term'
Required Data	VROFF_Case1.ROF

Expected Results

Verification of RESRAD-OFFSITE Table 2.16 (below)

Table 2-16 Comparison of the RESRAD-OFFSITE Results and the Spreadsheet Results for the Release Rates of Nuclide to Groundwater for Case I Concerning U-238 and Its Progenies, with Notable Disagreement Highlighted

	U-238		U-234		Th-230		Ra-226		Pb-210		Po-210	
Time (yr)	RESRAD-OFFSITE	Spread-sheet	RESRAD-OFFSITE	Spread-sheet	RESRAD-OFFSITE	Spread-sheet	RESRAD-OFFSITE	Spread-sheet	RESRAD-OFFSITE	Spread-sheet	RESRAD-OFFSITE	Spread-sheet
0	9.96E+09	9.96E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1	9.87E+09	9.87E+09	2.80E+04	2.80E+04	1.06E-04	1.06E-04	1.30E-05	1.30E-05	6.94E-08	6.94E-08	1.95E-07	1.81E-07
2	9.79E+09	9.79E+09	5.55E+04	5.55E+04	4.19E-04	4.19E-04	1.03E-04	1.03E-04	1.11E-06	1.11E-06	4.84E-06	4.85E-06
3	9.71E+09	9.71E+09	8.26E+04	8.26E+04	9.36E-04	9.36E-04	3.46E-04	3.46E-04	5.56E-06	5.56E-06	3.00E-05	3.00E-05
4	9.63E+09	9.63E+09	1.09E+05	1.09E+05	1.65E-03	1.65E-03	8.15E-04	8.15E-04	1.73E-05	1.73E-05	1.06E-04	1.06E-04
5	9.55E+09	9.55E+09	1.35E+05	1.35E+05	2.56E-03	2.56E-03	1.58E-03	1.58E-03	4.17E-05	4.17E-05	2.77E-04	2.77E-04
25	8.02E+09	8.02E+09	5.68E+05	5.68E+05	5.50E-02	5.50E-02	1.69E-01	1.69E-01	1.99E-02	1.99E-02	1.79E-01	1.79E-01
50	6.33E+09	6.33E+09	8.97E+05	8.97E+05	1.79E-01	1.79E-01	1.09E+00	1.09E+00	2.26E-01	2.26E-01	2.11E+00	2.11E+00
75	4.85E+09	4.85E+09	1.03E+06	1.03E+06	3.17E-01	3.17E-01	2.90E+00	2.90E+00	7.98E-01	7.98E-01	7.57E+00	7.57E+00
100	3.57E+09	3.57E+09	1.01E+06	1.01E+06	4.27E-01	4.27E-01	5.19E+00	5.19E+00	1.71E+00	1.71E+00	1.63E+01	1.63E+01
150	1.51E+09	1.51E+09	6.43E+05	6.43E+05	4.32E-01	4.32E-01	7.80E+00	7.80E+00	3.17E+00	3.17E+00	3.05E+01	3.05E+01
200	1.41E+08	1.41E+08	8.02E+04	8.02E+04	7.63E-02	7.63E-02	1.82E+00	1.82E+00	8.36E-01	8.36E-01	8.07E+00	8.07E+00
250	4.27E+06	4.27E+06	3.03E+03	3.03E+03	3.83E-03	3.83E-03	1.13E-01	1.13E-01	5.63E-02	5.63E-02	5.44E-01	5.44E-01
300	1.29E+05	1.29E+05	1.10E+02	1.10E+02	1.78E-04	1.78E-04	6.23E-03	6.23E-03	3.27E-03	3.27E-03	3.17E-02	3.17E-02
350	3.90E+03	3.90E+03	3.87E+00	3.87E+00	7.81E-06	7.81E-06	3.16E-04	3.16E-04	1.73E-04	1.73E-04	1.67E-03	1.67E-03
400	1.18E+02	1.18E+02	1.34E-01	1.34E-01	3.30E-07	3.30E-07	1.50E-05	1.50E-05	8.49E-06	8.49E-06	8.23E-05	8.23E-05
450	3.56E+00	3.56E+00	4.54E-03	4.54E-03	1.35E-08	1.35E-08	6.85E-07	6.85E-07	3.96E-07	3.96E-07	3.84E-06	3.84E-06
500	1.08E-01	1.08E-01	1.53E-04	1.53E-04	5.41E-10	5.41E-10	3.01E-08	3.01E-08	1.77E-08	1.77E-08	1.72E-07	1.72E-07
550	3.26E-03	3.25E-03	5.07E-06	5.07E-06	2.13E-11	2.13E-11	1.28E-09	1.28E-09	7.69E-10	7.69E-10	7.46E-09	7.46E-09
600	9.84E-05	9.84E-05	1.67E-07	1.67E-07	8.24E-13	8.24E-13	5.35E-11	5.35E-11	3.25E-11	3.25E-11	3.15E-10	3.15E-10
650	2.97E-06	2.97E-06	5.47E-09	5.47E-09	3.15E-14	3.15E-14	2.18E-12	2.18E-12	1.34E-12	1.34E-12	1.30E-11	1.30E-11
700	8.98E-08	8.98E-08	1.78E-10	1.78E-10	1.19E-15	1.19E-15	8.78E-14	8.78E-14	5.44E-14	5.44E-14	5.28E-13	5.28E-13
750	2.71E-09	2.71E-09	5.77E-12	5.77E-12	4.48E-17	4.48E-17	3.48E-15	3.48E-15	2.17E-15	2.17E-15	2.11E-14	2.11E-14
800	8.20E-11	8.20E-11	1.86E-13	1.86E-13	1.67E-18	1.67E-18	1.36E-16	1.36E-16	8.56E-17	8.56E-17	8.32E-16	8.32E-16
850	2.48E-12	2.48E-12	5.97E-15	5.97E-15	6.20E-20	6.20E-20	5.27E-18	5.27E-18	3.34E-18	3.34E-18	3.24E-17	3.24E-17
900	7.49E-14	7.49E-14	1.91E-16	1.91E-16	2.29E-21	2.29E-21	2.02E-19	2.02E-19	1.29E-19	1.29E-19	1.25E-18	1.25E-18
950	2.26E-15	2.26E-15	8.81E+05	8.81E+05	8.39E-23	8.40E-23	7.70E-21	7.70E-21	4.92E-21	4.92E-21	4.78E-20	4.78E-20
1000	6.84E-17	6.84E-17	8.74E+05	8.74E+05	3.07E-24	3.07E-24	2.91E-22	2.91E-22	1.87E-22	1.87E-22	1.82E-21	1.82E-21

11.7 TEST CASE 020-001

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-020-001
Test Summary	Tests OFFSITE gaseous and particulate C-14 inhalation pathways
Created By/Date	DJL 1/14/20 (based on EG verification)
Test Objective	Test features of OFFSITE gaseous and particulate C-14 inhalation pathways
Procedure	Run file; compare with expected results, consult Verification report and V&V folder: 'Special radionuclides'
Required Data	'INHALATION OF CARBON-14.ROF'
Expected Results	'C14 inhalation.xlsx' in 'Special radionuclides' V&V folder

11.8 TEST CASE 020-002

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-020-002
Test Summary	Tests OFFSITE tritium inhalation pathways
Created By/Date	DJL 1/14/20 (based on EG verification)
Test Objective	Test features of OFFSITE tritium inhalation pathways
Procedure	Run file; compare with expected results, consult Verification report and V&V folder: 'Special radionuclides'
Required Data	'INHALATION OF HYDROGEN-3.ROF'
Expected Results	'H3 inhalation.xlsx' in 'Special radionuclides' V&V folder

11.9 TEST CASE 020-003

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-020-003
Test Summary	Tests OFFSITE Rn-222 inhalation pathways
Created By/Date	DJL 1/14/20 (based on EG verification)
Test Objective	Test features of OFFSITE Rn-222 inhalation pathways
Procedure	Run file; compare with expected results, consult Verification report and V&V folder: 'Special radionuclides'
Required Data	'RN222 FROM HOUSEHOLD WATER USE.ROF'
Expected Results	'Rn 222 household water.xlsx' in 'Special radionuclides' V&V folder

11.10 TEST CASE 020-004

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-020-004
Test Summary	Tests OFFSITE Rn-220 inhalation pathways
Created By/Date	DJL 1/14/20 (based on EG verification)
Test Objective	Test features of OFFSITE Rn-220 inhalation pathways
Procedure	Run file; compare with expected results, consult Verification report and V&V folder: 'Special radionuclides'
Required Data	'RN220 FROM HOUSEHOLD WATER USE.ROF'
Expected Results	'Rn 220 household water.xlsx' in 'Special radionuclides' V&V folder

11.11 TEST CASE 027-001

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-27-001
Test Summary	Test the presentation of output reports.
Created By/Date	CW 10/17/2019
Test Objective	To test the presentation of output reports.

Procedure

1) Run the code with initial concentration of 100 pCi/g for U-238.
2) Three report files should be generated: Summary.rep, DAUDOSE.REP, and INTRISK.REP
3) Open Summary.rep from report Reviewer, and check the following
   a. whether it includes Code name, version, T½ limit, running time, and page number, report type (Parent Dose Report), title, and input file name on each page
   b. Table of Contents should include the following elements and their corresponding page numbers.
      i. DCF summary including DCF library, the values involved in the calculation including current values, default value, and parameter name
      ii. Site-specific parameter summary, echoing all the inputs parameters and some calculated intermediate parameters, including input value, default value, code computed value, and parameter name.
      iii. Contaminated zone and Total Dose Summary: size and dimensions, initial radionuclides and concentrations, total dose at each report time, and maximum total dose.
      iv. Total Dose Components for each report time: dose contribution for each radionuclide and pathway
      v. Dose/Source Ratios Summed Over All Pathways
      vi. Single Radionuclide Soil Guidelines
      vii. Dose Per Nuclide Summed Over All Pathways
      viii. Soil Concentration Per Nuclide
      ix. Run Time Information

4) Open DAUDOSE.REP and check the following
    a. whether it includes Code name, version, T½ limit, running time, and page number, report type (Parent Dose Report), title, and input file name on each page
    b. Table of Contents should include total dose components summed to progeny: Total Dose Contribution for each individual Radionuclides and Pathways
5) Open INTRISK.REP and check the following
    a. whether it includes Code name, version, T ½ limit, running time, and page number, report type (Parent Dose Report), title, and input file name on each page
    b. Table of Contents should include
        i. Cancer Risk Slope Factors summary table should include library name, and parameter values (current value and default) and parameter name
        ii. Excess Cancer Risk for each individual radionuclide and pathway at each report time

Required Data None.

Expected Results The reports should have the required content and format.

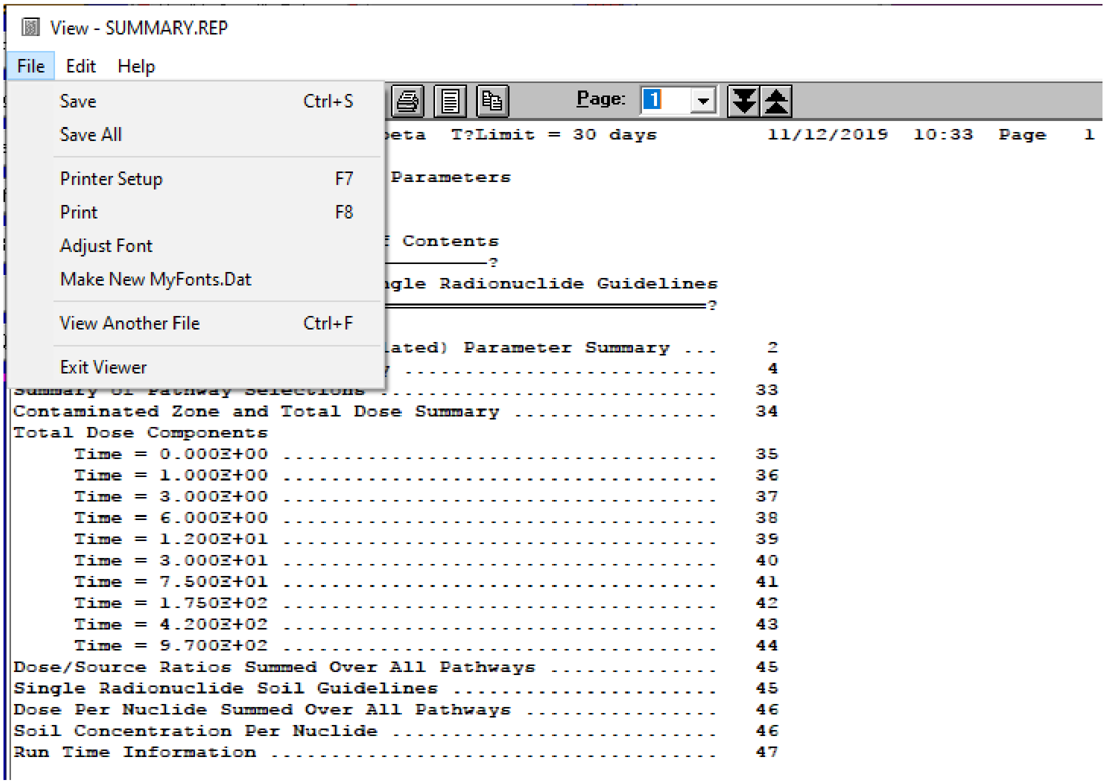
11.12 TEST CASE 027-002

Project	**RESRAD-OFFSITE**
Test Case ID	RESROFF-TEST-27-002s
Test Summary	Test the functionality of report Viewer
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of report Viewer

Procedure

1) Run the code with initial concentration of 100 pCi/g for Ac-227.
2) Click View->Text Output -> Parent Dose Report, the report Viewer should pop up and open SUMMARY.REP file.
3) The File menu should function as its self-description.
4) Edit menu should enable to select and copy of the present page
5) Help menu should open the help file for the code with Report Viewer topic page opened.
6) The Tool bar icons are also self-explained.
   a. The page up/down should work.
   b. Put the cursor on the page number box, type 3, and the press Enter key, and Page 3 should present.
   c. Click the dropdown arrow of page number, a list of pages should appear, select 8, and click Enter key. Page 8 should present.
7) Repeat Step 2 using Toolbar icon, left side navigation panel -> View Output -> Parent Dose Report, Iconic Navigator|Results|Parent Dose Report.

Required Data	None.
Expected Results	The code should behave as described in each step.


View - SUMMARY.REP
File Edit Help
Save Ctrl+S
Save All
Printer Setup F7
Print F8
Adjust Font
Make New MyFonts.Dat
View Another File Ctrl+F
Exit Viewer
Page: 1
eta T?Limit = 30 days 11/12/2019 10:33 Page 1
Parameters
Contents
gle Radionuclide Guidelines
ated) Parameter Summary ... 2
.... 4
.... 33
Contaminated Zone and Total Dose Summary 34
Total Dose Components
Time = 0.000E+00 35
Time = 1.000E+00 36
Time = 3.000E+00 37
Time = 6.000E+00 38
Time = 1.200E+01 39
Time = 3.000E+01 40
Time = 7.500E+01 41
Time = 1.750E+02 42
Time = 4.200E+02 43
Time = 9.700E+02 44
Dose/Source Ratios Summed Over All Pathways 45
Single Radionuclide Soil Guidelines 45
Dose Per Nuclide Summed Over All Pathways 46
Soil Concentration Per Nuclide 46
Run Time Information 47

11.13 TEST CASE 028-001

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-28-001
Test Summary	Test the functionality of Wresplot
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Wresplot

Procedure

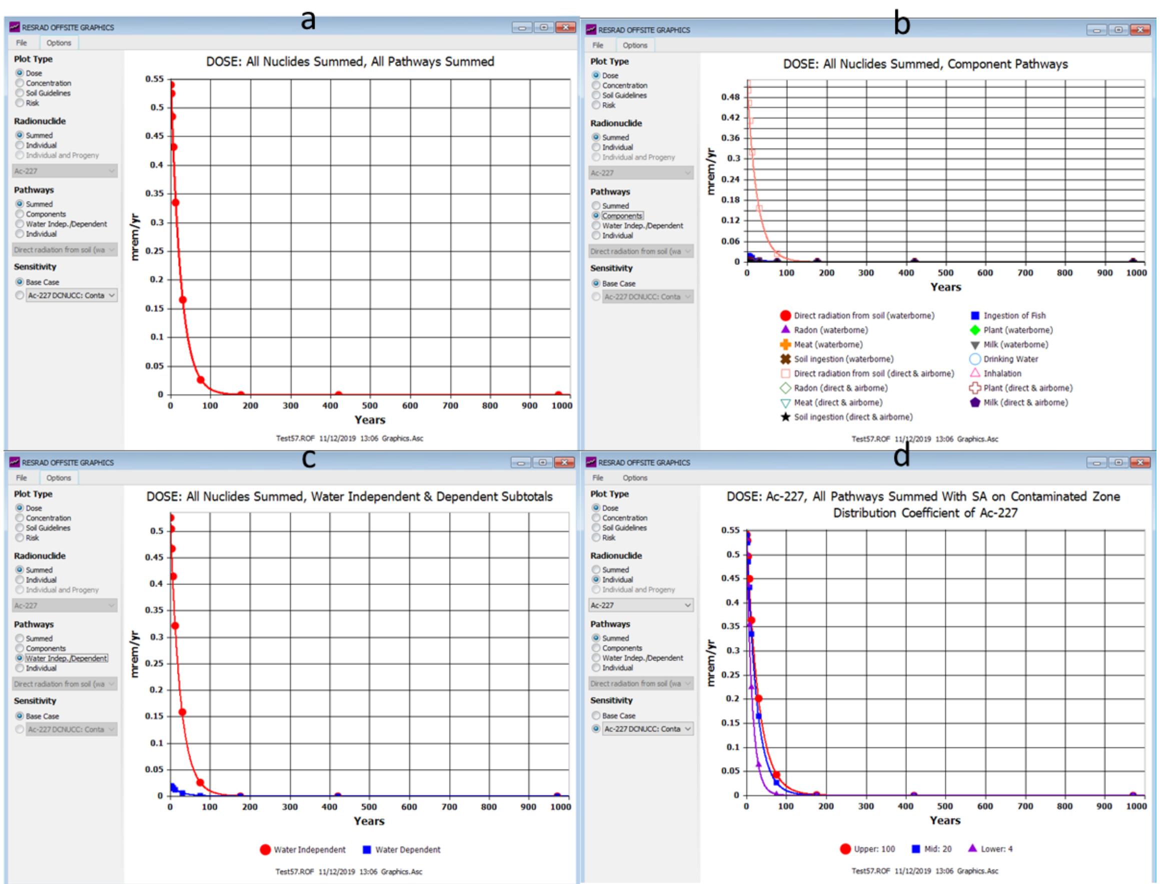
1) Run the code with initial concentration of 100 pCi/g for Ac-227 and sensitivity analysis for precipitation and contaminated zone distribution coefficient. Save the project to Test57.rof and run the code.
2) Click View|Deterministics Graphics to open Wresplot displaying the graph of current calculation.
3) Check the bottom of the right panel; it should include the input file name, file generation data, and the graphics file name, Graphics.Asc by default.
4) In the left panel, it should include Plot Type (including Dose, Concentration, Soil Guidelines, and Risk), Radionuclide (including Summed, Individual, and Individual and Progeny), Pathways (including Summed, components, water independent/dependent, and Individual), and Sensitivity (Base Case, and dropdown list for each sensitivity analysis parameter)
5) Click every option for Plot Type, Radionuclide, Pathways, and Sensitivity, and check the plot in the right panel, including X and Y-axis, plot title, legend, etc. Moving the cursor along X-axis, a textbox with information of the year where the cursor is at and the corresponding Y-axis value should display next to the cursor.
6) Under Sensitivity section, select each of the two parameters, then check the plot in the right panel.
7) The File menu should function as the self-description of each submenu.
   a. Print Review submenu should bring up a window similar to Figure e. Clicking Print should bring up a printer selection window and clicking Export to should bring up a window as shown in Figure f for file format option.
   b. Export Graphics submenu should bring up a window similar to Figure f for file format selection. Depending on software installed in the testing computer, the formation options could be different for different computers.

c. Export Data submenu should enable to save the data to a .csv file.

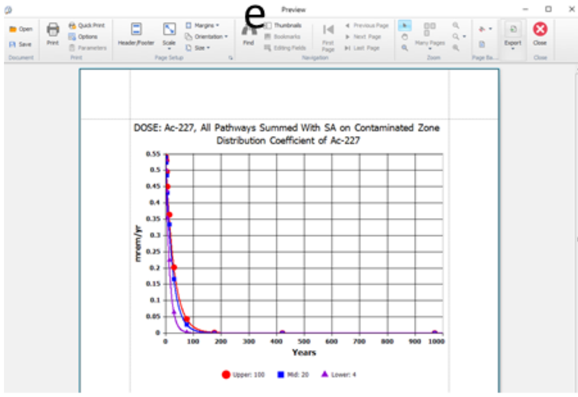
8) Repeat Step 2 using Toolbar icon, left side navigation panel -> View Output -> Deterministic Graphics, Iconic Navigator|Results| Deterministic Graphics.

Required Data None.

Expected Results The code should have the required elements and behave as described in each step.

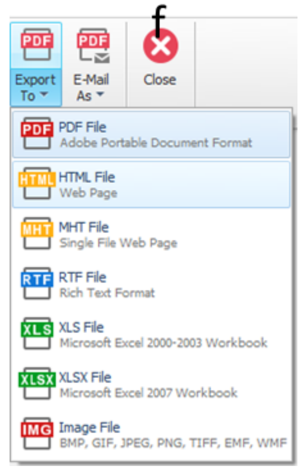


e



Preview
DOSE: Ac-227, All Pathways Summed With SA on Contaminated Zone Distribution Coefficient of Ac-227
mrem/yr
Years

f

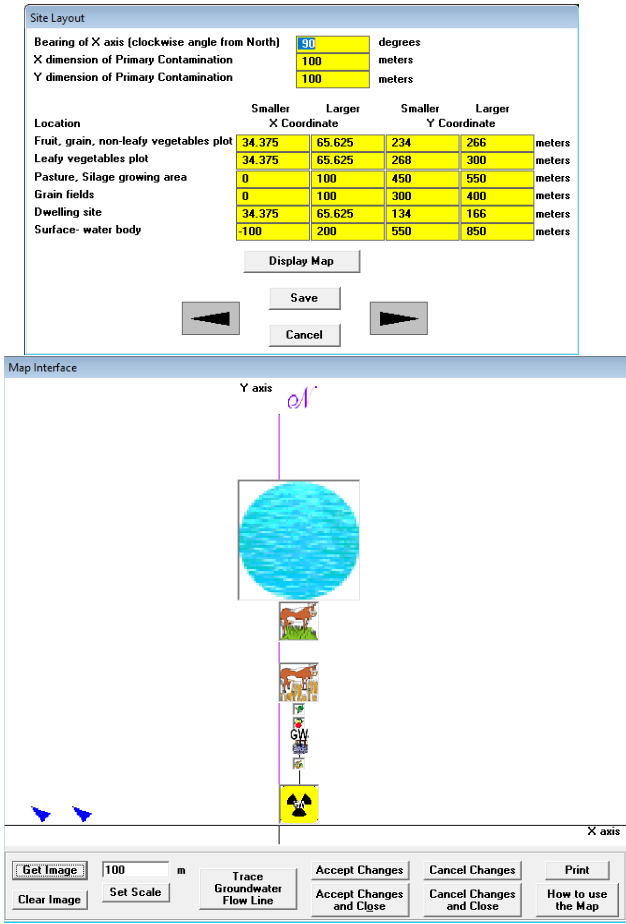


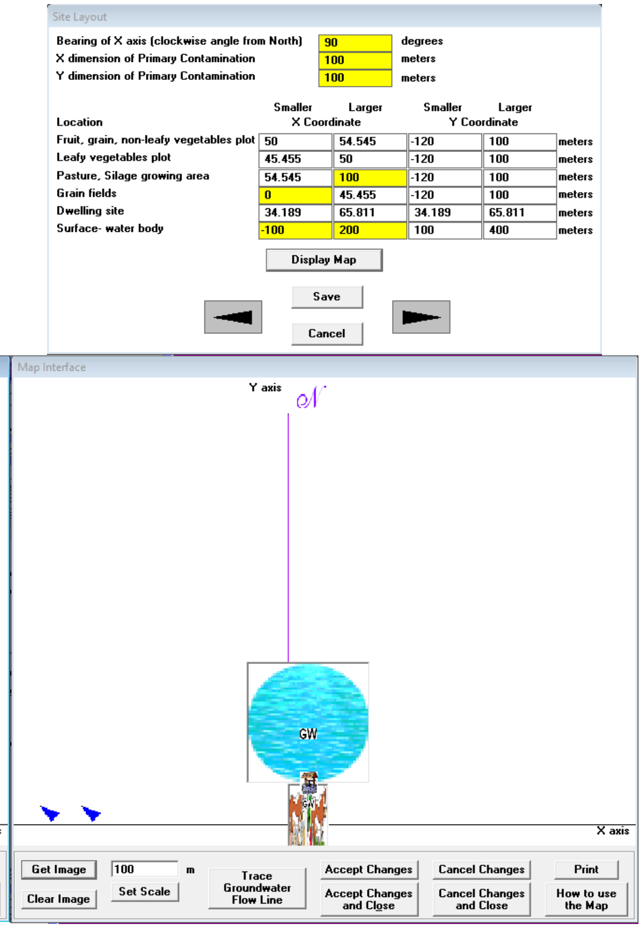
Export To
E-Mail As
Close
PDF File
Adobe Portable Document Format
HTML File
Web Page
MHT File
Single File Web Page
RTF File
Rich Text Format
XLS File
Microsoft Excel 2000-2003 Workbook
XLSX File
Microsoft Excel 2007 Workbook
Image File
BMP, GIF, JPEG, PNG, TIFF, EMF, WMF

11.14 TEST CASE 029-001

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-29-001
Test Summary	Test the functionality of Onsite Scenario Template.
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Onsite Scenario Template.
Procedure	1) Launch the code. Click Modify Data -> Site Layout. The default site should look like the left figures in the Expected Results section. 2) Click File -> Onsite Scenario Template. A new window with caption "Onsite Scenario Primary Contamination" should pop up. Click Save to close the window. 3) Click Site Layout, and the site should look like the figure on the right side of the Expected Results section.
Required Data	None

Expected Results





11.15 TEST CASE 029-002

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-29-002

Test Summary Test if Simulate the RESRAD-Onsite Code works properly.

Created By/Date CW 10/17/2019

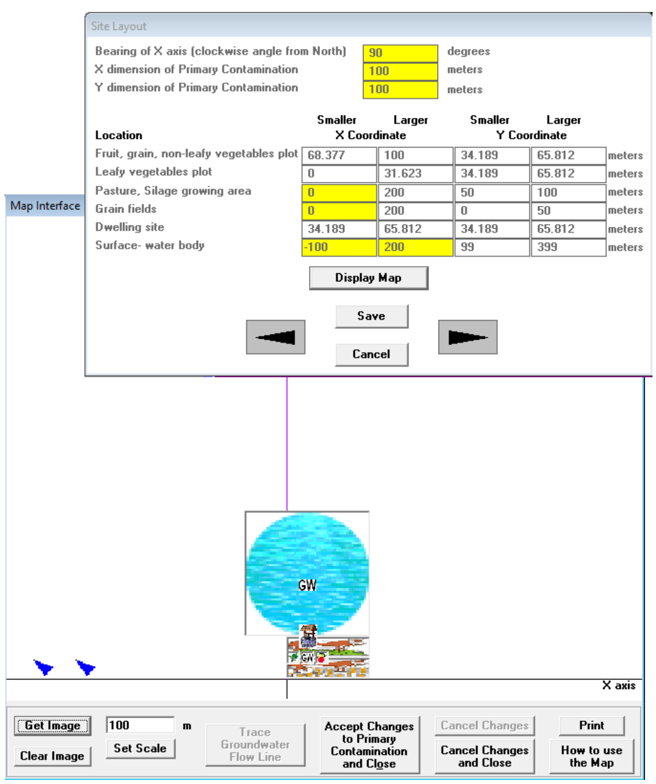
Test Objective To test the functionality of Simulate the RESRAD-Onsite Code.

Procedure

1) Launch the code. Click File -> Simulate the RESRAD-Onsite code. A new window with caption “Title & Radiological Data” should pop up. Click Close.
2) Click Site Layout, and the site data should be identical to the figure shown in the Expected Results section.

Required Data None

Expected Results



11.16 TEST CASE 030-001

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-30-001
Test Summary	Test whether DCF Editor works properly.
Created By/Date	CW 10/17/2019
Test Objective	To test DCF Editor interface. The response of DCF Editor to the main interface is tested in control level test and the data is checked elsewhere.

Procedure

1) Launch DCF Editor by clicking File-> DCF Editor from the main interface, or by double clicking DCF Editor executable from DCF installation folder. The default DCF folder is in c:\RESRAD_Family\DCF\3.1 for RESRAD-OFFSITE.
2) The DCF Editor version number, and creation date should display correctly.
3) The default should be the following
   a. radionuclides library: ICRP107
   b. Library option: Create a new DCF library
   c. Base External DCF: DCFPAK3.02
   d. Base internal DCF: DCFPAK3.02 (Adult)
   e. Base risk library: DCFPAK3.02 Morbidity
4) Changing radionuclide library to ICRP 38 will change the external, internal, and risk library to FGR 12, FGR 11, and FGR 13 Morbidity, respectively.
5) With ICRP107 selected, click View a Default Library (Read Only), then View Library, and a new window of DCFPAK3.02 (Adult) library should pop out.
6) In the window, the default Selected Nuclide should be Ac-233, and for tabs, namely, Dose Conversion Factors, Slope Factors, Radon, and Transfer Factors, should present.
7) Click each tab and check whether all the layouts are shown properly, and whether the background of each text box is in yellow, whether the units are conventional units.
8) Change to Cs-137, and repeat Step 7.
9) Change to Zr-91 and repeat Step 7.
10) With Zr-97 selected and try to change the external, internal, and ingestion DCF. Any changes should not be allowed.

11) Click Dose Factors Help button on the Upper-right corner, and check whether the Help file works properly.
12) Click Another library, and the code should close this window and go back to the main interface of DCF Editor.
13) Select library to view to DOE STD-1196-2011 (Reference Person), and repeat Steps 6-12.
14) Select ICRP38 radionuclide library, and repeat Steps 6-13.
15) Click Help -> General Hep and check whether the Help file window pop up and whether the content in the right panel presents accordingly to the click of the contents list in the left panel.
16) Click F1 key from the main DCF Editor interface and repeat Step 15.
17) Click Help -> Context-Sensitive Help and check whether the Help file works properly.
18) Select ICRP107 and Create a new DCF library, type "Test DCF Editor' in the Box of "Type the name of the new DCF library", then type "This is test 006" in the Library Description box, and click Create Library button.
19) In the pop-up window, select Ac-227, then click the selection circle under Default DCFPAK3.02 in the External and Ingestion DCF frame, and type 0 in the text box, and the click Exit Program. This will change the ingestion and external DCF of Ac-227 to zero and save it to a new library named Test DCF Editor.
20) From RESRAD-OFFSITE main interface, click Change Title, then select Test DCF Editor from the drop-down list of Internal expose dose library.
21) Select Ac-227 from the Initial Concentrations form
22) Save the project as Test006.rof to UserFiles under the application folder, and run the code.
23) Open test006.rof and check whether the library "Test DCF Editor" in used
24) From the summary report (Page 2), check whether the external DCF was zero.

Required Data None.

Expected Results DCF Editor works properly.

1) Available DCF libraries changes correctly when radionuclide library is changed.
2) Can view DCF values
3) Can create new library by modifying a set of base libraries
4) The created library can be read in and used by RESRAD-OFFSITE code correctly
5) Menu works properly.

11.17 TEST CASE 031-001

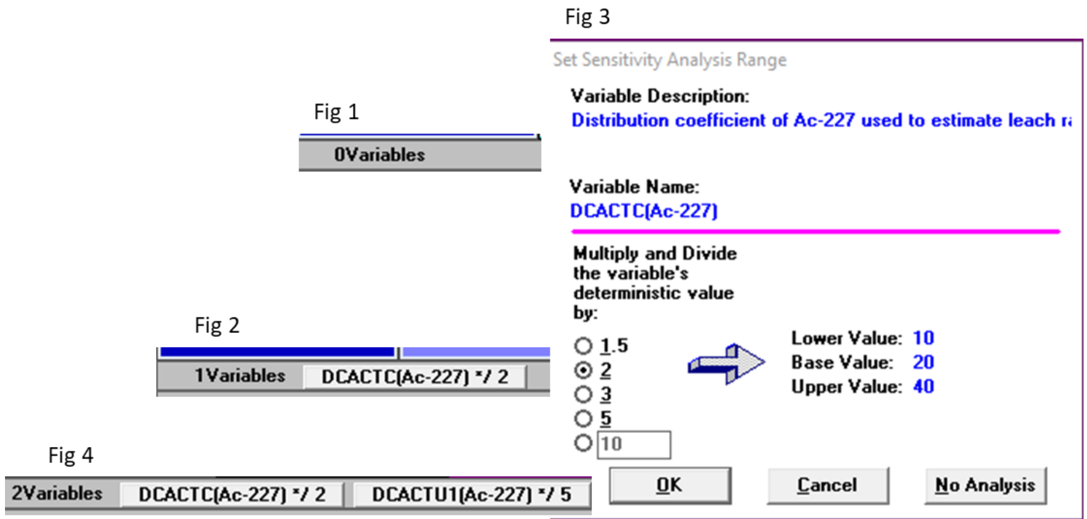
Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-31-001
Test Summary	Test the functionality of Sensitivity Analysis (Single Parameter)
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Sensitivity Analysis (Single Parameter)

Procedure

1) Launch the code and open Initial Concentration form and select Ac-227, then open Radionuclide Specific Release form.
2) Make sure menu View|Sensitivity Input Summery is selected. Information as shown in Fig 1 should present at the bottom left corner of the main interface.
3) Put cursor focus on the second text box with default value of 20, then click Form Options|Sensitivity Analysis (Single Parameter) menu, a window like Fig 3 should pop up. Click OK.
4) Check the bottom left corner of the main interface again. Information as shown in Fig 2 should present, indicating the available parameter for sensitivity analysis.
5) Double clicking Fig 2 should bring up a window like Fig 3. Make sure the selected factor is 2.
6) Open Distribution Coefficient
7) Put cursor on Unsaturated Zone and click Form Options|Sensitivity Analysis (Single Parameter) menu. Select factor 5 from the pop-up sensitivity analysis setting form, then save the form.
8) Check the bottom left corner of the main interface again. Information as shown in Fig 4 should present, indicating the available parameter for sensitivity analysis.
9) Double clicking on the Variable DCACTU1 should bring up the sensitivity analysis setting window for the unsaturated zone 1 distribution coefficient, check if the selected factor is 5.
10) Save project to Test52.rof, then open it in a text editor and check SDCACTC(1) = 2, SDCACTU1(1) = 5, NSENA = 2.
11)

Required Data None.

Expected Results The code should behave as described in each step.



11.18 TEST CASE 031-002

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-31-002

Test Summary Test the functionality of setting Multiparameter Sensitivity Analysis

Created By/Date CW 10/17/2019

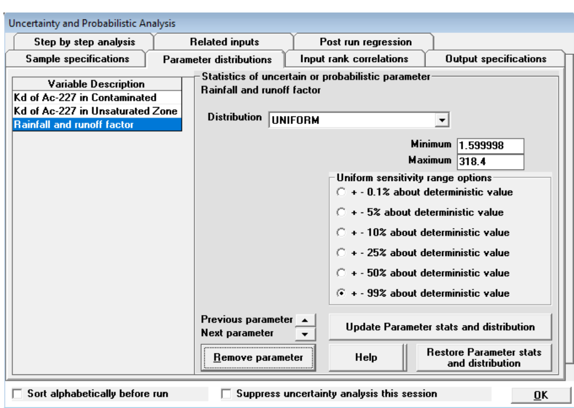
Test Objective To test the functionality of setting Multiparameter Sensitivity Analysis

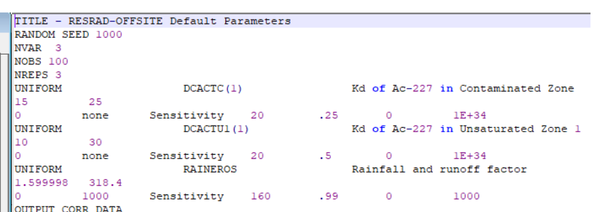
Procedure

1) Launch the code and open Initial Concentration form and select Ac-227, then follow User's Guide Section 6.3 to set multiparameter sensitivity analysis using the example shown in the left figure.
2) Setting the Uniform Sensitivity range potions to 25%, 50%, and 99%, respectively.
3) Save the form and then the project.
4) Open the generated .rof file in a text editor and check NUM_SAMPS = 300, NUMVAR = 3, NUMRELVAR = 0.
5) There should be file with file extension .LHS generated in the same folder as the .rof file. Open it in a text editor and it should look like the right figure.

Required Data None.

Expected Results The code should behave as described in each step.





```
TITLE - RESRAD-OFFSITE Default Parameters
RANDOM SEED 1000
NVAR  3
NOBS 100
NREPS 3
UNIFORM                  DCACTC(1)                Kd of Ac-227 in Contaminated Zone
15         25
0          none      Sensitivity    20       .25       0        1E+34
UNIFORM                  DCACTU1(1)               Kd of Ac-227 in Unsaturated Zone 1
10         30
0          none      Sensitivity    20       .5        0        1E+34
UNIFORM                  RAINEROS                 Rainfall and runoff factor
1.599998   318.4
0          1000      Sensitivity    160      .99       0        1000
OUTPUT CORR DATA
```

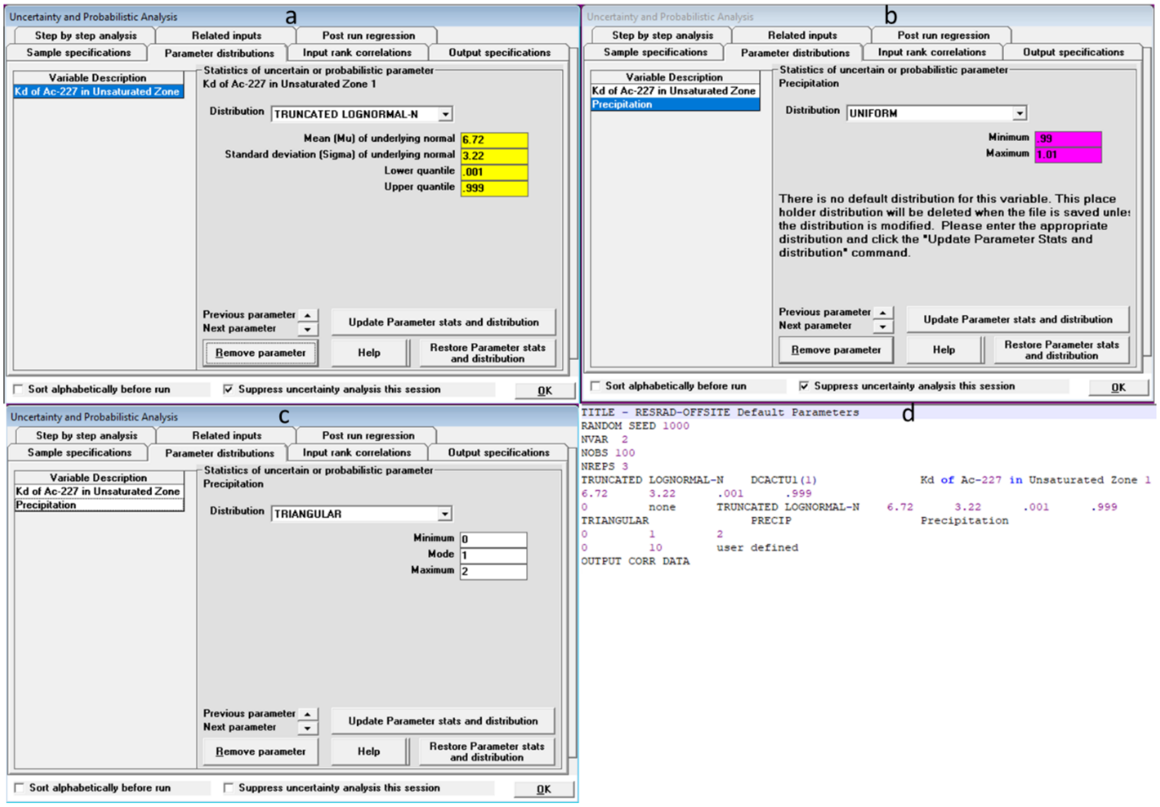
11.19 TEST CASE 032-001

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-32-001
Test Summary	Test the functionality of setting Uncertainty/Probabilistic Analysis
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of setting Uncertainty/Probabilistic Analysis

Procedure

1) Launch the code and open Initial Concentration form and select Ac-227, then open Distribution Coefficients form. Put the cursor on the Unsaturated Zone 1 text box, and click Form Options|Uncertainty/Probabilistic Analysis menu. Uncertainty Analysis window like Fig a should pop up.
2) Open Physical and Hydrological form, put cursor on Precipitation text box, and the click Form Options|Uncertainty/Probabilistic Analysis menu. A window like Fig b should pop up. Note the two boxes in purple.
3) Change the Distribution and associated values to those shown in Fig c, then click Update Parameters stats and distribution.
4) Click OK to save the form and then save the project to Test53.rof.
5) Open Test53.rof and check UM_SAMPS = 300, NUMVAR = 2, NUMRELVAR = 0.
6) There should be file called Test53.LHS generated in the same folder as Test53.rof. Open it and it should look like Fig d.

Required Data	None.
Expected Results	The code should behave as described in each step.


a
Uncertainty and Probabilistic Analysis
Step by step analysis
Related inputs
Post run regression
Sample specifications
Parameter distributions
Input rank correlations
Output specifications
Variable Description
Kd of Ac-227 in Unsaturated Zone
Statistics of uncertain or probabilistic parameter
Kd of Ac-227 in Unsaturated Zone 1
Distribution TRUNCATED LOGNORMAL-N
Mean (Mu) of underlying normal 6.72
Standard deviation (Sigma) of underlying normal 3.22
Lower quantile .001
Upper quantile .999
Previous parameter
Next parameter
Update Parameter stats and distribution
Remove parameter
Help
Restore Parameter stats and distribution
Sort alphabetically before run
Suppress uncertainty analysis this session
OK
b
Uncertainty and Probabilistic Analysis
Kd of Ac-227 in Unsaturated Zone
Precipitation
Statistics of uncertain or probabilistic parameter
Precipitation
Distribution UNIFORM
Minimum .99
Maximum 1.01
There is no default distribution for this variable. This place holder distribution will be deleted when the file is saved unles the distribution is modified. Please enter the appropriate distribution and click the "Update Parameter Stats and distribution" command.
c
Uncertainty and Probabilistic Analysis
Kd of Ac-227 in Unsaturated Zone
Precipitation
Statistics of uncertain or probabilistic parameter
Precipitation
Distribution TRIANGULAR
Minimum 0
Mode 1
Maximum 2
d
TITLE - RESRAD-OFFSITE Default Parameters
RANDOM SEED 1000
NVAR 2
NOBS 100
NREPS 3
TRUNCATED LOGNORMAL-N DCACTU1(1) Kd of Ac-227 in Unsaturated Zone 1
6.72 3.22 .001 .999
0 none TRUNCATED LOGNORMAL-N 6.72 3.22 .001 .999
TRIANGULAR PRECIP Precipitation
0 1 2
0 10 user defined
OUTPUT CORR DATA

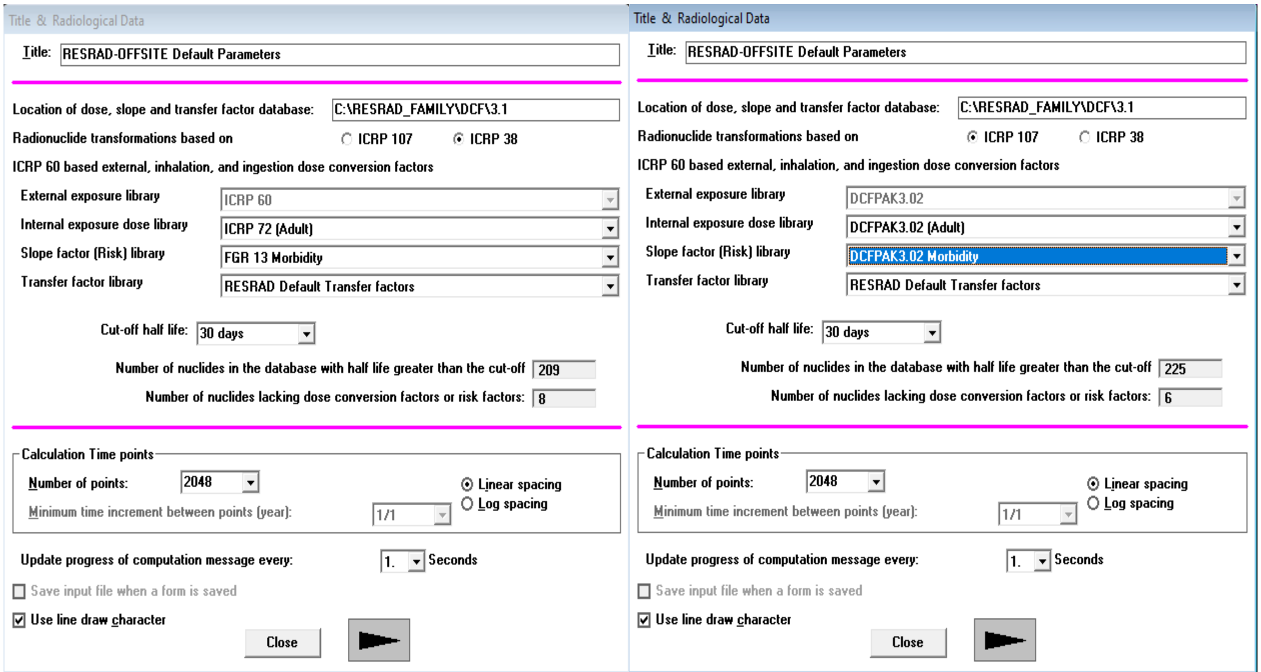
11.20 TEST CASE 033-001

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-33-001
Test Summary	Test the File navigation function from the left panel of GUI.
Created By/Date	CW 10/17/2019
Test Objective	To test whether the File navigation button from the left panel work properly.
Procedure	1) Launch the code. The default main window panel should be divided into left panel and a blank right-side panel with an Iconic Navigator located on the upper-right corner. The left side panel containing the version number of the code, and seven navigation buttons. 2) Clicking File button should bring the File Options form up. 3) Test New and Save functions in General Scenarios section following RESOFF-TEST-35-001. 4) Test Open and Save as functions in General Scenarios section following RESOFF-TEST-35-002. 5) Test Onsite Scenario Template fie following RESOFF-TEST-35-004. 6) Test Simulate RESARD (onsite) Code following RESOFF-TEST-35-005.
Required Data	None.
Expected Results	The same as test cases RESOFF-TEST-35-001, 002, 004

11.21 TEST CASE 033-002

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-33-002
Test Summary	Test the Change Title navigation function from the left panel of GUI.
Created By/Date	CW 10/17/2019
Test Objective	To test whether the Change Title navigation button from the left panel work properly.
Procedure	1) Launch the code and click Change Title button on the left panel. The “Title & Radiological Data” window should pop up. 2) Under default setup, it should be identical to the left screenshot shown in Expected Results section. 3) Change to ICRP 38 database, and the form should be identical to the right screenshot.
Required Data	None.

Expected Results



11.22 TEST CASE 033-003

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-33-003
Test Summary	Test the functionality of Set Pathways navigation in the left panel of GUI.
Created By/Date	CW 10/17/2019
Test Objective	To Test the functionality of Set Pathways navigation in the left panel of GUI.

Procedure

1) Launch the code and click Set Pathways in the left panel
2) The Set Pathways form should pop up and stay right by the left panel. By default, all the pathways should be on except Radon pathway.
3) Click all the press buttons one by one, the pathways should be turned off and the pathway icons should present an off marker
4) Click all the press buttons one by one again to turn on all the pathways. The off marker on the pathway icons should go away.
5) Clicking Radon pathway should not get any response at this time when no radionuclides are selected.
6) Repeat Steps 3-4 by pressing the pathway icons, rather than the press button.
7) Turn off all the pathways again except external pathway.
8) Click Close, and the pathway form should be closed.
9) Click Initial Concentrations form and select Ac-227.
10) Save the input to file Test011.rof and Run the code.
11) Open the input file Test011.rof in a text editor such asNotepad, and should see SELPATH = 1, indicating only external pathway is selected.
12) Open the file Summary.REP in the application folder using a text editor and look into the Summary of Pathway Selections section. All the pathways should be suppressed except that external gamma is active.
13) Open Test011.rof and add Ra-226 from the Initial Concentrations form, and turn on Radon pathway. Save the file and Run the code again.
14) Check TEST011.rof and the variable SELPATH should be 257.

15) Check Summary.REP and only external gamma and radon pathways should be active.

Required Data None.

Expected Results Pathway form should be opened and closed from the left panel navigation.

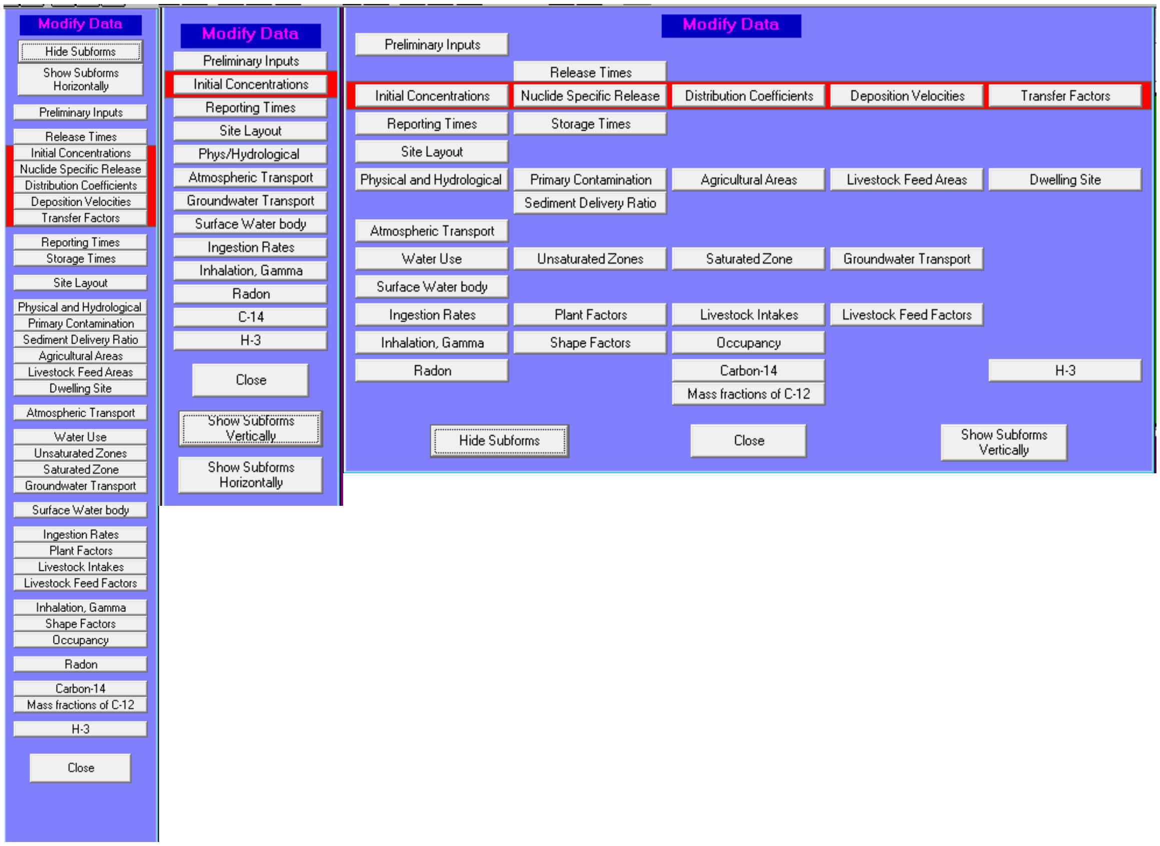
Pathways can be turned on and off by pressing either the press buttons or the pathway icons.

The selection of pathways should be correctly written into the input file and echoed in the report file.

11.23 TEST CASE 033-004

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-33-004
Test Summary	Test the functionality of Modify Data navigation in the left panel of GUI.
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Modify Data navigation in the left panel of GUI.
Procedure	1) Click Modify Data button from the left navigation panel. The Modify Data form should pop up and stay right next the left panel. Depending on the setup of last run, it should like one of the three formats as shown in Expected Results section, namely, Case 1, 2, and 3. The default is the left one. 2) Open the form again. For Case 1, click "Hide Subforms" button, it should look like Case 2. 3) Click "Show Subforms Vertically" in Case 2, the form should change back to Case 1. 4) In either Case 1 or 2, clicking "Show Subforms Horizontally", the form should change to Case 3. 5) In Case 3, clicking Hide Subforms should change the form to Case 2; and clicking Show Subforms Vertically should change the form to Case 1. 6) Clicking Close in any Case should close the form.
Required Data	None.

Expected Results



11.24 TEST CASE 033-005

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-33-005
Test Summary	Test the functionality of Iconic Navigator
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Iconic Navigator

Procedure

1) Launch the code.
2) Click Problem tab of Iconic Navigator.
    a. Clicking File icon should bring up the window for selection of input file. Select an input file, and the file should be loaded to the main interface.
    b. Clicking Title icon should bring up the Title & Radiological Data form
    c. Clicking Dose Factors should bring up the DCF Editor window.
    d. Clicking Input/Pathway should open the Inputs & Pathways tab of Iconic Navigator.
    e. Clicking Sensitivity icon should turn on/off the Sensitivity Input Summary at the bottom left corner of the main interface.
    f. Clicking Uncertainty Analysis button should bring up the Uncertainty and Probabilistic Analysis form.
    g. Clicking Run button should run the code using the loaded input file.
    h. Clicking Results should open the Results tab of the Iconic Navigator.
3) Clicking Input & Pathways Tab.
    a. Clicking each icon should open one associated form. Then run the code.
4) Click Results tab.
    a. Clicking Parent Dose Report button should open Summary.rep file. Clicking Deterministic Graphics icon should open the graphics Wresplot.exe with loaded data.
    b. Clicking Progeny Dose Report icon should open DAUDOSE.REP file, Clicking Health Risk Report icon should open INTRISK.REP file.
    c. Run the code with uncertainty analysis.

   d. Clicking Graphics under Uncertainty/Probabilistic Analysis frame should open forms Uncertainty and Probabilistic Analysis, Probabilistic/Uncertainty Outputs, and Probabilistic Temporal Plots.
   e. Clicking Dose and Risk Report icon should open MCSUMMAR.REP file.
   f. Clicking Input Report icon should open LHS.REP file.
5) Clicking Help tab and the REARD program website and contact information should present under this tab, as well as the function of F1 key for help.

Required Data None.

Expected Results The code should behave as described in each step.

11.25 TEST CASE 034-001

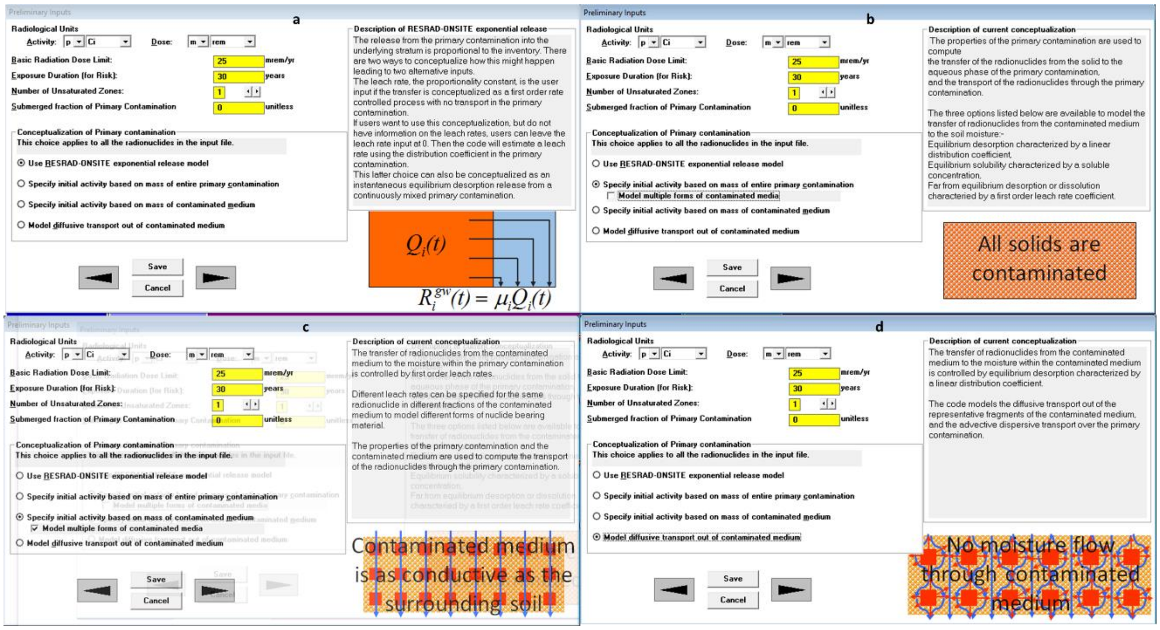
Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-001
Test Summary	Test the functionality of Form Preliminary Inputs
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Form Preliminary Inputs.

Procedure

1) On the left panel, click Modify Data -> Preliminary Inputs. The form should pop up with Figure a as default setting, including the units and values in textboxes. The background of each textbox should be in yellow if the values are default values; otherwise, in white.
2) Change the unit to Bq. The unit in Forms Initial Concentrations and Transfer Factors should change accordingly.
3) Changing the selection of Conceptualization frame from top to bottom in order, the form should look like Figure a, b, c and d, respectively. Selection of "Model multiple forms of contaminated media" under settings of either Figure b or c will change the other's setting.
4) The Number of Unsaturated Zones should be able to be changed between 0 and 5. Once this value is change, need to check Form Unsaturated Zones to check if the number of unsaturated zone changed in that form accordingly.
5) Submerged fraction of Primary Contamination should be able to changed 0-1; however, once its value is larger than 0, the Number of Unsaturated Zone should update to 0 automatically.
6) Change the values in textboxes and the units, save the input to Test13.rof, then check whether the input file is correctly written. The variables in this form include BRDL, ED, and NS. SUBMERGEDF, PCOPTION, and MULTIFORM.

Required Data None.

Expected Results



11.26 TEST CASE 034-002

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-002
Test Summary	Test the functionality of Form Release Times
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Form Release Times.

Procedure

1) On the left panel, clicking Modify Data -> Release Times should open a pop-up window with caption "Times at which Release Properties are Specified (years)".
2) Clicking "Insert New 1st time and shift down existing times and associated release data" 8 times. Every click should shift down the newly generated textbox by one row. The default of each generated textbox should be 0.
3) Click "Delete 1st time and associated release data and shift up exiting data" for 8 times, all the newly generated textboxes should be deleted.
4) Clicking "Add new xx-th time at which release changes" should generate a textbox corresponding to xx-th release time.
5) Specifying a value to each box in an increasing order. Change the value of the top box to a negative value, an error message should pop-up. Similarly, changing the largest value to more than 100000 should also trigger an error message window.
6) Change the third textbox value to a value less than the one in the second box, a warning message should show in the bottom-left box. Clicking Close. An error message should pop-up pointing out this error.
7) Make sure the input to this form is correct, close the form. Check Form Nuclide Specific Release. The release time in the form should change accordingly.
8) save the file to Test14.rof, and then check the values in the generated input file in a text editor. The variable to check is RELTIME(1) - (9).

Required Data	None.
Expected Results	The behavior of the code should be the same as described in each step.

11.27 TEST CASE 034-003

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-003
Test Summary	Test the functionality of Form Initial Concentrations
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Form Initial Concentrations.

Procedure

1) Open the Initial Concentrations window and visually check the format, fonts, spelling, and default setting.
2) Check the unit is correct according to Form Preliminary Inputs.
3) The upper right box should indicate the radionuclide database and cutoff half-life.
4) Frame "Transfer Mechanism" should be available.
5) Select Ac-227, then click button "Add Ac-227 21.77y", Ac-227 should be added to the left panel with a concentration of 100 unit. Highlight it and then change the Nuclide Concentration value to 50. Its concentration should update to 50 in the left panel.
6) Clicking Delete "Ac-227" should remove it from the left panel.
7) Select U-238 from right panel and add it. The radionuclides in the U-238 decay change with half-life larger than the cutoff halflife should be added to the left panel with U-238 having a concentration of 50 units and all others zero concentration.
8) Close the form and save the project to Test15.rof. Check the variables NUCNAM and S. Their values should be identical to the input to the form.

Required Data	None.
Expected Results	The behavior of the code should be the same as described in each step.

11.28 TEST CASE 034-004

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-004

Test Summary Test the functionality of Form Nuclide Specific Release

Created By/Date CW 10/17/2019

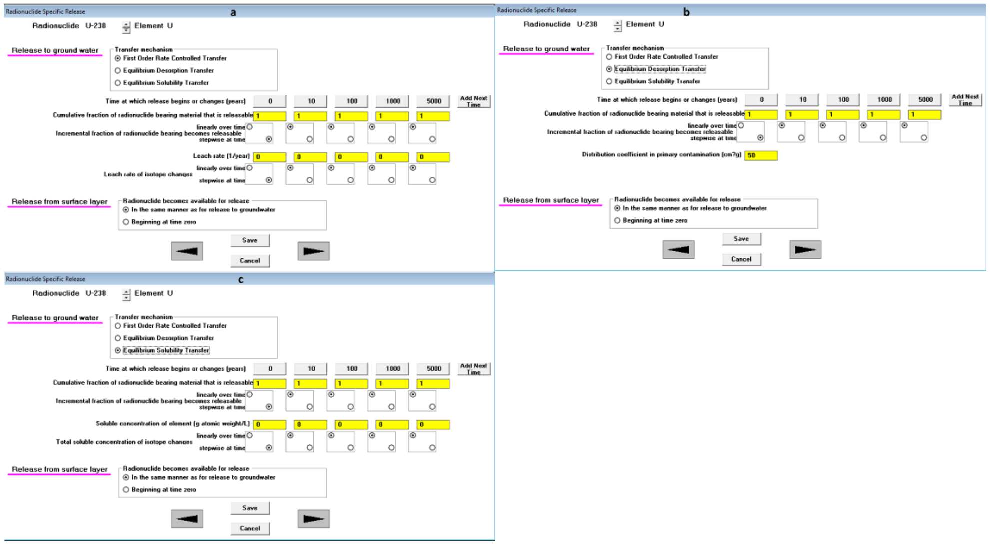
Test Objective To the functionality of Form Nuclide Specific Release.

Procedure

1) Select a conceptualization other than "RESRAD-ONSITE exponential release model" in Preliminary Inputs form
2) Select U-238 in Form Initial Concentrations with all default setting, and set release time to 0, 10, 100, and 1000 in Release Time form.
3) Open the Form "Nuclide Specific Release". Initial Concentrations Form should also be opened automatically if not opened at the time. Visually check the format, fonts, spelling, and default setting.
4) Check Radionuclide can be selected for each one in U-238 decay chain.
5) A button called "Add Next Time" should be available next the last release time. Clicking it should close the Nuclide Specific Release form and open Release Times form. In the Release Time form, add the 5th release starting time, 5000 yr and close the form.
6) Clicking a specific release time in the Nuclide Specific Release form should result in closing the form and open the Release Time form with the specified release time highlighted for modification.
7) Open the Form "Nuclide Specific Release" again, the newly added release starting time of 5000 should be added into the release time row.
8) Changing the options in Transfer Mechanism frame should change the interface. Figures a-c show the interfaces corresponding to First order release, Equilibrium Desorption, and Equilibrium Solubility release, respectively.
9) Change one value or option for each radionuclide, close the form, and save the file to Test15.rof.
10) Check the values in the generated input file match the inputs in the interface. The variables include RELTIME, RLEACH, SOLUB, RELFRAC, RELTIMEOPT, RELTIMEOPTP, RELOPT.

Required Data None.

Expected Results



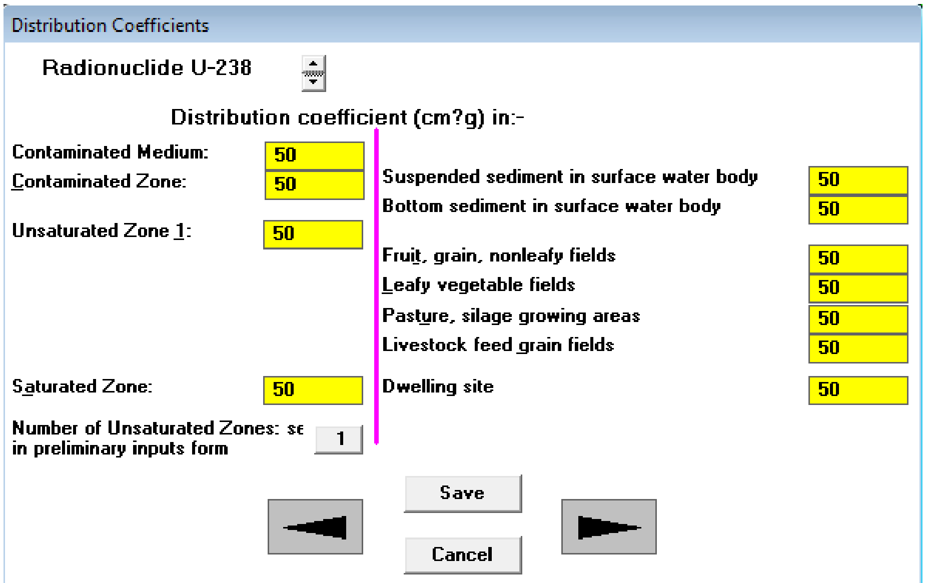
11.29 TEST CASE 034-005

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-005
Test Summary	Test the functionality of Distribution Coefficients form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Distribution Coefficients form.

Procedure

1) With U-238 selected with default settings. Open Distribution Coefficients form and visually check the format, fonts, spelling, and default setting.
2) The form should be available for inputs as shown in the Figure in Expected Results.
3) When either of the first or second options in Conceptualization of Primary Contamination in Preliminary form is selected, the distribution coefficient input box for Contaminated Medium will be gray out.
4) Clicking the value of Number of Unsaturated Zone should open the Preliminary Inputs form
5) Change at least one value for each radionuclide, and save the project to Test17.rof.
6) Check the following variables in the generated input file and their value should match the input, DCACTC, DCACTCM, DCACTDWE, DCACTSWB, DCACTSWS, DCACTU1, DCACTS, DCACTV1, DCACTV2, DCACTL1, DCACTL2.

Required Data	None.
Expected Results	The behavior of the code should be the same as described in each step.


Distribution Coefficients
Radionuclide U-238
Distribution coefficient (cm?g) in:-
Contaminated Medium:
50
Contaminated Zone:
50
Unsaturated Zone 1:
50
Saturated Zone:
50
Number of Unsaturated Zones: se
in preliminary inputs form
1
Suspended sediment in surface water body
50
Bottom sediment in surface water body
50
Fruit, grain, nonleafy fields
50
Leafy vegetable fields
50
Pasture, silage growing areas
50
Livestock feed grain fields
50
Dwelling site
50
Save
Cancel

11.30 TEST CASE 034-006

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-006
Test Summary	Test the functionality of Deposition Velocities form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Deposition Velocities form.
Procedure	1) Select U-238 with default settings. Open Deposition Velocity form and visually check the format, fonts, spelling, and default setting. 2) Change at least one value for each radionuclide in the U-238 decay chain. Save the form and the project to Test18.rof. 3) Check the variables DEPVEL, and DEPVELT in the generated file; they should match the input values in the interface.
Required Data	None.
Expected Results	The behavior of the code should be the same as described in each step.

11.31 TEST CASE 034-007

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-007
Test Summary	Test the functionality of Transfer Factors form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Transfer Factors form.
Procedure	1) Select U-238 with all default settings. Open Transfer Factors form, and visually check the format, fonts, spelling, and default setting. 2) Change at least one value for each radionuclide, and save the form. 3) Save the project to Test19.rof. Check the following variables' values; they should match the input. RTF, I_M, BIOFAC.
Required Data	None.
Expected Results	The behavior of the code should be the same as described in each step.

11.32 TEST CASE 034-008

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-008

Test Summary Test the functionality of Reporting Times form

Created By/Date CW 10/17/2019

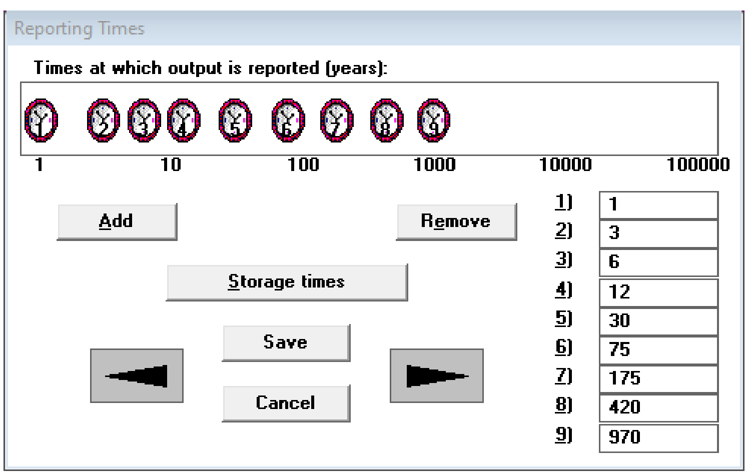
Test Objective To test the functionality of Reporting Times form.

Procedure

1) Click Modify Data -> Reporting Times. Visually check the format, fonts, and spelling.
2) It should have contents as shown in the figure, allowing up to 9 input times.
3) Check the lower and upper bounds. Each value should be (0, 100000]
4) Check Add and Remove buttons
5) Clicking "Storage times" button should bring the form up.
6) Save the form and the project to Test20.rof.
7) Check the variable T(1)-(10) in the file; they should be identical to the input in GUI.

Required Data None.

Expected Results The behavior of the code should be the same as described in each step.



11.33 TEST CASE 034-009

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-009

Test Summary Test the functionality of Storage Times form

Created By/Date CW 10/17/2019

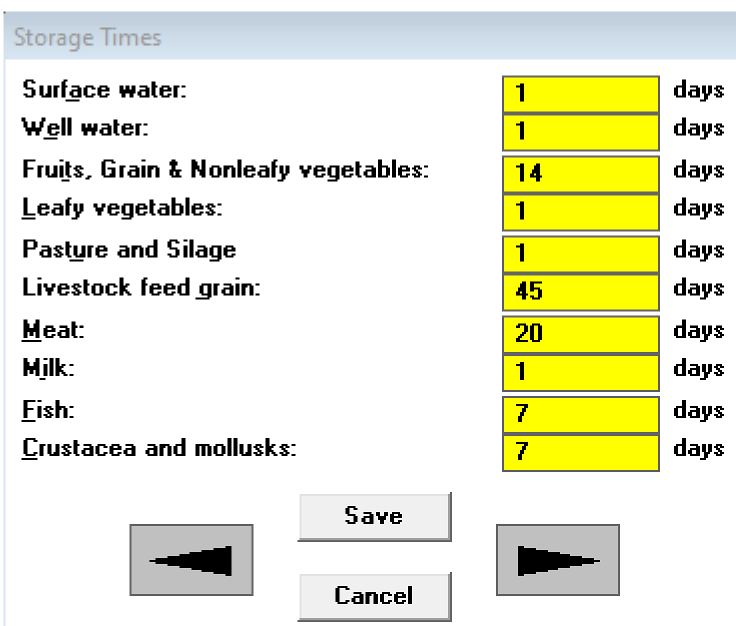
Test Objective To test the functionality of Storage Times form.

Procedure

1) Click Modify Data -> Storage Times. Visually check the format, fonts, and spelling.
2) Check the lower and upper bounds for each input box value. It should be no less than 0.
3) Change two or more values.
4) Save the form and the project to Test21.rof.
5) Check the variable STOR_T(1)-(10) in the file; they should be identical to the input in GUI.

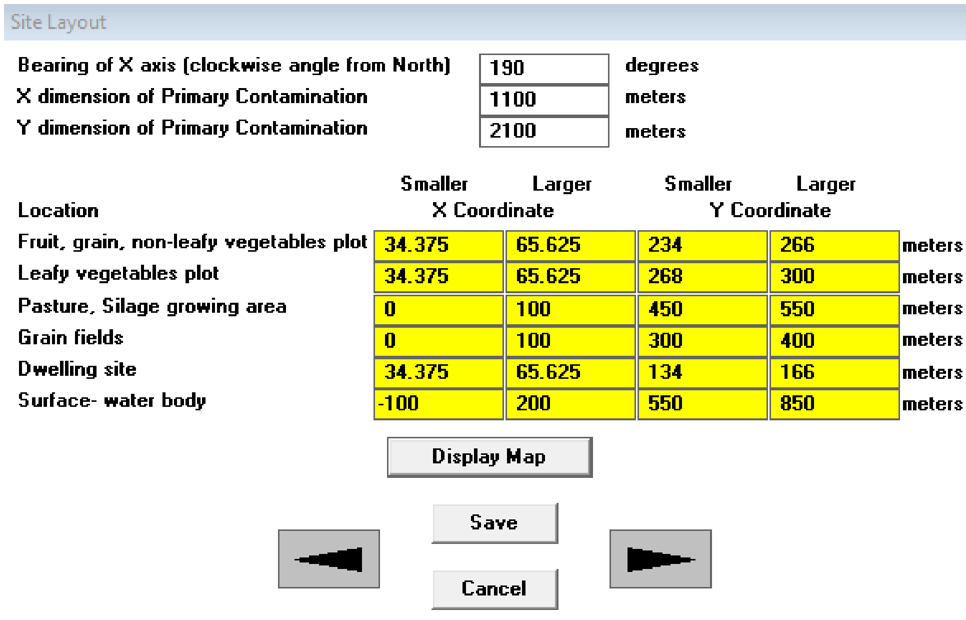
Required Data None.

Expected Results The behavior of the code should be the same as described in each step.



11.34 TEST CASE 034-010

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-010
Test Summary	Test the functionality of Site Layout form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Site Layout form.
Procedure	1) Open Site Layout form and visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. 2) Clicking Display Map should bring up the Map Interface window. 3) Change the values for Bearing of X axis, X and Y dimensions, and at least one value on each row and column of the site coordinate table. 4) Save the project to Test22.rof. 5) Check the following variables in the file; they should be identical to the input in GUI. NXBEARING, SOURCEXY, AGRIXY, DWELLXY, SWXY.
Required Data	None.
Expected Results	The behavior of the code should be the same as described in each step.


Site Layout
Bearing of X axis (clockwise angle from North) 190 degrees
X dimension of Primary Contamination 1100 meters
Y dimension of Primary Contamination 2100 meters
Smaller Larger Smaller Larger
Location X Coordinate Y Coordinate
Fruit, grain, non-leafy vegetables plot 34.375 65.625 234 266 meters
Leafy vegetables plot 34.375 65.625 268 300 meters
Pasture, Silage growing area 0 100 450 550 meters
Grain fields 0 100 300 400 meters
Dwelling site 34.375 65.625 134 166 meters
Surface- water body -100 200 550 850 meters
Display Map
Save
Cancel

11.35 TEST CASE 034-011

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-011

Test Summary Test the functionality of Map Interface form

Created By/Date CW 10/17/2019

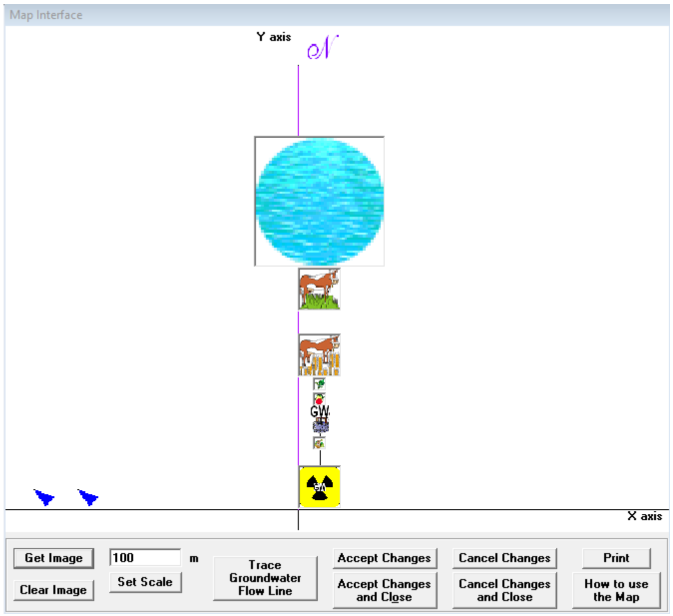
Test Objective To test the functionality of Map Interface form.

Procedure

1) Open Map Interface form by clicking Modify Data -> Site Layout -> Display Map
2) It should include the functions as shown in the figure.
3) Check the following buttons: Print, How to use the Map, Accept/Cancel changes, Accept/Cancel Changes and Close.
4) Move each icon in the map a little and the purple Y-axis line, then click Accept Changes and Close. The coordinate table in the Site Layout form should update accordingly.
5) Click Get Image should direct to select an image file. Select the file HypotheticalSuburbanScenarioOutline.JPG under UserFiles folder. The image should load to the code. Click Clear Image should remove the file from the code.
6) Change the scale value and click "Set Scale". The image should change accordingly.
7) Click Trace Groundwater Flow Line, the widow should update with GW line.
8) Clicking How to Trace a Flow Line button should open a file named GwFlowLinRO.pdf. Following the procedure in the file and check each button functions as designed.

Required Data None.

Expected Results The code should behave as described in each step.


Map Interface
Y axis
N
GW
X axis
Get Image
100
m
Set Scale
Clear Image
Trace Groundwater Flow Line
Accept Changes
Accept Changes and Close
Cancel Changes
Cancel Changes and Close
Print
How to use the Map

11.36 TEST CASE 034-012

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-012

Test Summary Test the functionality of Physical and Hydrological form

Created By/Date CW 10/17/2019

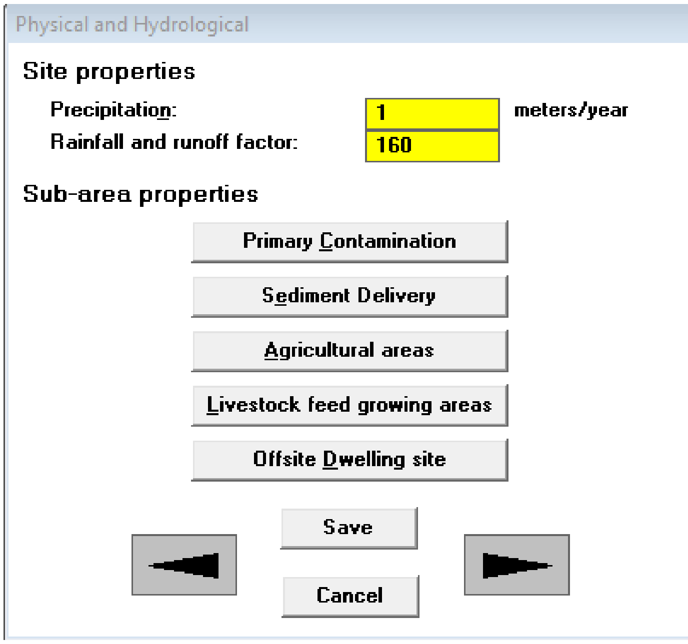
Test Objective To test the functionality of Physical and Hydrological form.

Procedure

1) Open Physical and Hydrological form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value.
2) It should contain Site Properties input, as shown in the figure.
3) Clicking each of the five buttons in Sub-area Properties section should bring up the corresponding forms.
4) Change the precipitation value and rainfall and runoff factor, save the form, and save the project to Test24.rof.
5) Check the variables PRECI and RAINEROS in the generated file. They should be identical to the input in GUI.

Required Data None.

Expected Results The code should behave as described in each step.


Physical and Hydrological
Site properties
Precipitation:
1
meters/year
Rainfall and runoff factor:
160
Sub-area properties
Primary Contamination
Sediment Delivery
Agricultural areas
Livestock feed growing areas
Offsite Dwelling site
Save
Cancel

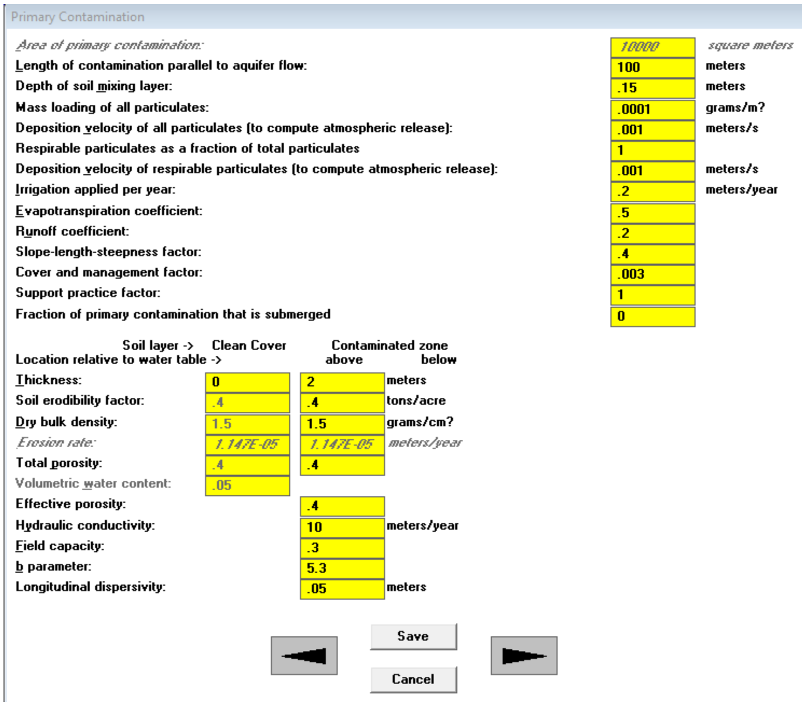
11.37 TEST CASE 034-013

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-013
Test Summary	Test the functionality of Primary Contamination form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Primary Contamination form.

Procedure

1) Open Primary Contamination form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value.
2) It should contain Site Properties input, as shown in the figure.
3) Check the consistence of Area of Primary Contamination with the X and Y dimesons in Site Layout form.
4) Check the consistence of Factor of primary contamination that is submerged with the Submerged fraction of Primary Contamination in Preliminary Input.
5) Modify at least two values in each column, save the form, and then save the project to Test25.rof.
6) Check the following variables in the generated input file. They should be the same as input in the GUI. AREA, LCZPAQ, DM, MLFD, DEPVEL_DUSTT, RESPFRACPC, DEPVEL_DUST, RI, EVAPTR, RUNOFF, SLPLENSTPPC, CRPMANGPC, CONVPRACPC, THICK0, TPCZ, VCZ, DENSCZ, ERODIBILITYCZ, FCCZ, BCZ, HCCZ, EPCZ, ALPHALCZ, SUBMERGEDDEPTH, COVER0, TPCV, VCV, DENSCV, ERODIBILITYCV, PH2OCV

Required Data	None.
Expected Results	The code should behave as described in each step.


Primary Contamination
Area of primary contamination: 10000 square meters
Length of contamination parallel to aquifer flow: 100 meters
Depth of soil mixing layer: .15 meters
Mass loading of all particulates: .0001 grams/m?
Deposition velocity of all particulates (to compute atmospheric release): .001 meters/s
Respirable particulates as a fraction of total particulates 1
Deposition velocity of respirable particulates (to compute atmospheric release): .001 meters/s
Irrigation applied per year: .2 meters/year
Evapotranspiration coefficient: .5
Runoff coefficient: .2
Slope-length-steepness factor: .4
Cover and management factor: .003
Support practice factor: 1
Fraction of primary contamination that is submerged 0
Soil layer -> Clean Cover Contaminated zone
Location relative to water table -> above below
Thickness: 0 2 meters
Soil erodibility factor: .4 .4 tons/acre
Dry bulk density: 1.5 1.5 grams/cm?
Erosion rate: 1.147E-05 1.147E-05 meters/year
Total porosity: .4 .4
Volumetric water content: .05
Effective porosity: .4
Hydraulic conductivity: 10 meters/year
Field capacity: .3
b parameter: 5.3
Longitudinal dispersivity: .05 meters
Save
Cancel

11.38 TEST CASE 034-014

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-014

Test Summary Test the functionality of Sediment Delivery Ratio form

Created By/Date CW 10/17/2019

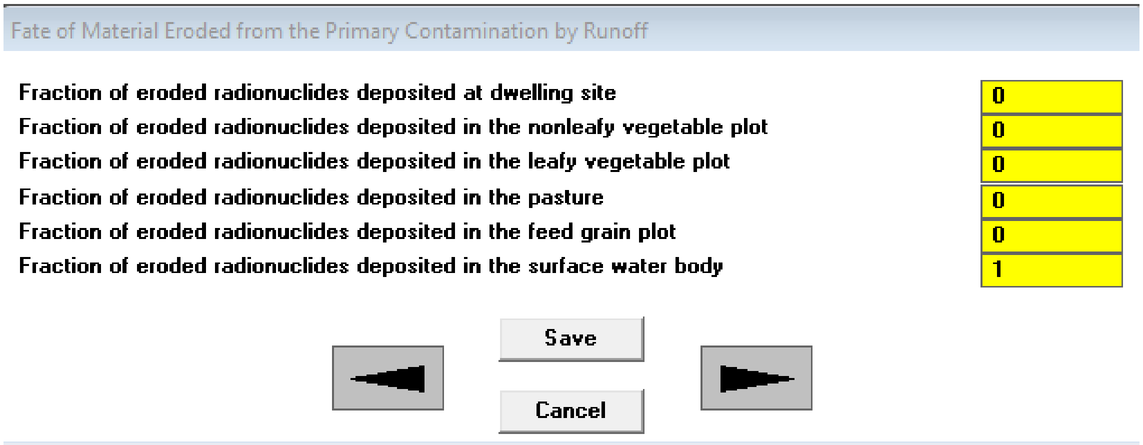
Test Objective To test the functionality of Sediment Delivery Ratio form.

Procedure

1) Open Sediment Delivery Ratio form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value.
2) It should the input boxes, as shown in the figure.
3) Check the lower and upper bounds, which should be 0 and 1, respectively.
4) The summation of the values in this form should be 1. Make it more than one, and an error message should pop up.
5) Check the values input in the form are consistent with the ones in Forms Dwelling Site, Agricultural Areas, Livestock Feed Areas, and Surface Water Body.
6) Change three or more values, save the form, and then save the project to Test26.rof.
7) Check the following variables in the generated input file; they should be identical to the input from GUI. SDR, SDROF(1)-(4) and SDRDELL

Required Data None.

Expected Results The code should behave as described in each step.


Fate of Material Eroded from the Primary Contamination by Runoff
Fraction of eroded radionuclides deposited at dwelling site
0
Fraction of eroded radionuclides deposited in the nonleafy vegetable plot
0
Fraction of eroded radionuclides deposited in the leafy vegetable plot
0
Fraction of eroded radionuclides deposited in the pasture
0
Fraction of eroded radionuclides deposited in the feed grain plot
0
Fraction of eroded radionuclides deposited in the surface water body
1
Save
Cancel

11.39 TEST CASE 034-015

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-015

Test Summary Test the functionality of Agricultural Areas form

Created By/Date CW 10/1/2019

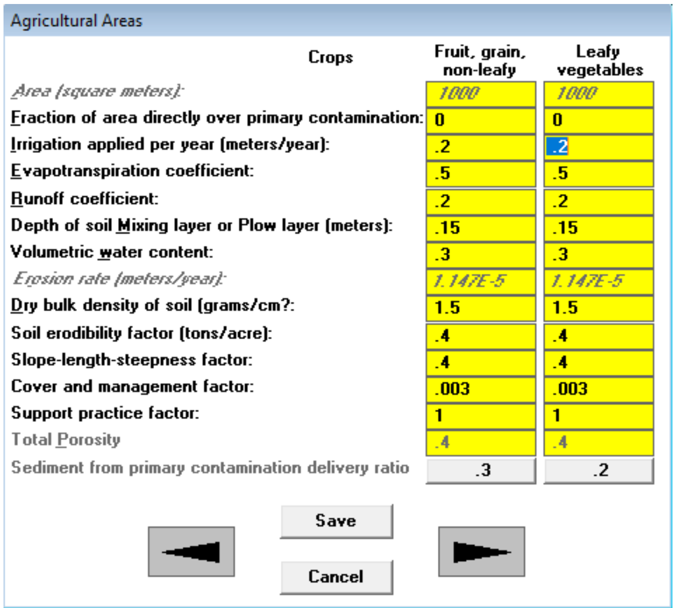
Test Objective To test the functionality of Agricultural Areas form.

Procedure

1) Open Agricultural Areas form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value.
2) It should have the same input boxes as the figure has.
3) Check the Area values; they should be grayed out in this form but match the inputs in Site Layout form.
4) Check the Erosion rate and Total Porosity values; they should be grayed out in this form but match the ones in Primary Contamination form
5) Check the Sediment delivery ratio values; they should be grayed out in this form but match the ones in Sediment Delivery Ratio form. Clicking the values in this form should bring up the Sediment Delivery Ratio form.
6) Change at least three values in each column, save the form, and save the project to Test27.rof.
7) Check the following variables in the generated file; they should be the same as inputs in GUI. AREAO(1) and (2), FAREA_PLANT(1) and (2), RIRRIG(1) and (2), EVAPTRN(1) and (2), RUNOF(1) and (2), DPTHMIXG(1) and (2), TMOF(1) and (2), EROSN(1) and (2), RHOB(1) and (2), ERODIBILITY(1) and (2), SLPLENSTP(1) and (2), CRPMANG(1) and (2), CONVPRAC(1) and (2), TPOF(1) and (2).

Required Data None.

Expected Results The code should behave as described in each step.



Agricultural Areas

Crops	Fruit, grain, non-leafy	Leafy vegetables
Area (square meters):	*1000*	*1000*
Fraction of area directly over primary contamination:	0	0
Irrigation applied per year (meters/year):	.2	.2
Evapotranspiration coefficient:	.5	.5
Runoff coefficient:	.2	.2
Depth of soil Mixing layer or Plow layer (meters):	.15	.15
Volumetric water content:	.3	.3
Erosion rate (meters/year):	*1.147E-5*	*1.147E-5*
Dry bulk density of soil (grams/cm?:	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total Porosity	.4	.4
Sediment from primary contamination delivery ratio	.3	.2

Save

Cancel

11.40 TEST CASE 034-016

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-016

Test Summary Test the functionality of Livestock Feed Areas form

Created By/Date CW 10/17/2019

Test Objective To test the functionality of Livestock Feed Areas form.

Procedure

1) This form should contain the same input content as Agricultural Areas form but for Livestock Feed Area, including Pasture Silage and Grain
2) Follow the same procedure for testing Agricultural Areas form, except that the variables to be checked in the generated input file should be AREAO(3) and (4), FAREA_PLANT(3) and (4), RIRRIG(3) and (4), EVAPTRN(3) and (4), RUNOF(3) and (4), DPTHMIXG(3) and (4), TMOF(3) and (4), EROSN(3) and (4), RHOB(3) and (4), ERODIBILITY(3) and (4), SLPLENSTP(3) and (4), CRPMANG(3) and (4), CONVPRAC(3) and (4), TPOF(3) and (4).

Required Data None.

Expected Results The code should behave as described in each step.

11.41 TEST CASE 034-017

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-017
Test Summary	Test the functionality of Dwelling Site form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Dwelling Site form.
Procedure	1) This form should contain the same input content as Agricultural Areas form but for Offsite Dwelling Area 2) Follow the same procedure for testing Agricultural Areas form, except that the variables to be checked in the generated input file should be AREAODWELL, , RIRRIGDWELL, EVAPTRNDWELL, RUNOFDWELL, DPTHMIXGDWELL, TMOFDWELL, EROSNDWELL, RHOBDWELL, ERODIBILITYDWELL, SLPLENSTPDWELL, CRPMANGDWELL, CONVPRACDWELL, TPOFDWELL.
Required Data	None.
Expected Results	The code should behave as described in each step.

11.42 TEST CASE 034-018

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-018

Test Summary Test the functionality of Atmospheric Transport form

Created By/Date CW 10/17/2019

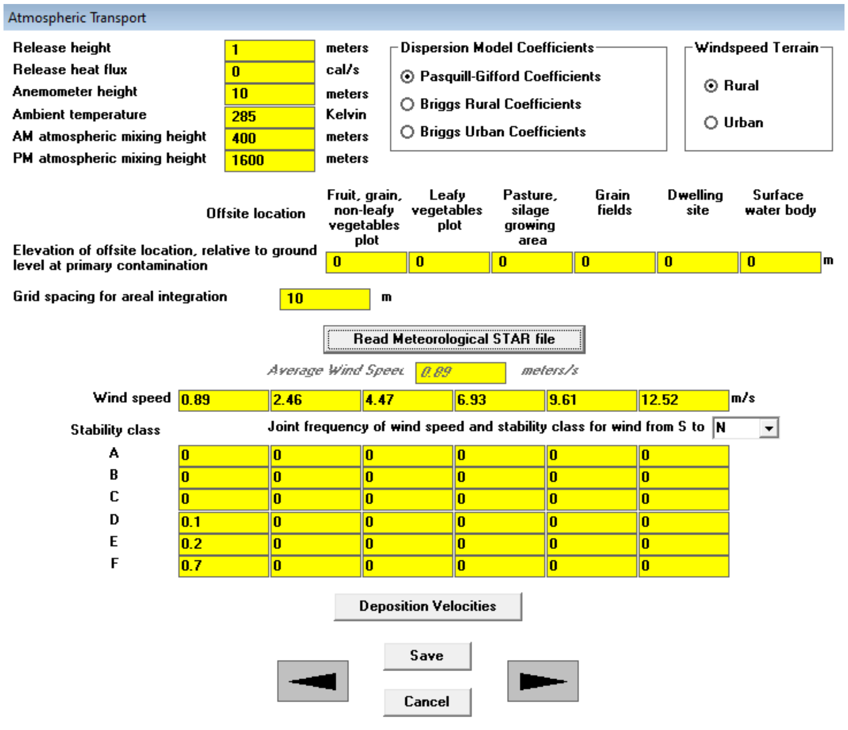
Test Objective To test the functionality of Atmospheric Transport form.

Procedure

1) Open Atmospheric Transport form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value.
2) It should have the same input boxes as the figure has.
3) Clicking Read Meteorological STAR file should allow to select a STAR file from the available list installed in Application folder\Metfiles. Loading of a selected STAR file should update the table.
4) Clicking Deposition Velocities should bring up the Deposition Velocities form.
5) Change at least one value in each input area, save the form, and save the project to Test30.rof.
6) Check the following variables in the generated input file; they should be the same as the inputs from GUI. AIRRELHT, HEATFLX, ANH, TABK, AMIX, PMIX, AGRIELEV, DWELLELEV, SWELEV, WIND, WINDSPEED, DFREQ, ATGRID

Required Data None.

Expected Results The code should behave as described in each step.


Atmospheric Transport
Release height
1
meters
Release heat flux
0
cal/s
Anemometer height
10
meters
Ambient temperature
285
Kelvin
AM atmospheric mixing height
400
meters
PM atmospheric mixing height
1600
meters
Dispersion Model Coefficients
Pasquill-Gifford Coefficients
Briggs Rural Coefficients
Briggs Urban Coefficients
Windspeed Terrain
Rural
Urban
Offsite location
Fruit, grain, non-leafy vegetables plot
Leafy vegetables plot
Pasture, silage growing area
Grain fields
Dwelling site
Surface water body
Elevation of offsite location, relative to ground level at primary contamination
0
0
0
0
0
0
m
Grid spacing for areal integration
10
m
Read Meteorological STAR file
Average Wind Speec
0.89
meters/s
Wind speed
0.89
2.46
4.47
6.93
9.61
12.52
m/s
Stability class
Joint frequency of wind speed and stability class for wind from S to
N
A
0
0
0
0
0
0
B
0
0
0
0
0
0
C
0
0
0
0
0
0
D
0.1
0
0
0
0
0
E
0.2
0
0
0
0
0
F
0.7
0
0
0
0
0
Deposition Velocities
Save
Cancel

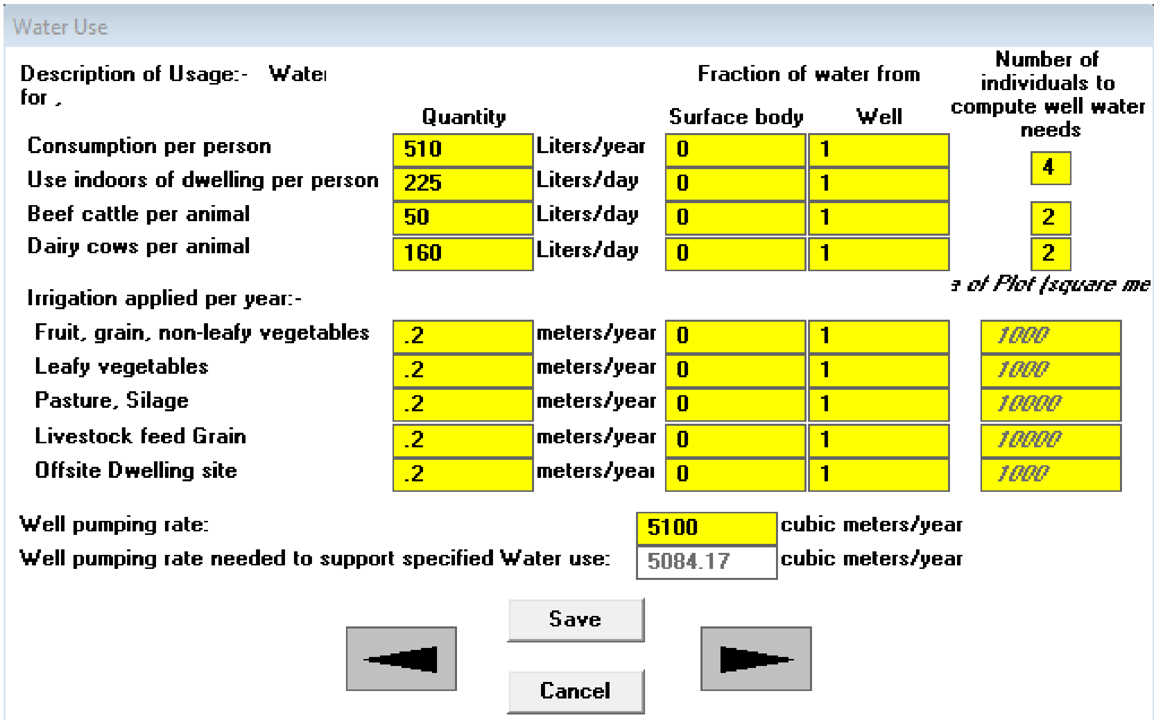
11.43 TEST CASE 034-019

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-019
Test Summary	Test the functionality of Water Use form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Water Use form.

Procedure

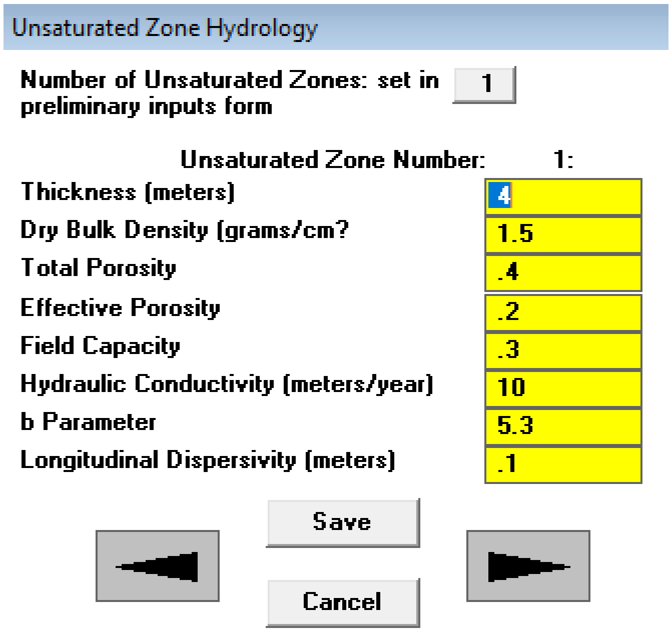
1) Open Water User form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value.
2) It should have the same input boxes as the figure has.
3) Check the Area of Plot; which should be grayed out and consistent with the inputs in Site Layout form.
4) Check the Fraction of water values. The summation of two columns should be 1.
5) Changes at least two values in each column, save the form, and save the project to Test31.rof.
6) Check the following variables in the generated file; they should be the same as inputs in the GUI. DWI, FDWI, FSWD, FWWD, HHW, FSWHH, FWWHH, LWI, FSWLV, FWWLV, FSWIR, FWWIR, FSWIRDWELL, FWWIRDWELL, NDWI, NLWI, UW

Required Data	None.
Expected Results	The code should behave as described in each step.


Water Use
Description of Usage:- Water for ,
Fraction of water from
Number of individuals to compute well water needs
Quantity
Surface body
Well
Consumption per person
510
Liters/year
0
1
4
Use indoors of dwelling per person
225
Liters/day
0
1
Beef cattle per animal
50
Liters/day
0
1
2
Dairy cows per animal
160
Liters/day
0
1
2
Irrigation applied per year:-
of Plot (square me
Fruit, grain, non-leafy vegetables
.2
meters/year
0
1
1000
Leafy vegetables
.2
meters/year
0
1
1000
Pasture, Silage
.2
meters/year
0
1
10000
Livestock feed Grain
.2
meters/year
0
1
10000
Offsite Dwelling site
.2
meters/year
0
1
1000
Well pumping rate:
5100
cubic meters/year
Well pumping rate needed to support specified Water use:
5084.17
cubic meters/year
Save
Cancel

11.44 TEST CASE 034-020

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-020
Test Summary	Test the functionality of Unsaturated Zones form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Unsaturated Zones form.
Procedure	1) Open Unsaturated Zones form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. 2) It should have the same input boxes as the figure has. 3) Clicking the Number of Unsaturated Zones should bring up the Preliminary Inputs form 4) Modify at least two values for each unsaturated zone, save the form, and the save the project to Test32.rof. 5) Check the following variables in the generated file; they should be the same as inputs in GUI. H, DENSUZ, TPUZ, EPUZ, FCUZ, HCUZ, BUZ, ALPHALU
Required Data	None.
Expected Results	The code should behave as described in each step.


Unsaturated Zone Hydrology
Number of Unsaturated Zones: set in preliminary inputs form
1
Unsaturated Zone Number: 1:
Thickness (meters)
4
Dry Bulk Density (grams/cm?
1.5
Total Porosity
.4
Effective Porosity
.2
Field Capacity
.3
Hydraulic Conductivity (meters/year)
10
b Parameter
5.3
Longitudinal Dispersivity (meters)
.1
Save
Cancel

11.45 TEST CASE 034-021

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-021
Test Summary	Test the functionality of Saturated Zone form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Saturated Zone form.
Procedure	1) Open Saturated Zone form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. 2) It should have the same input boxes as the figure has. 3) Modify at least two values for each unsaturated zone, save the form, and the save the project to Test33.rof. 4) Check the following variables in the generated file; they should be the same as inputs in GUI. DPTHAQ, DENSAQ, TPSZ, EPSZ, HCSZ, HGW, DWIBWT, ALPHALOW, ALPHATW, ALPHAVW, HGSW, DPTHAQSW, ALPHALOSW, ALPHATSW, ALPHAVSW
Required Data	None.
Expected Results	The code should behave as described in each step.

Saturated Zone Hydrology

Thickness of saturated zone:	100	meters
Dry Bulk Density of saturated zone:	1.5	grams/cm?
Total porosity of saturated zone:	.4	
Effective porosity of saturated zone:	.2	
Hydraulic Conductivity of saturated zone:	100	meters/year

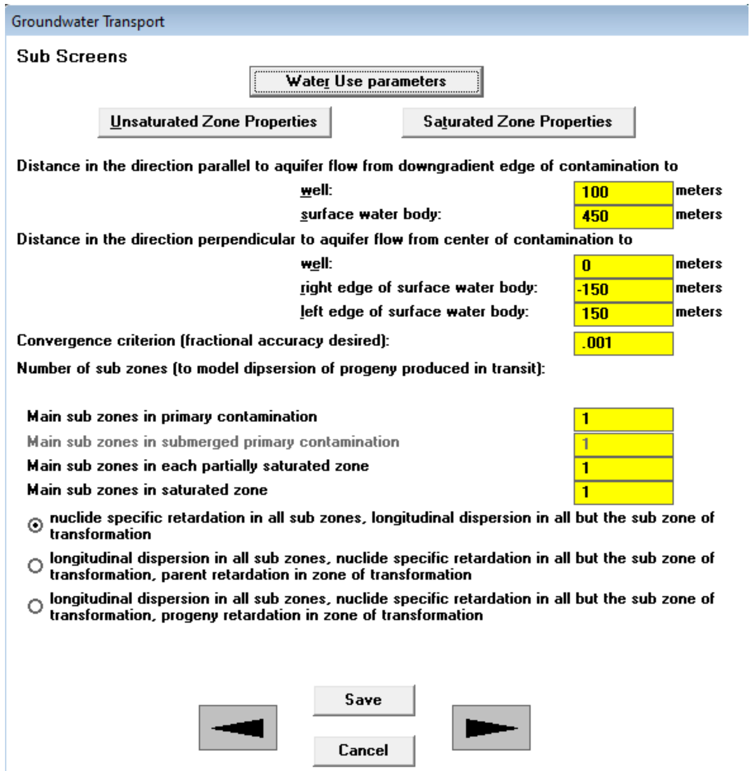
	to well	to surface waterbody	
Hydraulic Gradient of saturated zone:	.02	.02	
Depth of aquifer contributing:	10	5	meters below water table
Longitudinal Dispersivity of saturated zone:	3	10	meters
Horizontal lateral Dispersivity of saturated zone:	.4	1	meters
Vertical lateral Dispersivity of saturated zone:	.02	.06	meters

Save

Cancel

11.46 TEST CASE 034-022

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-022
Test Summary	Test the functionality of Groundwater Transport form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Groundwater Transport form.
Procedure	1) Open Groundwater Transport form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value. 2) It should have the same input boxes as the figure has. 3) Clicking the three buttons should bring up the forms of Water Use, Unsaturated Zones, and Saturated Zone 4) Check the options for subzone dispersion; they should respond to selection 5) Change at least three values, save the form, and then save the project to Test34.rof 6) Check the following variables in the generated file; they should be the same as inputs in GUI. OFFLPAQW, OFFLPAQS, OFFLNAQW, OFFLNAQSN, OFFLNAQSF, EPS, NPCM, NPCMF, NPCZ, NPCZF, NSPCZ, NSPCZF, NPSS, NPSSF, NAQS, NAQSF
Required Data	None.
Expected Results	The code should behave as described in each step.


Groundwater Transport
Sub Screens
Water Use parameters
Unsaturated Zone Properties
Saturated Zone Properties
Distance in the direction parallel to aquifer flow from downgradient edge of contamination to
well:
100
meters
surface water body:
450
meters
Distance in the direction perpendicular to aquifer flow from center of contamination to
well:
0
meters
right edge of surface water body:
-150
meters
left edge of surface water body:
150
meters
Convergence criterion (fractional accuracy desired):
.001
Number of sub zones (to model dipsersion of progeny produced in transit):
Main sub zones in primary contamination
1
Main sub zones in submerged primary contamination
1
Main sub zones in each partially saturated zone
1
Main sub zones in saturated zone
1
nuclide specific retardation in all sub zones, longitudinal dispersion in all but the sub zone of transformation
longitudinal dispersion in all sub zones, nuclide specific retardation in all but the sub zone of transformation, parent retardation in zone of transformation
longitudinal dispersion in all sub zones, nuclide specific retardation in all but the sub zone of transformation, progeny retardation in zone of transformation
Save
Cancel

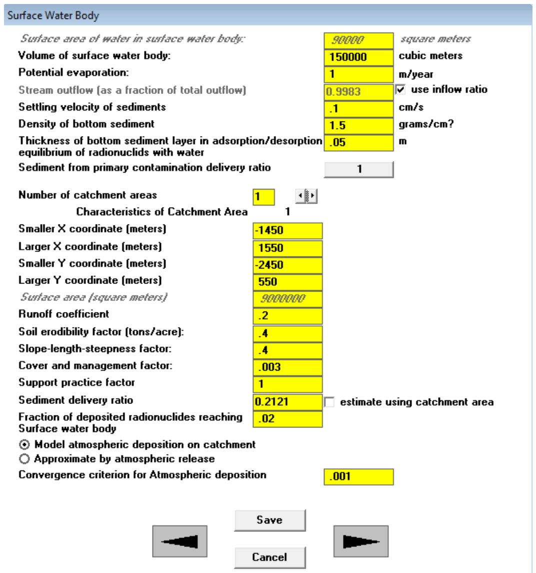
11.47 TEST CASE 034-023

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-023
Test Summary	Test the functionality of Surface Water Body form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Surface Water Body form.

Procedure

1) Open Surface Water Body form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value.
2) It should have the same input boxes as the figure has.
3) Check the Surface area of water body, which should be consistent with the inputs in Site Layout form
4) Check the Sediment Delivery ration button, which should be consistent with the input in Sediment Delivery Ration form. Clicking it should bring up the Sediment Delivery Ratio form.
5) Check the Number of catchment areas. The left and right arrow button should allow delete or add one catchment with default settings
6) Validate the catchment are using the coordinates
7) Modify at least three values in each column, save the form, and then save the project to Test35.rof
8) Check the following variables in the generated file; they should be the same as the inputs in GUI. ALAKE, VLAKE, EVAPOT, FSTMFLOW, FSTMFLOWIN, VSETTLE, RHOBSED, THICKSED, SDR, NCATCH, CATCHXY, AREACA, RUNOFFCA, ERODIBILITYCA, SLPLENSTPCA, CRPMANGCA, CONVPRACCA, SDRCA, SDRACOR, DDRCA, COMPUTEDEP, CONVCRITATM

Required Data	None.
Expected Results	The code should behave as described in each step.


Surface Water Body
Surface area of water in surface water body:
90000
square meters
Volume of surface water body:
150000
cubic meters
Potential evaporation:
1
m/year
Stream outflow (as a fraction of total outflow)
0.9983
use inflow ratio
Settling velocity of sediments
.1
cm/s
Density of bottom sediment
1.5
grams/cm?
Thickness of bottom sediment layer in adsorption/desorption equilibrium of radionuclids with water
.05
m
Sediment from primary contamination delivery ratio
1
Number of catchment areas
1
Characteristics of Catchment Area
1
Smaller X coordinate (meters)
-1450
Larger X coordinate (meters)
1550
Smaller Y coordinate (meters)
-2450
Larger Y coordinate (meters)
550
Surface area (square meters)
9000000
Runoff coefficient
.2
Soil erodibility factor (tons/acre):
.4
Slope-length-steepness factor:
.4
Cover and management factor:
.003
Support practice factor
1
Sediment delivery ratio
0.2121
estimate using catchment area
Fraction of deposited radionuclides reaching Surface water body
.02
Model atmospheric deposition on catchment
Approximate by atmospheric release
Convergence criterion for Atmospheric deposition
.001
Save
Cancel

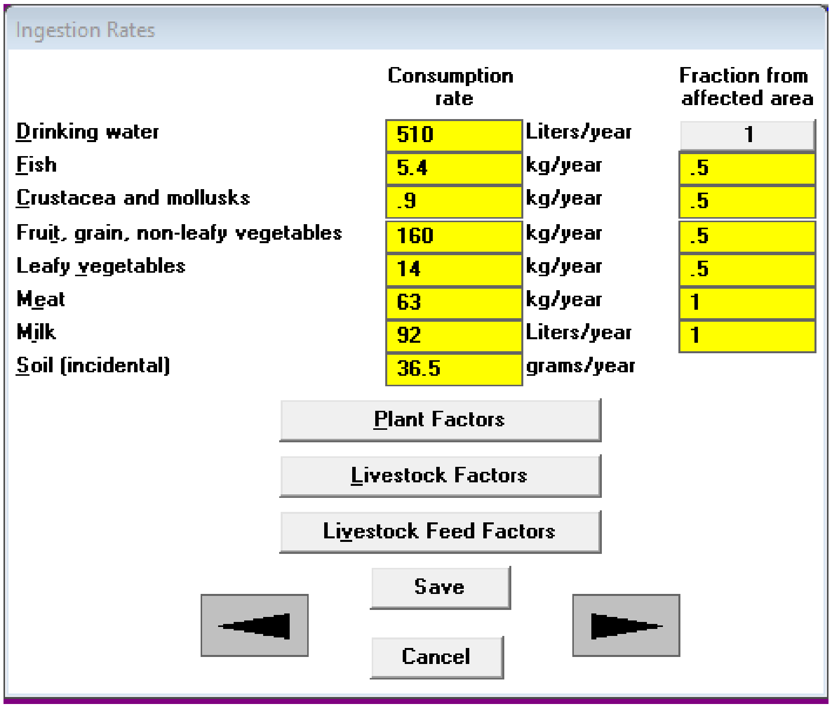
11.48 TEST CASE 034-024

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-024
Test Summary	Test the functionality of Ingestion Rates form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Ingestion Rates form.

Procedure

1) Open Ingestion Rates form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value.
2) It should have the same input boxes as the figure has.
3) Check the Drinking Water Consumption rate, which should be consistent with the input in Water Use form. Modification on either one should change the other one automatically.
4) Check the Drinking water fraction from affected area, which should be consistent with the inputs from Water Use form. Clicking of this button should bring up the Water Use form.
5) Check the three buttons. Clicking them should bring up forms of Plant Factors, Livestock Factors, and Livestock Feed Factors.
6) Modify at least two values in each column, save the form, and then save the project to Test36.rof.
7) Check the following variables in the generated file; they should be the same as inputs in GUI. DFI,DVI, DMI, SOIL, FFISH, FVEG, FMEMI

Required Data	None.
Expected Results	The code should behave as described in each step.


Ingestion Rates
Consumption rate
Fraction from affected area
Drinking water
510
Liters/year
1
Fish
5.4
kg/year
.5
Crustacea and mollusks
.9
kg/year
.5
Fruit, grain, non-leafy vegetables
160
kg/year
.5
Leafy vegetables
14
kg/year
.5
Meat
63
kg/year
1
Milk
92
Liters/year
1
Soil (incidental)
36.5
grams/year
Plant Factors
Livestock Factors
Livestock Feed Factors
Save
Cancel

11.49 TEST CASE 034-025

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-025

Test Summary Test the functionality of Plant Factors form

Created By/Date CW 10/17/2019

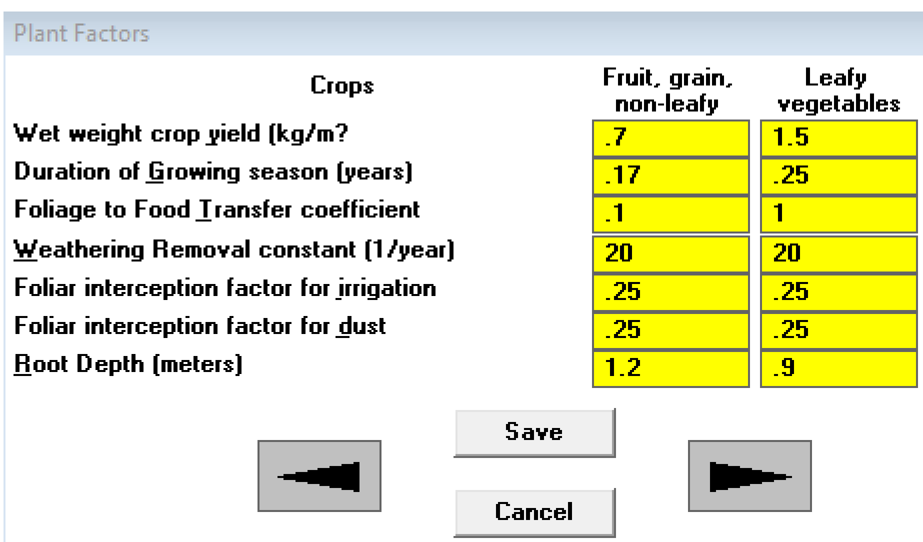
Test Objective To test the functionality of Plant Factors form.

Procedure

1) Open Plant Factors form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.
2) It should have the same input boxes as the figure has.
3) Modify at least two values in each column, save the form, and then save the project to Test37.rof.
4) Check the following variables in the generated file; they should be the same as inputs in GUI. YIELD, GROWTIME, FOLI_F, RWEATHER, FINTCEPT, DROOT

Required Data None.

Expected Results The code should behave as described in each step.



11.50 TEST CASE 034-026

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-026

Test Summary Test the functionality of Livestock Intakes form

Created By/Date CW 10/17/2019

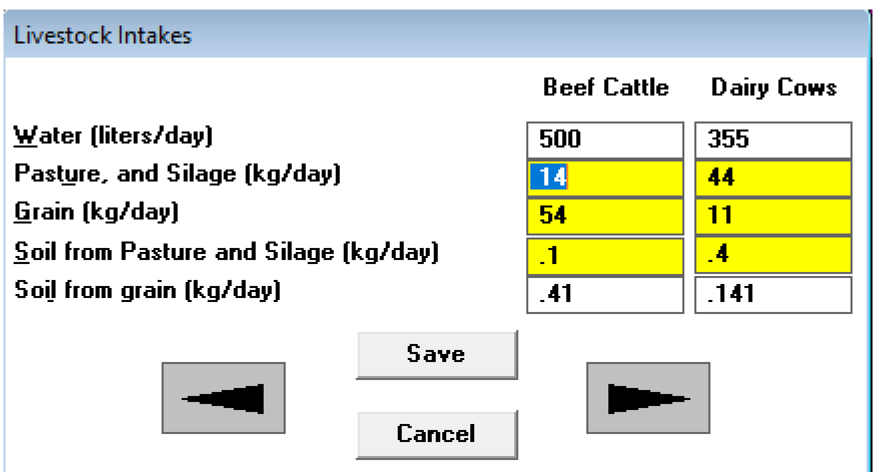
Test Objective To test the functionality of Livestock Intakes form.

Procedure

1) Follow the same procedure as testing of Plant Factors form, except checking the following variables, LWI, LFI, LSI.

Required Data None.

Expected Results The code should behave as described in each step.



11.51 TEST CASE 034-027

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-027

Test Summary Test the functionality of Livestock Feed Factors form

Created By/Date CW 10/17/2019

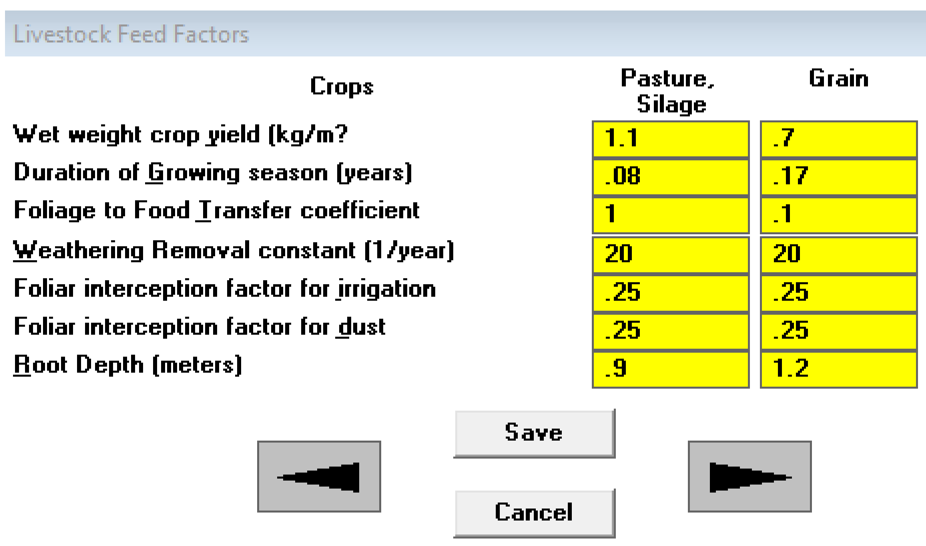
Test Objective To test the functionality of Livestock Feed Factors form.

Procedure

1) Follow the same procedure as testing of Plant Factors form, except checking the following variables, YIELD(3), YIELD(4), GROWTIME(3), GROWTIME(4), FOLI_F(3), FOLI_F(4), RWEATHER(3), RWEATHER(4), FINTCEPT(3,2), FINTCEPT(4,2), FINTCEPT(3,1), FINTCEPT(4,1), DROOT(3), DROOT(4)

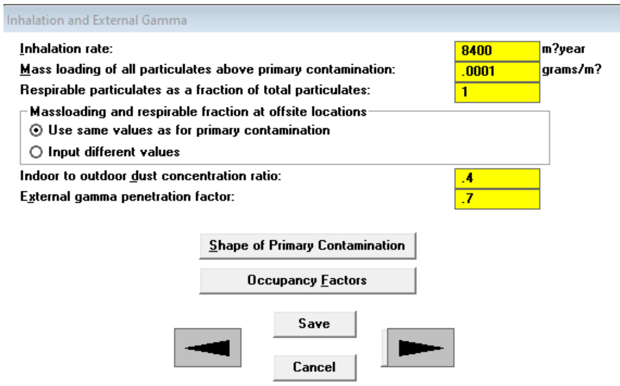
Required Data None.

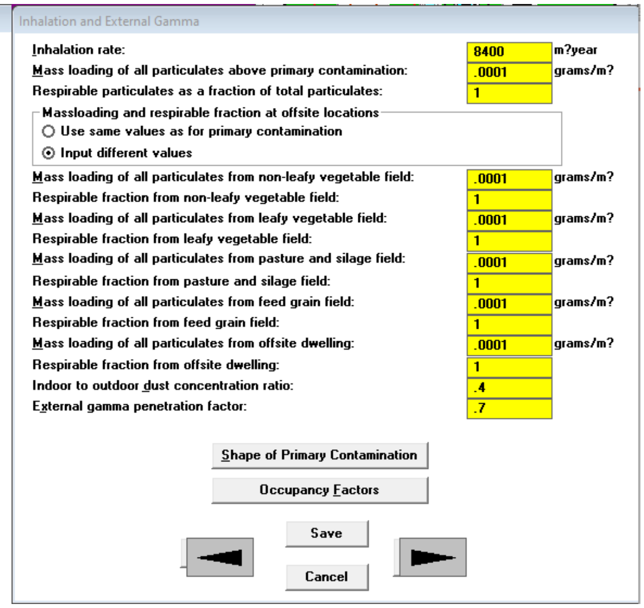
Expected Results The code should behave as described in each step.



11.52 TEST CASE 034-028

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-028
Test Summary	Test the functionality of Inhalation, Gamma form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Inhalation, Gamma form.
Procedure	1) Open Inhalation, Gamma form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value. 2) It should have the same input boxes as the left figure has. 3) Selection of Input different values under Massloading and respirable fraction at offsite locations should bring more input boxes, as shown in the right figure. 4) Clicking the two buttons should bring up the forms of Shape Factors and Occupancy. 5) With Input different values selected, modify at least three inputs, save the form, and then save the project to Test40.rof. 6) Check the following variables in the input file; they should be the same as the inputs in GUI. INHALR, SAMEMLRF, MLTOTOF, RESPFRACOF, MLTOTDWELL, RESPFRACDWELL, SHF3, SHF1
Required Data	None.
Expected Results	The code should behave as described in each step.


Inhalation and External Gamma
Inhalation rate:
8400
m?year
Mass loading of all particulates above primary contamination:
.0001
grams/m?
Respirable particulates as a fraction of total particulates:
1
Massloading and respirable fraction at offsite locations
Use same values as for primary contamination
Input different values
Indoor to outdoor dust concentration ratio:
.4
External gamma penetration factor:
.7
Shape of Primary Contamination
Occupancy Factors
Save
Cancel


Inhalation and External Gamma
Inhalation rate:
8400
m?year
Mass loading of all particulates above primary contamination:
.0001
grams/m?
Respirable particulates as a fraction of total particulates:
1
Massloading and respirable fraction at offsite locations
Use same values as for primary contamination
Input different values
Mass loading of all particulates from non-leafy vegetable field:
.0001
grams/m?
Respirable fraction from non-leafy vegetable field:
1
Mass loading of all particulates from leafy vegetable field:
.0001
grams/m?
Respirable fraction from leafy vegetable field:
1
Mass loading of all particulates from pasture and silage field:
.0001
grams/m?
Respirable fraction from pasture and silage field:
1
Mass loading of all particulates from feed grain field:
.0001
grams/m?
Respirable fraction from feed grain field:
1
Mass loading of all particulates from offsite dwelling:
.0001
grams/m?
Respirable fraction from offsite dwelling:
1
Indoor to outdoor dust concentration ratio:
.4
External gamma penetration factor:
.7
Shape of Primary Contamination
Occupancy Factors
Save
Cancel

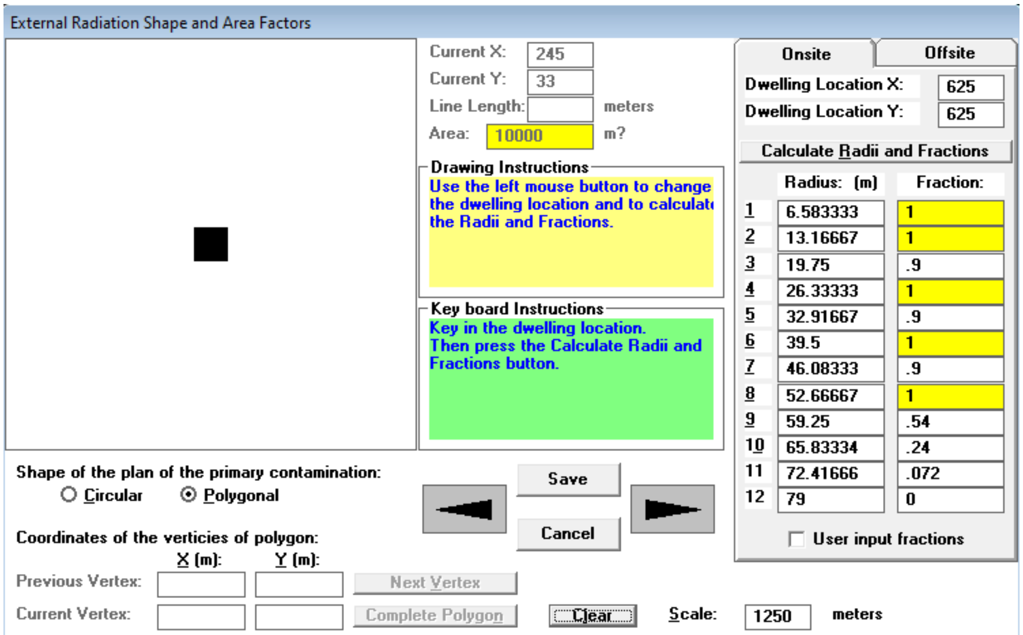
11.53 TEST CASE 034-029

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-029
Test Summary	Test the functionality of Shape Factors form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Shape Factors form.

Procedure

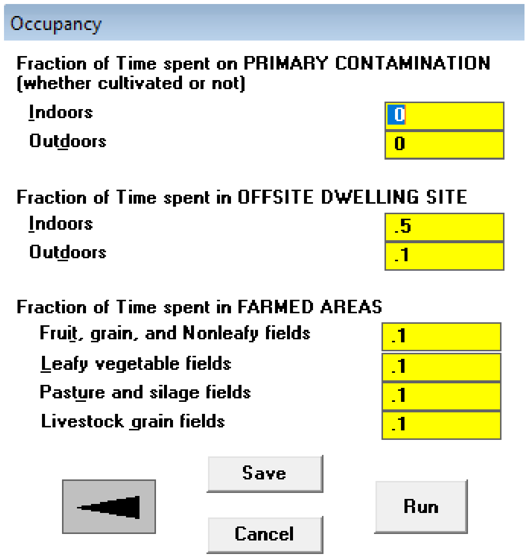
1) Open Shape Factors form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.
2) It should have the same input boxes as the figure has.
3) Select Onsite tab on the right panel.
4) Select Circular for Shape of the primary contamination, a circle should appear in the center. Click “Calculate Radii and Fractions”, and the code should calculate and list the results in the table in right panel.
5) Click Clear. The left panel should become blank.
6) Select Polygonal for Shape of primary contamination. Generate a polygon on the left panel using mouse. The button “Calculate Radii and Fractions” should be available should become available upon a polygon is generated. Click it and the results should be listed in the table.
7) Select Offsite tab on the right panel, and repeat Steps 4-6.
8) Save the form, and then save the project to Test41.rof.
9) Check the variable RAD_SHAPE in the generated input file; its value should be same as the calculated ones in the GUI.

Required Data	None.
Expected Results	The code should behave as described in each step.


External Radiation Shape and Area Factors
Current X: 245
Current Y: 33
Line Length: meters
Area: 10000 m?
Drawing Instructions
Use the left mouse button to change the dwelling location and to calculate the Radii and Fractions.
Key board Instructions
Key in the dwelling location. Then press the Calculate Radii and Fractions button.
Onsite
Offsite
Dwelling Location X: 625
Dwelling Location Y: 625
Calculate Radii and Fractions
Radius: (m)
Fraction:
1 6.583333 1
2 13.16667 1
3 19.75 .9
4 26.33333 1
5 32.91667 .9
6 39.5 1
7 46.08333 .9
8 52.66667 1
9 59.25 .54
10 65.83334 .24
11 72.41666 .072
12 79 0
User input fractions
Shape of the plan of the primary contamination:
Circular
Polygonal
Save
Cancel
Coordinates of the verticies of polygon:
X (m):
Y (m):
Previous Vertex:
Current Vertex:
Next Vertex
Complete Polygon
Clear
Scale: 1250 meters

11.54 TEST CASE 034-030

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-030
Test Summary	Test the functionality of Occupancy form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Occupancy form.
Procedure	1) Select Ac-227 in the Initial Concentrations form. 2) Open Occupancy form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value. 3) It should have the same input boxes as the figure has. 4) Modify at least three values, save the form, and then save the project as Test42.rof. 5) Check the following variables in the generated file; they should be the same as the inputs in GUI. FIND, FOTD, FINDDWELL, FOTDDWELL, OCCUPANCY(1) -(4) 6) Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.
Required Data	None.
Expected Results	The code should behave as described in each step.


Occupancy
Fraction of Time spent on PRIMARY CONTAMINATION
(whether cultivated or not)
Indoors
0
Outdoors
0
Fraction of Time spent in OFFSITE DWELLING SITE
Indoors
.5
Outdoors
.1
Fraction of Time spent in FARMED AREAS
Fruit, grain, and Nonleafy fields
.1
Leafy vegetable fields
.1
Pasture and silage fields
.1
Livestock grain fields
.1
Save
Cancel
Run

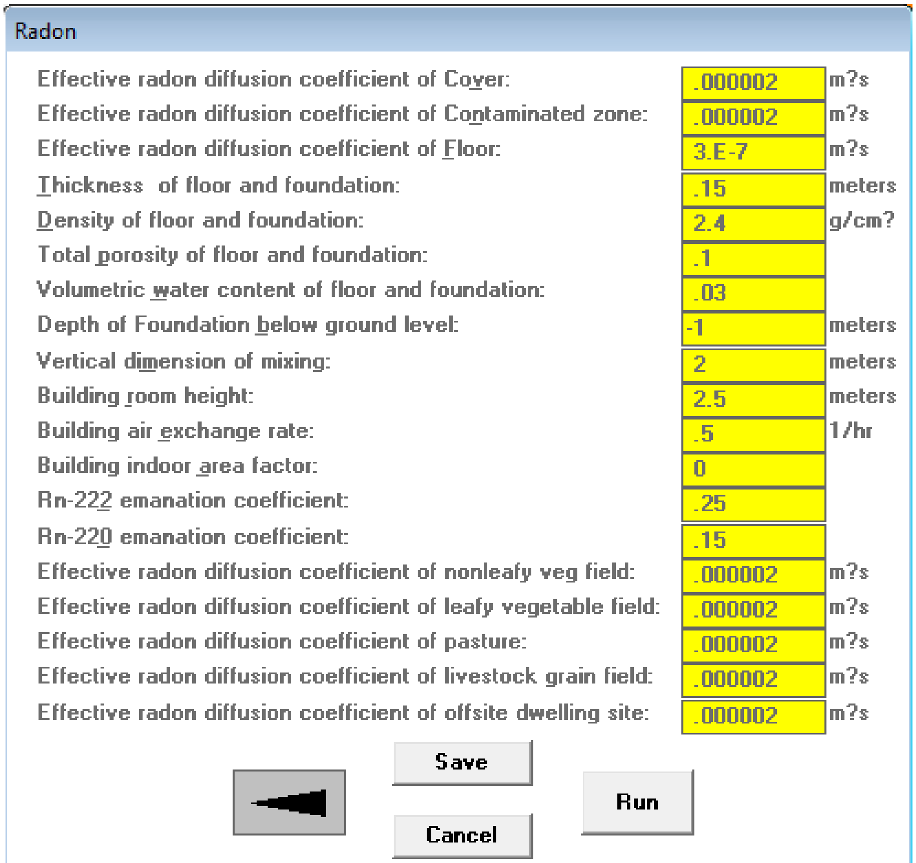
11.55 TEST CASE 034-031

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-002
Test Summary	Test the functionality of Radon form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Radon form.

Procedure

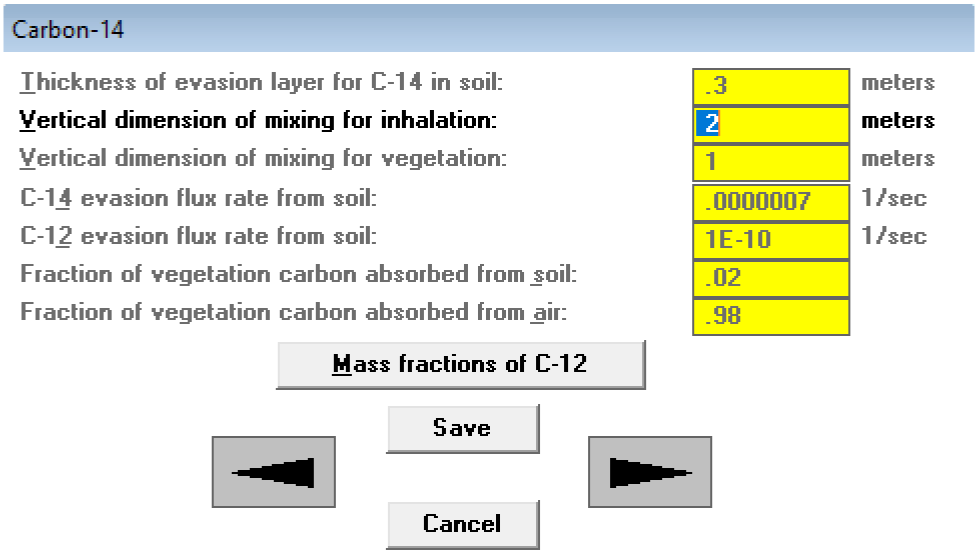
1) Open Radon form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.
2) It should have the same input boxes as the figure has.
3) All the input boxes in this form should be grayed out unless a radon parent Rn-222 or Rn-220 is present in the contamination radionuclide list.
4) Close the form. Select U-238 from the Initial Concentrations form and then turn on Radon pathway.
5) Open Radon form again; it should be available for modification now.
6) Modify at least three values, save the form, and then the project to Test43.rof.
7) Check the following variables in the generated file; they should be the same as the inputs in GUI. DIFCV, DIFCZ, DIFOS(1), DIFOS(2), DIFOS(3), DIFOS(4), DIFOS(5), DIFFL, FLOOR1, DENSFL, TPFL, PH2OFL, DMFL, HMIX, HRM, REXG, FAI, EMANA(1), EMANA(2)
8) Open the form again. Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.

Required Data	None.
Expected Results	The code should behave as described in each step.


Radon
Effective radon diffusion coefficient of Cover:
.000002
m?s
Effective radon diffusion coefficient of Contaminated zone:
.000002
m?s
Effective radon diffusion coefficient of Floor:
3.E-7
m?s
Thickness of floor and foundation:
.15
meters
Density of floor and foundation:
2.4
g/cm?
Total porosity of floor and foundation:
.1
Volumetric water content of floor and foundation:
.03
Depth of Foundation below ground level:
-1
meters
Vertical dimension of mixing:
2
meters
Building room height:
2.5
meters
Building air exchange rate:
.5
1/hr
Building indoor area factor:
0
Rn-222 emanation coefficient:
.25
Rn-220 emanation coefficient:
.15
Effective radon diffusion coefficient of nonleafy veg field:
.000002
m?s
Effective radon diffusion coefficient of leafy vegetable field:
.000002
m?s
Effective radon diffusion coefficient of pasture:
.000002
m?s
Effective radon diffusion coefficient of livestock grain field:
.000002
m?s
Effective radon diffusion coefficient of offsite dwelling site:
.000002
m?s
Save
Cancel
Run

11.56 TEST CASE 034-032

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-34-032
Test Summary	Test the functionality of Carbon-14 form
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Carbon-14 form.
Procedure	1) Open Carbon-14 form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value. 2) It should have the same input boxes as the figure has. 3) All the input boxes in this form should be grayed out unless C-14 is present in the contamination radionuclide list. 4) Select C-14 from the Initial Concentrations form. 5) Open Carbon-14 form again; it should be available for modification now. 6) Clicking Mass fractions of C-12 should bring up Mass fractions of C-12 form. 7) Modify the Vertical dimension of mixing for inhalation, save the form, and then the project to Test44.rof. 8) Check the following variables in the generated file; they should be the same as the inputs in GUI. DMC, HMIXV, C14EVSN, C12EVSN, CAIR, CSOIL
Required Data	None.
Expected Results	The code should behave as described in each step.


Carbon-14
Thickness of evasion layer for C-14 in soil:
.3
meters
Vertical dimension of mixing for inhalation:
2
meters
Vertical dimension of mixing for vegetation:
1
meters
C-14 evasion flux rate from soil:
.0000007
1/sec
C-12 evasion flux rate from soil:
1E-10
1/sec
Fraction of vegetation carbon absorbed from soil:
.02
Fraction of vegetation carbon absorbed from air:
.98
Mass fractions of C-12
Save
Cancel

11.57 TEST CASE 034-033

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-033

Test Summary Test the functionality of Mass fraction of C-12 form

Created By/Date CW 10/17/2019

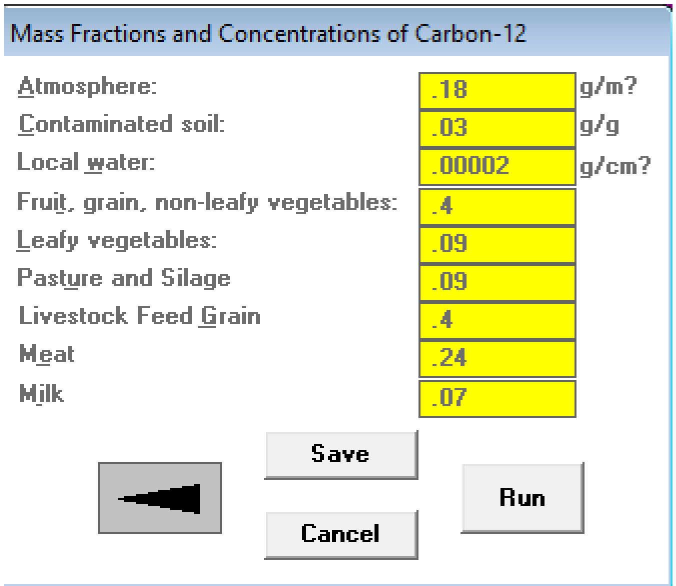
Test Objective To test the functionality of Mass fraction of C-12 form.

Procedure

1) Open Mass fraction of C-12 form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a changed value.
2) It should have the same input boxes as the figure has.
3) Select C-12 from the Initial Concentrations form.
4) Open Mass fraction of C-12 form again.
5) Save the form, and then the project to Test45.rof.
6) Check the following variables in the generated file; they should be the same as the inputs in GUI. C12AIR, C12CZ, C12WTR, C12PLANT(1), C12PLANT(2), C12PLANT(3), C12PLANT(4), C12MEAT_MILK(1), C12MEAT_MILK(2)
7) Open the form again. Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.

Required Data None.

Expected Results The code should behave as described in each step.


Mass Fractions and Concentrations of Carbon-12
Atmosphere:
.18
g/m?
Contaminated soil:
.03
g/g
Local water:
.00002
g/cm?
Fruit, grain, non-leafy vegetables:
.4
Leafy vegetables:
.09
Pasture and Silage
.09
Livestock Feed Grain
.4
Meat
.24
Milk
.07
Save
Cancel
Run

11.58 TEST CASE 034-034

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-34-034

Test Summary Test the functionality of H-3 form

Created By/Date CW 10/17/2019

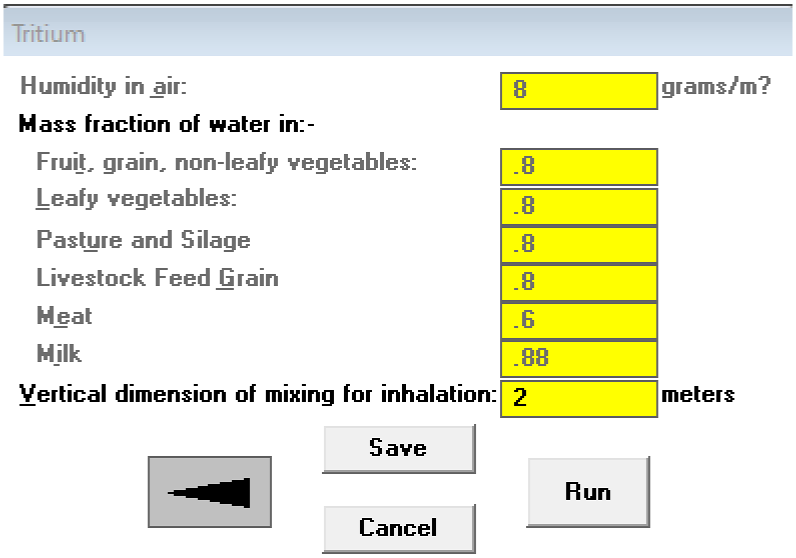
Test Objective To test the functionality of H-3 form.

Procedure

1) Select H-3 from the Initial Concentrations form.
2) Open H-3 form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.
3) It should have the same input boxes as the figure has.
4) Modify the Vertical dimension of mixing for inhalation, save the form, and then the project to Test46.rof.
5) Check the following variables in the generated file; they should be the same as the inputs in GUI. HUMID, H2OPLANT(1), H2OPLANT(2), H2OPLANT(3), H2OPLANT(4), H2OMEAT_MILK(1), H2OMEAT_MILK(2), HMX
6) Open the form again. Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.

Required Data None.

Expected Results The code should behave as described in each step.


Tritium
Humidity in air:
8
grams/m?
Mass fraction of water in:-
Fruit, grain, non-leafy vegetables:
.8
Leafy vegetables:
.8
Pasture and Silage
.8
Livestock Feed Grain
.8
Meat
.6
Milk
.88
Vertical dimension of mixing for inhalation:
2
meters
Save
Cancel
Run

11.59 TEST CASE 035-001

Project	**RESRAD-OFFSITE**
Test Case ID	**RESOFF-TEST-35-001**
Test Summary	Test if sub-menus File->New and Save work correctly
Created By/Date	CW 10/17/2019
Test Objective	To test GUI menu File|New/Save

Procedure

1) Make sure the application path in .ini file points to the application folder
2) Launch the code. Remember the main window caption, say Site1.ROF" for example.
3) Click File -> New. A new window with caption "Title & Radiological Data" should pop up.
4) Change the Title text box to: test menu File -> New/Save, then click "Close" button. The pop-up windows should be closed.
5) Click Set Pathways button on the left navigation panel, then check if all the pathways except Radon are on. If any is off, this test is failed.
6) Click Modify Data button from the left navigation panel, open the following forms in order and check if all the text box background is in yellow. If not, this test is failed.
   - I. Preliminary Inputs
   - II. Release Times
   - III. Initial Concentrations (check if the values in the top box is 100 pCi/g contaminated zone).
   - IV. Reporting times
   - V. Storage times
   - VI. Site Layout
   - VII. Physical and Hydrological
   - VIII. Primary contamination
   - IX. Sediment Delivery Ratio
   - X. Agricultural areas
   - XI. Livestock areas
   - XII. Dwelling site

XIII. Atmospheric transport
XIV. Water use
XV. Unsaturated zones
XVI. Saturated zones
XVII. Groundwater Transport
XVIII. Surface water transport
XIX. Surface water body
XX. Ingestion rates
XXI. Plant factors
XXII. Livestock intakes
XXIII. Livestock feed factors
XXIV. Inhalation, gamma
XXV. Shape factors
XXVI. Occupancy
XXVII. Radon
XXVIII. Carbon-14
XXIX. Mass fraction of C-12
XXX. H-3

7) Click File -> Save
8) Go to UserFiles folder under the application folder and open Site1.ROF file.
9) Check if files "Site1.ROF" and "Site1.CHN" are created
10) Open "Site1.ROF" and check if Variable Title = "test menu File -> New/Save"
11) IF so, this test is passed, otherwise, failed.
12) Repeat Steps 1-5 using icon "New" from tool bar.
13) Click icon "Save" from tool bar, and then Steps 8-10.
14) Repeat Steps 12 using keyboard Ctrl + S rather than tool bar, and then Step 13.

Required Data None.

Expected Results A new project can be generated from File|New, tool bar icon, and hotkey, and all the initial values are default values.

The generated input can be saved from File|Save, tool bar icon, and hotkey Ctrl + S, with correct values.

11.60 TEST CASE 035-002

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-35-002s
Test Summary	Test if submenus File->Open and Save As work correctly
Created By/Date	CW 10/17/2019
Test Objective	To test menu File|Open/Save as.

Procedure

1) Launch the code
2) Click File -> Open. A new window should pop up, requesting user to select which file to open. The default file location should be the folder where the input file was read to run the code last time.
3) Go to the QAFiles folder and select the file with name ending with "US.ROF", and click Open.
4) The main interface should update after loading the input file. Check if the caption of the window is the same as the input file name.
5) Click Modify Data from left navigation panel and then Initial Concentration button, and check if the unit is conventional unit in the pop-up window. If not, this test is failed.
6) Click File -> Save as. A new window should pop out and the default path in the address box should be the QAFiles. If not, this test is failed. Change to UserFiles folder
7) Type "Test002" in the File name box and click Save. A file named Test002.rof should be saved in the UserFiles folder.
8) Go to UserFiles folder and compare file Test002.rof with the original file. They should be identical. If not, this test is failed.
9) Repeat Steps 1-8 using Open icon in Tool bar.
10) Repeat Steps 1-8 using keys Ctrl + O.
11) Copy the QAFiles folder to a USB drive and repeat Steps 1-8.

Required Data	QAFiles folder in the installation.

11.61 TEST CASE 035-003

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-35-003
Test Summary	Test if the submenu File-> Title works correctly.
Created By/Date	CW 10/17/2019
Test Objective	To test menu File|Title.
Procedure	1) Launch the code. 2) Click File -> New. A new window with caption "Title & Radiological Data" should pop up. 3) Change the Title text box to: test menu Title, then click "Close" button. The pop-up windows should be closed. 4) Click File -> Save as, change the file address to UserFiles under the application folder, and type "Test003" in the File name box in the pop-up window. 5) Open "Test003.ROF" and check if Variable Title = "test menu Title" 6) IF so, this test is passed, otherwise, failed. 7) Repeat Steps 1-6 using hotkey Ctrl + T.
Required Data	None
Expected Results	The project tile should be able to be changed and saved correctly into the input file.

11.62 TEST CASE 035-004

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-35-004
Test Summary	Test if the DCF Editor can be called successfully from the menu of GUI.
Created By/Date	CW 10/17/2019
Test Objective	To test DCF Editor from GUI
Procedure	1) Launch the code 2) Click File -> DCF Editor. The DCF Editor interface should pop up. 3) Close the DCF Editor. 4) Click Modify Data from the left navigation panel and then Initial Concentration. 5) Select "Ac-227" in the pop-up Initial Concentration window. 6) Click File->Run 7) Repeat Step 2 and check if the DCF Editor pops up correctly.
Required Data	None.
Expected Results	The DCF Editor should be called from the GUI menu at the beginning phase of using code and in any phase of running the code.

11.63 TEST CASE 035-005

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-35-005
Test Summary	Test the menu Help works appropriately.
Created By/Date	CW 10/17/2019
Test Objective	To test menu Help.

Procedure

1) Launch the code.
2) Click Help-> Context Sensitive Help, the RESRAD-OFFSITE Help file should pop up.
3) Click "Ambient Temperature", "Darcy Velocity", and "Wind Speed", respectively, from the left panel under Tab Contents. The associated content should accordingly present on the right panel after each click.
4) Close RESRAD-OFFSITE Help file by clicking mark X on the top right corner of the window.
5) Press F1 at the main interface, the RESRAD-OFFSITE Help file should pop up. Repeat Steps 3 and 4.
6) Click Change Title from left navigation panel, put the cursor in Cut-off half life box in the pop-up Title & Radiological Data window, and then Press F1, the help file should pop up with the specific page "Half life limit for principle radionuclides" page open. Close the help file.
7) Click Modify Data -> Primary Contamination, and put the cursor in the Box Depth of soil mixing layer. Pressing F1 should open the Help file with Page "Depth of Soil Mixing Layer" open.
8) Click Modify Data -> Occupancy, and then put the cursor in Box Indoors on the top of the pop-out Occupancy window. Pressing F1 should open the Help file with page "Fraction of Time Spent Indoors Open Primary Contamination" open.
9) From the main interface, click Help -> User's Guide. A PDF file named UsersGuild.pdf should pop out. Close it.
10) Repeat Step 9 by pressing F3.
11) Click Help -> User's Technical Manual. A PDF file named UsersManuel.pdf should pop out. Close it.

12) Repeat Step 11 by pressing F4.

13) From the main interface, click Help -> About RESRAD-OFFSITE. The About RESRAD-OFFSITE should pop up.

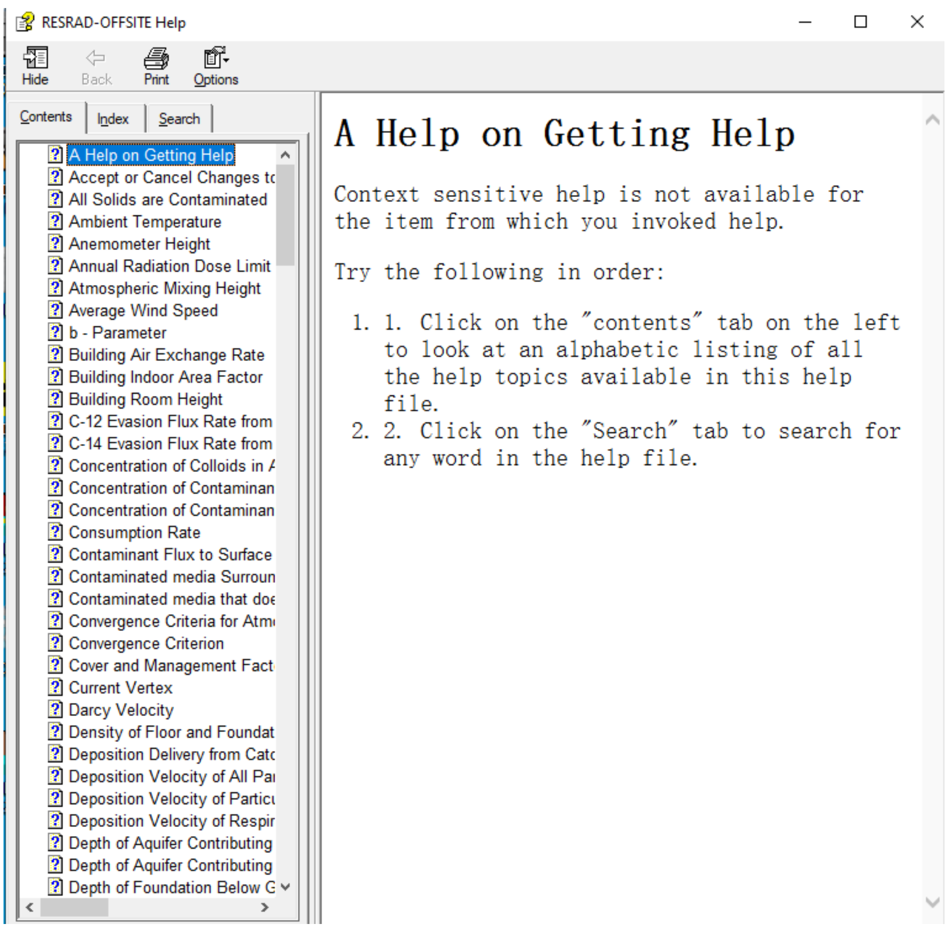
14) Close all the windows.

Required Data None

Expected Results The GUI should be able to open the Help file from menu and open a specific help page by press F1 with the cursor focusing on a particular variable input box.

The GUI should be able open User's Guide and User's Manual file from help menu or by pressing F3/F4 key at any window.

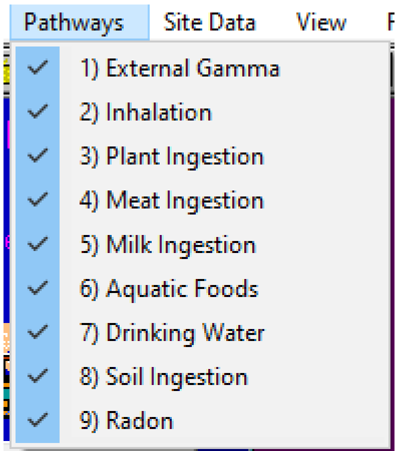
Help menu should be able to open About RESRAD-OFFSITE window.



11.64 TEST CASE 035-006

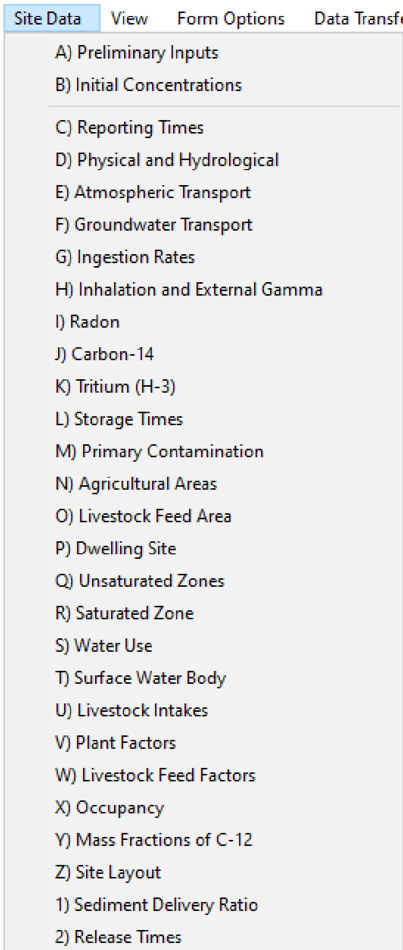
Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-35-006
Test Summary	Test the functionality of Pathways menu.
Created By/Date	CW 10/17/2019
Test Objective	To Test the functionality of Pathways menu.
Procedure	1) Launch the code and clicking Set Pathways form the left panel. By default, all the pathways should be on except Radon pathway. 2) Select U-238 from Initial Concentrations form. 3) Click Pathways from the menu 4) Click all the press buttons one by one, the check marker in front of nine pathways should go away and the pathway icons should present an off marker in the Set pathways form. 5) Click all the press buttons one by one again to turn on all the pathways. The check marker in front of nine pathways in Pathways menu should appear again and the off marker on the pathway icons in the Set pathways form should go away. 6) Turn off all the pathways again except external pathway. 7) Save the input to file Test47.rof. 8) Open the input file Test47.rof from notepad, and should see SELPATH = 1, indicating only external pathway is selected. 9) Open project Test47.rof, and turn on Radon pathway. Save the file and Save the project again. 10) Check TEST011.rof and the variable SELPATH should be 257.
Required Data	None.
Expected Results	Pathway form should be opened and closed from the menu. Pathways can be turned on and off by pressing either the press buttons or the pathway icons.

The selection of pathways should be correctly written into the input file and echoed in the report file.



11.65 TEST CASE 035-007

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-35-007
Test Summary	Test the functionality of Site Data menu
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Site Data menu.
Procedure	1) Launch the code and click Site Data menu. It should look like the attached figure. Visually check the format, fonts, and spelling. 2) Clicking the submenus one by one should open the corresponding form.
Required Data	None.
Expected Results	The code should behave as described in each step.


Site Data
View
Form Options
Data Transfe
A) Preliminary Inputs
B) Initial Concentrations
C) Reporting Times
D) Physical and Hydrological
E) Atmospheric Transport
F) Groundwater Transport
G) Ingestion Rates
H) Inhalation and External Gamma
I) Radon
J) Carbon-14
K) Tritium (H-3)
L) Storage Times
M) Primary Contamination
N) Agricultural Areas
O) Livestock Feed Area
P) Dwelling Site
Q) Unsaturated Zones
R) Saturated Zone
S) Water Use
T) Surface Water Body
U) Livestock Intakes
V) Plant Factors
W) Livestock Feed Factors
X) Occupancy
Y) Mass Fractions of C-12
Z) Site Layout
1) Sediment Delivery Ratio
2) Release Times

11.66 TEST CASE 035-008

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-35-008
Test Summary	Test the functionality of View menu
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of View menu.

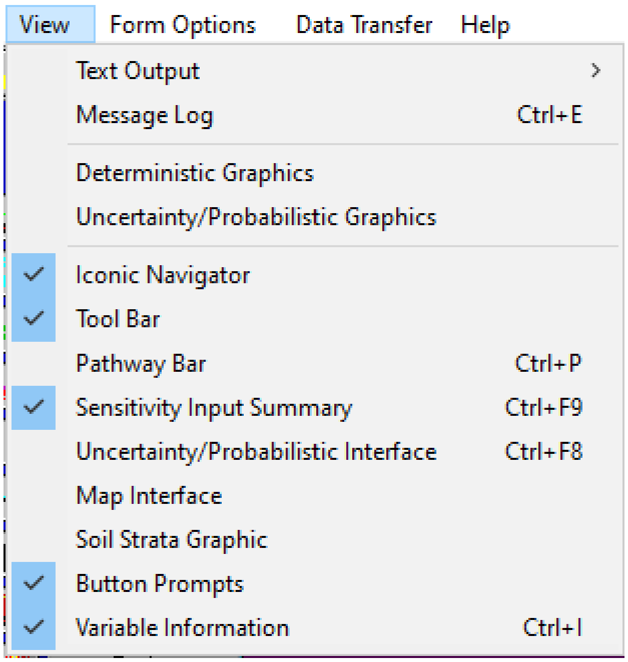
Procedure

1) Launch the code and click View menu. It should look like the attached figure. Visually check the format, fonts, and spelling.
2) Select U-238 and run the code.
3) Clicking Message Log should open OUTPUT.FIL file from Viewer.
4) Clicking Deterministic Graphics should open the graphics from WRESPLOT.EXE
5) Clicking Uncertainty/Probabilistic Graphics should bring up the Uncertainty and Probabilistic Analysis interactive window.
6) Clicking Iconic Navigator toggle Iconic Navigator window on the upper right corner of the main interface, and clicking it again should turn it on.
7) Clicking Tool Bar should toggle the tool bar between on and off.
8) Clicking Pathway Bar should toggle the pathway bar right under the main tool bar between on and off.
9) Clicking Sensitivity Input Summary should toggle the sensitivity variable list at the bottom left corner of the main interface between on and off.
10) Clicking Uncertainty/Probabilistic Interface should toggle the Uncertainty and Probabilistic Analysis interactive window between on and off.
11) Clicking Map Interface should toggle the Map Interface window between on and off.
12) Clicking Soil Strata Graphic should toggle the Soil Strata form between on and off
13) Turing on Button Prompts will display a descriptive name as the cursor lingers over the button on tool bar or iconic navigator.
14) Turning on Variable information will display the variable name, default value, and range of allowable value at the bottom of the main interface. Turn it on by clicking the submenu, and then open the Surface Water Body form. Put the cursor on Area of surface water body.

At the bottom of the windows should display the following information "Variable name: VLAKE   Default: 150000   Range: 1 to 1E34"

Required Data None.

Expected Results The code should behave as described in each step.



11.67 TEST CASE 035-009

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-35-009

Test Summary Test the functionality of Text Output menu

Created By/Date CW 10/17/2019

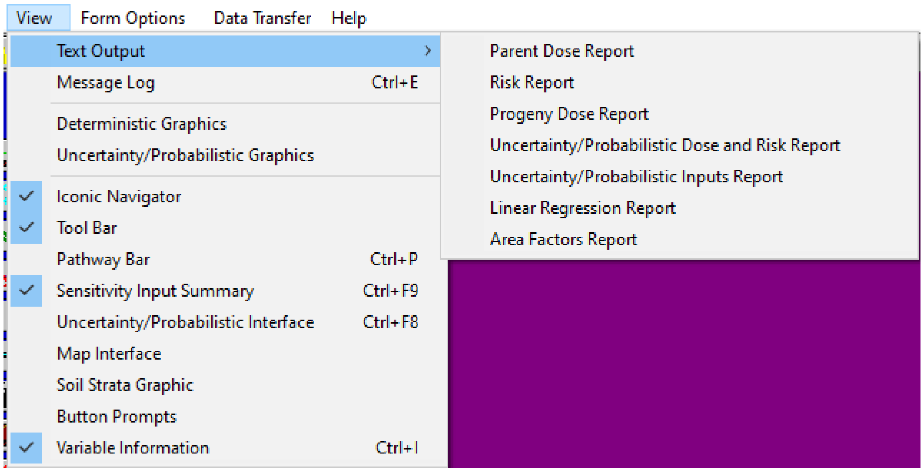
Test Objective To test the functionality of Text Output menu.

Procedure

1) Launch the code and click View menu. It should look like the attached figure. Visually check the format, fonts, and spelling.
2) Select U-238 and run the code.
3) Clicking menu View -> Text Output -> Parent Dose Report should open Summary.rep by Viewer.
4) Clicking View -> Text Output -> Risk Report should open INTRISK.REP by Viewer.
5) Clicking View -> Text Output -> Progeny Dose Report should open DAUDOSE.REP by Viewer.
6) Set up a parameter for uncertainty analysis and then run the code. Clicking View -> Text Output -> Uncertainty/Probabilistic Dose and Risk Report should open MCSUMMAR.REP by Viewer.
7) Generate area factors from File|Generate area factors. Clicking View -> Text Output -> Area Factors Report should open AREAFACTORTEXT.REP by Viewer.

Required Data None.

Expected Results The code should behave as described in each step.


View
Form Options
Data Transfer
Help
Text Output
Message Log Ctrl+E
Deterministic Graphics
Uncertainty/Probabilistic Graphics
Iconic Navigator
Tool Bar
Pathway Bar Ctrl+P
Sensitivity Input Summary Ctrl+F9
Uncertainty/Probabilistic Interface Ctrl+F8
Map Interface
Soil Strata Graphic
Button Prompts
Variable Information Ctrl+I
Parent Dose Report
Risk Report
Progeny Dose Report
Uncertainty/Probabilistic Dose and Risk Report
Uncertainty/Probabilistic Inputs Report
Linear Regression Report
Area Factors Report

11.68 TEST CASE 035-010

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-35-010

Test Summary Test the functionality of Form Options menu

Created By/Date CW 10/17/2019

Test Objective To test the functionality of Form Options menu.

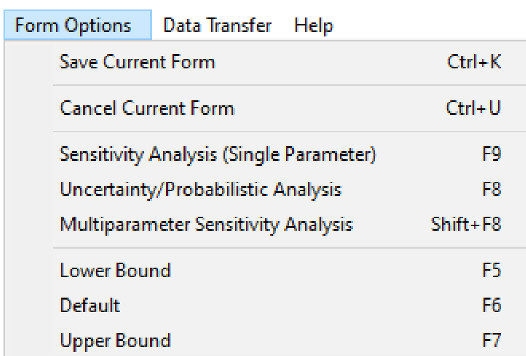
Procedure

1) Launch the code and click Form Options menu. It should look like the attached figure. Visually check the format, fonts, and spelling.
2) Open Initial Concentration form and select Ac-227, then click Form Options -> Save Current Form. The form should be closed. Open the form again and check if Ac-227 is selected with concentration of 100 pCi/g.
3) From Initial Concentration from, click Nuclide Specific Release button and the form should pop up. Change the value of "Specify the First Order Leach Rate Constant" from 0 to 10, then click Form Option -> Cancel Current Form button. The Radionuclide Specific Release form should be closed. Open it and check if the value of "Specify the First Order Leach Rate Constant" is 0, rather than 10.
4) Change the value 0 in Step 3 to 10, then save and close the Radionuclide Specific Release form. Open the form again, the value should be 10, rather than 0. Clicking Form Option -> Cancel Current Form button should close this form. Open it and check the value gain; it should be 10 rather than 0.
5) Restore the value to 0 by pressing F6 on the text box and click Save to close the Radionuclide Specific Release form. At this time, the Initial Concentration should still be open.
6) Clicking Form Option -> Cancel Current Form button should pop up a warning window with message "Changes to the Initial Concentration form cannot be canceled. Changes have to be reserved manually." Click Ok and close the pop-up windowm.
7) Open Distribution Coefficients form, put cursor focus on the Contaminated zone text box with default value of 20, then click Form Options|Sensitivity Analysis (Single Parameter) menu, the Set Sensitivity Analysis Range window should pop up. Click Cancel to close the form.

8) Open Distribution Coefficients form, put the cursor on the Unsaturated Zone 1 text box, and click Form Options|Uncertainty/Probabilistic Analysis menu. Uncertainty and Probabilistic Analysis window should pop up. Click Ok to close the window.
9) Open Physical and Hydrological form, put cursor on Precipitation text box, and the click Form Options|Uncertainty/Probabilistic Analysis menu. Uncertainty and Probabilistic Analysis window should pop up again with one more variable present on the left panel. Click OK to close the form.
10) Change the value of the Unsaturated Zone 1 text box to 10, and its background color should change to white. Click Form Options Form|Default, the default value (20) should replace the current value. Clicking Form Options Form|Lower Bound should change the value to its minimum allowable value and clicking Form Options Form|Upper Bound should change the value to its maximum allowable value.
11) Repeat Steps 1-10 using hot-keys listed on the right of the submenus.

Required Data None.

Expected Results The code should behave as described in each step.



11.69 TEST CASE 035-011

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-35-011

Test Summary Test the functionality of Data Transfer menu.

Created By/Date CW 10/17/2019

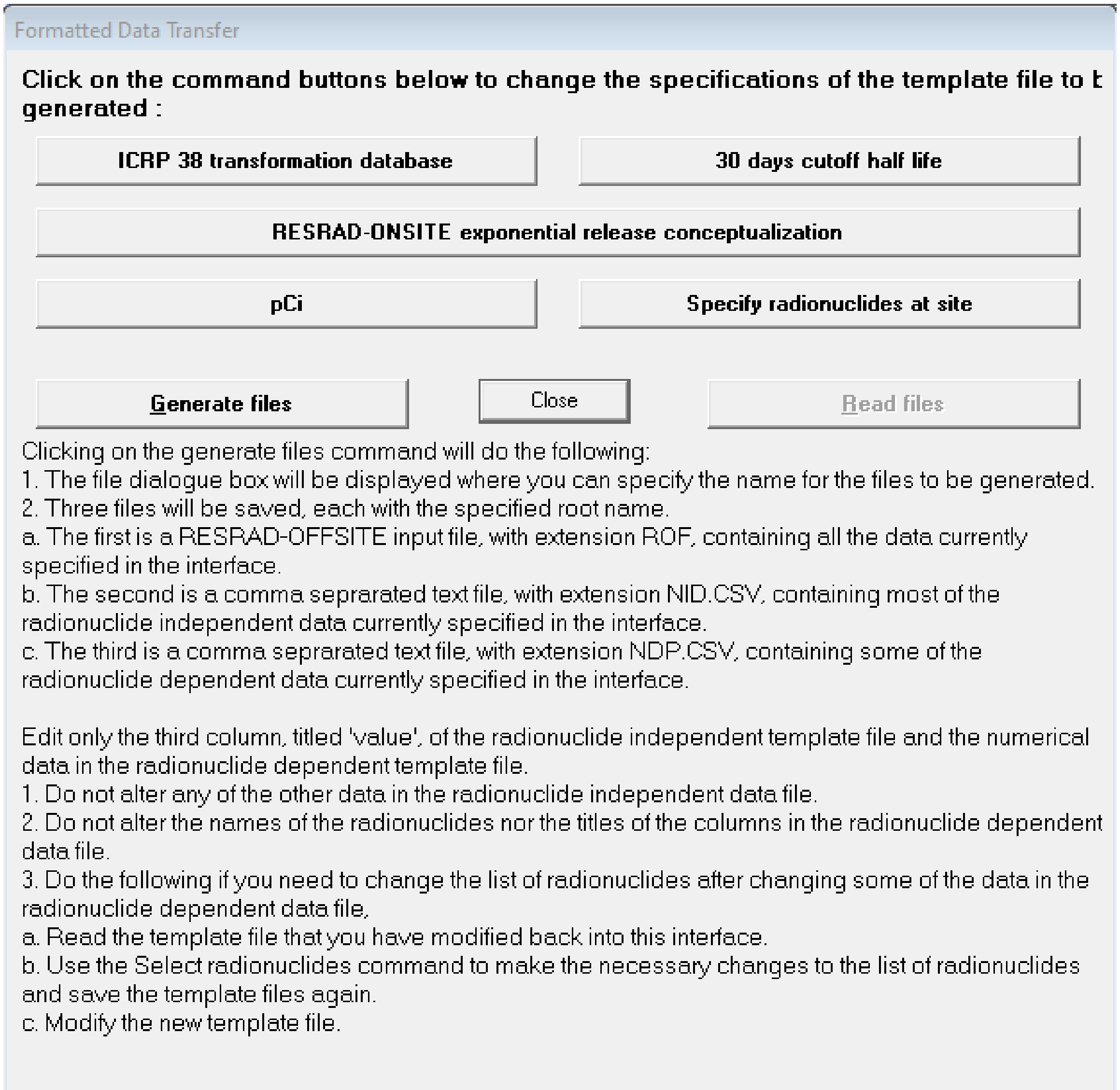
Test Objective To test the functionality of Data Transfer menu.

Procedure

1) Launch the code and save the project to Test55.rof.
2) Clicking Data Transfer|Generate Template files menu should bring up the Formatted Data Transfer form, as shown in the left figure.
3) Click Generate files button and give a name Test55-1.rof on the pop-up Save as window. Close the Formatted Data Transfer form.
4) Compare Test55.rof and Test55-1.rof. They should be identical.
5) Clicking Data Transfer|Read Template files should bring up the Formatted Data Transfer form with Read files button available for clicking.
6) Clicking Read files and select Test55-1.rof. A message window with warning message should popup. Click OK and then close the Formatted Data Transfer form.
7) Test55-1.rof should be loaded.

Required Data None.

Expected Results The code should behave as described in each step.



Formatted Data Transfer
Click on the command buttons below to change the specifications of the template file to b generated :
ICRP 38 transformation database
30 days cutoff half life
RESRAD-ONSITE exponential release conceptualization
pCi
Specify radionuclides at site
Generate files
Close
Read files
Clicking on the generate files command will do the following:
1. The file dialogue box will be displayed where you can specify the name for the files to be generated.
2. Three files will be saved, each with the specified root name.
a. The first is a RESRAD-OFFSITE input file, with extension ROF, containing all the data currently specified in the interface.
b. The second is a comma seprarated text file, with extension NID.CSV, containing most of the radionuclide independent data currently specified in the interface.
c. The third is a comma seprarated text file, with extension NDP.CSV, containing some of the radionuclide dependent data currently specified in the interface.
Edit only the third column, titled 'value', of the radionuclide independent template file and the numerical data in the radionuclide dependent template file.
1. Do not alter any of the other data in the radionuclide independent data file.
2. Do not alter the names of the radionuclides nor the titles of the columns in the radionuclide dependent data file.
3. Do the following if you need to change the list of radionuclides after changing some of the data in the radionuclide dependent data file,
a. Read the template file that you have modified back into this interface.
b. Use the Select radionuclides command to make the necessary changes to the list of radionuclides and save the template files again.
c. Modify the new template file.

11.70 TEST CASE 035-012

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-35-012

Test Summary Test the GUI's input functionality from control level.

Created By/Date CW 10/17/2019

Test Objective To test the GUI's input functionality from control level.

Procedure

1) Run the code and open the forms to be tested.
2) Check the overall layout and spelling of the form.
3) For each control (frame, text box, label.), check the following if applicable
   a. Spelling and legibility
   b. Alignment, size, and dimensions are appropriate.
   c. Whether the default values are loaded before any modification
   d. Whether the background of textbox is in yellow when default value is present and white when it is nondefault value.
   e. Check key F5, F6, F7 can restore the value to its minimum, default, and maximum
   f. Check its error checking function
      i. input a very small value (e.g., a negative value). An error message should present upon saving/closing the form with three options: change the currently input value to the lower bound of the variable, change to default value, and reentering the value.
      ii. input a very large number (e.g., 1e100 or 1.5 for fractions). An error message should present upon saving/closing the form with three options: change the current input value to the upper bound of the variable, change to default value, and reenter the value.
   g. Check if help works for this control. Put the cursor on the control and press F1 key, the help file should pop up, opening to the content for the specified variable.
   h. Check if the unit is consistent with the setting in Preliminary Input
4) Each control should respond correctly to actions.

Required Data None.

Expected Results The code should behave as described in each step.

11.71 TEST CASE 036-001

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-36-001
Test Summary	Test the Help file works appropriately.
Created By/Date	CW 10/17/2019
Test Objective	To test Help file.
Procedure	1) Launch the code and open the Help file from the main interface. 2) It should have Contents, Index, and Search elements. 3) It should include help information for parameters as shown in the figure. 4) Click "Contaminant Flux to Surface Water Body" and then click two places on the right panel where the text shows a hyperlink. The help file page associated with the text should open. 5) Click Search tab on the left panel, the type "precipitation" in the search bar and press Enter, then topics including the searching word should be listed in lower left panel. Clicking one should bring its content to the right panel.
Required Data	None
Expected Results	The Help file should have all the required content and functions.

- A Help on Getting Help
- Accept or Cancel Changes to Map Interface
- All Solids are Contaminated
- Ambient Temperature
- Anemometer Height
- Annual Radiation Dose Limit
- Atmospheric Mixing Height
- Average Wind Speed
- b - Parameter
- Building Air Exchange Rate
- Building Indoor Area Factor
- Building Room Height
- C-12 Evasion Flux Rate from Soil
- C-14 Evasion Flux Rate from Soil
- Concentration of Colloids in Aquifer
- Concentration of Contaminants in Surface Water
- Concentration of Contaminants in Well Water
- Consumption Rate
- Contaminant Flux to Surface Water Body
- Contaminated media Surrounded by Clean soil
- Contaminated media that does not Conduct Moisture Surrounded by Clean soil
- Convergence Criteria for Atmospheric Deposition
- Convergence Criterion
- Cover and Management Factor
- Current Vertex
- Darcy Velocity
- Density of Floor and Foundation
- Deposition Delivery from Catchment
- Deposition Velocity of All Particulates
- Deposition Velocity of Particulates to Compute Atmospheric Release
- Deposition Velocity of Respirable Particulates
- Depth of Aquifer Contributing to the Surface Water Body
- Depth of Aquifer Contributing to Well
- Depth of Foundation Below Ground Level
- Depth of Soil Mixing Layer
- Diffusion Coefficient of Radionuclide
- Dimensions of Contaminated Medium
- Direction of Ground Water Flow
- Direction of X-Axis
- Disperse Vertically or Not
- Dispersion Coefficient of Contaminant in Ground Water Transport
- Dispersion Model Coefficients
- Distance, Parallel to Aquifer Flow, from Contamination to Surface Water Body
- Distance, Parallel to Aquifer Flow, from Contamination to Well
- Distance, Perpendicular to Aquifer Flow, from Contamination to the Left Edge of the Surface Water Body
- Distance, Perpendicular to Aquifer Flow, from Contamination to the Right Edge of the Surface Water Body
- Distance, Perpendicular to Aquifer Flow, from Contamination to Well
- Distribution Coefficient
- Distribution Coefficient of Colloids
- Distribution Coefficient of Nuclides on Colloids
- Dose Conversion and Slope Factors
- Dose Conversion Factor Library
- Dry Bulk Density
- Dwelling Location
- Effective Diffusion Coefficient of the Radionuclide in the Contaminated Medium
- Effective Porosity
- Effective Radon Diffusion Coefficient
- Elevation of Offsite Receptor Location
- Equilibrium Desorption Transfer
- Equilibrium Dissolution Transfer
- Evapotranspiration Coefficient
- Exposure Duration
- Exposure Pathways
- External Gamma Penetration Factor
- Field Capacity
- First Order Rate Controlled Transfer
- Foliage-to-Food Transfer Coefficient
- Foliar Interception Factor for Dust
- Foliar Interception Factor for Irrigation
- Fraction of Agricultural Area Directly Over Primary Contamination
- Fraction of Food from the Contaminated Area
- Fraction of Radionuclide Bearing Material that is Releasable
- Fraction of Time Spent in Farmed Areas
- Fraction of Time Spent Indoors in Offsite Dwelling
- Fraction of Time Spent Indoors On Primary Contamination
- Fraction of Time Spent Outdoors in Offsite Dwelling Site
- Fraction of Time Spent Outdoors On Primary Contamination
- Fraction of Vegetation Carbon Absorbed from Air
- Fraction of Vegetation Carbon Absorbed from Soil
- Get Image of Map for Map Interface
- Grid Spacing for Atmospheric Transport
- Half Life Limit for Principal Radionuclides
- Horizontal Lateral Dispersivity of Saturated Zone
- Humidity in Air
- Hydraulic Conductivity
- Hydraulic Gradient
- Indoor Dust Filtration Factor
- Infiltration
- Infiltration Rate, Hydraulic Conductivity Check
- Mass Fraction of Stable Carbon in Plant
- Inhalation Dose Conversion Factor for Carbon-14
- Inhalation Rate
- Inhalation Slope Factor for Carbon-14
- Intake of Grain, Silage or Pasture by Livestock
- Intake of Soil with Grain, Silage or Paster by Livestock
- Irrigation Applied Per Year
- Joint Frequency of Wind Speed and Stability Class
- Land-Based Offsite Receptor Locations
- Launch Dose and Slope Factor Editor
- Leach Rate Constant
- Leach Rate Coefficient
- Length of Growing Season
- Length of Primary Contamination (in Direction Parallel to Aquifer Flow)
- Location of Dose, Slope and Transfer Factor Database
- Longitudinal Dispersivity in the Saturated Zone
- Longitudinal Dispersivity in the Unsaturated Zone
- Map Interface for Site Layout
- Mass Fraction of Stable Carbon in Meat
- Mass Fraction of Stable Carbon in Milk
- Mass Fraction of Water in Meat
- Mass Fraction of Water in Milk
- Mass Fraction of Water in Plant
- Mass Loading for Inhalation
- Mass Loading of All Particulates
- Mass Loading at Offsite Locations Same as at Primary Contamination
- Mass of Primary Contamination
- Mass and Volume of Contaminated Medium
- Minimum Time Increment
- Modeling Nuclide-Specif Retardation or Dispersion
- Modeling the Effects of Colloids In the Transport of the Contaminants
- Modeling Transport of Progeny Produced in Transit
- Modifying the Joint Frequency Data that Was Read in From a STAR File
- Model Multiple Forms of Contaminated Media
- Nuclide Concentration
- Nuclides in Database, List of
- Nuclides Present at the Site, List of
- Number of Catchments
- Number of Iterations for Equilibrium Solubility Transfer
- Number of Livestock Consuming Water
- Number of Main Sub Zones in Each Partially Saturated Zone
- Number of Main Sub Zones in a groundwater transport zone
- Number of Minor Subzones in Last Main Subzone
- Number of Individuals Consuming Water
- Number of Time Points
- Number of Unsaturated Zones
- Occupancy
- Onsite Vertical Dimension of Mixing
- Pore Water Velocity
- Porosity, Total
- Potential Evaporation from the Surface Water Body
- Precipitation
- Primary Contamination
- Radiological Activity
- Radiological Dose
- Radiological Transformation Database
- Radionuclide Bearing Material Becomes Releasable Temporally
- Radionuclide, Properties of
- Radionuclides become available for surface releases
- Radon Dose and Slope Factors
- Radon Emanation Coefficient
- Rainfall Erosion Index
- Rate of (Ground Water) Transport of Contaminant
- Read Meteorological STAR File
- Recharge Through and Ground Water Flow Under Primary Contamination Check
- Release Heat Flux
- Release Height
- Report Viewer
- Reporting Times
- Respirable Particulates as a Fraction of Total Particulates
- RESRAD-ONSITE Exponential Release Model
- Retardation Factor
- Retardation Factor Flag
- Root Depth
- Rsizing an Icon in the Map Interface
- Runoff Coefficient
- Save Input File when a Form is Saved
- Sector
- Sediment Delivery from Catchment
- Sediment Delivery Ratio
- Selecting the Dose Factor Library
- Selecting the Slope Factor Library
- Sensitivity Analysis
- Set Scale
- Settling Velocity of Sediment
- Shape and Dimensions of the Plan of the Primary Contamination for Direct Exposure
- Shape and Location Factor of Primary Contamination from Each Dwelling Location
- Shape of the Plan of the Primary Contamination
- SI (Metric) Prefixes
- Slope Factor Library
- Slope-Length-Steepness Factor
- Soil Erodibility Factor
- Soil Ingestion Rate
- Soluble Concentration
- Spacing of Time Points
- Specifying the Location of the Dwellings
- Specifying the Shape of the Primary Contamination
- Stable Carbon Concentration in Atmosphere
- Stable Carbon Concentration in Contaminated Soil
- Stable Carbon Concentration in Local Water
- Storage Times
- Stream outflow Fraction
- Submerged Fraction of Primary Contamination
- Support Practice Factor
- Surface Water Body
- Thickness of Bottom Sediment
- Thickness of Evasion Layer of C-14 in Soil
- Thickness of Floor and Foundation
- Thickness of Primary Contamination and of Cover
- Thickness of Saturated Zone
- Thickness of the Unsaturated Zone
- Time at Which Radionuclides First Become Releasable
- Time Horizon
- Times at Which Release Properties Change
- Title
- Total Porosity of Floor and Foundation
- Transfer Factor Library
- Transfer Factor, Intake to Animal Product
- Transfer Factor, Soil to Plant
- Transfer Factor, Water to Aquatic Food
- Transfer Mechanism
- Update Time Interval of Progress of Computation Message
- Use Line Draw Characters
- Vertical Later Dispersivity of Saturated Zone
- Volume of Surface Water Body
- Volumetric Water Content
- Volumetric Water Content of Contaminated Medium
- Volumetric Water Content of Floor and Foundation
- Water for Household Purposes
- Water for Use by Beef Cattle
- Water for Use by Dairy Cows
- Water from Surface Water Body
- Water from Well
- Water Intake
- Weathering Removal Constant
- Well Location
- Well Pumping Rate
- Well Pumping Rate Needed to Support Specified Water Use
- Wet Weight Crop Yield
- Wind Speed
- Wind Speed Terrain

11.72 TEST CASE 037

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-037

Test Summary Tests OFFSITE's DCF data

Created By/Date DJL 11/26/2019

Test Objective Tests OFFSITE's DCF Data

Procedure

1. Spot check based on PM scope request
2. <u>Verify by comparing data in manual, input form, input echo in results</u>
3. ICRP60/ICRP72 External: Table A.2-3
4. Further verification details are in the "Data Verification/DCF Verification" V&V folder.

Required Data NA

Expected Results Underlined steps in above procedure

11.73 TEST CASE 038

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-038

Test Summary Tests OFFSITE’s Slope factor data

Created By/Date DJL 11/26/2019

Test Objective Tests OFFSITE’s Slope Factor Data

Procedure

1. Spot check based on PM scope request
2. Verify by comparing data in manual, input form, input echo in results
3. Further verification details are in the “Data Verification/slope factor Verification” V&V folder.

Required Data NA

Expected Results Underlined steps in above procedure

11.74 TEST CASE 039

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-039

Test Summary Tests OFFSITE’s Transfer factor data

Created By/Date DJL 11/26/2019

Test Objective Tests OFFSITE’s Transfer factor Data

Procedure

1. Spot check based on PM scope request
2. <u>Verify by comparing data in manual, input form, input echo in results</u>
3. Further verification details are in the “Data Verification/Transfer factor Verification” V&V folder.

Required Data NA

Expected Results Underlined steps in above procedure

11.75 TEST CASE 040

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-040
Test Summary	Tests OFFSITE's Nuclide decay and ingrowth data
Created By/Date	DJL 11/26/2019
Test Objective	Tests OFFSITE's Nuclide decay and ingrowth Data
Procedure	1. Spot check based on PM scope request 2. Verify by comparing data in the .CHN file in the UsersFiles with Table A.1-1 in User's Manual 3. Further verification details are in the "Data Verification/Nuclide decay and ingrowth Verification" V&V folder.
Required Data	NA
Expected Results	Underlined steps in above procedure

11.76 TEST CASE 041

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-41
Test Summary	Tests OFFSITE's external radiation model
Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's to external radiation model
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'external-pathway'
Required Data	EXTERNAL-1.ROF, EXTERNAL-2.ROF,
Expected Results	Compare with Table 1 of "Verification of External Model and External Exposure Pathway Dose.docx" in R:_QA_Files\OFFSITE\V&V\external-pathway\

11.77 TEST CASE 042

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-042

Test Summary Tests OFFSITE's default uncertainty distribution data

Created By/Date DJL 11/26/2019

Test Objective Tests default uncertainty distribution data

Procedure

1. Spot check based on PM scope request
2. Verify by comparing data in probabilistic input form and Appendix C of "Default Parameter Values and Distribution in RESRAD-ONSITE V7.2, RESRAD-BUILD V3.5, and RESRAD-OFFSITE V4.0 Computer Codes
3. Further verification details are in the "Data Verification/parameter distribution comparison" V&V folder.

Required Data NA

Expected Results Underlined steps in above procedure

11.78 TEST CASE 044

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-044

Test Summary Tests OFFSITE's validation of user's email for download

Created By/Date DJL 11/26/2019

Test Objective Tests OFFSITE's validation of user's email for download

Procedure

1. Go through download registration process on website.
2. <u>Verify receipt of email for access to download</u>
3. <u>Verify email link allows access</u>
4. <u>Verify download</u>

Required Data NA

Expected Results Underlined steps in above procedure

11.79 TEST CASE 047

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-047
Test Summary	Tests OFFSITE's Area factor tool
Created By/Date	DJL 11/26/2019 BASED ON EG suggestion
Test Objective	Tests OFFSITE's area factor tool
Procedure	1. perform an area factors run with a very narrow range (or a point range if that is possible) of dimensions. 2. Check that the area factors are calculated using the dose from the critical location. 3. Manually input the values for the critical run and verify that the dose matches the dose from the area factors run.
Required Data	NA
Expected Results	Area factor from tool is the ratio of the peak dose from the limited and full contaminated area.

11.80 TEST CASE 048

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-048

Test Summary Tests OFFSITE's generation of template files tool

Created By/Date DJL 11/26/2019 BASED ON EG suggestion

Test Objective Tests OFFSITE's generation of template files tool

Procedure

1. generate the data transfer template files, make copies of these files for later use
2. open them in excel
3. multiply each input by some constant, not too large a constant to avoid exceeding the upper bound.
   a. can do this by copying an expression and then copying back the value of the expression.
4. read the modified template file.
5. do a few <u>spot checks of inputs</u> in the forms; automate the checking of all the inputs as in the steps below
6. generate another set of template files.
7. compare with the copies of the template files in 1 and <u>verify that they are in the ratio of the constant used in 3.</u>
8. divide by the factor used in 3.
9. read the modified template file.
10. Chain through all the input forms to <u>verify that the inputs are back at their defaults</u>.

Required Data NA

Expected Results Underlined steps in above procedure.

11.81 TEST CASE 049

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-049

Test Summary Tests OFFSITE's pathway option tool

Created By/Date DJL 11/26/2019 BASED ON EG suggestion

Test Objective Tests OFFSITE's pathway option tool

Procedure

1. create an input file with only one exposure pathway active.
2. Chain through all the input forms to verify the enabled / disabled status of the inputs in the forms.
3. Run the file and check the input echo.
4. Repeat for each exposure pathway.

Required Data NA

Expected Results Underlined steps in above procedure.

11.82 TEST CASE 050

Project **RESRAD-OFFSITE**

Test Case ID RESOFF-TEST-050

Test Summary Tests OFFSITE's transformation database option tool

Created By/Date DJL 11/26/2019 BASED ON EG suggestion

Test Objective Tests OFFSITE's transformation database option tool

Procedure

1. create an input file under one choice of transformation data
2. change all the radionuclide specific properties (release properties, distribution coefficients, transfer factors, deposition velocities).
3. switch to the other transformation data.
4. <u>verify that the radionuclide specific properties that were input in 2 are still there</u>. Can use the data transfer feature do this more easily.

Required Data NA

Expected Results Underlined steps in above procedure.

11.83 TEST CASE 051

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-051
Test Summary	Tests OFFSITE's transformation DCF database option tool
Created By/Date	DJL 11/26/2019 BASED ON EG suggestion
Test Objective	Tests OFFSITE's transformation DCF database option tool
Procedure	1. Select one of the transformation data choices. 2. <u>Verify the choices of libraries available for the internal dose library and the risk library</u>. 3. Repeat for the other choice of transformation data. 4. Repeat the check after creating a user library under each of the transformation data choices.
Required Data	NA
Expected Results	Underlined steps in above procedure.

11.84 TEST CASE 052

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-052
Test Summary	Tests OFFSITE's transformation DCF database option tool
Created By/Date	DJL 11/26/2019 BASED ON EG suggestion
Test Objective	Tests OFFSITE's transformation DCF database option tool
Procedure	1. Use the example in Appendix E.4, but after verifying the calculations described there.
Required Data	NA
Expected Results	Underlined steps in above procedure.

11.85 TEST CASE 053

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-053
Test Summary	Tests OFFSITE's source conceptualization options tool
Created By/Date	DJL 11/26/2019 BASED ON EG suggestion
Test Objective	Tests OFFSITE's source conceptualization options tool
Procedure	1. Create an input file under each of the 4 main conceptualizations and the two sub conceptualizations. 2. <u>Verify that the appropriate release options are shown</u> in the source form and or the release properties form.
Required Data	NA
Expected Results	Underlined steps in above procedure.

11.86 TEST CASE 054-001

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-054-001
Test Summary	Tests OFFSITE C14 concentration in primary contamination
Created By/Date	DJL 1/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE C14 concentration in primary contamination
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'special radionuclides'
Required Data	CARBON-14.ROF
Expected Results	Compare the primary contamination concentrations with c14.xlsx in V&V folder on 'special radionuclides'

11.87 TEST CASE 054-002

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-054-002
Test Summary	Tests OFFSITE C14 plant concentrations
Created By/Date	DJL 1/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE C14 plant concentrations
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'special radionuclides'
Required Data	CARBON-14.ROF
Expected Results	Compare the plant concentrations with c14.xlsx in V&V folder on 'special radionuclides'

11.88 TEST CASE 054-003

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-054-003
Test Summary	Tests OFFSITE C14 meat and milk concentrations
Created By/Date	DJL 1/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE C14 meat and milk concentrations
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'special radionuclides'
Required Data	CARBON-14.ROF
Expected Results	Compare the meat and milk concentrations with c14.xlsx in V&V folder on 'special radionuclides'

11.89 TEST CASE 054-004

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-054-004
Test Summary	Tests OFFSITE H3 concentration in primary contamination
Created By/Date	DJL 1/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE H3 concentration in primary contamination
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'special radionuclides'
Required Data	HYDROGEN-3.ROF
Expected Results	Compare the primary contamination concentrations with H3.xlsx in V&V folder on 'special radionuclides'

11.90 TEST CASE 054-005

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-054-005
Test Summary	Tests OFFSITE H3 plant concentrations
Created By/Date	DJL 1/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE H3 plant concentrations
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'special radionuclides'
Required Data	HYDROGEN-3.ROF
Expected Results	Compare the plant concentrations with h3.xlsx in V&V folder on 'special radionuclides'

11.91 TEST CASE 054-006

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-054-006
Test Summary	Tests OFFSITE H3 meat and milk concentrations
Created By/Date	DJL 1/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE H3 meat and milk concentrations
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'special radionuclides'
Required Data	HYDROGEN-3.ROF
Expected Results	Compare the meat and milk concentrations with H3.xlsx in V&V folder on 'special radionuclides'

11.92 TEST CASE 111

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-111
Test Summary	Tests OFFSITE Activated Metal Case I: new source term
Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term; delay 500 years
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	ACTIVATED METAL-500_1000 COSTANT.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M3.2-11

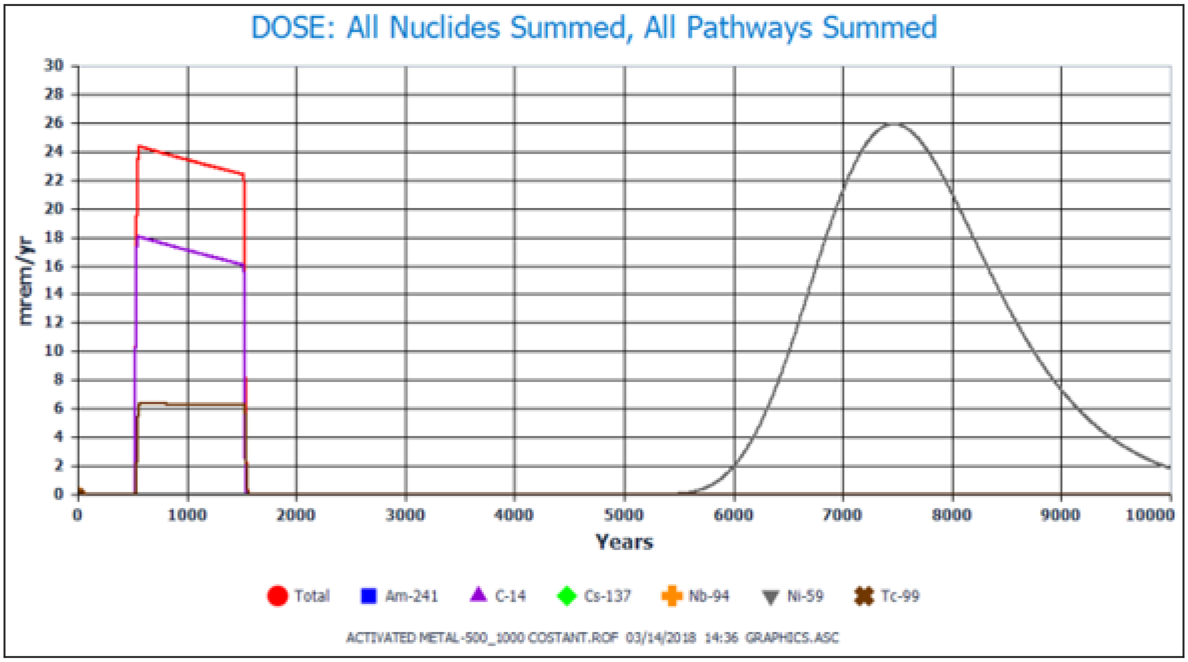


Figure M3-2 Potential Radiation Dose Associated with Disposal of Activated Metals – Delayed Releases for 500 years

11.93 TEST CASE 112

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docxRESOFF-TEST-112
Test Summary	Tests OFFSITE Activated Metal Case II : new source term
Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term; delay 1000 years
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	ACTIVATED METAL-1000_10000 COSTANT.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figgues M4.1-10

11.94 TEST CASE 113

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx-TEST-113
Test Summary	Tests OFFSITE Activated Metal Case III : increasing corrosion rate
Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term; increasing corrosion rate
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	ACTIVATED METAL-500_1000 INCREASE.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M5.2-11

11.95 TEST CASE 114

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx-TEST-114
Test Summary	Tests OFFSITE Activated Metal Case IV : TRU Waste
Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term;
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	OTHER WASTE-KD=0_500-V2_DT2.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M6.2-7

11.96 TEST CASE 115

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx
Test Summary	Tests OFFSITE Activated Metal Case V : Grouted TRU Waste
Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term;
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	OTHER WASTE-KD=CEMENT_500_DT2-DUST-REVISED.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M7.2-7

11.97 TEST CASE 116

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx
Test Summary	Tests OFFSITE Activated Metal Case VI : Grouted TRU Waste
Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term;
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	OTHER WASTE-KD=0_500_DT1-DIF-DUST-REVISED.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M8.2-7

11.98 TEST CASE 117

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx
Test Summary	Tests OFFSITE Activated Metal Case VII : Grouted TRU Waste w diffusion
Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term;
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	SELAED SOURCES-TRENCH-LEACH_300-800-V2.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M9.2-3

11.99 TEST CASE 118

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx
Test Summary	Tests OFFSITE Activated Metal Case VII : Grouted TRU Waste w solubility-controlled release
Created By/Date	DJL 11/24/2019 BASED ON JJC VERIFICATION
Test Objective	Test features of OFFSITE new source term;
Procedure	Run file below, compare to expected results, consult Verification report and V&V folder on 'Source Term Benchmarking with Dust'
Required Data	SELAED SOURCES-TRENCH-SOLUBILITY_300-800-V2.ROF
Expected Results	Compare with Figures Manual 4.0, vol. 1, App M, Figures M10.2-12

11.100 TEST CASE 401

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx
Test Summary	Tests OFFSITE Plant concentrations
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE plant concentrations;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on ‘combined testing (food concentration and ingestion dose)”
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figures 1-4 of “Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx” in R:_QA_Files\OFFSITE\V&V\combined testing (food concentration and ingestion dose)

11.101 TEST CASE 402

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx
Test Summary	Tests OFFSITE Meat and Milk concentrations
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE Meat & milk concentrations;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figures 5-6 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in R:_QA_Files\OFFSITE\V&V\combined testing (food concentration and ingestion dose)

11.102 TEST CASE 403

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx
Test Summary	Tests OFFSITE Aquatic Foods concentrations
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE aquatic food concentrations;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figures 7-8 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in R:_QA_Files\OFFSITE\V&V\combined testing (food concentration and ingestion dose)

11.103 TEST CASE 404

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx
Test Summary	Tests OFFSITE Plant ingestion dose
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE plant pathway dose;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figures 9 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in R:_QA_Files\OFFSITE\V&V\combined testing (food concentration and ingestion dose)

11.104 TEST CASE 405

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx
Test Summary	Tests OFFSITE Meat and Milk Pathway Doses
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE Meat and Milk Pathway Doses;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figures 10 & 11 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in R:_QA_Files\OFFSITE\V&V\combined testing (food concentration and ingestion dose)

11.105 TEST CASE 406

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx
Test Summary	Tests OFFSITE Aquatic Pathway Doses
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE Aquatic Pathway Doses;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figure 12 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in R:_QA_Files\OFFSITE\V&V\combined testing (food concentration and ingestion dose)

11.106 TEST CASE 407

Project	**RESRAD-OFFSITE**
Test Case ID	Compilation of verification of RESRAD-OFFSITE 4.0 formatted with test cases.docx
Test Summary	Tests OFFSITE Drinking Water Pathway Doses
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE Drinking Water Pathway Doses;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'combined testing (food concentration and ingestion dose)"
Required Data	SR-90-COMPREHENSIVE.ROF
Expected Results	Compare with Figure 13 of "Verification of Plant meat milk aquatic food concentration and ingestion pathway dose.docx" in R:_QA_Files\OFFSITE\V&V\combined testing (food concentration and ingestion dose)

11.107 TEST CASE 411

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-411
Test Summary	Tests OFFSITE's Offsite soil concentration in leafy vegetable agricultural field
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE soil concentration in leafy vegetable agricultural field;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-test1.rof
Expected Results	Compare with Figure 1 of "Verification of Accumulation at offsite location.docx" in R:_QA_Files\OFFSITE\V&V\accumulation-at-offsite-testing

11.108 TEST CASE 412

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-412
Test Summary	Tests OFFSITE's Offsite soil concentration in pasture agricultural field
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test Offsite soil concentration in pasture agricultural field;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-test2.rof
Expected Results	Compare with Figure 2 of "Verification of Accumulation at offsite location.docx" in R:_QA_Files\OFFSITE\V&V\accumulation-at-offsite-testing

11.109 TEST CASE 413

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-413
Test Summary	Tests OFFSITE's Offsite soil concentration in grain agricultural field
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE soil concentration in grain agricultural field;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-test3.rof
Expected Results	Compare with Figures 3 of "Verification of Accumulation at offsite location.docx" in R:_QA_Files\OFFSITE\V&V\accumulation-at-offsite-testing

11.110 TEST CASE 414

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-414
Test Summary	Tests OFFSITE's Offsite soil concentration in Non-leafy vegetable agricultural field
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE soil concentration in non-leafy vegetable agricultural field;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-test4.rof
Expected Results	Compare with Figure 4 of "Verification of Accumulation at offsite location.docx" in R:_QA_Files\OFFSITE\V&V\accumulation-at-offsite-testing

11.111 TEST CASE 415

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-415
Test Summary	Tests OFFSITE's Offsite soil concentration in non-leafy vegetable agricultural field contributed by erosion
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE soil concentration in non-leafy vegetable agricultural field contributed by erosion;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-Test4-erosion-only.rof.rof
Expected Results	Compare with Figures 5 of "Verification of Accumulation at offsite location.docx" in R:_QA_Files\OFFSITE\V&V\accumulation-at-offsite-testing

11.112 TEST CASE 416

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-416
Test Summary	Tests OFFSITE's Offsite soil concentration in non-leafy vegetable agricultural field contributed by air deposition
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE soil concentration in non-leafy vegetable agricultural field contributed by air deposition;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-Test4-air-dep-only.rof.rof
Expected Results	Compare with Figure 6 of "Verification of Accumulation at offsite location.docx" in R:_QA_Files\OFFSITE\V&V\accumulation-at-offsite-testing

11.113 TEST CASE 417

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-417
Test Summary	Tests OFFSITE's Offsite soil concentration in non-leafy vegetable agricultural field contributed by surface water irrigation
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE soil concentration in non-leafy vegetable agricultural field contributed by surface water irrigation;
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'accumulation-at-offsite-testing"
Required Data	offsite-accumulation-Test4-surface-water-only.rof.rof
Expected Results	Compare with Figures 7 of "Verification of Accumulation at offsite location.docx" in R:_QA_Files\OFFSITE\V&V\accumulation-at-offsite-testing

11.114 TEST CASE 421

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-421
Test Summary	Tests OFFSITE's Offsite air concentration (Briggs rural, no deposition, with plume rise)
Created By/Date	DJL 11/24/2019 based on SK Verification
Test Objective	Test features of OFFSITE air concentration (Briggs rural, no deposition, with plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air-dispersion-model-testing'
Required Data	AIR DISPERSION RUN1.rof
Expected Results	Compare with Table 2 of "Verification of Atmospheric Transport Model.docx" in R:_QA_Files\OFFSITE\V&V\air-dispersion-model-testing

11.115 TEST CASE 422

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-422
Test Summary	Tests OFFSITE's Offsite air concentration (PG, dry deposition, with plume rise)
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air concentration (PG, dry deposition, with plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air-dispersion-model-testing'
Required Data	AIR DISPERSION RUN2.rof
Expected Results	Compare with Table 2 of "Verification of Atmospheric Transport Model.docx" in R:_QA_Files\OFFSITE\V&V\air-dispersion-model-testing

11.116 TEST CASE 423

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-423
Test Summary	Tests OFFSITE's Offsite air concentration (PG, dry & wet deposition, with plume rise)
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air concentration (PG, dry & wet deposition, with plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air-dispersion-model-testing'
Required Data	AIR DISPERSION RUN3.rof
Expected Results	Compare with Table 2 of "Verification of Atmospheric Transport Model.docx" in R:_QA_Files\OFFSITE\V&V\air-dispersion-model-testing

11.117 TEST CASE 424

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-424
Test Summary	Tests OFFSITE's Offsite air concentration (PG, no deposition, no plume rise)
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air concentration (PG, no deposition, no plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air-dispersion-model-testing'
Required Data	AIR DISPERSION RUN4.rof
Expected Results	Compare with Table 3 of "Verification of Atmospheric Transport Model.docx" in R:_QA_Files\OFFSITE\V&V\air-dispersion-model-testing

11.118 TEST CASE 425

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-425
Test Summary	Tests OFFSITE's Offsite air concentration (PG, dry deposition, no plume rise)
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air concentration (PG, dry deposition, no plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air-dispersion-model-testing'
Required Data	AIR DISPERSION RUN5.rof
Expected Results	Compare with Table 3 of "Verification of Atmospheric Transport Model.docx" in R:_QA_Files\OFFSITE\V&V\air-dispersion-model-testing

11.119 TEST CASE 426

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-426
Test Summary	Tests OFFSITE's Offsite air concentration (PG, dry & wet deposition, no plume rise)
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air concentration (PG, dry and wet deposition, no plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air-dispersion-model-testing'
Required Data	AIR DISPERSION RUN6.rof
Expected Results	Compare with Table 3 of "Verification of Atmospheric Transport Model.docx" in R:_QA_Files\OFFSITE\V&V\air-dispersion-model-testing

11.120 TEST CASE 427

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-427
Test Summary	Tests OFFSITE's Offsite air concentration (PG, wet deposition, no plume rise)
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air concentration (PG, wet deposition, no plume rise)
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air-dispersion-model-testing'
Required Data	AIR DISPERSION RUN7.rof
Expected Results	Compare with Table 4 of "Verification of Atmospheric Transport Model.docx" in R:_QA_Files\OFFSITE\V&V\air-dispersion-model-testing

11.121 TEST CASE 428

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-428
Test Summary	Tests OFFSITE's Offsite air depletion
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE air depletion
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'air-dispersion-model-testing'
Required Data	AIR DISPERSION RUN5.rof
Expected Results	Compare with Table 5 & 6 of "Verification of Atmospheric Transport Model.docx" in R:_QA_Files\OFFSITE\V&V\air-dispersion-model-testing

11.122 TEST CASE 431

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-431
Test Summary	Tests OFFSITE's Offsite surface water body accumulation with cover Tc-99
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE surface Water body accumulation with cover
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'surface-water-model-testing'
Required Data	SURF-WATER-CHECK-TC99-TEST1.rof
Expected Results	Compare with Figure 1 of "Verification of Surface Water Model.docx" in R:_QA_Files\OFFSITE\V&V\surface-water-model-testing

11.123 TEST CASE 432

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-432
Test Summary	Tests OFFSITE's Offsite surface water body accumulation no cover Tc-99
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE surface Water body accumulation no cover
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'surface-water-model-testing'
Required Data	SURF-WATER-CHECK-TC99-TEST2.rof
Expected Results	Compare with figure 2 of "Verification of Surface Water Model.docx" in R:_QA_Files\OFFSITE\V&V\surface-water-model-testing

11.124 TEST CASE 433

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-433
Test Summary	Tests OFFSITE's Offsite surface water body accumulation with cover, U-234
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE surface Water body accumulation no cover
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'surface-water-model-testing'
Required Data	SURF-WATER-CHECK-U234-TEST1.rof
Expected Results	Compare with figure 3 of "Verification of Surface Water Model.docx" in R:_QA_Files\OFFSITE\V&V\surface-water-model-testing

11.125 TEST CASE 434

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-434
Test Summary	Tests OFFSITE's Offsite surface water body accumulation no cover, U-234
Created By/Date	DJL 11/24/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE surface Water body accumulation no cover
Procedure	Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'surface-water-model-testing'
Required Data	SURF-WATER-CHECK-U234-TEST2.rof
Expected Results	Compare with figure 4 of "Verification of Surface Water Model.docx" in R:_QA_Files\OFFSITE\V&V\surface-water-model-testing

11.126 TEST CASE 435

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-435
Test Summary	Tests OFFSITE's release to air
Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's release to air
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'air release'
Required Data	AIR RELEASE COMP CASE1.ROF, AIR RELEASE COMP CASE2.ROF
Expected Results	Compare with figure 1 & 2 of "Verification of Air Release from surface layer.docx" in R:_QA_Files\OFFSITE\V&V\Air release\

11.127 TEST CASE 436

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-436
Test Summary	Tests OFFSITE's release to erosion
Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's release to erosion
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'erosion release'
Required Data	EROSION RELEASE COMP CASE1.ROF, EROSION RELEASE COMP CASE2.ROF
Expected Results	Compare with figure 1 & 2 of "Verification of Erosion Release from surface layer.docx" in R:_QA_Files\OFFSITE\V&V\Erosion release\

11.128 TEST CASE 437

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-437
Test Summary	Tests OFFSITE's external radiation model
Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's to external radiation model
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'external-pathway'
Required Data	EXTERNAL-1.ROF, EXTERNAL-2.ROF,
Expected Results	Compare with Table 1 of "Verification of External Model and External Exposure Pathway Dose.docx" in R:_QA_Files\OFFSITE\V&V\external-pathway\

11.129 TEST CASE 438

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-438
Test Summary	Tests OFFSITE's external radiation model
Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's external radiation model
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'external-pathway'
Required Data	EXTERNAL-3.ROF, EXTERNAL-4.ROF
Expected Results	Compare with Figures 1-4 of "Verification of External Model and External Exposure Pathway Dose.docx" in R:_QA_Files\OFFSITE\V&V\external-pathway\

11.130 TEST CASE 439

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-439
Test Summary	Tests OFFSITE's Particulate inhalation
Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's Particulate inhalation
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'particulate inhalation pathway'
Required Data	INHALATION-1.ROF, INHALATION-2.ROF, INHALATION-3.ROF, INHALATION-4.ROF
Expected Results	Compare with figure 1-8 of "Verification of Particulate Inhalation Pathway Dose.docx" in R:_QA_Files\OFFSITE\V&V\Particulate Inhalation Pathway

11.131 TEST CASE 440

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-440
Test Summary	Tests OFFSITE's Soil ingestion
Created By/Date	DJL 12/19/2019 BASED ON SK VERIFICATION
Test Objective	Test features of OFFSITE's Soil ingestion
Procedure	Run files below, compare to expected results, consult report spreadsheets in V&V folder on 'soil ingestion pathway'
Required Data	SOIL-INGESTION-1.ROF, SOIL-INGESTION-2.ROF, SOIL-INGESTION-3.ROF, SOIL-INGESTION-4.ROF
Expected Results	Compare with figure 1-8 of "Verification of Soil Ingestion Pathway Dose.docx" in R:_QA_Files\OFFSITE\V&V\Soil ingestion pathway

11.132 TEST CASE 441

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-441
Test Summary	Tests OFFSITE's groundwater transport model Kd=0
Created By/Date	DJL 11/24/2019 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=0
Procedure	Copy AQFLUXIN.dat from the \KD0\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\flux input'
Required Data	UNSATURATED FLUXIN KD 0.rof
Expected Results	Compare results from WTFLUXIN.DAT with spreadsheet 'unsaturated 0.xlsx' in R:_QA_Files\OFFSITE\V&V\Groundwater transport\flux input

11.133 TEST CASE 442

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-442
Test Summary	Tests OFFSITE's groundwater transport model Kd=1
Created By/Date	DJL 11/24/2019 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=1
Procedure	Copy AQFLUXIN.dat from the \KD1\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\flux input'
Required Data	UNSATURATED FLUXIN KD 1.rof
Expected Results	Compare results from WTFLUXIN.DAT with spreadsheet unsaturated 1.xlsx in R:_QA_Files\OFFSITE\V&V\Groundwater transport\flux input

11.134 TEST CASE 443

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-443
Test Summary	Tests OFFSITE's groundwater transport model Kd=10
Created By/Date	DJL 11/24/2019 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=10
Procedure	Copy AQFLUXIN.dat from the \KD10\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\flux input'
Required Data	UNSATURATED FLUXIN KD 10.rof
Expected Results	Compare results from WTFLUXIN.DAT with spreadsheet unsaturated 10.xlsx in R:_QA_Files\OFFSITE\V&V\Groundwater transport\flux input

11.135 TEST CASE 444

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-444
Test Summary	Tests OFFSITE's groundwater transport model Kd=100
Created By/Date	DJL 11/24/2019 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=100
Procedure	Copy AQFLUXIN.dat from the \KD10\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\flux input'
Required Data	UNSATURATED FLUXIN KD 100.rof
Expected Results	Compare results from WTFLUXIN.DAT with spreadsheet unsaturated 100.xlsx in R:_QA_Files\OFFSITE\V&V\Groundwater transport\flux input

11.136 TEST CASE 445

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-445
Test Summary	Tests OFFSITE's groundwater transport model Kd=0
Created By/Date	DJL 01/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=0
Procedure	Copy AQFLUXIN.dat from the \SKD0\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\ pulse input over part of the transport zone\'
Required Data	SATURATED FLUXIN KD 0.rof
Expected Results	Compare results from GWtoSWBFLUX.DAT with spreadsheet 'saturated 0.xlsx' in R:_QA_Files\OFFSITE\V&V\Groundwater transport\pulse input over part of the transport zone\

11.137 TEST CASE 446

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-446
Test Summary	Tests OFFSITE's groundwater transport model Kd=1
Created By/Date	DJL 01/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=1
Procedure	Copy AQFLUXIN.dat from the \SKD1\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\ pulse input over part of the transport zone\'
Required Data	SATURATED FLUXIN KD 1.rof
Expected Results	Compare results from GWtoSWBFLUX.DAT with spreadsheet unsaturated 1.xlsx in R:_QA_Files\OFFSITE\V&V\Groundwater transport\ pulse input over part of the transport zone\

11.138 TEST CASE 447

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-447
Test Summary	Tests OFFSITE's groundwater transport model Kd=10
Created By/Date	DJL 01/14/20 BASED ON EG VERIFICATION
Test Objective	Tests OFFSITE's groundwater transport model Kd=10
Procedure	Copy AQFLUXIN.dat from the \SKD10\AQFLUXIN1 folder to the OFFSITE root directory. Run file below, compare to expected results, consult report spreadsheets in V&V folder on 'Groundwater transport\ pulse input over part of the transport zone\'
Required Data	SATURATED FLUXIN KD 10.rof
Expected Results	Compare results from GWtoSWBFLUX.DAT with spreadsheet unsaturated 10.xlsx in R:_QA_Files\OFFSITE\V&V\Groundwater transport\ pulse input over part of the transport zone\'

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APPENDIX 12: TESTERS' REPORTS

The reports written by those who performed the release testing for each of the tests defined in the previous section, while performing each test or soon after, are gathered in this section. These reports are similar to field notes or laboratory notes and are therefore not edited.

12.1 TEST CASE 001 TESTER'S REPORT

Documented in Results_ Test Case 001.msg of 2/14/2020 3:09 PM

Results: Test Case 001

LePoire, David J. Thu 2/14/2020 3:09 PM

From Microsoft Windows support page: https://support.microsoft.com/en-us/help/13853/windows-lifecycle-fact-sheet

The two currently supported Windows Operating Systems are Windows 10 and Windows 8.1: (Windows 7 extended supported ended Jan 14, 2020)

Windows 10 version history	Date of availability	End of service for Home, Pro, Pro Education, and Pro for Workstations editions	End of service for Enterprise and Education editions
Windows 10, version 1909	November 12, 2019	May 11, 2021	May 10, 2022**
Windows 10, version 1903	May 21, 2019	December 8, 2020	December 8, 2020
Windows 10, version 1809	November 13, 2018	May 12, 2020	May 11, 2021**
Windows 10, version 1803	April 30, 2018	November 12, 2019	November 10, 2020
Windows 10, version 1709	October 17, 2017	April 9, 2019	April 14, 2020
Windows 10, version 1703	April 5, 2017*	October 9, 2018	October 8, 2019
Windows 10, version 1607	August 2, 2016	April 10, 2018	April 9, 2019
Windows 10, version 1511	November 10, 2015	October 10, 2017	October 10, 2017
Windows 10, released July 2015 (version 1507)	July 29, 2015	May 9, 2017	May 9, 2017

* Windows 10, version 1703 for Enterprise, Education, and IOT Enterprise editions were released on April 11,

Windows 8.1 and 7

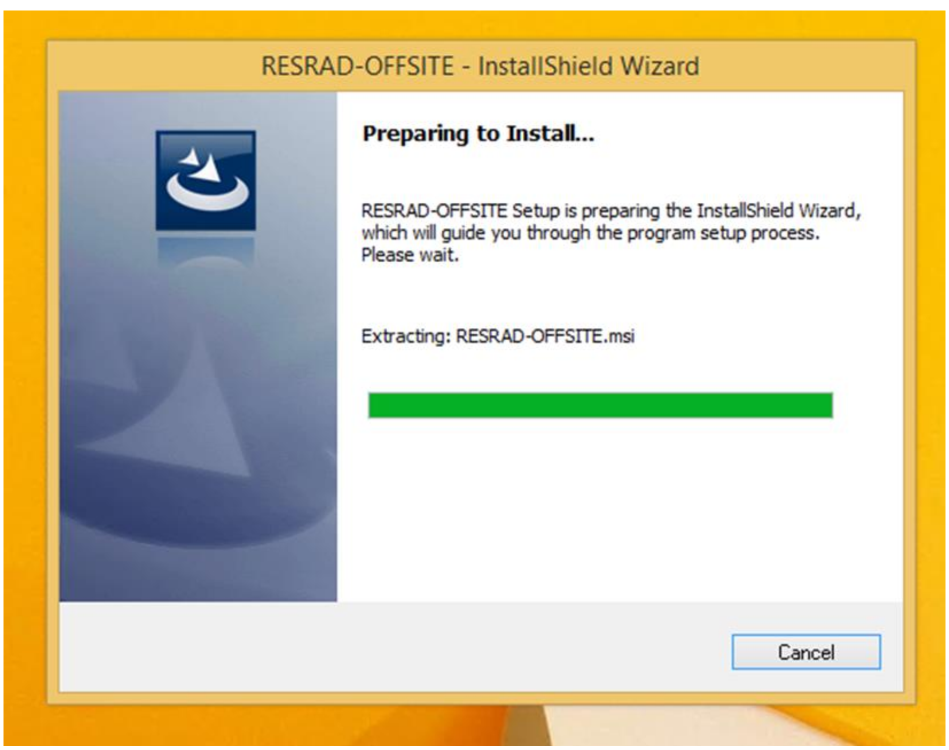
Prior releases of the Windows operating system are governed by the Fixed Lifecycle Policy. This policy comprises two phases: mainstream support and extended support. See Microsoft Business, Developer and Desktop Operating Systems Policy for more details.

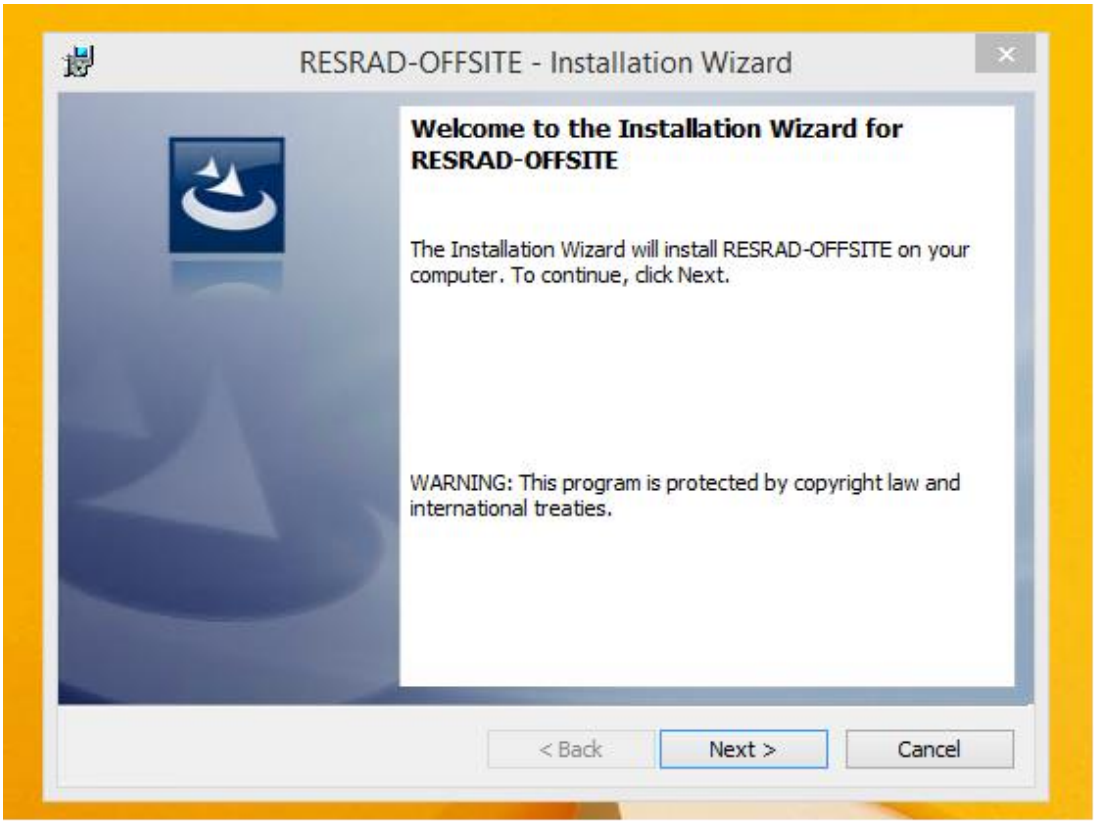
Client operating systems	End of mainstream support	End of extended support
Windows 8.1	January 9, 2018	January 10, 2023
Windows 7, service pack 1*	January 13, 2015	January 14, 2020

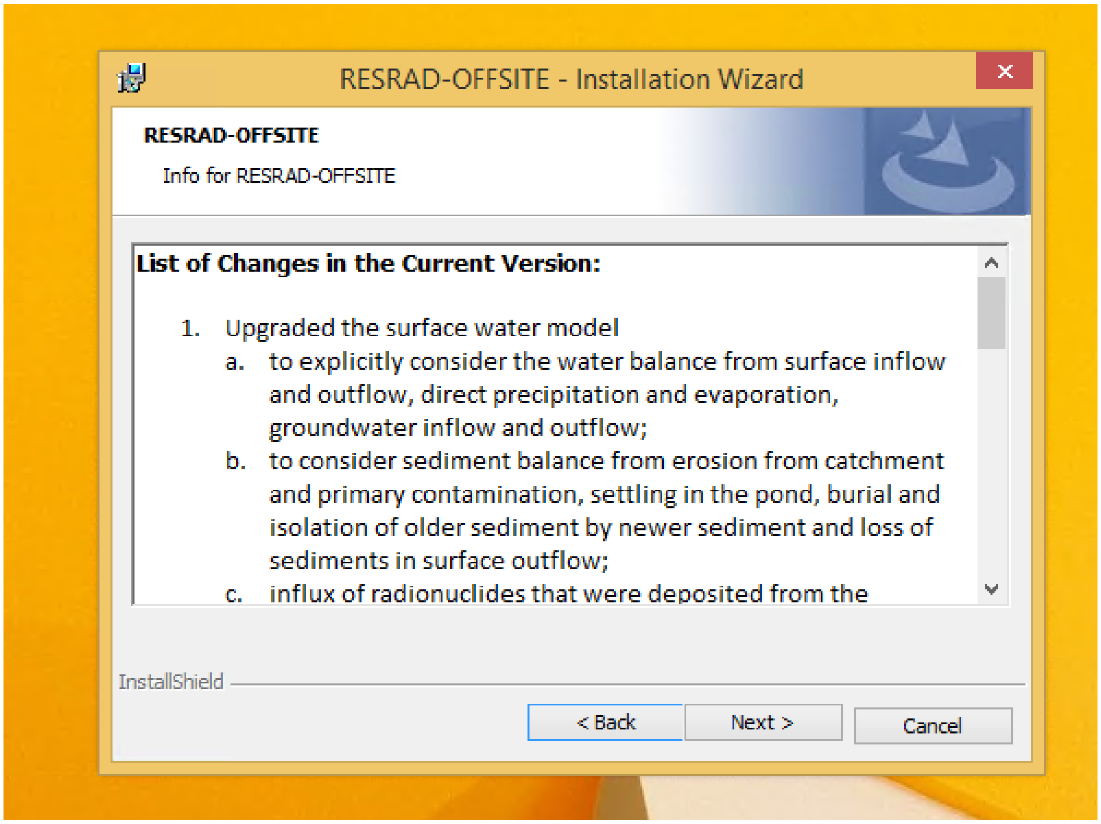
*** Support for Windows 7 RTM without service packs ended on April 9, 2013.**

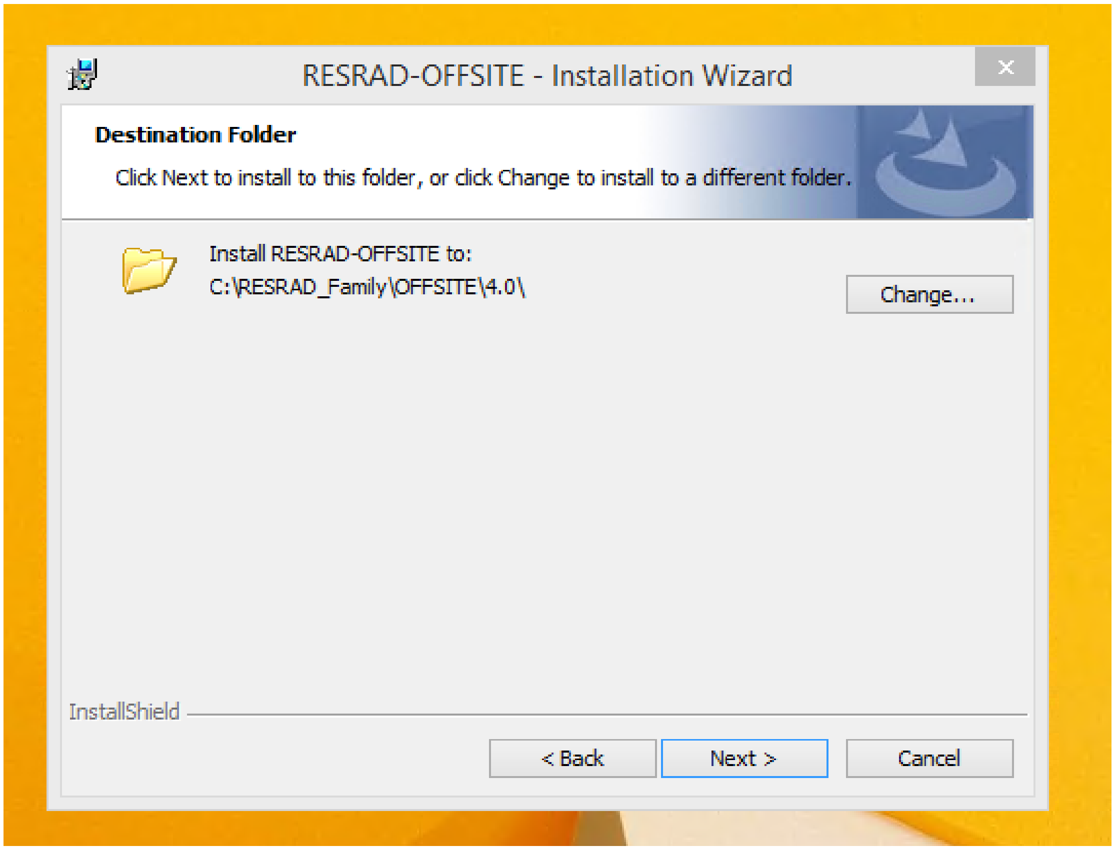
Prior versions of Windows, including Windows 8.1, have limited support when running on new processors and chipsets from manufacturers like Intel, AMD, NVidia, and Qualcomm. For more information, see Microsoft Lifecycle Policy. A device may not be able to run prior versions of Windows if the device hardware is incompatible, lacks current drivers, or is otherwise outside the original equipment manufacturer's (OEM) support period.

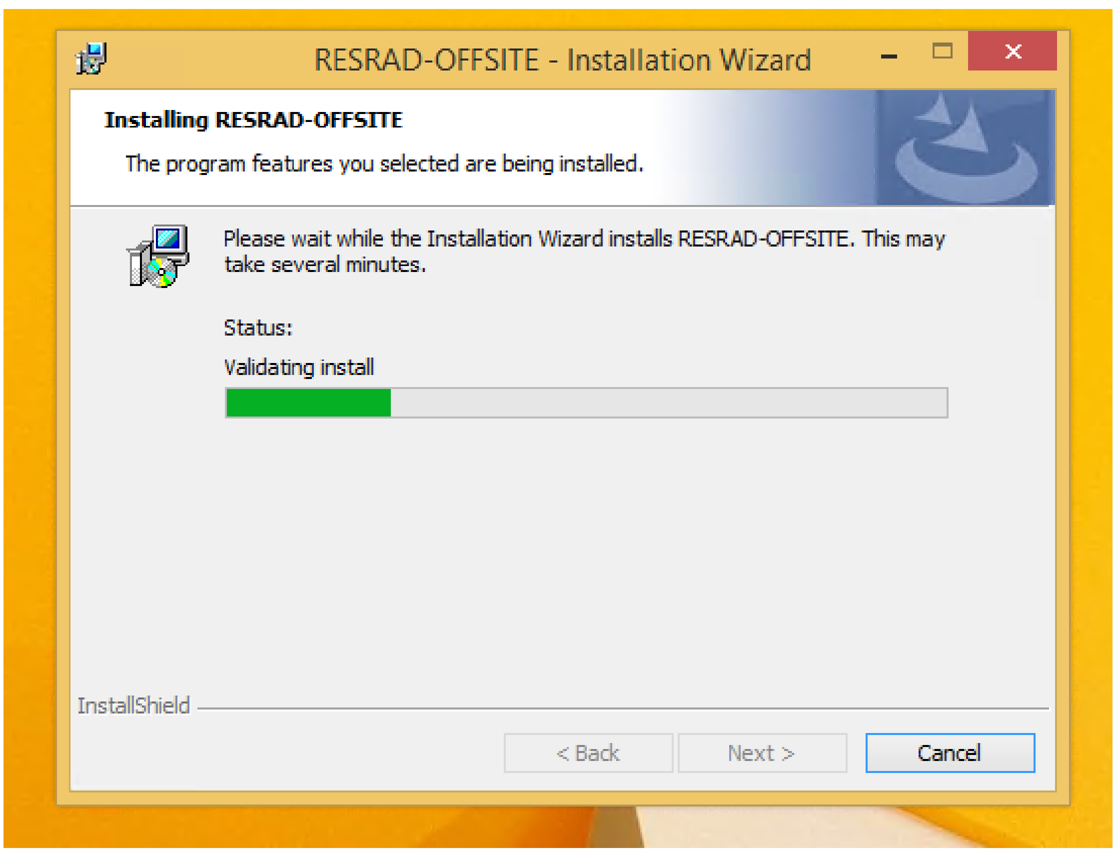
Installing on VM Win 8:

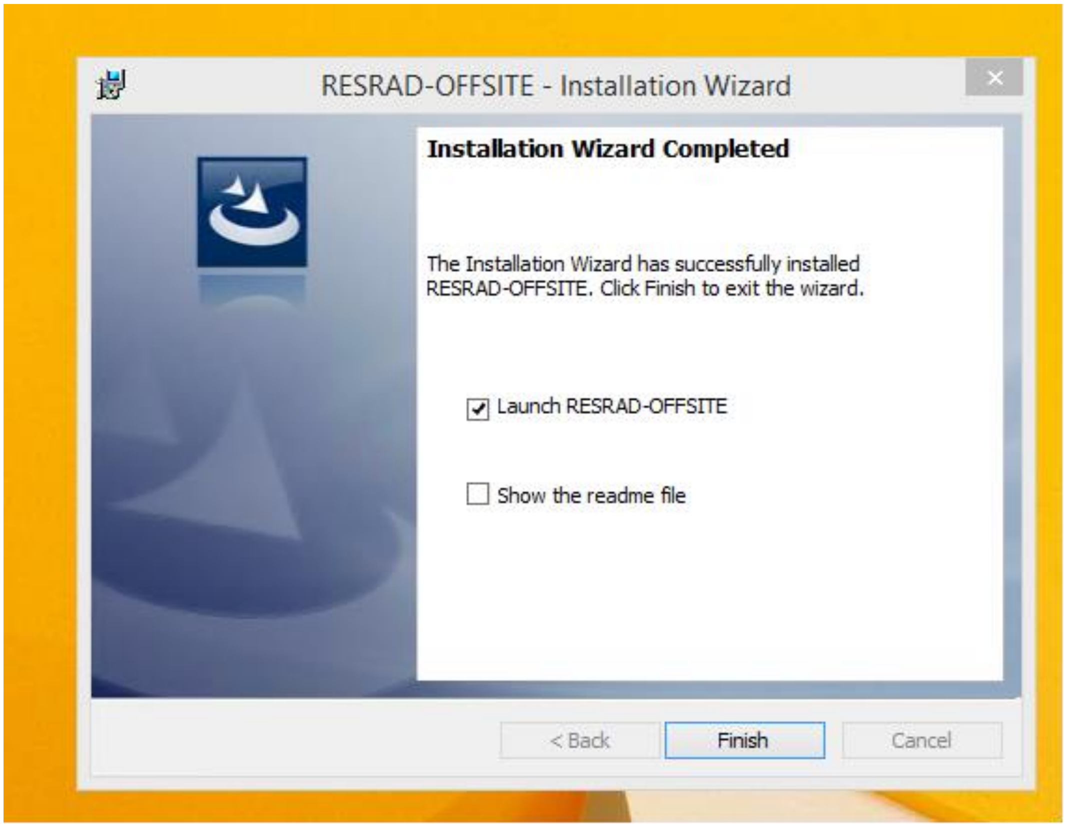


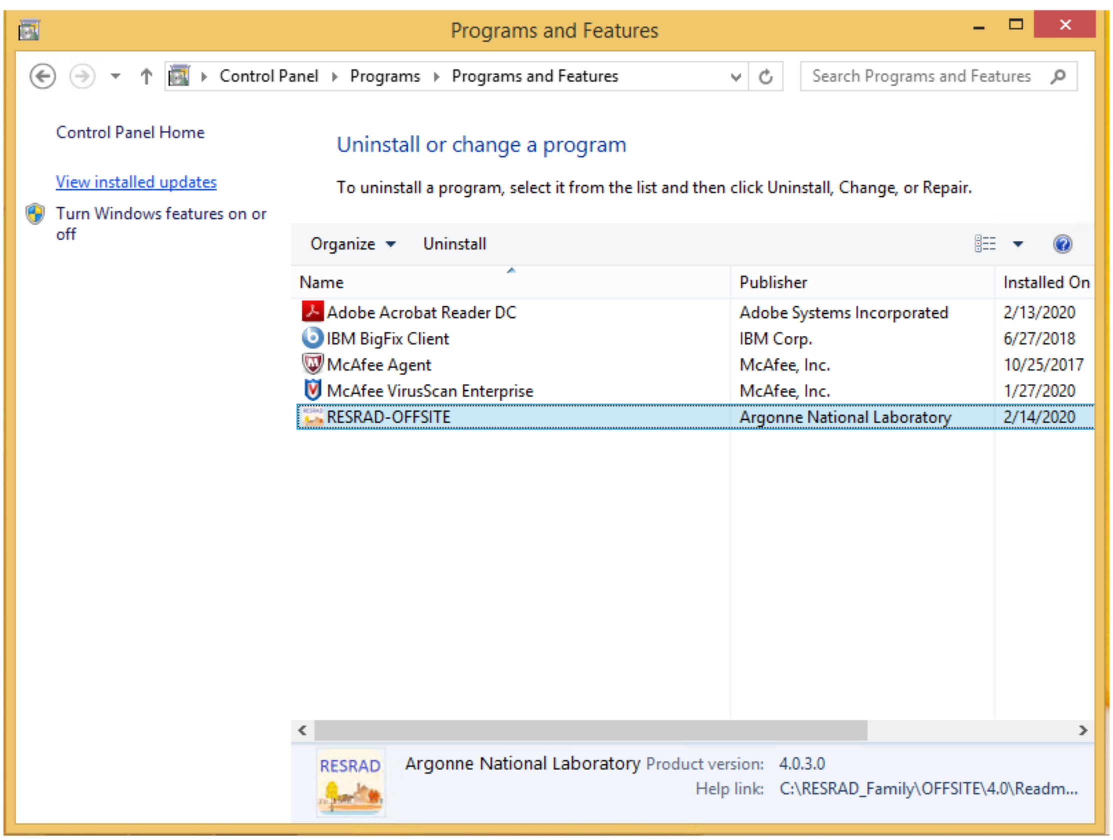

RESRAD-OFFSITE - Installation Wizard
Welcome to the Installation Wizard for RESRAD-OFFSITE
The Installation Wizard will install RESRAD-OFFSITE on your computer. To continue, click Next.
WARNING: This program is protected by copyright law and international treaties.
< Back
Next >
Cancel

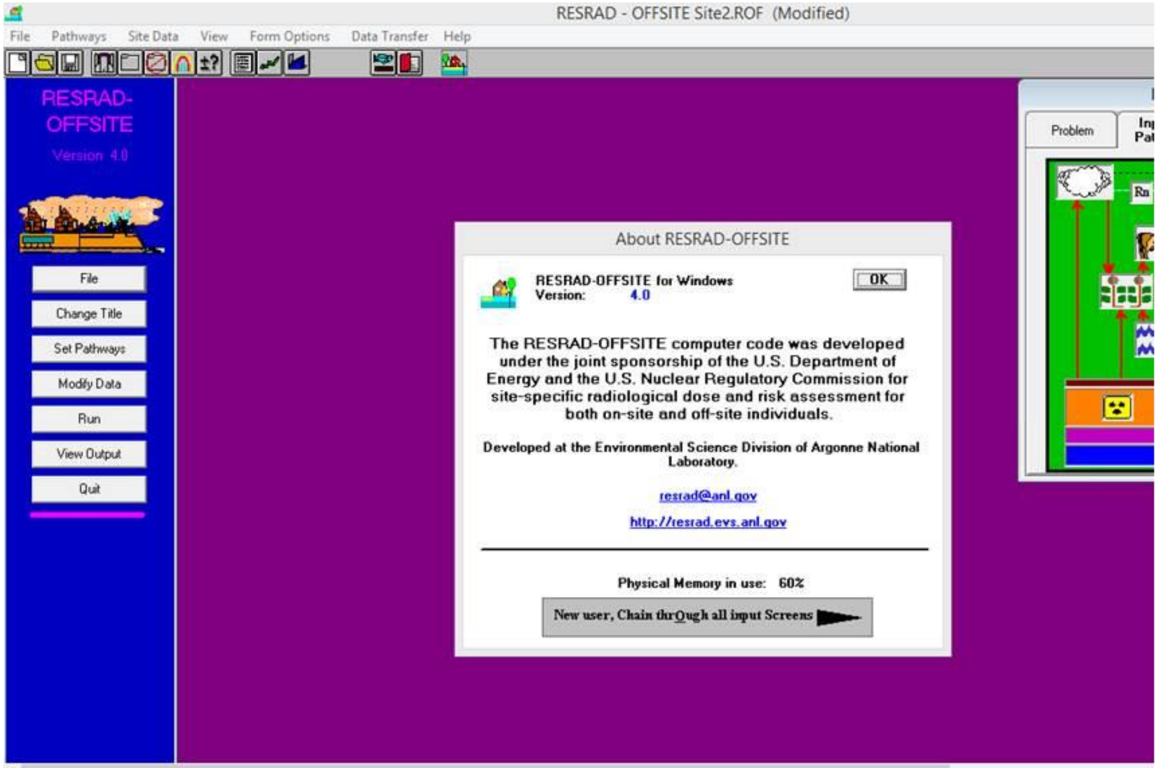

RESRAD-OFFSITE - Installation Wizard
RESRAD-OFFSITE
Info for RESRAD-OFFSITE
List of Changes in the Current Version:
1. Upgraded the surface water model
a. to explicitly consider the water balance from surface inflow and outflow, direct precipitation and evaporation, groundwater inflow and outflow;
b. to consider sediment balance from erosion from catchment and primary contamination, settling in the pond, burial and isolation of older sediment by newer sediment and loss of sediments in surface outflow;
c. influx of radionuclides that were deposited from the
InstallShield
< Back
Next >
Cancel

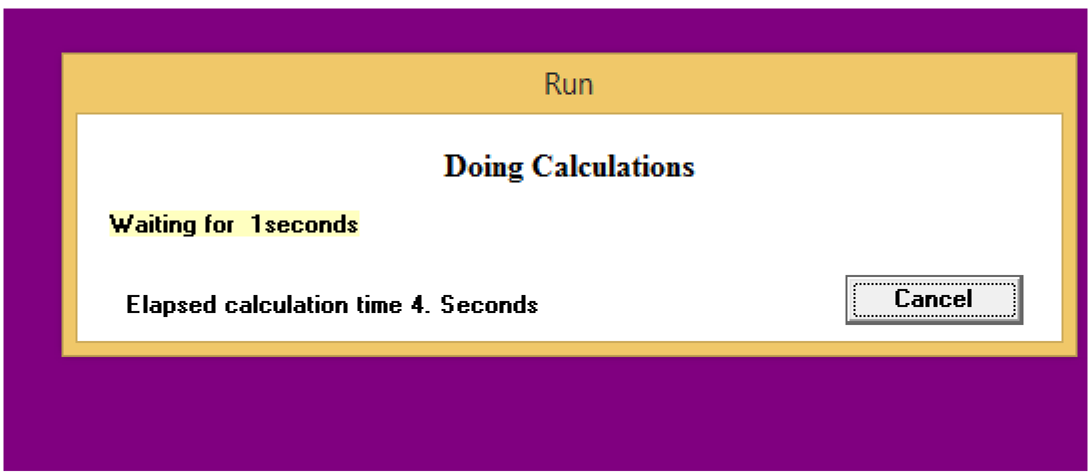

RESRAD-OFFSITE - Installation Wizard
Destination Folder
Click Next to install to this folder, or click Change to install to a different folder.
Install RESRAD-OFFSITE to:
C:\RESRAD_Family\OFFSITE\4.0\
Change...
InstallShield
< Back
Next >
Cancel

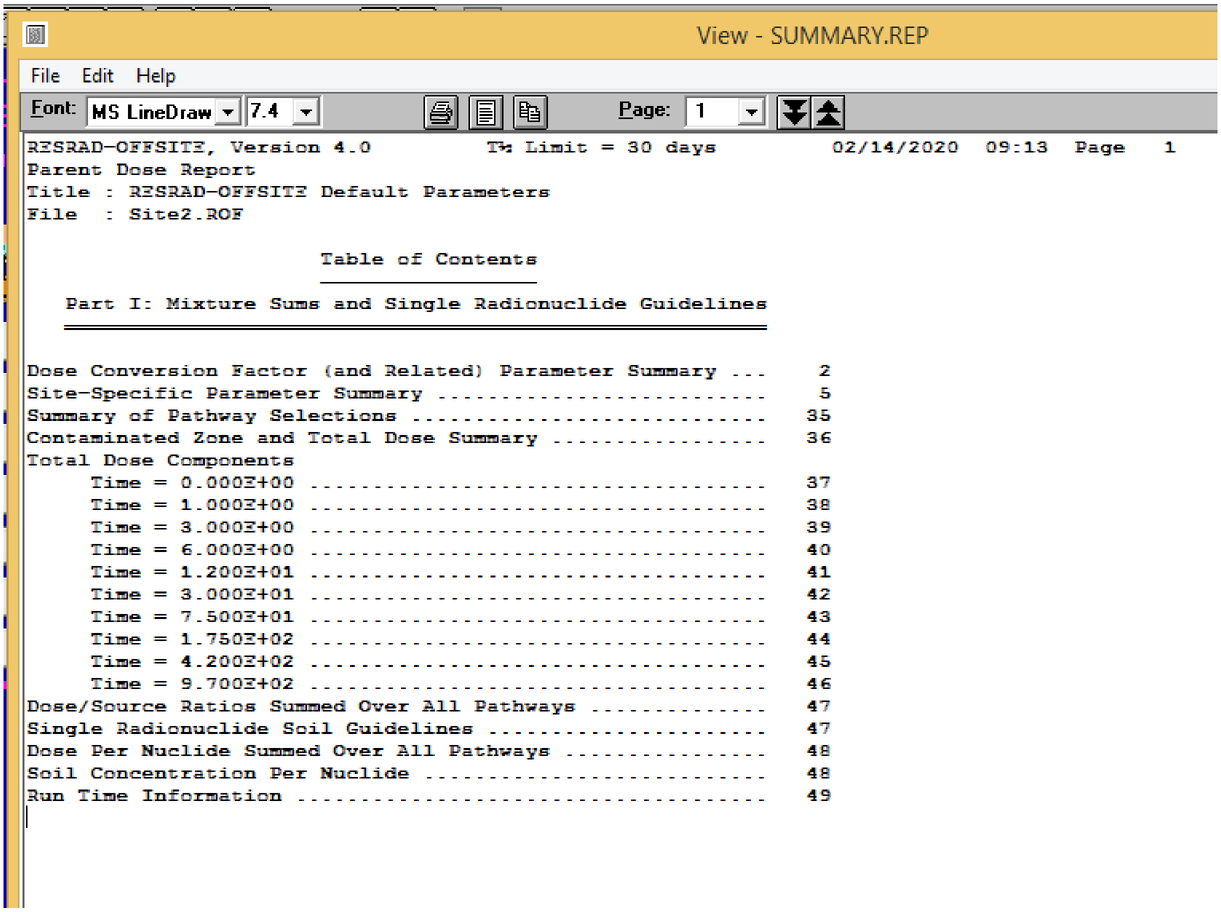

RESRAD-OFFSITE - Installation Wizard
Installing RESRAD-OFFSITE
The program features you selected are being installed.
Please wait while the Installation Wizard installs RESRAD-OFFSITE. This may take several minutes.
Status:
Validating install
InstallShield
< Back
Next >
Cancel


RESRAD-OFFSITE - Installation Wizard
Installation Wizard Completed
The Installation Wizard has successfully installed RESRAD-OFFSITE. Click Finish to exit the wizard.
Launch RESRAD-OFFSITE
Show the readme file
< Back
Finish
Cancel


Programs and Features
Control Panel
Programs
Programs and Features
Search Programs and Features
Control Panel Home
View installed updates
Turn Windows features on or off
Uninstall or change a program
To uninstall a program, select it from the list and then click Uninstall, Change, or Repair.
Organize
Uninstall
Name
Publisher
Installed On
Adobe Acrobat Reader DC
Adobe Systems Incorporated
2/13/2020
IBM BigFix Client
IBM Corp.
6/27/2018
McAfee Agent
McAfee, Inc.
10/25/2017
McAfee VirusScan Enterprise
McAfee, Inc.
1/27/2020
RESRAD-OFFSITE
Argonne National Laboratory
2/14/2020
RESRAD
Argonne National Laboratory Product version: 4.0.3.0
Help link: C:\RESRAD_Family\OFFSITE\4.0\Readm...


RESRAD - OFFSITE Site2.ROF (Modified)
File Pathways Site Data View Form Options Data Transfer Help
RESRAD-OFFSITE
Version 4.0
File
Change Title
Set Pathways
Modify Data
Run
View Output
Quit
About RESRAD-OFFSITE
RESRAD-OFFSITE for Windows
Version: 4.0
OK
The RESRAD-OFFSITE computer code was developed under the joint sponsorship of the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission for site-specific radiological dose and risk assessment for both on-site and off-site individuals.
Developed at the Environmental Science Division of Argonne National Laboratory.
resrad@anl.gov
http://resrad.evs.anl.gov
Physical Memory in use: 60%
New user, Chain thrOugh all input Screens
Problem


Run
Doing Calculations
Waiting for 1seconds
Elapsed calculation time 4. Seconds
Cancel

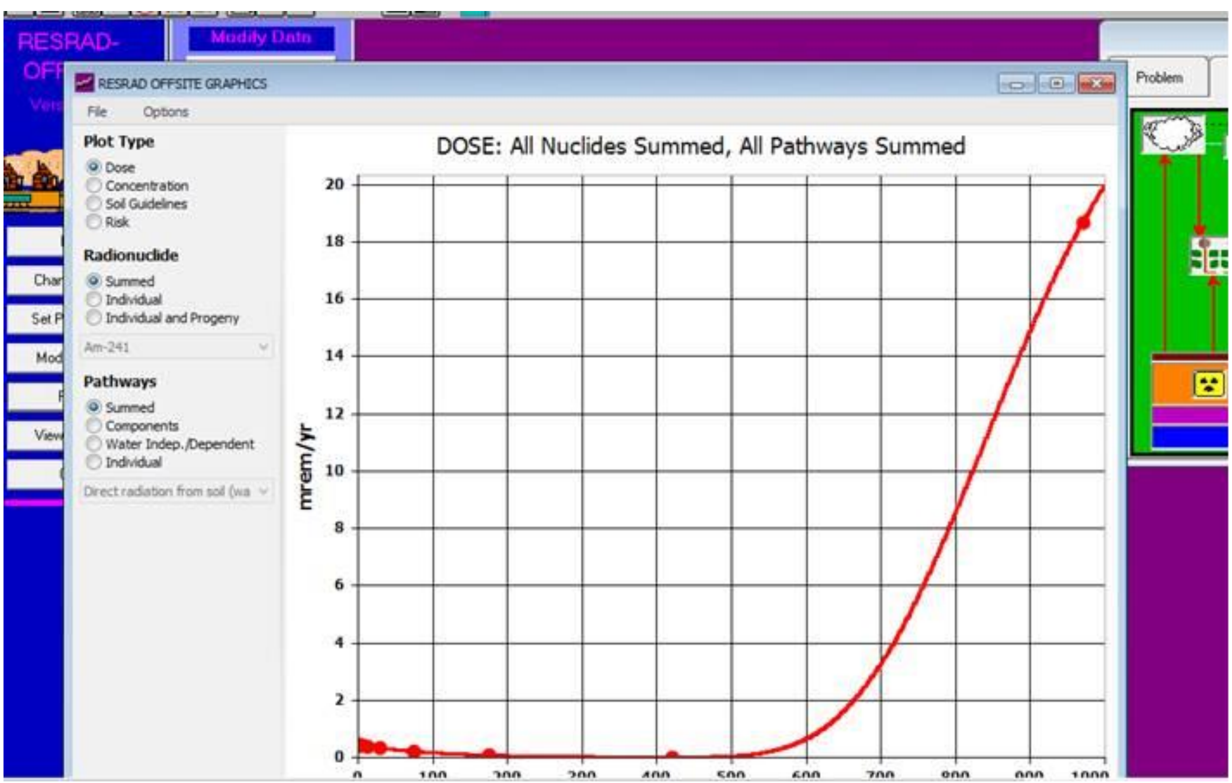



```
RESRAD-OFFSITE, Version 4.0         T½ Limit = 30 days        02/14/2020  09:13  Page   1
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File  : Site2.ROF

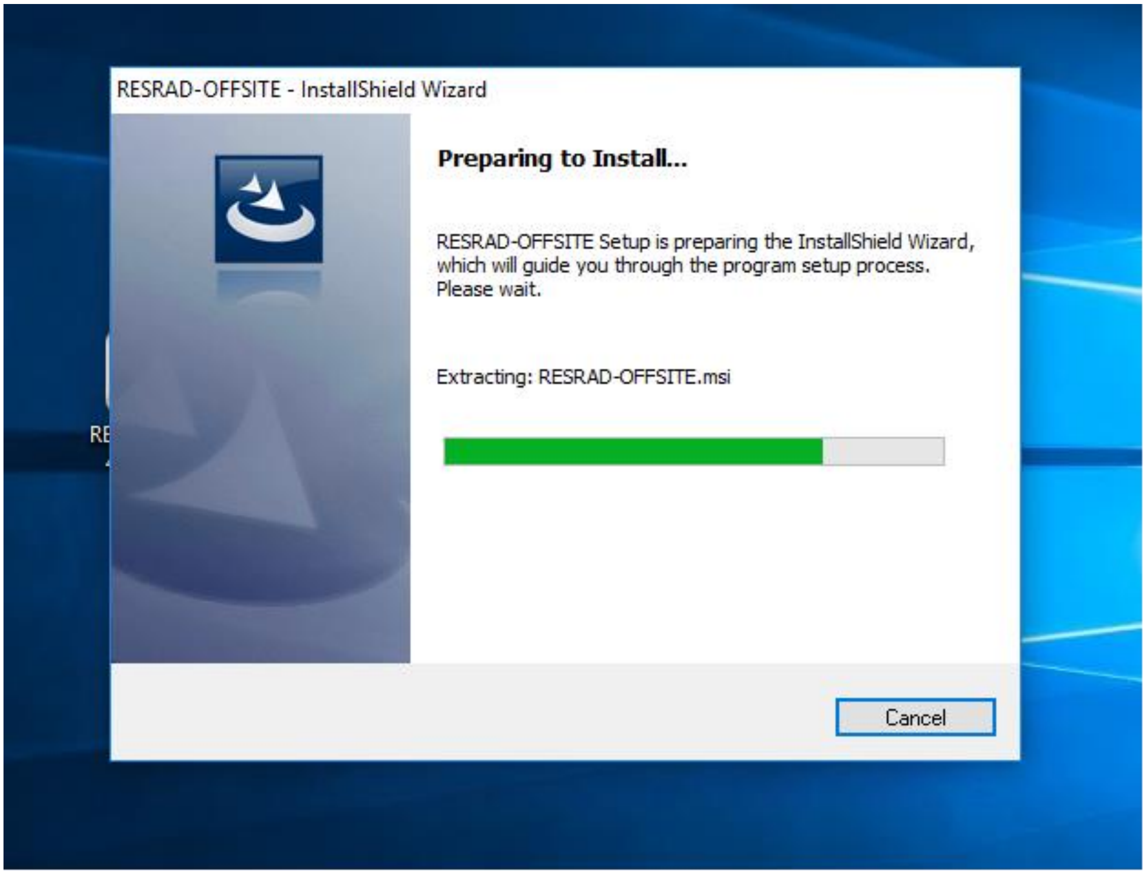
                       Table of Contents
                       _________________

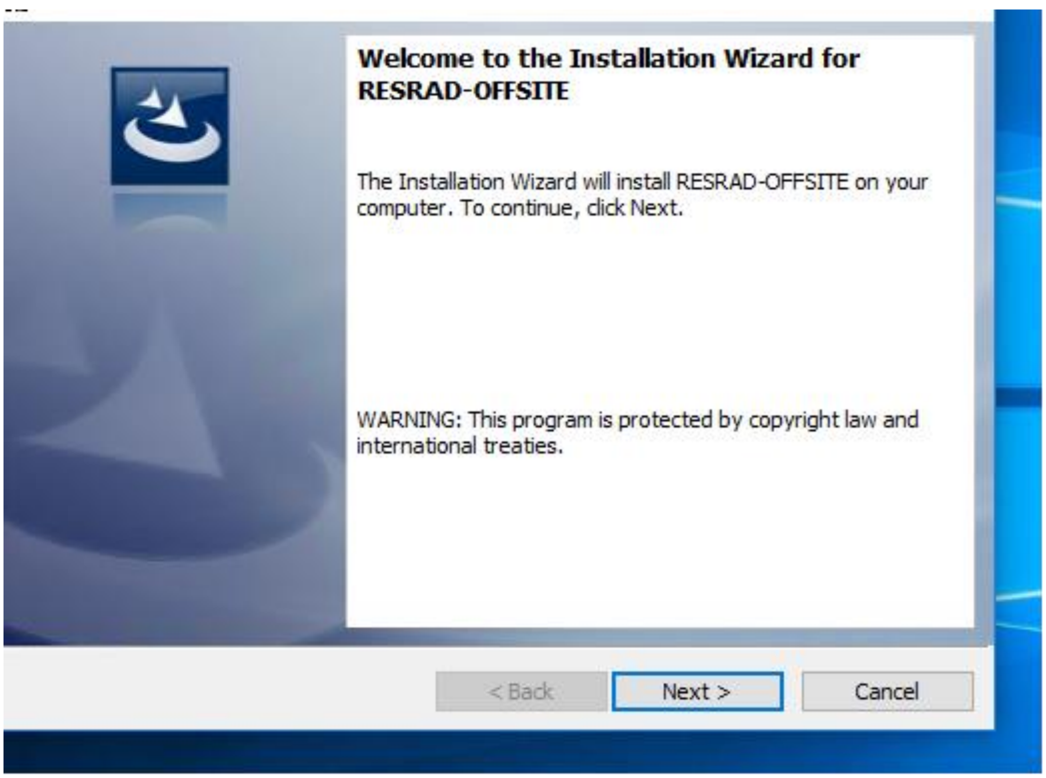
   Part I: Mixture Sums and Single Radionuclide Guidelines
   _______________________________________________________

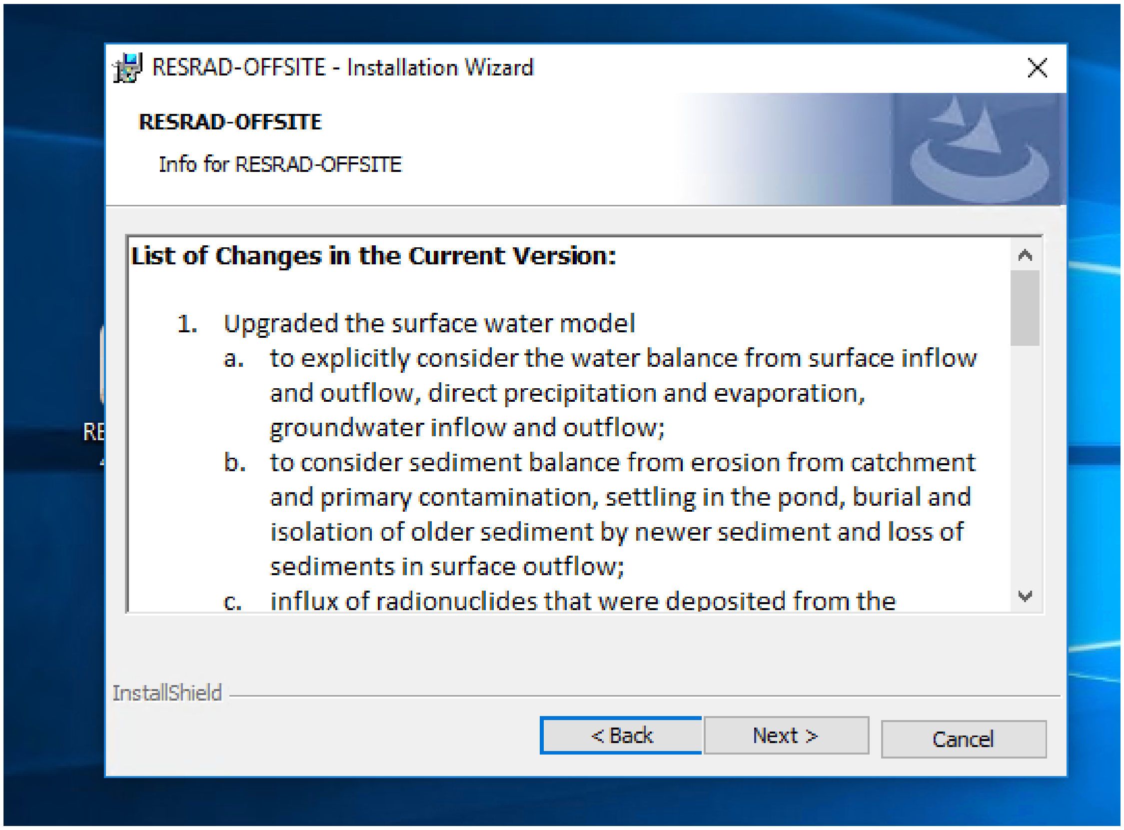
Dose Conversion Factor (and Related) Parameter Summary ...    2
Site-Specific Parameter Summary ...........................    5
Summary of Pathway Selections .............................   35
Contaminated Zone and Total Dose Summary ..................   36
Total Dose Components
     Time = 0.000E+00 ....................................   37
     Time = 1.000E+00 ....................................   38
     Time = 3.000E+00 ....................................   39
     Time = 6.000E+00 ....................................   40
     Time = 1.200E+01 ....................................   41
     Time = 3.000E+01 ....................................   42
     Time = 7.500E+01 ....................................   43
     Time = 1.750E+02 ....................................   44
     Time = 4.200E+02 ....................................   45
     Time = 9.700E+02 ....................................   46
Dose/Source Ratios Summed Over All Pathways ...............   47
Single Radionuclide Soil Guidelines .......................   47
Dose Per Nuclide Summed Over All Pathways .................   48
Soil Concentration Per Nuclide ............................   48
Run Time Information ......................................   49
```

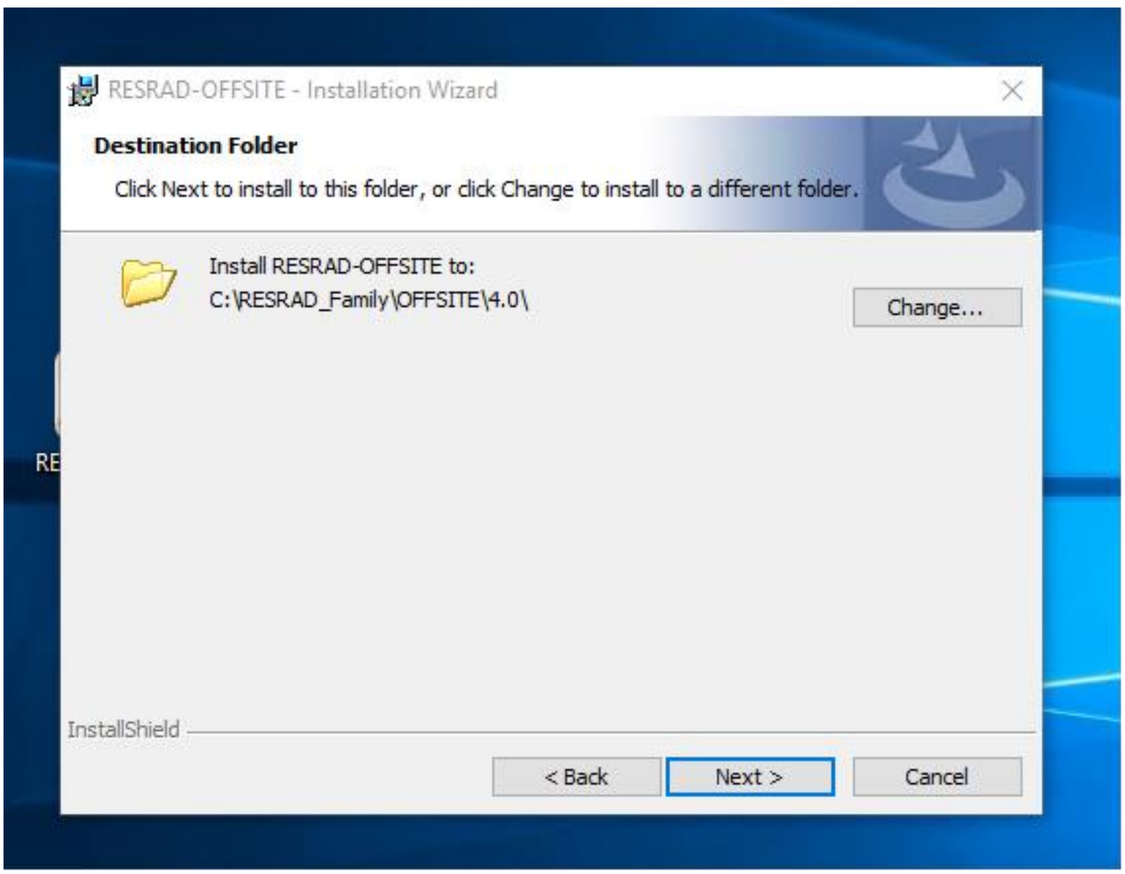


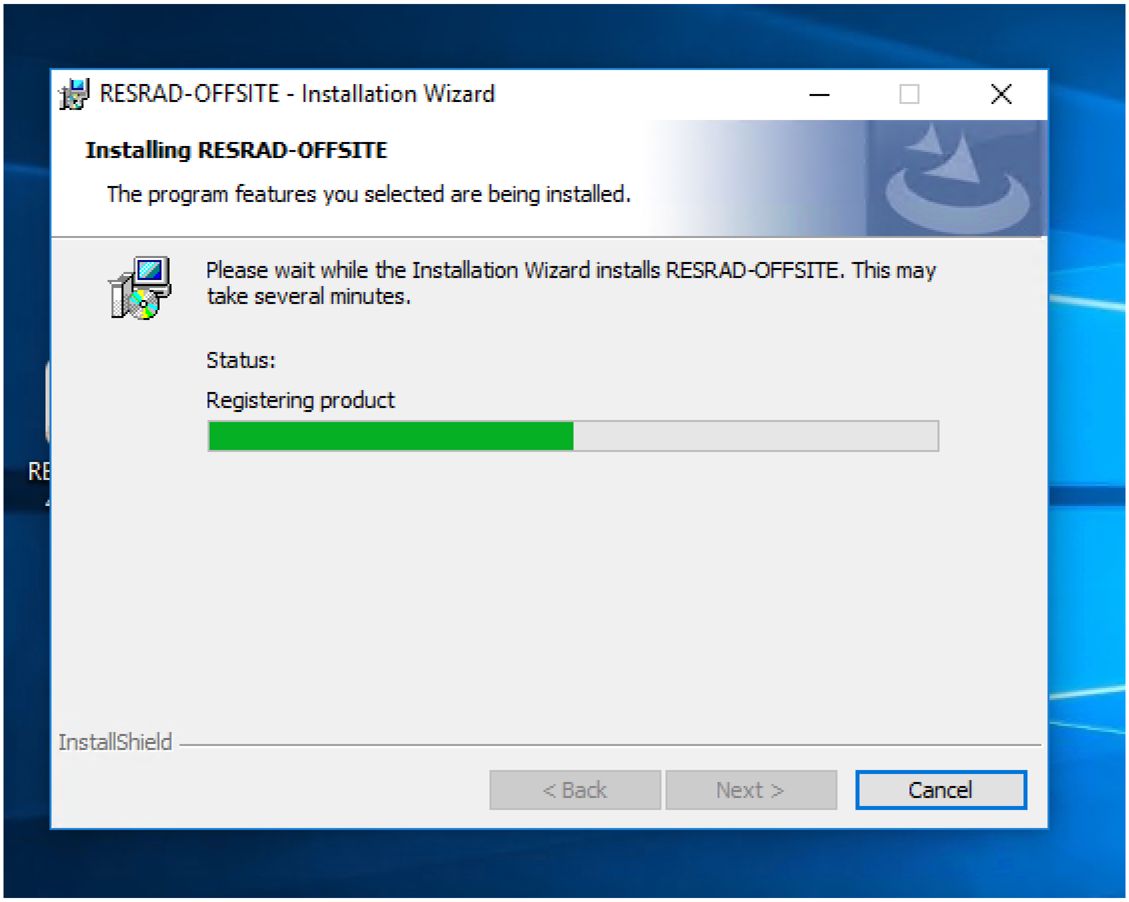
On VM Win10

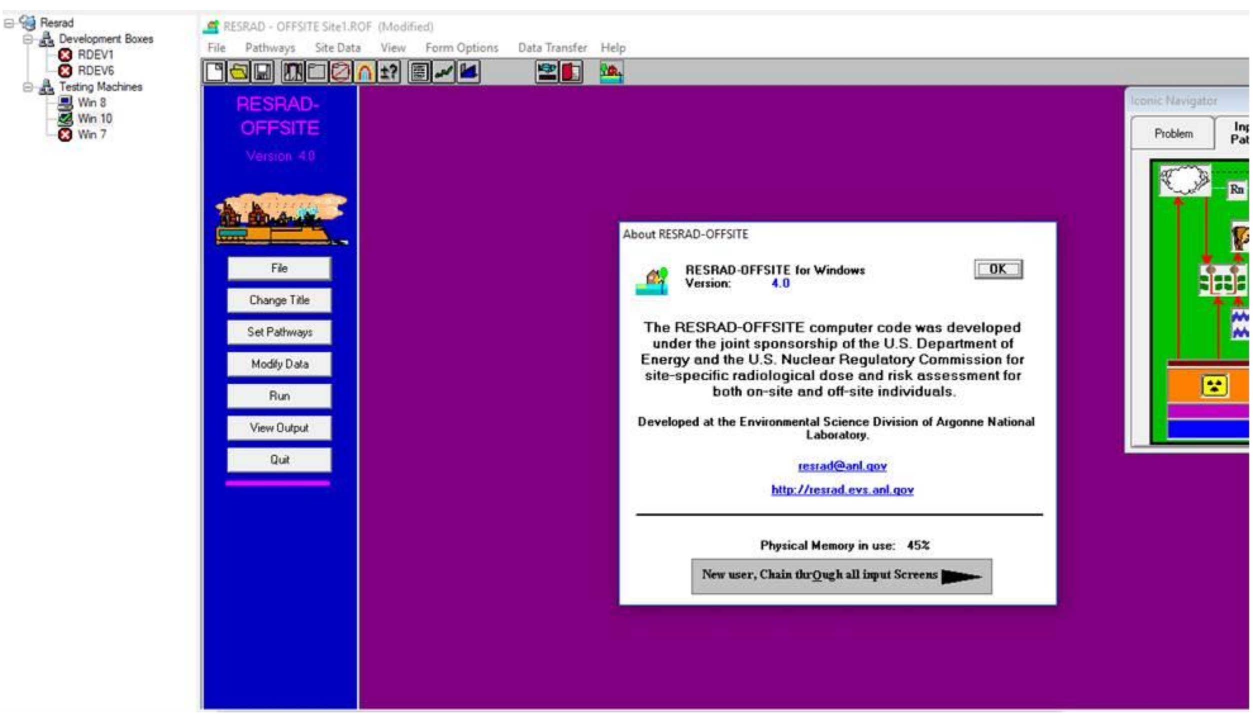

RESRAD-OFFSITE - InstallShield Wizard
Preparing to Install...
RESRAD-OFFSITE Setup is preparing the InstallShield Wizard, which will guide you through the program setup process. Please wait.
Extracting: RESRAD-OFFSITE.msi
Cancel

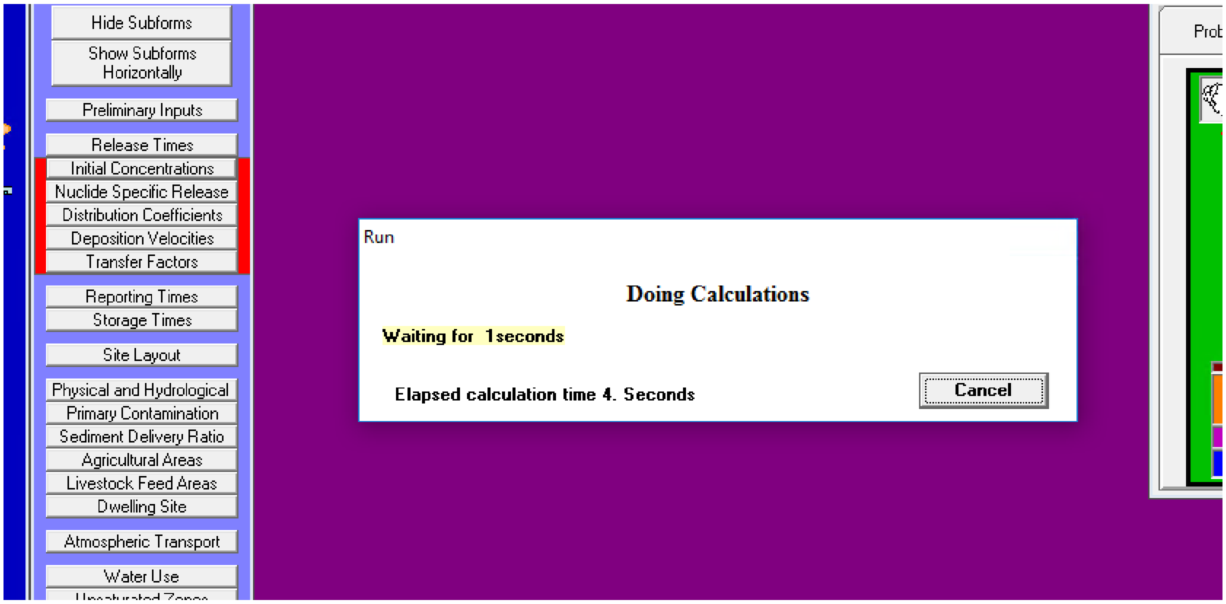

Welcome to the Installation Wizard for RESRAD-OFFSITE
The Installation Wizard will install RESRAD-OFFSITE on your computer. To continue, click Next.
WARNING: This program is protected by copyright law and international treaties.
< Back
Next >
Cancel

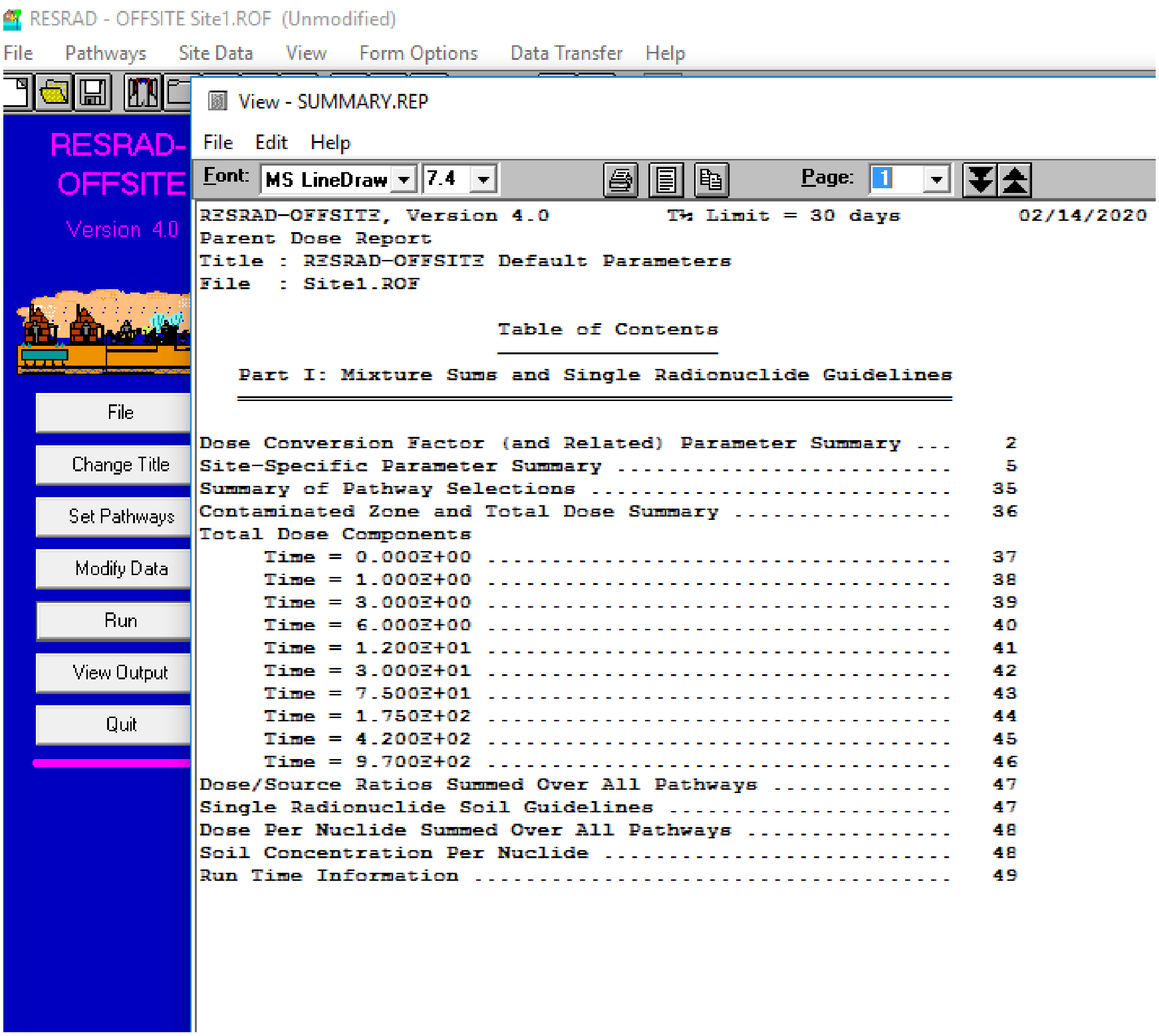

RESRAD-OFFSITE - Installation Wizard
RESRAD-OFFSITE
Info for RESRAD-OFFSITE
List of Changes in the Current Version:
1. Upgraded the surface water model
a. to explicitly consider the water balance from surface inflow and outflow, direct precipitation and evaporation, groundwater inflow and outflow;
b. to consider sediment balance from erosion from catchment and primary contamination, settling in the pond, burial and isolation of older sediment by newer sediment and loss of sediments in surface outflow;
c. influx of radionuclides that were deposited from the
InstallShield
< Back
Next >
Cancel


RESRAD-OFFSITE - Installation Wizard
Destination Folder
Click Next to install to this folder, or click Change to install to a different folder.
Install RESRAD-OFFSITE to:
C:\RESRAD_Family\OFFSITE\4.0\
Change...
InstallShield
< Back
Next >
Cancel


RESRAD-OFFSITE - Installation Wizard
Installing RESRAD-OFFSITE
The program features you selected are being installed.
Please wait while the Installation Wizard installs RESRAD-OFFSITE. This may take several minutes.
Status:
Registering product
InstallShield
< Back
Next >
Cancel


RESRAD-OFFSITE
File
Change Title
Set Pathways
Modify Data
Run
View Output
Quit
About RESRAD-OFFSITE
RESRAD-OFFSITE for Windows
OK
The RESRAD-OFFSITE computer code was developed under the joint sponsorship of the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission for site-specific radiological dose and risk assessment for both on-site and off-site individuals.
Developed at the Environmental Science Division of Argonne National Laboratory.
resrad@anl.gov
http://resrad.evs.anl.gov
Physical Memory in use: 45%
New user, Chain thrOugh all input Screens


Hide Subforms
Show Subforms Horizontally
Preliminary Inputs
Release Times
Initial Concentrations
Nuclide Specific Release
Distribution Coefficients
Deposition Velocities
Transfer Factors
Reporting Times
Storage Times
Site Layout
Physical and Hydrological
Primary Contamination
Sediment Delivery Ratio
Agricultural Areas
Livestock Feed Areas
Dwelling Site
Atmospheric Transport
Water Use
Run
Doing Calculations
Waiting for 1seconds
Elapsed calculation time 4. Seconds
Cancel


RESRAD - OFFSITE Site1.ROF (Unmodified)
File Pathways Site Data View Form Options Data Transfer Help
View - SUMMARY.REP
File Edit Help
Font: MS LineDraw 7.4
Page: 1
RESRAD-OFFSITE
Version 4.0
File
Change Title
Set Pathways
Modify Data
Run
View Output
Quit
RESRAD-OFFSITE, Version 4.0 T½ Limit = 30 days 02/14/2020
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File : Site1.ROF
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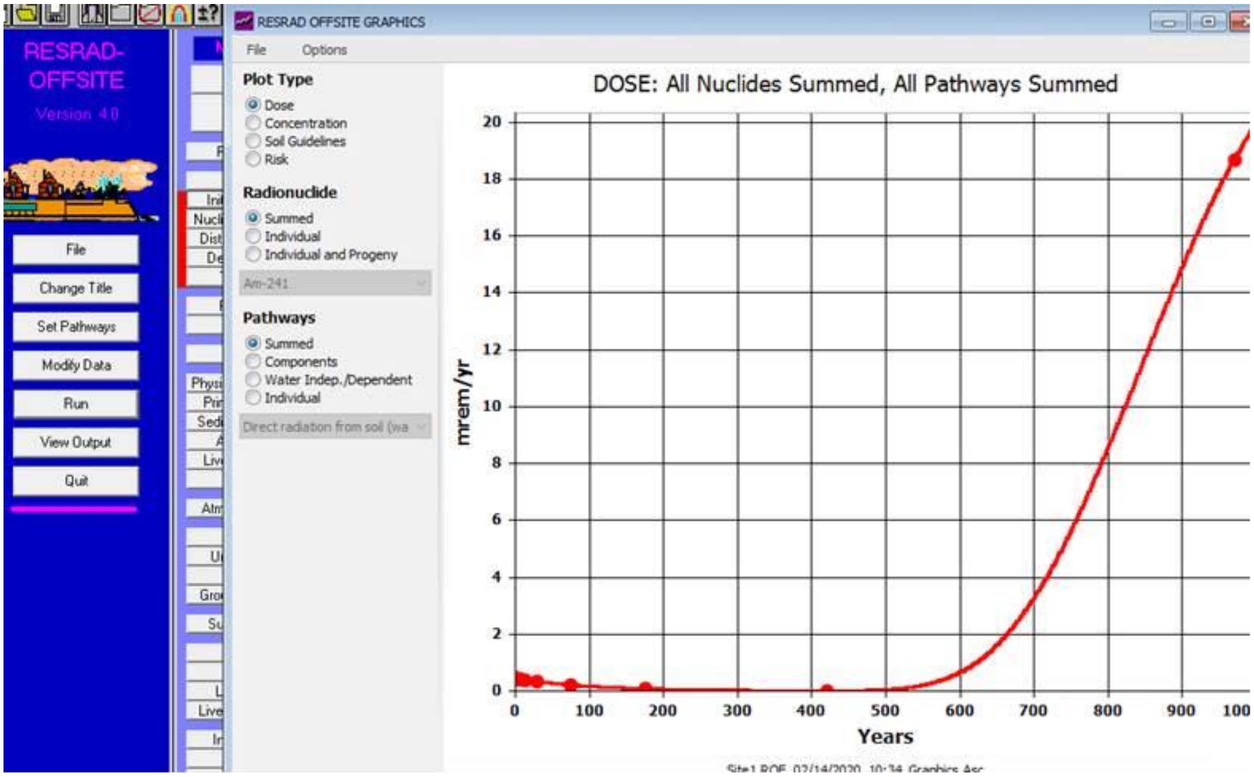
Summary of Pathway Selections 35
Contaminated Zone and Total Dose Summary 36
Total Dose Components
Time = 0.000E+00 37
Time = 1.000E+00 38
Time = 3.000E+00 39
Time = 6.000E+00 40
Time = 1.200E+01 41
Time = 3.000E+01 42
Time = 7.500E+01 43
Time = 1.750E+02 44
Time = 4.200E+02 45
Time = 9.700E+02 46
Dose/Source Ratios Summed Over All Pathways 47
Single Radionuclide Soil Guidelines 47
Dose Per Nuclide Summed Over All Pathways 48
Soil Concentration Per Nuclide 48
Run Time Information 49


RESRAD OFFSITE GRAPHICS
File
Options
RESRAD-OFFSITE
Version 4.0
File
Change Title
Set Pathways
Modify Data
Run
View Output
Quit
Plot Type
Dose
Concentration
Soil Guidelines
Risk
Radionuclide
Summed
Individual
Individual and Progeny
Am-241
Pathways
Summed
Components
Water Indep./Dependent
Individual
Direct radiation from soil (wa
DOSE: All Nuclides Summed, All Pathways Summed
mrem/yr
Years

12.2 TEST CASE 002 TESTER'S REPORT

Documented in Test-002_report.docx of 2/20/2020 6:32 AM

Test Case 002 Report

By cheng wang 2/13/2020

Objective: To test OFFSITE Nuclide Decay and Ingrowth

Conclusion: the code worked as expected.

Procedure:

1. Copy input files to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\002

2. Run the input file.

3. Export the concentration for U-238, U-234, Th-230, Ra-226, Pb-210, Po-210 to the folder.

4. Put all the results in file "test-001_comp.xlsx" and compare with the expected results.

As shown in test-001_comp.xlsx, the results matched with the expected results, except the concentrations of Pb-210 and Po-210 at time 1 year. The discrepancies are acceptable.

Year	Pb-210 from code	Pb-210 hand-calculated	Po-210 form code	Po-210 hand-calculated
1	1.38E-15	1.40E-15	4.13E-16	4.01E-16

12.3 TEST CASE 003-001 TESTER'S REPORT

Documented in Test-003-001_report.docx of 2/19/2020 3:16 PM

Test Case 003-001 report

By cheng wang 2/13/2020

Objective:

Conclusion: the code worked as expected.

Procedure:

1. Copy input files to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\003-001

2. Run the input file.

3. Copy file “CZTHICK3.DAT” to the testing folder, rearrange the data to file “CZTHICK3.xlsx”, and compare the results with the expected ones.

The results calculated by code matched with the expected results.

12.4 TEST CASE 003-002 TESTER'S REPORT

Documented in Test-003-002_report.docx of 2/19/2020 3:16 PM

Test Case 003-002 report

By cheng wang 2/13/2020

Objective: Tests OFFSITE Source Term Mixing Concentration

Conclusion: the code worked as expected

Procedure

1. Copy input files to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\003-002

2. Run the input file.

3. Copy file "CZTHICK3.DAT" to the testing folder, rearrange the data to file "CZTHICK3.xlsx", and compare the results with the expected ones.

The results calculated by code matched with the expected results.

12.5 TEST CASE 003-003 TESTER'S REPORT

Documented in Test-003-003_report.docx of 2/19/2020 3:24 PM

Test Case 003-003 report

By cheng wang 2/13/2020

Objective: Tests OFFSITE Source Term Mixing Concentration

Conclusion: the code worked as expected

Procedure

1. Copy input files to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\003-003

2. Run the input file.

3. Copy file "CZTHICK3.DAT" to the testing folder, rearrange the data to file "CZTHICK3.xlsx", and compare the results with the expected ones.

The results calculated by code matched with the expected results.

12.6 TEST CASE 005 TESTER'S REPORT

Documented in Test-005_report.docx of 2/27/2020 9:13 AM

Test Case 005 report

By cheng wang 2/13/2020; corrected the Objective on 2/26/2020

Objective: Test OFFSITE Source Term leaching

Conclusion: the code worked as expected

> Suggest to remove Table 2.16 from the Expected Results section because the revised results in V&V folder is used now.

Procedure

1. Copy input files to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\005

2. Run the input file.

3. Copy file "AQFLUXIN.DAT" to the testing folder, rearrange the data to file "AQFLUXIN.xlsx", and compare the results with the expected release to groundwater in file "Revised Verification for U238.xls" tab "release"

The results calculated by code matched with the expected results, except the minor discrepancies on the values for Pb-210 and Po-210 at year1.

Year	Pb-210 by code	Po-210 by code	Pb-210 by hand-calculation	Po-210 by hand-calculation
1	6.87E-08	2.01E-07	6.94E-08	1.81E-07

12.7 TEST CASE 020-001 TESTER'S REPORT

Documented in Test-020-001_report.docx of 2/19/2020 7:25 PM

Test Case 020-001 report

By cheng wang 2/13/2020

Objective: Tests OFFSITE gaseous and particulate C-14 pathways

Conclusion: the code worked as expected

Need to modify the input file; change the initial concentration from 100 Bq/g to 1 Bq/g (according to file "20-001 inhalation of carbon 14.docx" in V&V\Special radionuclides\ folder)

Procedure

1. Copy input files to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\020-001

2. Run the input file.

3. Export "Dose: C-14, Inhalation" data to file "C-14_inh.csv" using Wresplot.

4. Export data from "C-14_inh.csv" to file "C-14_inh.xlsx". Copy hand-calculated results from file "C14 inhalation.xlsx" tab "gas and particulates" to "C-14_inh.xlsx", and compare them.

The results calculated by code matched with the expected results.

12.8 TEST CASE 020-002 TESTER'S REPORT

Documented in Test-020-002_report.docx of 2/20/2020 8:19 AM

Test Case 020-002 report

By cheng wang 2/13/2020

Objective: To tess OFFSITE tritium inhalation pathways

Conclusion: the code worked as expected

Procedure

1. Copy the input file to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\020-002

2. Run the input file.

3. Export "Dose: H-3, Inhalation" data to file "H-3_inh.csv" using Wresplot.

4. Export data from "H-3_inh.csv" to file "H-3_inh.xlsx". Copy hand-calculated results from file "H3 inhalation.xlsx" tab "gas no particulates" to "H-3_inh.xlsx", and compare them.

The results calculated by code matched with the expected results.

12.9 TEST CASE 020-003 TESTER'S REPORT

Documented in Test-020-003_report.docx of 2/19/2020 8:08 PM

Test Case 020-003 report

By cheng wang 2/13/2020

Objective: Tests OFFSITE Rn-222 inhalation pathways

Conclusion: the code worked as expected

Procedure

1. Copy the input file to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\020-003

2. Run the input file.

3. Export "Dose: All Nuclides Summed, Radon (Waterborne)" data to file "Rn-222_water.csv" using Wresplot.

4. Export data from "Rn-222_water.csv" to file "Rn-222_water.xlsx". Copy hand-calculated results from file "Rn 222 household water.xlsx" tab "RnProgenyDose" to "Rn-222_water.xlsx", and compare them.

The results calculated by code matched with the expected results.

12.10 TEST CASE 020-004 TESTER'S REPORT

Documented in Test-020-004_report.docx of 2/20/2020 5:00 AM

Test Case 020-004 report

By cheng wang 2/13/2020

Objective: Test OFFSITE Rn-220 inhalation pathways

Conclusion: the code worked as expected

Procedure

1. Copy the input file to the folder C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\020-004

2. Run the input file.

3. Export "Dose: All Nuclides Summed, Radon (Waterborne)" data to file "Rn-220_water.csv" using Wresplot.

4. Export data from "Rn-220_water.csv" to file "Rn-220_water.xlsx". Copy hand-calculated results from file "Rn 220 household water.xlsx" tab "RnProgenyDose" to "Rn-220_water.xlsx", and compare them.

The results calculated by code matched with the expected results.

12.11 TEST CASE 027-001 TESTER'S REPORT

Documented in Results-Test-27-1.docx of 2/26/2020 4:09 PM

Results for Test Case 27-1

Test performed as described. Went through the report files and found all elements and formatting worked as described in the test case. The three report files (summary.rep, intrisk.rep, and daudose.rep) are also saved.

12.12 TEST CASE 027-002 TESTER'S REPORT

Documented in Results-Test-27-2.docx of 2/17/2020 8:00 AM

Results for Test Case 27-2

Step 1 Open RESRAD-OFFSITE Version 4.0

Step 2 Click on "Modify Data" command button in DOS Emulator

Step 3 Select "Initial Concentrations" Form

Step 4 Add Ac-227 in "Initial Concentrations" Form

Step5 Close the form and save file as Test_27-2.rof

Step 6 Click on "Run" command button in DOS Emulator

Step 7 The report Viewer pops up and opens SUMMARY.REP file.

Step 8 Clicked on File menu and checked its functions (Save, Save All, Printer Setup, Print, Adjust Font, Make New MyFonts.Dat, View Another File, and Exit Viewer). Screenshots for some are below

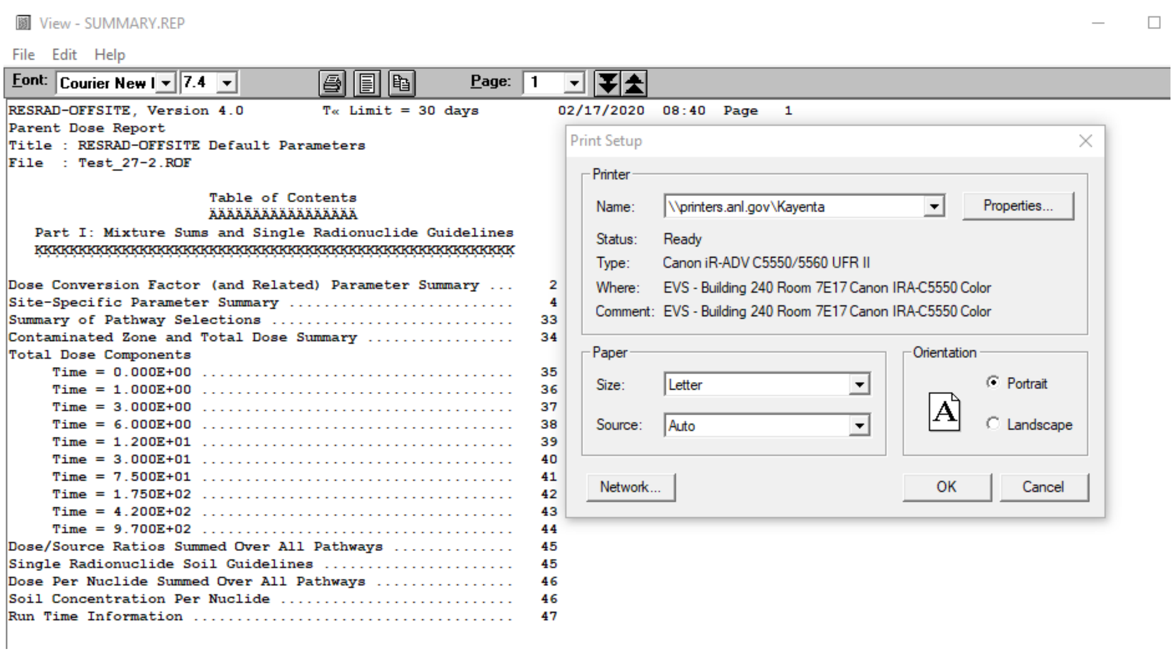


Figure 1 Printer Setup Screenshot

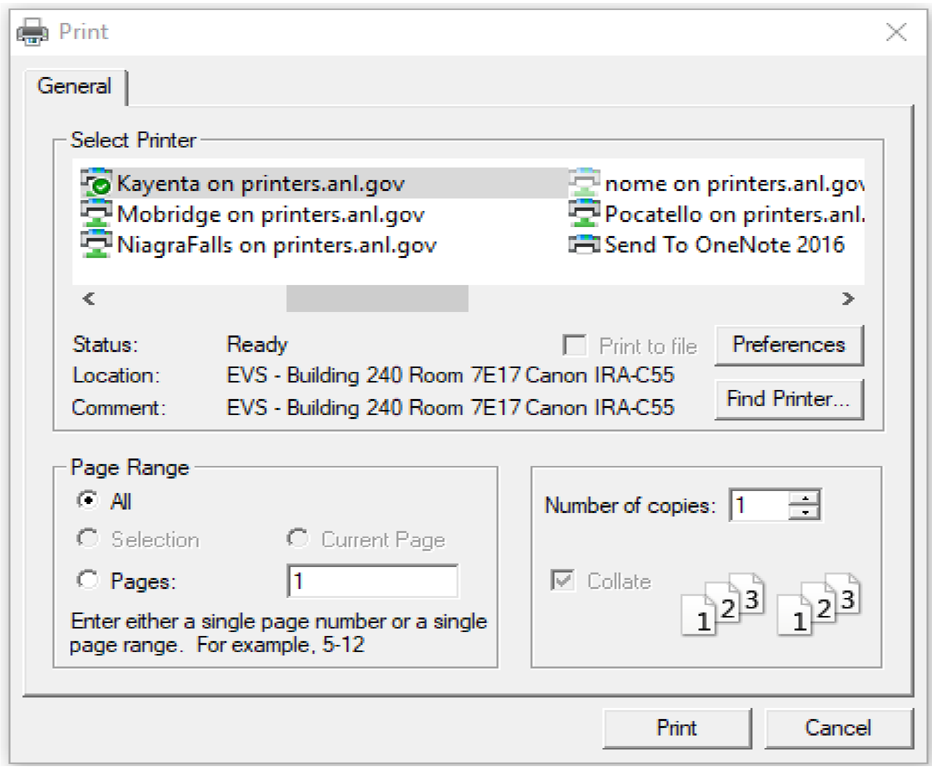
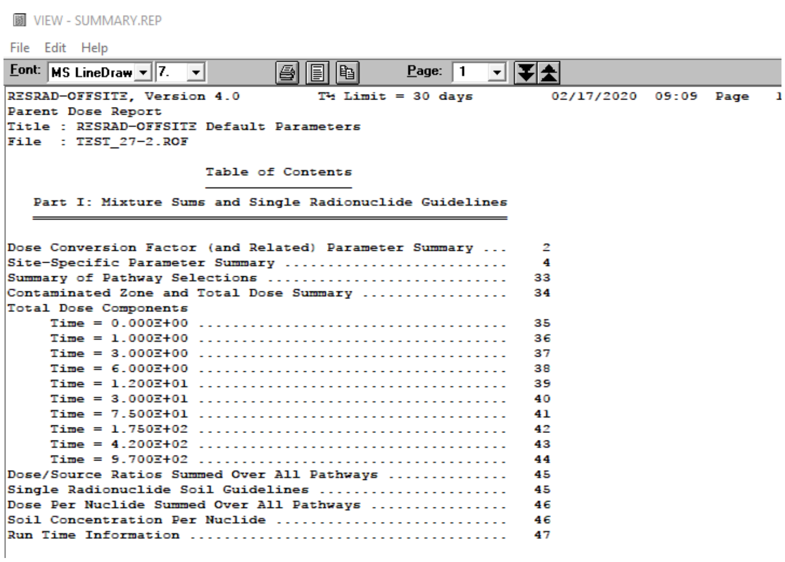
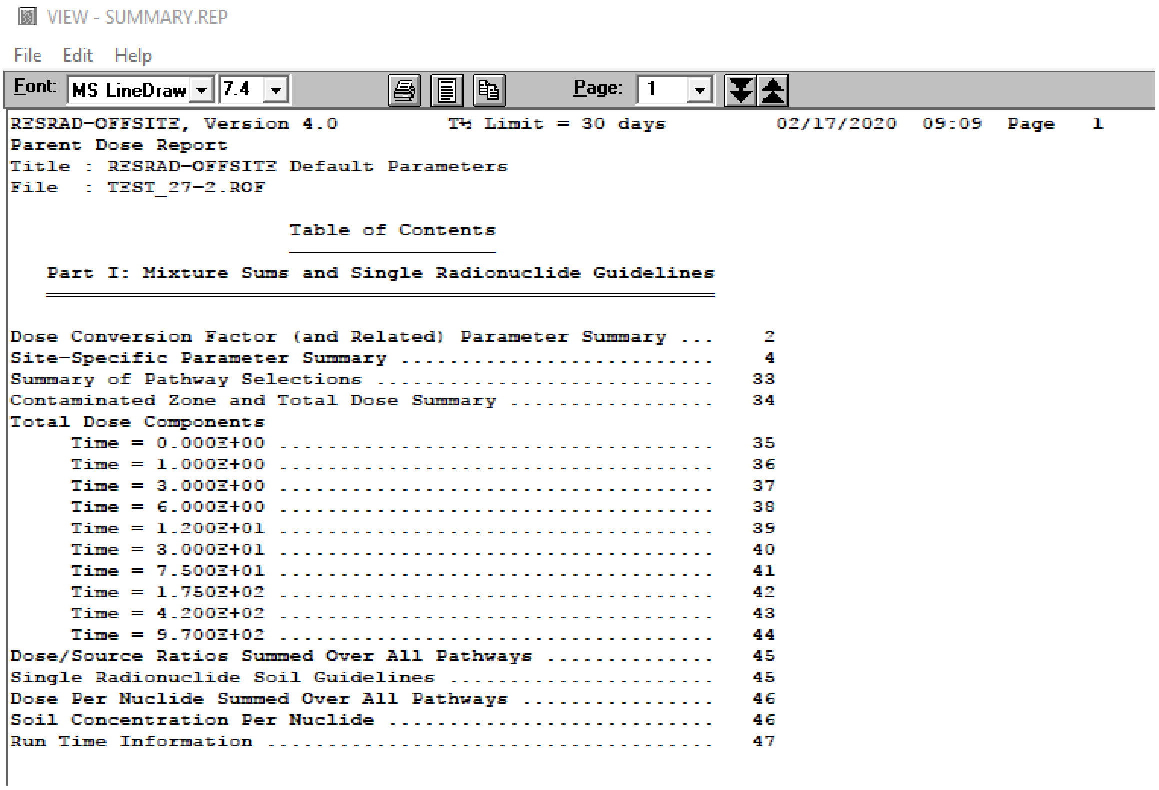


Figure Print Screenshot

Clicking on “Adjust Font” changed the font size to 7(see screenshot below)



Clicking on “Make New MyFonts.Dat” changed the font size to 7.4(see screenshot below)



RESRAD-OFFSITE, Version 4.0 T½ Limit = 30 days 02/17/2020 09:09 Page 1
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File : TEST_27-2.ROF

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

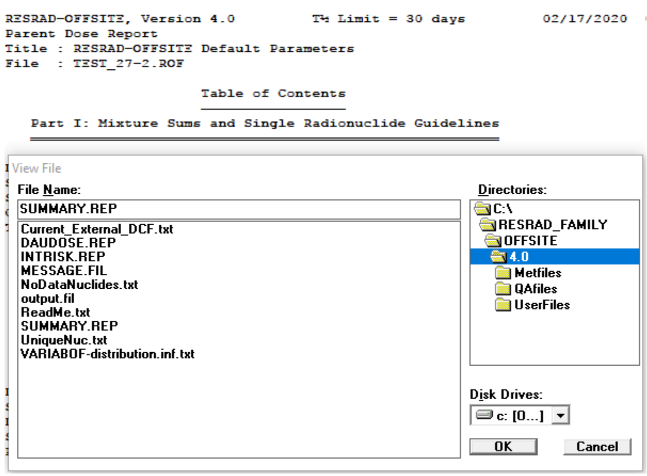
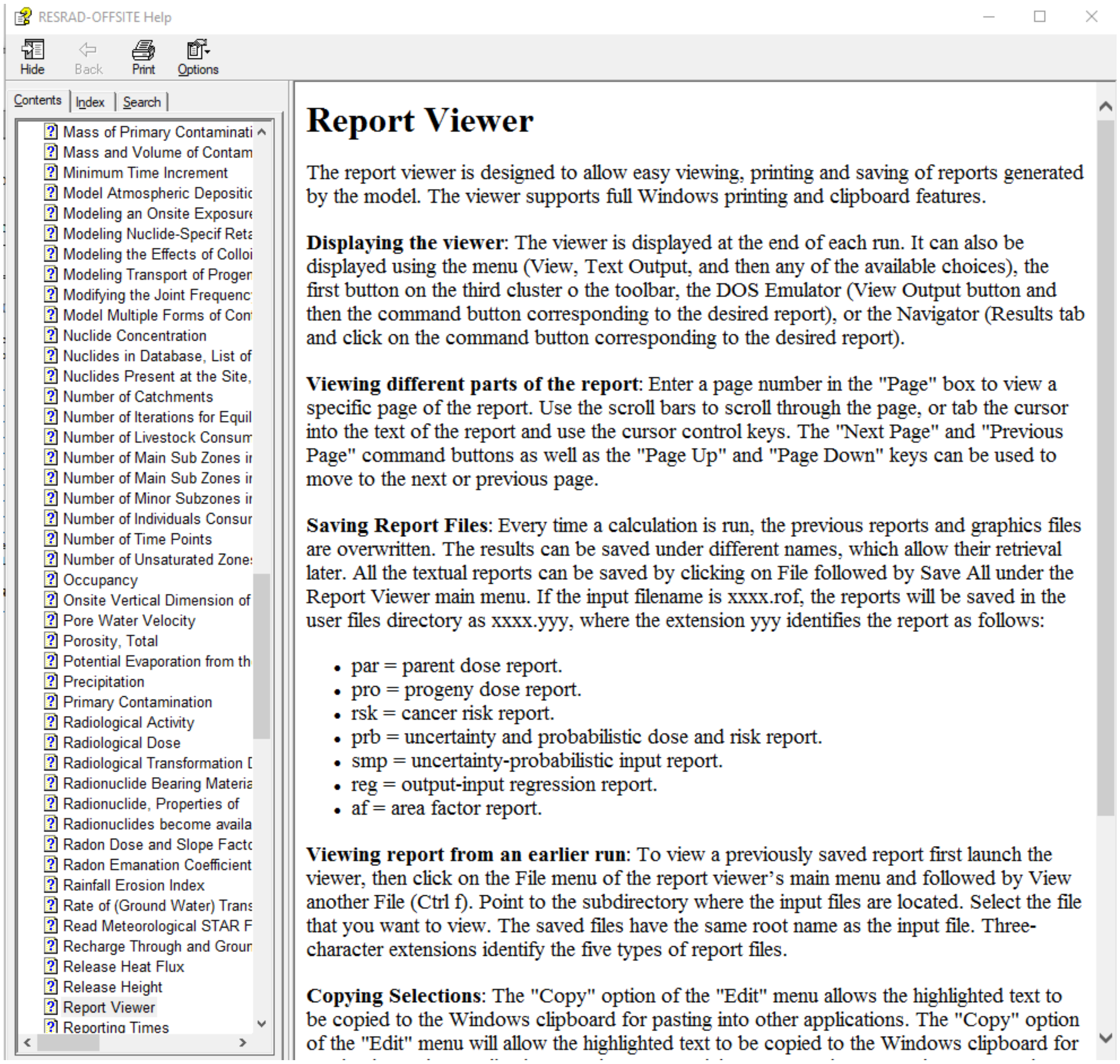


Figure View Another File Screenshot

Exit Viewer closes the file.

Step 9 Edit menu enabled to select all and copy of the present page

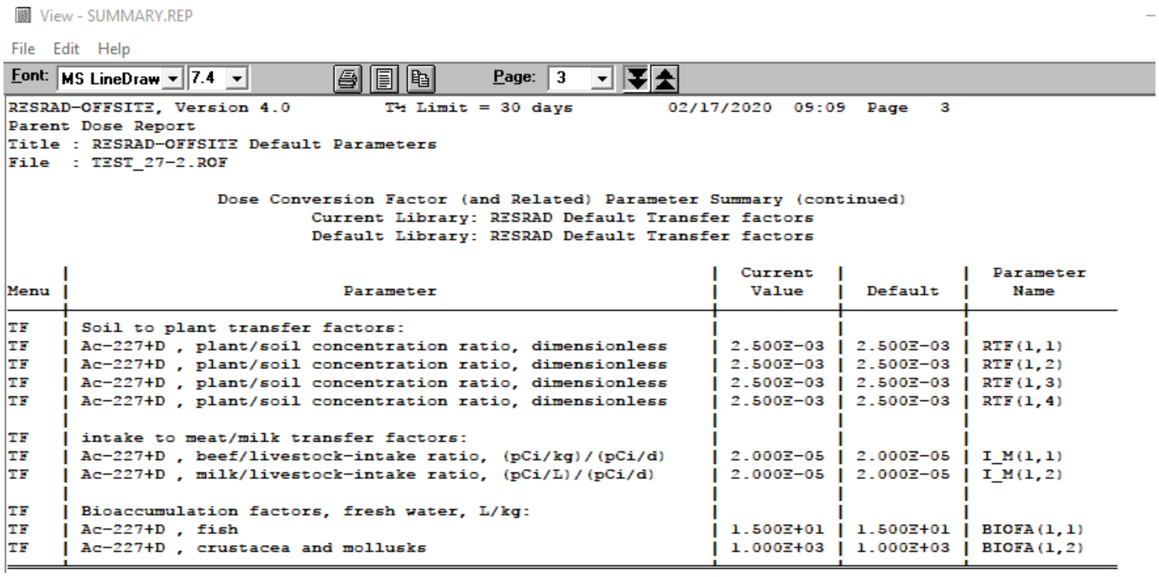
Step10 Help menu opened the help file for the code with Report Viewer topic page opened (see screenshot below)



Step 11 Checked Tool bar icons.

The page up/down worked.

Step 12 Put the cursor on the page number box, type 3, and the press Enter key, and Page 3 (see screenshot below).

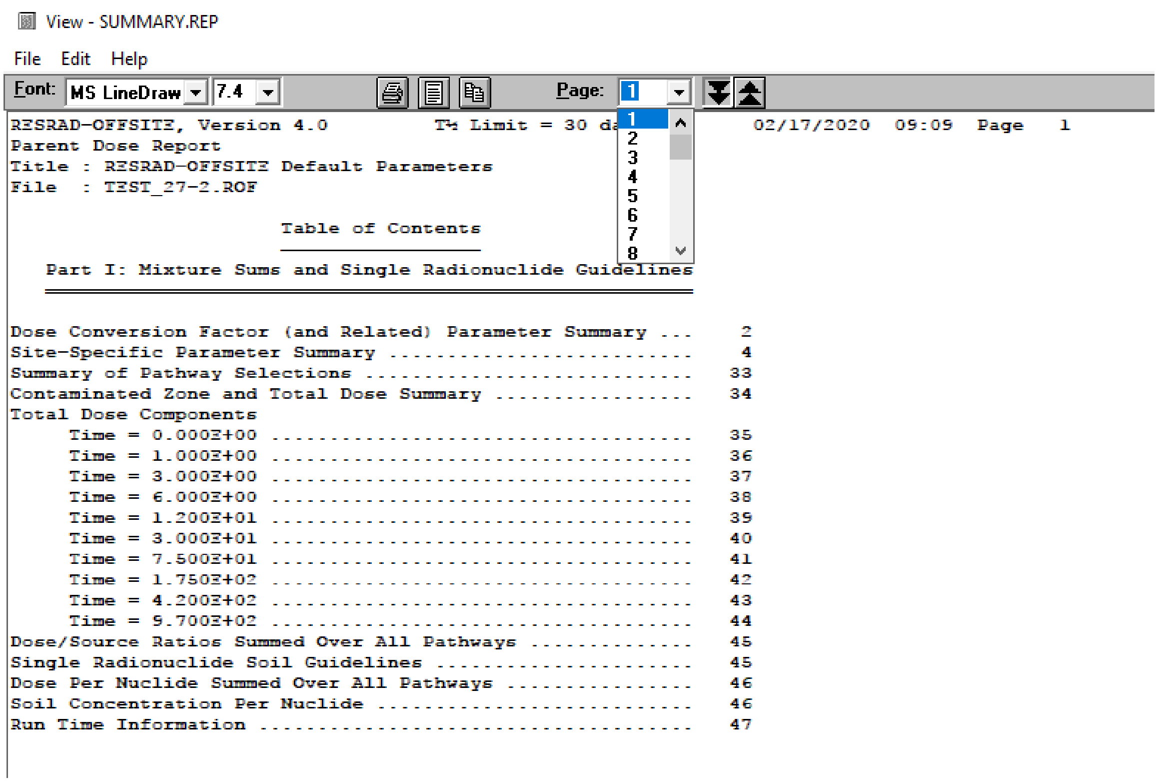


RESRAD-OFFSITE, Version 4.0 T½ Limit = 30 days 02/17/2020 09:09 Page 3
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File : TEST_27-2.ROF

Dose Conversion Factor (and Related) Parameter Summary (continued)
Current Library: RESRAD Default Transfer factors
Default Library: RESRAD Default Transfer factors

Menu	Parameter	Current Value	Default	Parameter Name
TF	Soil to plant transfer factors:			
TF	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
TF	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,2)
TF	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,3)
TF	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,4)
TF	intake to meat/milk transfer factors:			
TF	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	I_M(1,1)
TF	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	I_M(1,2)
TF	Bioaccumulation factors, fresh water, L/kg:			
TF	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFA(1,1)
TF	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFA(1,2)

Step 13 Clicked the dropdown arrow of page number, a list of pages appeared (see screenshot below)



RESRAD-OFFSITE, Version 4.0 T½ Limit = 30 da 02/17/2020 09:09 Page 1
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File : TEST_27-2.ROF

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Step 14 Used Toolbar icon->View>Test Output>Parent Dose Report, Left side navigation panel -> View Output -> Parent Dose Report, Iconic Navigator>Results|>Parent Dose Report. All opened “SUMMARY.REP.”

12.13 TEST CASE 028-001 TESTER'S REPORT

Documented in RESOFF-TEST-001 Test Cases ekg.pdf of 2/12/2020 3:21 PM

Project	**RESRAD-OFFSITE**
Test Case ID	RESOFF-TEST-28-001
Test Summary	Test the functionality of Wresplot
Created By/Date	CW 10/17/2019
Test Objective	To test the functionality of Wresplot

Procedure

1) Run the code with initial concentration of 100 pCi/g for Ac-227 and sensitivity analysis for precipitation and contaminated zone distribution coefficient. Save the project to Test57.rof and run the code.
2) Click View|Deterministics Graphics to open Wresplot displaying the graph of current calculation.
3) Check the bottom of the right panel; it should include the input file name, file generation data, and the graphics file name, Graphics.Asc by default.
4) In the left panel, it should include Plot Type (including Dose, Concentration, Soil Guidelines, and Risk), Radionuclide (including Summed, Individual, and Individual and Progeny), Pathways (including Summed, components, water independent/dependent, and Individual), and Sensitivity (Base Case, and dropdown list for each sensitivity analysis parameter)
5) Click every option for Plot Type, Radionuclide, Pathways, and Sensitivity, and check the plot in the right panel, including X and Y-axis, plot title, legend, etc. Moving the cursor along X-axis, a textbox with information of the year where the cursor is at and the corresponding Y-axis value should display next to the cursor.
6) Under Sensitivity section, select each of the two parameters, then check the plot in the right panel.
7) The File menu should function as the self-description of each submenu.
   a. Print Review submenu should bring up a window similar to Figure e. Clicking Print should bring up a printer selection window and clicking Export to should bring up a window as shown in Figure f for file format option.

Comments 10

Comment or use @ to invite others

gnanapragasam Feb 12
done

gnanapragasam Feb 12
done

gnanapragasam Feb 12
specified item are observed

gnanapragasam Feb 12
all specifed items/options are visible

gnanapragasam Feb 12
Clicked every combination of the plot options. Checked that the y value is displayed when the cursor is moved in the plot window.

gnanapragasam Feb 12
Checked while doing step 5

gnanapragasam Feb 12
observed plot in print preview mode

to the cursor.
6) Under Sensitivity section, select each of the two parameters, then check the plot in the right panel.
7) The File menu should function as the self-description of each submenu.
   a. Print Review submenu should bring up a window similar to Figure e. Clicking Print should bring up a printer selection window and clicking Export to should bring up a window as shown in Figure f for file format option.

   b. Export Graphics submenu should bring up a window similar to Figure f for file format selection. Depending on software installed in the testing computer, the formation options could be different for different computers.
   c. Export Data submenu should enable to save the data to a .csv file.
8) Repeat Step 2 using Toolbar icon, left side navigation panel -> View Output -> Deterministic Graphics, Iconic Navigator|Results| Deterministic Graphics.

gnanapragasam Feb 12
observed the option available for export

gnanapragasam Feb 12
exported data from a plot

gnanapragasam Feb 12
launched the deterministic graphics using the three methods:
tool bar
buttons on the left panel
iconic navigator

12.14 TEST CASE 029-001 TESTER'S REPORT

Documented in Results-Test-29-1.docx of 2/17/2020 8:302 AM

Results for Test Case 29-1

Step 1 Open RESRAD-OFFSITE Version 4.0

Step 2 Click Modify Data on the Left Navigation Panel

Step 3 Click on Site Layout. The Site Layout Looks as in the Screenshot below

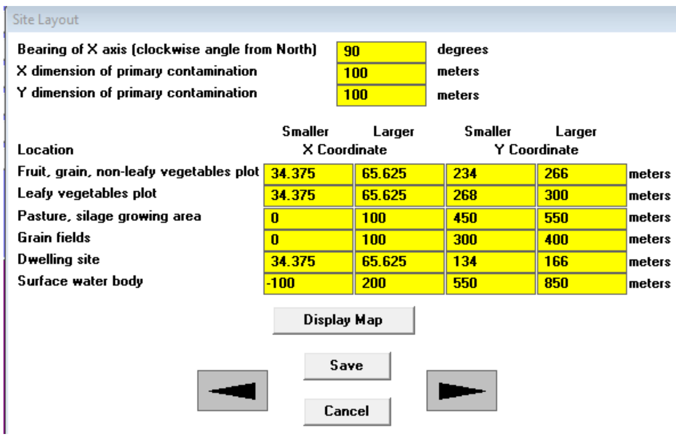


Figure Site Layout Screenshot

Step 4 Click on Display Map (The Map of the site as in the Screenshot below)

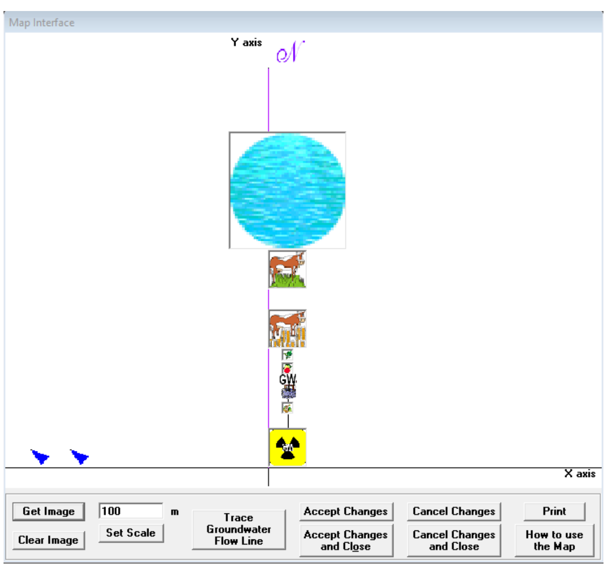


Figure Site Layout Map Screenshot

Step 5 Click File on the left Navigation Panel – File Options Window opens

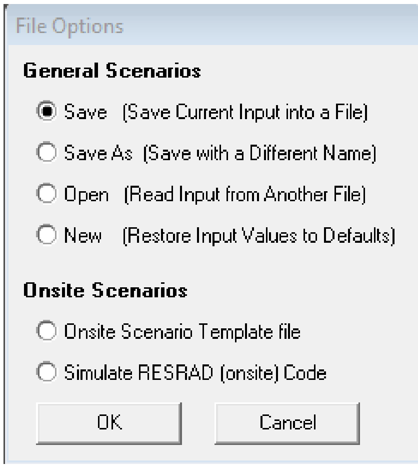


Figure File Options Window Screenshot

Step 6 Check Onsite Scenario Template file button and click OK, A new window with caption (see Screenshot below) opens

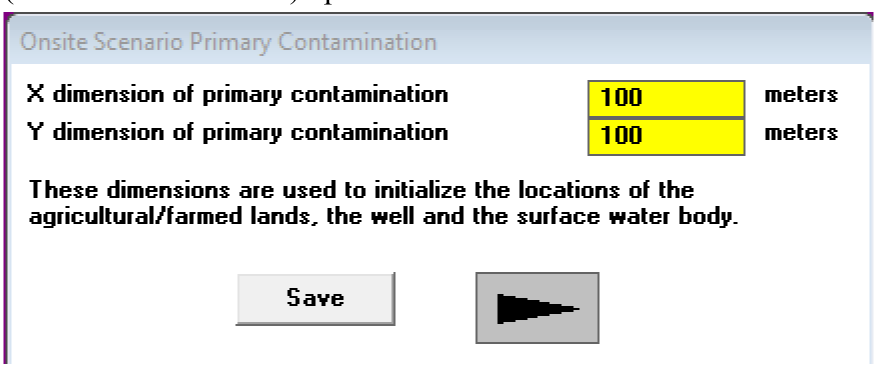
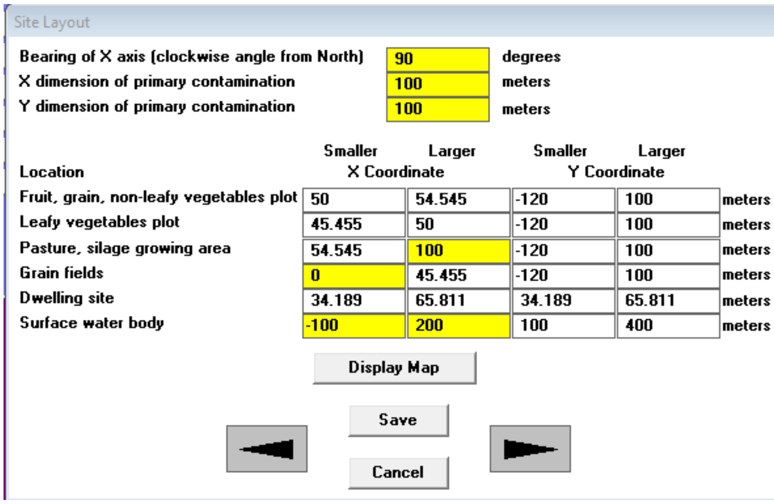


Figure Onsite Scenario Primary Contamination Window Screenshot

Step 7 Click Save

Step 8 Click Site Layout (see Screenshot below)


Site Layout

Bearing of X axis (clockwise angle from North)	90	degrees
X dimension of primary contamination	100	meters
Y dimension of primary contamination	100	meters

Location	Smaller X Coordinate	Larger X Coordinate	Smaller Y Coordinate	Larger Y Coordinate	
Fruit, grain, non-leafy vegetables plot	50	54.545	-120	100	meters
Leafy vegetables plot	45.455	50	-120	100	meters
Pasture, silage growing area	54.545	100	-120	100	meters
Grain fields	0	45.455	-120	100	meters
Dwelling site	34.189	65.811	34.189	65.811	meters
Surface water body	-100	200	100	400	meters

Display Map
Save
Cancel

Figure Site Layout Screenshot (Note change in the Site Layout)

Step 9 Click on Display Map (see Screenshot below)

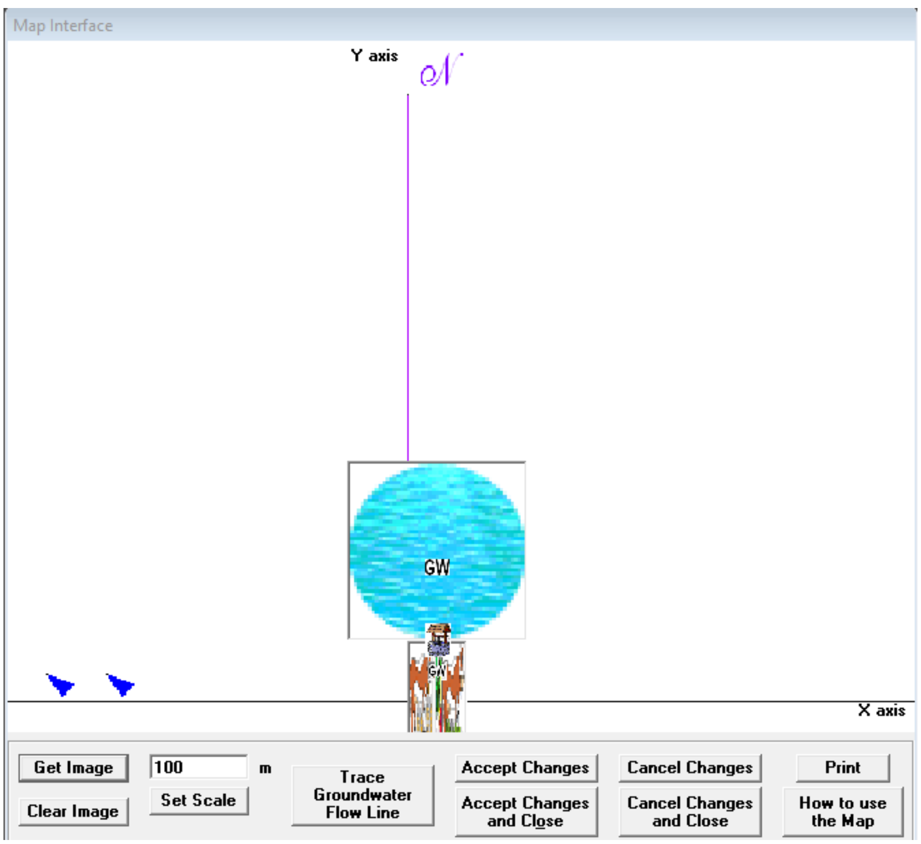


Figure Site Layout Map Screenshot – Note change in the Site Layout Map

12.15 TEST CASE 029-002 TESTER'S REPORT

Documented in Test Case 31-1-JJCheng.docx of 2/17/2020 9:02 AM

Results for Test Case 29-2

Step 1 Open RESRAD-OFFSITE Version 4.0

Step 2 Click File on the Left Navigation Panel– File Options Window opens

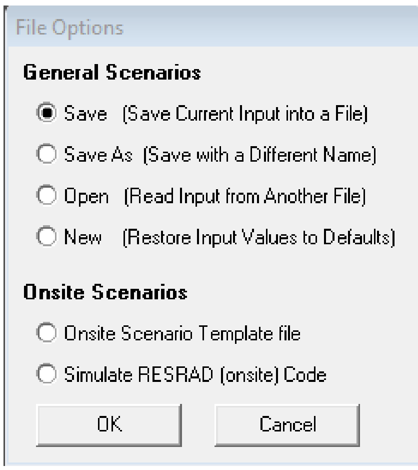


Figure File Options Window Screenshot

Step 3 Check Simulate RESRAD (onsite) Code button and click OK, A new window with caption (see Screenshot below) opens

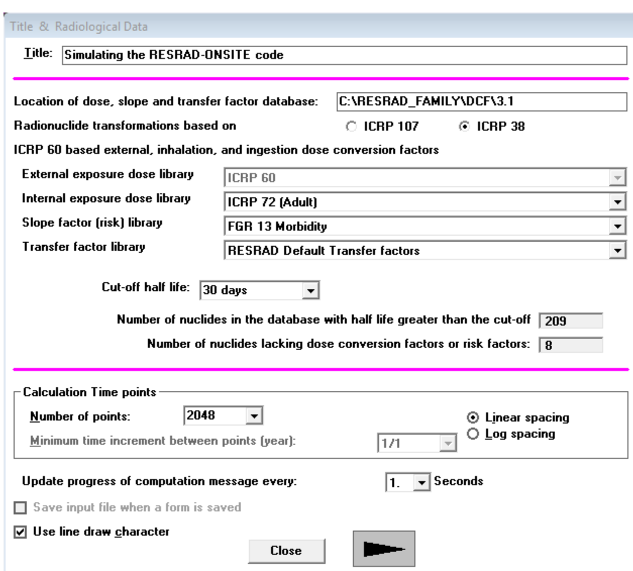


Figure Title & Radiological Data Window Screenshot

Step 4 Click Close

Step 5 Click Modify Data on the Left Navigation Panel

Step 6 Click Site Layout (see Screenshot below)

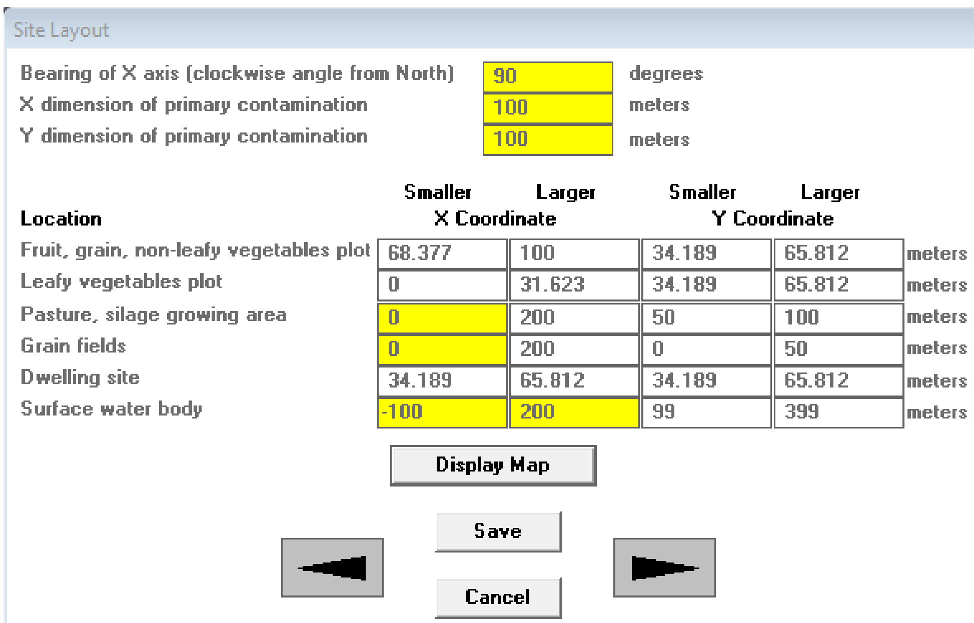


Figure Site Layout Screenshot

Step 7 Click on Display Map (see Screenshot below)

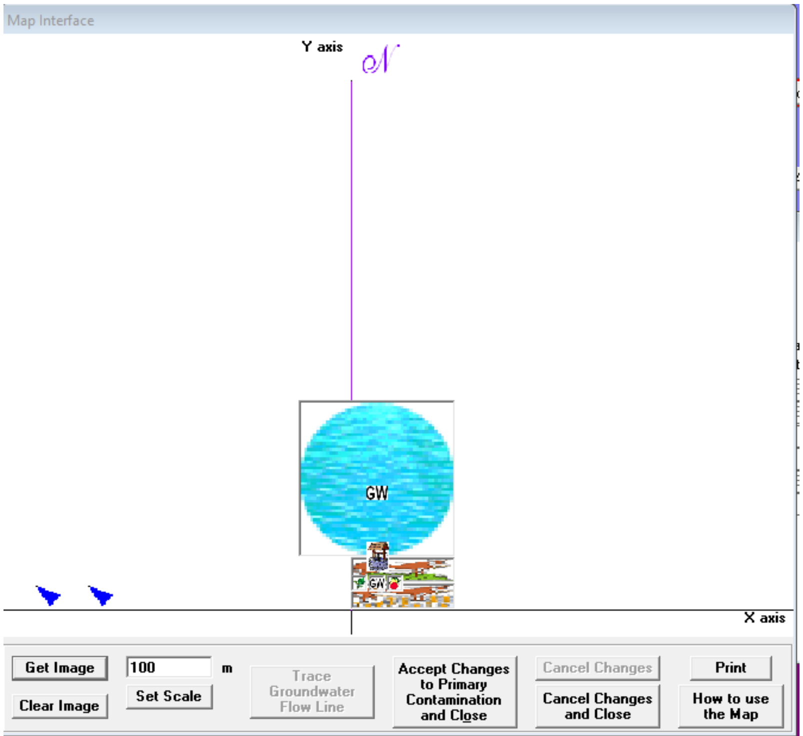


Figure Site Layout Map Screenshot

Step 8 Compare Site Layout and Site Layout Map screenshots with the screenshots in the RESRAD-OFFSITE Test Cases file.

12.16 TEST CASE 030-001 TESTER'S REPORT

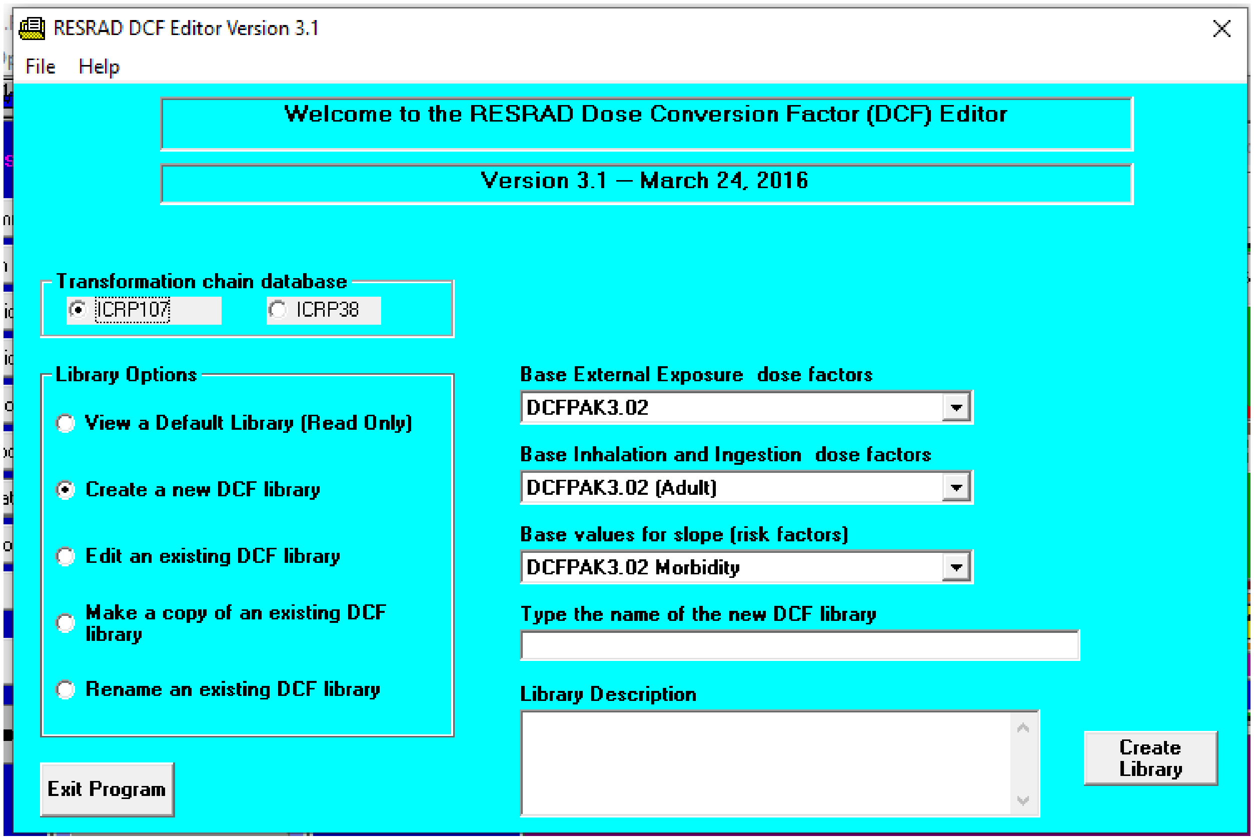
Documented in Test Case 30-1.msg of 2/14/2020 11:40 AM

Test Case 30-1

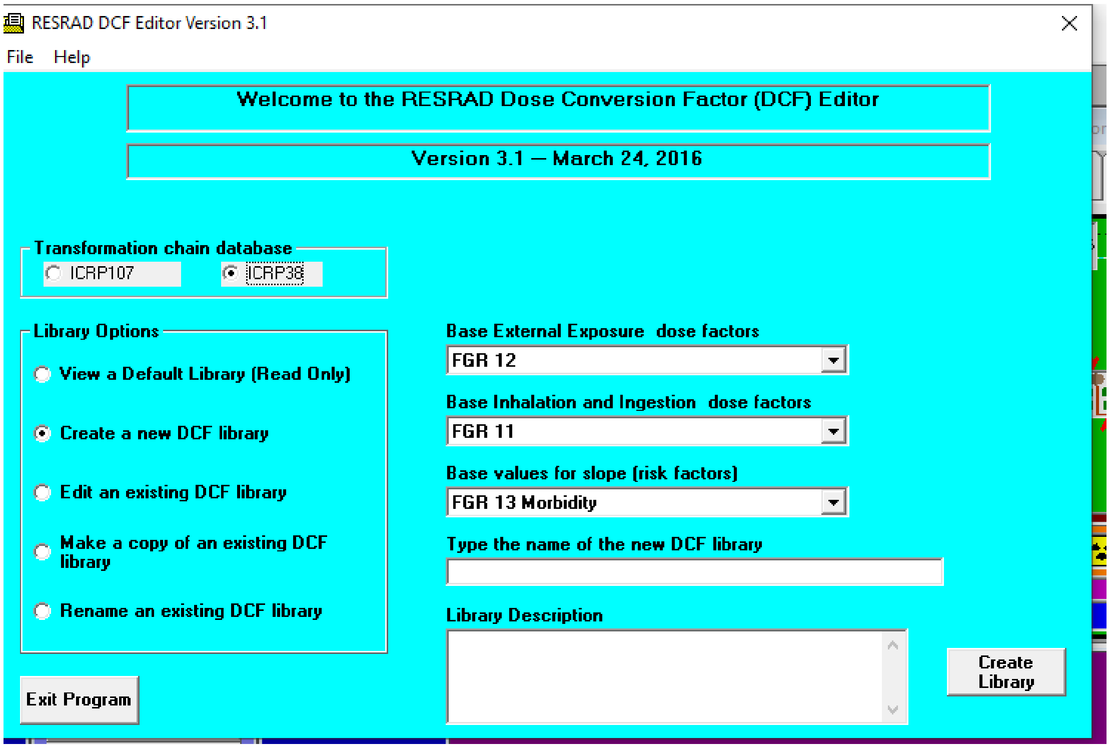
LePoire, David J. Thu 2/20/2020 11:40 AM

Summary: Went through exercising the DCF editor. Successfully created new library and connected it to input and used it.

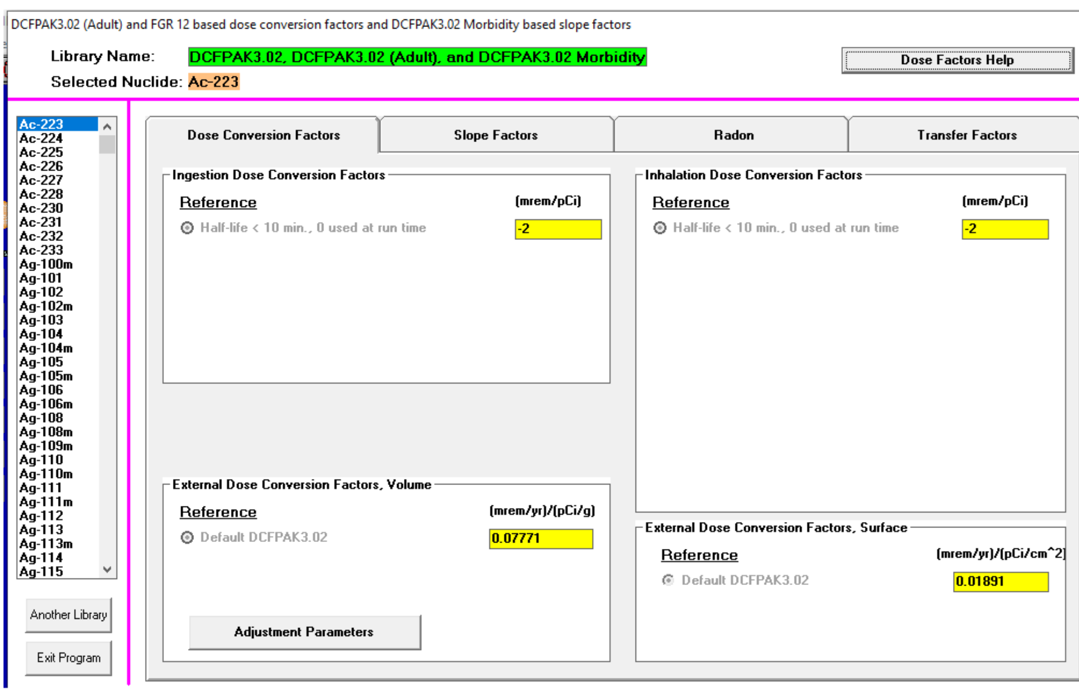
1-3) Default setting:



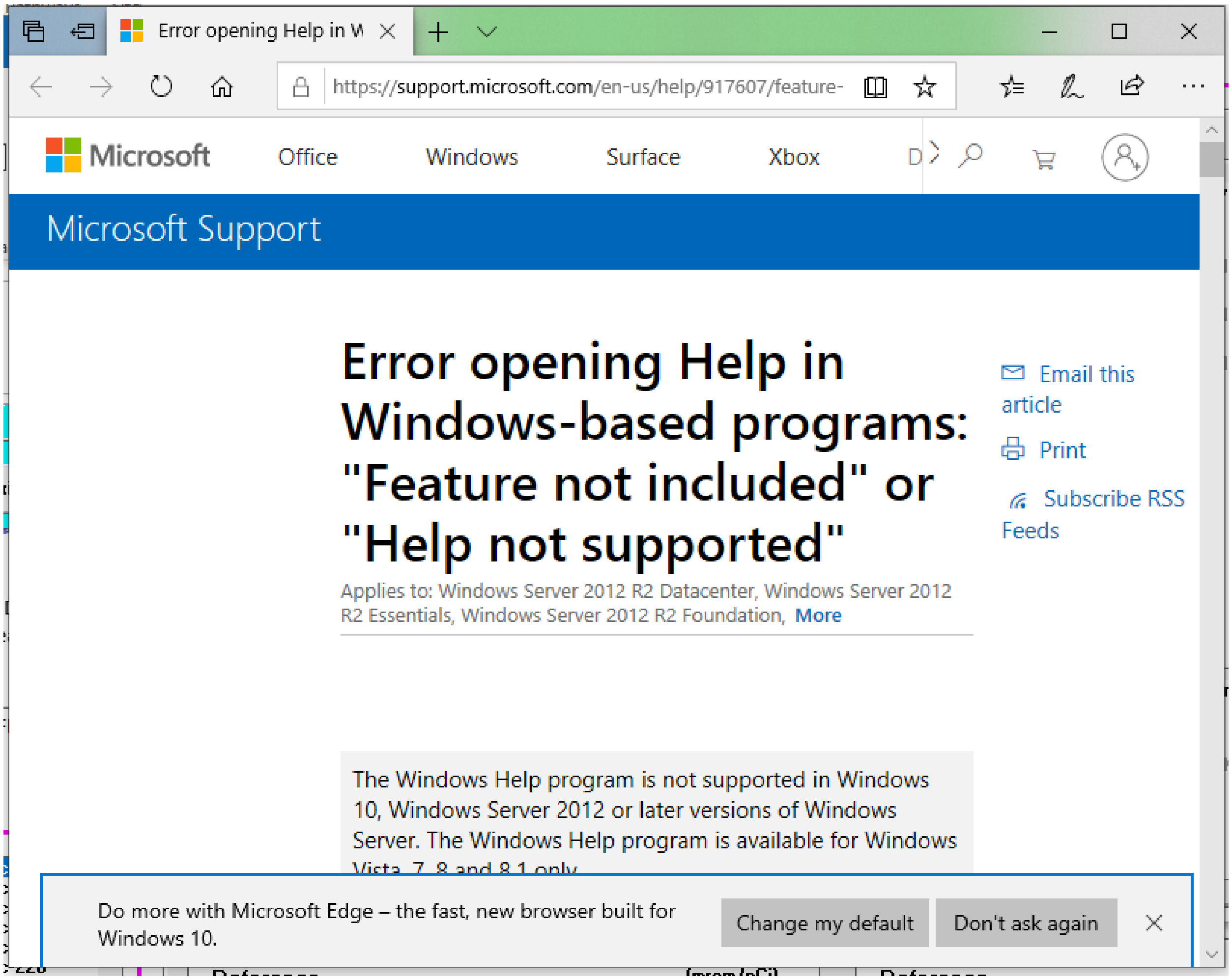
4) ICRP-38 setting:



5-9) Default viewing: Went through tabs and radionuclides Cs-137 and Zr-97. (Note: Zr-91 in not in the database. The test problem should be changed to refer to Zr-87 instead of Zr-91, as was done in step 10).

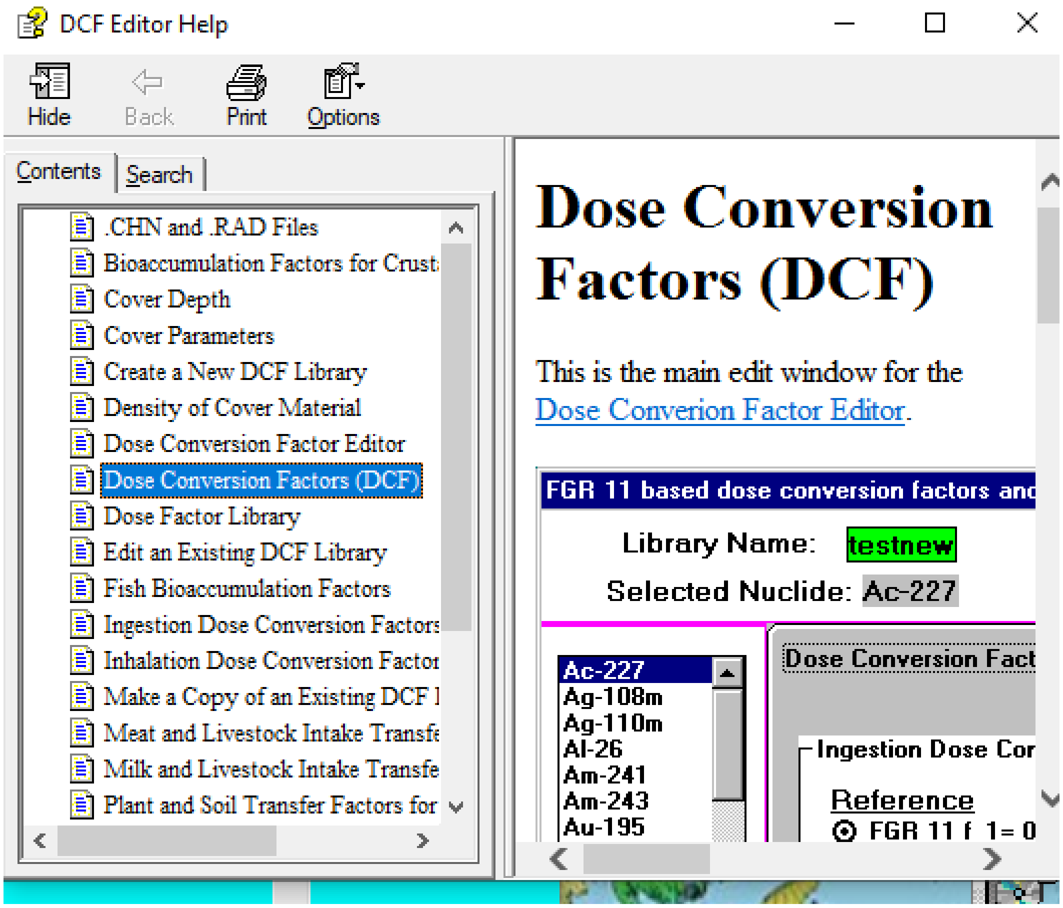


11) Help from DCF editor did not work:

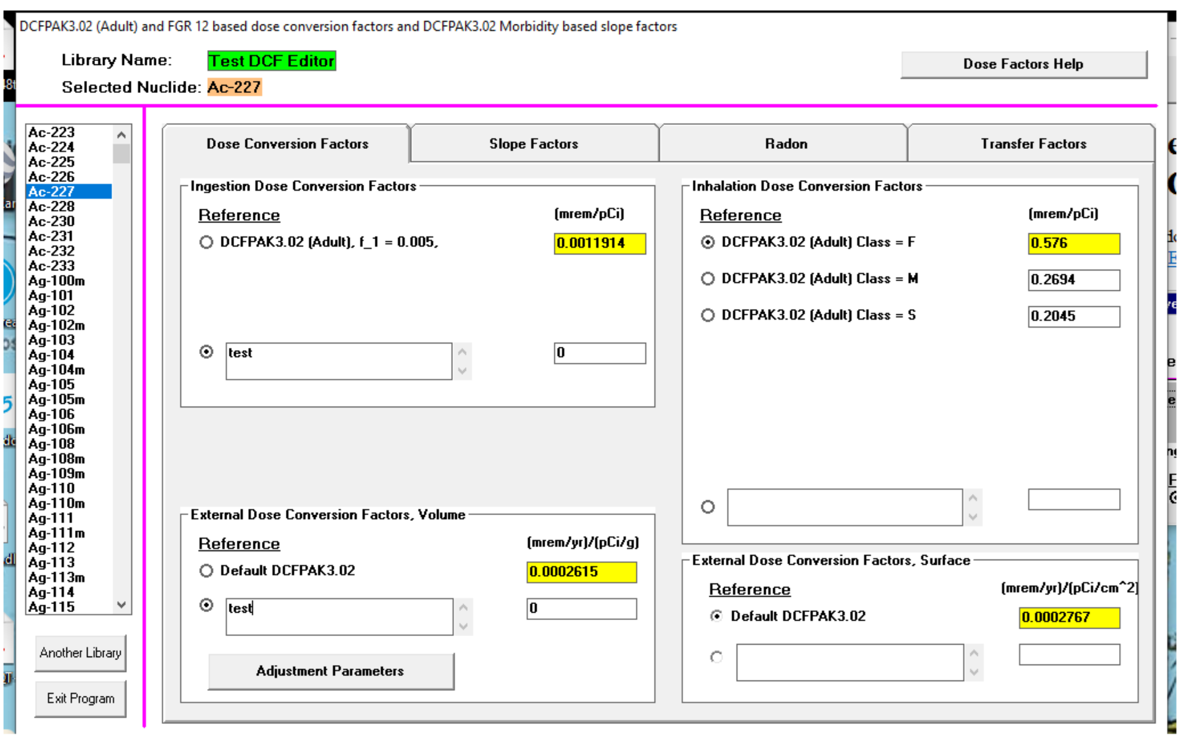


12-14) Repeated above for DOE STD and FGR 11

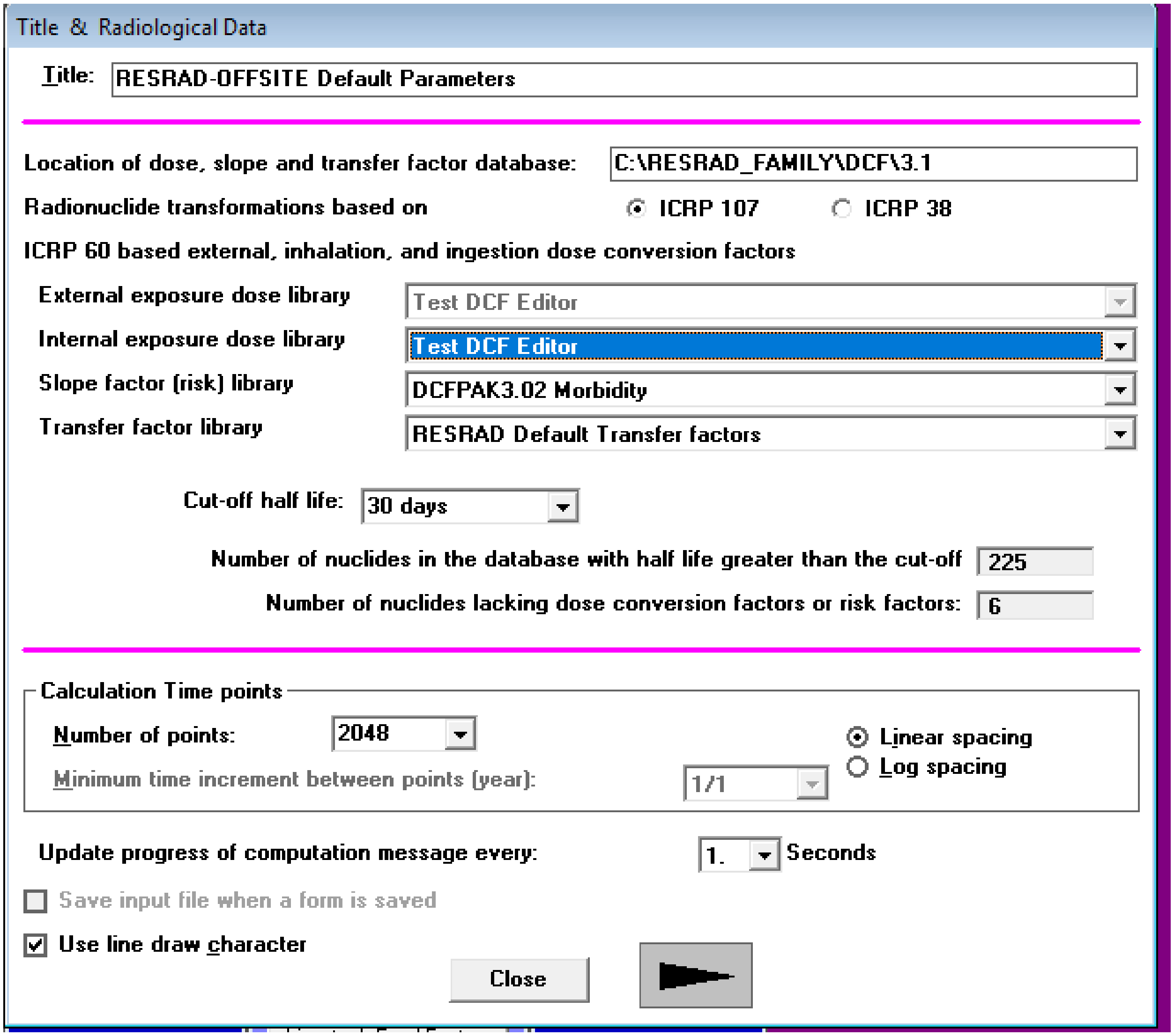
16-17) Help works from the main screen:



Edit mode test:



See new library in list



New DCF data was used:

```
RESRAD-OFFSITE, Version 4.0         T½ Limit = 30 days         02/20/2020  13:32  Page    2
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File  : Site6.ROF

                          Dose Conversion Factor (and Related) Parameter Summary
                                     Current Library: Test DCF Editor
                                       Default Library: DCFPAK3.02

     |                                                              |  Current  |           |  Parameter
Menu |                         Parameter                            |   Value   |  Default  |    Name
-----+--------------------------------------------------------------+-----------+-----------+-----------
DCSF | DCF's for external ground radiation, (mrem/yr)/(pCi/g)       |           |           |
DCSF | Ac-227    (Source: Test DCF Editor)                          | 0.000E+00 | 2.615E-04 | DCFEXT(  1)
DCSF | At-219    (Source: DCFPAK3.02)                               | 0.000E+00 | 0.000E+00 | DCFEXT(  2)
DCSF | Bi-211    (Source: DCFPAK3.02)                               | 2.410E-01 | 2.410E-01 | DCFEXT(  3)
DCSF | Bi-215    (Source: DCFPAK3.02)                               | 1.369E+00 | 1.369E+00 | DCFEXT(  4)
DCSF | Fr-223    (Source: DCFPAK3.02)                               | 1.758E-01 | 1.758E-01 | DCFEXT(  5)
DCSF | Pb-211    (Source: DCFPAK3.02)                               | 3.680E-01 | 3.680E-01 | DCFEXT(  6)
DCSF | Po-211    (Source: DCFPAK3.02)                               | 4.707E-02 | 4.707E-02 | DCFEXT(  7)
DCSF | Po-215    (Source: DCFPAK3.02)                               | 9.452E-04 | 9.452E-04 | DCFEXT(  8)
DCSF | Ra-223    (Source: DCFPAK3.02)                               | 5.791E-01 | 5.791E-01 | DCFEXT(  9)
DCSF | Rn-219    (Source: DCFPAK3.02)                               | 2.970E-01 | 2.970E-01 | DCFEXT( 10)
DCSF | Th-227    (Source: DCFPAK3.02)                               | 5.641E-01 | 5.641E-01 | DCFEXT( 11)
DCSF | Tl-207    (Source: DCFPAK3.02)                               | 2.391E-02 | 2.391E-02 | DCFEXT( 12)
     |                                                              |           |           |

                                     Current Library: Test DCF Editor
                                   Default Library: DCFPAK3.02 (Adult)

     |                                                              |  Current  |           |  Parameter
Menu |                         Parameter                            |   Value   |  Default  |    Name
-----+--------------------------------------------------------------+-----------+-----------+-----------
DCSF | Dose conversion factors for inhalation, mrem/pCi:            |           |           |
DCSF | Ac-227+D                                                     | 6.459E-01 | 6.459E-01 | DCF2(1)
     |                                                              |           |           |
DCSF | Dose conversion factors for ingestion, mrem/pCi:             |           |           |
DCSF | Ac-227+D                                                     | 4.151E-04 | 1.606E-03 | DCF3(1)
     |                                                              |           |           |
```

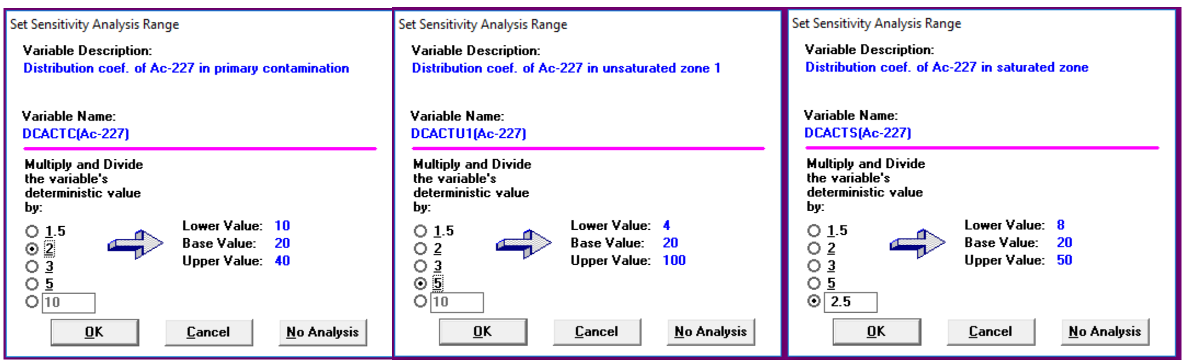
12.17 TEST CASE 031-001 TESTER'S REPORT

Documented in Test Case 31-1-JJCheng.docx of 2/14/2020 9:49 PM

Test Case 31-1 – Test the functionality of sensitivity analysis (single parameter)

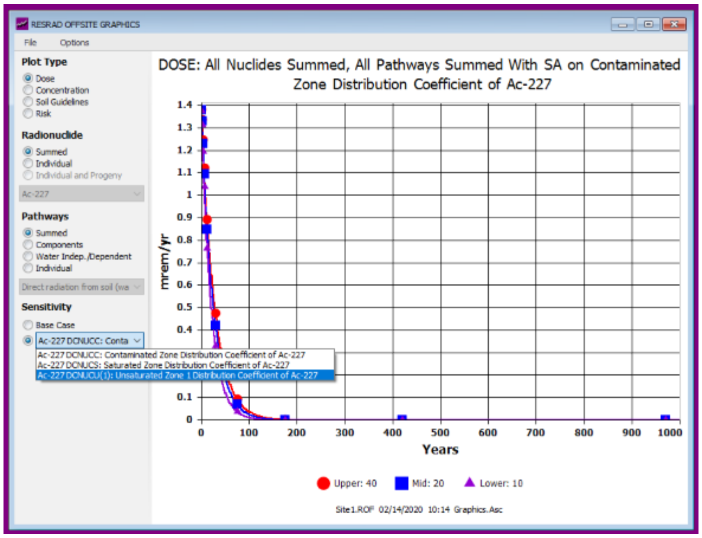
- Launched RESRAD-OFFSITE, used the default template, chose Ac-227 as the radionuclide of concern, entered an initial soil concentration of 100 pCi/g.

- Set Kd of the contaminated zone (in the radionuclide specific release input screen), unsaturated zone (in the distribution coefficient input screen), and saturated zone (in the distribution coefficient input screen) for sensitivity analysis via the menu bar option [Form Options-Sensitivity Analysis (single parameter)], tool bar option (the rainbow button), and hot key (F9) option, respectively, and set an analysis range of 2, 5, and 2.5, respectively.

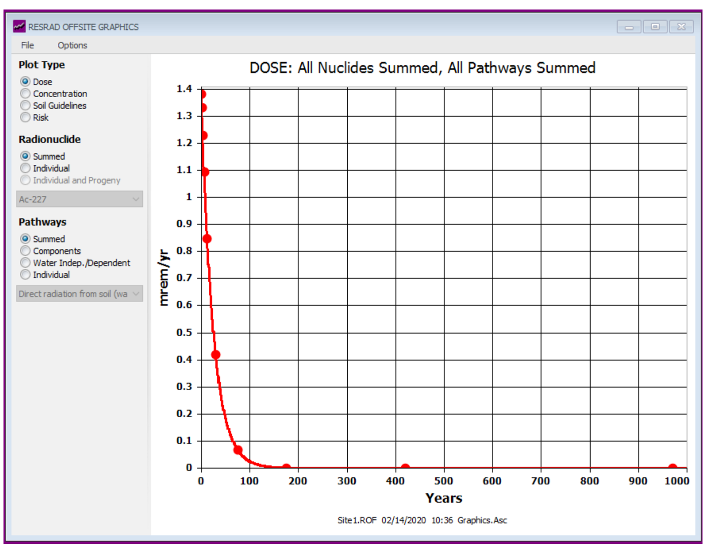


- Saw the settings appeared at the sensitivity analysis information bar at the bottom of the main interface

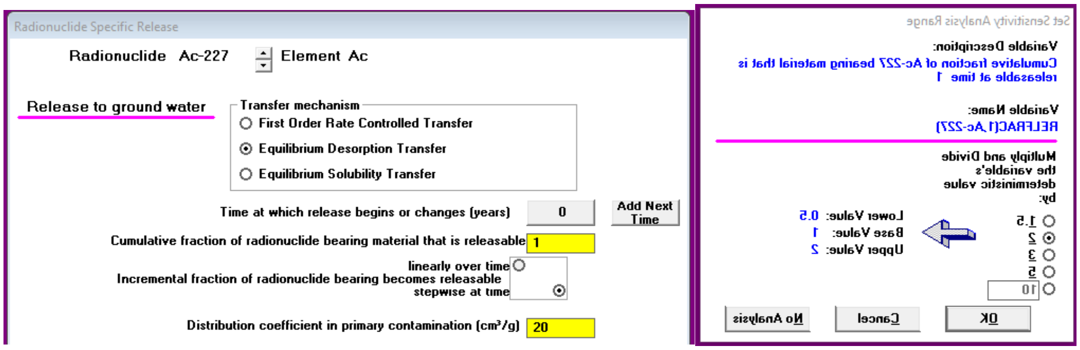
- Run calculations. Opened the Deterministic Graphics viewer. The sensitivity analysis options were available in the options selection panel. The graphic viewer displayed the sensitivity analysis results based on the selection.

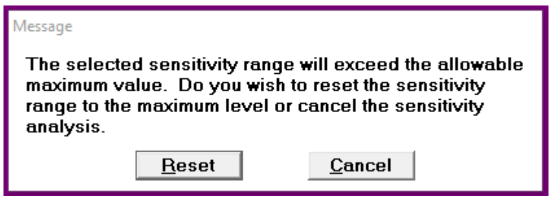


- Cancelled each sensitivity analysis by clicking the "no analysis" tab in the Set Sensitivity Analysis Range window. All sensitivity analyses were cancelled successfully, verified by 0 variable listed in the sensitivity analysis summary bar at the bottom of the main interface, and no sensitivity analysis options in the Deterministic Graphics viewer after running the code.

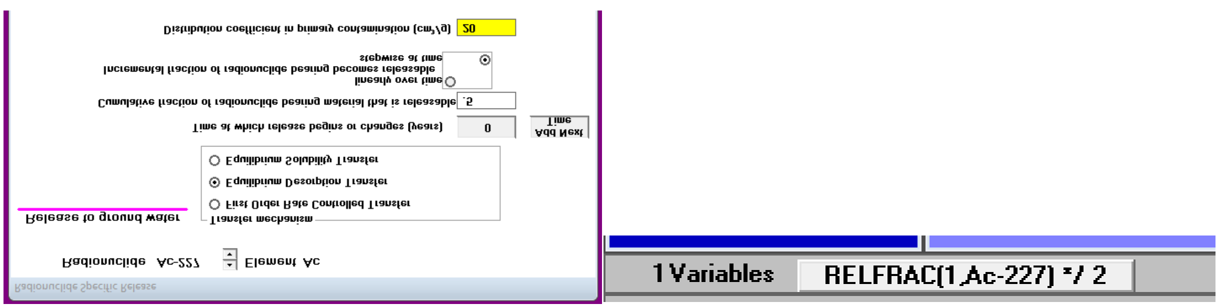


- Chose the Equilibrium Desorption Transfer as the release mechanism for Ac-227. Chose the cumulative releasable fraction at time 0 (default value is 1) for sensitivity analysis, and set a range value of 2. The code successfully provided warning against the selected range. Cancelled the sensitivity analysis.

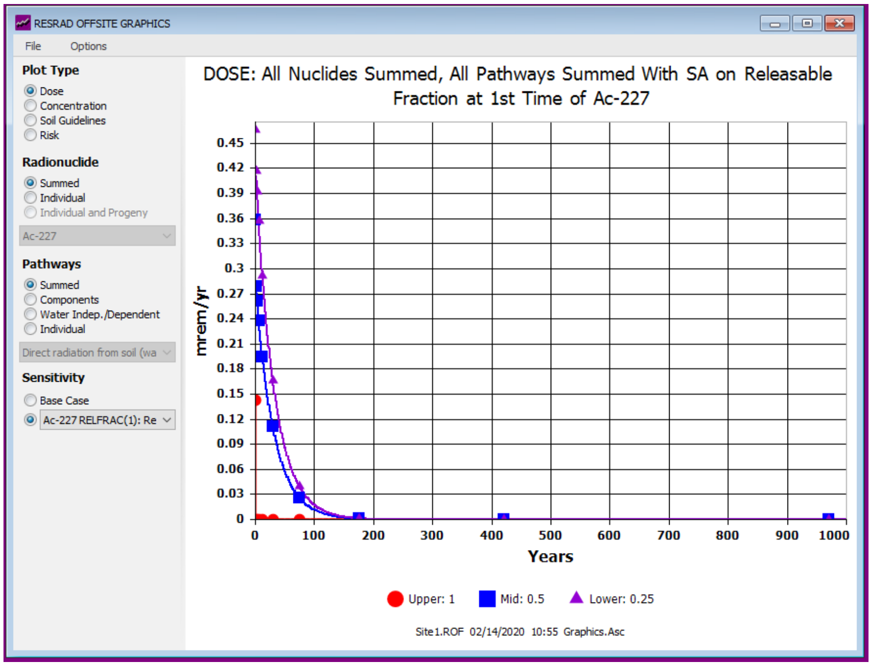




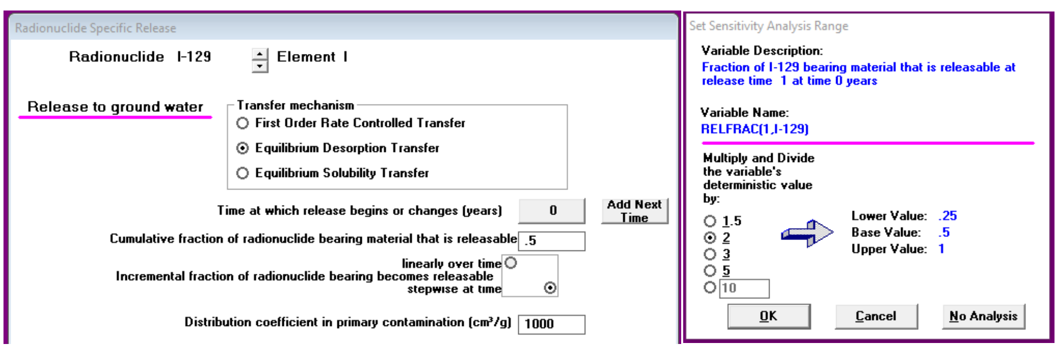
- Changed the cumulative releasable fraction at time 0 to 0.5, and reselected it for sensitivity analysis with a range of 2. Ran the code.



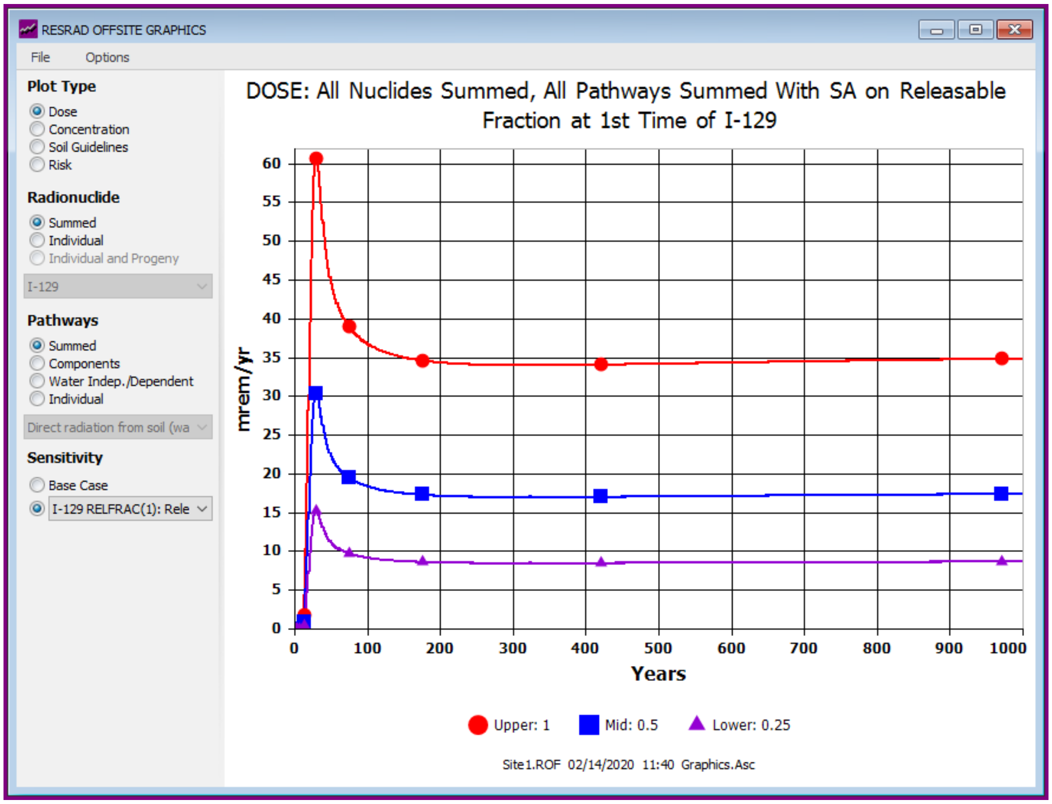
- Opened the Deterministic Graphics Viewer. The sensitivity analysis results were displayed as shown below. The results make sense because the external radiation pathway is the dominant pathway and half-life of Ac-227 is short, 21.772 years.



- Deleted Ac-227 and chose I-129 (half-life 1.57e7 years). Kept the Equilibrium Desorption Transfer as the release mechanism. Changed the Kd in primary contamination to 1000 cm3/g and the cumulative releasable fraction to 0.5 at time 0. Set sensitivity analysis for the releasable fraction with a range of 2. Ran the code.



- Opened the Deterministic Graphics Viewer. The sensitivity analysis results were displayed as shown below. The results make sense because the water-dependent pathways (milk, drinking water, and meat) are the dominant pathways, Kd of the primary contamination is large (1000 cm3/g) and I-129 is long-lived.



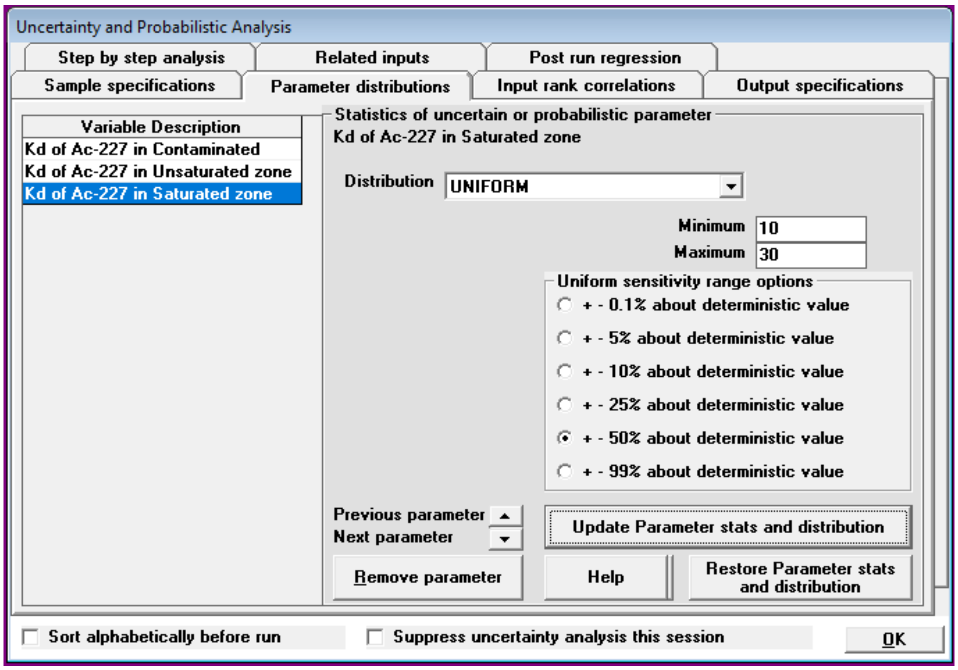
- The code is equipped with all the sensitivity analysis functions required for selecting one parameter at a time.

12.18 TEST CASE 031-002 TESTER'S REPORT

Documented in Test Case 31-2-JJCheng.docx of 2/14/2020 12:25 PM

Test Case 31-2 – Test the functionality of setting multiparamter sensitivity analysis

- Used default input template. Chose Ac-227 as radionuclide of concern with an initial concentration of 100 pCi/g.
- Selected Kd of the contaminated zone, unsaturated zone, and saturated zone for uncertainty analysis with a uniform sensitivity range by clicking Shift-F8. Chose Uniform distribution and set the range to be +-25%, +-50%, and +-99%, respectively. Saved the input file.



- In the generated input file (Site2.rof), the total number of observation was shown as 300 (NUM_SMPS=300) for three input parameters (NUMVAR=3).

SITE2 - Notepad

File Edit Format View Help

```
DEPVEL = .001,
DEPVELT = .001,
NSENA = 0,
NUM_SAMPS = 300, NUMVAR = 3, NUMRELVAR = 0,
SELPATH = 255,
NAIFLXT = 0 ,
NAQFLXT = 0 ,
NSFST = 0 ,
NSWFLXT = 0 ,
NSWCONC = 0 ,
NWWCONC = 0 ,
STARFILEREAD = 0 ,
STARFILELOCATION = ' ',
SAVEGTDATA = 0 ,
&END
```

- Opened the generated LHS input file (Site2.lhs) with Notepad, and noticed the recordings of the three Kd parameters for uncertainty analysis with the selected distribution function and range of distributions, the number of observation (default 100), and the number of repetition (3).

SITE2 - Notepad

File Edit Format View Help

```
TITLE - RESRAD-OFFSITE Default Parameters
RANDOM SEED 1000
NVAR  3
NOBS 100
NREPS 3
UNIFORM                 DCACTC(1)               Kd of Ac-227 in Contaminated zone
15         25
0          none      Sensitivity    20       .25       0         1E+34
UNIFORM                 DCACTU1(1)              Kd of Ac-227 in Unsaturated zone 1
10         30
0          none      Sensitivity    20       .5        0         1E+34
UNIFORM                 DCACTS(1)               Kd of Ac-227 in Saturated zone
.1999998   39.8
0          none      Sensitivity    20       .99       0         1E+34
OUTPUT CORR DATA
```

- If the code were ran, an uncertainty analysis with the above settings would be performed.
- The function of setting multiparameter sensitivity analysis was imeplemented successfully.

12.19 TEST CASE 032-001 TESTER'S REPORT

Documented in Test-032-001_report.docx of 2/20/2020 6:44 AM

Test-032-001 Report

By cheng wang 2/17/2020

Objective: To test the functionality of setting Uncertainty/Probabilistic Analysis

Conclusion: the code worked as expected.

Procedure:

1. Followed the procedure described in test case

2. The generated files were saved in the folder 032-001

3. The screenshots were presented as follows. They matched the expected results.

Figure a

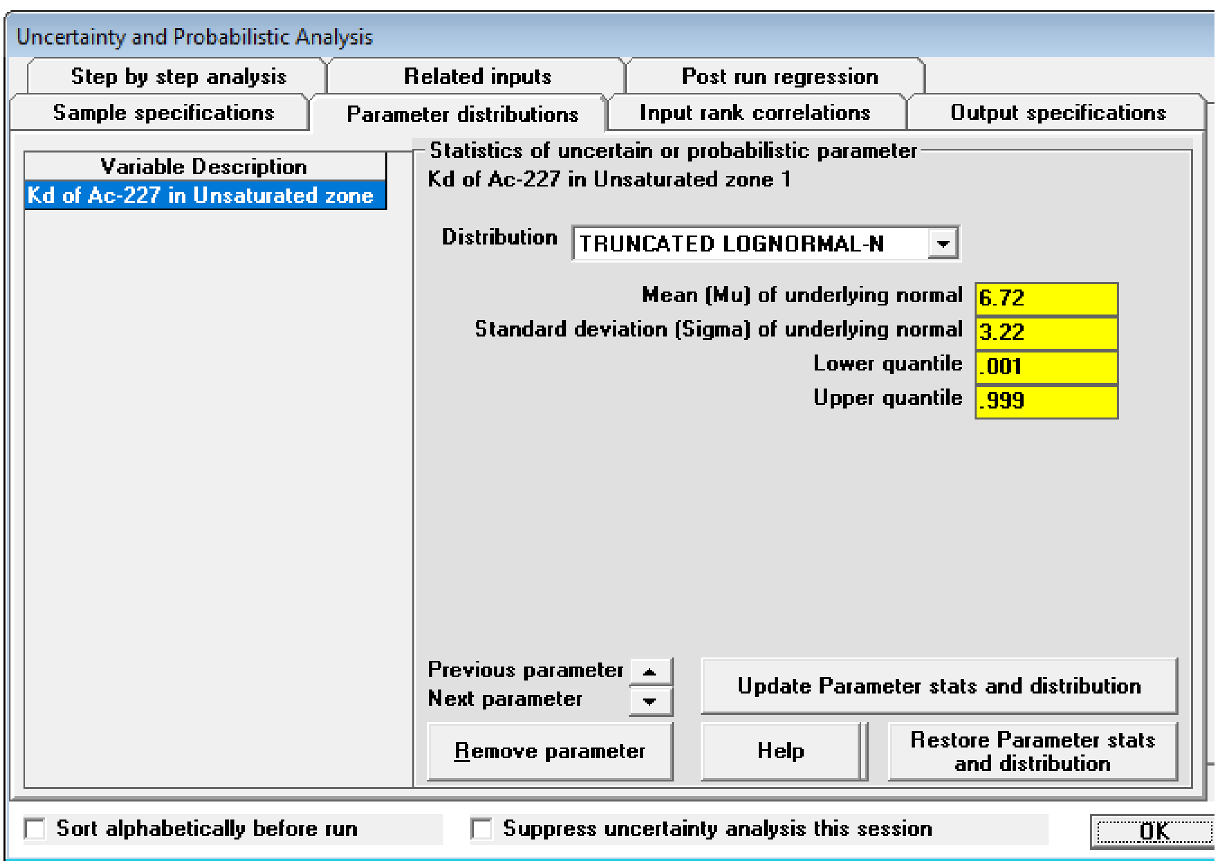


Figure b

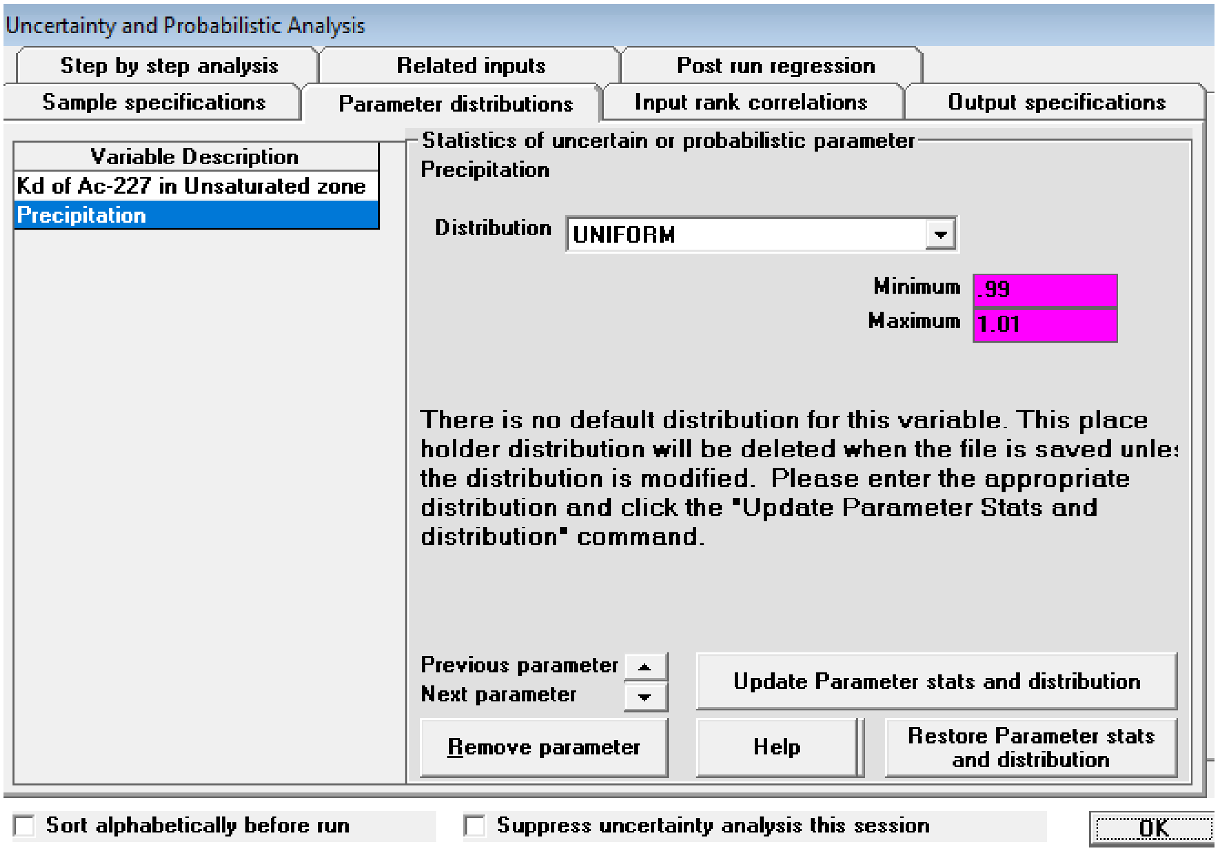

Uncertainty and Probabilistic Analysis
Step by step analysis
Related inputs
Post run regression
Sample specifications
Parameter distributions
Input rank correlations
Output specifications
Variable Description
Kd of Ac-227 in Unsaturated zone
Precipitation
Statistics of uncertain or probabilistic parameter
Precipitation
Distribution
UNIFORM
Minimum
.99
Maximum
1.01
There is no default distribution for this variable. This place holder distribution will be deleted when the file is saved unle: the distribution is modified. Please enter the appropriate distribution and click the "Update Parameter Stats and distribution" command.
Previous parameter
Next parameter
Update Parameter stats and distribution
Remove parameter
Help
Restore Parameter stats and distribution
Sort alphabetically before run
Suppress uncertainty analysis this session
OK

Figure c

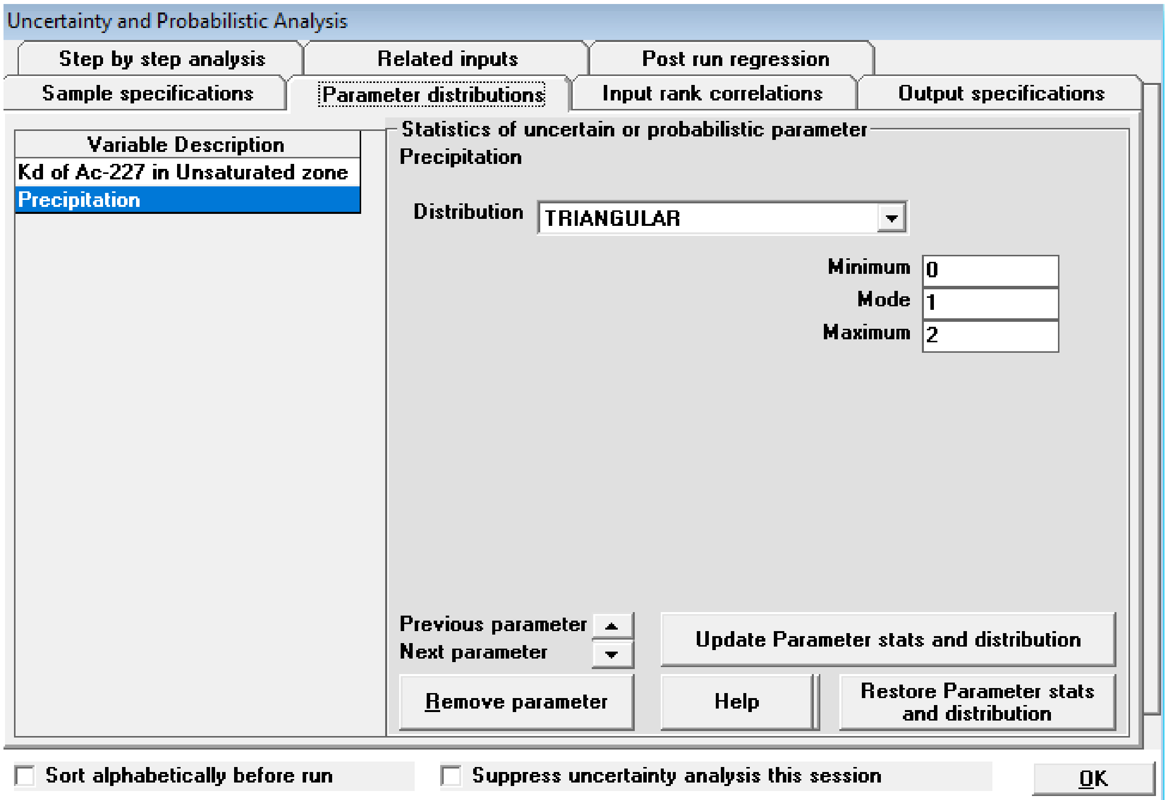


Figure c-1

```
NUM_SAMPS = 300, NUMVAR = 2, NUMRELVAR = 0,
```

Figure d

TEST53.LHS

```
TITLE - RESRAD-OFFSITE Default Parameters
RANDOM SEED 1000
NVAR  2
NOBS 100
NREPS 3
TRUNCATED LOGNORMAL-N    DCACTU1(1)               Kd of Ac-227 in Unsaturated zone 1
6.72      3.22      .001      .999
0         none      TRUNCATED LOGNORMAL-N    6.72      3.22      .001      .999
TRIANGULAR               PRECIP                   Precipitation
0         1         2
0         10        user defined
OUTPUT CORR DATA

```

12.20 TEST CASE 033-001 TESTER'S REPORT

Documented in Test-033-001_report.docx of 2/20/2020 9:05 AM

Test-033-001 report

By cheng wang 2/17/2020

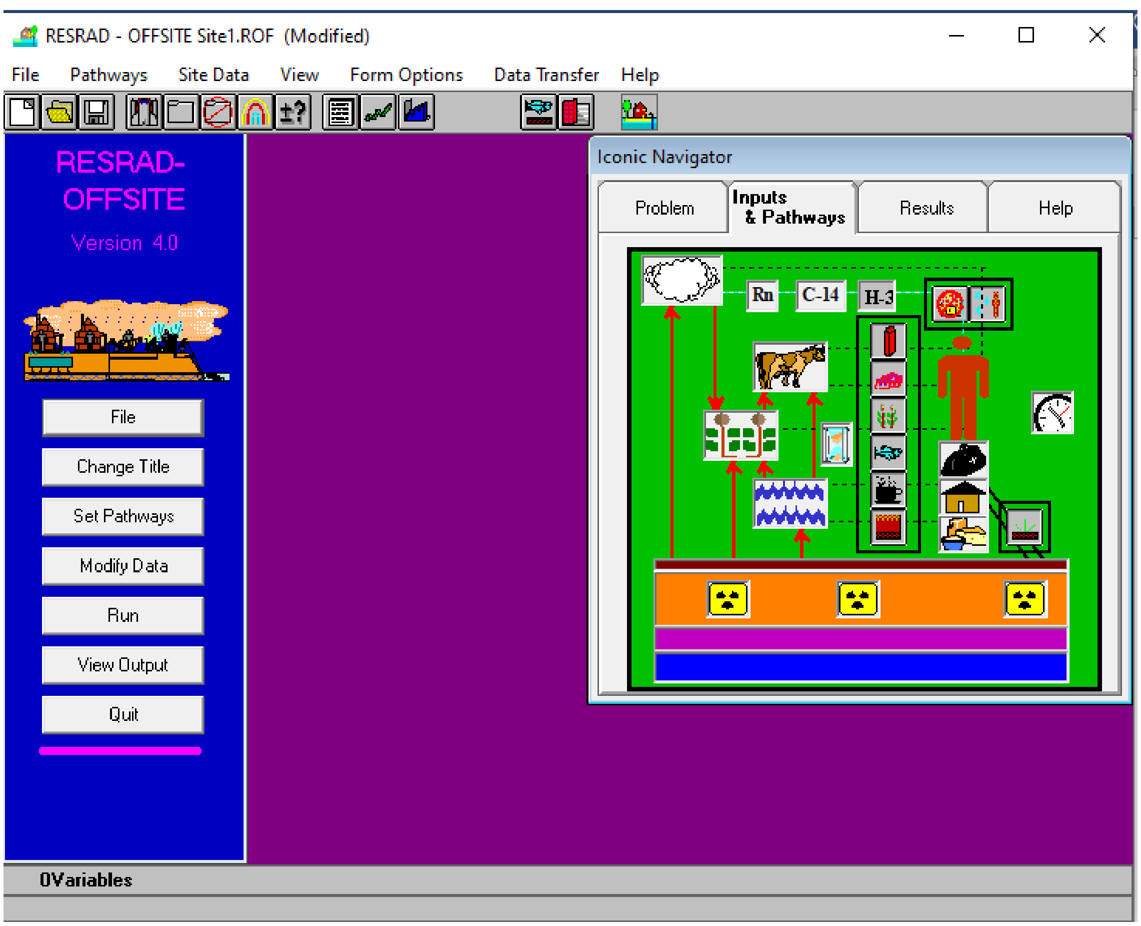
Objective: Test the File navigation function from the left panel of GUI.

Conclusion: the code worked as expected.

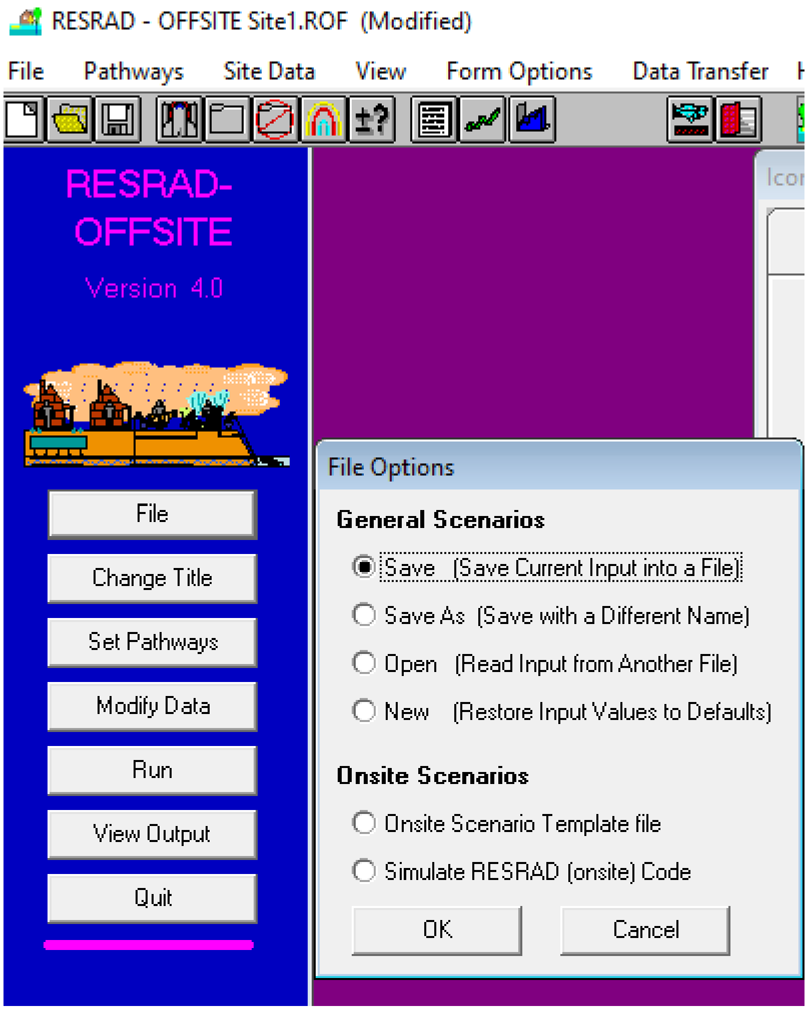
Suggest to modify the description of Test Case 035-001 which is use as Step 3) in this test case: remove "Reporting times" and "Surface water transport" from the bullet list in Step 6). "Reporting times" form was not designed to have yellow background, and there is no Surface Water Transport form.

Procedure:

1.Followed Step 1) in Test Case 033-001; worked as expected.



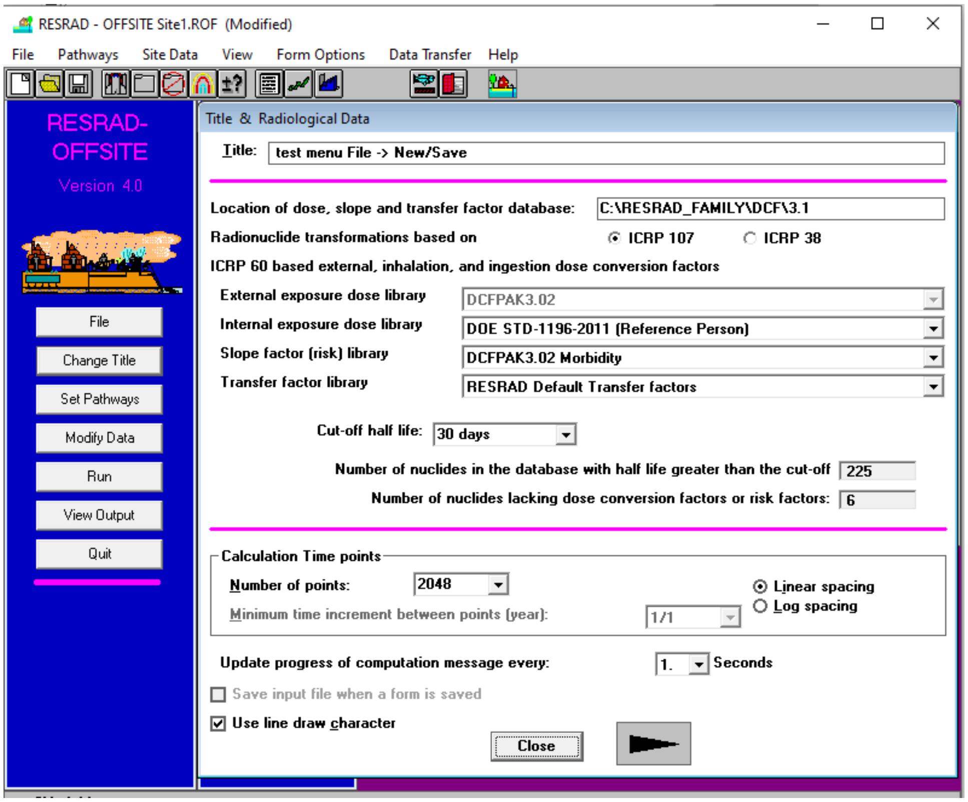
2. Followed Step 2): worked as expected

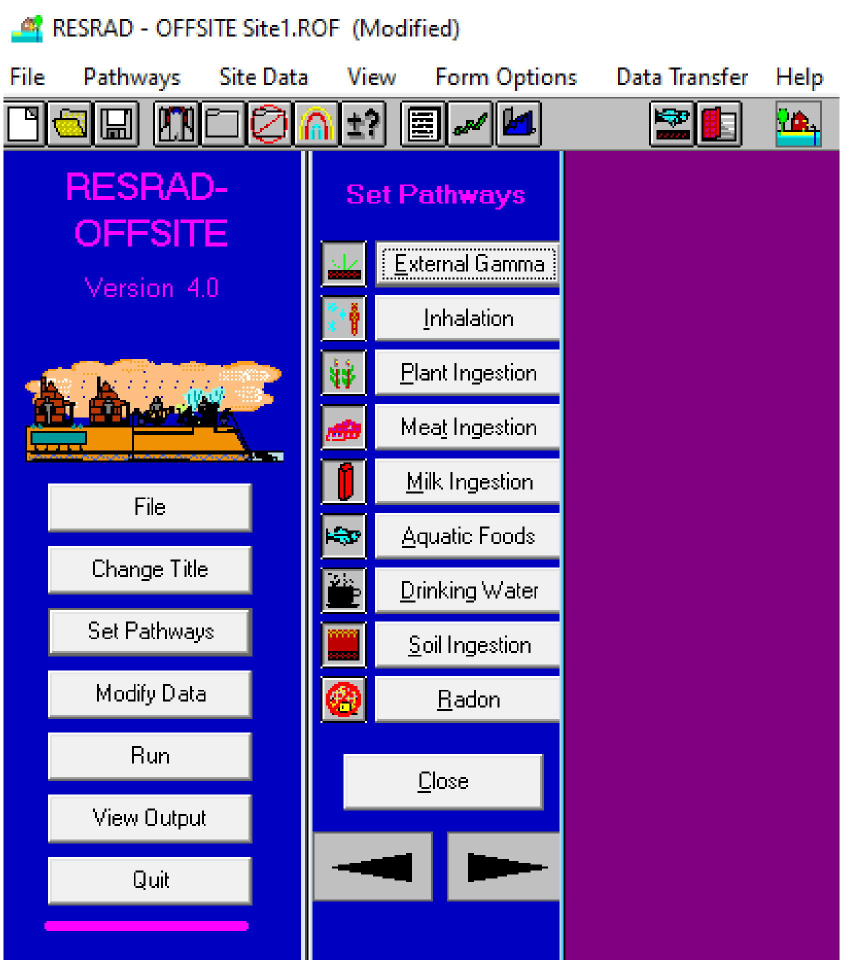


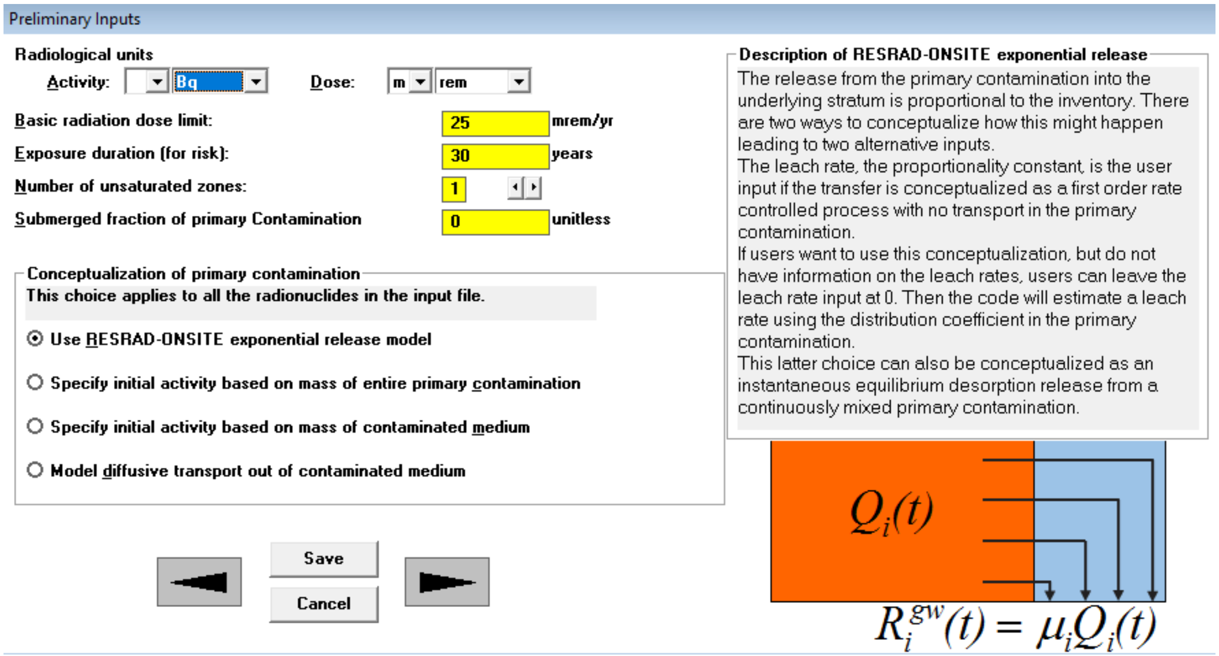
3 (a). Followed Step 3) in test case description for testing “New” button; worked as expected except the following two issues:

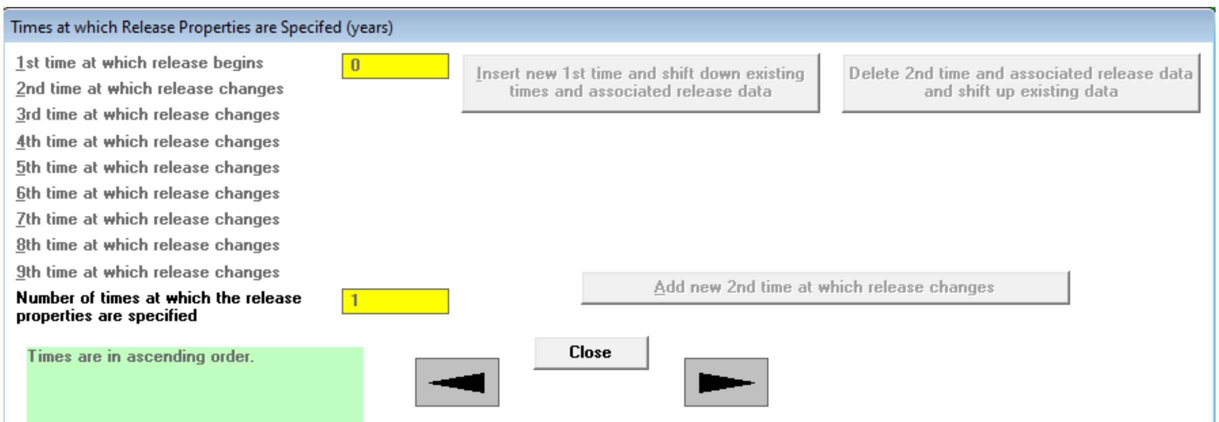
only the background of text boxes in Reporting times for are not in yellow. Reporting times are not model calculation parameters. Suggest removing this form in the bullet list of this step in the test case description.

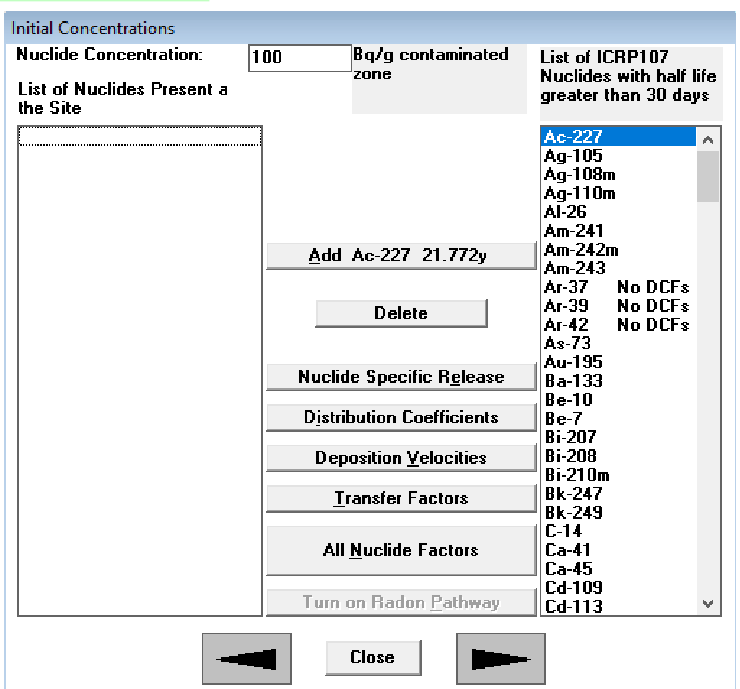
There is no Surface Water Transport form; suggest remove this bullet from the list of this step in the test case description


RESRAD - OFFSITE Site1.ROF (Modified)
File Pathways Site Data View Form Options Data Transfer Help
RESRAD-OFFSITE
Version 4.0
File
Change Title
Set Pathways
Modify Data
Run
View Output
Quit
Title & Radiological Data
Title: test menu File -> New/Save
Location of dose, slope and transfer factor database: C:\RESRAD_FAMILY\DCF\3.1
Radionuclide transformations based on ICRP 107 ICRP 38
ICRP 60 based external, inhalation, and ingestion dose conversion factors
External exposure dose library DCFPAK3.02
Internal exposure dose library DOE STD-1196-2011 (Reference Person)
Slope factor (risk) library DCFPAK3.02 Morbidity
Transfer factor library RESRAD Default Transfer factors
Cut-off half life: 30 days
Number of nuclides in the database with half life greater than the cut-off 225
Number of nuclides lacking dose conversion factors or risk factors: 6
Calculation Time points
Number of points: 2048
Minimum time increment between points (year): 1/1
Linear spacing
Log spacing
Update progress of computation message every: 1. Seconds
Save input file when a form is saved
Use line draw character
Close


RESRAD - OFFSITE Site1.ROF (Modified)
File Pathways Site Data View Form Options Data Transfer Help
RESRAD-OFFSITE
Version 4.0
File
Change Title
Set Pathways
Modify Data
Run
View Output
Quit
Set Pathways
External Gamma
Inhalation
Plant Ingestion
Meat Ingestion
Milk Ingestion
Aquatic Foods
Drinking Water
Soil Ingestion
Radon
Close


Preliminary Inputs
Radiological units
Activity: Bq
Dose: m rem
Basic radiation dose limit: 25 mrem/yr
Exposure duration (for risk): 30 years
Number of unsaturated zones: 1
Submerged fraction of primary Contamination 0 unitless
Conceptualization of primary contamination
This choice applies to all the radionuclides in the input file.
Use RESRAD-ONSITE exponential release model
Specify initial activity based on mass of entire primary contamination
Specify initial activity based on mass of contaminated medium
Model diffusive transport out of contaminated medium
Save
Cancel
Description of RESRAD-ONSITE exponential release
The release from the primary contamination into the underlying stratum is proportional to the inventory. There are two ways to conceptualize how this might happen leading to two alternative inputs.
The leach rate, the proportionality constant, is the user input if the transfer is conceptualized as a first order rate controlled process with no transport in the primary contamination.
If users want to use this conceptualization, but do not have information on the leach rates, users can leave the leach rate input at 0. Then the code will estimate a leach rate using the distribution coefficient in the primary contamination.
This latter choice can also be conceptualized as an instantaneous equilibrium desorption release from a continuously mixed primary contamination.
$Q_i(t)$
$R_i^{gw}(t) = \mu_i Q_i(t)$


Times at which Release Properties are Specifed (years)
1st time at which release begins 0
2nd time at which release changes
3rd time at which release changes
4th time at which release changes
5th time at which release changes
6th time at which release changes
7th time at which release changes
8th time at which release changes
9th time at which release changes
Number of times at which the release properties are specified 1
Insert new 1st time and shift down existing times and associated release data
Delete 2nd time and associated release data and shift up existing data
Add new 2nd time at which release changes
Times are in ascending order.
Close


Initial Concentrations
Nuclide Concentration: 100 Bq/g contaminated zone
List of Nuclides Present a the Site
List of ICRP107 Nuclides with half life greater than 30 days
Add Ac-227 21.772y
Delete
Nuclide Specific Release
Distribution Coefficients
Deposition Velocities
Transfer Factors
All Nuclide Factors
Turn on Radon Pathway
Close
Ac-227
Ag-105
Ag-108m
Ag-110m
Al-26
Am-241
Am-242m
Am-243
Ar-37 No DCFs
Ar-39 No DCFs
Ar-42 No DCFs
As-73
Au-195
Ba-133
Be-10
Be-7
Bi-207
Bi-208
Bi-210m
Bk-247
Bk-249
C-14
Ca-41
Ca-45
Cd-109
Cd-113

Storage Times

Surface water:	1	days
Well water:	1	days
Fruits, grain & nonleafy vegetables:	14	days
Leafy vegetables:	1	days
Pasture and silage	1	days
Livestock feed grain:	45	days
Meat:	20	days
Milk:	1	days
Fish:	7	days
Crustacea and mollusks:	7	days

Save

Cancel

Site Layout

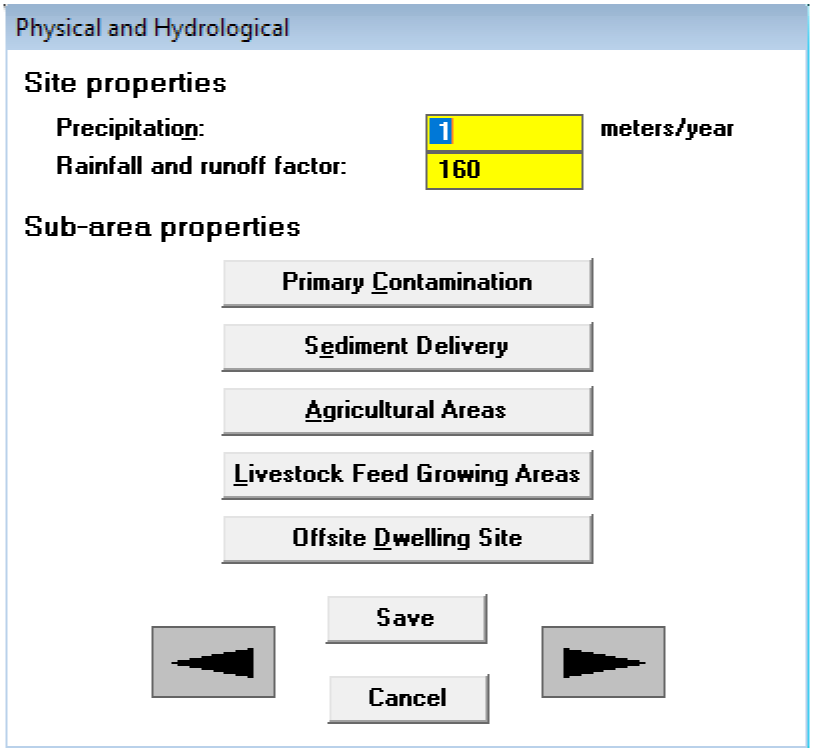
Bearing of X axis (clockwise angle from North)	90	degrees
X dimension of primary contamination	100	meters
Y dimension of primary contamination	100	meters

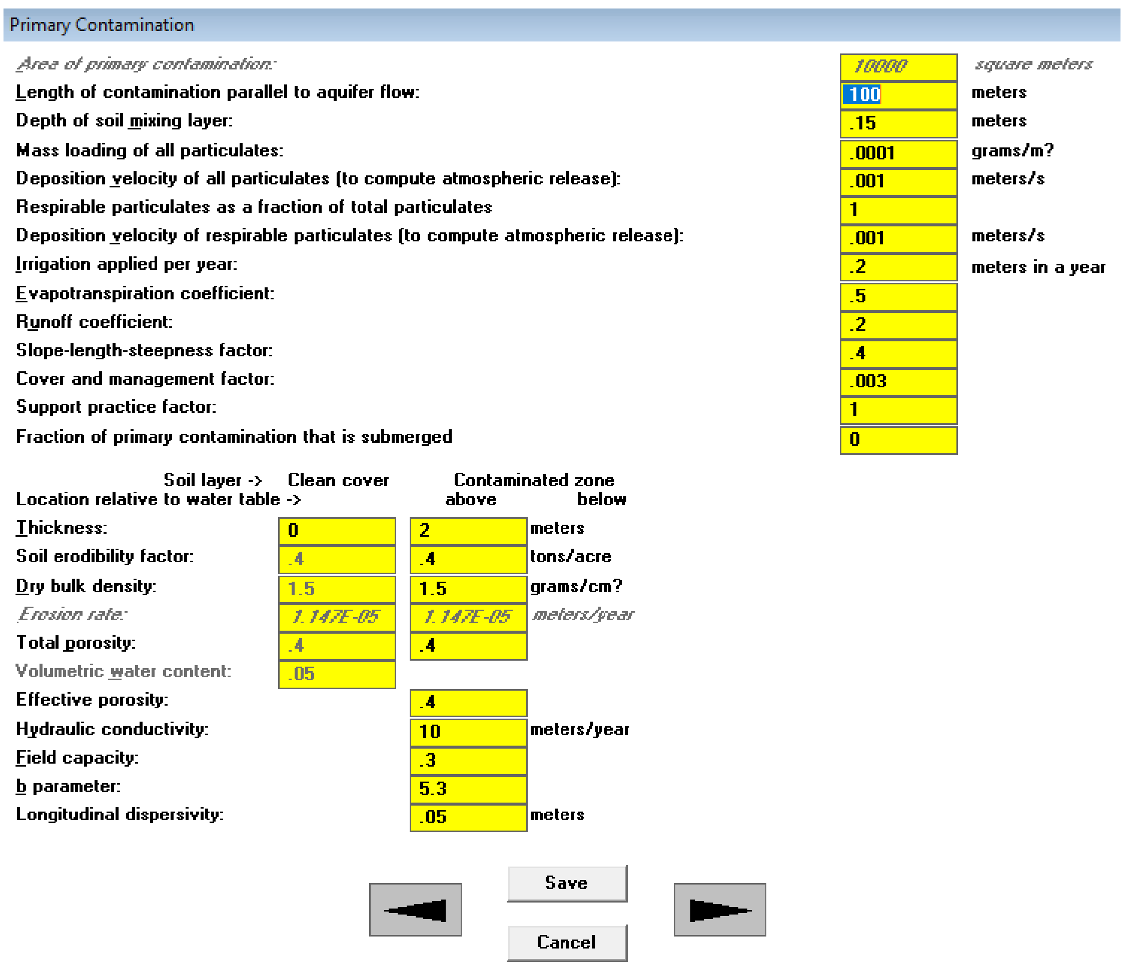
Location	Smaller X Coordinate	Larger X Coordinate	Smaller Y Coordinate	Larger Y Coordinate	
Fruit, grain, non-leafy vegetables plot	34.375	65.625	234	266	meters
Leafy vegetables plot	34.375	65.625	268	300	meters
Pasture, silage growing area	0	100	450	550	meters
Grain fields	0	100	300	400	meters
Dwelling site	34.375	65.625	134	166	meters
Surface water body	-100	200	550	850	meters

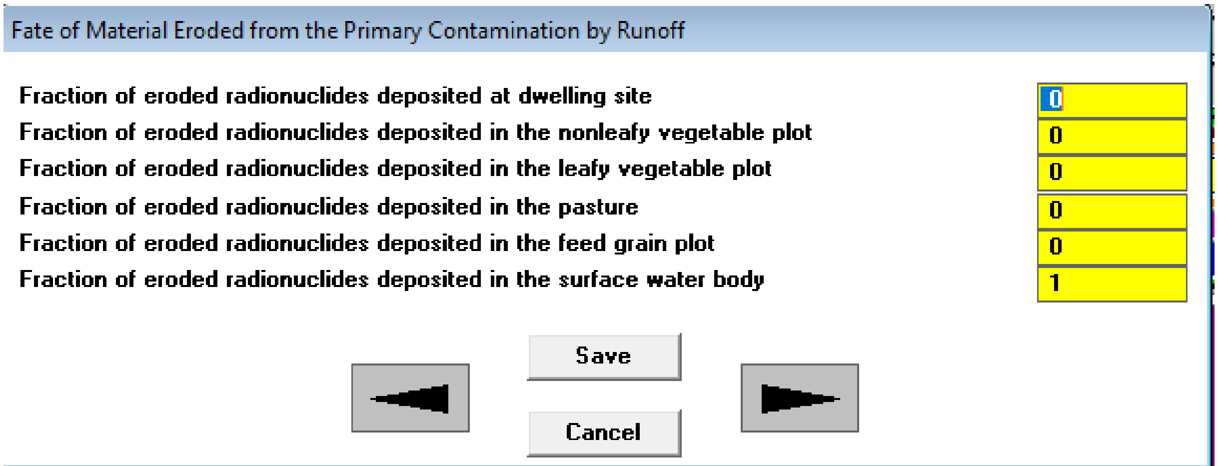
Display Map

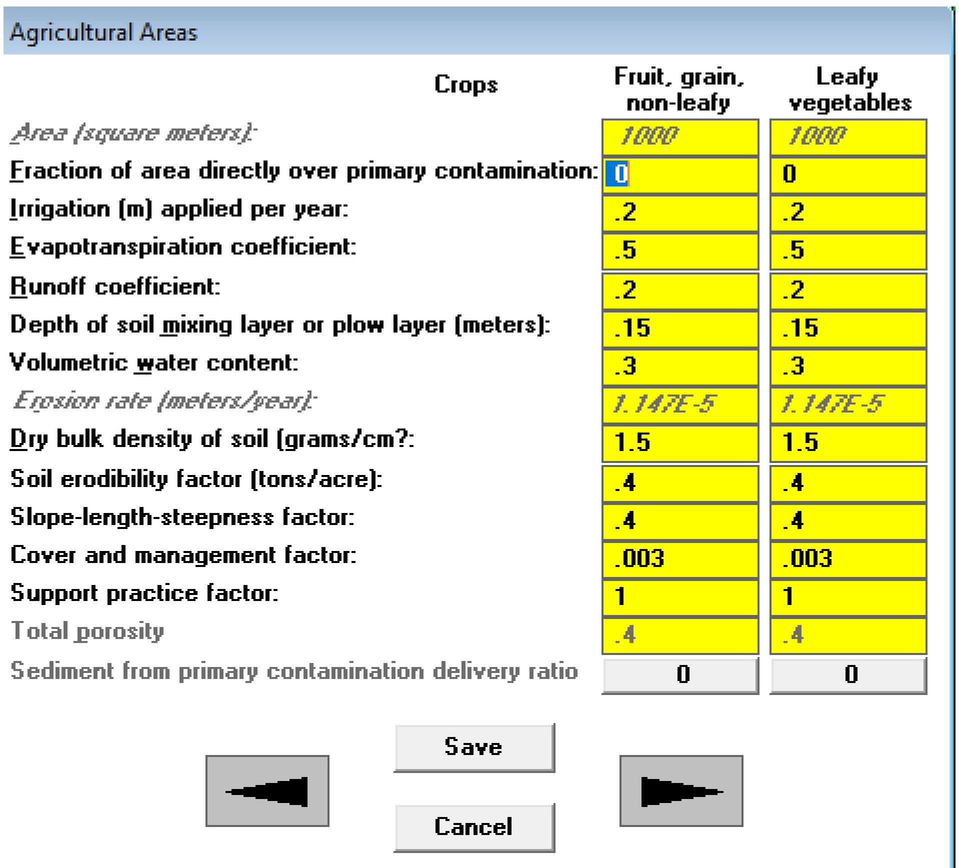
Save

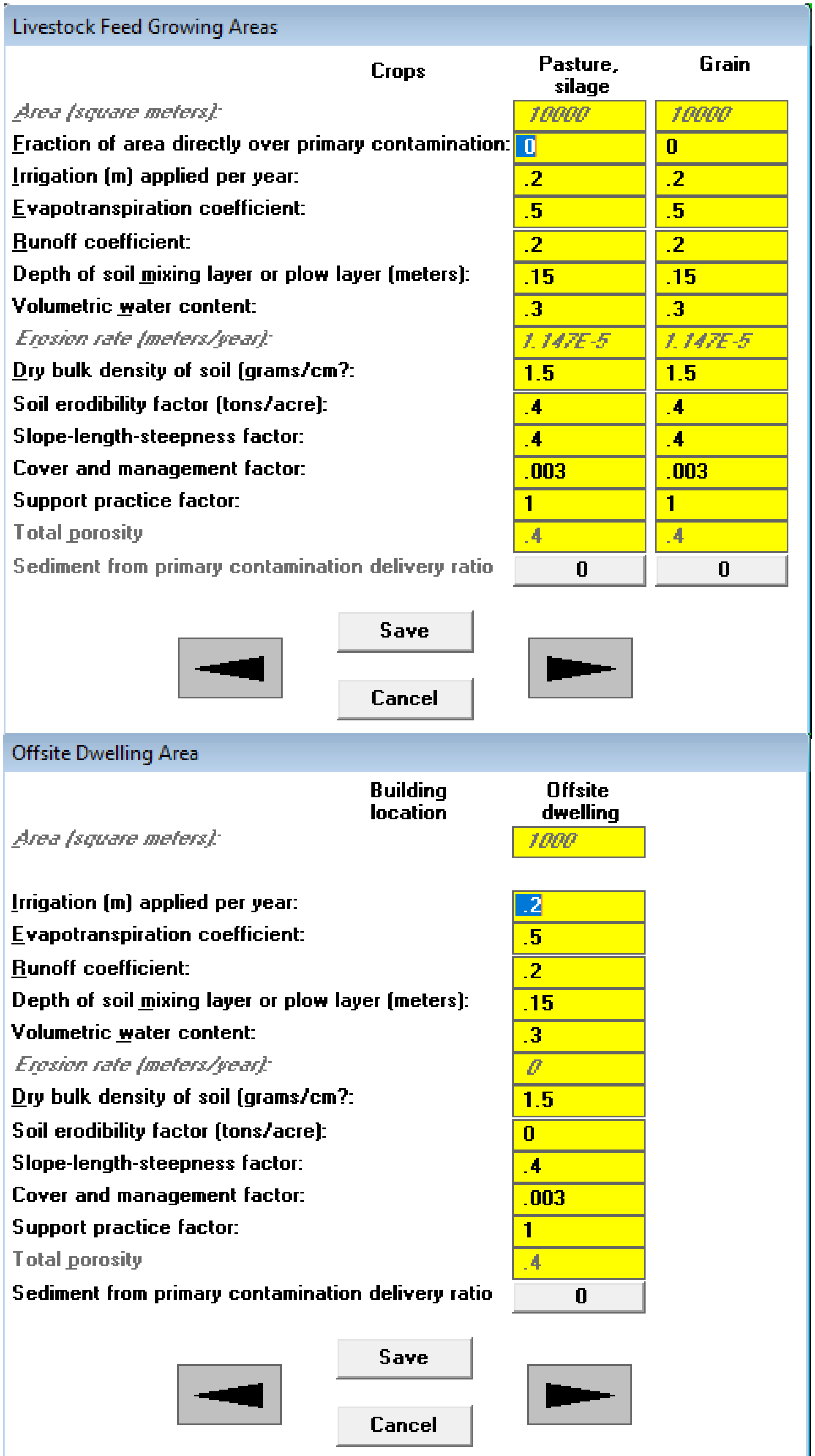
Cancel

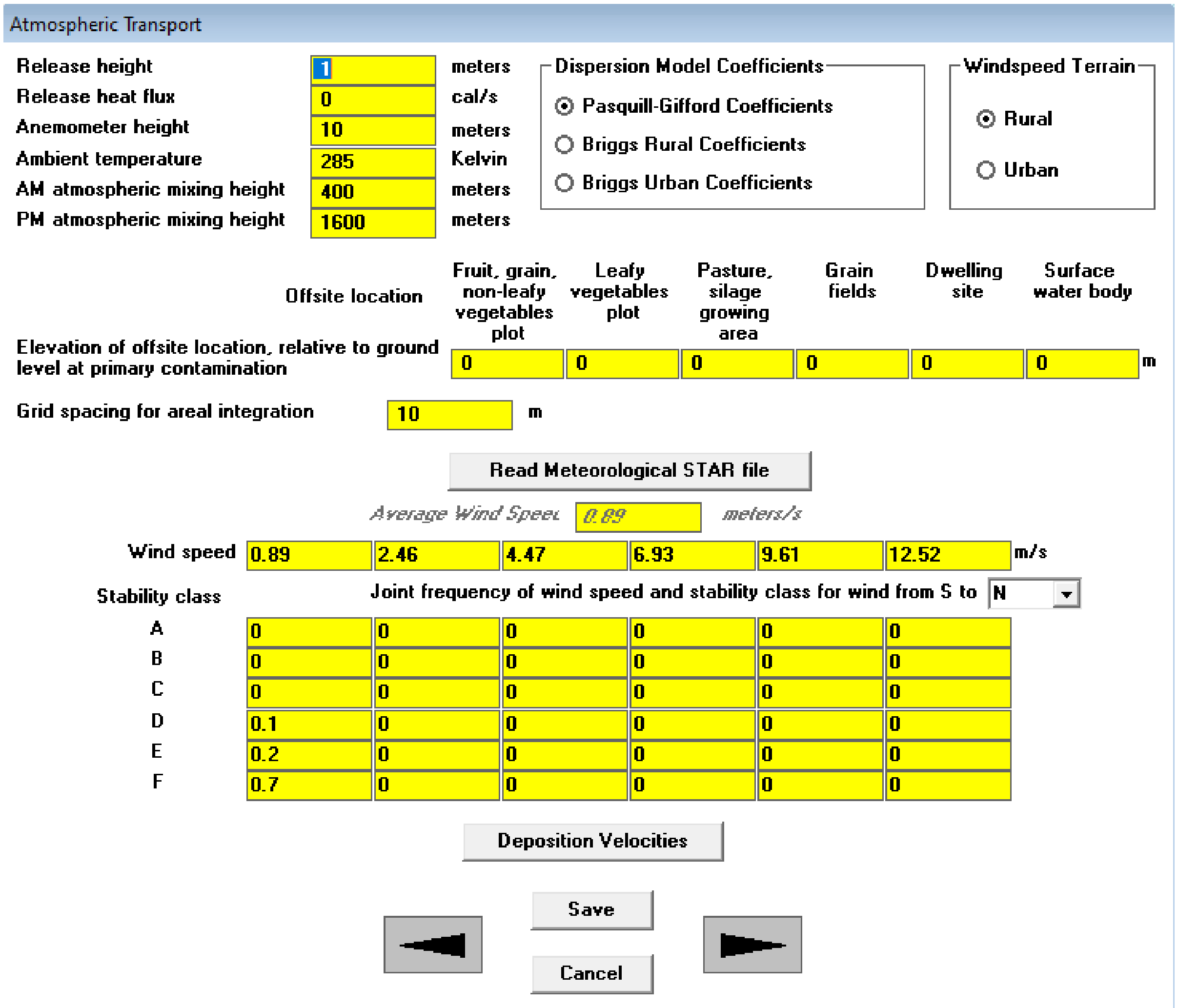

Physical and Hydrological
Site properties
Precipitation: 1 meters/year
Rainfall and runoff factor: 160
Sub-area properties
Primary Contamination
Sediment Delivery
Agricultural Areas
Livestock Feed Growing Areas
Offsite Dwelling Site
Save
Cancel

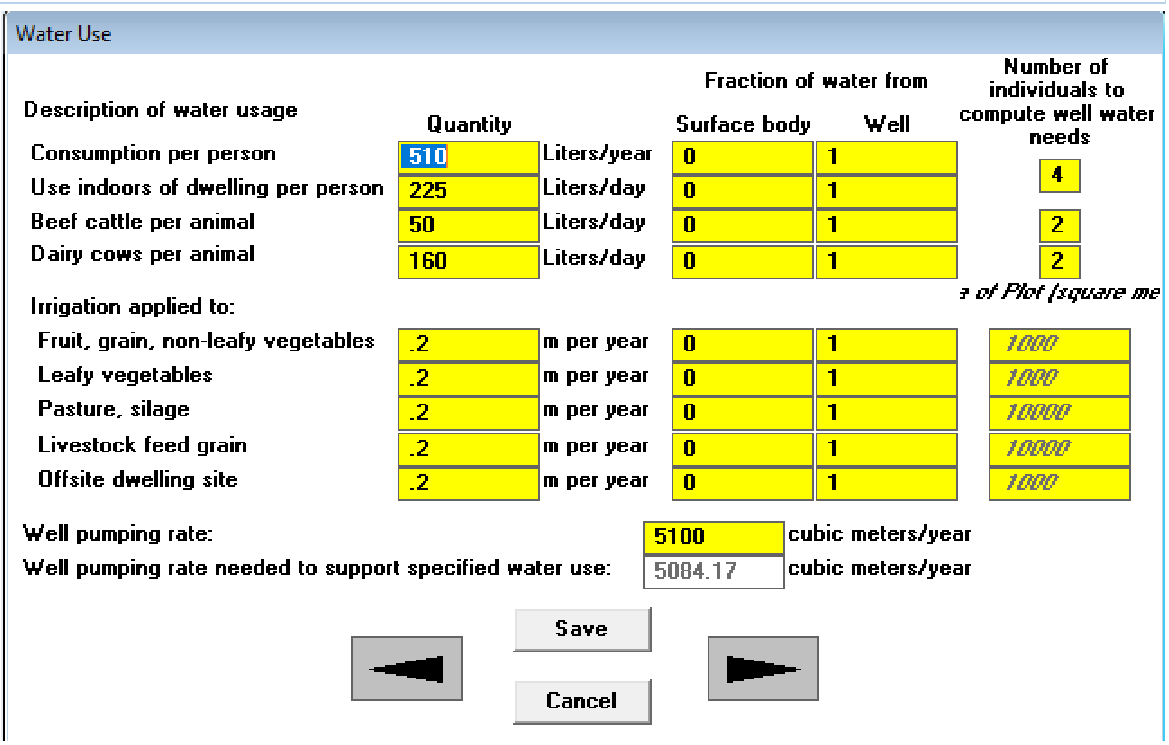

Primary Contamination
Area of primary contamination: 10000 square meters
Length of contamination parallel to aquifer flow: 100 meters
Depth of soil mixing layer: .15 meters
Mass loading of all particulates: .0001 grams/m?
Deposition velocity of all particulates (to compute atmospheric release): .001 meters/s
Respirable particulates as a fraction of total particulates 1
Deposition velocity of respirable particulates (to compute atmospheric release): .001 meters/s
Irrigation applied per year: .2 meters in a year
Evapotranspiration coefficient: .5
Runoff coefficient: .2
Slope-length-steepness factor: .4
Cover and management factor: .003
Support practice factor: 1
Fraction of primary contamination that is submerged 0
Soil layer -> Clean cover Contaminated zone
Location relative to water table -> above below
Thickness: 0 2 meters
Soil erodibility factor: .4 .4 tons/acre
Dry bulk density: 1.5 1.5 grams/cm?
Erosion rate: 1.147E-05 1.147E-05 meters/year
Total porosity: .4 .4
Volumetric water content: .05
Effective porosity: .4
Hydraulic conductivity: 10 meters/year
Field capacity: .3
b parameter: 5.3
Longitudinal dispersivity: .05 meters
Save
Cancel

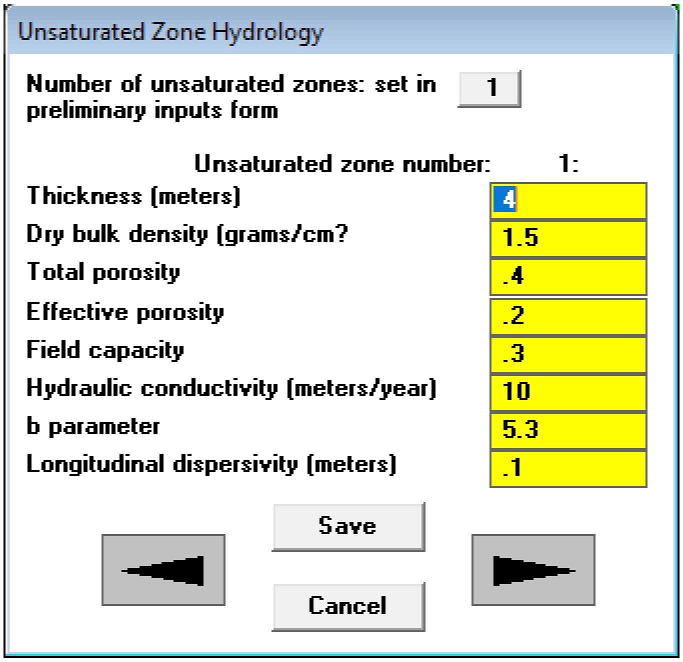

Fate of Material Eroded from the Primary Contamination by Runoff
Fraction of eroded radionuclides deposited at dwelling site
0
Fraction of eroded radionuclides deposited in the nonleafy vegetable plot
0
Fraction of eroded radionuclides deposited in the leafy vegetable plot
0
Fraction of eroded radionuclides deposited in the pasture
0
Fraction of eroded radionuclides deposited in the feed grain plot
0
Fraction of eroded radionuclides deposited in the surface water body
1
Save
Cancel

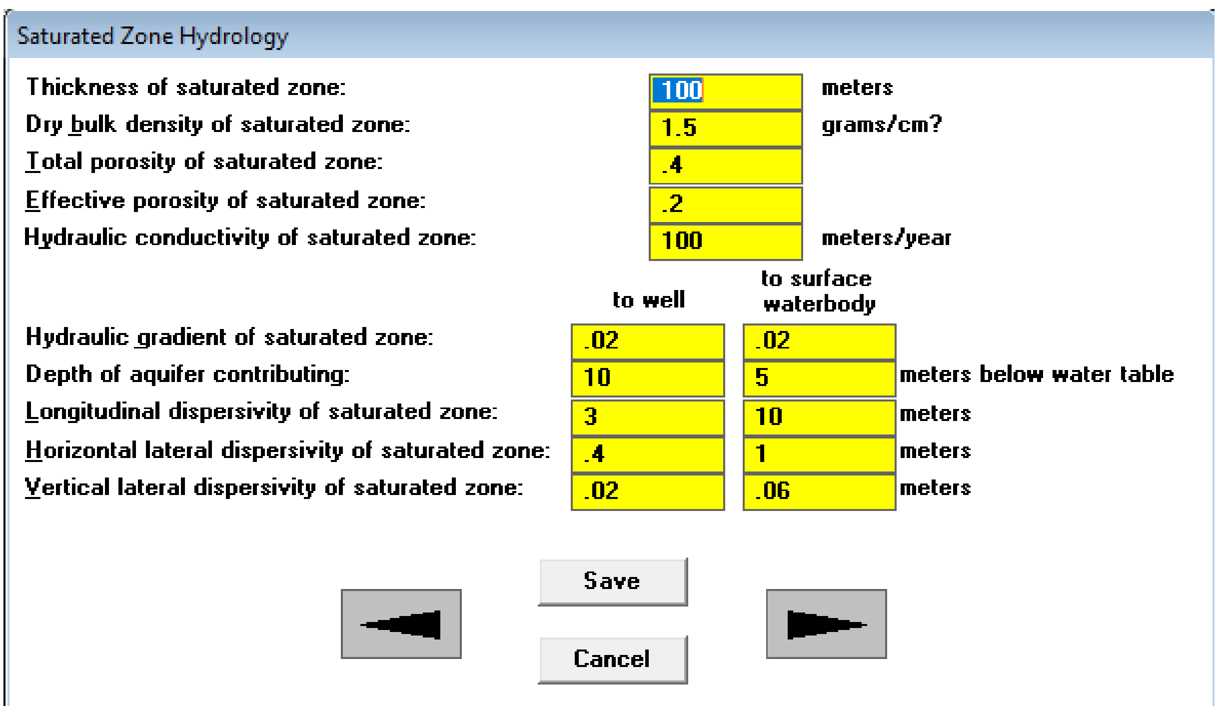

Agricultural Areas
Crops
Fruit, grain, non-leafy
Leafy vegetables
Area (square meters): 1000 1000
Fraction of area directly over primary contamination: 0 0
Irrigation (m) applied per year: .2 .2
Evapotranspiration coefficient: .5 .5
Runoff coefficient: .2 .2
Depth of soil mixing layer or plow layer (meters): .15 .15
Volumetric water content: .3 .3
Erosion rate (meters/year): 1.147E-5 1.147E-5
Dry bulk density of soil (grams/cm?: 1.5 1.5
Soil erodibility factor (tons/acre): .4 .4
Slope-length-steepness factor: .4 .4
Cover and management factor: .003 .003
Support practice factor: 1 1
Total porosity .4 .4
Sediment from primary contamination delivery ratio 0 0
Save
Cancel

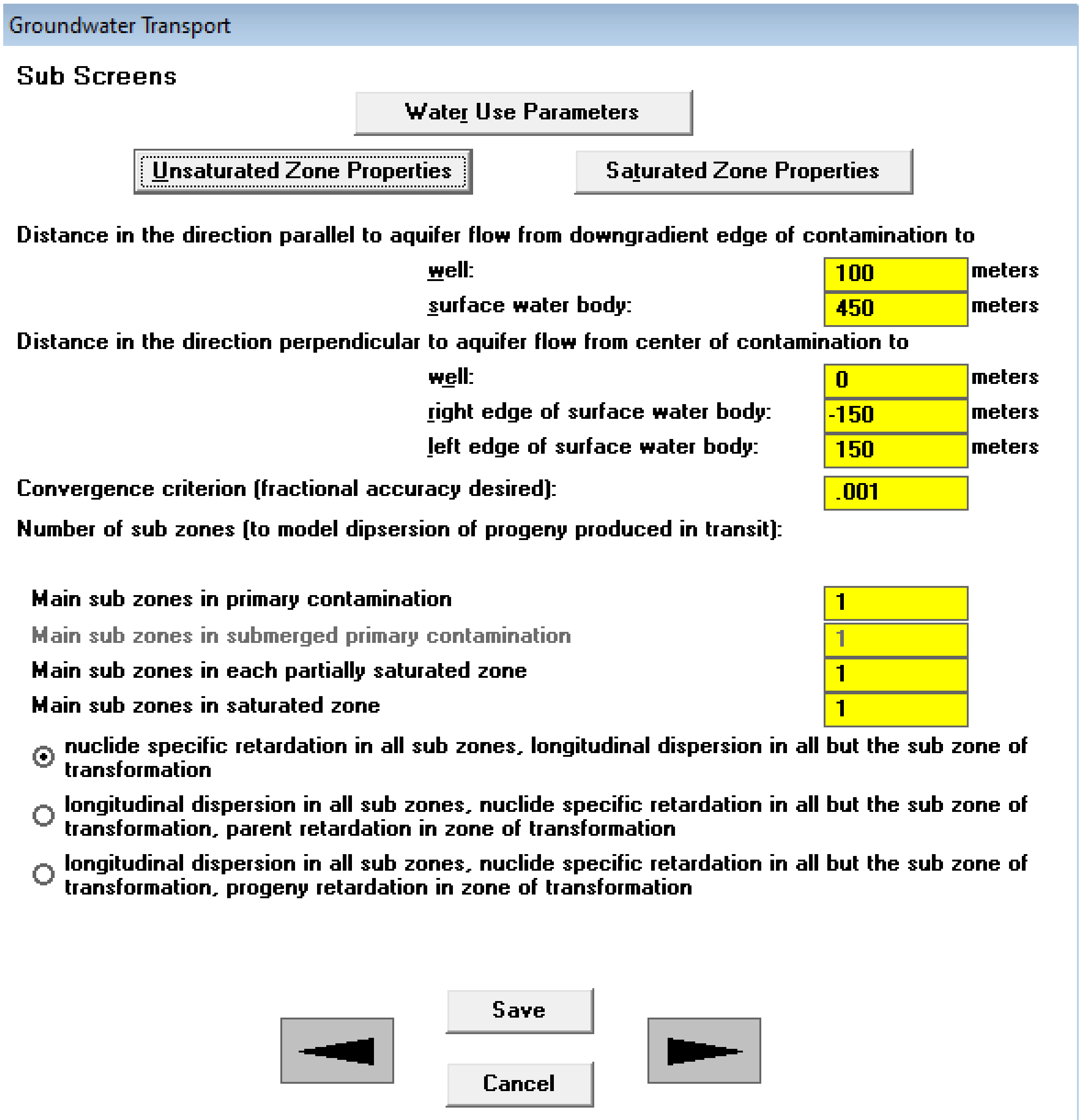

Livestock Feed Growing Areas
Crops
Pasture, silage
Grain
Area (square meters):
10000
10000
Fraction of area directly over primary contamination:
0
0
Irrigation (m) applied per year:
.2
.2
Evapotranspiration coefficient:
.5
.5
Runoff coefficient:
.2
.2
Depth of soil mixing layer or plow layer (meters):
.15
.15
Volumetric water content:
.3
.3
Erosion rate (meters/year):
1.147E-5
1.147E-5
Dry bulk density of soil (grams/cm?:
1.5
1.5
Soil erodibility factor (tons/acre):
.4
.4
Slope-length-steepness factor:
.4
.4
Cover and management factor:
.003
.003
Support practice factor:
1
1
Total porosity
.4
.4
Sediment from primary contamination delivery ratio
0
0
Save
Cancel
Offsite Dwelling Area
Building location
Offsite dwelling
Area (square meters):
1000
Irrigation (m) applied per year:
.2
Evapotranspiration coefficient:
.5
Runoff coefficient:
.2
Depth of soil mixing layer or plow layer (meters):
.15
Volumetric water content:
.3
Erosion rate (meters/year):
0
Dry bulk density of soil (grams/cm?:
1.5
Soil erodibility factor (tons/acre):
0
Slope-length-steepness factor:
.4
Cover and management factor:
.003
Support practice factor:
1
Total porosity
.4
Sediment from primary contamination delivery ratio
0
Save
Cancel

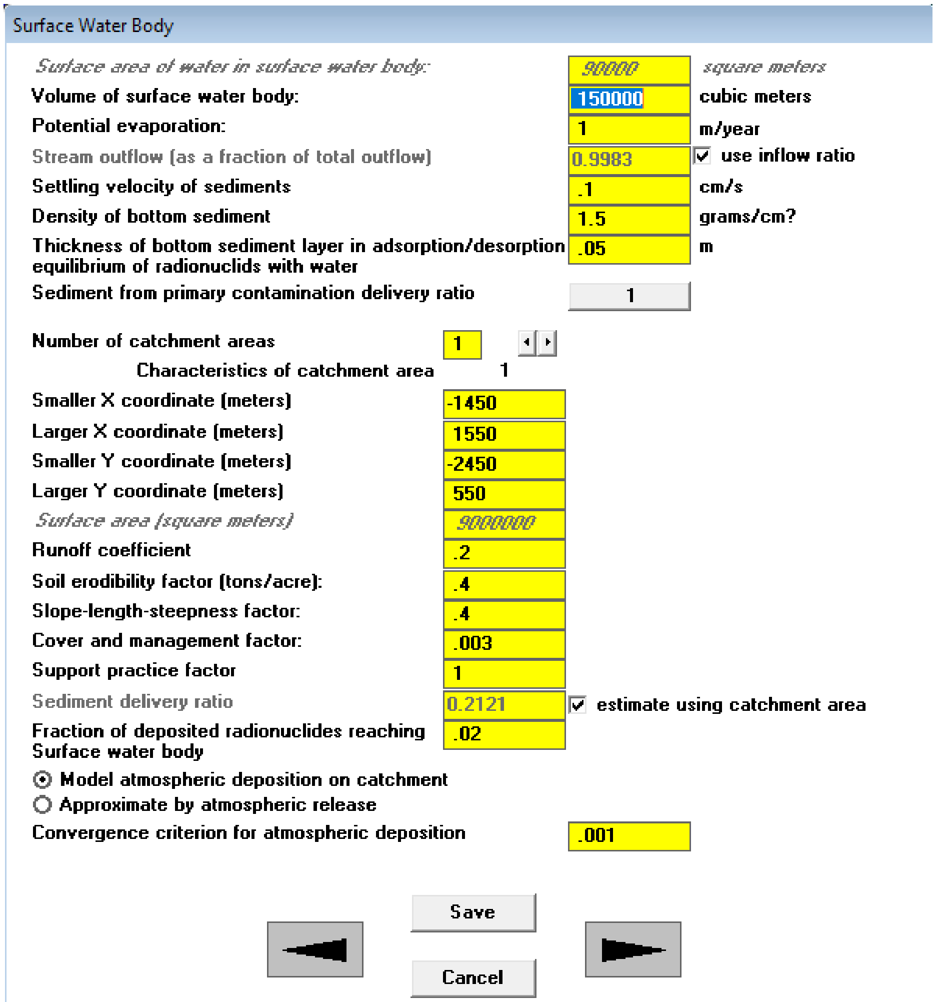

Atmospheric Transport
Release height
1
meters
Release heat flux
0
cal/s
Anemometer height
10
meters
Ambient temperature
285
Kelvin
AM atmospheric mixing height
400
meters
PM atmospheric mixing height
1600
meters
Dispersion Model Coefficients
Pasquill-Gifford Coefficients
Briggs Rural Coefficients
Briggs Urban Coefficients
Windspeed Terrain
Rural
Urban
Offsite location
Fruit, grain, non-leafy vegetables plot
Leafy vegetables plot
Pasture, silage growing area
Grain fields
Dwelling site
Surface water body
Elevation of offsite location, relative to ground level at primary contamination
0
0
0
0
0
0
m
Grid spacing for areal integration
10
m
Read Meteorological STAR file
Average Wind Speed
0.89
meters/s
Wind speed
0.89
2.46
4.47
6.93
9.61
12.52
m/s
Stability class
Joint frequency of wind speed and stability class for wind from S to
N
A
0
0
0
0
0
0
B
0
0
0
0
0
0
C
0
0
0
0
0
0
D
0.1
0
0
0
0
0
E
0.2
0
0
0
0
0
F
0.7
0
0
0
0
0
Deposition Velocities
Save
Cancel

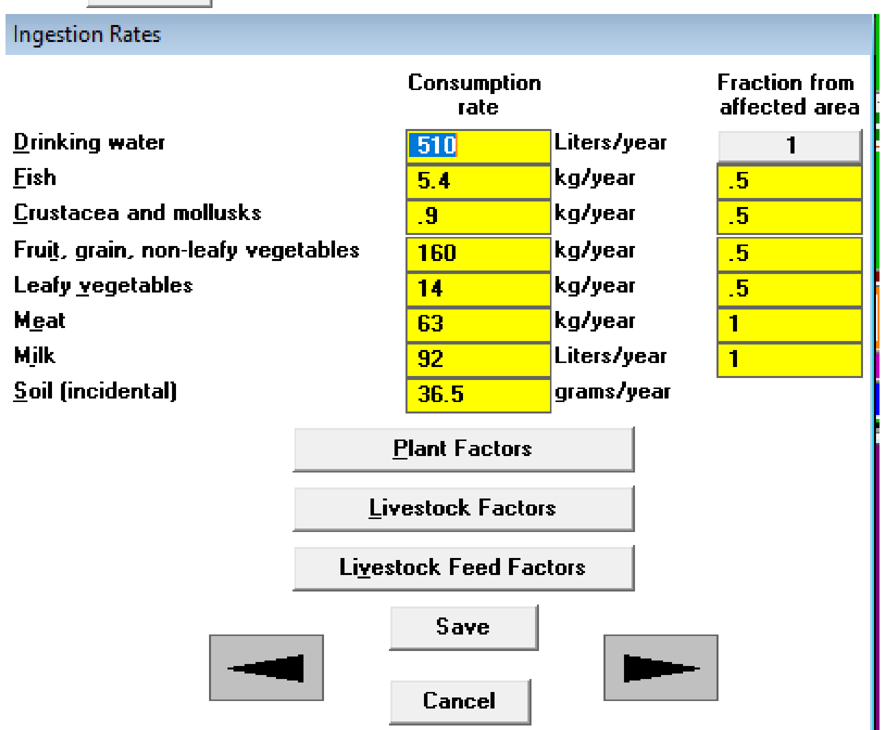

Water Use
Description of water usage
Quantity
Fraction of water from
Surface body
Well
Number of individuals to compute well water needs
Consumption per person
510
Liters/year
0
1
4
Use indoors of dwelling per person
225
Liters/day
0
1
Beef cattle per animal
50
Liters/day
0
1
2
Dairy cows per animal
160
Liters/day
0
1
2
Irrigation applied to:
of Plot (square me
Fruit, grain, non-leafy vegetables
.2
m per year
0
1
1000
Leafy vegetables
.2
m per year
0
1
1000
Pasture, silage
.2
m per year
0
1
10000
Livestock feed grain
.2
m per year
0
1
10000
Offsite dwelling site
.2
m per year
0
1
1000
Well pumping rate:
5100
cubic meters/year
Well pumping rate needed to support specified water use:
5084.17
cubic meters/year
Save
Cancel

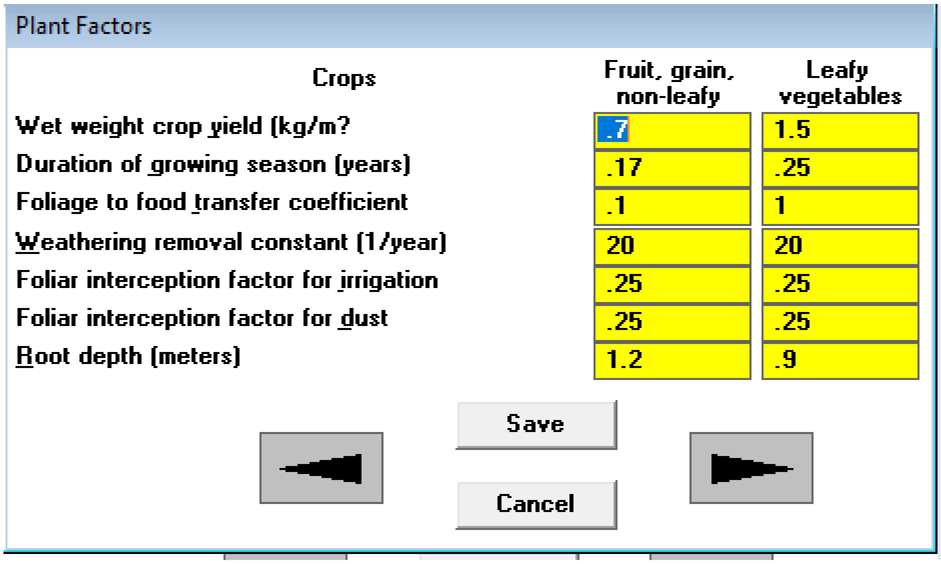

Unsaturated Zone Hydrology
Number of unsaturated zones: set in preliminary inputs form
1
Unsaturated zone number: 1:
Thickness (meters)
4
Dry bulk density (grams/cm?
1.5
Total porosity
.4
Effective porosity
.2
Field capacity
.3
Hydraulic conductivity (meters/year)
10
b parameter
5.3
Longitudinal dispersivity (meters)
.1
Save
Cancel

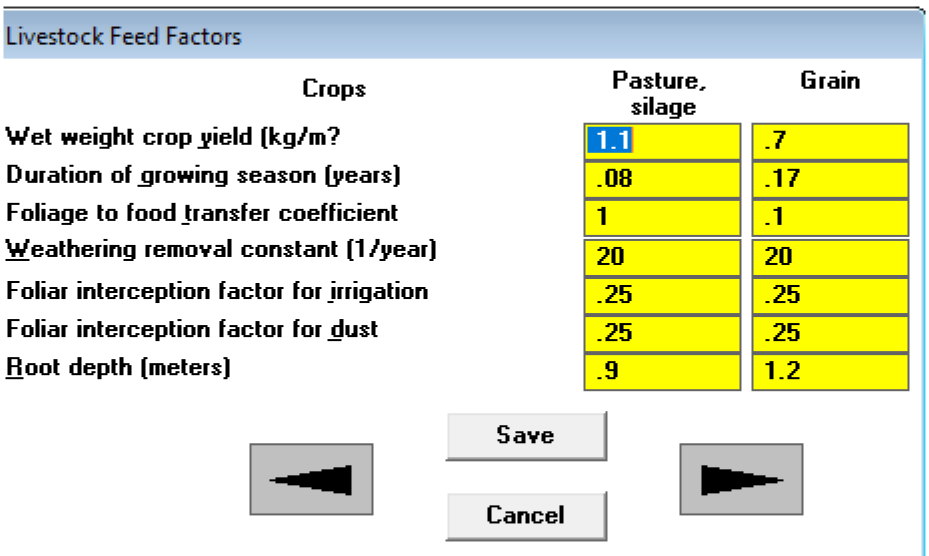

Saturated Zone Hydrology
Thickness of saturated zone:
100
meters
Dry bulk density of saturated zone:
1.5
grams/cm?
Total porosity of saturated zone:
.4
Effective porosity of saturated zone:
.2
Hydraulic conductivity of saturated zone:
100
meters/year
to well
to surface waterbody
Hydraulic gradient of saturated zone:
.02
.02
Depth of aquifer contributing:
10
5
meters below water table
Longitudinal dispersivity of saturated zone:
3
10
meters
Horizontal lateral dispersivity of saturated zone:
.4
1
meters
Vertical lateral dispersivity of saturated zone:
.02
.06
meters
Save
Cancel

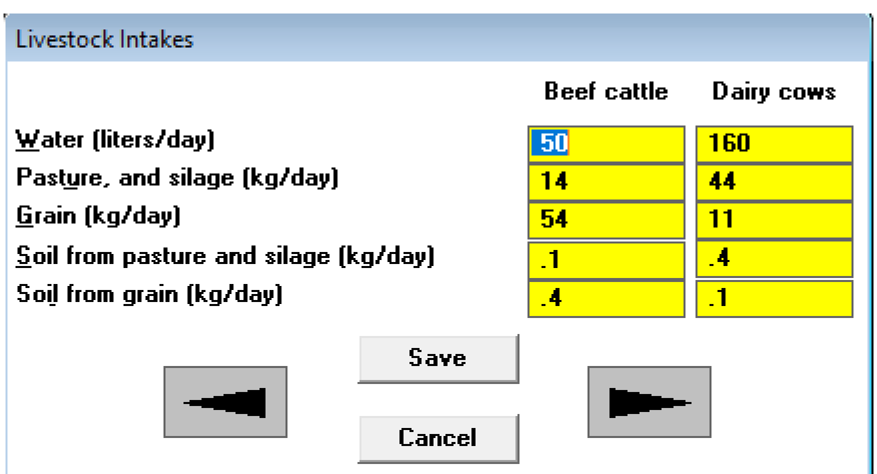

Groundwater Transport
Sub Screens
Water Use Parameters
Unsaturated Zone Properties
Saturated Zone Properties
Distance in the direction parallel to aquifer flow from downgradient edge of contamination to
well:
100
meters
surface water body:
450
meters
Distance in the direction perpendicular to aquifer flow from center of contamination to
well:
0
meters
right edge of surface water body:
-150
meters
left edge of surface water body:
150
meters
Convergence criterion (fractional accuracy desired):
.001
Number of sub zones (to model dipsersion of progeny produced in transit):
Main sub zones in primary contamination
1
Main sub zones in submerged primary contamination
1
Main sub zones in each partially saturated zone
1
Main sub zones in saturated zone
1
nuclide specific retardation in all sub zones, longitudinal dispersion in all but the sub zone of transformation
longitudinal dispersion in all sub zones, nuclide specific retardation in all but the sub zone of transformation, parent retardation in zone of transformation
longitudinal dispersion in all sub zones, nuclide specific retardation in all but the sub zone of transformation, progeny retardation in zone of transformation
Save
Cancel

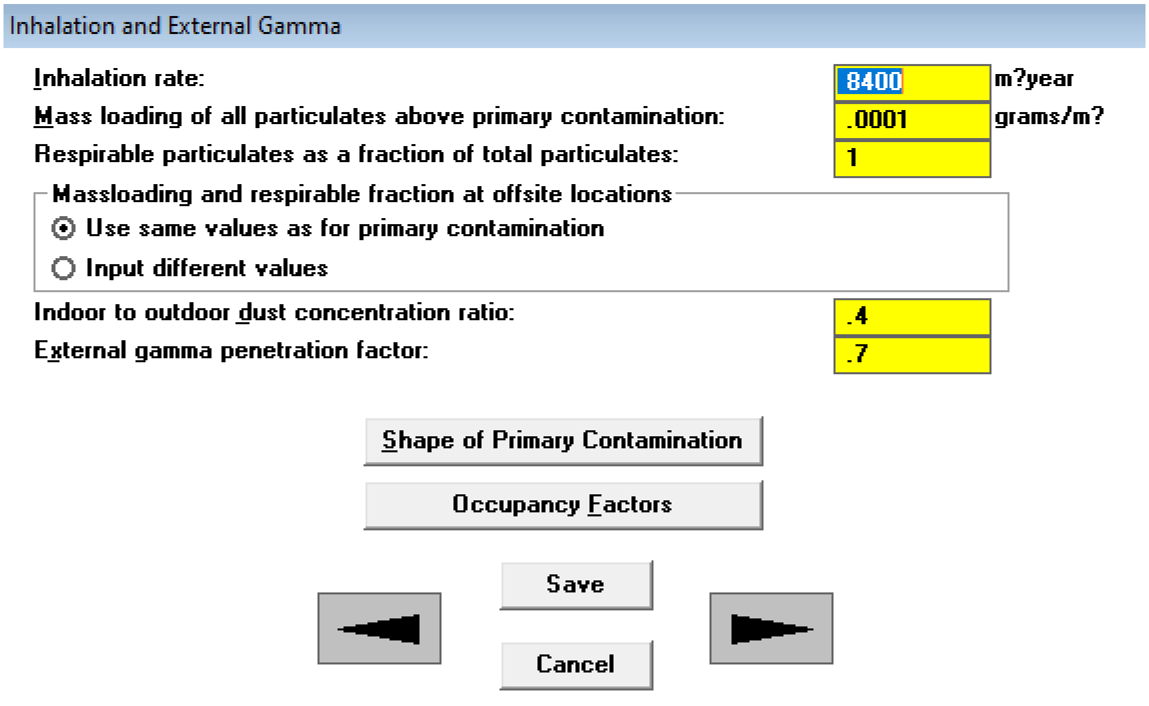

Surface Water Body
Surface area of water in surface water body:
90000
square meters
Volume of surface water body:
150000
cubic meters
Potential evaporation:
1
m/year
Stream outflow (as a fraction of total outflow)
0.9983
use inflow ratio
Settling velocity of sediments
.1
cm/s
Density of bottom sediment
1.5
grams/cm?
Thickness of bottom sediment layer in adsorption/desorption equilibrium of radionuclides with water
.05
m
Sediment from primary contamination delivery ratio
1
Number of catchment areas
1
Characteristics of catchment area
1
Smaller X coordinate (meters)
-1450
Larger X coordinate (meters)
1550
Smaller Y coordinate (meters)
-2450
Larger Y coordinate (meters)
550
Surface area (square meters)
9000000
Runoff coefficient
.2
Soil erodibility factor (tons/acre):
.4
Slope-length-steepness factor:
.4
Cover and management factor:
.003
Support practice factor
1
Sediment delivery ratio
0.2121
estimate using catchment area
Fraction of deposited radionuclides reaching Surface water body
.02
Model atmospheric deposition on catchment
Approximate by atmospheric release
Convergence criterion for atmospheric deposition
.001
Save
Cancel

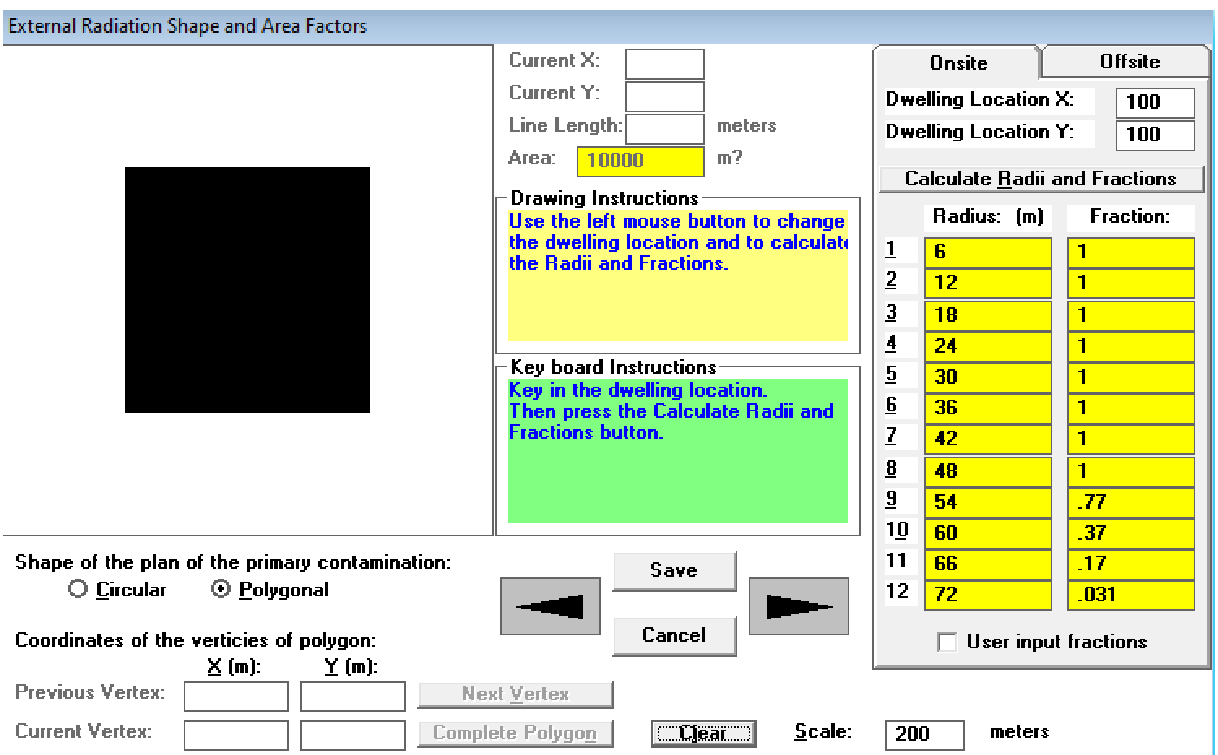

Ingestion Rates
Consumption rate
Fraction from affected area
Drinking water
510
Liters/year
1
Fish
5.4
kg/year
.5
Crustacea and mollusks
.9
kg/year
.5
Fruit, grain, non-leafy vegetables
160
kg/year
.5
Leafy vegetables
14
kg/year
.5
Meat
63
kg/year
1
Milk
92
Liters/year
1
Soil (incidental)
36.5
grams/year
Plant Factors
Livestock Factors
Livestock Feed Factors
Save
Cancel

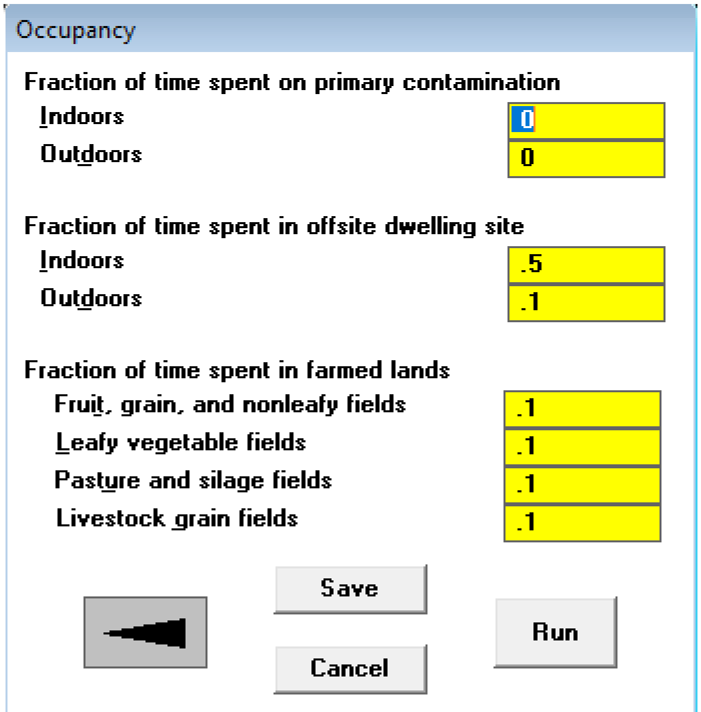

Plant Factors
Crops
Fruit, grain, non-leafy
Leafy vegetables
Wet weight crop yield (kg/m?
.7
1.5
Duration of growing season (years)
.17
.25
Foliage to food transfer coefficient
.1
1
Weathering removal constant (1/year)
20
20
Foliar interception factor for irrigation
.25
.25
Foliar interception factor for dust
.25
.25
Root depth (meters)
1.2
.9
Save
Cancel

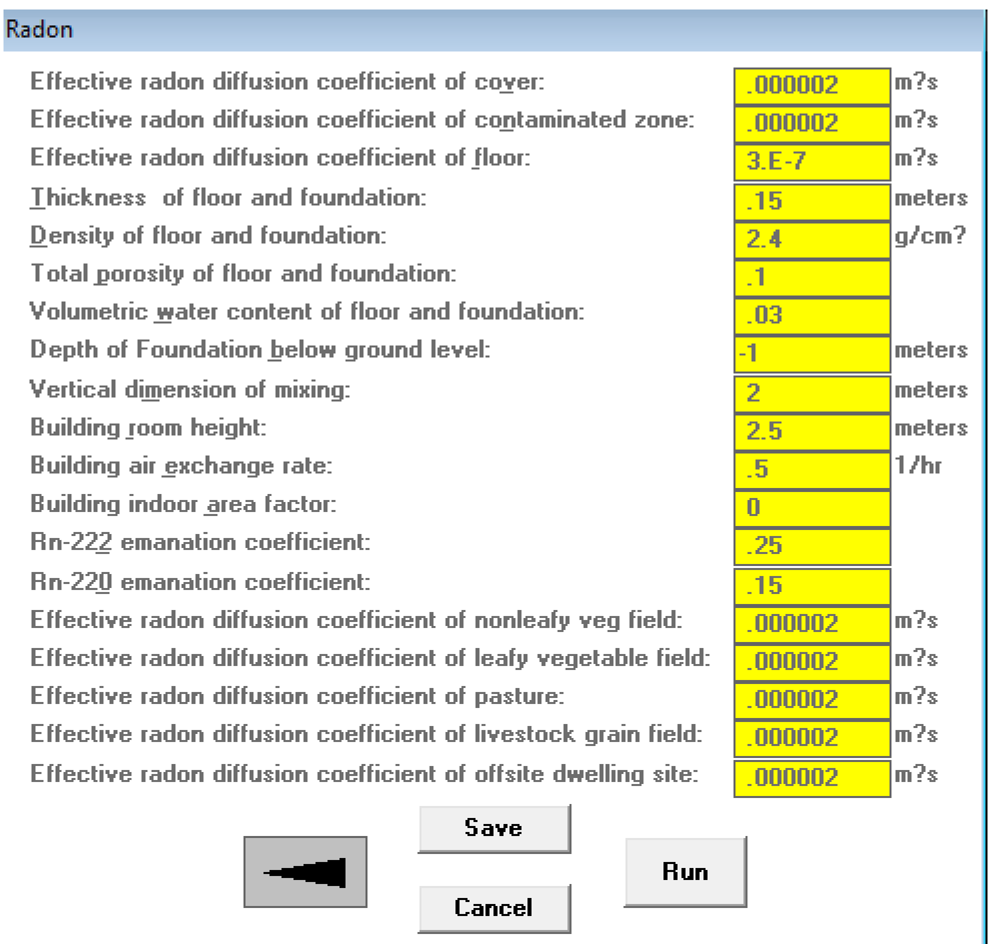

Livestock Feed Factors
Crops
Pasture, silage
Grain
Wet weight crop yield (kg/m?
1.1
.7
Duration of growing season (years)
.08
.17
Foliage to food transfer coefficient
1
.1
Weathering removal constant (1/year)
20
20
Foliar interception factor for irrigation
.25
.25
Foliar interception factor for dust
.25
.25
Root depth (meters)
.9
1.2
Save
Cancel

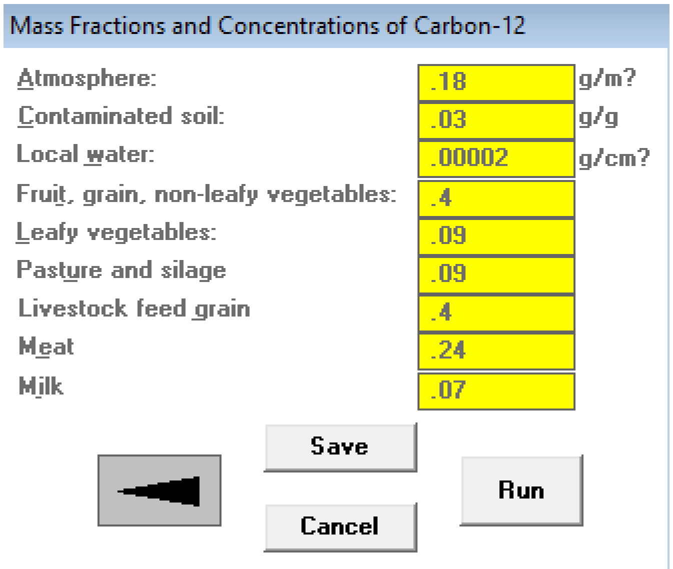

Livestock Intakes
Beef cattle
Dairy cows
Water (liters/day)
50
160
Pasture, and silage (kg/day)
14
44
Grain (kg/day)
54
11
Soil from pasture and silage (kg/day)
.1
.4
Soil from grain (kg/day)
.4
.1
Save
Cancel

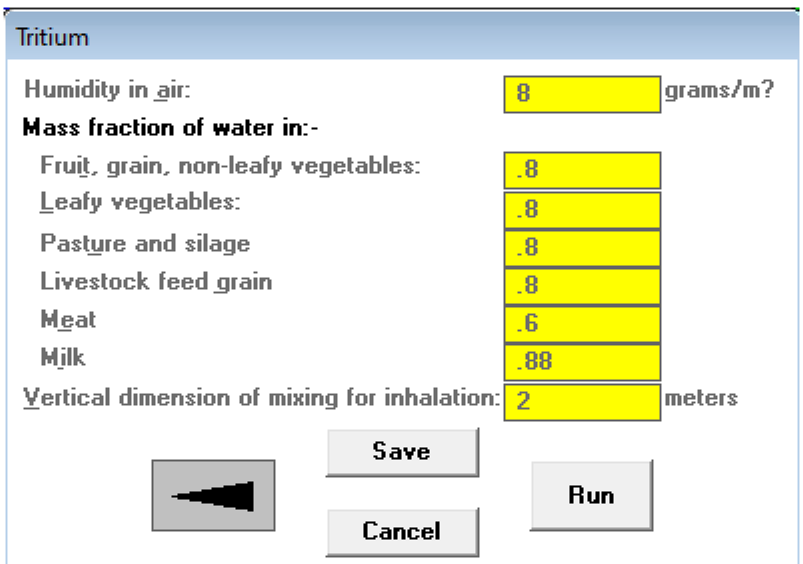

Inhalation and External Gamma
Inhalation rate:
8400
m?year
Mass loading of all particulates above primary contamination:
.0001
grams/m?
Respirable particulates as a fraction of total particulates:
1
Massloading and respirable fraction at offsite locations
Use same values as for primary contamination
Input different values
Indoor to outdoor dust concentration ratio:
.4
External gamma penetration factor:
.7
Shape of Primary Contamination
Occupancy Factors
Save
Cancel


External Radiation Shape and Area Factors
Current X:
Current Y:
Line Length:
meters
Area:
10000
m?
Drawing Instructions
Use the left mouse button to change the dwelling location and to calculate the Radii and Fractions.
Key board Instructions
Key in the dwelling location.
Then press the Calculate Radii and Fractions button.
Onsite
Offsite
Dwelling Location X:
100
Dwelling Location Y:
100
Calculate Radii and Fractions
Radius: (m)
Fraction:
1 6 1
2 12 1
3 18 1
4 24 1
5 30 1
6 36 1
7 42 1
8 48 1
9 54 .77
10 60 .37
11 66 .17
12 72 .031
User input fractions
Shape of the plan of the primary contamination:
Circular
Polygonal
Save
Cancel
Coordinates of the verticies of polygon:
X (m):
Y (m):
Previous Vertex:
Next Vertex
Current Vertex:
Complete Polygon
Clear
Scale:
200
meters


Occupancy
Fraction of time spent on primary contamination
Indoors 0
Outdoors 0
Fraction of time spent in offsite dwelling site
Indoors .5
Outdoors .1
Fraction of time spent in farmed lands
Fruit, grain, and nonleafy fields .1
Leafy vegetable fields .1
Pasture and silage fields .1
Livestock grain fields .1
Save
Cancel
Run


Radon
Effective radon diffusion coefficient of cover: .000002 m?s
Effective radon diffusion coefficient of contaminated zone: .000002 m?s
Effective radon diffusion coefficient of floor: 3.E-7 m?s
Thickness of floor and foundation: .15 meters
Density of floor and foundation: 2.4 g/cm?
Total porosity of floor and foundation: .1
Volumetric water content of floor and foundation: .03
Depth of Foundation below ground level: -1 meters
Vertical dimension of mixing: 2 meters
Building room height: 2.5 meters
Building air exchange rate: .5 1/hr
Building indoor area factor: 0
Rn-222 emanation coefficient: .25
Rn-220 emanation coefficient: .15
Effective radon diffusion coefficient of nonleafy veg field: .000002 m?s
Effective radon diffusion coefficient of leafy vegetable field: .000002 m?s
Effective radon diffusion coefficient of pasture: .000002 m?s
Effective radon diffusion coefficient of livestock grain field: .000002 m?s
Effective radon diffusion coefficient of offsite dwelling site: .000002 m?s
Save
Cancel
Run

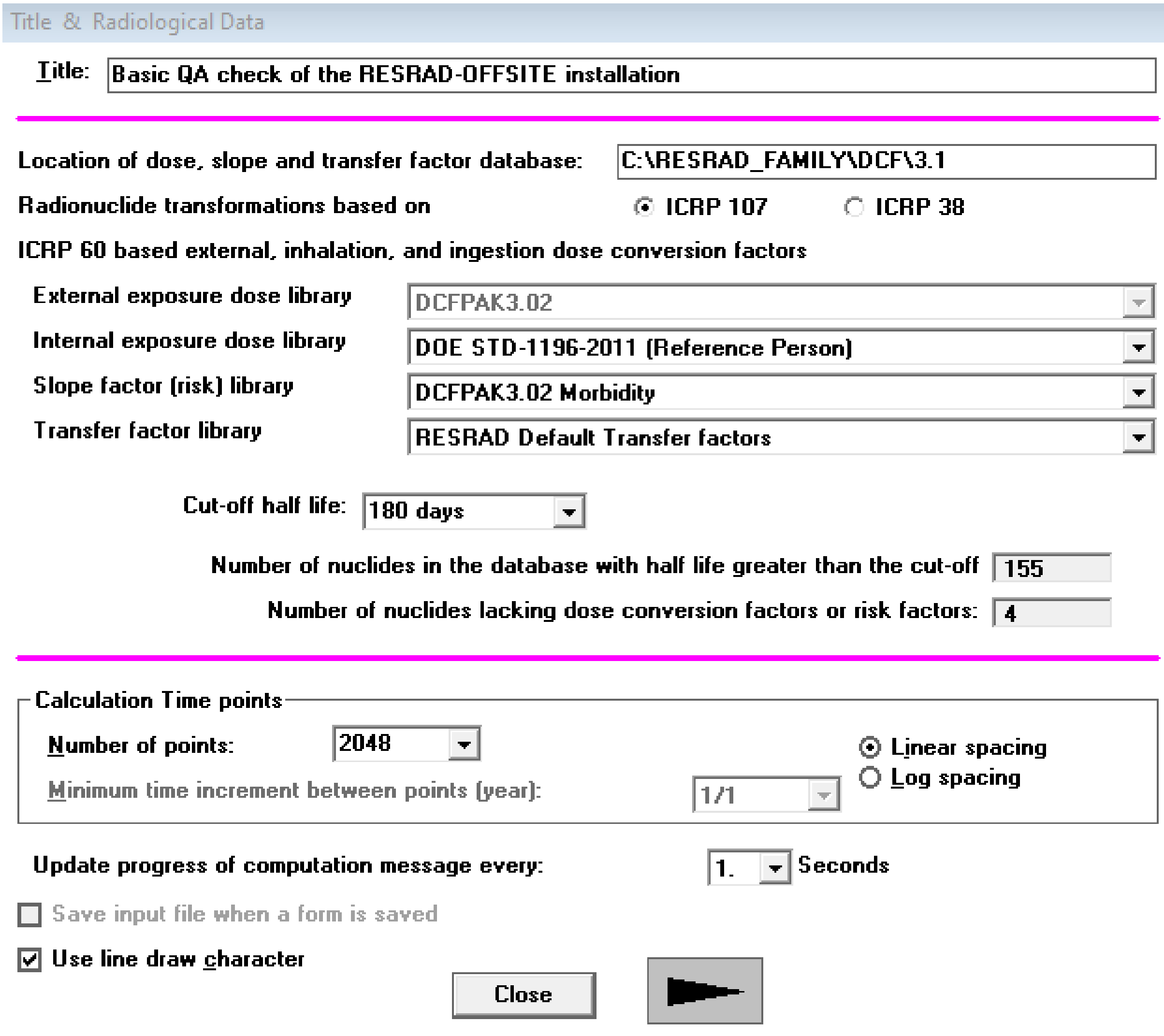




3.(b) Followed Step 3) in the test case for “Save” button: worked as expected

```
TITLE = 'test menu File -> New/Save',
```

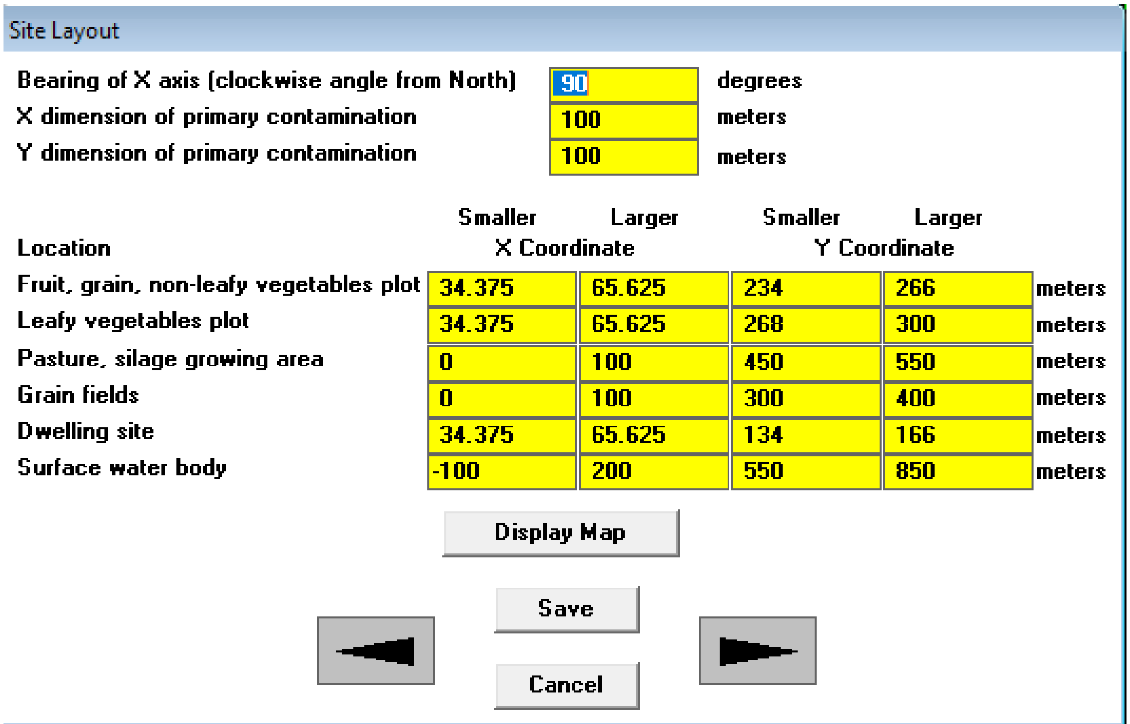
4. Followed Step 4) of the test case description. Opened file “BASIC RESRAD-OFFSITE INSTALLATION QA.ROF” in the QAFiles folder rather than the file with file name ending with “US.ROF”. Worked as expected.



Compare the file generated by “Save as” button using the following command statement. The differences between the two files were output to the file named diff.txt. File diiff.txt indicates that there was no difference between the two files, meaning the “Save as” button worked as expected.

```
C:\Users\ChengWang>fc "C:\Users\ChengWang\Research\Projects\RESRAD\OFFSITE\v4.0\ReleaseTesting\033-001\test002.rof"  "C:
\RESRAD_Family\OFFSITE\4.0\QAfiles\BASIC RESRAD-OFFSITE INSTALLATION QA.ROF" >C:\Users\ChengWang\Research\Projects\RESRA
D\OFFSITE\v4.0\ReleaseTesting\033-001\diff.txt
```

5. Followed Step 5) of the test case. This step should follow Test Case 029-001, rather than Test Case 35-004. Worked as expected.



Site Layout

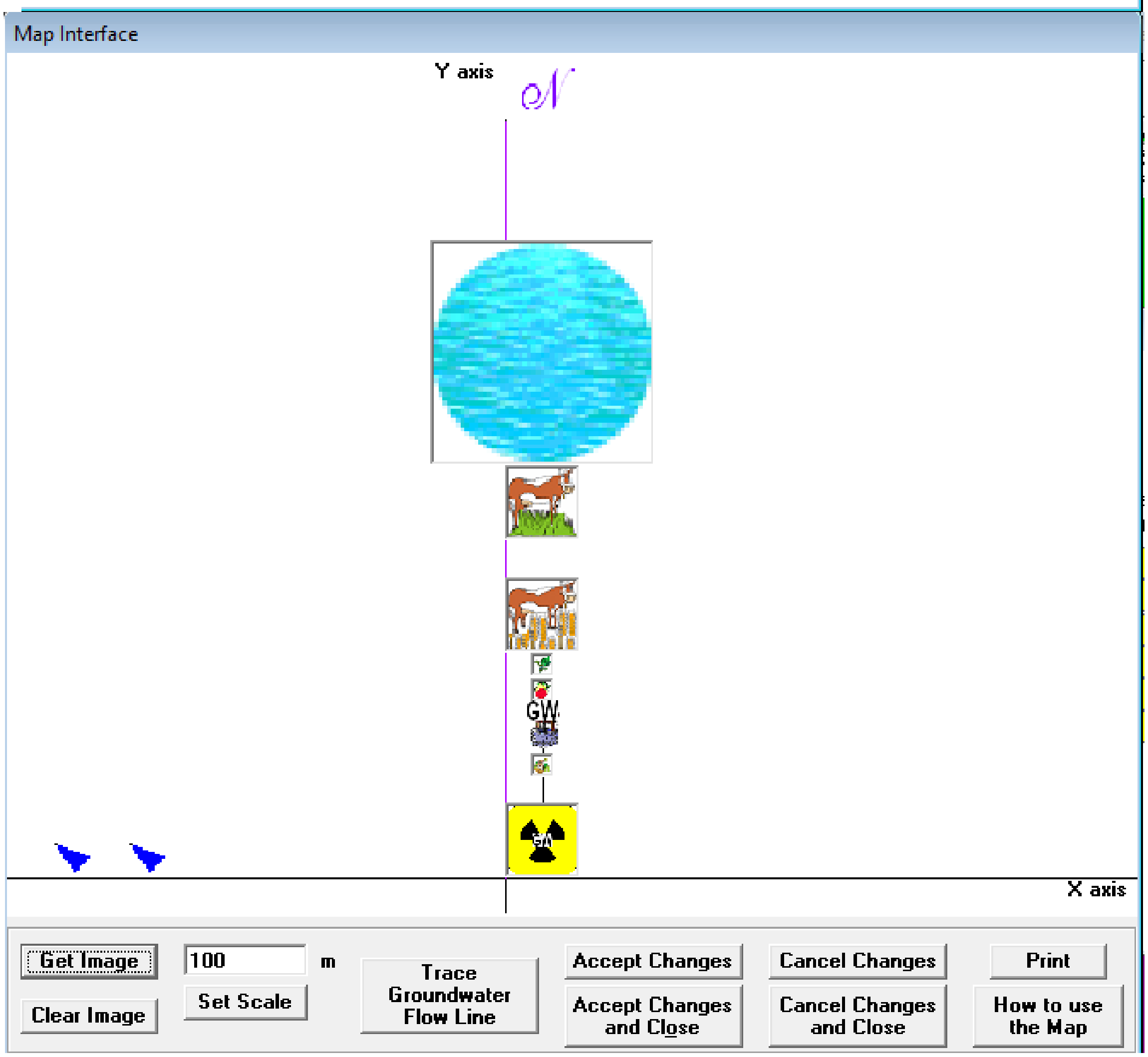
Bearing of X axis (clockwise angle from North)	90	degrees
X dimension of primary contamination	100	meters
Y dimension of primary contamination	100	meters

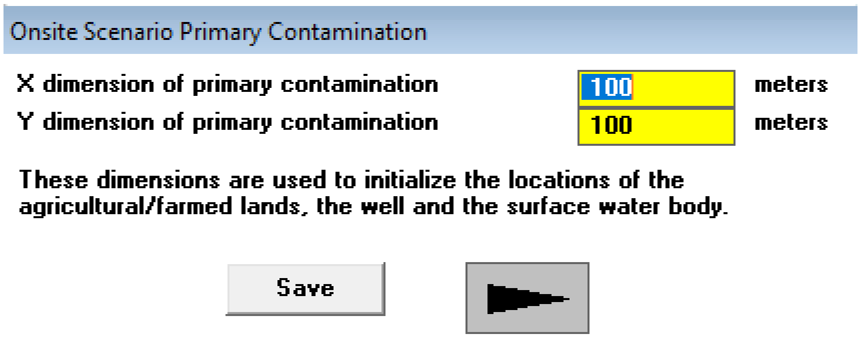
Location	Smaller X Coordinate	Larger X Coordinate	Smaller Y Coordinate	Larger Y Coordinate	
Fruit, grain, non-leafy vegetables plot	34.375	65.625	234	266	meters
Leafy vegetables plot	34.375	65.625	268	300	meters
Pasture, silage growing area	0	100	450	550	meters
Grain fields	0	100	300	400	meters
Dwelling site	34.375	65.625	134	166	meters
Surface water body	-100	200	550	850	meters

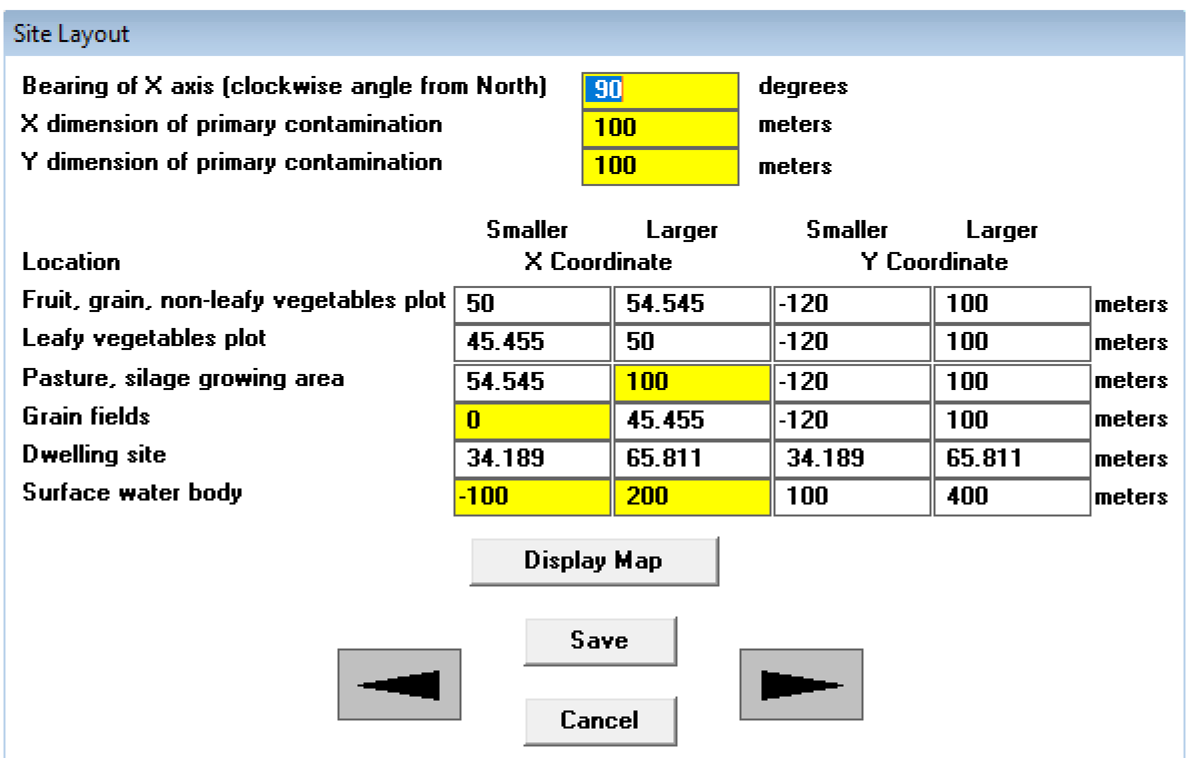
Display Map

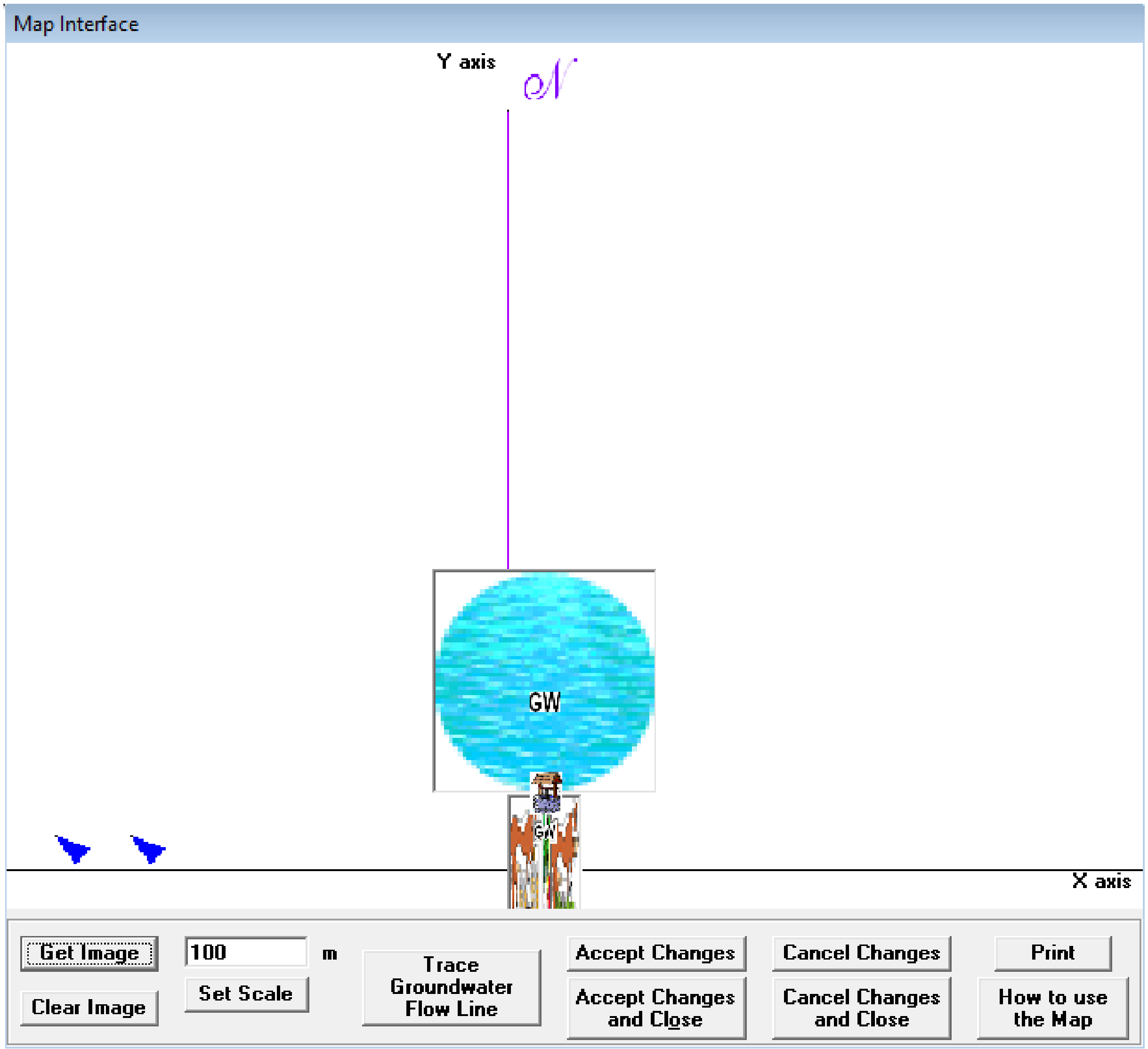
Save

Cancel

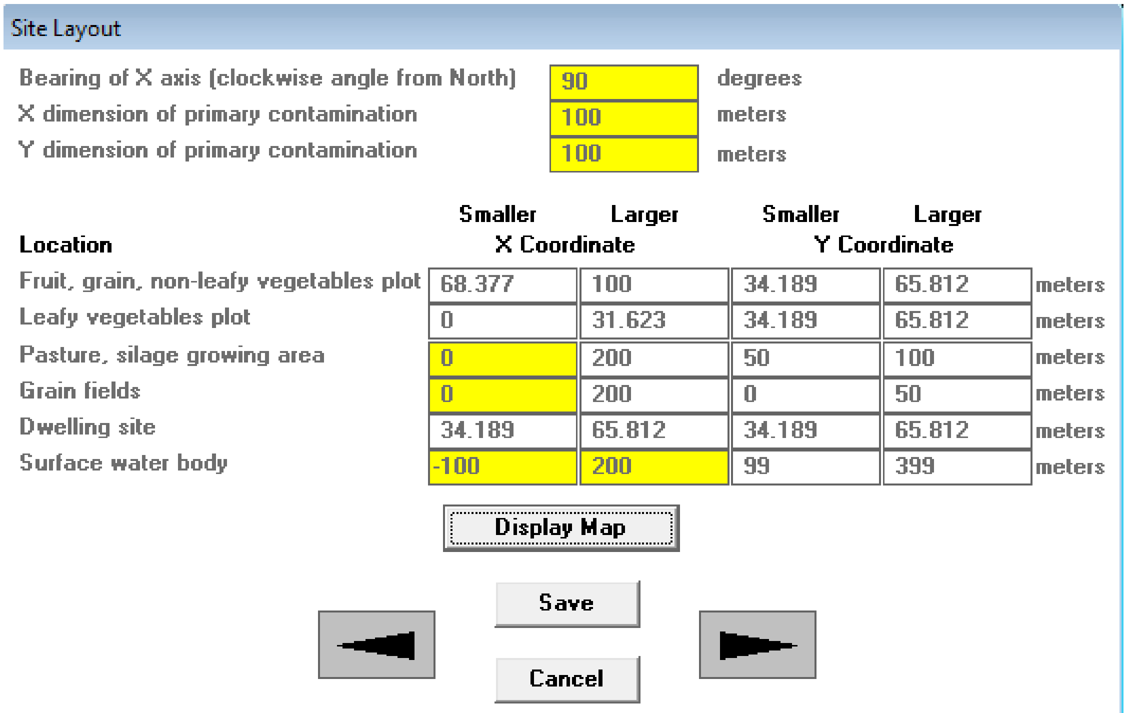


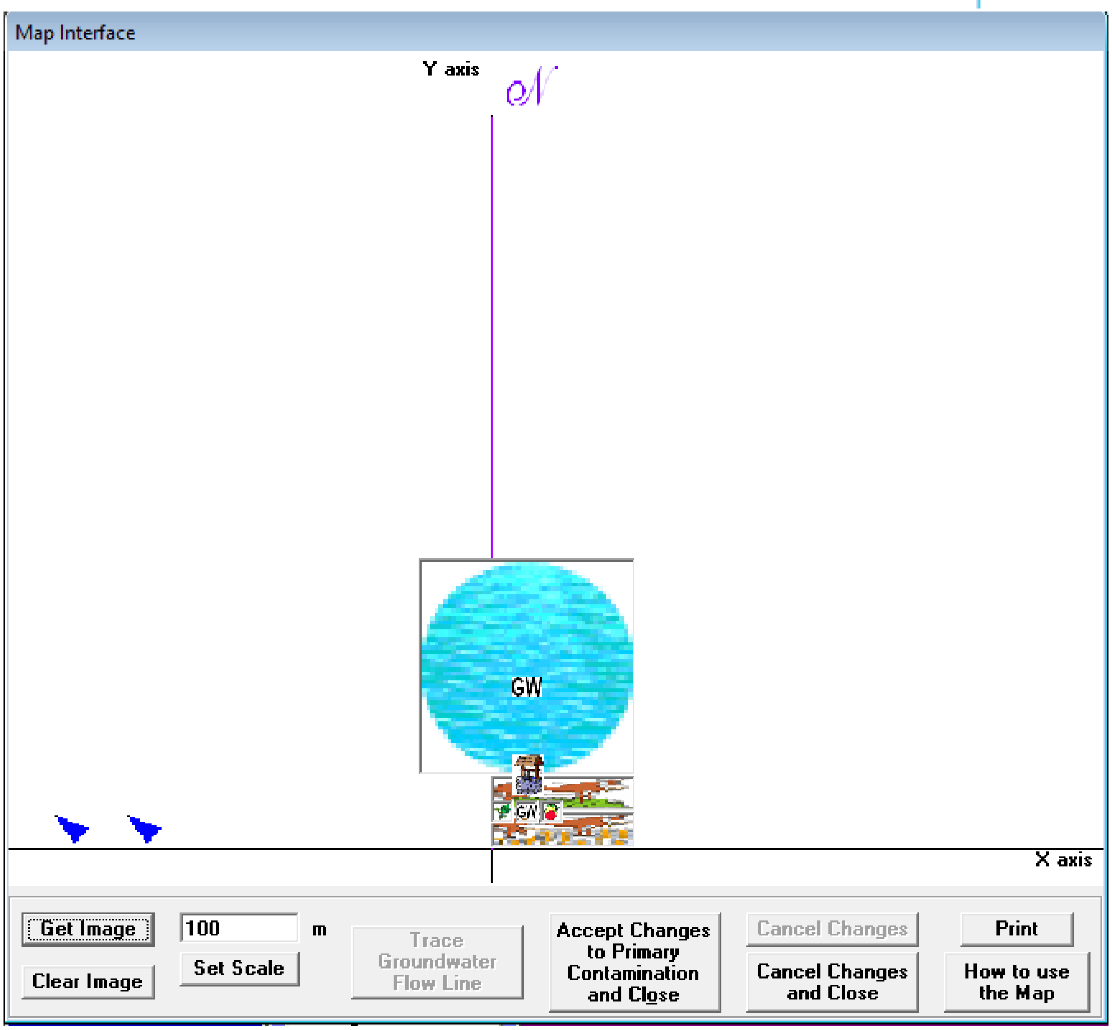

Onsite Scenario Primary Contamination
X dimension of primary contamination
100
meters
Y dimension of primary contamination
100
meters
These dimensions are used to initialize the locations of the agricultural/farmed lands, the well and the surface water body.
Save


Site Layout
Bearing of X axis (clockwise angle from North)
90
degrees
X dimension of primary contamination
100
meters
Y dimension of primary contamination
100
meters
Smaller
Larger
Smaller
Larger
Location
X Coordinate
Y Coordinate
Fruit, grain, non-leafy vegetables plot
50
54.545
-120
100
meters
Leafy vegetables plot
45.455
50
-120
100
meters
Pasture, silage growing area
54.545
100
-120
100
meters
Grain fields
0
45.455
-120
100
meters
Dwelling site
34.189
65.811
34.189
65.811
meters
Surface water body
-100
200
100
400
meters
Display Map
Save
Cancel



6. Followed Step 6) of the test case description. This step should follow Test Case 029-002, rather than Test Case 35-005. Worked as expected.


Site Layout
Bearing of X axis (clockwise angle from North)
90
degrees
X dimension of primary contamination
100
meters
Y dimension of primary contamination
100
meters
Smaller
Larger
Smaller
Larger
Location
X Coordinate
Y Coordinate
Fruit, grain, non-leafy vegetables plot
68.377
100
34.189
65.812
meters
Leafy vegetables plot
0
31.623
34.189
65.812
meters
Pasture, silage growing area
0
200
50
100
meters
Grain fields
0
200
0
50
meters
Dwelling site
34.189
65.812
34.189
65.812
meters
Surface water body
-100
200
99
399
meters
Display Map
Save
Cancel


Map Interface
Y axis
N
GW
GW
X axis
Get Image
100
m
Set Scale
Clear Image
Trace Groundwater Flow Line
Accept Changes to Primary Contamination and Close
Cancel Changes
Cancel Changes and Close
Print
How to use the Map

12.21 TEST CASE 033-002 TESTER'S REPORT

Documented in Test-033-002_report.docx of 2/20/2020 6:47 AM

Test Case 033-002 report

By Cheng Wang 2/17/2020

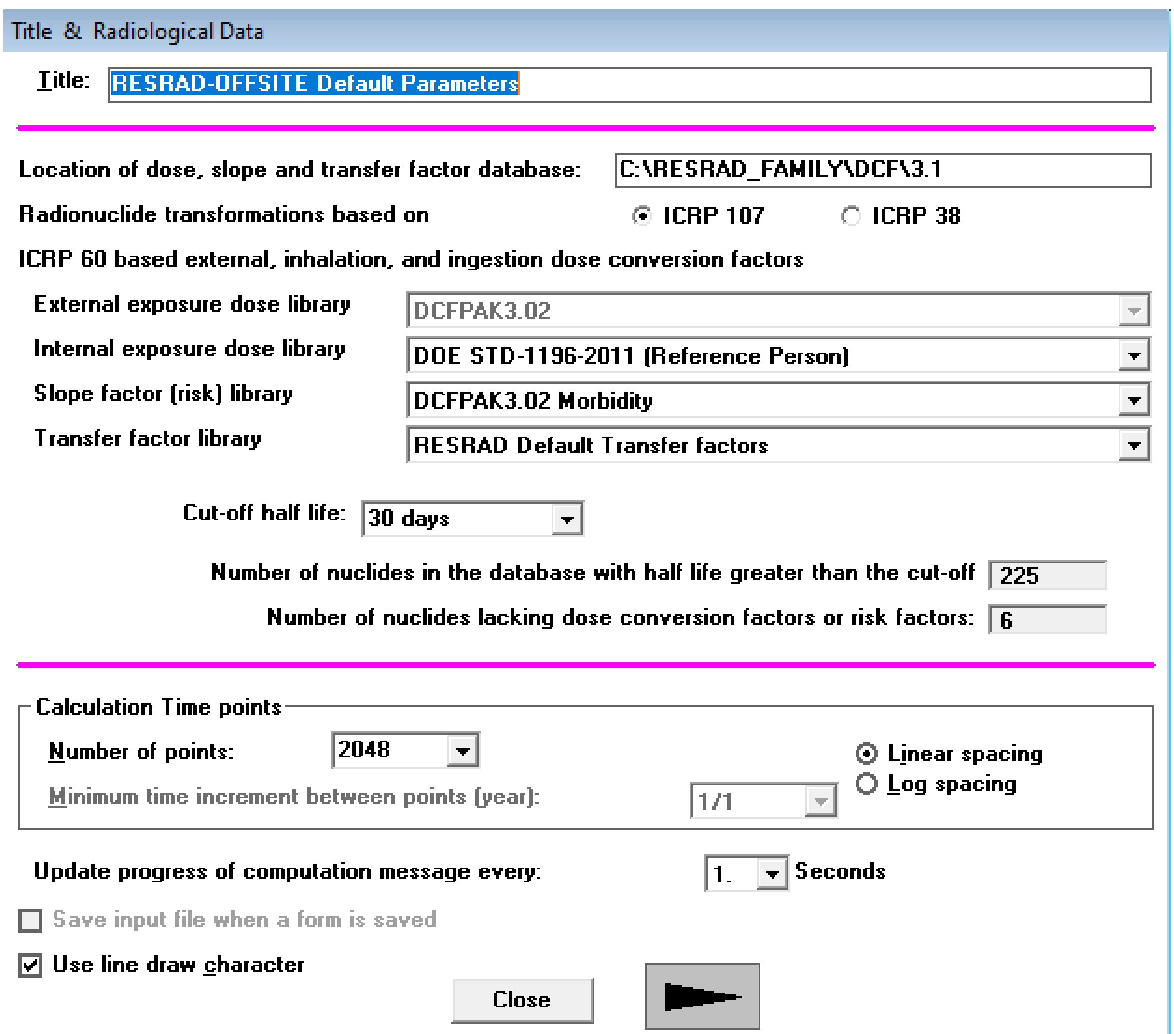
Objective: to test the Change Title navigation function from the left panel of GUI.

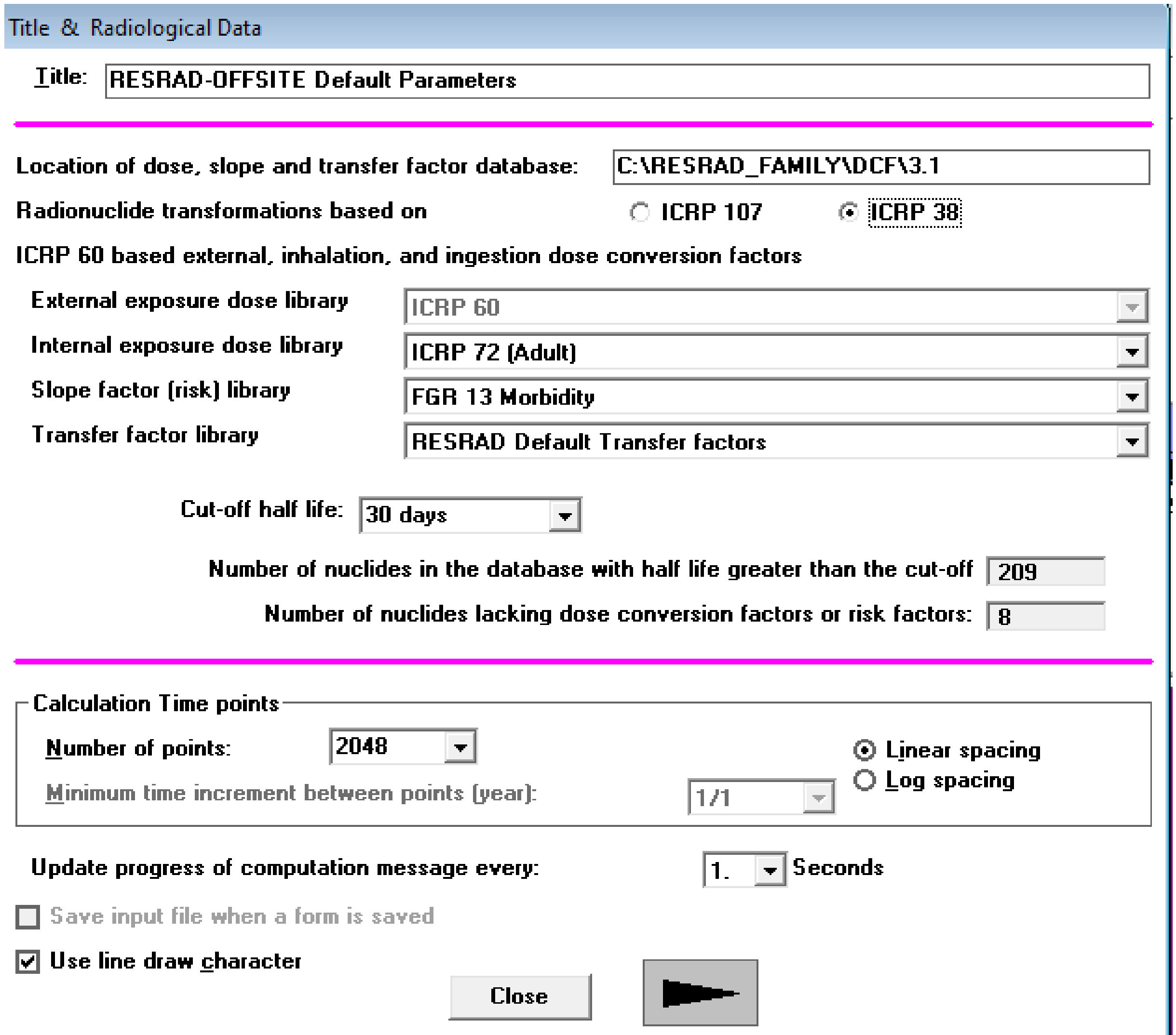
Conclusion: the code worked as expected.

Procedure:

1.Followed the procedure in the test case description. Worked as expected.

The left panel and the right panel of the expected results in test case description should switch.




Title & Radiological Data
Title: RESRAD-OFFSITE Default Parameters
Location of dose, slope and transfer factor database: C:\RESRAD_FAMILY\DCF\3.1
Radionuclide transformations based on
ICRP 107
ICRP 38
ICRP 60 based external, inhalation, and ingestion dose conversion factors
External exposure dose library
ICRP 60
Internal exposure dose library
ICRP 72 (Adult)
Slope factor (risk) library
FGR 13 Morbidity
Transfer factor library
RESRAD Default Transfer factors
Cut-off half life: 30 days
Number of nuclides in the database with half life greater than the cut-off 209
Number of nuclides lacking dose conversion factors or risk factors: 8
Calculation Time points
Number of points: 2048
Minimum time increment between points (year): 1/1
Linear spacing
Log spacing
Update progress of computation message every: 1. Seconds
Save input file when a form is saved
Use line draw character
Close

12.22 TEST CASE 033-003 TESTER'S REPORT

Documented in Test-033-003_report.docx of 2/20/2020 6:49 AM

Test Case 033-003 report

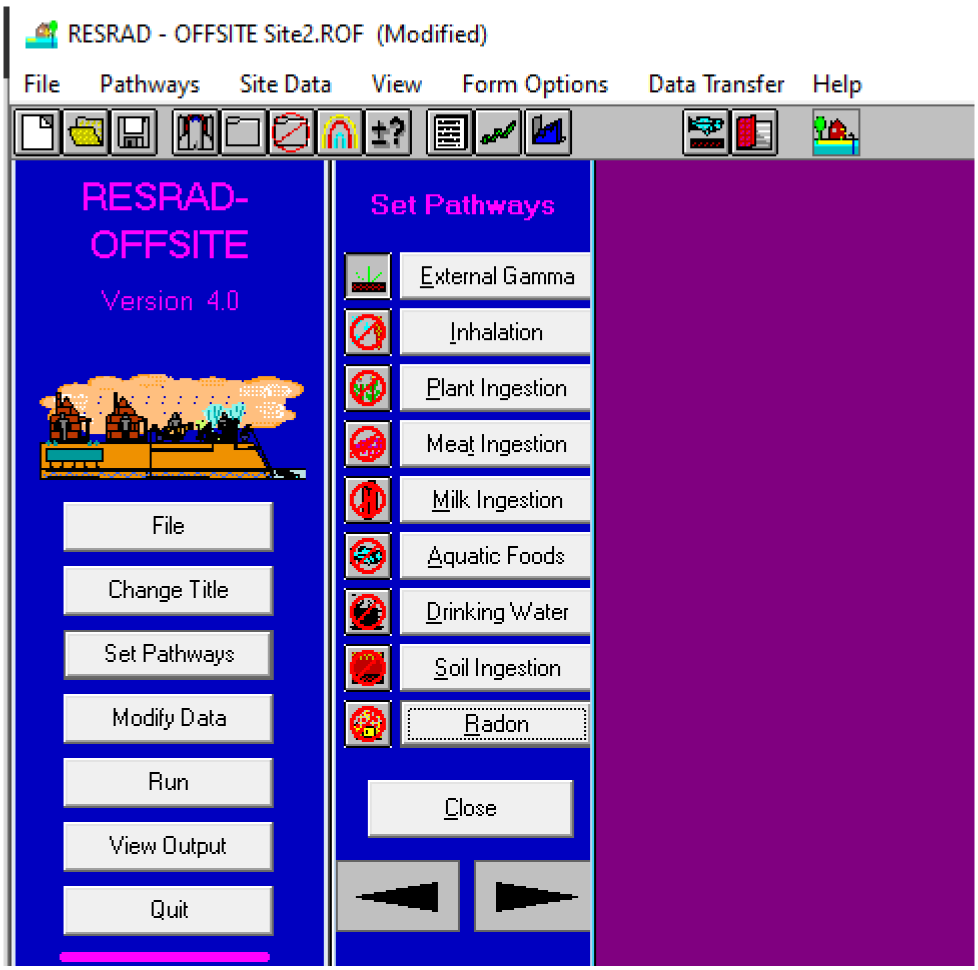
By cheng wang 2/17/2020

Objective: To Test the functionality of Set Pathways navigation in the left panel of GUI.

Conclusion: the code worked as expected.

Procedure:

1. Followed the procedure of the test case description.
   - Visually check for Steps 2 – 6; worked as expected
   - For Step 7), worked as expected



- For Step 11), worked as expected

```
SELPATH = 1,
```

- For Step 12), worked as expected

```
            Summary of Pathway Selections

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

- For Step 14), worked as expected

```
SELPATH = 257,
```

- For Step 15), worked as expected

```
            Summary of Pathway Selections

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

12.23 TEST CASE 033-004 TESTER'S REPORT

Documented in Test-033-004_report.docx of 2/20/2020 6:50 AM

Test Case 033-004 report

By Cheng Wang 2/17/2020

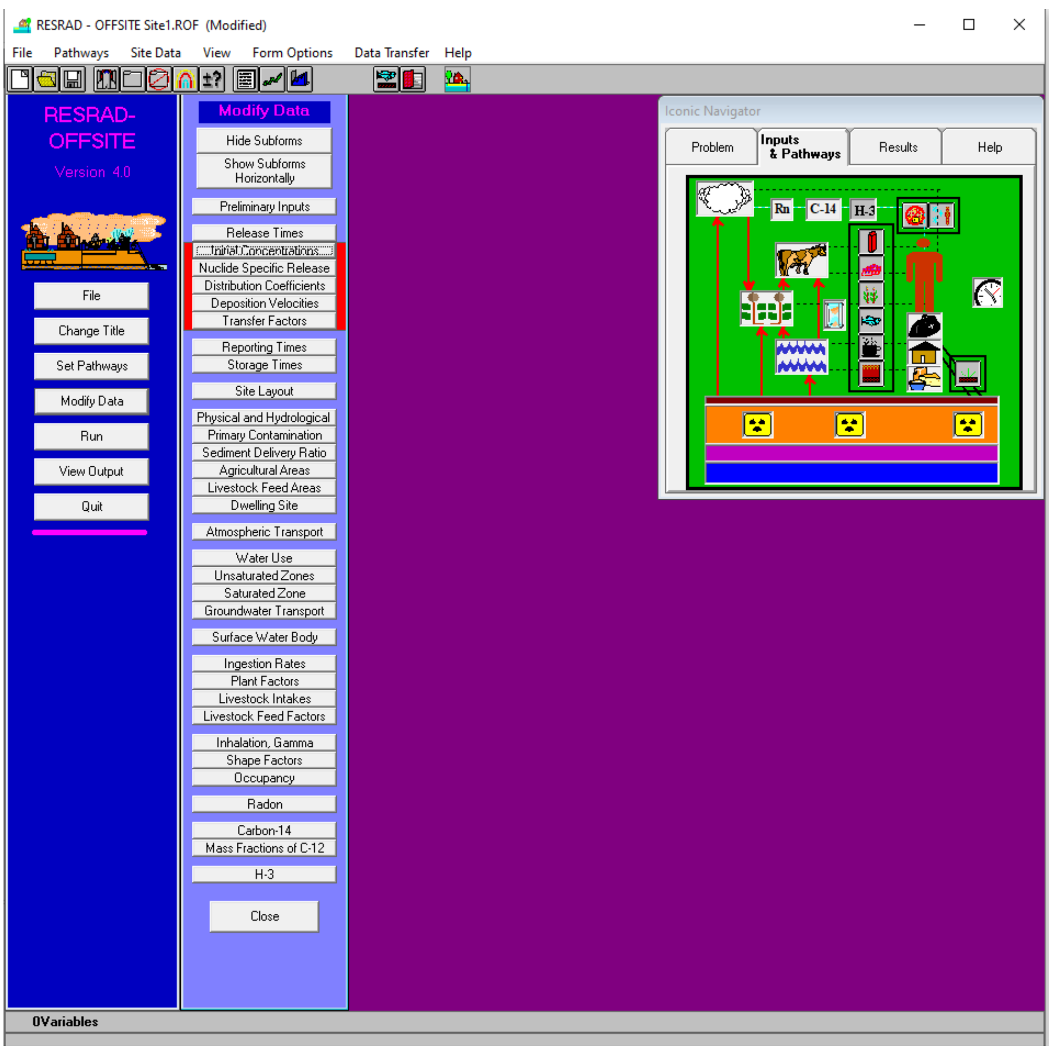
Objective: Test the functionality of Modify Data navigation in the left panel of GUI.

Conclusion: the code worked as expected.

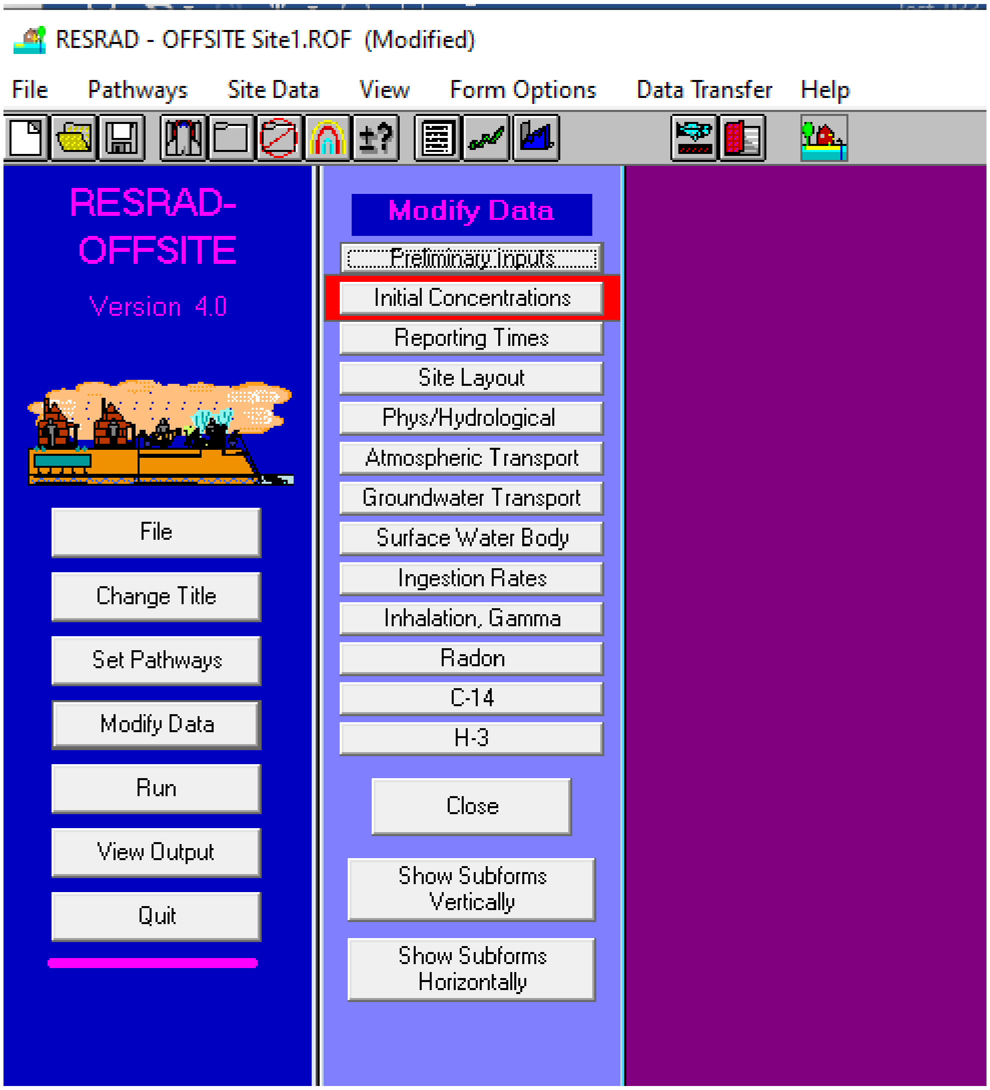
Procedure:

1. Followed the procedure of test case description.

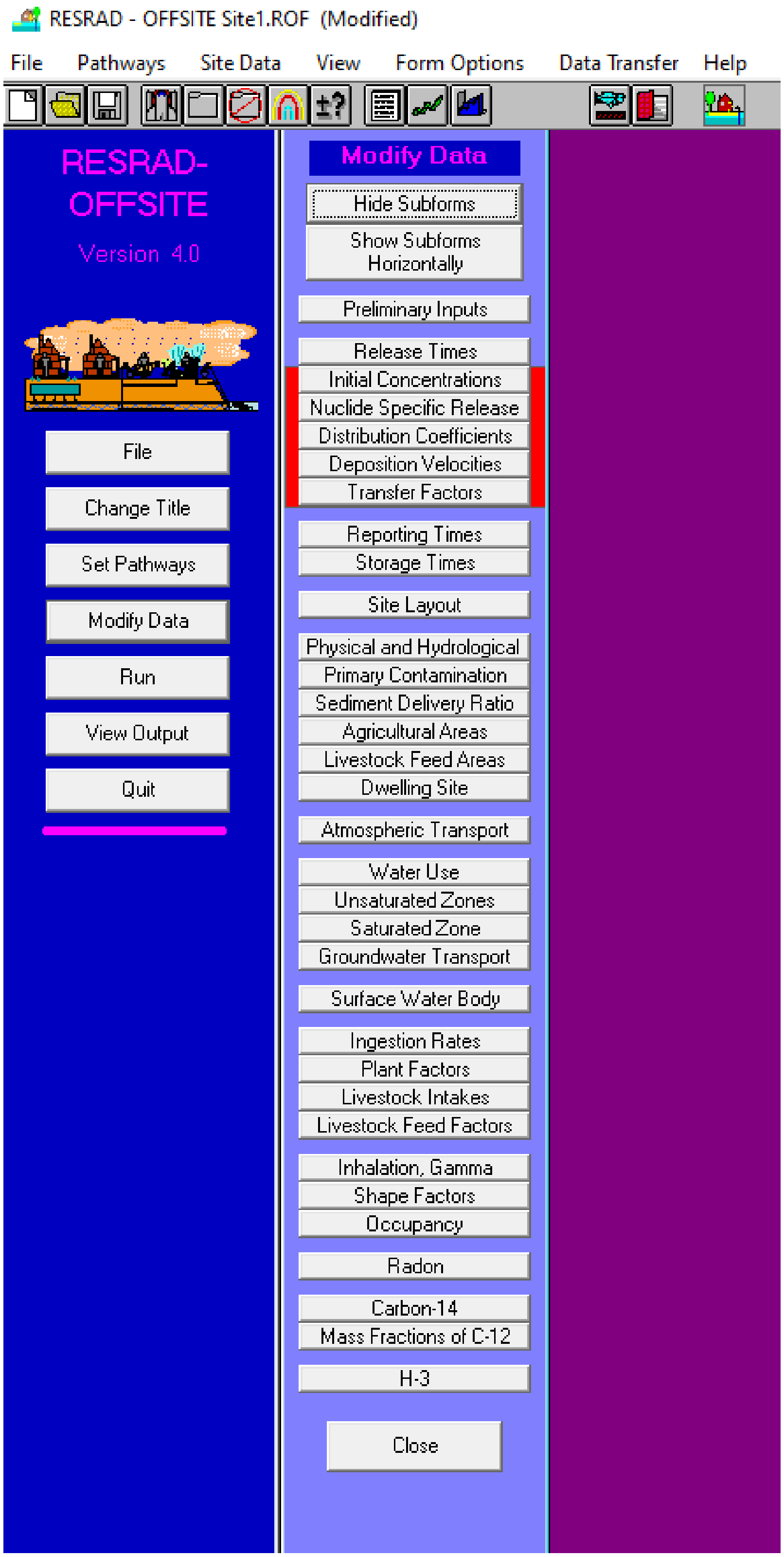
- Screenshot for Step 1) of test case. Worked as expected.



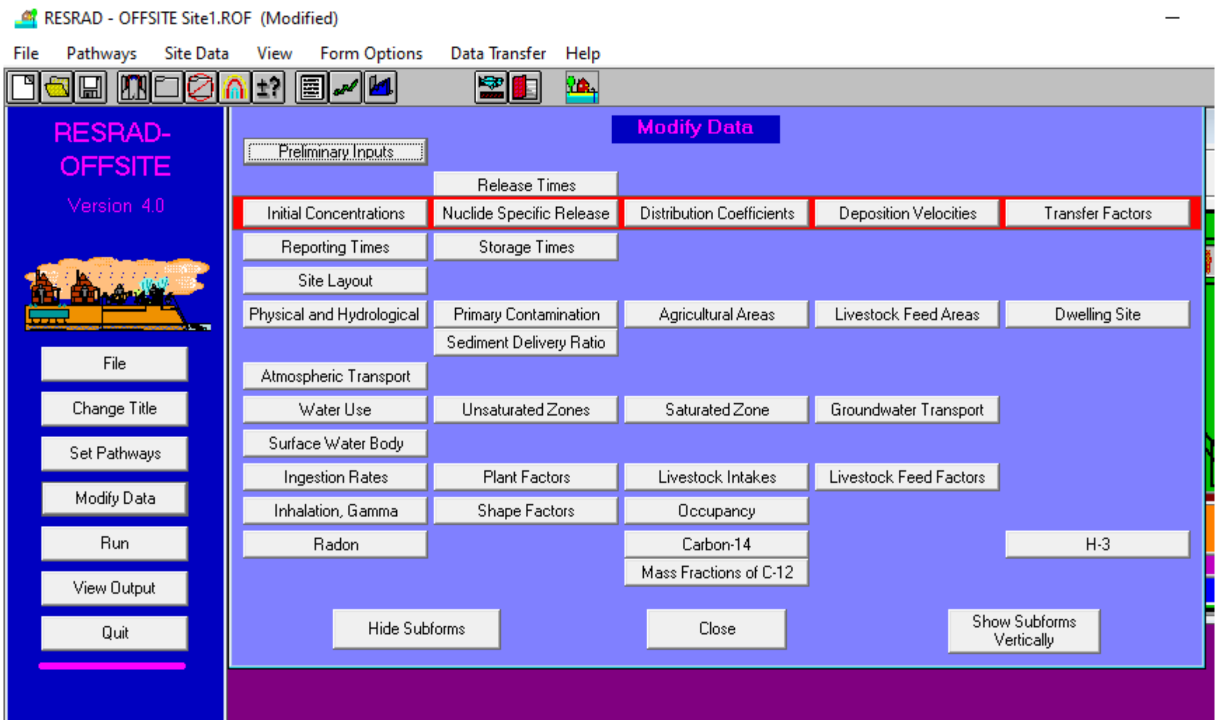
- Screenshot for Step 2) of test case. Worked as expected.



- Screenshot for Step 3). Worked as expected.



- Screenshot for Step 4). Worked as expected.



- Screenshot for Step 5). Worked as expected

12.24 TEST CASE 033-005 TESTER'S REPORT

Documented in Test-033-005_report.docx of 2/20/2020 6:52 AM

Test Case 033-005 report

By Cheng Wagn 2/17/2020

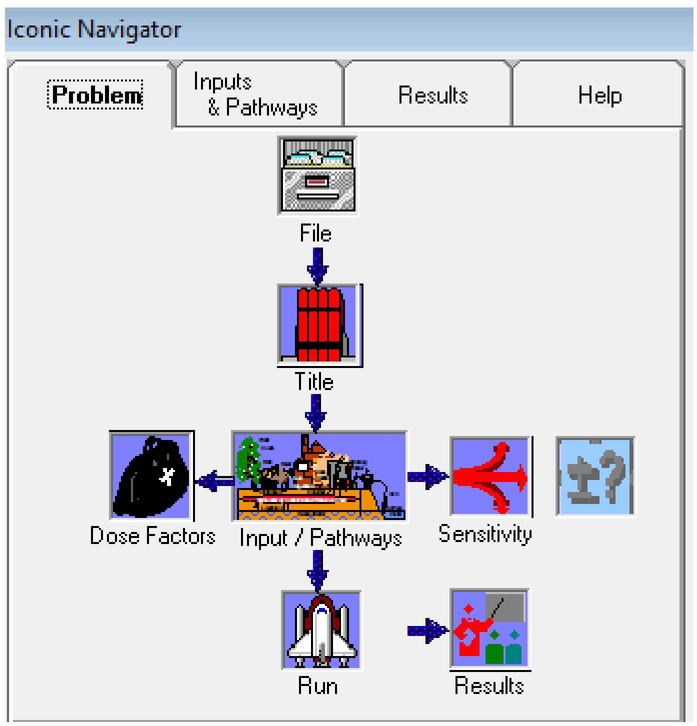
Test Objective: To test the functionality of Iconic Navigator.

Results: the code worked as expected.

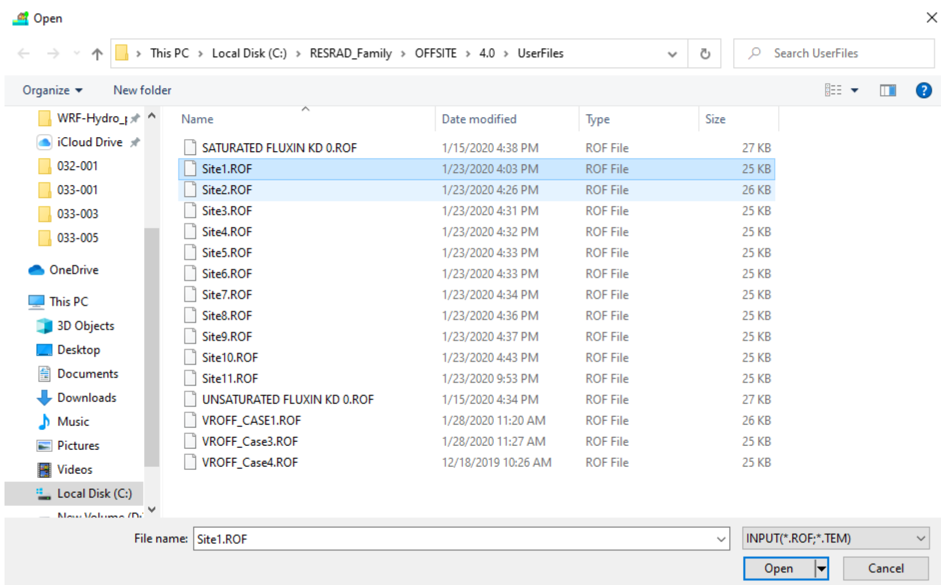
Procedure:

1) Launch the code.

2) Click Problem tab of Iconic Navigator.

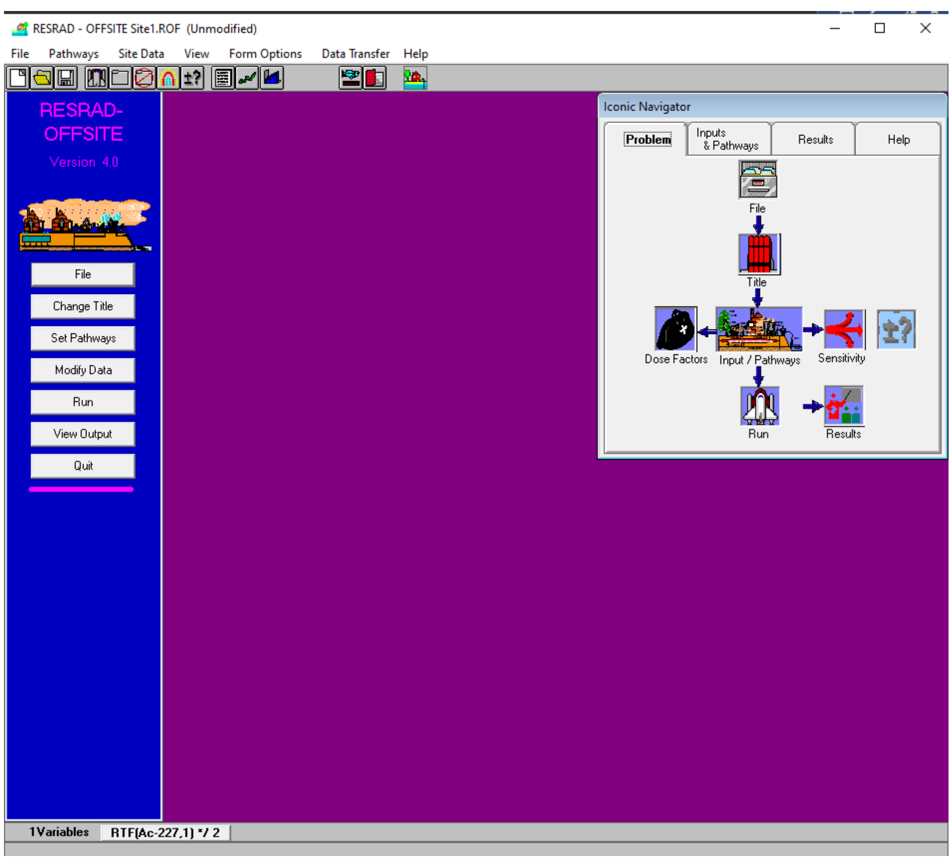


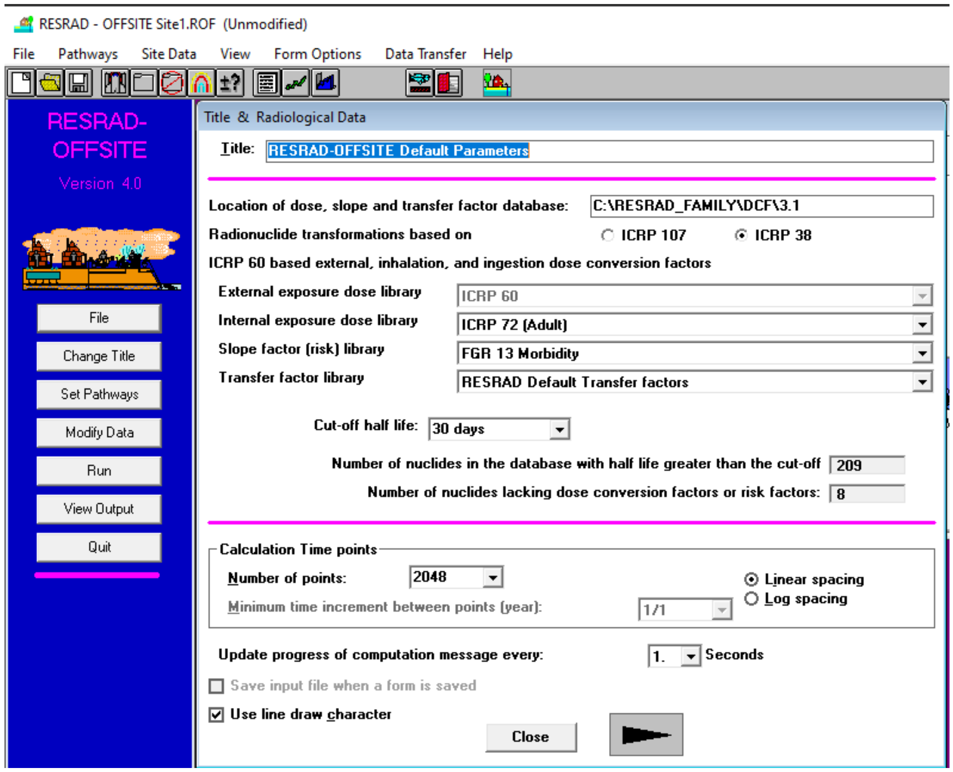
a. Clicking File icon should bring up the window for selection of input file. Select an input file, and the file should be loaded to the main interface.



Worked as expected.

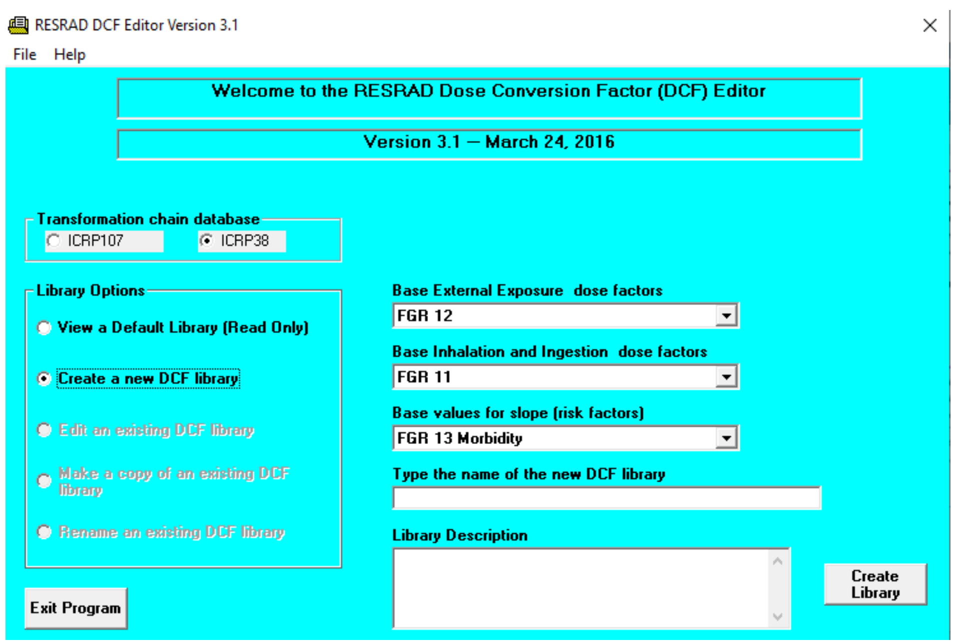
b. Clicking Title icon should bring up the Title & Radiological Data form





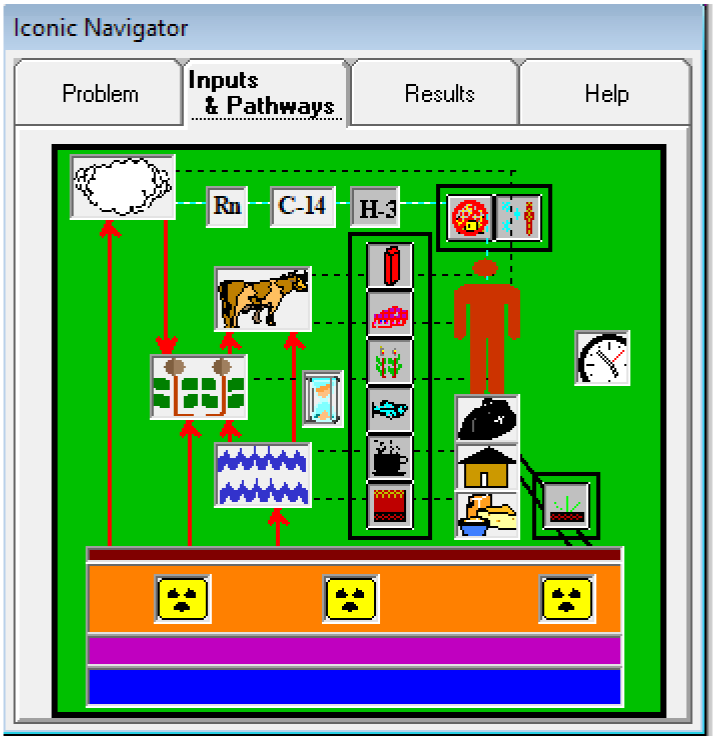
Worked as expected.

c. Clicking Dose Factors should bring up the DCF Editor window.



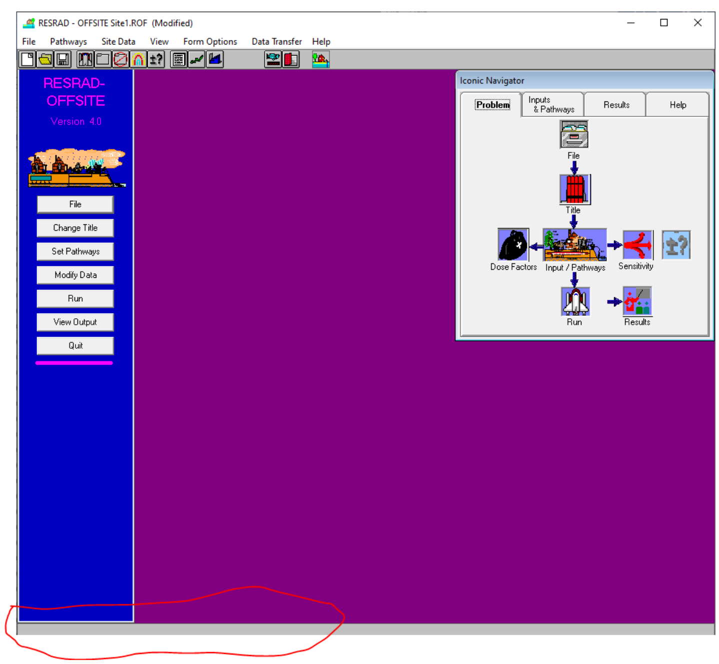
Worked as expected.

d. Clicking Input/Pathway should open the Inputs & Pathways tab of Iconic Navigator.



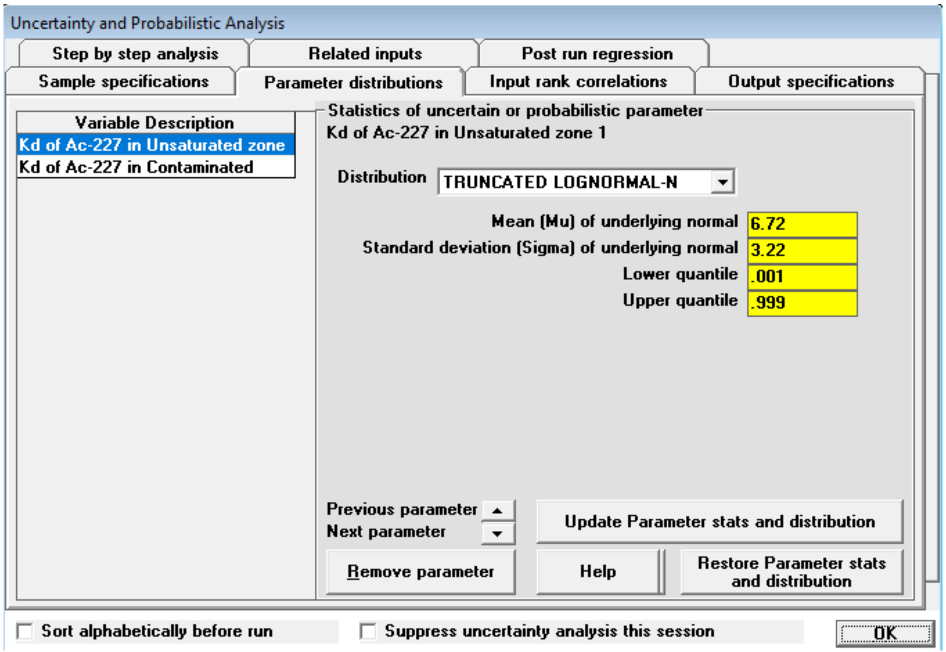
Worked as expected.

e. Clicking Sensitivity icon should turn on/off the Sensitivity Input Summary at the bottom left corner of the main interface.



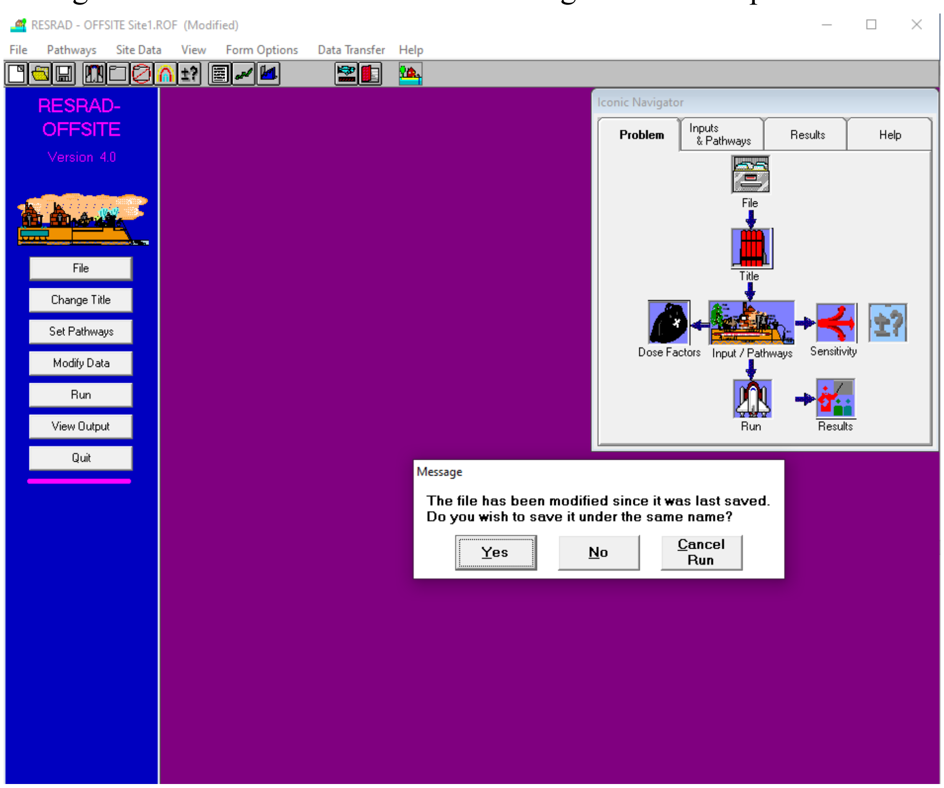
Comparison with the screenshot in Step 2). a shows the code worked as expected by turning off the sensitivity parameter information.

f. Clicking Uncertainty Analysis button should bring up the Uncertainty and Probabilistic Analysis form.



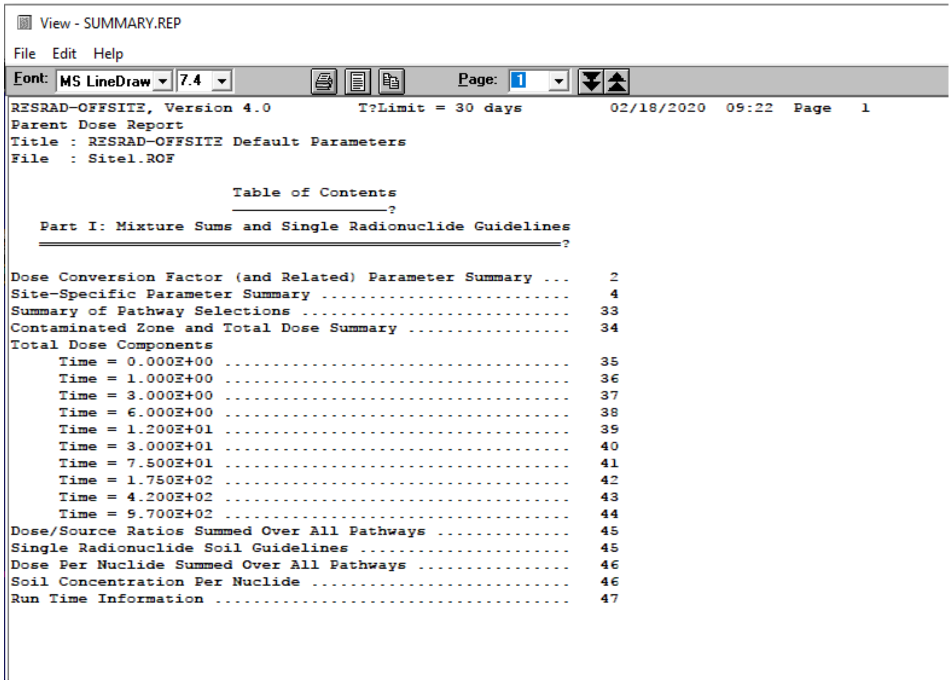
Worked as expected.

g. Clicking Run button should run the code using the loaded input file.



Worked as expected.

h. Clicking Results should open the Results tab of the Iconic Navigator.




```
RESRAD-OFFSITE, Version 4.0        T?Limit = 30 days        02/18/2020  09:22  Page   1
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File  : Site1.ROF

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                       ----------------?
   Part I: Mixture Sums and Single Radionuclide Guidelines
   ======================================================?

Dose Conversion Factor (and Related) Parameter Summary ...    2
Site-Specific Parameter Summary ..........................    4
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Total Dose Components
     Time = 0.000E+00 ....................................   35
     Time = 1.000E+00 ....................................   36
     Time = 3.000E+00 ....................................   37
     Time = 6.000E+00 ....................................   38
     Time = 1.200E+01 ....................................   39
     Time = 3.000E+01 ....................................   40
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```

Worked as expected.

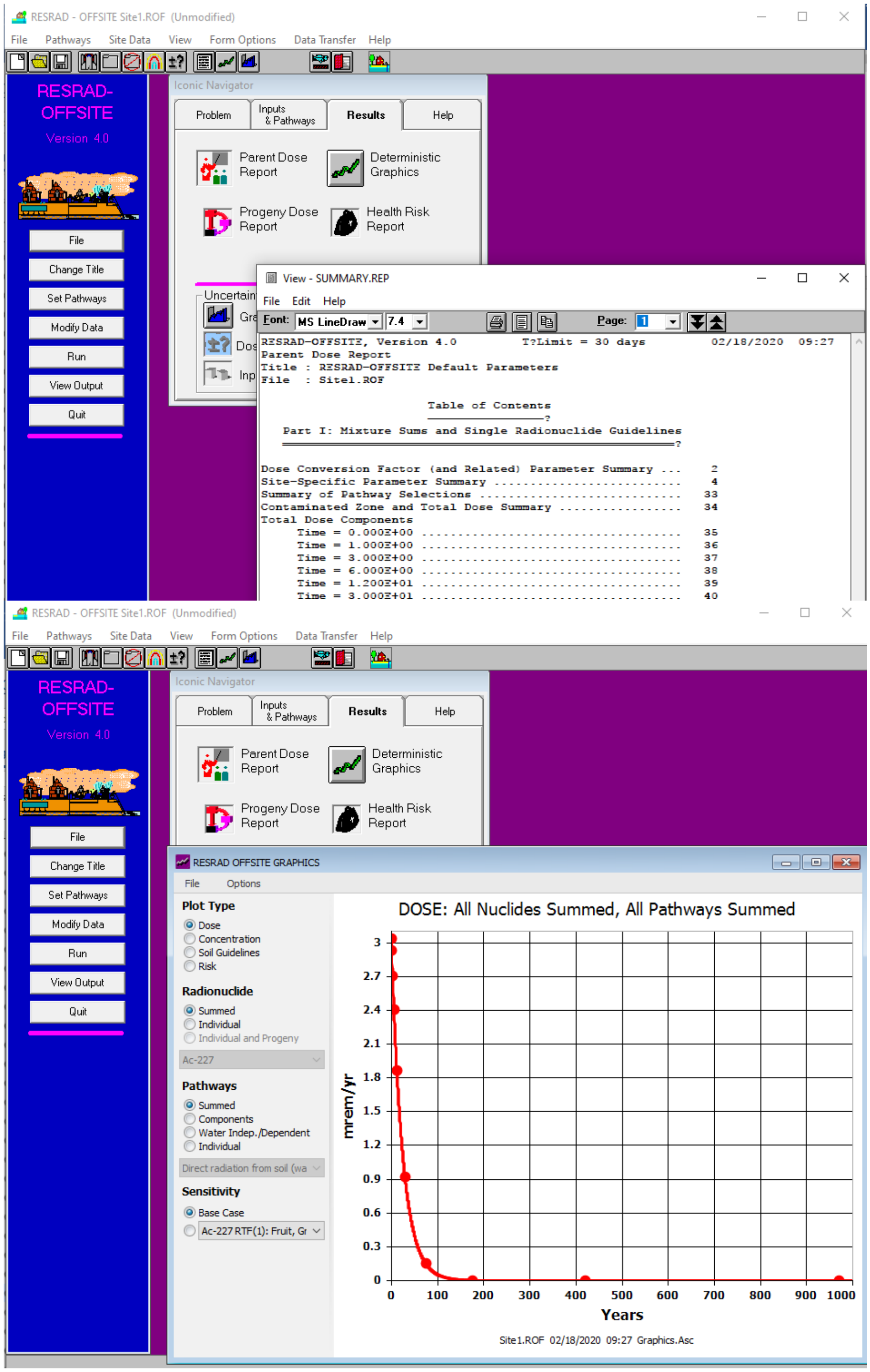
3) Clicking Input & Pathways Tab.

a. Clicking each icon should open one associated form. Then run the code.

Worked as expected.

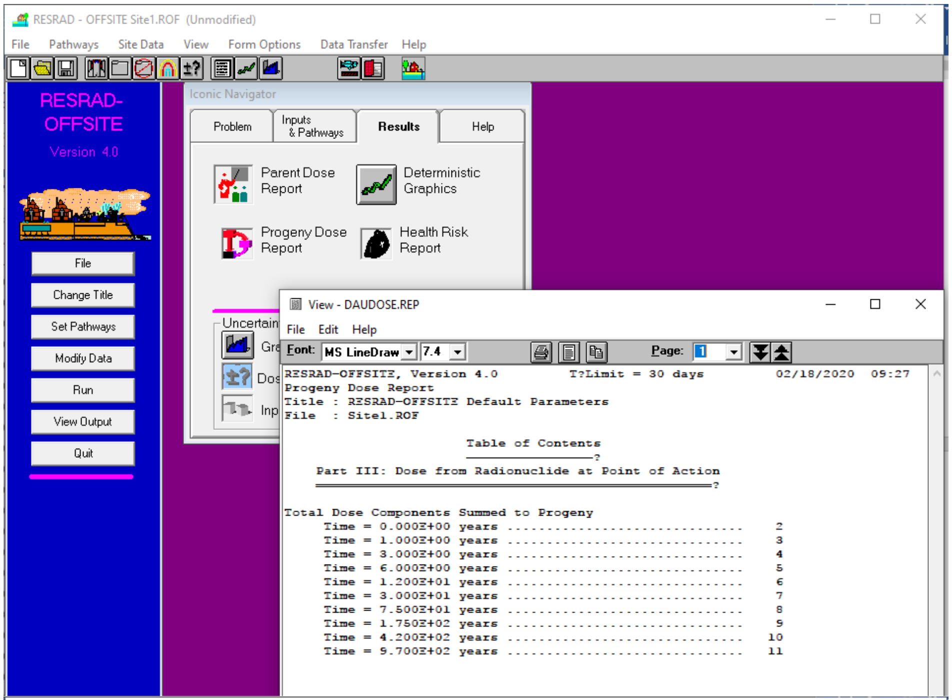
4) Click Results tab.

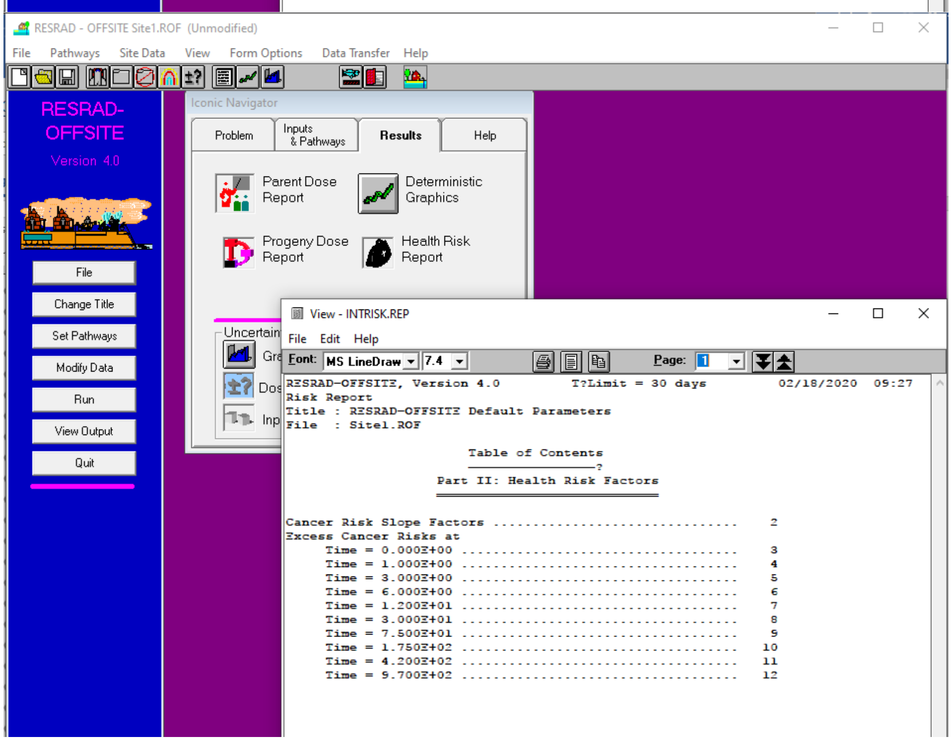
a. Clicking Parent Dose Report button should open Summary.rep file. Clicking Deterministic Graphics icon should open the graphics Wresplot.exe with loaded data.



Worked as expected.

b. Clicking Progeny Dose Report icon should open DAUDOSE.REP file, Clicking Health Risk Report icon should open INTRISK.REP file.

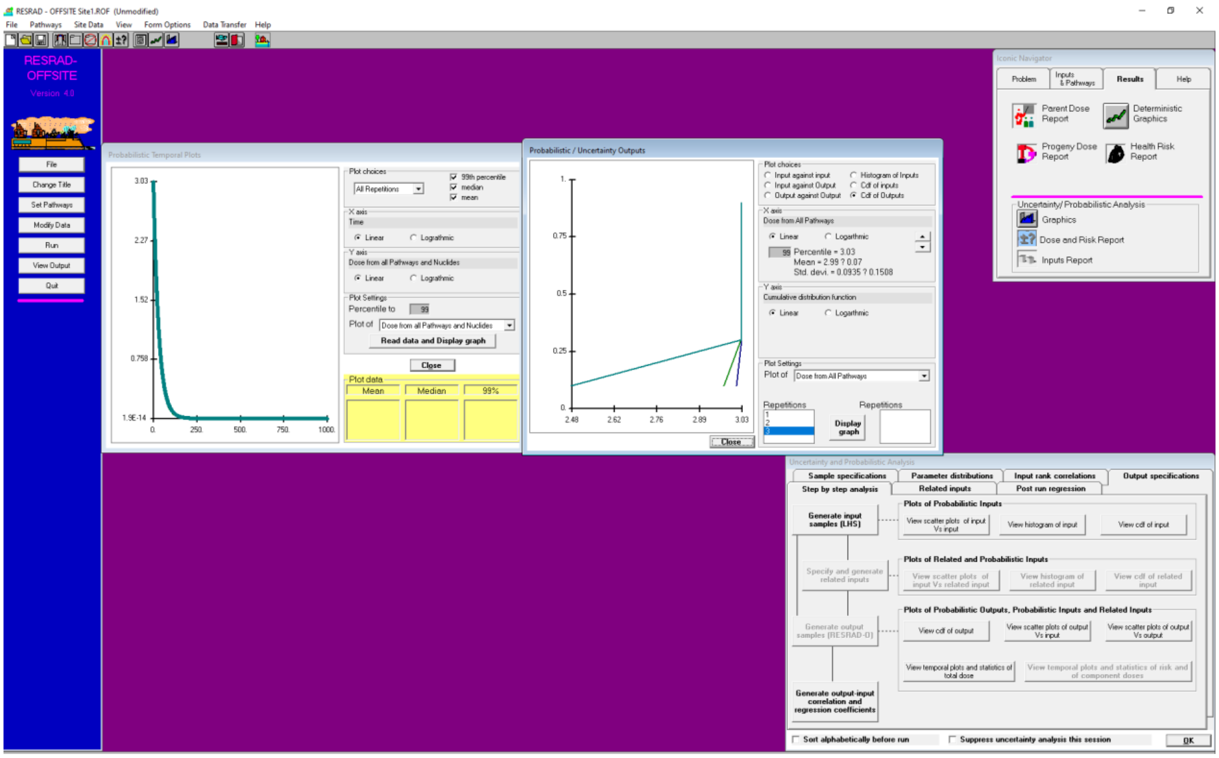




Worked as expected.

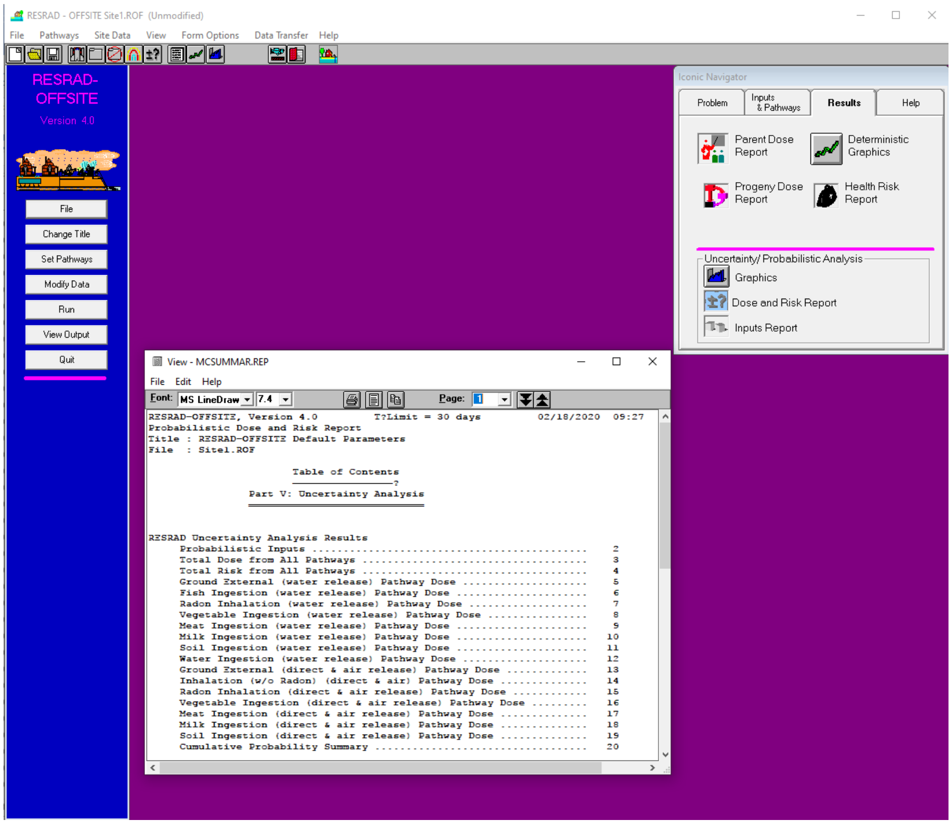
c. Run the code with uncertainty analysis.

d. Clicking Graphics under Uncertainty/Probabilistic Analysis frame should open forms Uncertainty and Probabilistic Analysis, Probabilistic/Uncertainty Outputs, and Probabilistic Temporal Plots.



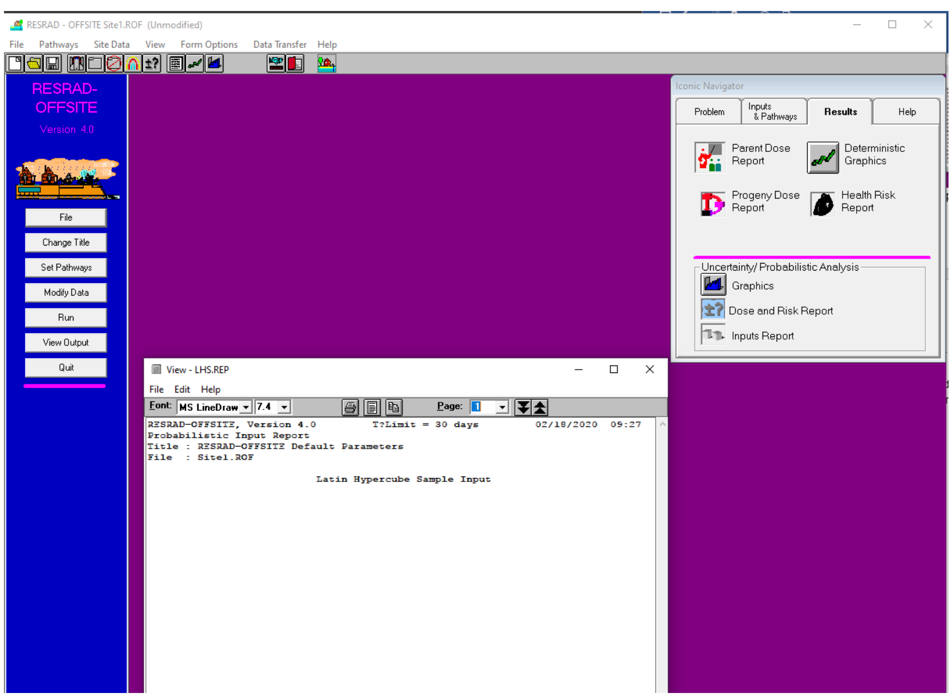
Worked as expected.

e. Clicking Dose and Risk Report icon should open MCSUMMAR.REP file.

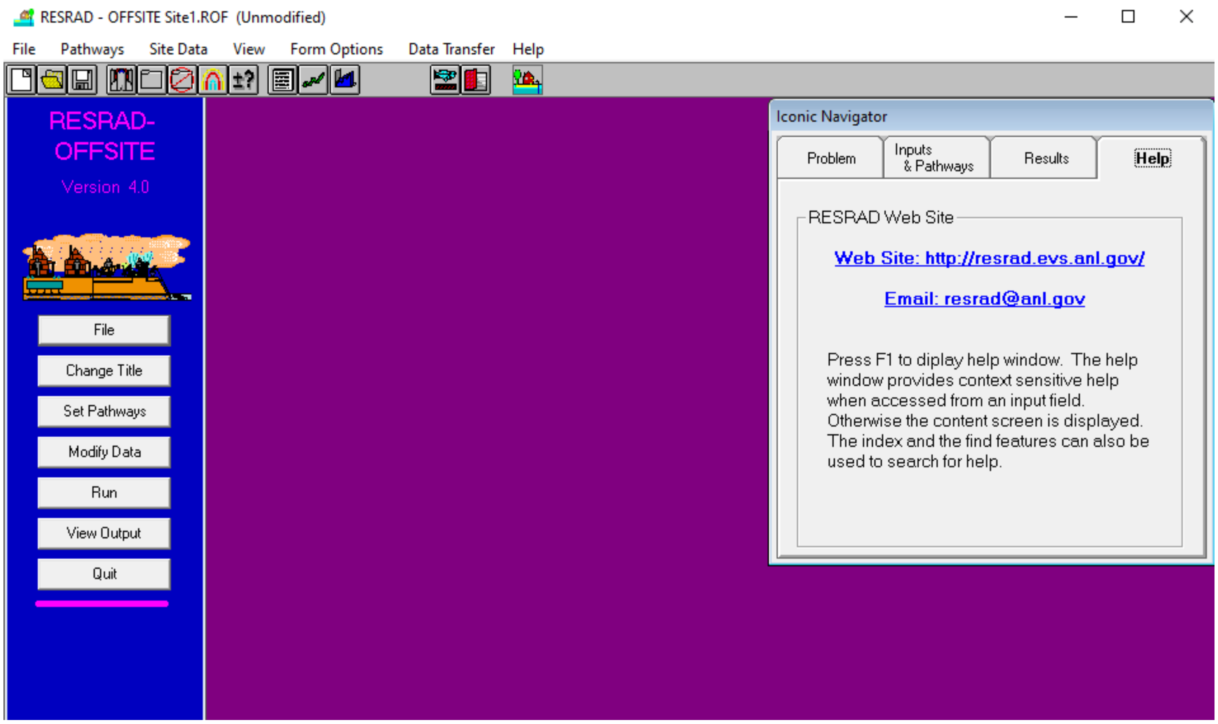


Worked as expected.

f. Clicking Input Report icon should open LHS.REP file.



5) Clicking Help tab and the REARD program website and contact information should present under this tab, as well as the function of F1 key for help.



Worked as expected.

12.25 TEST CASE 034-001 TESTER'S REPORT

Documented in Test-034-001_report.docx of 2/20/2020 6:54 AM

Test Case 034-001 report

By Cheng Wang 2/18/2020

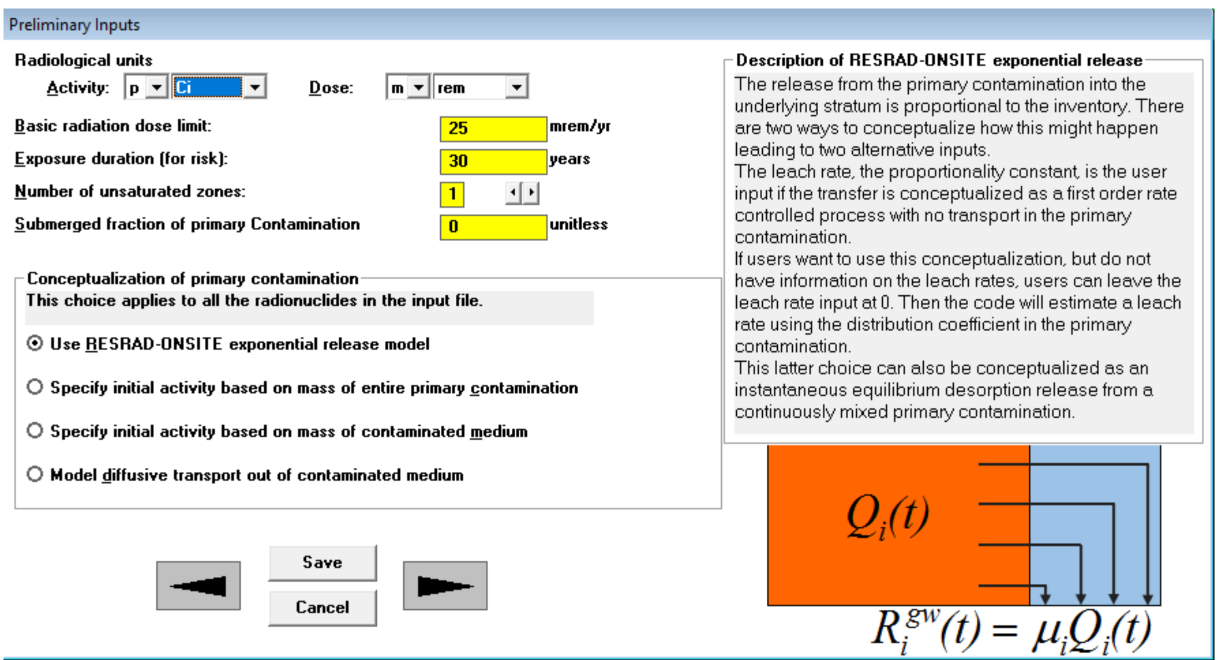
Test Objective: To test the functionality of Form Preliminary Inputs.

Test conclusion: the code worked as expected.

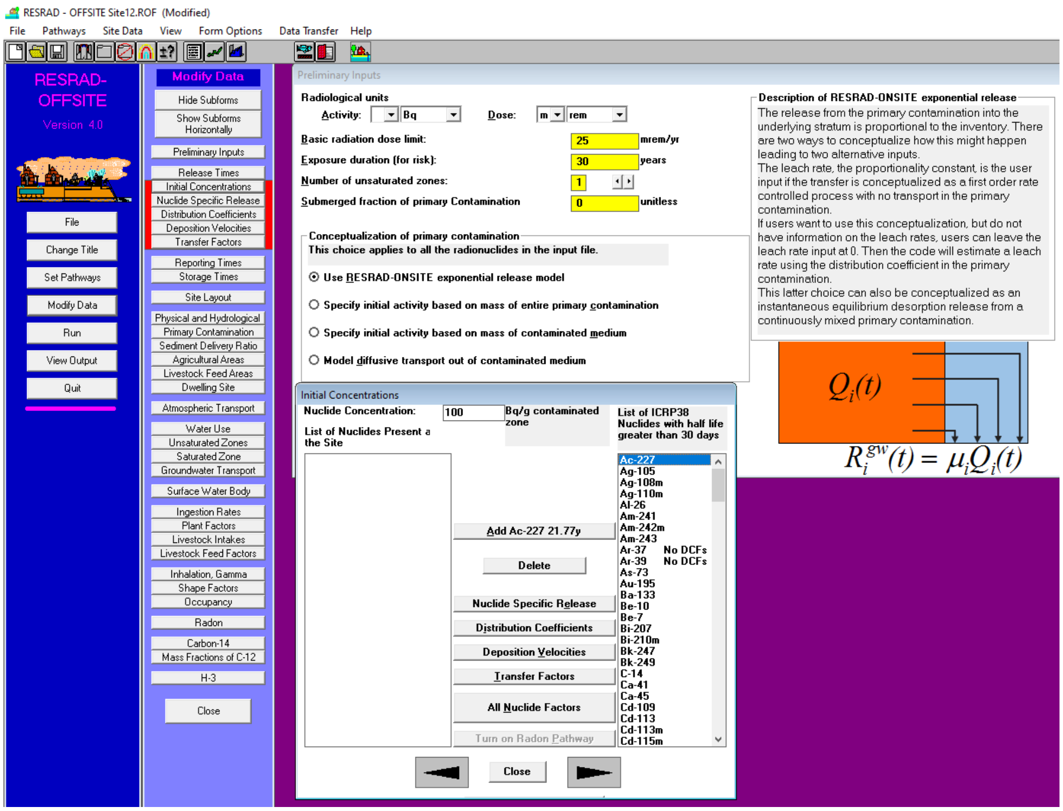
Procedure:

1) On the left panel, click Modify Data -> Preliminary Inputs. The form should pop up with Figure a as default setting, including the units and values in textboxes. The background of each textbox should be in yellow if the values are default values; otherwise, in white.

Worked as expected.

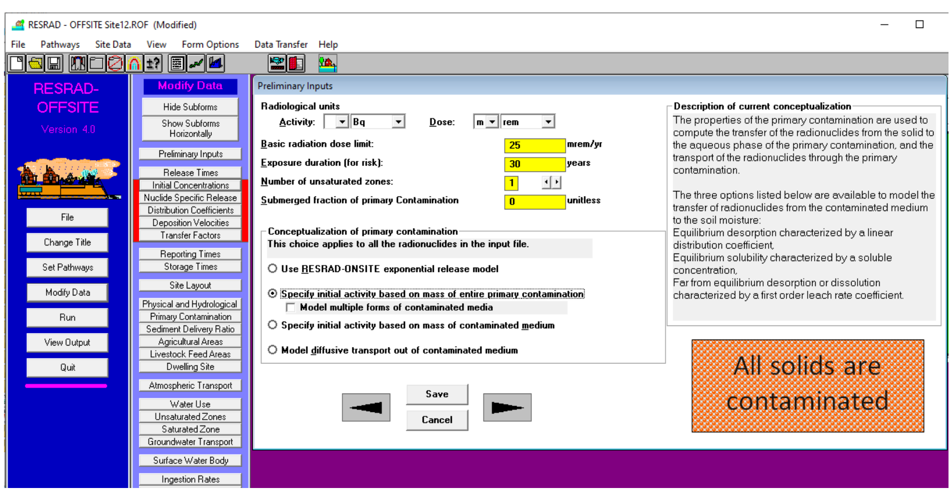


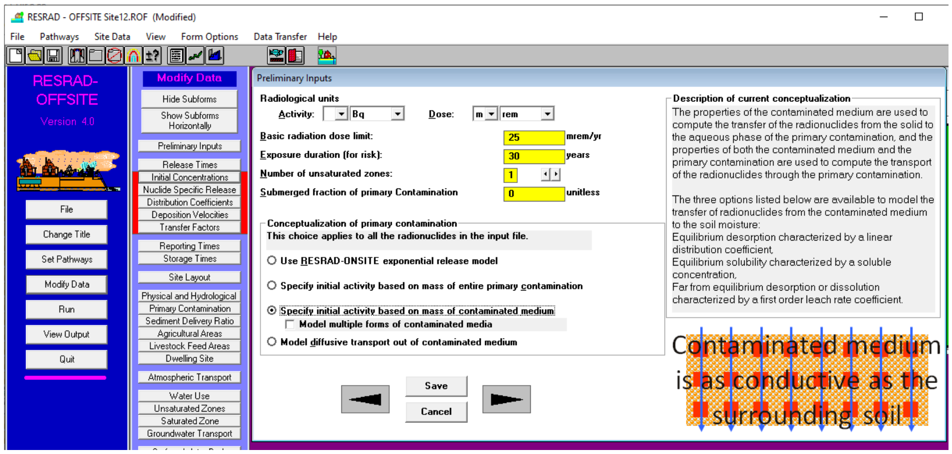
2) Change the unit to Bq. The unit in Forms Initial Concentrations and Transfer Factors should change accordingly.

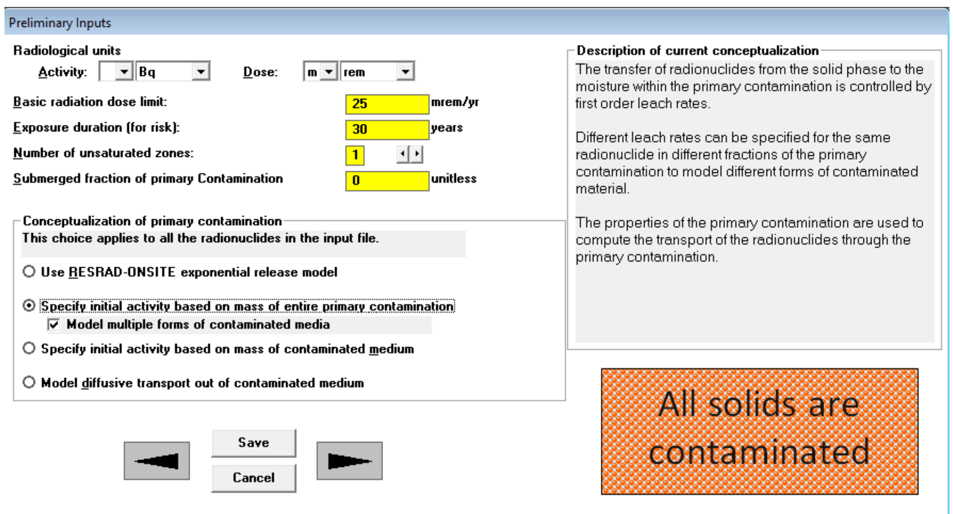


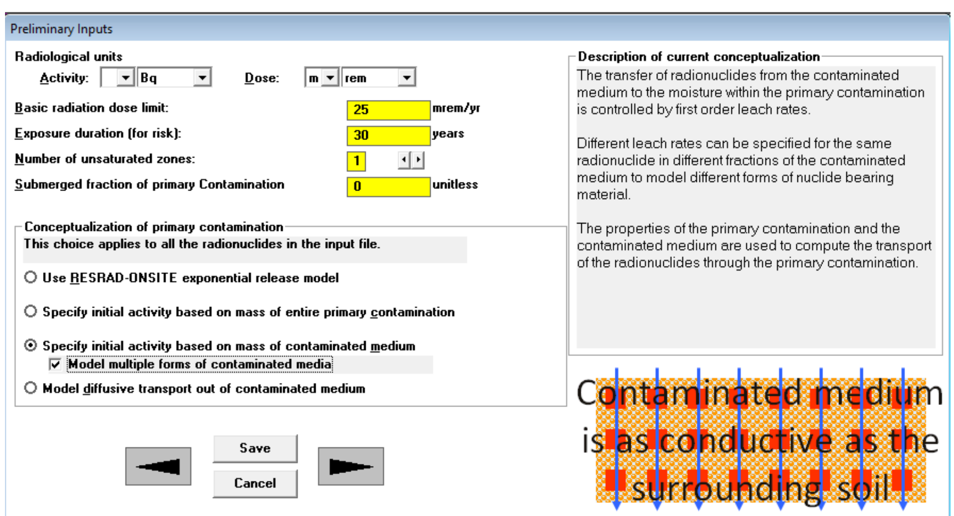
Worked as expected.

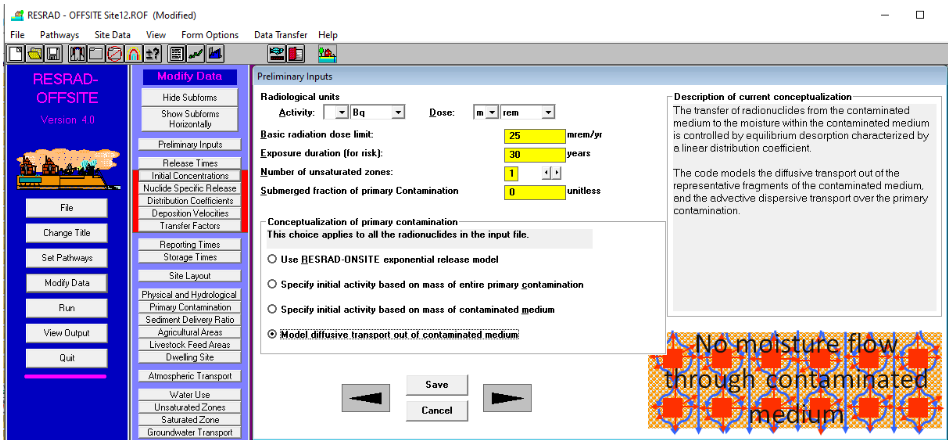
3) Changing the selection of Conceptualization frame from top to bottom in order, the form should look like Figure a, b, c and d, respectively. Selection of "Model multiple forms of contaminated media" under settings of either Figure b or c will change the other's setting.




Contaminated medium is as conductive as the surrounding soil

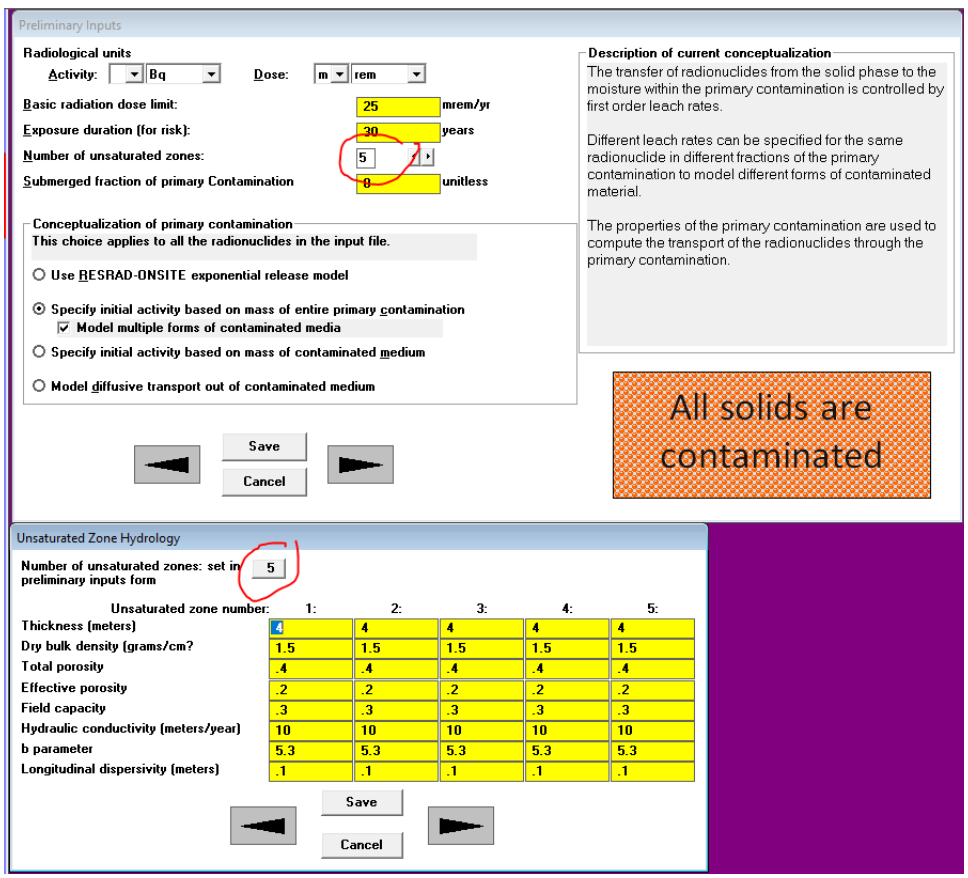

All solids are contaminated


Contaminated medium is as conductive as the surrounding soil



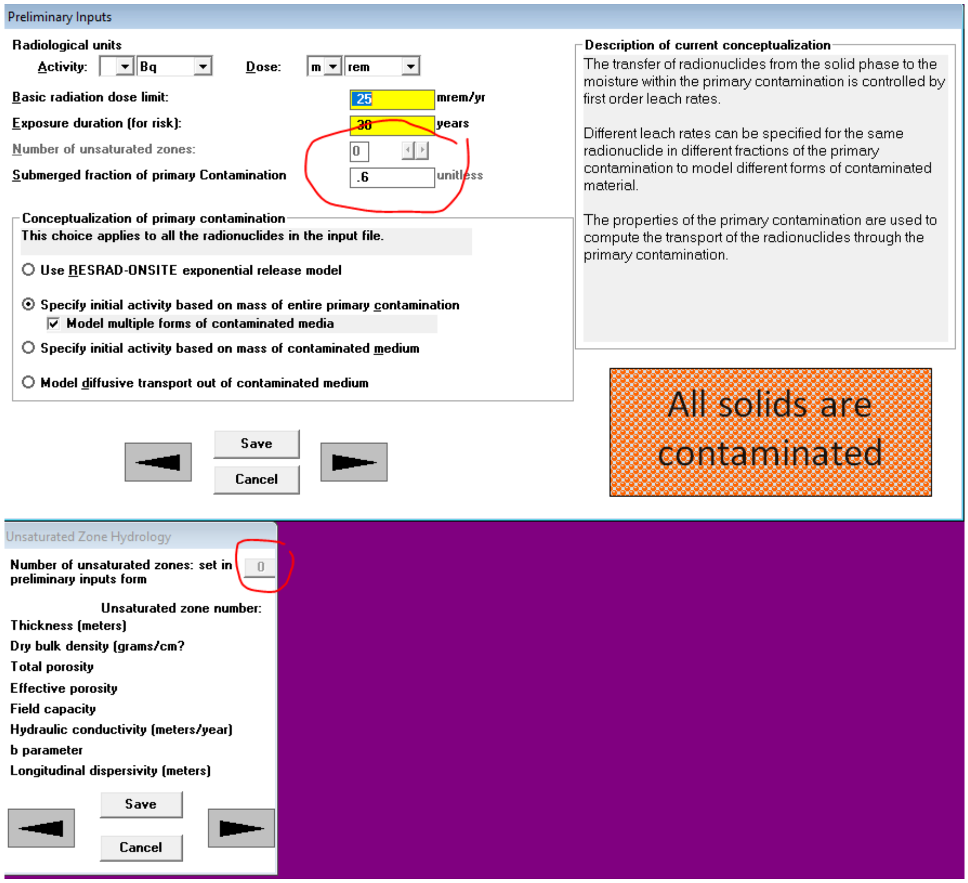
worked as expected.

4) The Number of Unsaturated Zones should be able to be changed between 0 and 5. Once this value is change, need to check Form Unsaturated Zones to check if the number of unsaturated zone changed in that form accordingly.



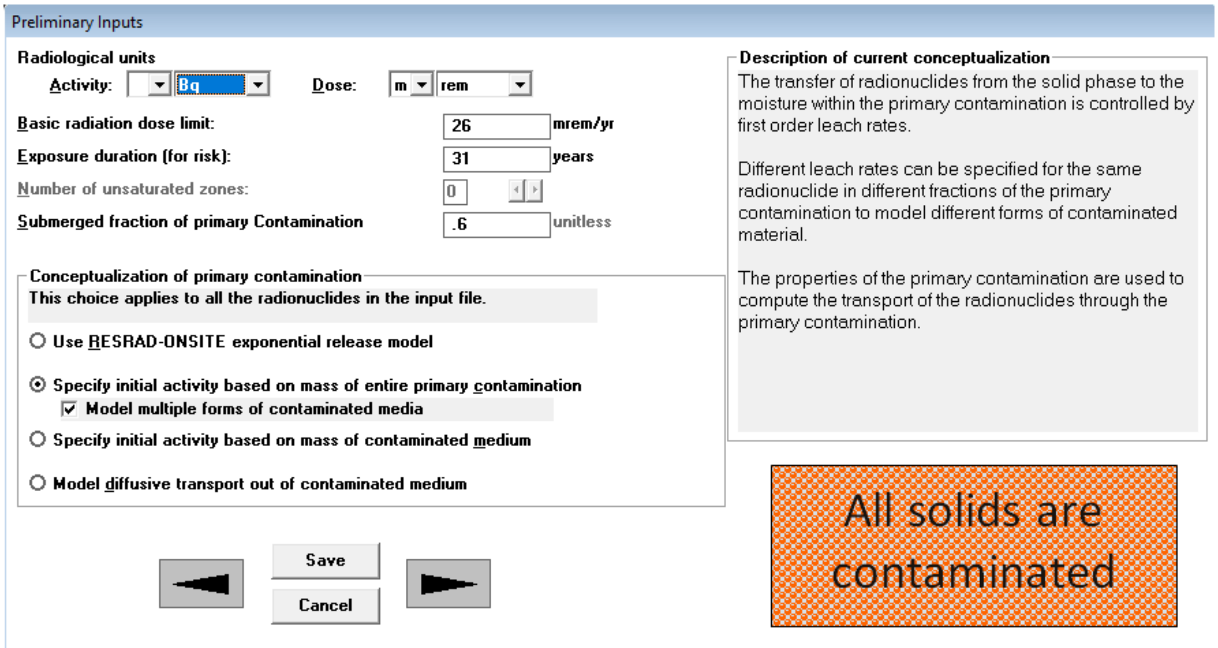
Worked as expected.

5) Submerged fraction of Primary Contamination should be able to changed 0-1; however, once its value is larger than 0, the Number of Unsaturated Zone should update to 0 automatically.



worked as expected.

6) Change the values in textboxes and the units, save the input to Test13.rof, then check whether the input file is correctly written. The variables in this form include BRDL, ED, and NS. SUBMERGEDF, PCOPTION, and MULTIFORM.




```
BRDL = 26,
ED = 31,
NS = 0,
MULTIFORM = 1,
PCOPTION = 1,
SUBMERGEDF = .6,
```

Worked as expected.

12.26 TEST CASE 034-002 TESTER'S REPORT

Documented in Test-034-002_report.docx of 2/20/2020 6:55 AM

Test Case 034-002 report

By Cheng Wang 2/18/2020

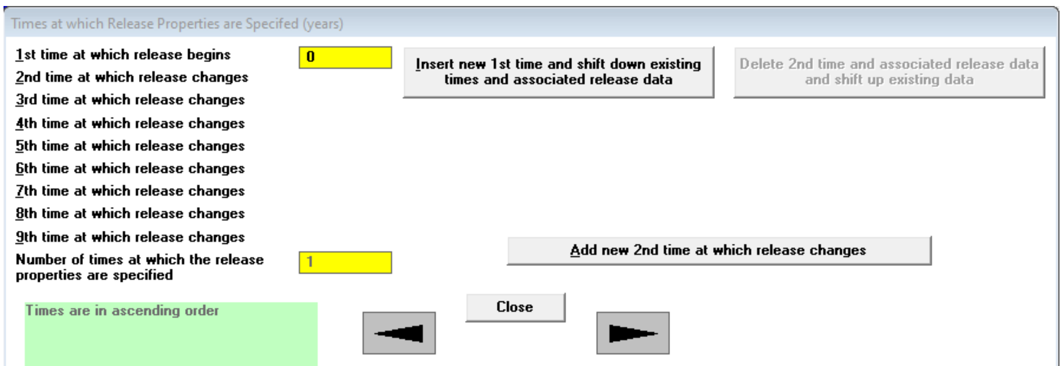
Objective: To test the functionality of Form Release Times.

Conclusion: the code worked as expected.

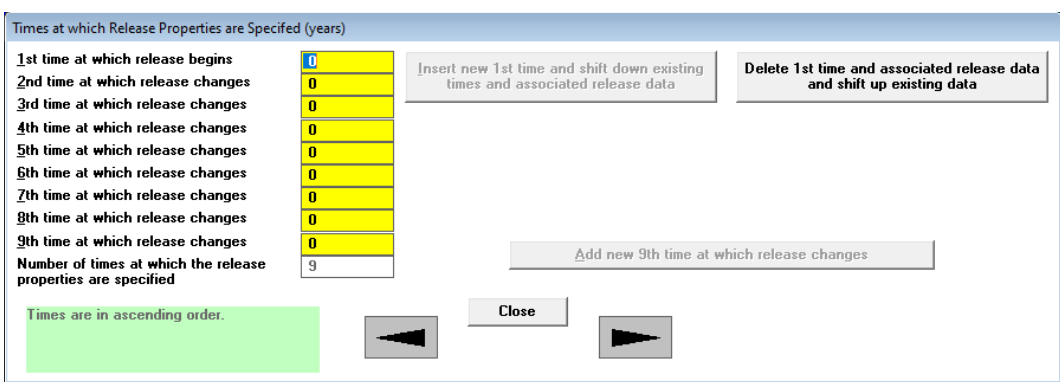
Procedure:

1) On the left panel, clicking Modify Data -> Release Times should open a pop-up window with caption "Times at which Release Properties are Specified (years)".

Worked as expected.

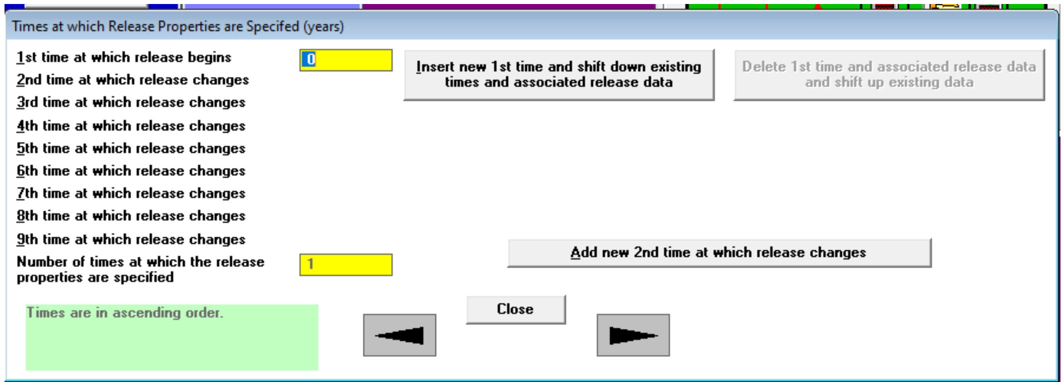


2) Clicking "Insert New 1sth time and shift down existing times and associated release data" 8 times. Every click should shift down the newly generated textbox by one row. The default of each generated textbox should be 0.



Worked as expected.

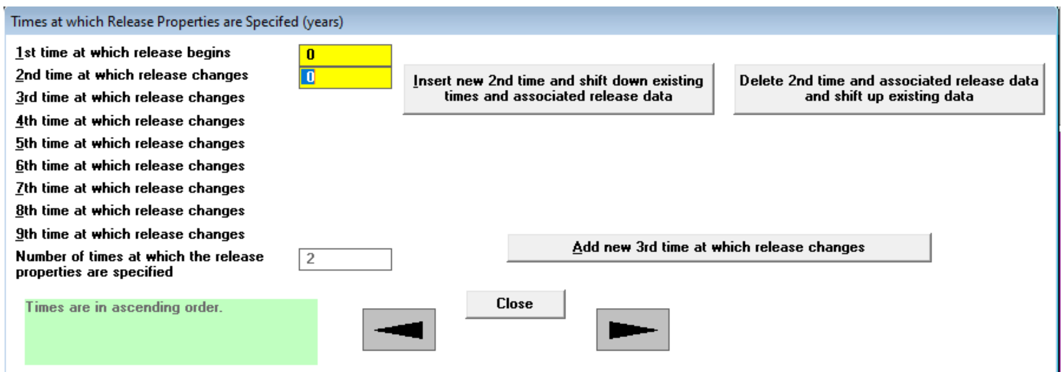
3) Click "Delete 1st time and associated release data and shift up exiting data" for 8 times, all the newly generated textboxes should be deleted.



Worked as expected.

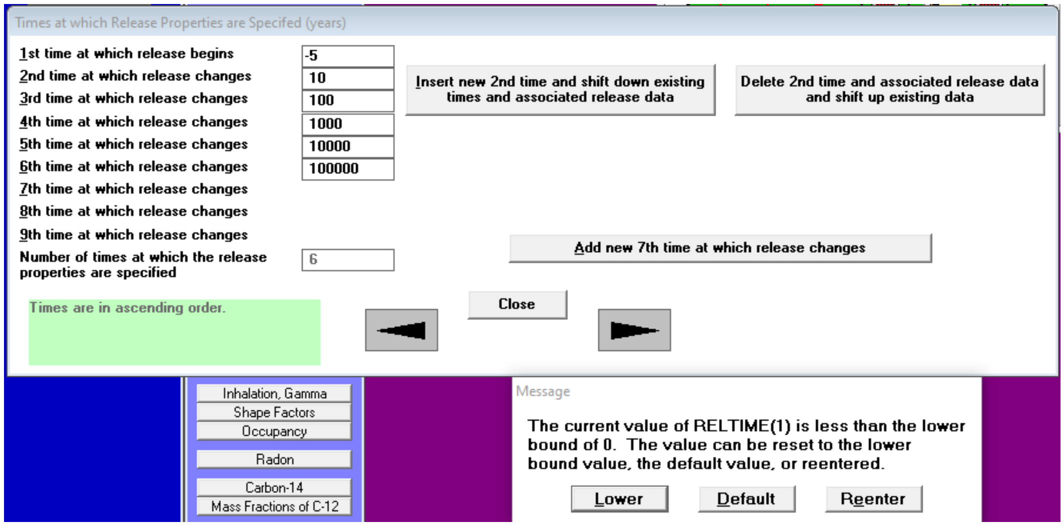
4) Clicking "Add new 2th time at which release changes" should generate a textbox corresponding to 2th release time.

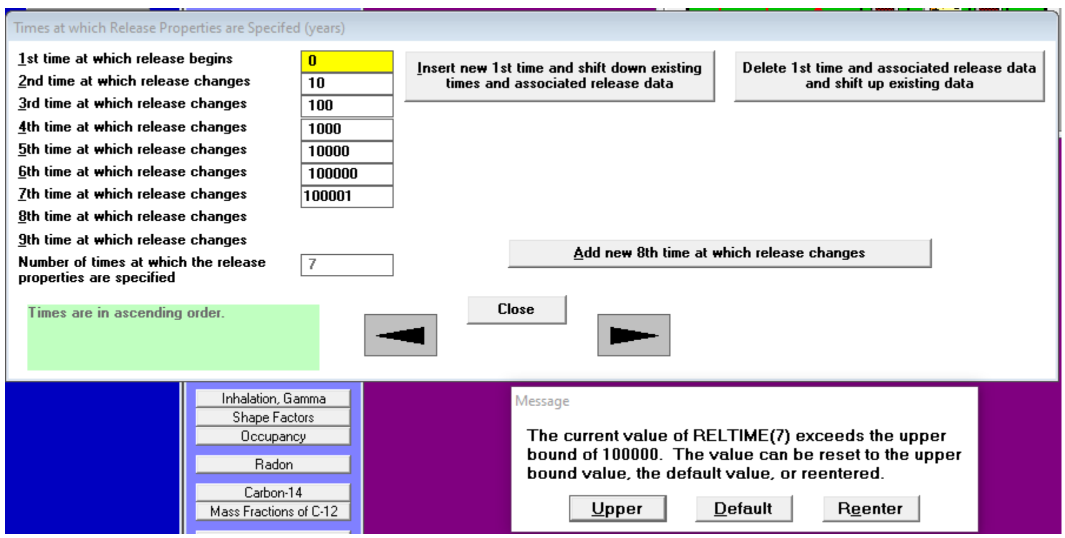
Continue from Step 3) screenshot.



Worked as expected.

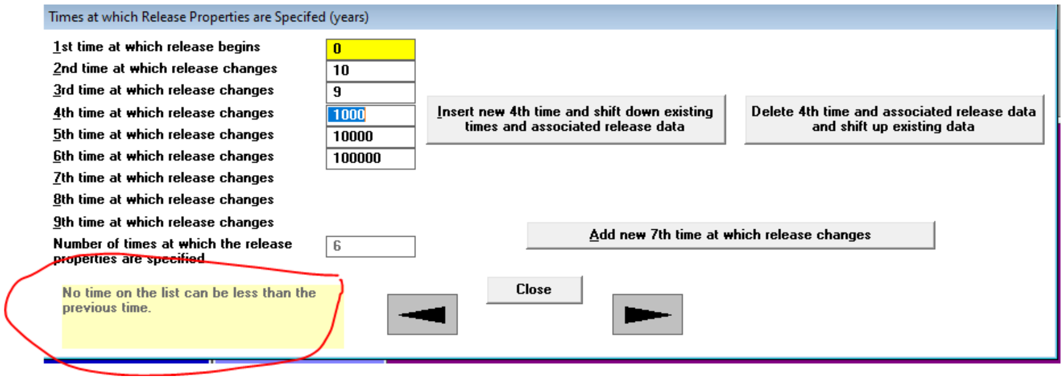
5) Specifying a value to each box in an increasing order. Change the value if the top box to a negative value, an error message should pop-up. Similarly, changing the largest value to more than 100000 should also trigger an error message window.

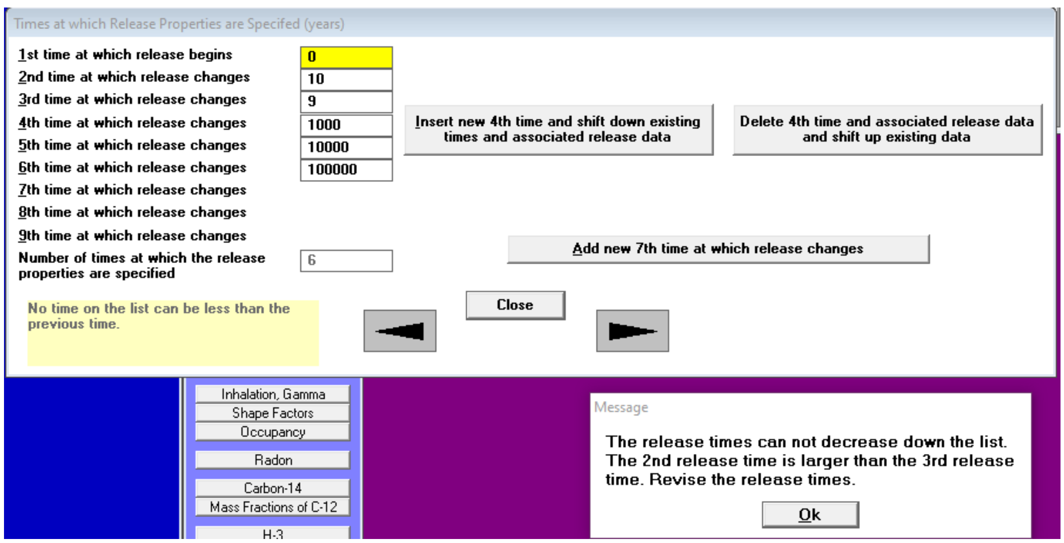




Worked as expected.

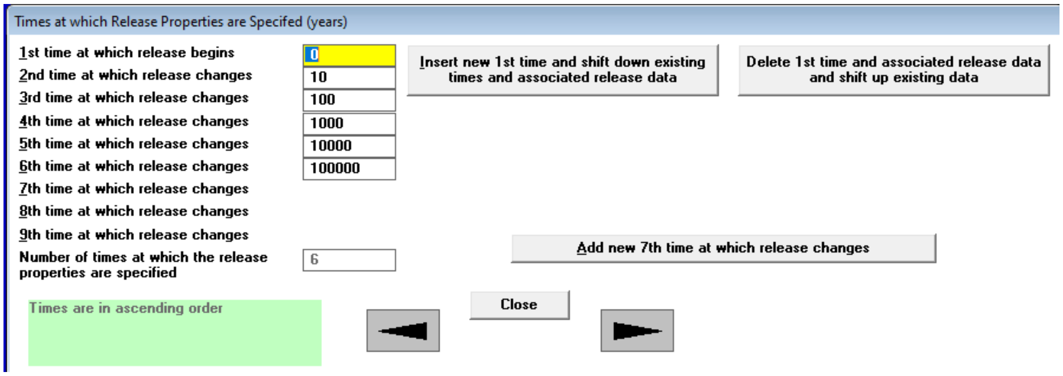
6) Change the third textbox value to a value less than the one in the second box, a warning message should show in the bottom-left box. Clicking Close. An error message should pop-up pointing out this error.

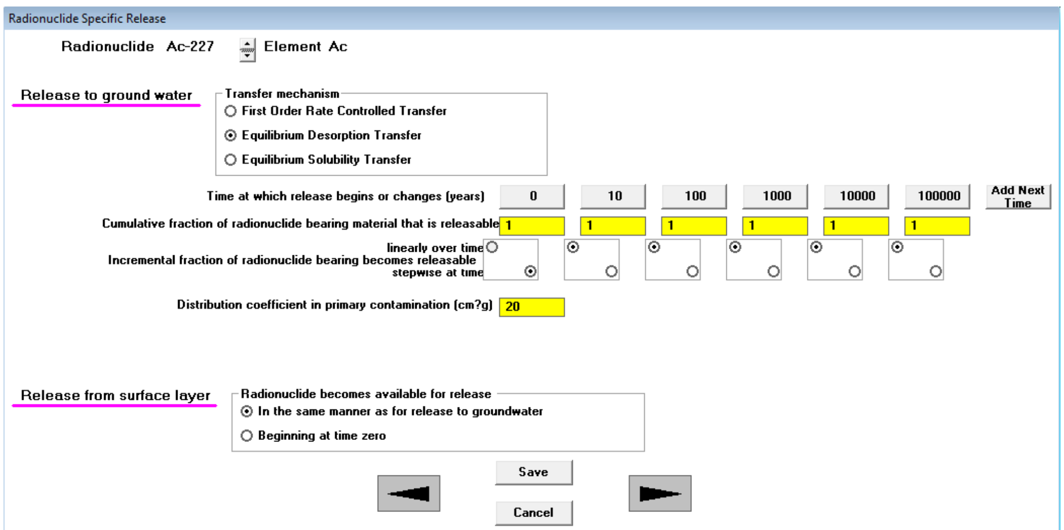




Worked as expected.

7) Make sure the input to this form is correct, close the form. Check Form Nuclide Specific Release. The release time in the form should change accordingly.





Worked as expected.

8) save the file to Test14.rof, and then check the values in the generated input file. The variable to check is RELTIME(1) - (9).

Worked as expected.

```
RELTIME(1) = 0,
RELTIME(2) = 10,
RELTIME(3) = 100,
RELTIME(4) = 1000,
RELTIME(5) = 10000,
RELTIME(6) = 100000,
RELTIME(7) = 0,
RELTIME(8) = 0,
RELTIME(9) = 0,
```

12.27 TEST CASE 034-003 TESTER'S REPORT

Documented in Test-034-003_report.docx of 2/18/2020 8:41 AM

Test Case 034-003 report

By Cheng Wang 2/18/2020

Objective: To test the functionality of Form Initial Concentrations.

Conclusion: The code worked as expected.

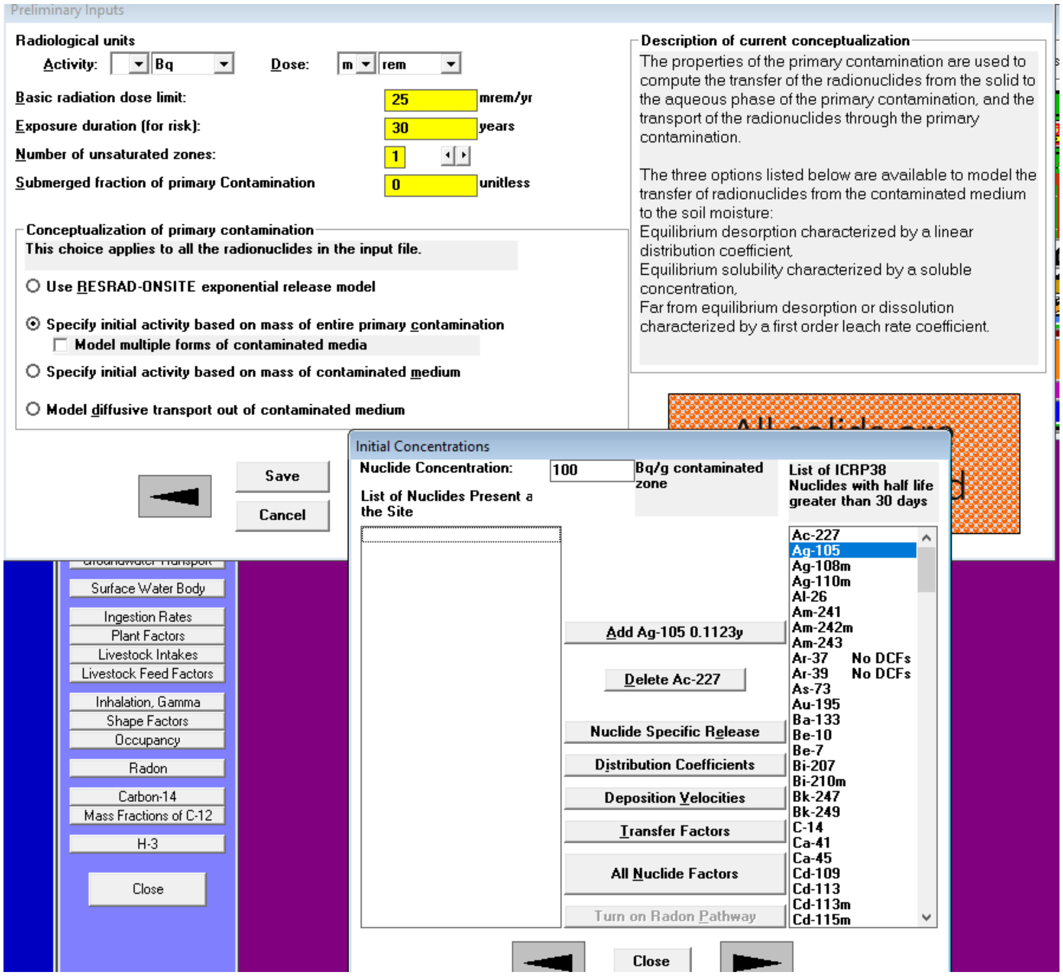
- Suggest modify Step 4) of test case description to "Frame "Transfer Mechanism" should be available after a radionuclide is selected."
- Suggest modify Step 8) of test case description: change "identical" to "equivalent"

Procedure:

1) Open the Initial Concentrations window and visually check the format, fonts, spelling, and default setting.

The form presents as expected.

2) Check the unit is correct according to Form Preliminary Inputs.

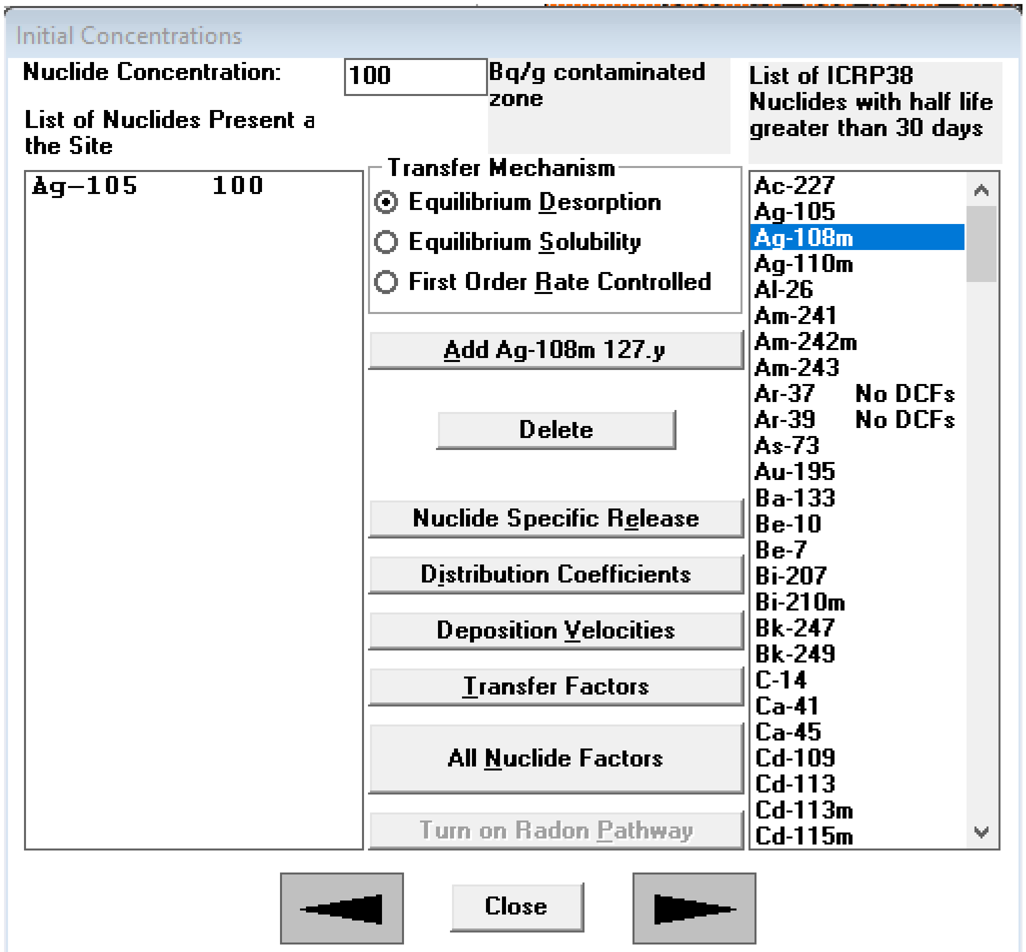


Worked as expected.

3) The upper right box should indicate the radionuclide database and cutoff half-life.

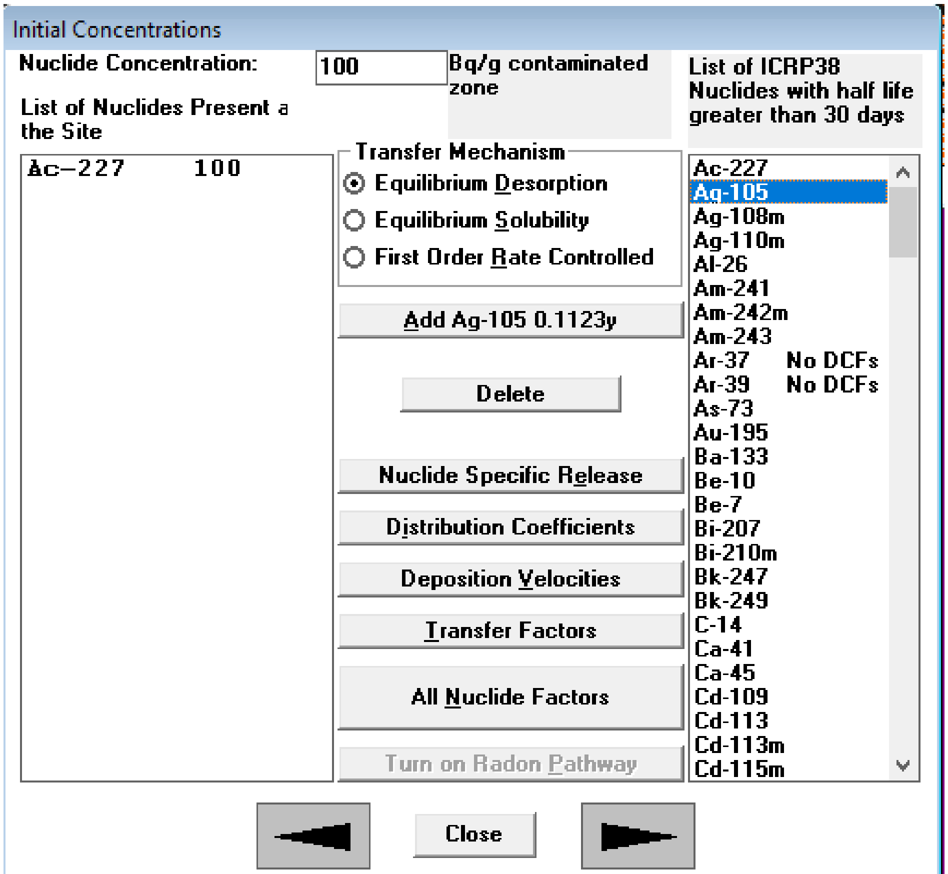
Worked as expected.

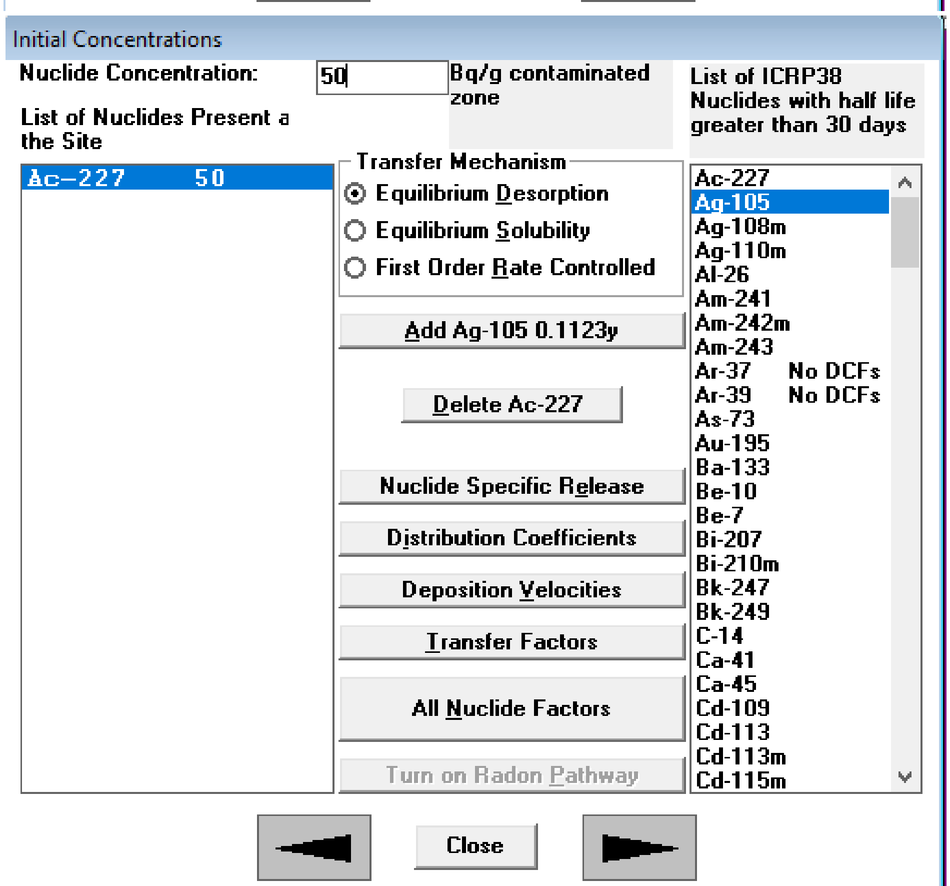
4) Frame “Transfer Mechanism” should be available.



Worked as expected after adding a radionuclide.

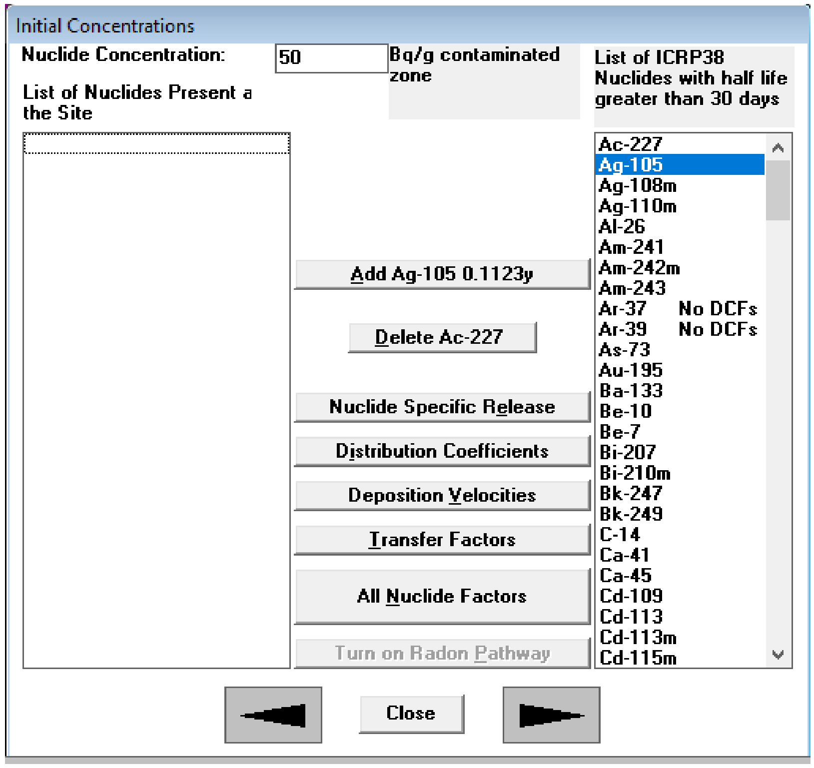
5) Select Ac-227, then click button “Add Ac-227 21.77y”, Ac-227 should be added to the left panel with a concentration of 100 unit. Highlight it and then change the Nuclide Concentration value to 50. Its concentration should update to 50 in the left panel.


Initial Concentrations
Nuclide Concentration:
100
Bq/g contaminated zone
List of Nuclides Present a the Site
Ac−227 100
Transfer Mechanism
Equilibrium Desorption
Equilibrium Solubility
First Order Rate Controlled
Add Ag-105 0.1123y
Delete
Nuclide Specific Release
Distribution Coefficients
Deposition Velocities
Transfer Factors
All Nuclide Factors
Turn on Radon Pathway
List of ICRP38 Nuclides with half life greater than 30 days
Ac-227
Ag-105
Ag-108m
Ag-110m
Al-26
Am-241
Am-242m
Am-243
Ar-37 No DCFs
Ar-39 No DCFs
As-73
Au-195
Ba-133
Be-10
Be-7
Bi-207
Bi-210m
Bk-247
Bk-249
C-14
Ca-41
Ca-45
Cd-109
Cd-113
Cd-113m
Cd-115m
Close


Initial Concentrations
Nuclide Concentration:
50
Bq/g contaminated zone
List of Nuclides Present a the Site
Ac−227 50
Transfer Mechanism
Equilibrium Desorption
Equilibrium Solubility
First Order Rate Controlled
Add Ag-105 0.1123y
Delete Ac-227
Nuclide Specific Release
Distribution Coefficients
Deposition Velocities
Transfer Factors
All Nuclide Factors
Turn on Radon Pathway
List of ICRP38 Nuclides with half life greater than 30 days
Ac-227
Ag-105
Ag-108m
Ag-110m
Al-26
Am-241
Am-242m
Am-243
Ar-37 No DCFs
Ar-39 No DCFs
As-73
Au-195
Ba-133
Be-10
Be-7
Bi-207
Bi-210m
Bk-247
Bk-249
C-14
Ca-41
Ca-45
Cd-109
Cd-113
Cd-113m
Cd-115m
Close

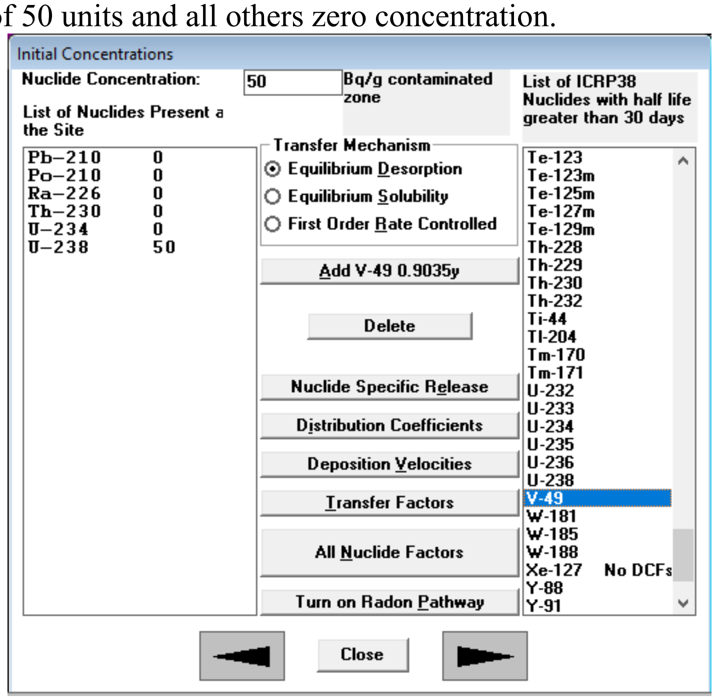
Worked as expected.

6) Clicking Delete "Ac-227" should remove it from the left panel.



Worked as expected.

7) Select U-238 from right panel and add it. The radionuclides in the U-238 decay change with half-life larger than the cutoff halflife should be added to the left panel with U-2328 having a concentration of 50 units and all others zero concentration.



Worked as expected.

8) Close the form and save the project to Test15.rof. Check the variables NUCNAM and S. Their value should be identical to the input to the form.

```
NUCNAM = 'Pb-210+D', 'Po-210', 'Ra-226+D', 'Th-230', 'U-234',
'U-238', 'U-238+D', 'LAST',
S = 5*0, 2*1351.351,
```

Note that 1351.351 pCi is equivalent to 50 Bq. Change the concentration to 50 pCi and save the input file to Test165.rof.

```
NUCNAM = 'Pb-210+D', 'Po-210', 'Ra-226+D', 'Th-230', 'U-234',
'U-238', 'U-238+D', 'LAST',
S = 5*0, 2*50,
```

Worked expected. Suggest to modify the test case description.

12.28 TEST CASE 034-004 TESTER'S REPORT

Documented in Test_034-004_report.docx of 2/18/2020 9:05 AM

Test Case 034-004 Report

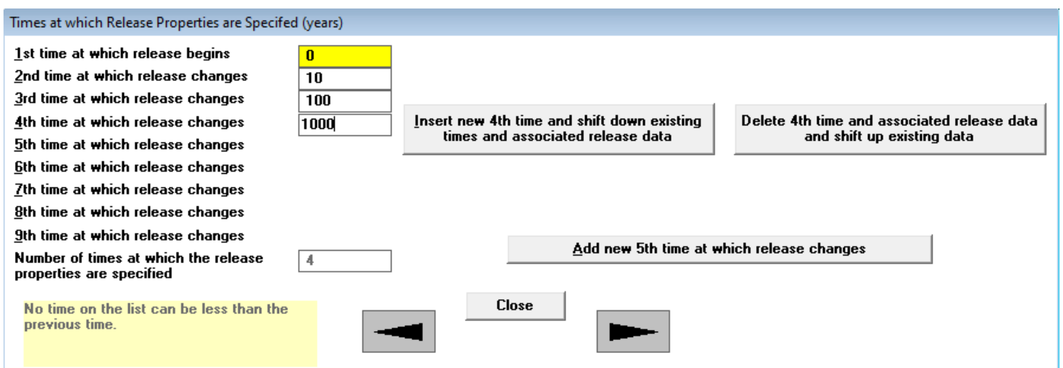
By Cheng Wang 2/18/2020

Objective: To the functionality of Form Nuclide Specific Release.

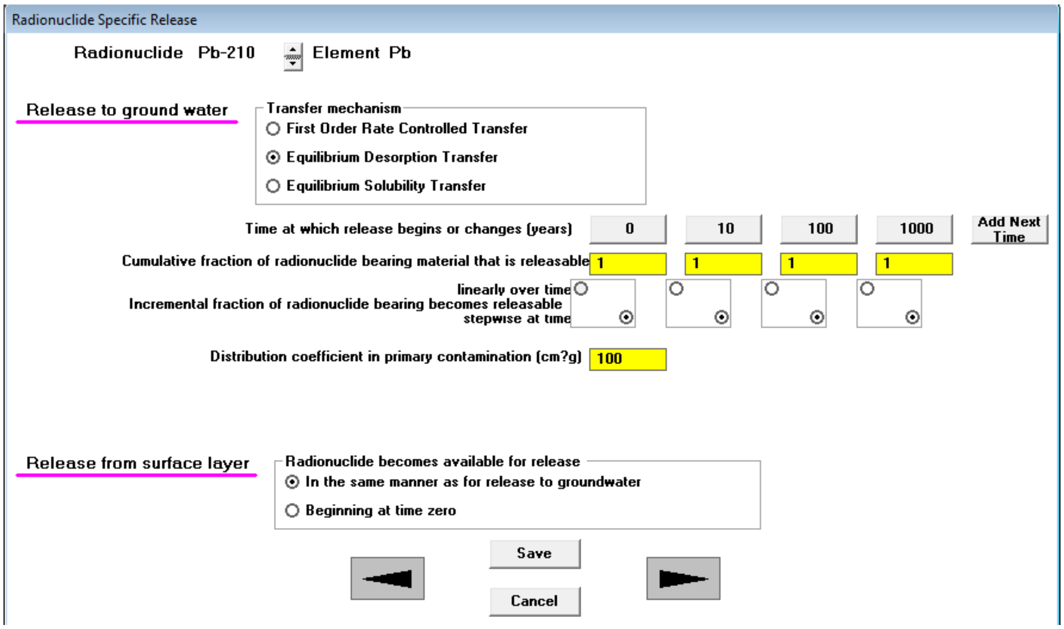
Conclusion: The code worked as expected.

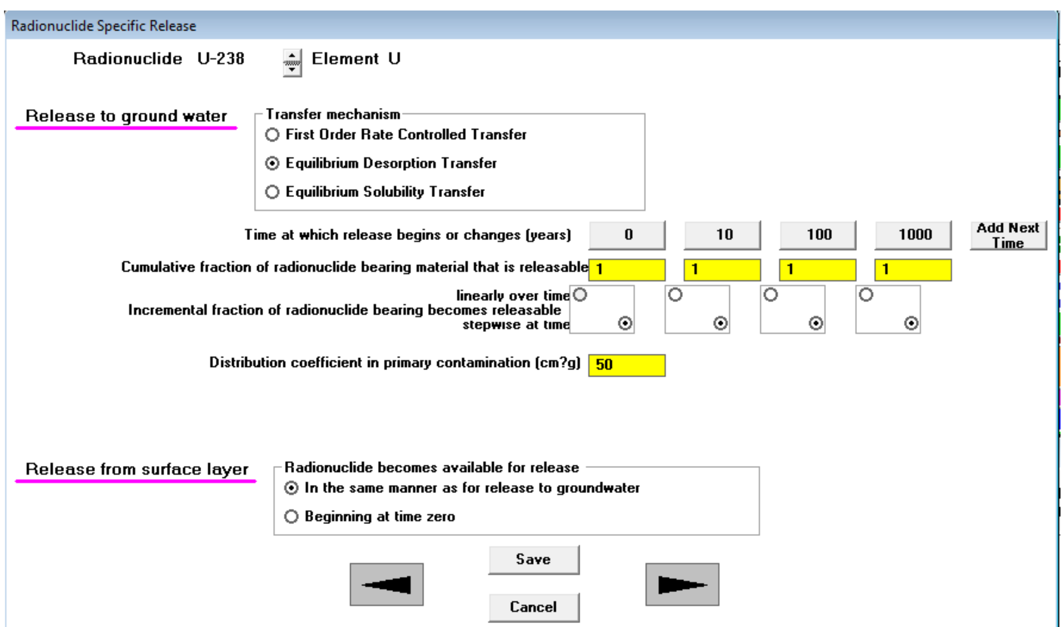
Procedure:

1) Select U-238 in Form Initial Concentrations with all default setting, and set release time to 0, 10, 100, and 1000 in Release Time form.



2) Open the Form “Nuclide Specific Release”. Initial Concentrations Form should also be opened automatically if not opened at the time. Visually check the format, fonts, spelling, and default setting.





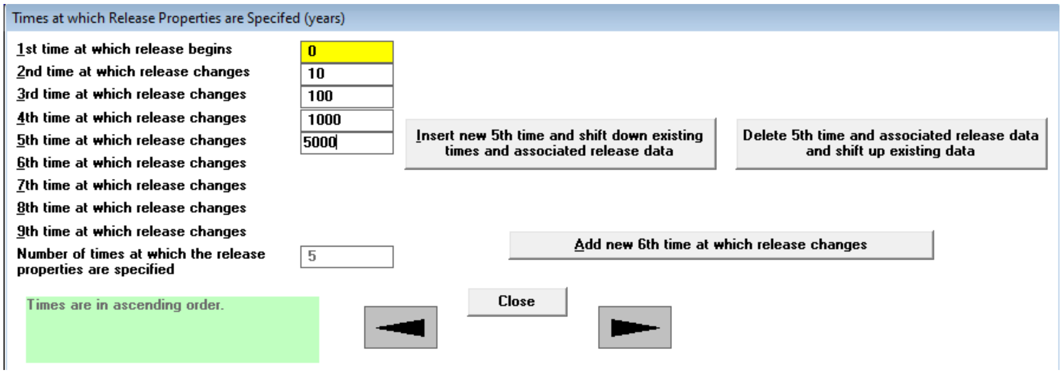
Worked as expected.

3) Check Radionuclide can be selected for each one in U-238 decay chain.

Worked as expected, as shown in the screenshots in Step 2).

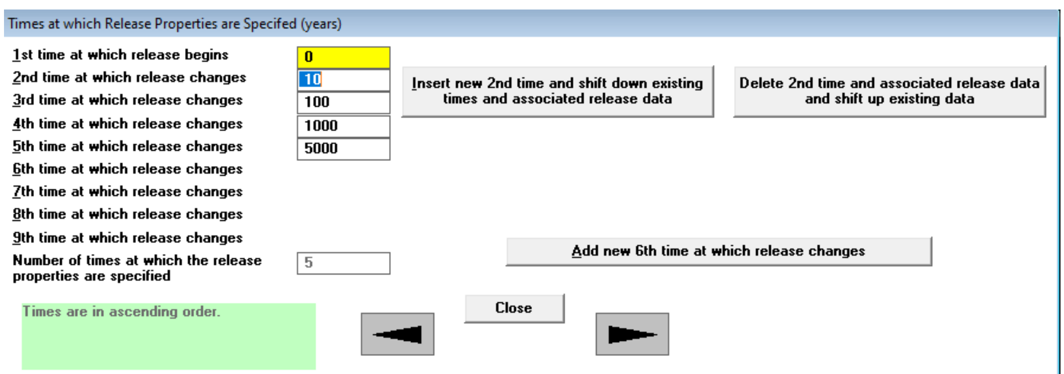
4) A button called “Add Next Time” should be available next the last release time. Clicking it should close the Nuclide Specific Release form and open Release Times form. In the Release Time form, add the 5th release starting time, 5000 yr and close the form.

Worked as expected.



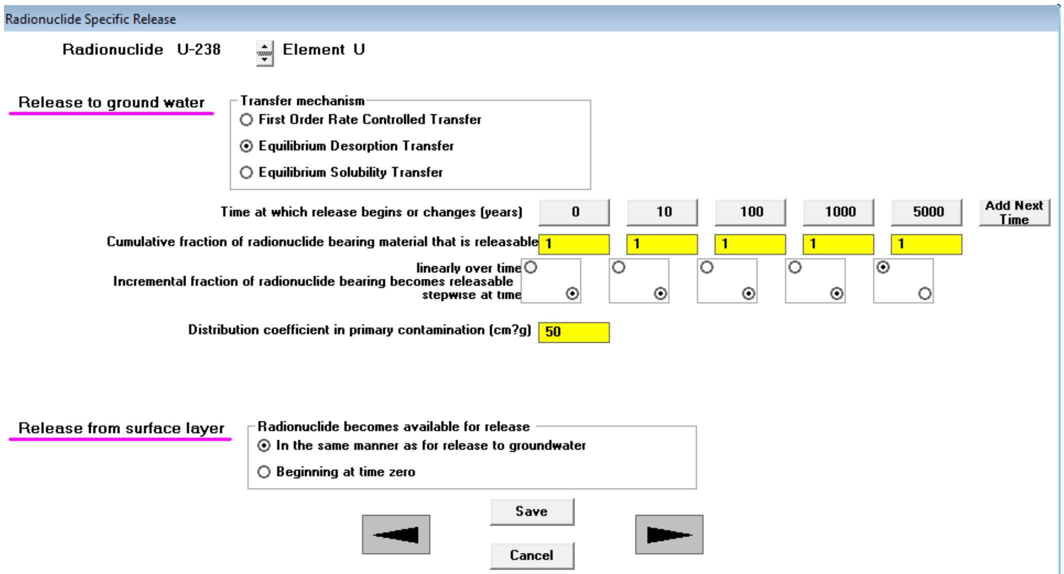
5) Clicking a specific release time in the Nuclide Specific Release form should result in closing the form and open the Release Time form with the specified release time highlighted for modification.

Clicking the second release time “10” in the form generated the following screenshot.



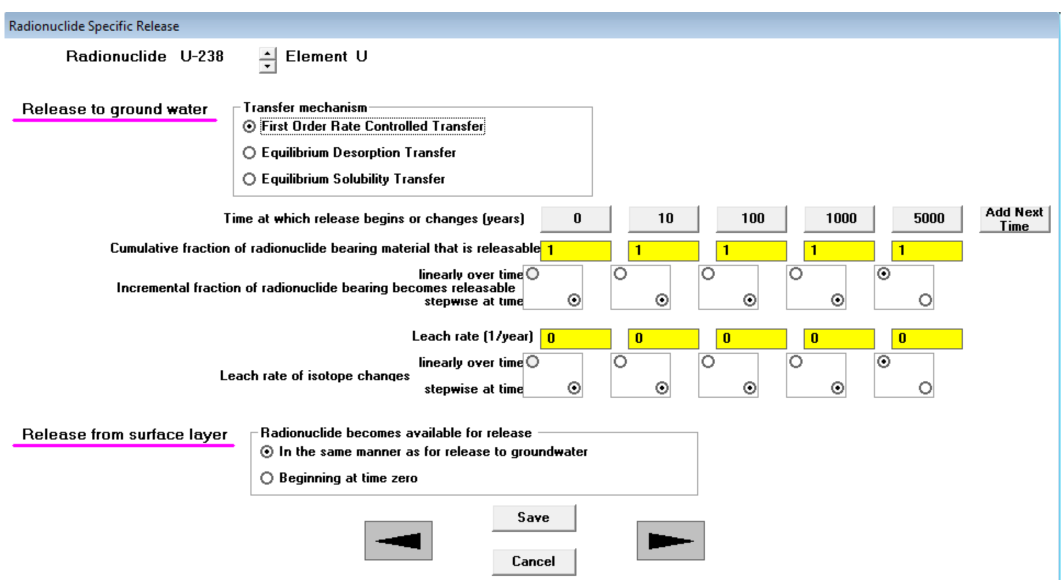
Worked as expected.

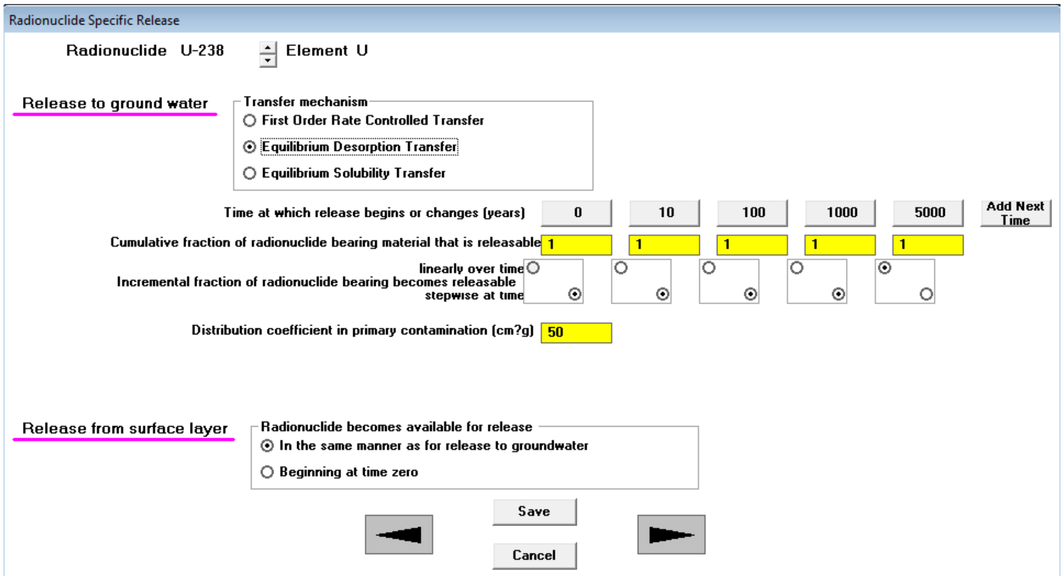
6) Open the Form "Nuclide Specific Release" again, the newly added release starting time of 5000 should be added into the release time row.

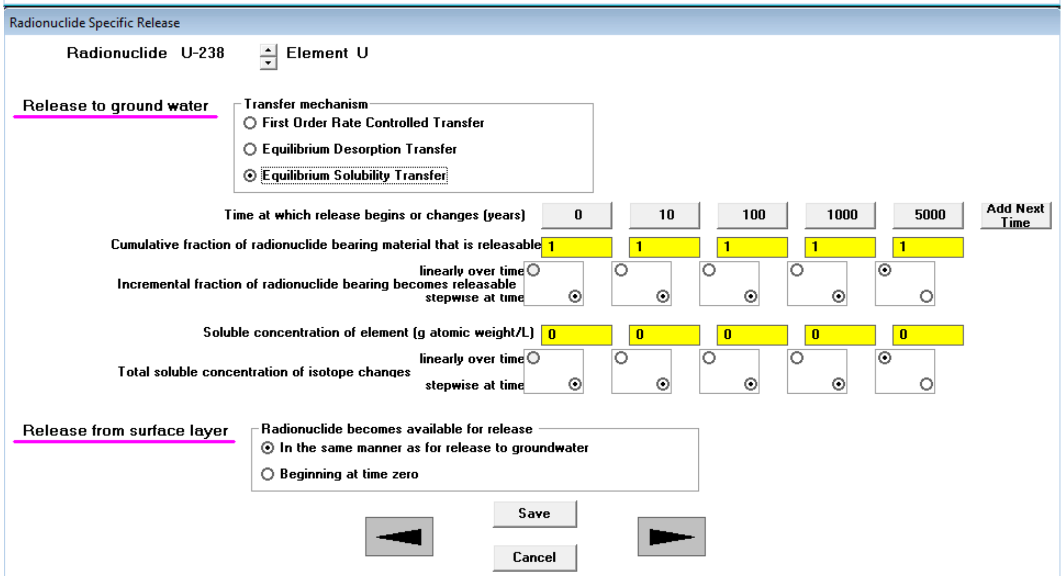


Worked as expected.

7) Changing the options in Transfer Mechanism frame should change the interface. Figures a-c show the interfaces corresponding to First order release, Equilibrium Desorption, and Equilibrium Solubility release, respectively.







Worked as expected.

8) Change one value or option for each radionuclide, close the form, and save the file to Test15.rof.

Changed Transfer mechanism to the following:

Pb-210: First order rate controlled transfer

Po-210: Equilibrium desorption

Ra-226: Equilibrium solubility

Th-230: First order rate controlled transfer

U-234: Equilibrium desorption

U-238: Equilibrium solubility

Changed the Cumulative fraction of radionuclide bearing material that is releasable to the following values.

Pb-210: 0.1

Po-210: 0.2

Ra-226: 0.3

Th-230: 0.4

U-234: 0.5

U-238: 0.6

9) Check the values in the generated input file match the inputs in the interface. The variables include RELTIME, RLEACH, SOLUB, RELFRAC, RELTIMEOPT, RELTIMEOPTP, RELOPT.

```
RELTIME(1)  = 0,
RELTIME(2)  = 10,
RELTIME(3)  = 100,
RELTIME(4)  = 1000,
RELTIME(5)  = 5000,
RELTIME(6)  = 0,
RELTIME(7)  = 0,
RELTIME(8)  = 0,
RELTIME(9)  = 0,
RLEACH = 63*0,
SOLUB = 63*0,
RELFRAC = .1, 8*1, .2, 8*1, .3, 8*1, .4, 8*1, .5, 8*1, .6, 8*1,
 .6, 8*1,
RELTIMEOPT = 4*1, 5*0, 4*1, 5*0, 4*1, 5*0, 4*1, 5*0, 4*1, 5*0,
 4*1, 5*0, 4*1, 5*0,
RELTIMEOPTP = 4*1, 5*0, 4*1, 5*0, 4*1, 5*0, 4*1, 5*0, 4*1, 5*0,
 4*1, 5*0, 4*1, 5*0,
RELOPT = 0, 1, 2, 0, 3*2,
RELAIRTIMEOPT = 7*0,
```

Worked as expected.

12.29 TEST CASE 034-005 TESTER'S REPORT

Documented in Test-034-005_report.docx of 2/20/2020 7:27 AM

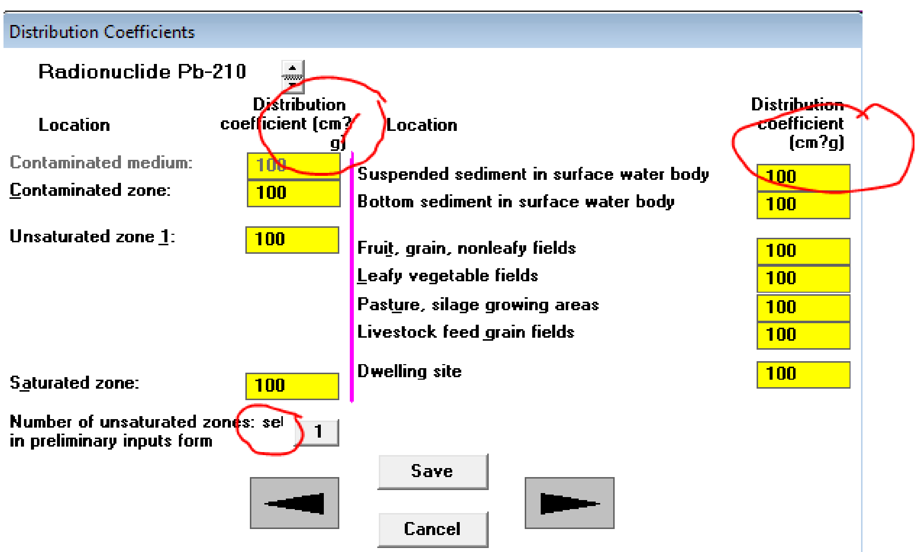
Test Case 034-005 report

By Cheng Wang 2/18/2020

Objective: To test the functionality of Distribution Coefficients form.

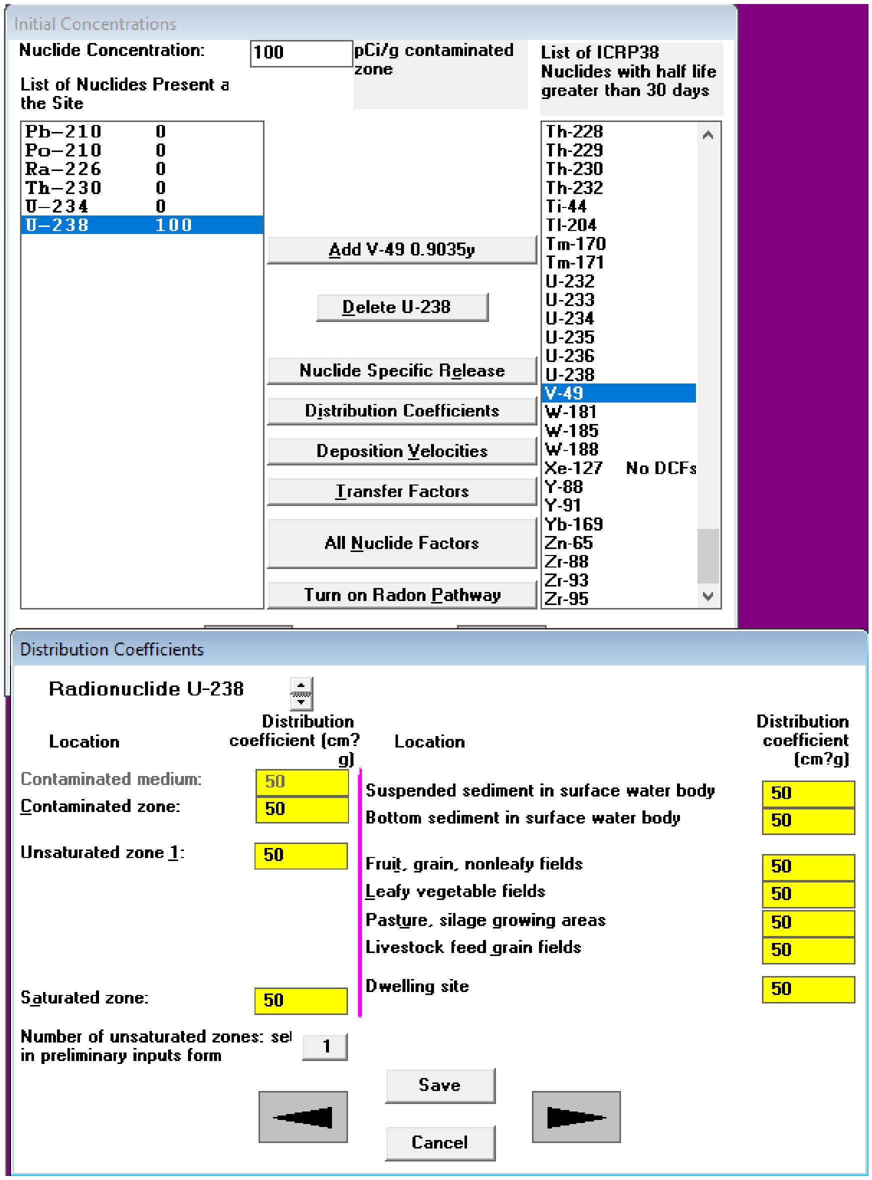
Conclusion: the code worked as expected.

The following minor font format issues were identified when computer system locale is Chinese; no issues when English (US) is used.



Procedure:

1) With U-238 selected with default settings. Open Distribution Coefficients form and visually check the format, fonts, spelling, and default setting.

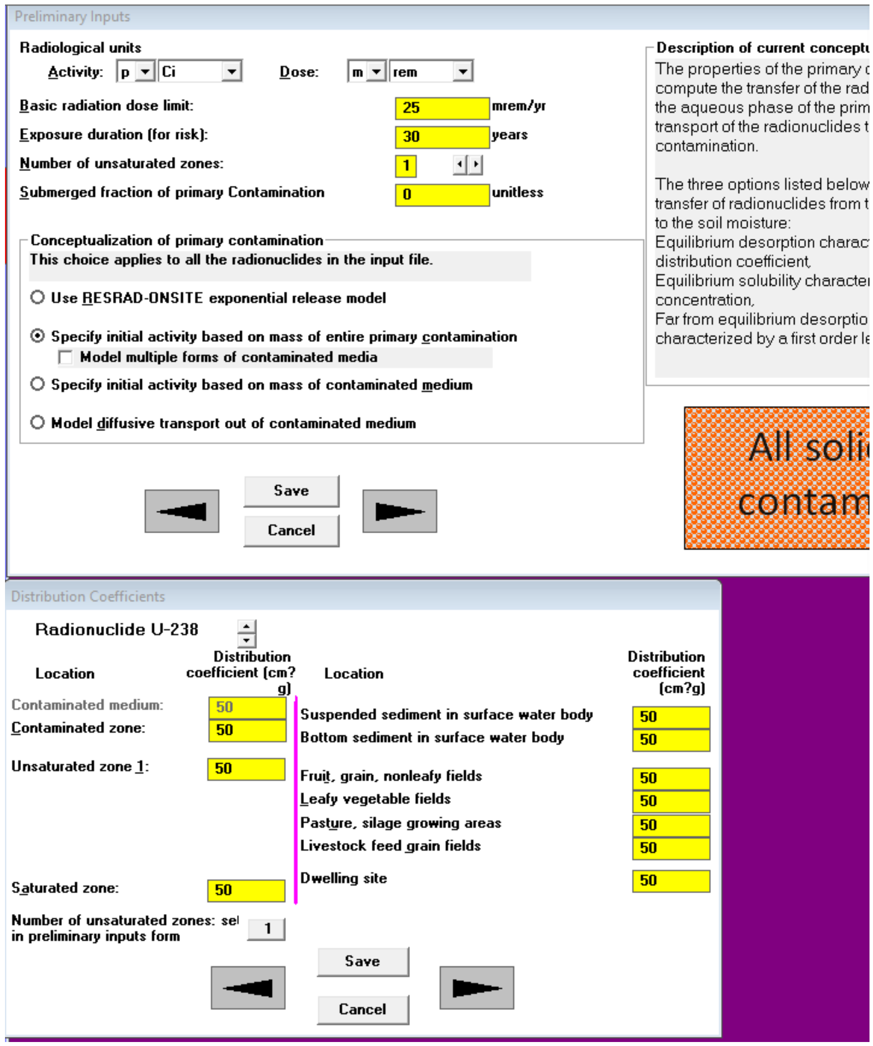


Worked as expected.

2) The form should be available for inputs as shown in the Figure in Expected Results.

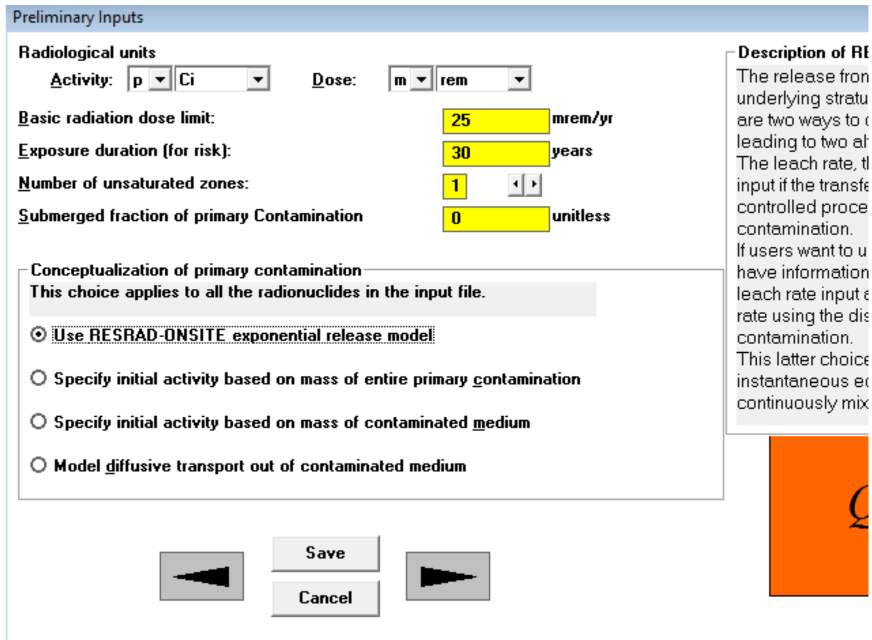
Worked as expected, as shown in the screenshot of Step 2)

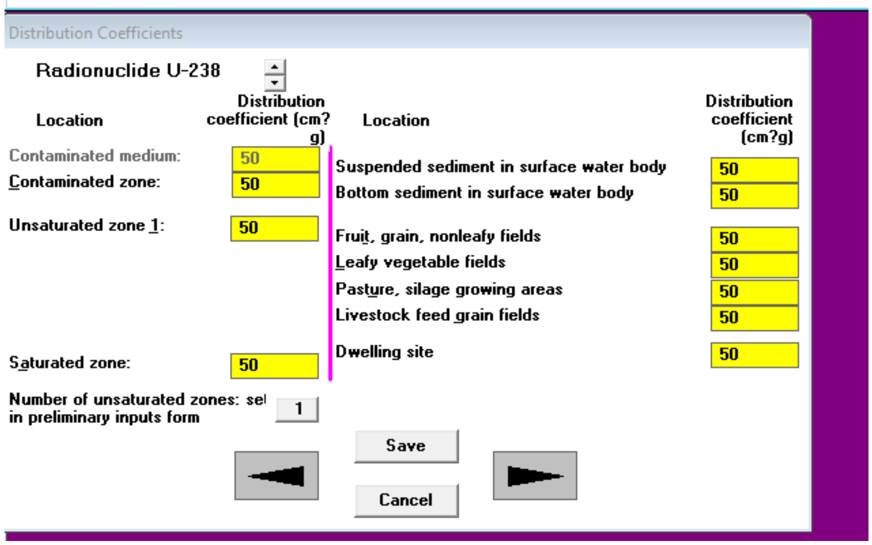
3) When either of the first or second options in Conceptualization of Primary Contamination in Preliminary form is selected, the distribution coefficient input box for Contaminated Medium will be gray out.



worked as expected.

4) Clicking the value of Number of Unsaturated Zone should open the Preliminary Inputs form

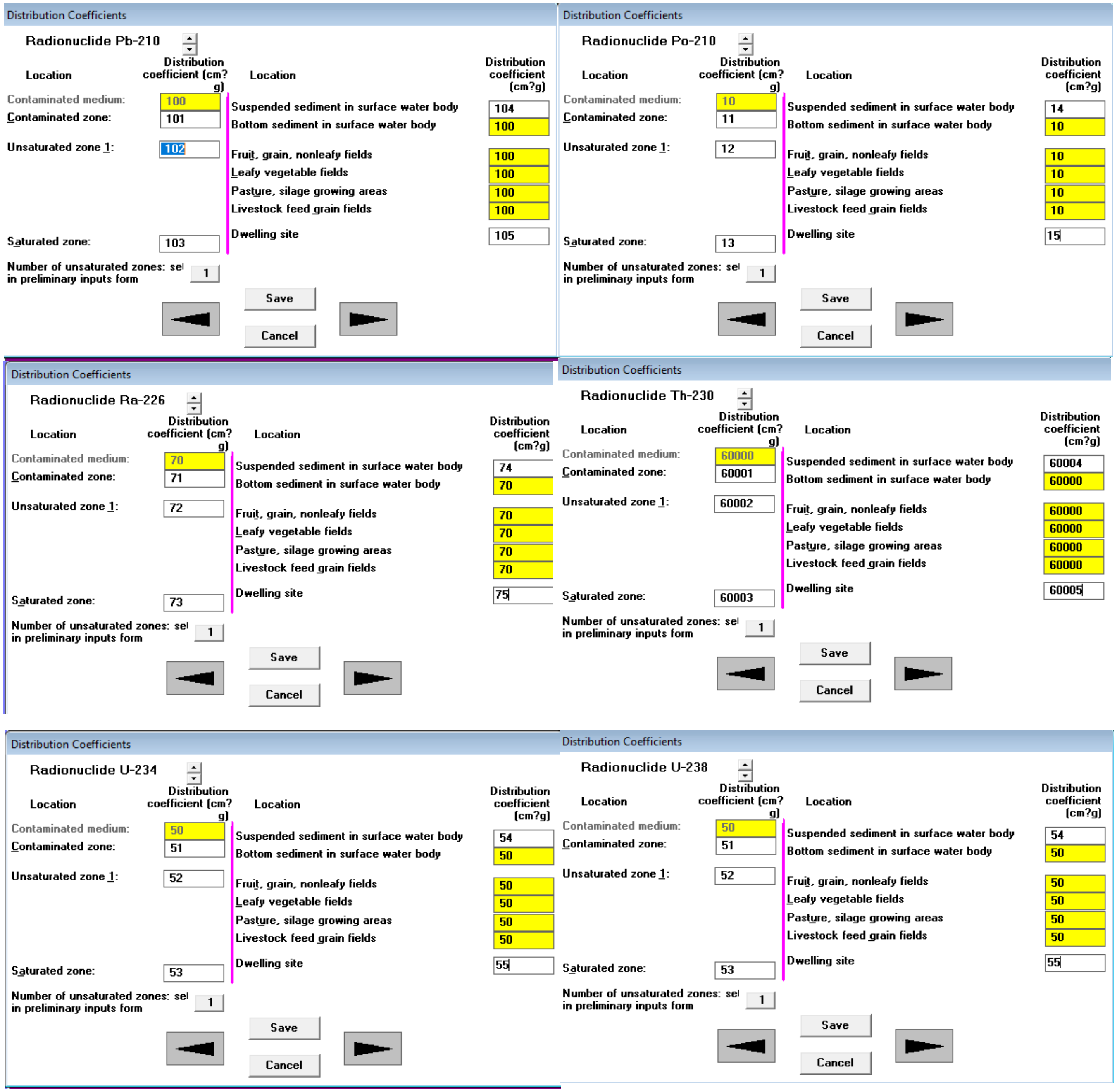




worked as expected.

5) Change at least one value for each radionuclide, and save the project to Test17.rof.

Made the changes as shown in the screenshot.



6) Check the following variables in the generated input file and their value should match the input, DCACTC, DCACTCM, DCACTDWE, DCACTSWB, DCACTSWS, DCACTU1, DCACTS, DCACTV1, DCACTV2, DCACTL1, DCACTL2.

```
DCACTC = 101, 11, 71, 60001, 3*51,
DCACTCM = 100, 10, 70, 60000, 3*50,
DCACTDWE = 105, 15, 75, 60005, 3*55,
DCACTSWB = 100, 10, 70, 60000, 3*50,
DCACTSWS = 104, 14, 74, 60004, 3*54,
DCACTU1 = 102, 12, 72, 60002, 3*52,
DCACTS = 103, 13, 73, 60003, 3*53,
DCACTV1 = 100, 10, 70, 60000, 3*50,
DCACTV2 = 100, 10, 70, 60000, 3*50,
DCACTL1 = 100, 10, 70, 60000, 3*50,
DCACTL2 = 100, 10, 70, 60000, 3*50,
```

worked as expected.

12.30 TEST CASE 034-006 TESTER'S REPORT

Documented in Test-034-006_report.docx of 2/18/2020 11:50 AM

Test Case 034-006 report

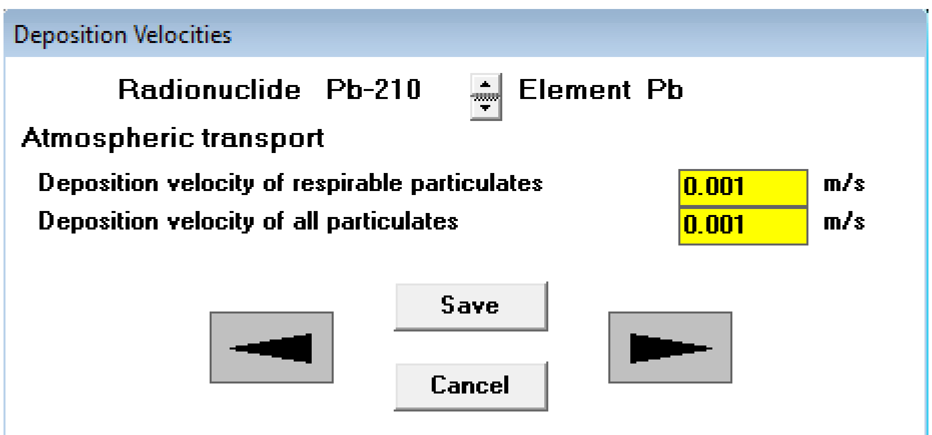
By Cheng Wang 2/18/2020

Objective: To test the functionality of Deposition Velocities form

Conclusion: the code worked as expected.

Procedure:

1) Select U-238 with default settings. Open Deposition Velocity form and visually check the format, fonts, spelling, and default setting.



Worked as expected.

2) Change at least one value for each radionuclide in the U-238 decay chain. Save the form and the project to Test18.rof.

Made the following changes:

Deposition velocity of respirable particulates for Pb-210, Po-210, Ra-226 were changed to 0.002, 0.003, 0.004, respectively.

Deposition velocity of all particulates for Th-230, U-234, U-238 were changed to 0.005, 0.007, and 0.007, respectively.

3) Check the variables DEPVEL, and DEPVELT in the generated file; they should match the input values in the interface.

```
DEPVEL = .002, .003, .004, 4*.001,
DEPVELT = 3*.001, .005, 3*.007,
```

Worked as expected.

12.31 TEST CASE 034-007 TESTER'S REPORT

Documented in Test-034-007_report.docx of 2/18/2020 12:13 PM

Test Case 034-007 report

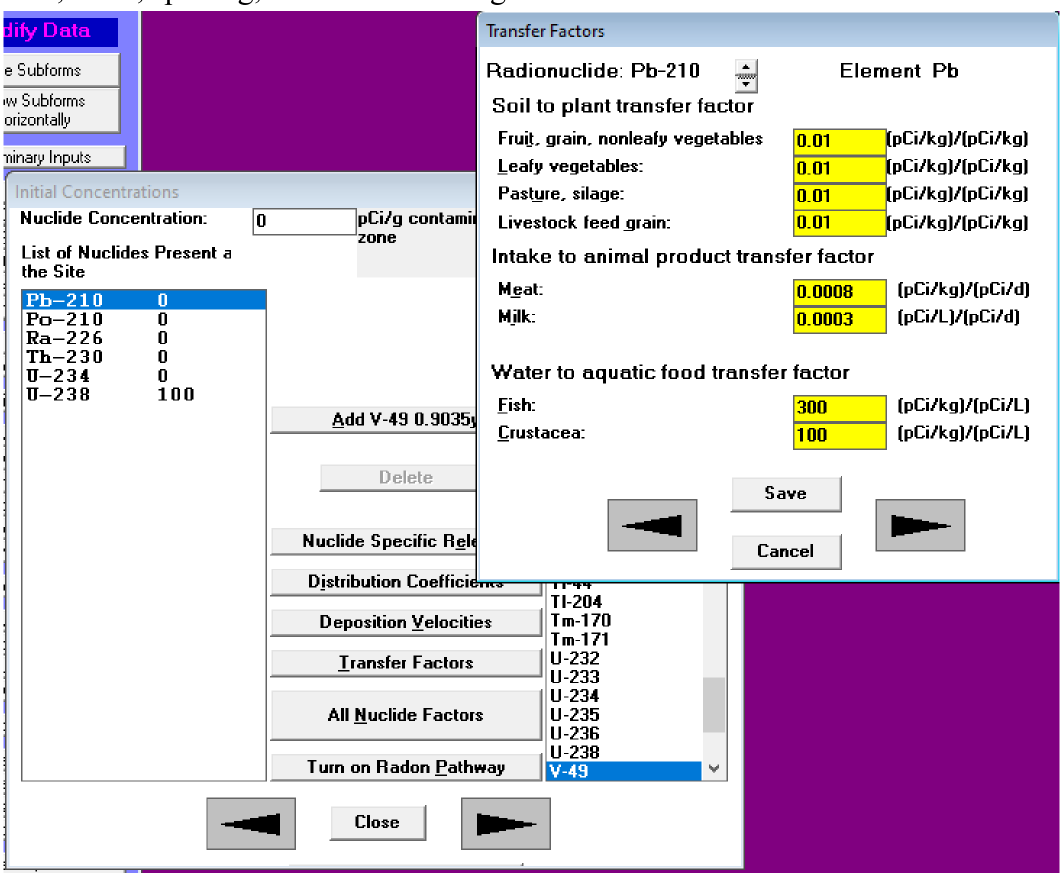
By Cheng Wang 2/18/2020

Objective: To test the functionality of Transfer Factors form.

Conclusion: the code worked as expected.

Procedure:

1) Select U-238 with all default settings. Open Transfer Factors form, and visually check the format, fonts, spelling, and default setting.



Worked as expected.

2) Change at least one value for each radionuclide, and save the form.

Made the following changes:

	Pb-210	Po-210	Ra-226	Th-230	U-234	U-238
Fruit, grain	0.01	.001	.05	.001	.0025	.0025
Leafy	.02	.002	.04	.002	.0026	.0026
Pasture	.02	.003	.04	.003	.0027	.0027
Livestock	.02	.004	.04	.004	.0028	.0028
Meal	.0009	.005	.001	.0001	.00035	.00035
milk	0004	.00035	.001	.000005	.0007	.0007
Fish	301	101	51	.100	11	11
Crustacea	101	20001	250	501	61	61

3) Save the project to Test19.rof. Check the following variables' values; they should match the input. RTF, I_M, BIOFAC.

```
RTF = .01, .001, .05, .001, 3*.0025, .02, .002, .04, .002, 3*.0026,
 .02, .003, .04, .003, 3*.0027, .02, .004, .04, .004, 3*.0028,
I_M = .0009, .005, .001, .0001, 3*.00035, .0004, .00035, .001,
 .000005, 3*.0007,
BIOFAC = 301, 101, 51, 100, 3*11, 101, 20001, 250, 501, 3*61,
```

Worked as expected.

12.32 TEST CASE 034-008 TESTER'S REPORT

Documented in Test-034-008_report.docx of 2/18/2020 12:24 PM

Test Case 034-008 report

By cheng wang 2/18/2020

Objective: To test the functionality of Reporting Times form

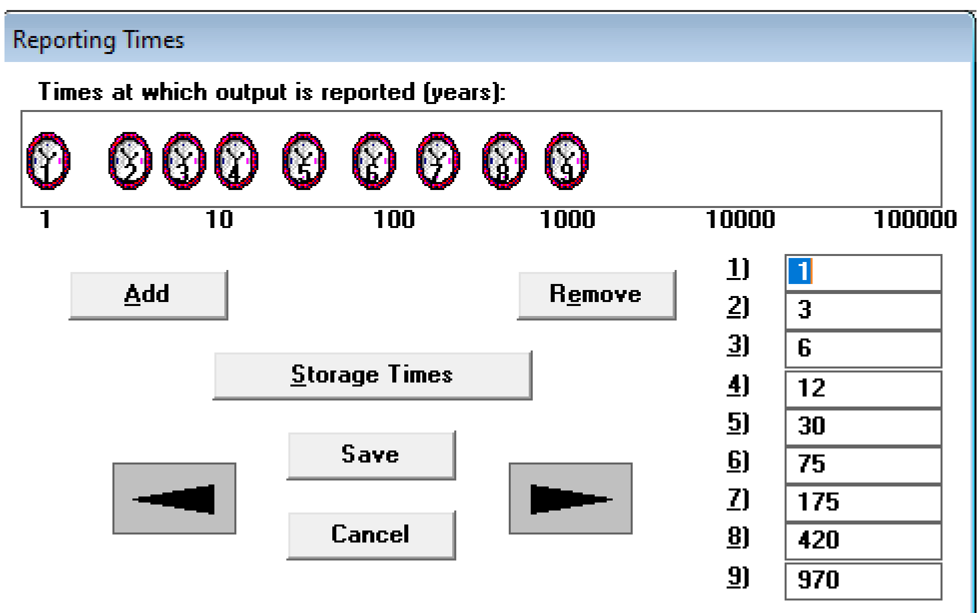
Conclusion: The code worked as expected.

Procedure:

1) Click Modify Data -> Reporting Times. Visually check the format, fonts, and spelling.

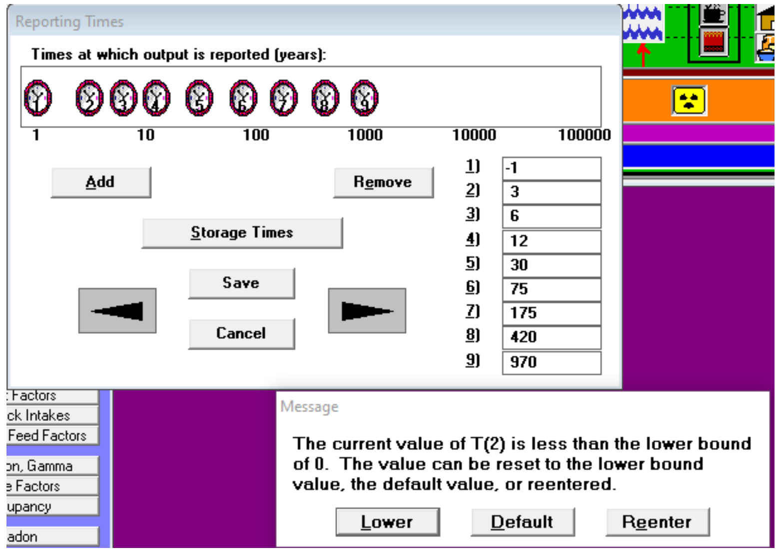
Worked as expected.

2) It should have contents as shown in the figure, allowing up to 9 input times.



Worked as expected.

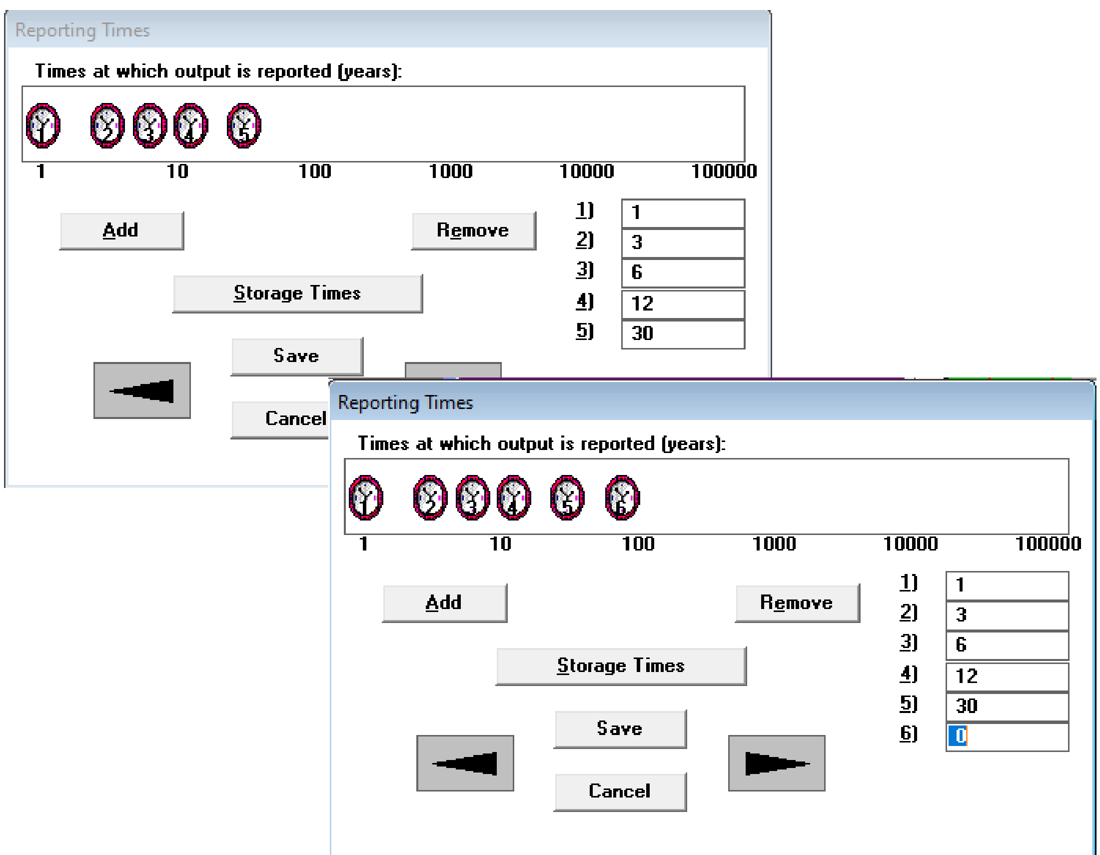
3) Check the lower and upper bounds. Each value should be (0, 100000]



When a number larger than 100000 was input, it is changed to 100000 automatically.

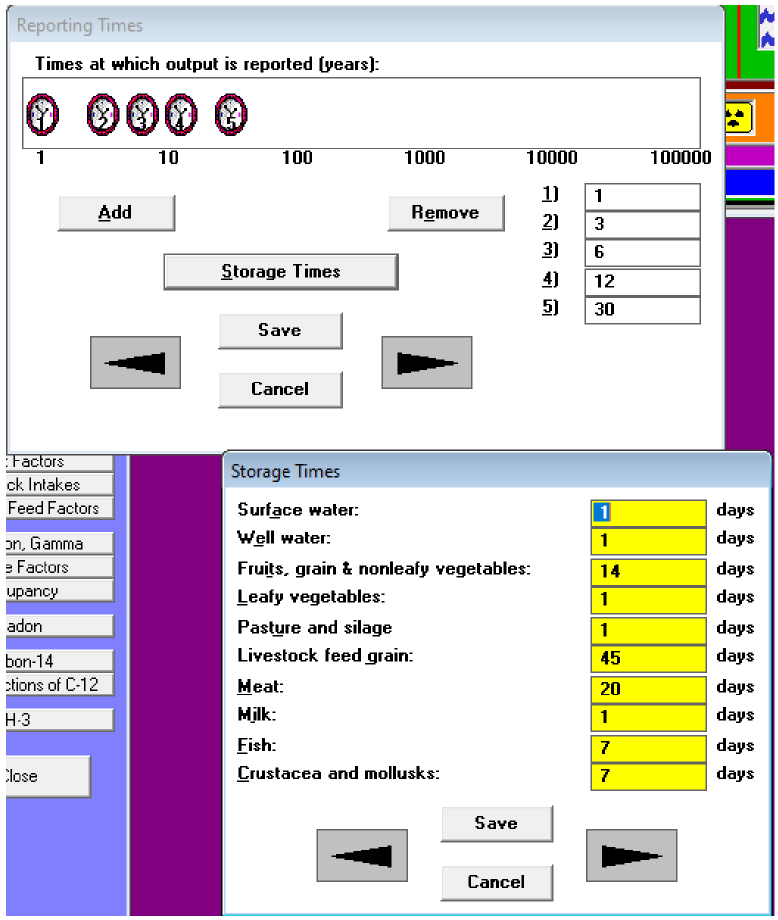
Worked as expected.

4) Check Add and Remove buttons



Worked as expected.

5) Clicking "Storage times" button should bring the form up.



Worked as expected.a

6) Save the form and the project to Test20.rof.

7) Check the variable T(1)-(10) in the file; they should be identical to the input in GUI.

Worked as expected.

```
T(1) = 0,
T(2) = 1,
T(3) = 3,
T(4) = 6,
T(5) = 12,
T(6) = 30,
T(7) = 0,
T(8) = 0,
T(9) = 0,
T(10) = 0,
```

12.33 TEST CASE 034-009 TESTER'S REPORT

Documented in Test-034-009_report.docx of 2/18/2020 12:31 PM

Test Case 034-009 report

By cheng wang 2/18/2020

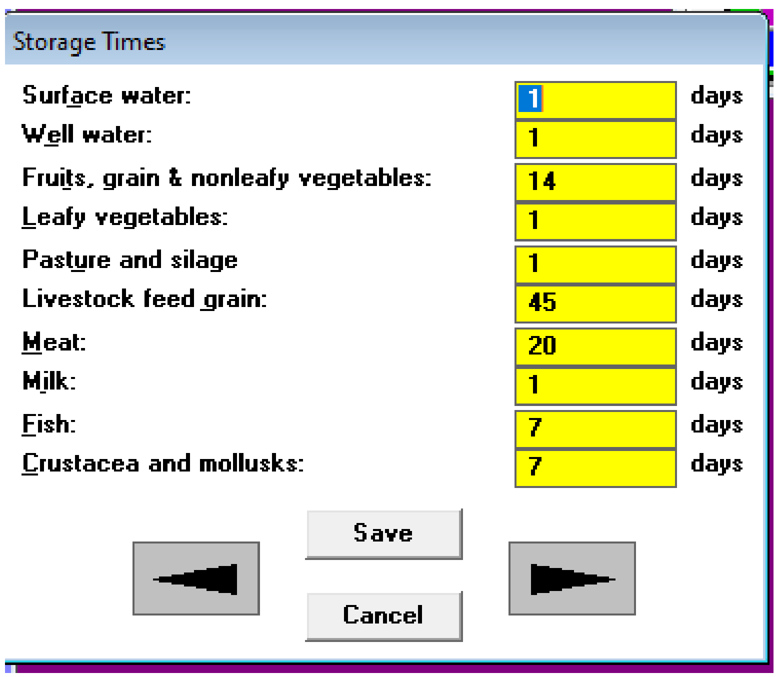
Objective: To test the functionality of Storage Times form.

Conclusion: The code worked as expected

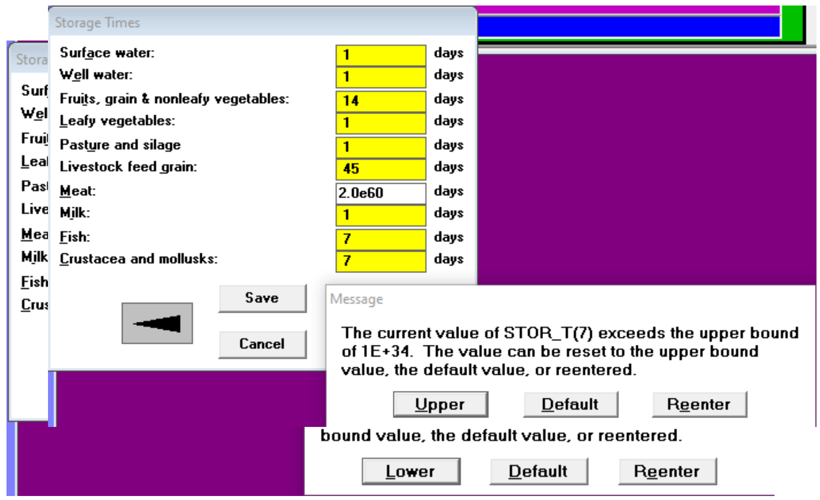
Procedure:

1) Click Modify Data -> Storage Times. Visually check the format, fonts, and spelling.

Worked as expected.



2) Check the lower and upper bounds for each input box value. It should be no less than 0.



Worked as expected.

3) Change two or more values.

Changed values for Surface water, Well water, and Crustacea and mollusks to 2, 3, and 10, respectively.

4) Save the form and the project to Test21.rof.

5) Check the variable STOR_T(1)-(10) in the file; they should be identical to the input in GUI.

```
STOR_T(1) = 2,
STOR_T(2) = 3,
STOR_T(3) = 14,
STOR_T(4) = 1,
STOR_T(5) = 1,
STOR_T(6) = 45,
STOR_T(7) = 20,
STOR_T(8) = 1,
STOR_T(9) = 7,
STOR_T(10) = 10,
```

Worked as expected.

12.34 TEST CASE 034-010 TESTER'S REPORT

Documented in Test-034-010_report.docx of 2/18/2020 12:39 PM

Test Case 034-010 report

By cheng wang 2/18/2020

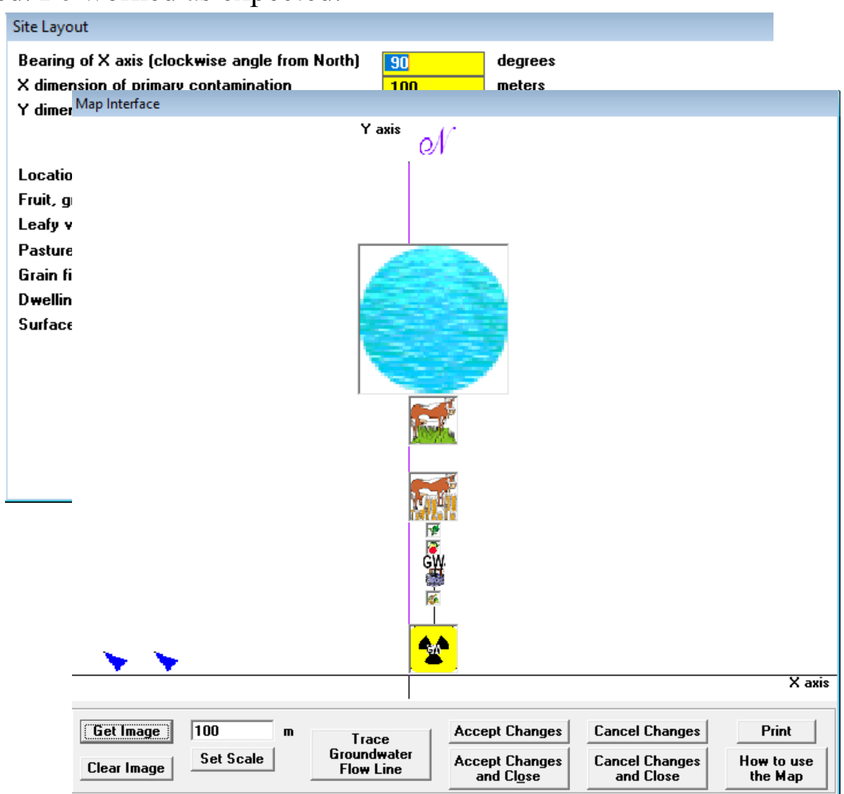
Objective: To test the functionality of Site Layout form.

Conclusion: the code worked as expected.

Procedure:

1) Open Site Layout form and visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

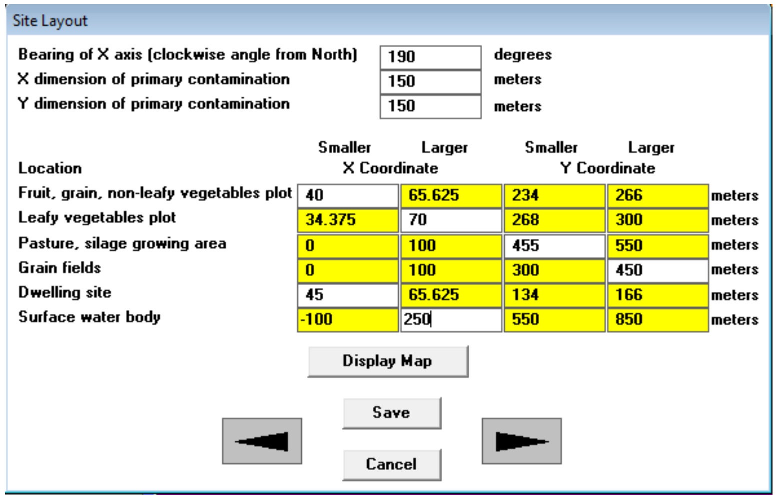
Worked as expected. F6 worked as expected.



2) Clicking Display Map should bring up the Map Interface window.

Worked as expected.

3) Change the values for Bearing of X axis, X and Y dimensions, and at least one value on each row and column of the site coordinate table.



4) Save the project to Test22.rof.

5) Check the following variables in the file; they should be identical to the input in GUI. NXBEARING, SOURCEXY, AGRIXY, DWELLXY, SWXY.

```
NXBEARING = 190,
SOURCEXY(1) = 150,
SOURCEXY(2) = 150,
AGRIXY(1,1) = 40,
AGRIXY(2,1) = 65.625,
AGRIXY(3,1) = 234,
AGRIXY(4,1) = 266,
AGRIXY(1,2) = 34.375,
AGRIXY(2,2) = 70,
AGRIXY(3,2) = 268,
AGRIXY(4,2) = 300,
AGRIXY(1,3) = 0,
AGRIXY(2,3) = 100,
AGRIXY(3,3) = 455,
AGRIXY(4,3) = 550,
AGRIXY(1,4) = 0,
AGRIXY(2,4) = 100,
AGRIXY(3,4) = 300,
AGRIXY(4,4) = 450,
DWELLXY(1) = 45,
DWELLXY(2) = 65.625,
DWELLXY(3) = 134,
DWELLXY(4) = 166,
SWXY(1) =-100,
SWXY(2) = 250,
SWXY(3) = 550,
SWXY(4) = 850,
```

Worked as expected.

12.35 TEST CASE 034-011 TESTER'S REPORT

Documented in Test-034-011_report.docx of 2/18/2020 12:56 PM

Test Case 034-011 report

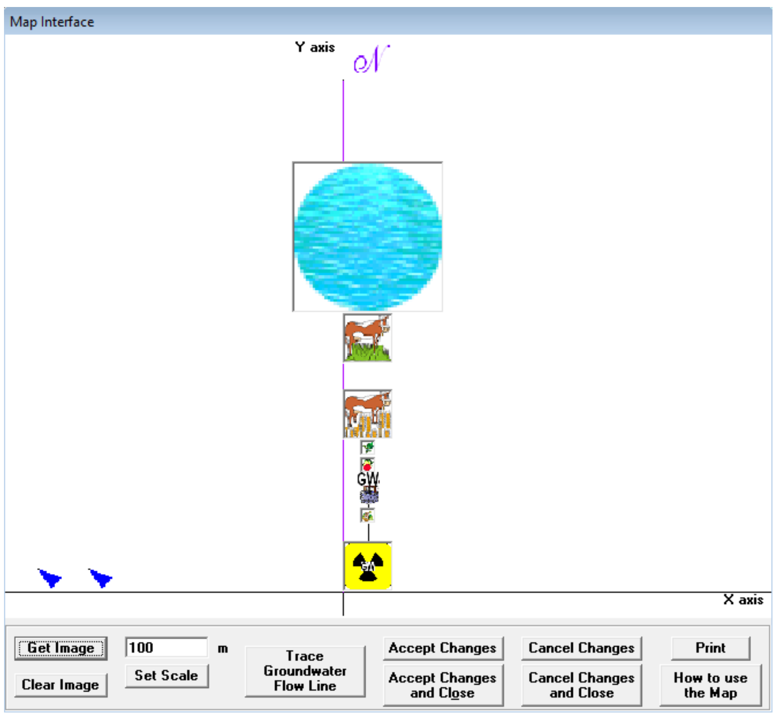
By cheng wang 2/18/2020

Objective: To test the functionality of Map Interface form.

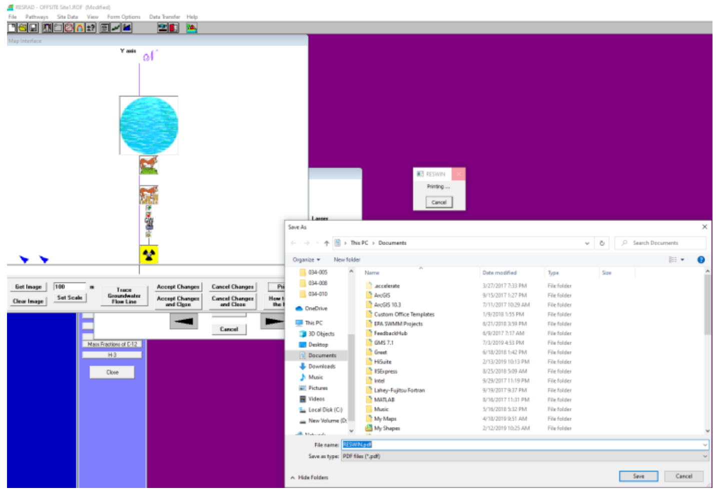
Conclusion: the code worked as expected.

Procedure:

1) Open Map Interface form by clicking Modify Data -> Site Layout -> Display Map
2) It should include the functions as shown in the figure.



3) Check the following buttons: Print, How to use the Map, Accept/Cancel changes, Accept/Cancel Changes and Close.

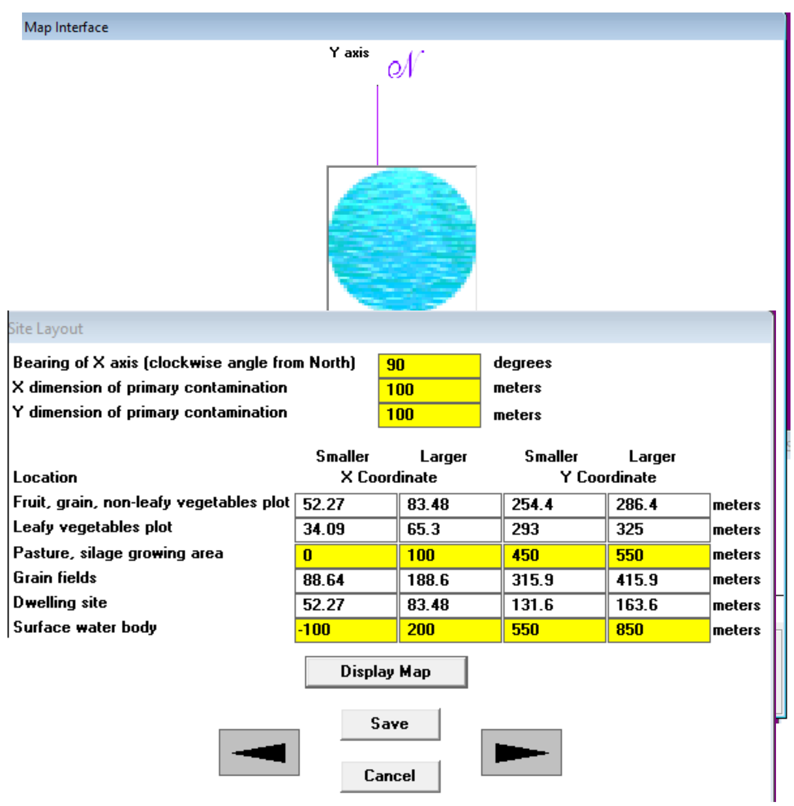


How to use the map button opens file mapGuideRO.pdf

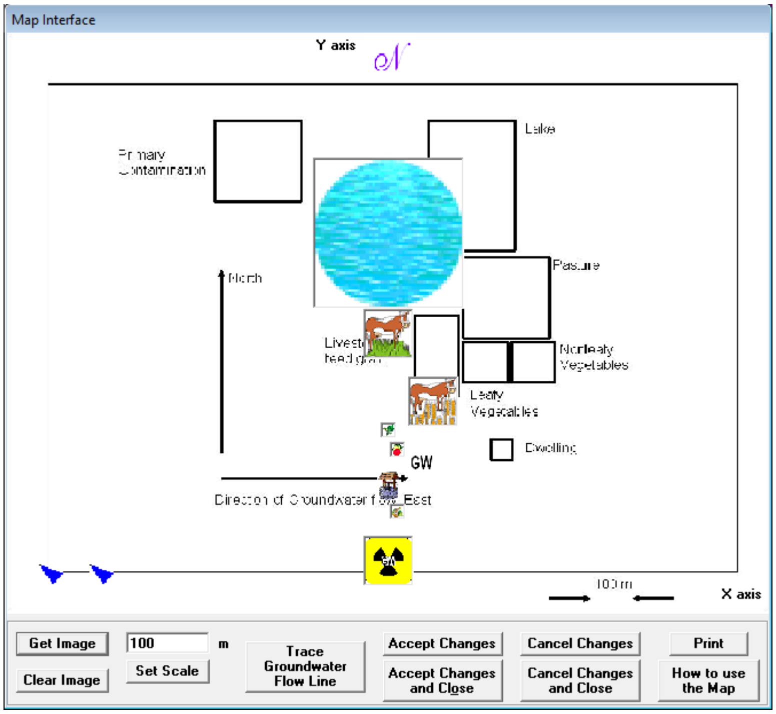
Accept changes, Cancel Changes button, Accept Changes and Close button, and Cancel Changes and Close button worked as expected.

4) Move each icon in the map a little and the purple Y-axis line, then click Accept Changes and Close. The coordinate table in the Site Layout form should update accordingly.

Worked as expected

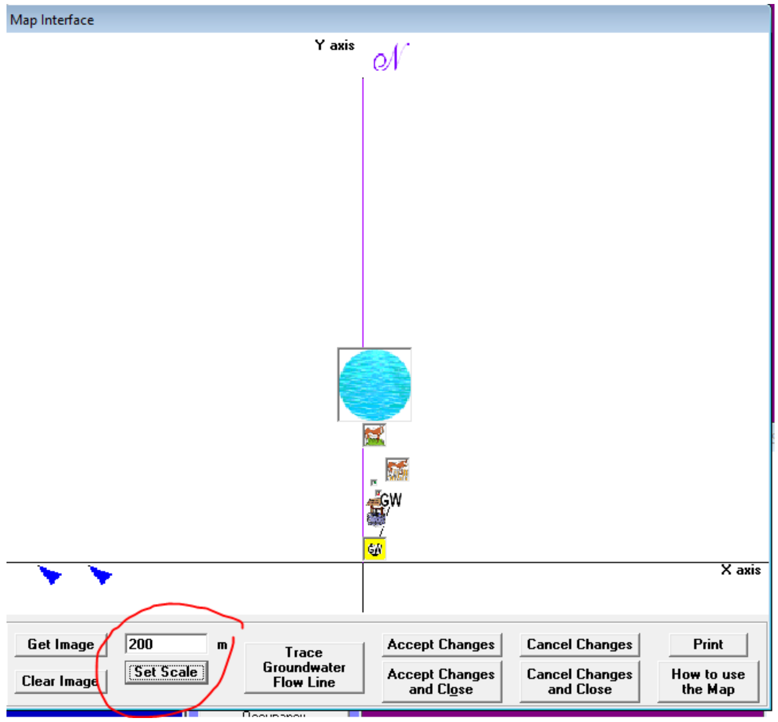


5) Click Get Image should direct to select an image file. Select the file HypotheticalSuburbanScenarioOutline.JPG under UserFiles folder. The image should load to the code. Click Clear Image should remove the file from the code.



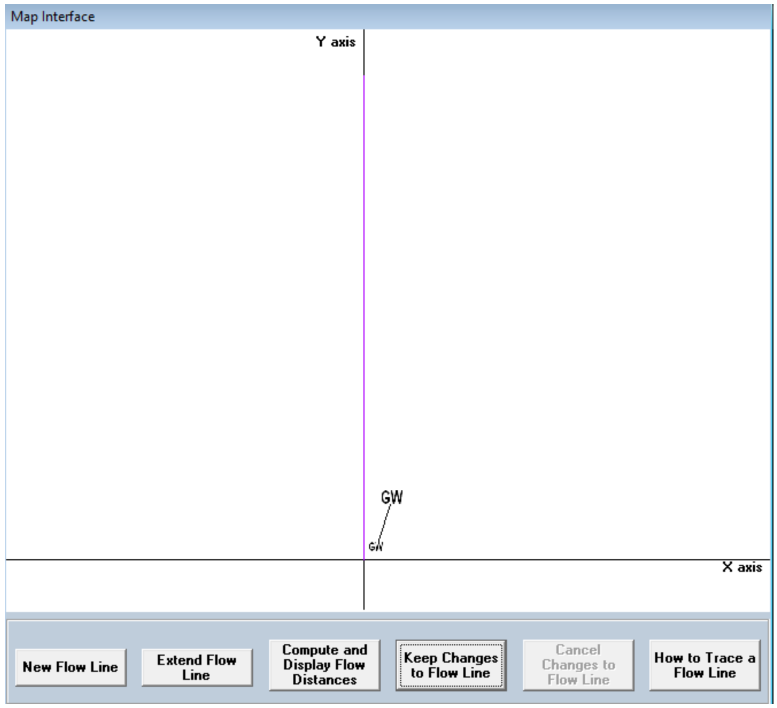
worked as expected. “Clear Image” just removed the loaded picture.

6) Change the scale value and click "Set Scale". The image should change accordingly.



Worked as expected.

7) Click Trace Groundwater Flow Line, the widow should update with GW line.



worked as expected.

8) Clicking How to Trace a Flow Line button should open a file named GwFlowLinRO.pdf. Following the procedure in the file and check each button functions as designed.

Worked as expected.

12.36 TEST CASE 034-012 TESTER'S REPORT

Documented in Test-034-12_report.docx of 2/18/2020 1:25 PM

Test Case 034-012 report

By cheng wang 2/8/2020

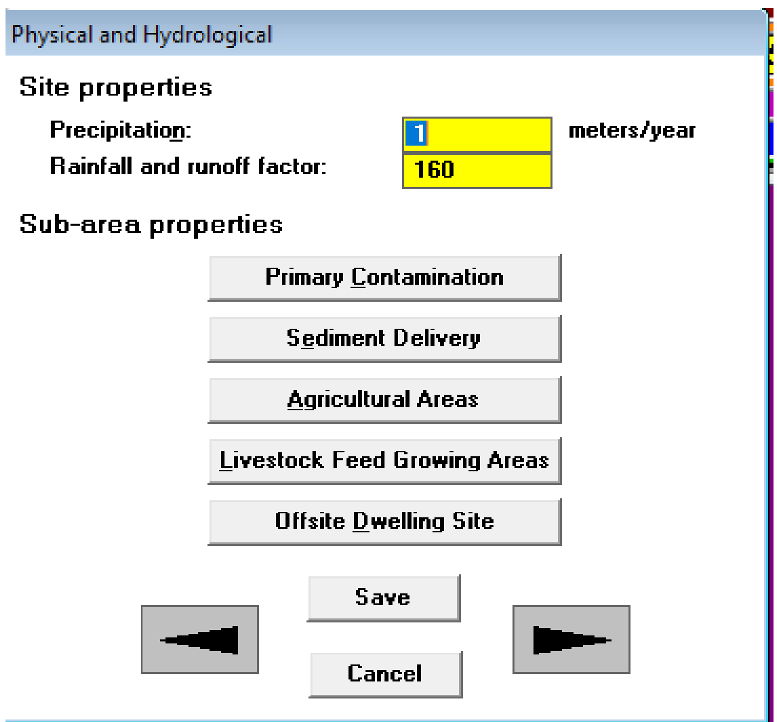
Objective: To test the functionality of Physical and Hydrological form.

Conclusion: the code worked as expected.

Procedure:

1) Open Physical and Hydrological form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.



2) It should contain Site Properties input, as shown in the figure.

Worked as expected.

3) Clicking each of the five buttons in Sub-area Properties section should bring up the corresponding forms.

Worked as expected.

4) Change the precipitation value and rainfall and runoff factor, save the form, and save the project to Test24.rof.

Changed the values to 2 and 162 respectively.

5) Check the variables PRECI and RAINEROS in the generated file. They should be identical to the input in GUI.

```
PRECIP = 2,
RAINEROS = 162,
```

Worked as expected.

12.37 TEST CASE 034-013 TESTER'S REPORT

Documented in Test-034-013_report.docx of 2/20/2020 7:27 AM

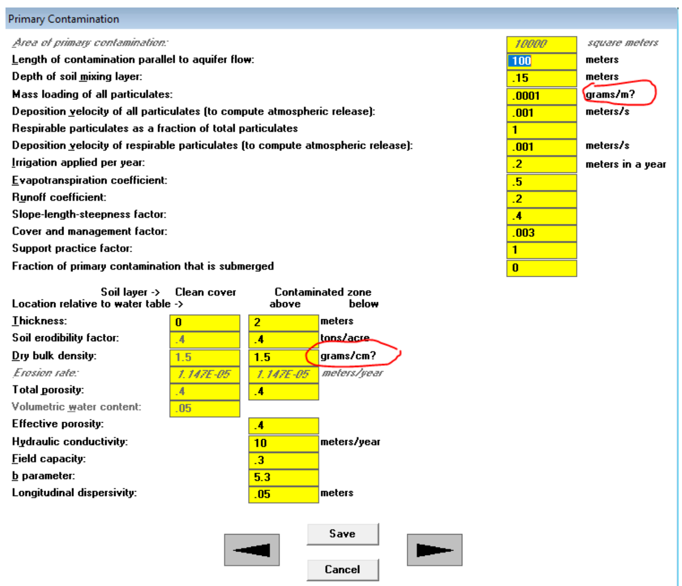
Test Case 034-013 report

By cheng wang 2/18/2020

Objective: To test the functionality of Primary Contamination form.

Conclusion: the code worked as expected.

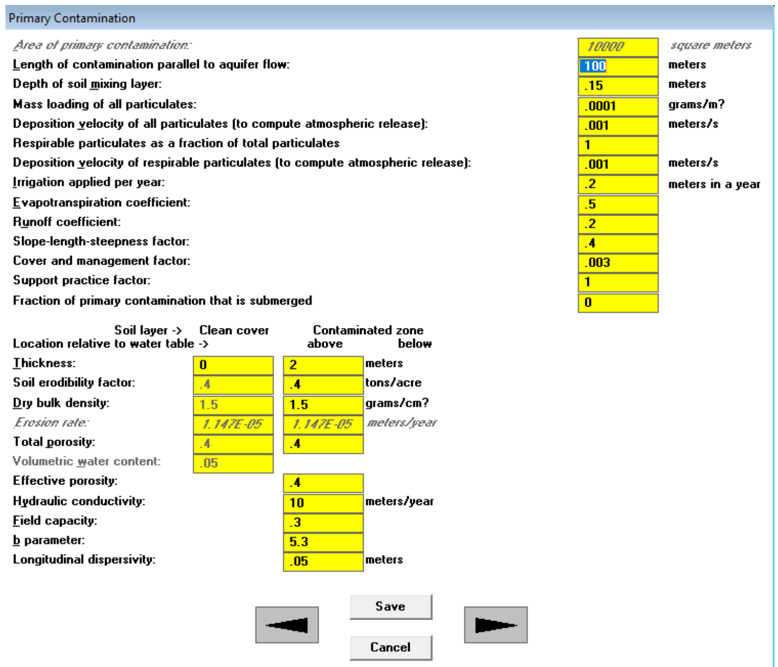
minor issue on font format when computer system locale is Chinese; no issues when English (US) is used.



Procedure:

1) Open Primary Contamination form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.



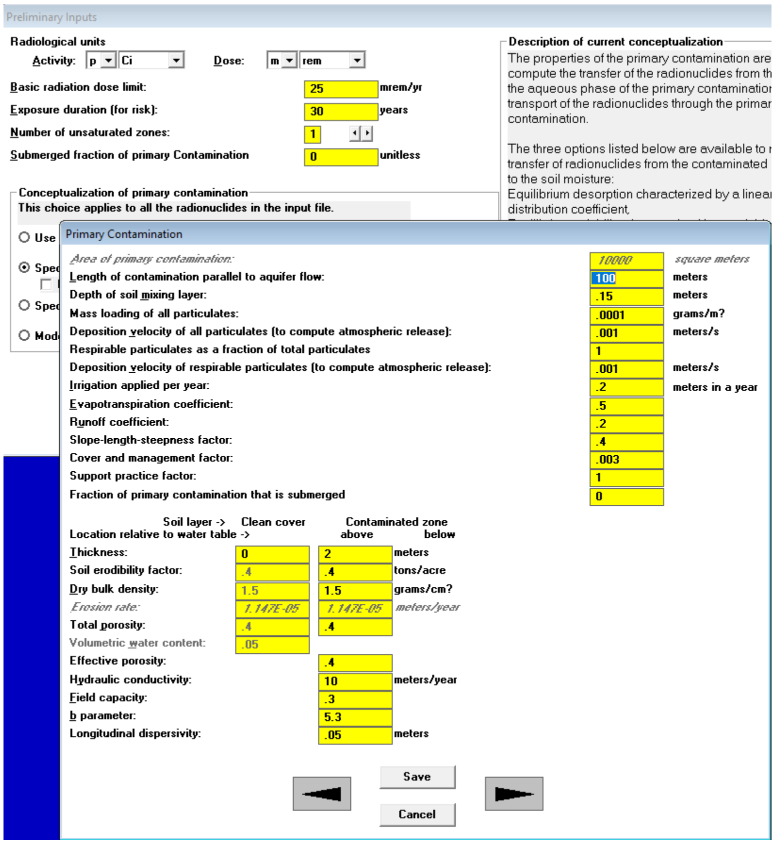
2) It should contain Site Properties input, as shown in the figure.

Worked as expected.

3) Check the consistence of Area of Primary Contamination with the X and Y dimesons in Site Layout form.

The values are consistent.

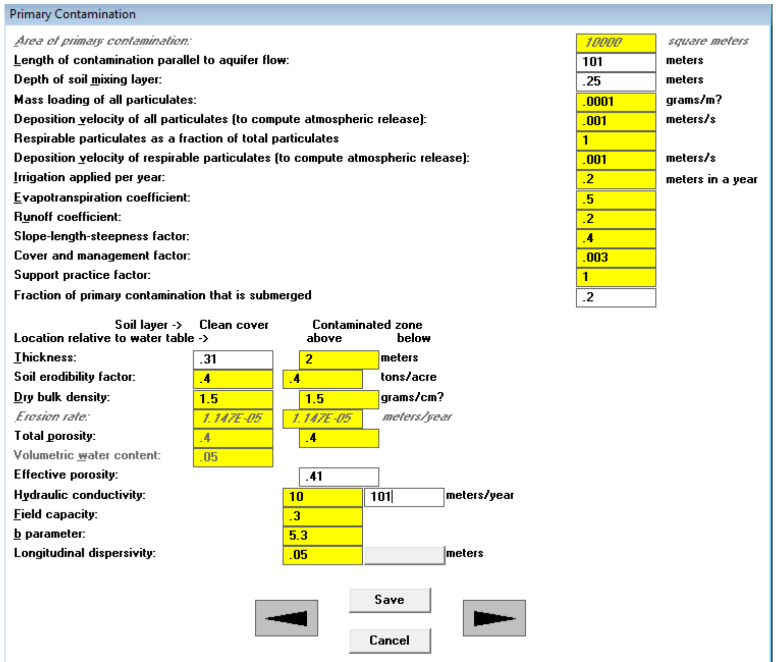
4) Check the consistence of Factor of primary contamination that is submerged with the Submerged fraction of Primary Contamination in Preliminary Input.



The values matched.

5) Modify at least two values in each column, save the form, and then save the project to Test25.rof.

Made the following changes.



6) Check the following variables in the generated input file. They should be the same as input in the GUI. AREA, LCZPAQ, DM, MLFD, DEPVEL_DUSTT, RESPFRACPC, DEPVEL_DUST, RI, EVAPTR, RUNOFF, SLPLENSTPPC, CRPMANGPC, CONVPRACPC, THICK0, TPCZ, VCZ, DENSCZ, ERODIBILITYCZ, FCCZ, BCZ, HCCZ, EPCZ, ALPHALCZ, SUBMERGEDDEPTH, COVER0, TPCV, VCV, DENSCV, ERODIBILITYCV, PH2OCV

```
AREA = 10000,
LCZPAQ = 101,
DM = .25,
MLFD = .0001,
DEPVEL_DUSTT = .001,
RESPFRACPC = 1,
DEPVEL_DUST = .001,
RI = .2,
EVAPTR = .5,
RUNOFF = .2,
SLPLENSTPPC = .4,
CRPMANGPC = .003,
CONVPRACPC = 1,
THICK0 = 2,
TPCZ = .4,
VCZ = 1.147E-05,
DENSCZ = 1.5,
ERODIBILITYCZ = .4,
FCCZ = .3,
BCZ = 5.3,
HCCZ = 10,
EPCZ = .41,
ALPHALCZ = .05,
SUBMERGEDDEPTH = 0,
COVER0 = .31,
TPCV = .4,
VCV = 1.147E-05,
DENSCV = 1.5,
ERODIBILITYCV = .4,
PH2OCV = .05,
HCSZ = 101,
```

worked as expected.

12.38 TEST CASE 034-014 TESTER'S REPORT

Documented in Test-034-014_report.docx of 2/18/2020 1:56 PM

Test Case 034-014 report

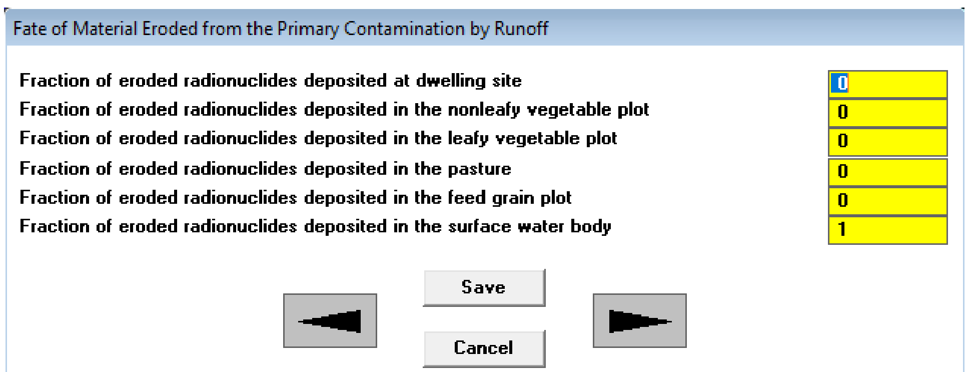
By cheng wang 2/18/2020

Objective: To test the functionality of Sediment Delivery Ratio form

Conclusion: the code worked as expected

Procedure:

1) Open Sediment Delivery Ratio form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.



Worked as expected.

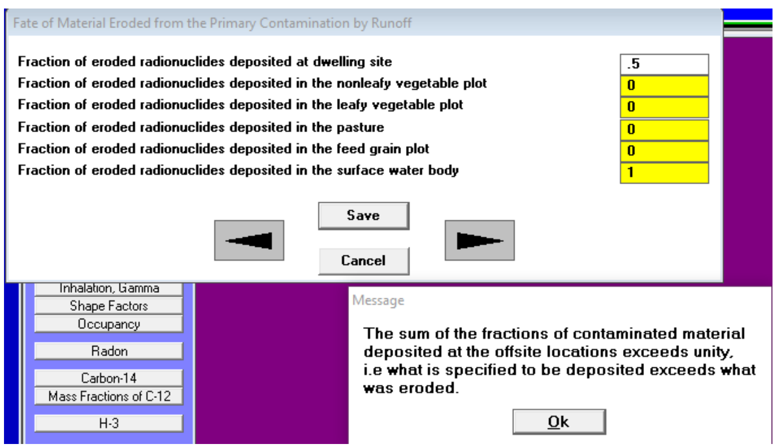
2) It should the input boxes, as shown in the figure.

Worked as expected.

3) Check the lower and upper bounds, which should be 0 and 1, respectively.

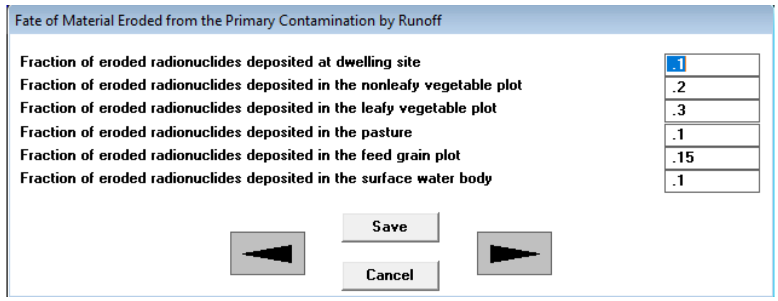
Worked as expected.

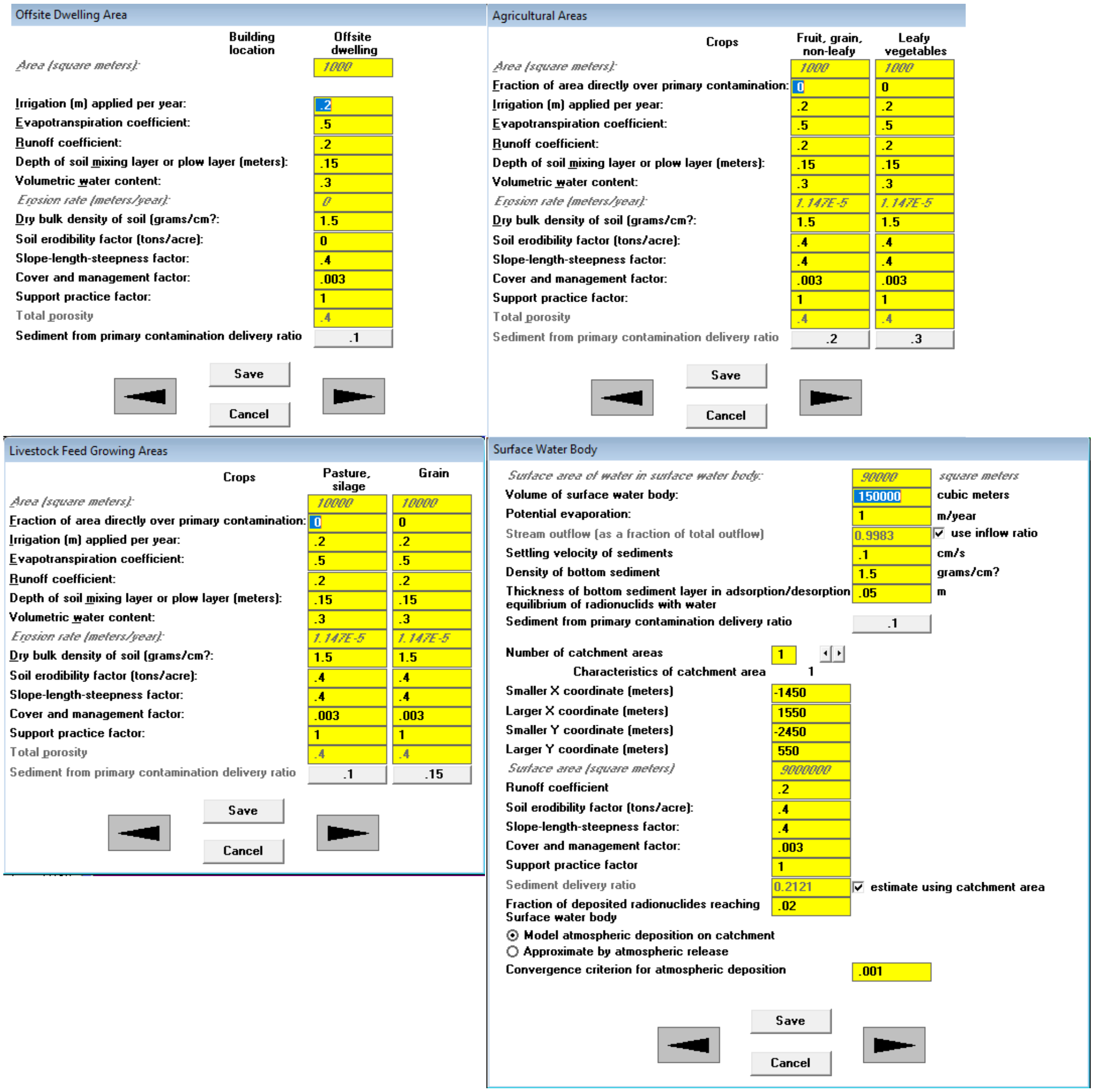
4) The summation of the values in this form should be 1. Make it more than one, and an error message should pop up.



Worked as expected.

5) Check the values input in the form are consistent with the ones in Forms Dwelling Site, Agricultural Areas, Livestock Feed Areas, and Surface Water Body.





Worked as expected.

6) Change three or more values, save the form, and then save the project to Test26.rof.

Made changes as shown in the screenshot in Step 5).

7) Check the following variables in the generated input file; they should be identical to the input from GUI. SDR, SDROF(1)-(4) and SDRDELL

```
SDR = .1,
```

worked as expected.

```
SDROF(1) = .2,
SDROF(2) = .3,
SDROF(3) = .1,
SDROF(4) = .15,
SDRDWELL = .1,
```

12.39 TEST CASE 034-015 TESTER'S REPORT

Documented in Test-034-015_report.docx of 2/20/2020 7:29 AM

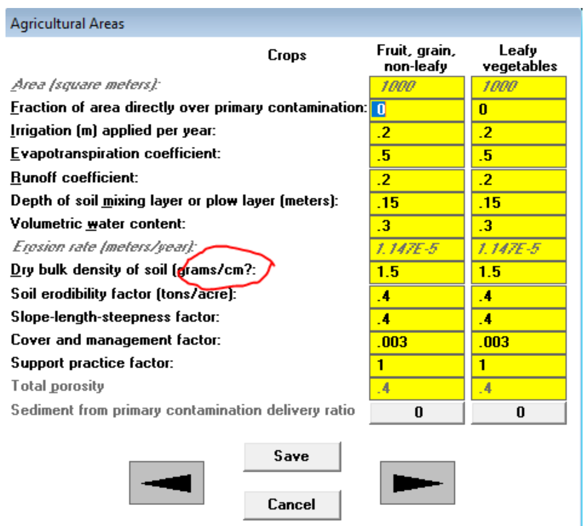
Test Case 034-015 report

By cheng wang 2/18/2020

Objective: To test the functionality of Agricultural Areas form.

Conclusion: the code worked as expected.

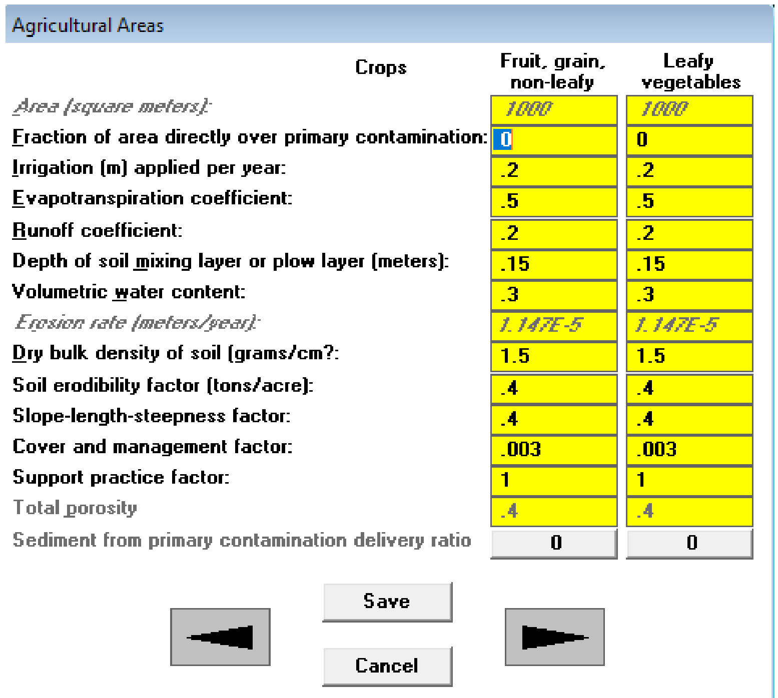
Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used..



Procedure:

1) Open Agricultural Areas form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

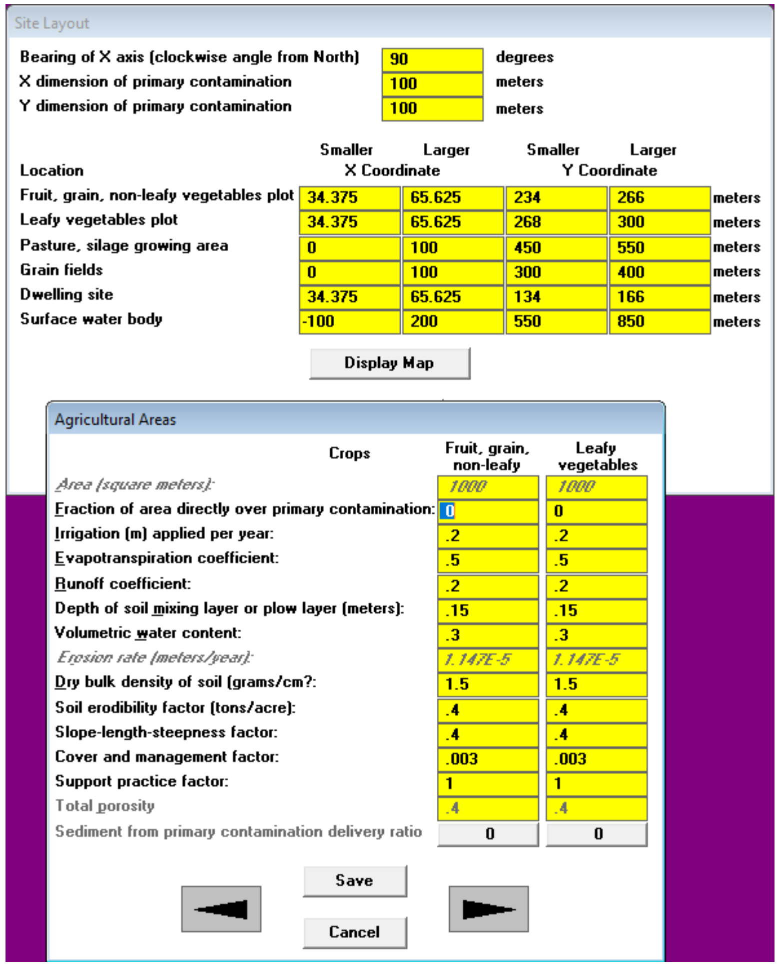
Worked as expected.



2) It should have the same input boxes as the figure has.

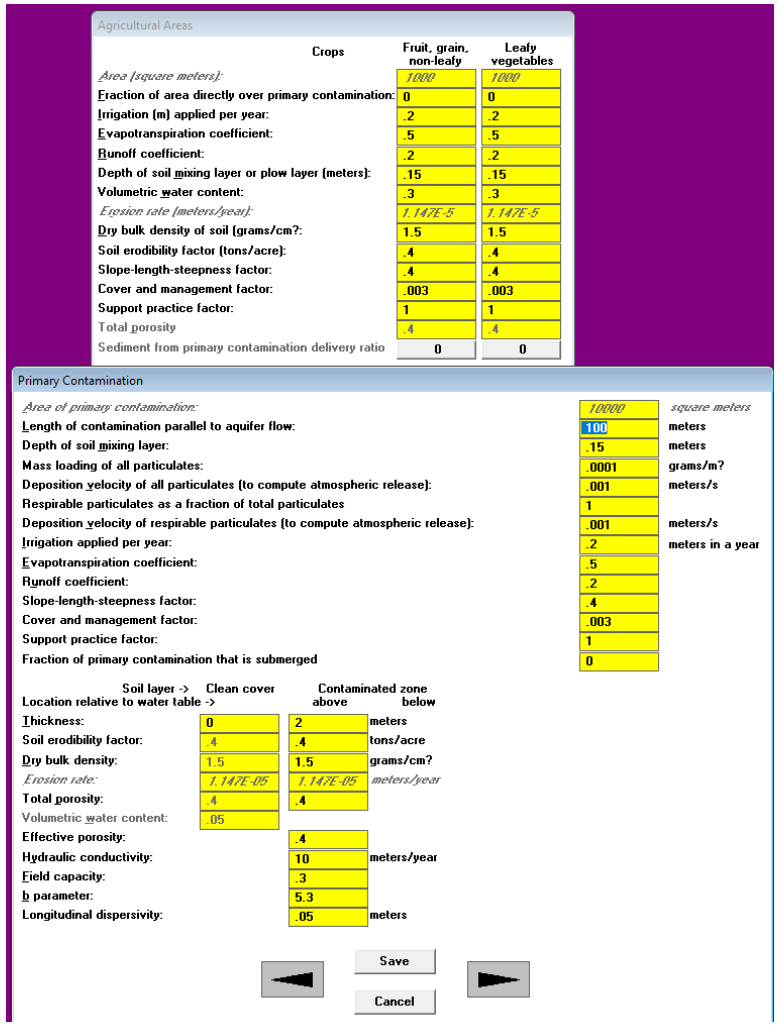
Worked as expected.

3) Check the Area values; they should be grayed out in this form but match the inputs in Site Layout form.



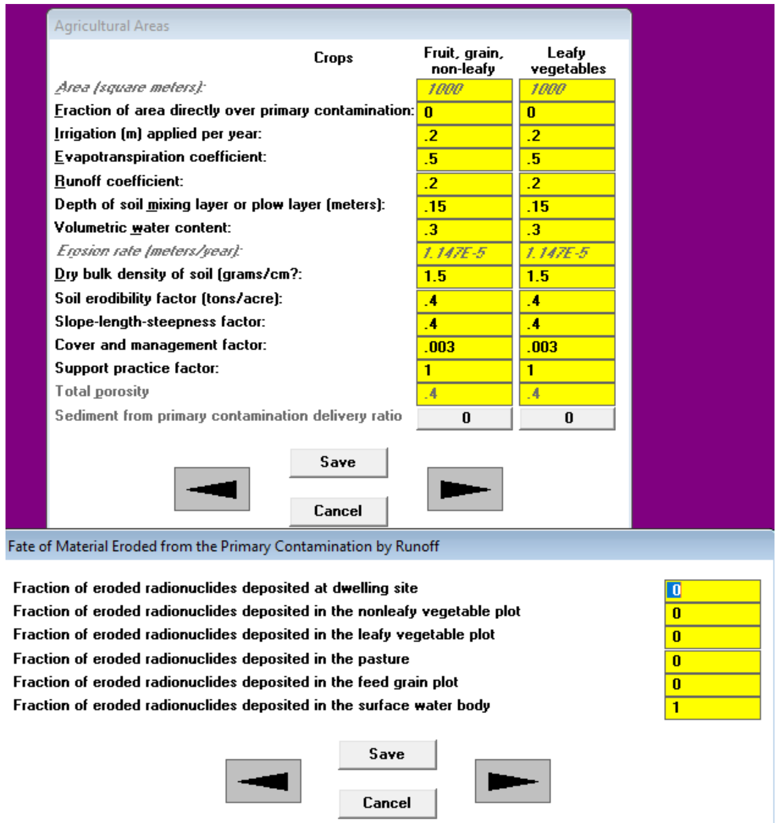
Worked as expected.

4) Check the Erosion rate and Total Porosity values; they should be grayed out in this form but match the ones in Primary Contamination form



worked as expected.

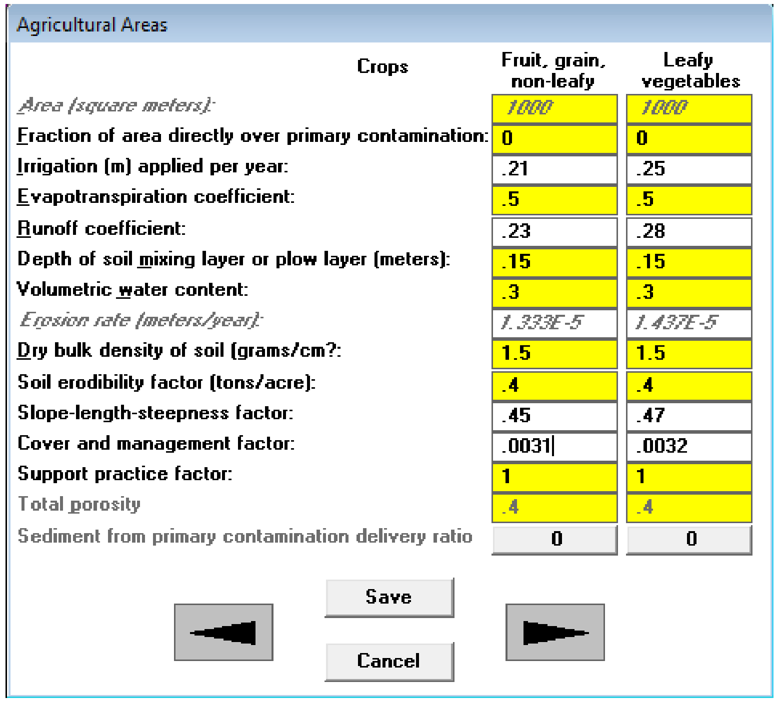
5) Check the Sediment delivery ratio values; they should be grayed out in this form but match the ones in Sediment Delivery Ratio form. Clicking the values in this form should bring up the Sediment Delivery Ratio form.



worked as expected.

6) Change at least three values in each column, save the form, and save the project to Test27.rof.

Made the following changes.



7) Check the following variables in the generated file; they should be the same as inputs in GUI. AREAO(1) and (2), FAREA_PLANT(1) and (2), RIRRIG(1) and (2), EVAPTRN(1) and (2), RUNOF(1) and (2), DPTHMIXG(1) and (2), TMOF(1) and (2), EROSN(1) and (2), RHOB(1) and (2), ERODIBILITY(1) and (2), SLPLENSTP(1) and (2), CRPMANG(1) and (2), CONVPRAC(1) and (2), TPOF(1) and (2).

```
AREAO(1) = 1000,
AREAO(2) = 1000,
AREAO(3) = 10000,
AREAO(4) = 10000,
AREAODWELL = 1000,
FAREA_PLANT(1) = 0,
FAREA_PLANT(2) = 0,
FAREA_PLANT(3) = 0,
FAREA_PLANT(4) = 0,
RIRRIG(1) = .21,
RIRRIG(2) = .25,
RIRRIG(3) = .2,
RIRRIG(4) = .2,
RIRRIGDWELL = .2,
EVAPTRN(1) = .5,
EVAPTRN(2) = .5,
EVAPTRN(3) = .5,
EVAPTRN(4) = .5,
EVAPTRNDWELL = .5,
RUNOF(1) = .23,
RUNOF(2) = .28,
RUNOF(3) = .2,
RUNOF(4) = .2,
RUNOFDWELL = .2,
```

```
DPTHMIXG(1) = .15,
DPTHMIXG(2) = .15,
DPTHMIXG(3) = .15,
DPTHMIXG(4) = .15,
DPTHMIXGDWELL = .15,
TMOF(1) = .3,
TMOF(2) = .3,
TMOF(3) = .3,
TMOF(4) = .3,
TMOFDWELL = .3,
EROSN(1) = 1.333E-05,
EROSN(2) = 1.437E-05,
EROSN(3) = 1.147E-05,
EROSN(4) = 1.147E-05,
EROSNDWELL = 0,
RHOB(1) = 1.5,
RHOB(2) = 1.5,
RHOB(3) = 1.5,
RHOB(4) = 1.5,
RHOBDWELL = 1.5,
ERODIBILITY(1) = .4,
ERODIBILITY(2) = .4,
ERODIBILITY(3) = .4,
ERODIBILITY(4) = .4,
ERODIBILITYDWELL = 0,
SLPLENSTP(1) = .45,
SLPLENSTP(2) = .47,
SLPLENSTP(3) = .4,
SLPLENSTP(4) = .4,
SLPLENSTPDWELL = .4,
```

```
CRPMANG(1) = .0031,
CRPMANG(2) = .0032,
CRPMANG(3) = .003,
CRPMANG(4) = .003,
CRPMANGDWELL = .003,
CONVPRAC(1) = 1,
CONVPRAC(2) = 1,
CONVPRAC(3) = 1,
CONVPRAC(4) = 1,
CONVPRACDWELL = 1,
TPOF(1) = .4,
TPOF(2) = .4,
TPOF(3) = .4,
TPOF(4) = .4,
TPOFDWELL = .4,
```

Worked as expected.

12.40 TEST CASE 034-016 TESTER'S REPORT

Documented in Test-034-016_report.docx of 2/20/2020 7:30 AM

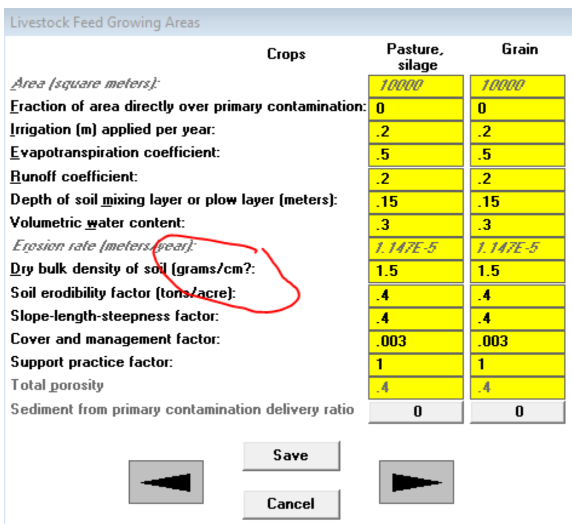
Test Case 034-016 report

By cheng wang 2/18/2020

Objective: To test the functionality of Livestock Feed Areas form.

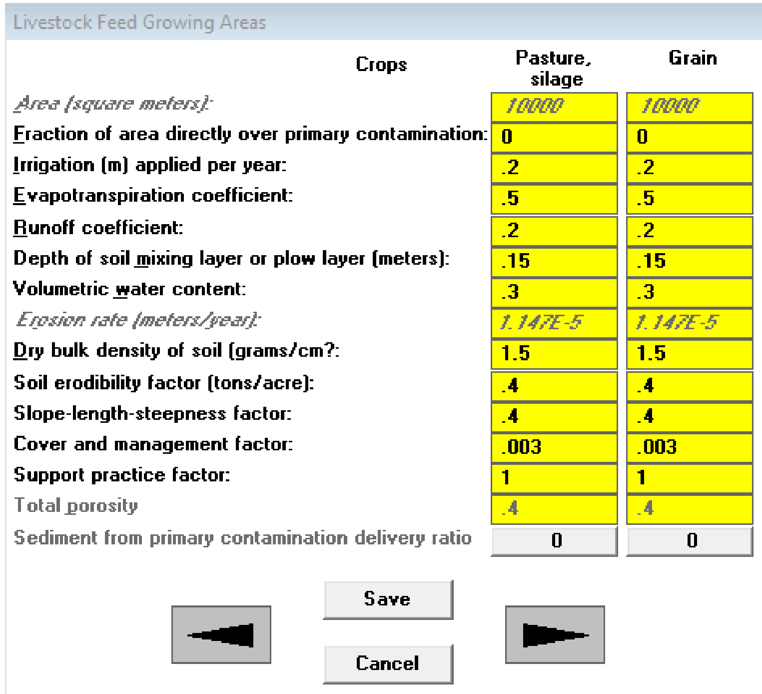
Conclusion: the code worked as expected.

Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used..



Procedure:

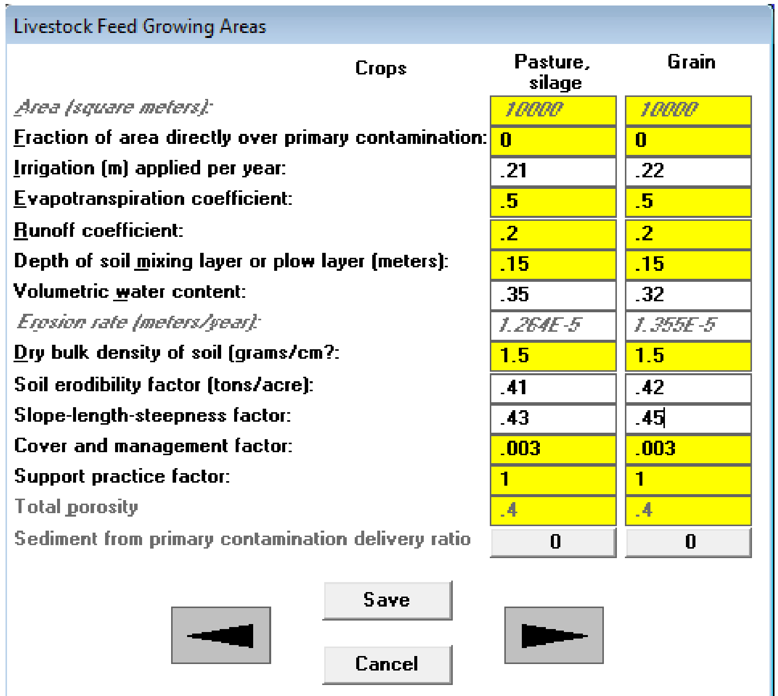
1) This form should contain the same input content as Agricultural Areas form but for Livestock Feed Area, including Pasture Silage and Grain



Worked as expected.

2) Follow the same procedure for testing Agricultural Areas form, except that the variables to be checked in the generated input file should be AREAO(3) and (4), FAREA_PLANT(3) and (4), RIRRIG(3) and (4), EVAPTRN(3) and (4), RUNOF(3) and (4), DPTHMIXG(3) and (4), TMOF(3) and (4), EROSN(3) and (4), RHOB(3) and (4), ERODIBILITY(3) and (4), SLPLENSTP(3) and (4), CRPMANG(3) and (4), CONVPRAC(3) and (4), TPOF(3) and (4).

Made the following changes to the file for Test Case 034-015 (test27.rof) and saved the input file as Test28.rof.


Livestock Feed Growing Areas
Crops
Pasture, silage
Grain
Area (square meters):
10000
10000
Fraction of area directly over primary contamination:
0
0
Irrigation (m) applied per year:
.21
.22
Evapotranspiration coefficient:
.5
.5
Runoff coefficient:
.2
.2
Depth of soil mixing layer or plow layer (meters):
.15
.15
Volumetric water content:
.35
.32
Erosion rate (meters/year):
1.264E-5
1.355E-5
Dry bulk density of soil (grams/cm?:
1.5
1.5
Soil erodibility factor (tons/acre):
.41
.42
Slope-length-steepness factor:
.43
.45
Cover and management factor:
.003
.003
Support practice factor:
1
1
Total porosity
.4
.4
Sediment from primary contamination delivery ratio
0
0
Save
Cancel

```
AREAO(1) = 1000,
AREAO(2) = 1000,
AREAO(3) = 10000,
AREAO(4) = 10000,
AREAODWELL = 1000,
FAREA_PLANT(1) = 0,
FAREA_PLANT(2) = 0,
FAREA_PLANT(3) = 0,
FAREA_PLANT(4) = 0,
RIRRIG(1) = .21,
RIRRIG(2) = .25,
RIRRIG(3) = .21,
RIRRIG(4) = .22,
RIRRIGDWELL = .2,
EVAPTRN(1) = .5,
EVAPTRN(2) = .5,
EVAPTRN(3) = .5,
EVAPTRN(4) = .5,
EVAPTRNDWELL = .5,
RUNOF(1) = .23,
RUNOF(2) = .28,
RUNOF(3) = .2,
RUNOF(4) = .2,
RUNOFDWELL = .2,
DPTHMIXG(1) = .15,
DPTHMIXG(2) = .15,
DPTHMIXG(3) = .15,
DPTHMIXG(4) = .15,
DPTHMIXGDWELL = .15,

TMOF(1) = .3,
TMOF(2) = .3,
TMOF(3) = .35,
TMOF(4) = .32,
TMOFDWELL = .3,
EROSN(1) = 1.333E-05,
EROSN(2) = 1.437E-05,
EROSN(3) = 1.264E-05,
EROSN(4) = 1.355E-05,
EROSNDWELL = 0,
RHOB(1) = 1.5,
RHOB(2) = 1.5,
RHOB(3) = 1.5,
RHOB(4) = 1.5,
RHOBDWELL = 1.5,
ERODIBILITY(1) = .4,
ERODIBILITY(2) = .4,
ERODIBILITY(3) = .41,
ERODIBILITY(4) = .42,
ERODIBILITYDWELL = 0,
SLPLENSTP(1) = .45,
SLPLENSTP(2) = .47,
SLPLENSTP(3) = .43,
SLPLENSTP(4) = .45,
SLPLENSTPDWELL = .4,

CRPMANG(1) = .0031,
CRPMANG(2) = .0032,
CRPMANG(3) = .003,
CRPMANG(4) = .003,
CRPMANGDWELL = .003,
CONVPRAC(1) = 1,
CONVPRAC(2) = 1,
CONVPRAC(3) = 1,
CONVPRAC(4) = 1,
CONVPRACDWELL = 1,
TPOF(1) = .4,
TPOF(2) = .4,
TPOF(3) = .4,
TPOF(4) = .4,
TPOFDWELL = .4,
```

Worked as expected.

12.41 TEST CASE 034-017 TESTER'S REPORT

Documented in Test-034-017_report.docx of 2/20/2020 7:31 AM

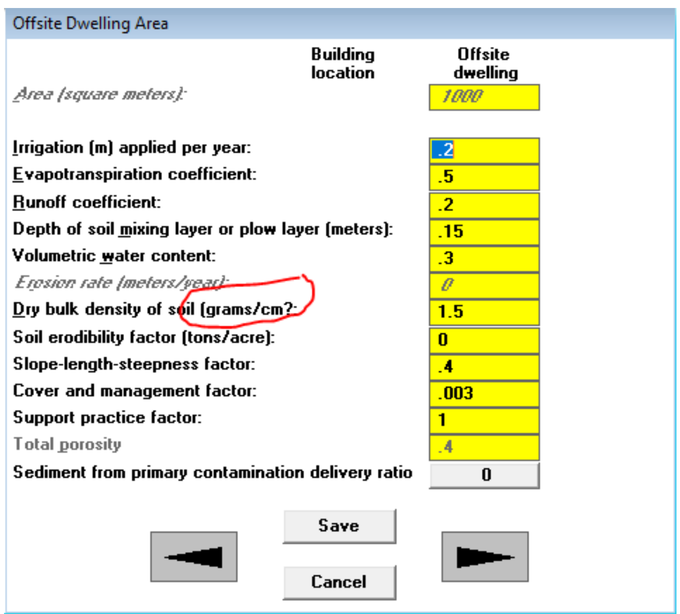
Test Case 034-017 report

By cheng wang 2/18/2020

Objective: To test the functionality of Dwelling Site form.

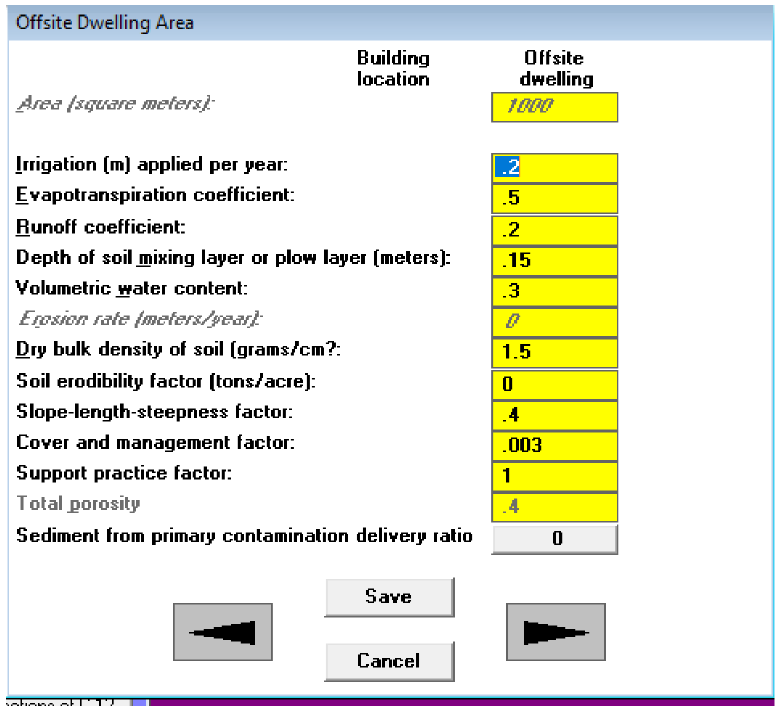
Conclusion: the code worked as expected

Minor issue on the font format when computer system locale is Chinese; no issues when English (US) is used..



Procedure:

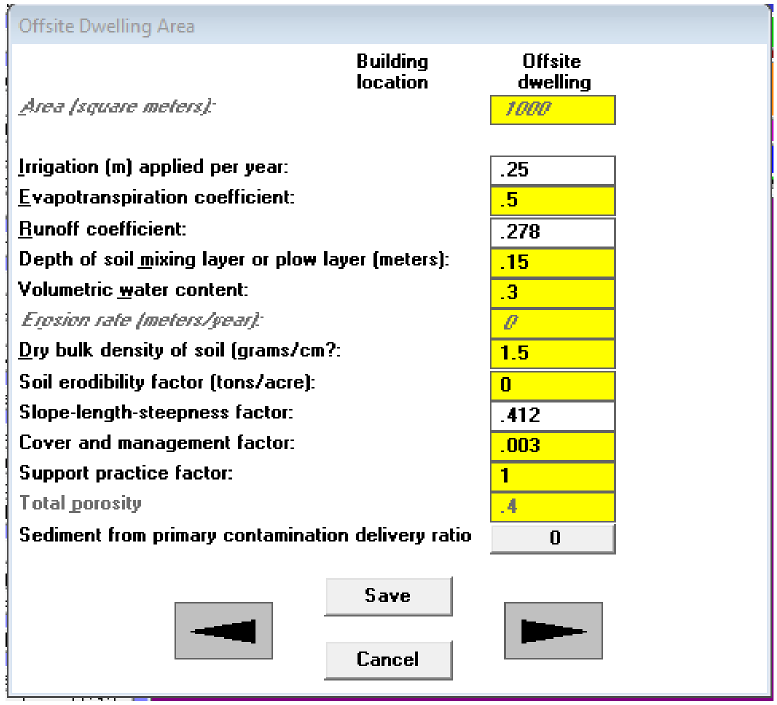
1) This form should contain the same input content as Agricultural Areas form but for Offsite Dwelling Area



Worked as expected.

2) Follow the same procedure for testing Agricultural Areas form, except that the variables to be checked in the generated input file should be AREAODWELL, FAREA_PLANTDWELL, RIRRIGDWELL, EVAPTRNDWELL, RUNOFDWELL, DPTHMIXGDWELL, TMOFDWELL, EROSNDWELL, RHOBDWELL, ERODIBILITYDWELL, SLPLENSTPDWELL, CRPMANGDWELL, CONVPRACDWELL, TPOFDWELL.

Made the following changes based on the file for Test Case 034-016 (test28.rof).




```
AREAO(1) = 1000,
AREAO(2) = 1000,
AREAO(3) = 10000,
AREAO(4) = 10000,
AREAODWELL = 1000,
FAREA_PLANT(1) = 0,
FAREA_PLANT(2) = 0,
FAREA_PLANT(3) = 0,
FAREA_PLANT(4) = 0,
RIRRIG(1) = .21,
RIRRIG(2) = .25,
RIRRIG(3) = .21,
RIRRIG(4) = .22,
RIRRIGDWELL = .25,
EVAPTRN(1) = .5,
EVAPTRN(2) = .5,
EVAPTRN(3) = .5,
EVAPTRN(4) = .5,
EVAPTRNDWELL = .5,
RUNOF(1) = .23,
RUNOF(2) = .28,
RUNOF(3) = .2,
RUNOF(4) = .2,
RUNOFDWELL = .278,
DPTHMIXG(1) = .15,
DPTHMIXG(2) = .15,
DPTHMIXG(3) = .15,
DPTHMIXG(4) = .15,
DPTHMIXGDWELL = .15,
TMOF(1) = .3,
TMOF(2) = .3,
TMOF(3) = .35,
TMOF(4) = .32,
TMOFDWELL = .3,
EROSN(1) = 1.333E-05,
EROSN(2) = 1.437E-05,
EROSN(3) = 1.264E-05,
EROSN(4) = 1.355E-05,
EROSNDWELL = 0,
RHOB(1) = 1.5,
RHOB(2) = 1.5,
RHOB(3) = 1.5,
RHOB(4) = 1.5,
RHOBDWELL = 1.5,
ERODIBILITY(1) = .4,
ERODIBILITY(2) = .4,
ERODIBILITY(3) = .41,
ERODIBILITY(4) = .42,
ERODIBILITYDWELL = 0,
SLPLENSTP(1) = .45,
SLPLENSTP(2) = .47,
SLPLENSTP(3) = .43,
SLPLENSTP(4) = .45,
SLPLENSTPDWELL = .412,
CRPMANG(1) = .0031,
CRPMANG(2) = .0032,
CRPMANG(3) = .003,
CRPMANG(4) = .003,
CRPMANGDWELL = .003,
CONVPRAC(1) = 1,
CONVPRAC(2) = 1,
CONVPRAC(3) = 1,
CONVPRAC(4) = 1,
CONVPRACDWELL = 1,
TPOF(1) = .4,
TPOF(2) = .4,
TPOF(3) = .4,
TPOF(4) = .4,
TPOFDWELL = .4,
```

worked as expected.

12.42 TEST CASE 034-018 TESTER'S REPORT

Documented in Test-034-018_report.docx of 2/18/2020 2:52 PM

Test Case 034-018 report

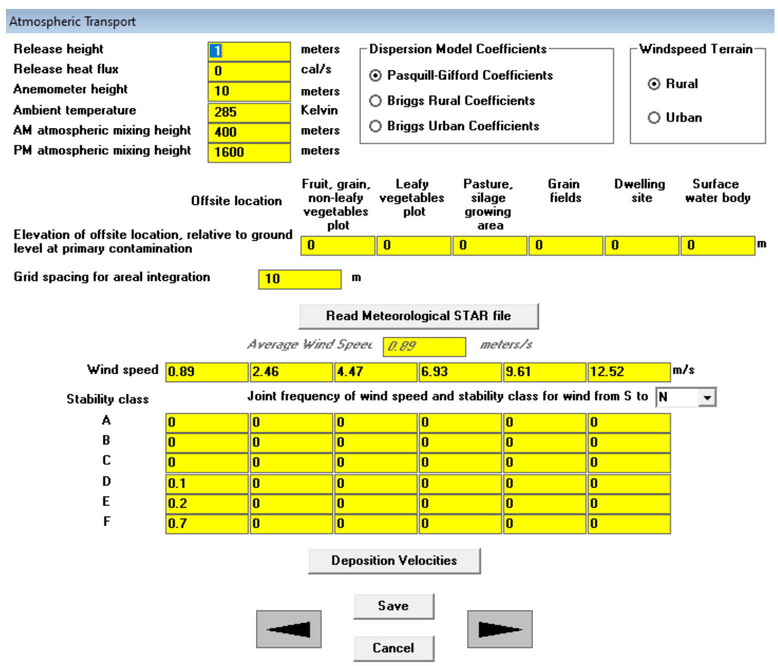
By Cheng Wang

Objective: To test the functionality of Atmospheric Transport form.

Conclusion: the code worked as expected.

Procedure

1) Open Atmospheric Transport form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.



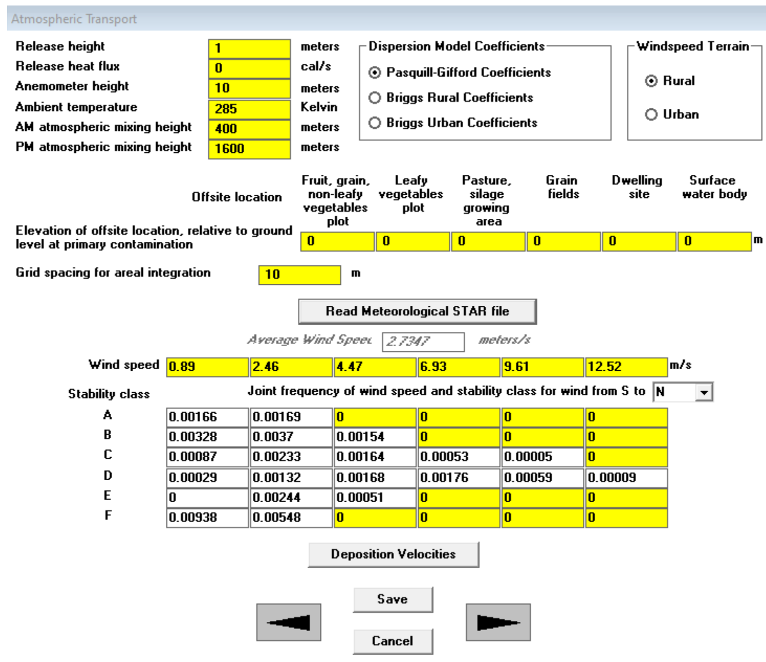
Worked as expected.

2) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

3) Clicking Read Meteorological STAR file should allow to select a STAR file from the available list installed in Application folder\Metfiles. Loading of a selected STAR file should update the table.

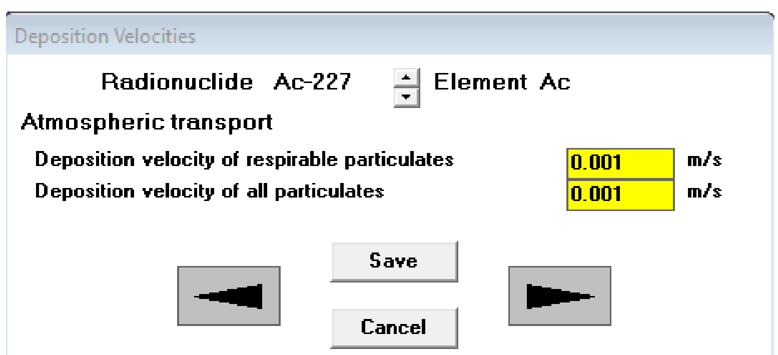
Read in AZ_PHOENIX.str.



worked as expected.

4) Clicking Deposition Velocities should bring up the Deposition Velocities form.

Added Ac-227 to initial contractions, and then click the mentioned button.

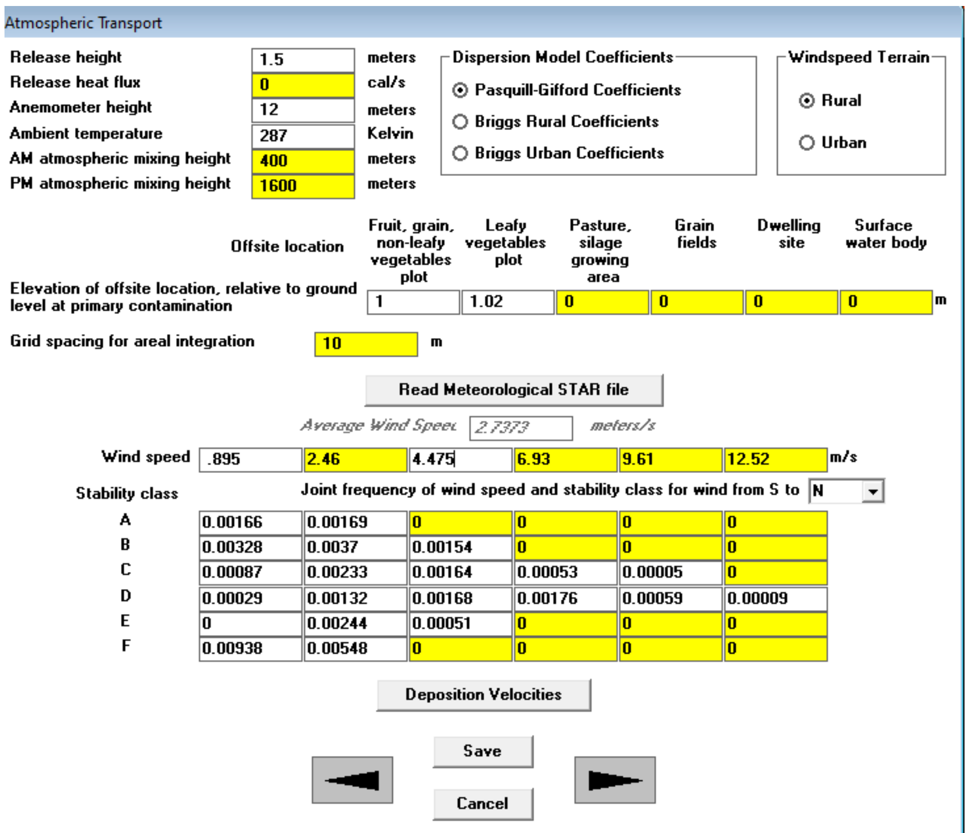


Worked as expcted.

5) Change at least one value in each input area, save the form, and save the project to Test30.rof.

6) Check the following variables in the generated input file; they should be the same as the inputs from GUI. AIRRELHT, HEATFLX, ANH, TABK, AMIX, PMIX, AGRIELEV, DWELLELEV, SWELEV, WIND, WINDSPEED, DFREQ, ATGRID

Made the following changes.



```
AIRRELHT = 1.5,
HEATFLX = 0,
ANH = 12,
TABK = 287,
AMIX = 400,
PMIX = 1600,
AGRIELEV(1) = 1,
AGRIELEV(2) = 1.02,
AGRIELEV(3) = 0,
AGRIELEV(4) = 0,
DWELLELEV = 0,
SWELEV = 0,
WIND = 2.7373,
WINDSPEED(1) = .895,
WINDSPEED(2) = 2.46,
WINDSPEED(3) = 4.475,
WINDSPEED(4) = 6.93,
WINDSPEED(5) = 9.61,
WINDSPEED(6) = 12.52,
ATGRID = 10,
```

```
DFREQ(1,1,1) = .00166,
DFREQ(2,1,1) = .00169,
DFREQ(3,1,1) = 0,
DFREQ(4,1,1) = 0,
DFREQ(5,1,1) = 0,
DFREQ(6,1,1) = 0,
DFREQ(1,2,1) = .00328,
DFREQ(2,2,1) = .0037,
DFREQ(3,2,1) = .00154,
DFREQ(4,2,1) = 0,
DFREQ(5,2,1) = 0,
DFREQ(6,2,1) = 0,
DFREQ(1,3,1) = .00087,
DFREQ(2,3,1) = .00233,
DFREQ(3,3,1) = .00164,
DFREQ(4,3,1) = .00053,
DFREQ(5,3,1) = .00005,
DFREQ(6,3,1) = 0,
DFREQ(1,4,1) = .00029,
DFREQ(2,4,1) = .00132,
DFREQ(3,4,1) = .00168,
DFREQ(4,4,1) = .00176,
DFREQ(5,4,1) = .00059,
DFREQ(6,4,1) = .00009,
DFREQ(1,5,1) = 0,
DFREQ(2,5,1) = .00244,
DFREQ(3,5,1) = .00051,
DFREQ(4,5,1) = 0,
DFREQ(5,5,1) = 0,
DFREQ(6,5,1) = 0,
DFREQ(1,6,1) = .00938,
DFREQ(2,6,1) = .00548,
DFREQ(3,6,1) = 0,
DFREQ(4,6,1) = 0,
DFREQ(5,6,1) = 0,
DFREQ(6,6,1) = 0,
```

Worked as expected.

12.43 TEST CASE 034-019 TESTER'S REPORT

Documented in Test-034-019_report.docx of 2/20/2020 7:33 PM

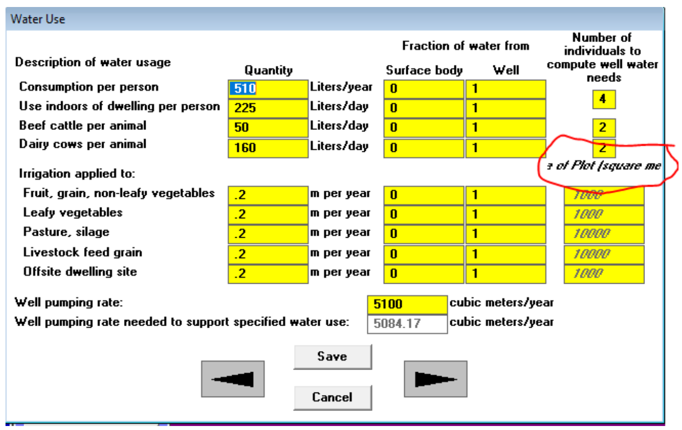
Test Case 034-019 report

By cheng wang 2/18/2020

Objective: To test the functionality of Water Use form.

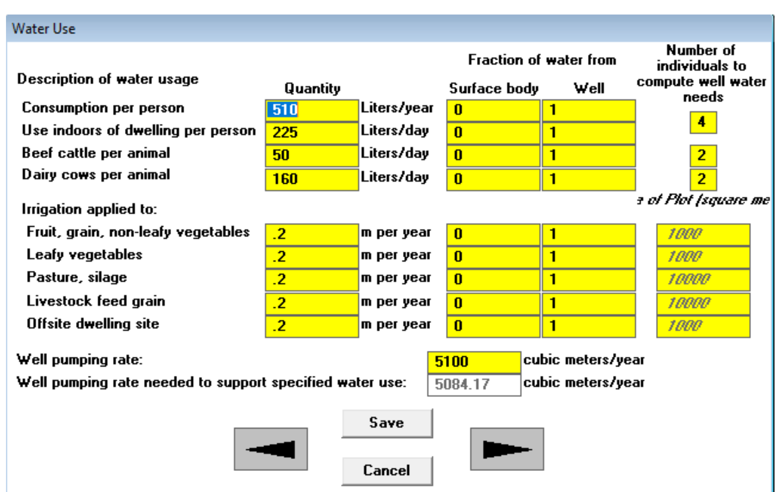
Conclusion: the code worked as expected.

Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used.



Procedure:

1) Open Water Use form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.



Worked as expected.

2) It should have the same input boxes as the figure has.

Worked as expected.

3) Check the Area of Plot; which should be grayed out and consistent with the inputs in Site Layout form.

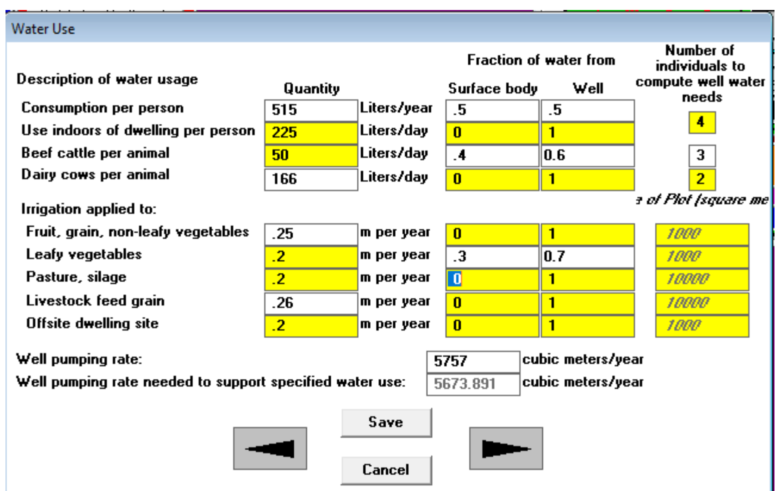
Worked as expected, as shown in the screenshot of Step 1).

4) Check the Fraction of water values. The summation of two columns should be 1.

Worked as expected, as shown in the screenshot of Step 1).

5) Changes at least two values in each column, save the form, and save the project to Test31.rof.

Made the following changes.



6) Check the following variables in the generated file; they should be the same as inputs in the GUI. DWI, FDWI, FSWD, FWWD, HHW, FSWHH, FWWHH, LWI, FSWLV, FWWLV, FSWIR, FWWIR, FSWIRDWELL, FWWIRDWELL, NDWI, NLWI, UW

```
DWI = 515,
FDWI = 1,
FSWD = .5,
FWWD = .5,
HHW = 225,
FSWHH = 0,
FWWHH = 1,
LWI(1) = 50,
LWI(2) = 166,
FSWLV(1) = .4,
FWWLV(1) = .6,
FSWLV(2) = 0,
FWWLV(2) = 1,
FSWIR(1) = 0,
FWWIR(1) = 1,
FSWIR(2) = .3,
FWWIR(2) = .7,
FSWIR(3) = 0,
FWWIR(3) = 1,
FSWIR(4) = 0,
FWWIR(4) = 1,
FSWIRDWELL = 0,
FWWIRDWELL = 1,
NDWI = 4,
NLWI(1) = 3,
NLWI(2) = 2,
UW = 5757,
```

Worked as expected.

12.44 TEST CASE 034-020 TESTER'S REPORT

Documented in Test-034-020_report.docx of 2/20/2020 7:34 PM

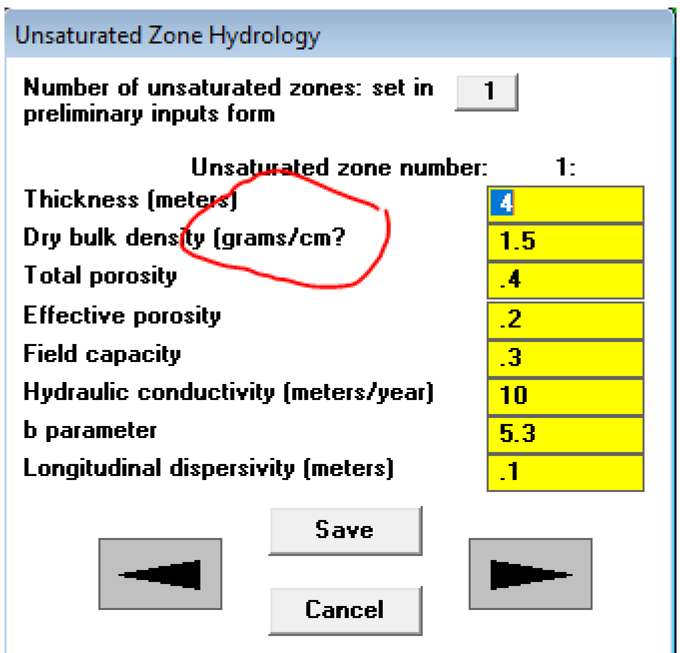
Test Case 034-020 report

By cheng wang 2/18/2020

Objective: To test the functionality of Unsaturated Zones form.

Conclusion: the code worked as expected.

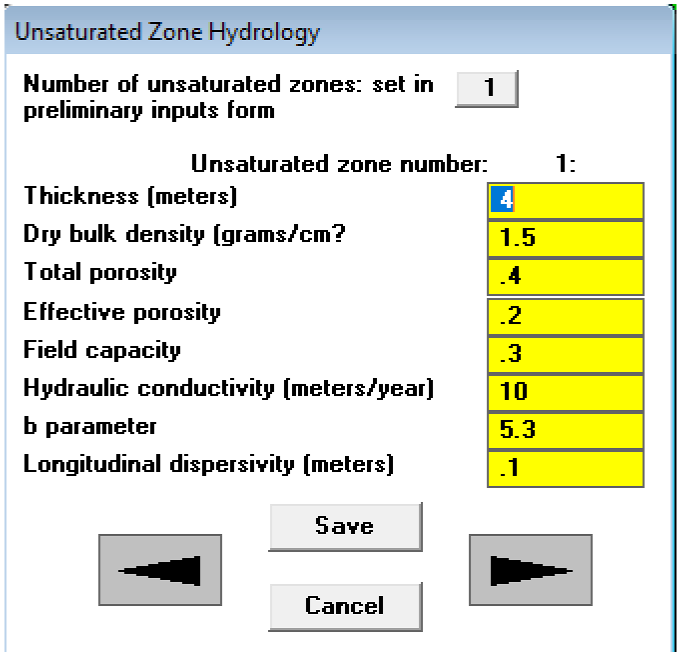
Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used.



Procedure:

1) Open Unsaturated Zones form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.

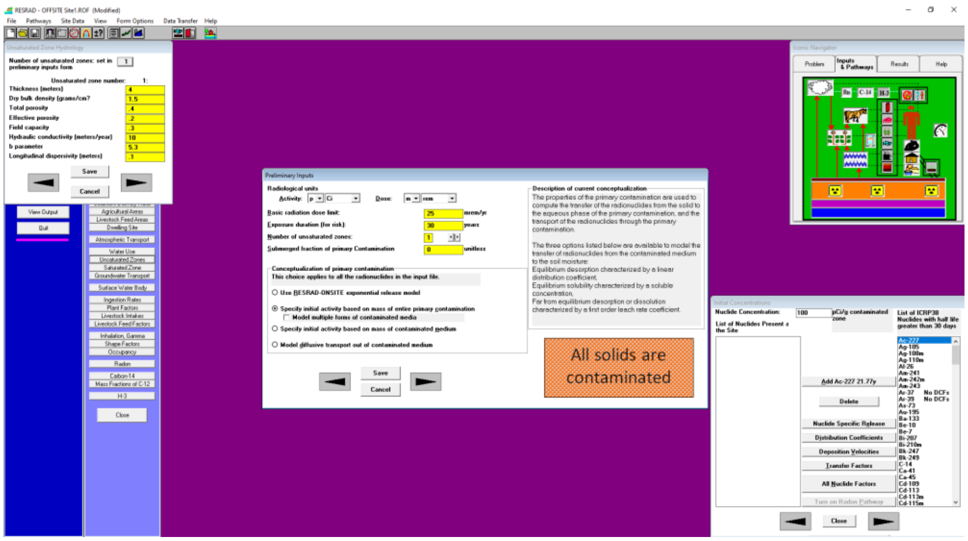


2) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

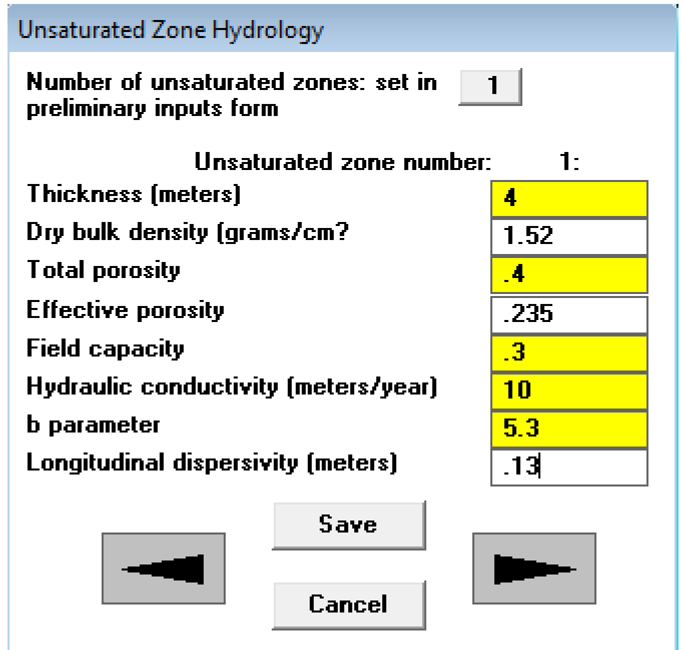
3) Clicking the Number of Unsaturated Zones should bring up the Preliminary Inputs form

Worked as expected.



4) Modify at least two values for each unsaturated zone, save the form, and the save the project to Test32.rof.

Made the following changes.



5) Check the following variables in the generated file; they should be the same as inputs in GUI. H, DENSUZ, TPUZ, EPUZ, FCUZ, HCUZ, BUZ, ALPHALU

```
H(1)  = 4,              FCUZ(1)  = .3,
H(2)  = 4,              FCUZ(2)  = .3,
H(3)  = 4,              FCUZ(3)  = .3,
H(4)  = 4,              FCUZ(4)  = .3,
H(5)  = 4,              FCUZ(5)  = .3,
DENSUZ(1)  = 1.52,      HCUZ(1)  = 10,
DENSUZ(2)  = 1.5,       HCUZ(2)  = 10,
DENSUZ(3)  = 1.5,       HCUZ(3)  = 10,
DENSUZ(4)  = 1.5,       HCUZ(4)  = 10,
DENSUZ(5)  = 1.5,       HCUZ(5)  = 10,
TPUZ(1)  = .4,          BUZ(1)  = 5.3,
TPUZ(2)  = .4,          BUZ(2)  = 5.3,
TPUZ(3)  = .4,          BUZ(3)  = 5.3,
TPUZ(4)  = .4,          BUZ(4)  = 5.3,
TPUZ(5)  = .4,          BUZ(5)  = 5.3,
EPUZ(1)  = .235,        ALPHALU(1)  = .13,
EPUZ(2)  = .2,          ALPHALU(2)  = .1,
EPUZ(3)  = .2,          ALPHALU(3)  = .1,
EPUZ(4)  = .2,          ALPHALU(4)  = .1,
EPUZ(5)  = .2,          ALPHALU(5)  = .1,
```

Worked as expected.

12.45 TEST CASE 034-021 TESTER'S REPORT

Documented in Test-034-021_report.docx of 2/20/2020 7:35 PM

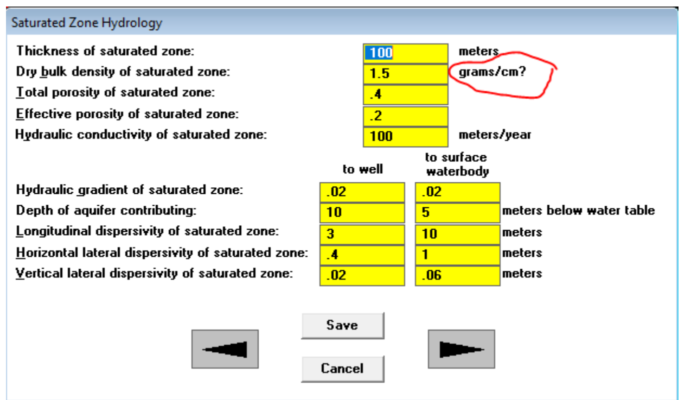
Test Case 034-021 report

By Cheng Wang 2/18/2020

Objective: Test the functionality of Saturated Zone form

Conclusion: the code worked as expected

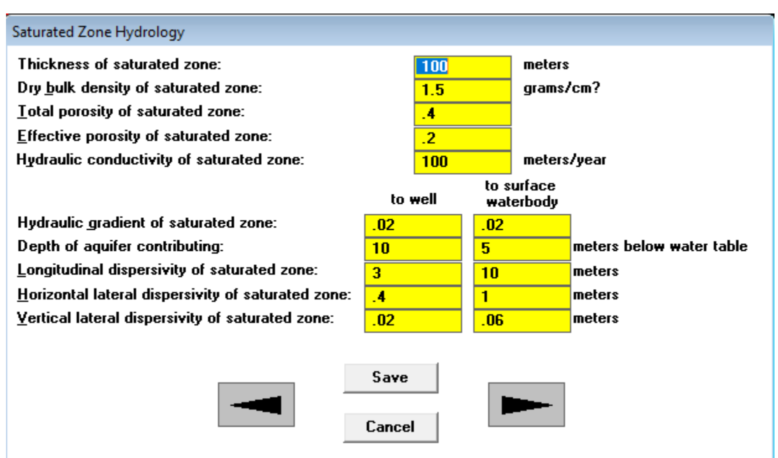
Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used.



Procedure:

1) Open Saturated Zone form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.

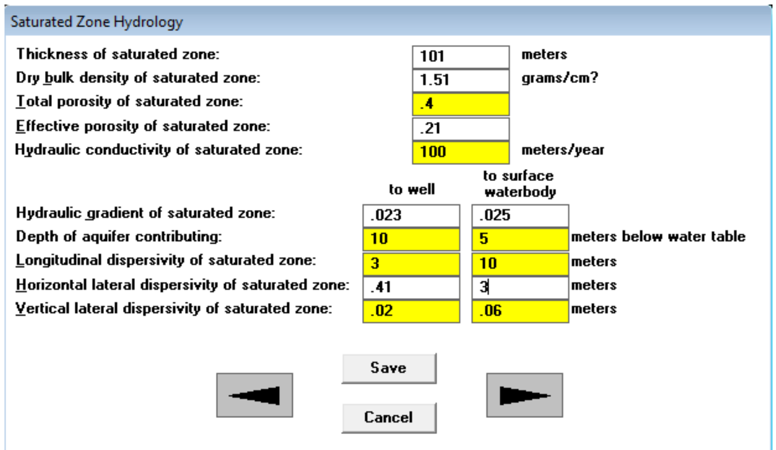


2) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

3) Modify at least two values for each unsaturated zone, save the form, and the save the project to Test33.rof.

Made the following changes.



4) Check the following variables in the generated file; they should be the same as inputs in GUI. DPTHAQ, DENSAQ, TPSZ, EPSZ, HCSZ, HGW, DWIBWT, ALPHALOW, ALPHATW, ALPHAVW, HGSW, DPTHAQSW, ALPHALOSW, ALPHATSW, ALPHAVSW

```
DPTHAQ = 101,
DENSAQ = 1.51,
TPSZ = .4,
EPSZ = .21,
HCSZ = 100,
HGW = .023,
DWIBWT = 10,
ALPHALOW = 3,
ALPHATW = .41,
ALPHAVW = .02,
HGSW = .025,
DPTHAQSW = 5,
ALPHALOSW = 10,
ALPHATSW = 3,
ALPHAVSW = .06,
```

Worked as expected.

12.46 TEST CASE 034-022 TESTER'S REPORT

Documented in Test-034-022_report.docx of 2/18/2020 9:29 PM

Test Case 034-022 report

By cheng wang 2/18/2020

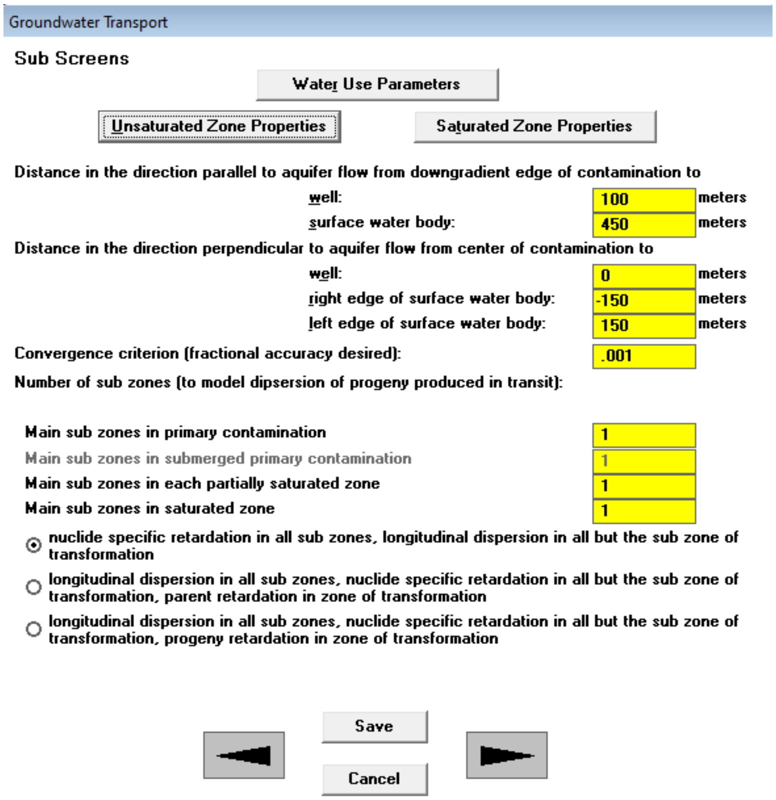
Objective: To test the functionality of Groundwater Transport form.

Conclusion: the code worked as expected.

Procedure:

1) Open Groundwater Transport form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.



2) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

3) Clicking the three buttons should bring up the forms of Water Use, Unsaturated Zones, and Saturated Zone

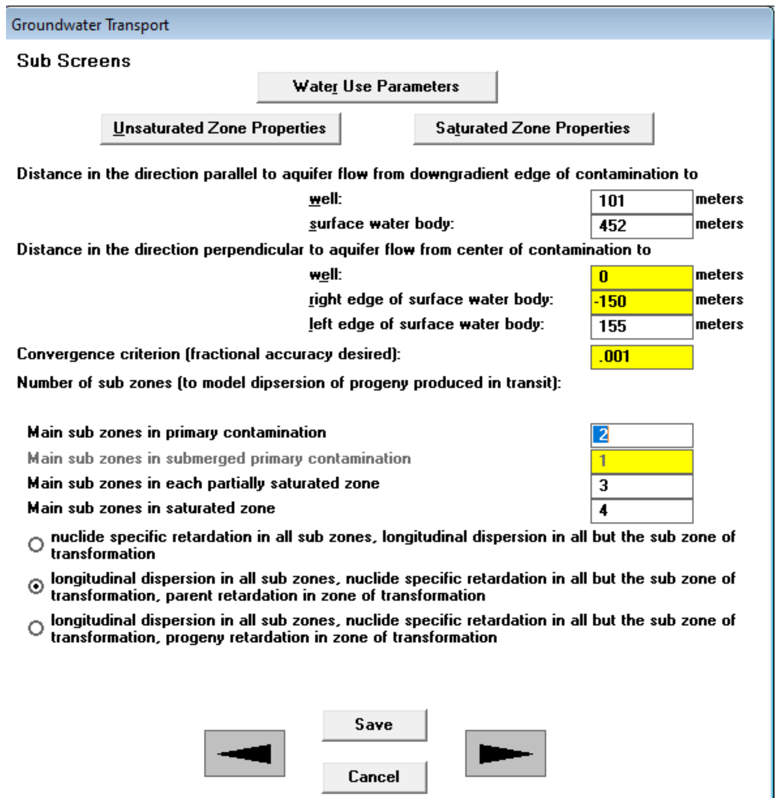
Worked as expected.

4) Check the options for subzone dispersion; they should respond to selection

Worked as expected.

5) Change at least three values, save the form, and then save the project to Test34.rof

Made the following changes.



6) Check the following variables in the generated file; they should be the same as inputs in GUI. OFFLPAQW, OFFLPAQS, OFFLNAQW, OFFLNAQSN, OFFLNAQSF, EPS, NPCM, NPCMF, NPCZ, NPCZF, NSPCZ, NSPCZF, NPSS, NPSSF, NAQS, NAQSF

Worked as expected.

```
OFFLPAQW = 101,
OFFLPAQS = 452,
OFFLNAQW = 0,
OFFLNAQSN =-150,
OFFLNAQSF = 155,
EPS = .001,
NPCM = 1,
NPCMF = 1,
NPCZ = 2,
NPCZF = 1,
NSPCZ = 1,
NSPCZF = 1,
NPSS = 3,
NPSSF = 1,
NAQS = 4,
NAQSF = 1,
```

12.47 TEST CASE 034-023 TESTER'S REPORT

Documented in Test-034-023_report.docx of 2/20/2020 7:37 AM

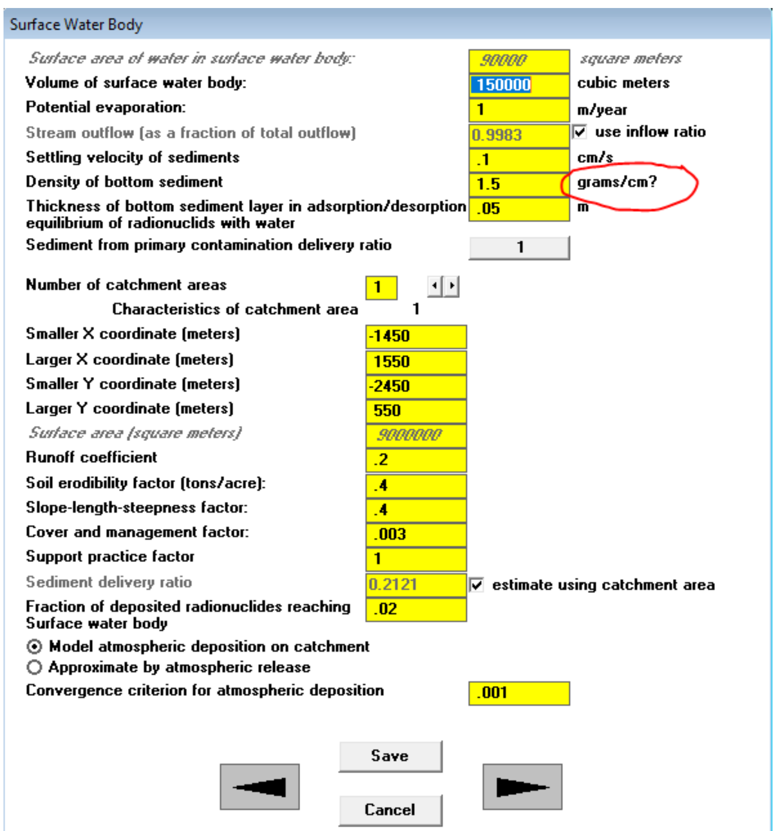
Test Case 034-023 report

By cheng wang 2/18/2020

Objective: To test the functionality of Surface Water Body form.

Conclusion: the code worked as expected.

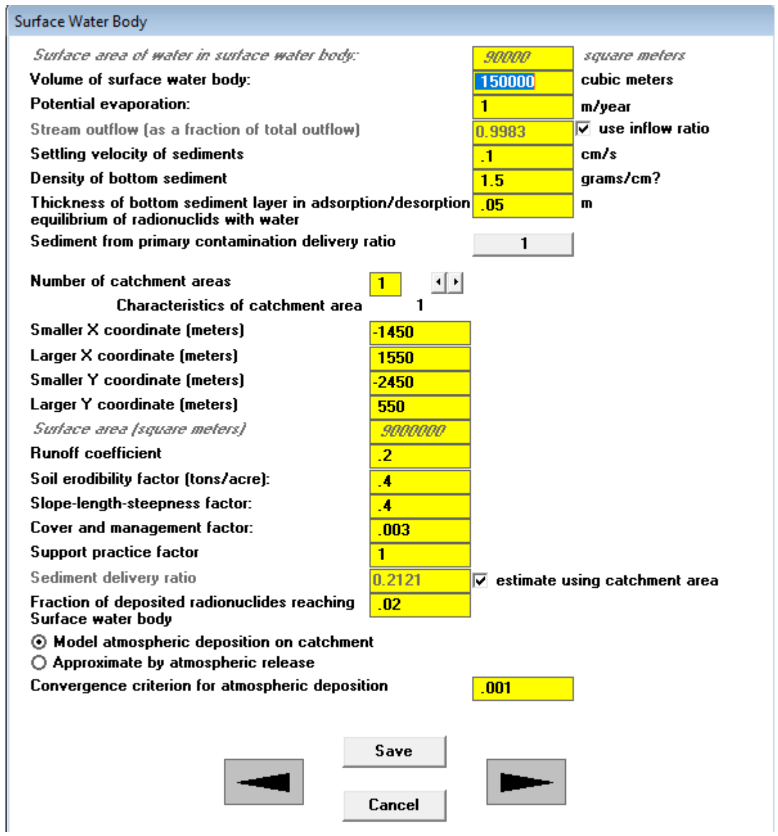
Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used.



Procedure:

1) Open Surface Water Body form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

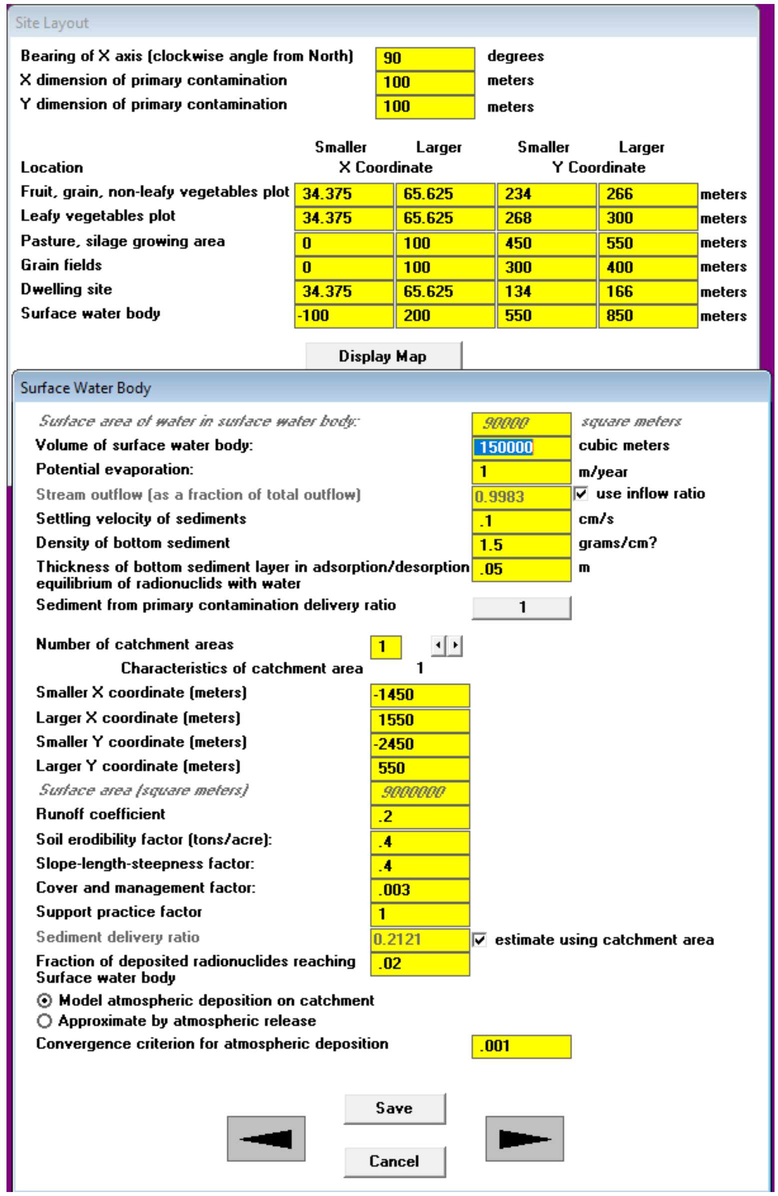
Worked as expected.



2) It should have the same input boxes as the figure has.

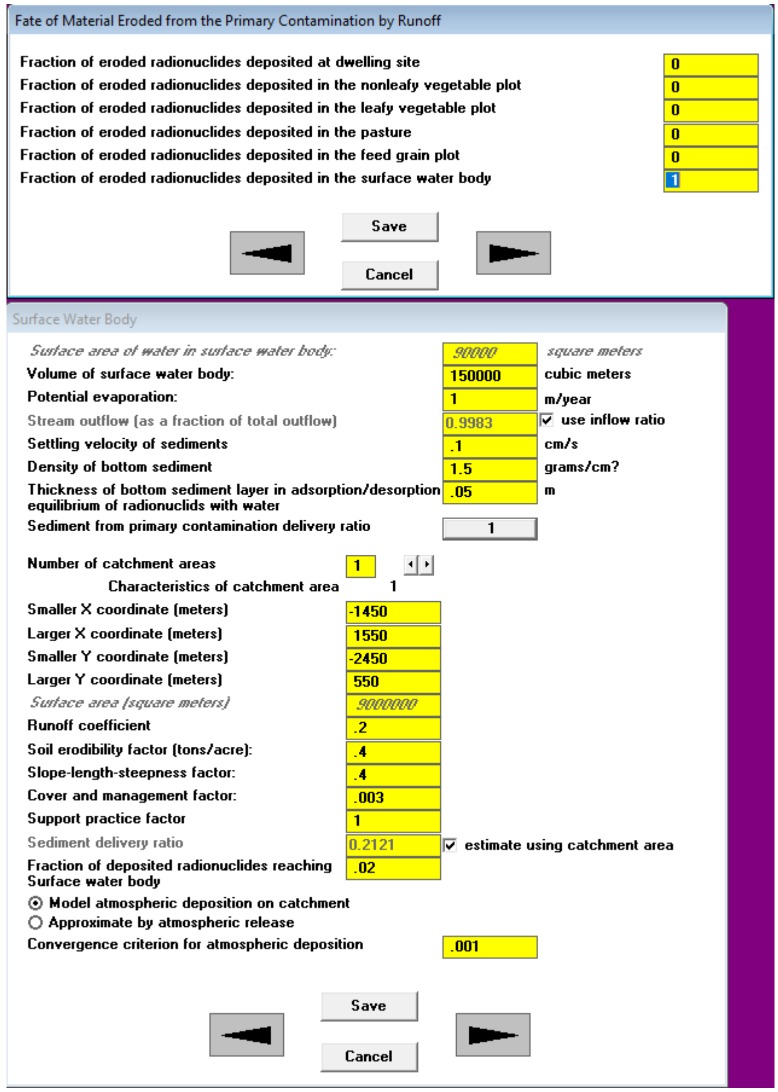
As shown in the screenshot of Step 1).

3) Check the Surface area of water body, which should be consistent with the inputs in Site Layout form



The values matched.

4) Check the Sediment Delivery ration button, which should be consistent with the input in Sediment Delivery Ration form. Clicking it should bring up the Sediment Delivery Ratio form.


Fate of Material Eroded from the Primary Contamination by Runoff

Fraction of eroded radionuclides deposited at dwelling site	0
Fraction of eroded radionuclides deposited in the nonleafy vegetable plot	0
Fraction of eroded radionuclides deposited in the leafy vegetable plot	0
Fraction of eroded radionuclides deposited in the pasture	0
Fraction of eroded radionuclides deposited in the feed grain plot	0
Fraction of eroded radionuclides deposited in the surface water body	1

Save
Cancel

Surface Water Body

Surface area of water in surface water body:	90000	square meters
Volume of surface water body:	150000	cubic meters
Potential evaporation:	1	m/year
Stream outflow (as a fraction of total outflow)	0.9983	use inflow ratio
Settling velocity of sediments	.1	cm/s
Density of bottom sediment	1.5	grams/cm?
Thickness of bottom sediment layer in adsorption/desorption equilibrium of radionuclids with water	.05	m
Sediment from primary contamination delivery ratio	1	

Number of catchment areas 1
Characteristics of catchment area 1

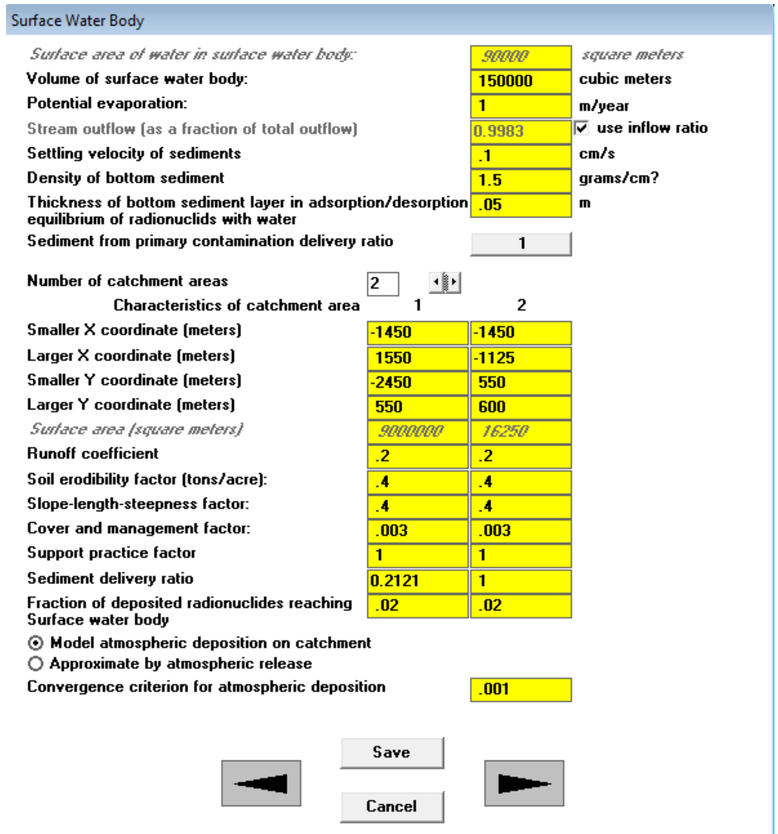
Smaller X coordinate (meters)	-1450	
Larger X coordinate (meters)	1550	
Smaller Y coordinate (meters)	-2450	
Larger Y coordinate (meters)	550	
Surface area (square meters)	9000000	
Runoff coefficient	.2	
Soil erodibility factor (tons/acre):	.4	
Slope-length-steepness factor:	.4	
Cover and management factor:	.003	
Support practice factor	1	
Sediment delivery ratio	0.2121	estimate using catchment area
Fraction of deposited radionuclides reaching Surface water body	.02	

Model atmospheric deposition on catchment
Approximate by atmospheric release
Convergence criterion for atmospheric deposition .001

Save
Cancel

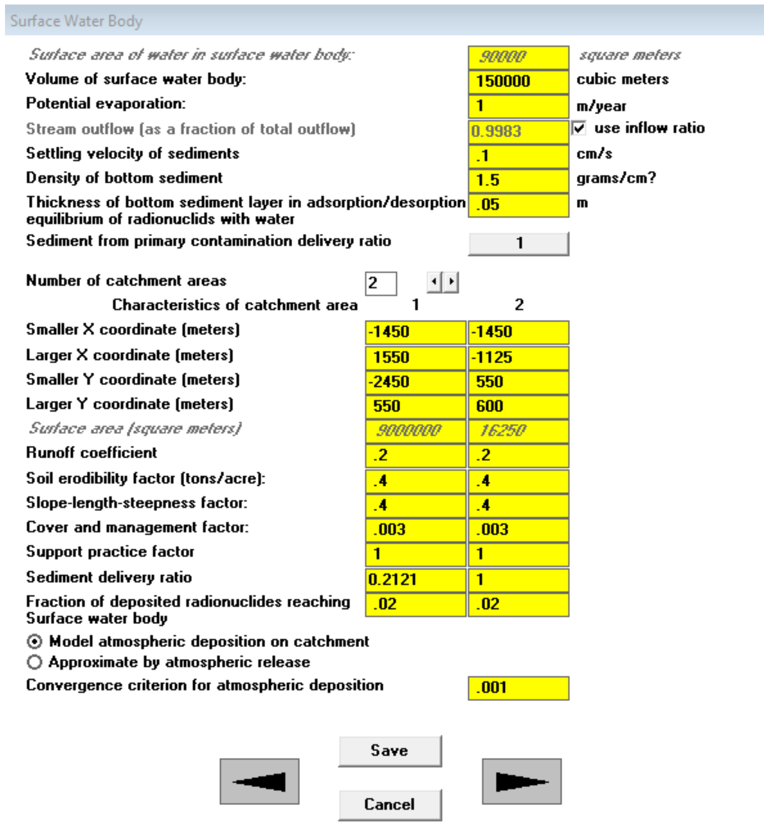
worked as expected.

5) Check the Number of catchment areas. The left and right arrow button should allow delete or add one catchment with default settings



Worked as expected.

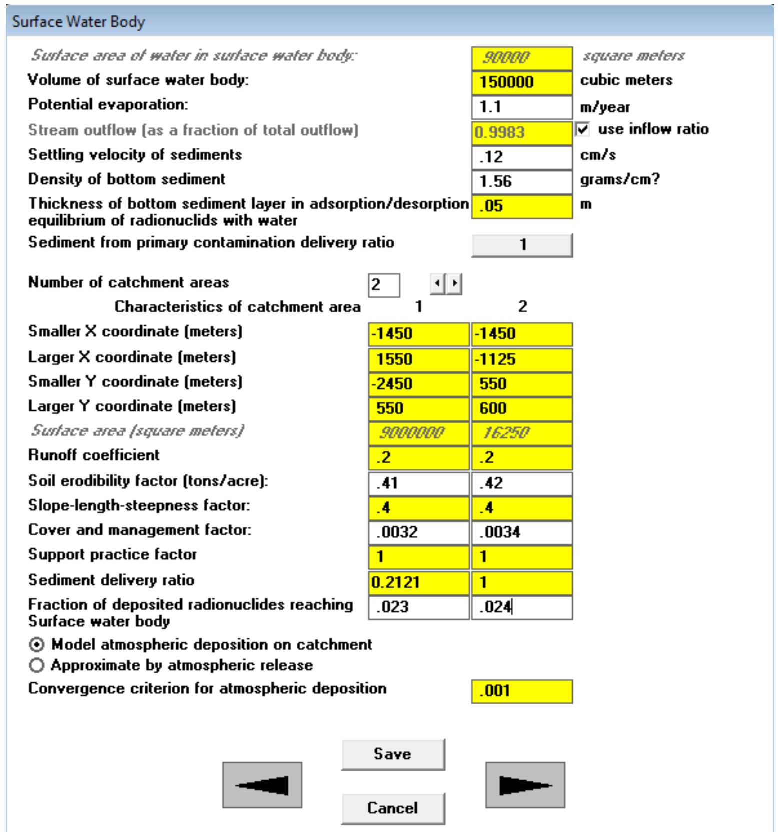
6) Validate the catchment area using the coordinates



The values matched.

7) Modify at least three values in each column, save the form, and then save the project to Test35.rof

Made the following changes.



8) Check the following variables in the generated file; they should be the same as the inputs in GUI. ALAKE, VLAKE, EVAPOT, FSTMFLOW, FSTMFLOWIN, VSETTLE, RHOBSED, THICKSED, SDR, NCATCH, CATCHXY, AREACA, RUNOFFCA, ERODIBILITYCA, SLPLENSTPCA, CRPMANGCA, CONVPRACCA, SDRCA, SDRACOR, DDRCA, COMPUTEDEP, CONVCRITATM

Worked as expected.

```
ALAKE = 90000,
VLAKE = 150000,
EVAPOT = 1.1,
FSTMFLOW = .9983,
FSTMFLOWIN = 1,
VSETTLE = .12,
RHOBSED = 1.56,
THICKSED = .05,
SDR = 1,
NCATCH = 2,
CATCHXY(1,1) =-1450,
CATCHXY(1,2) =-1450,
CATCHXY(1,3) =-1125,
CATCHXY(1,4) =-800,
CATCHXY(1,5) =-450,
CATCHXY(1,6) =-200,
CATCHXY(1,7) = 200,
CATCHXY(1,8) = 550,
CATCHXY(1,9) = 900,
CATCHXY(1,10) = 1225,
CATCHXY(2,1) = 1550,
CATCHXY(2,2) =-1125,
CATCHXY(2,3) =-800,
CATCHXY(2,4) =-450,
CATCHXY(2,5) =-100,
CATCHXY(2,6) = 300,
CATCHXY(2,7) = 550,
CATCHXY(2,8) = 900,
CATCHXY(2,9) = 1225,
CATCHXY(2,10) = 1550,
CATCHXY(3,1) =-2450,
CATCHXY(3,2) = 550,
CATCHXY(3,3) = 550,
CATCHXY(3,4) = 550,
CATCHXY(3,5) = 550,
CATCHXY(3,6) = 850,
CATCHXY(3,7) = 550,
CATCHXY(3,8) = 550,
CATCHXY(3,9) = 550,
CATCHXY(3,10) = 550,
CATCHXY(4,1) = 550,
CATCHXY(4,2) = 600,
CATCHXY(4,3) = 650,
CATCHXY(4,4) = 775,
CATCHXY(4,5) = 850,
CATCHXY(4,6) = 900,
CATCHXY(4,7) = 850,
CATCHXY(4,8) = 775,
CATCHXY(4,9) = 650,
CATCHXY(4,10) = 600,
AREACA(1) = 9000000,
AREACA(2) = 16250,
AREACA(3) = 32500,
AREACA(4) = 78750,
AREACA(5) = 105000,
AREACA(6) = 25000,
AREACA(7) = 105000,
AREACA(8) = 78750,
```

```
AREACA(9) = 32500,
AREACA(10) = 16250,
RUNOFFCA(1) = .2,
RUNOFFCA(2) = .2,
RUNOFFCA(3) = .2,
RUNOFFCA(4) = .2,
RUNOFFCA(5) = .2,
RUNOFFCA(6) = .2,
RUNOFFCA(7) = .2,
RUNOFFCA(8) = .2,
RUNOFFCA(9) = .2,
RUNOFFCA(10) = .2,
ERODIBILITYCA(1) = .41,
ERODIBILITYCA(2) = .42,
ERODIBILITYCA(3) = .4,
ERODIBILITYCA(4) = .4,
ERODIBILITYCA(5) = .4,
ERODIBILITYCA(6) = .4,
ERODIBILITYCA(7) = .4,
ERODIBILITYCA(8) = .4,
ERODIBILITYCA(9) = .4,
ERODIBILITYCA(10) = .4,
SLPLENSTPCA(1) = .4,
SLPLENSTPCA(2) = .4,
SLPLENSTPCA(3) = .4,
SLPLENSTPCA(4) = .4,
SLPLENSTPCA(5) = .4,
SLPLENSTPCA(6) = .4,
SLPLENSTPCA(7) = .4,
SLPLENSTPCA(8) = .4,
SLPLENSTPCA(9) = .4,
SLPLENSTPCA(10) = .4,
CRPMANGCA(1) = .0032,
CRPMANGCA(2) = .0034,
CRPMANGCA(3) = .003,
CRPMANGCA(4) = .003,
CRPMANGCA(5) = .003,
CRPMANGCA(6) = .003,
CRPMANGCA(7) = .003,
CRPMANGCA(8) = .003,
CRPMANGCA(9) = .003,
CRPMANGCA(10) = .003,
```

```
CONVPRACCA(1) = 1,
CONVPRACCA(2) = 1,
CONVPRACCA(3) = 1,
CONVPRACCA(4) = 1,
CONVPRACCA(5) = 1,
CONVPRACCA(6) = 1,
CONVPRACCA(7) = 1,
CONVPRACCA(8) = 1,
CONVPRACCA(9) = 1,
CONVPRACCA(10) = 1,
SDRCA(1) = .2121,
SDRACOR = 0,
SDRCA(2) = 1,
SDRCA(3) = 1,
SDRCA(4) = 1,
SDRCA(5) = 1,
SDRCA(6) = 1,
SDRCA(7) = 1,
SDRCA(8) = 1,
SDRCA(9) = 1,
SDRCA(10) = 1,
DDRCA(1) = .023,
DDRCA(2) = .024,
DDRCA(3) = .02,
DDRCA(4) = .02,
DDRCA(5) = .02,
DDRCA(6) = .02,
DDRCA(7) = .02,
DDRCA(8) = .02,
DDRCA(9) = .02,
DDRCA(10) = .02,
COMPUTEDEP = 1,
CONVCRITATM = .001,
```

12.48 TEST CASE 034-024 TESTER'S REPORT

Documented in Test-034-024_report.docx of 2/20/2020 7:38 AM

Test Case 034-024 report

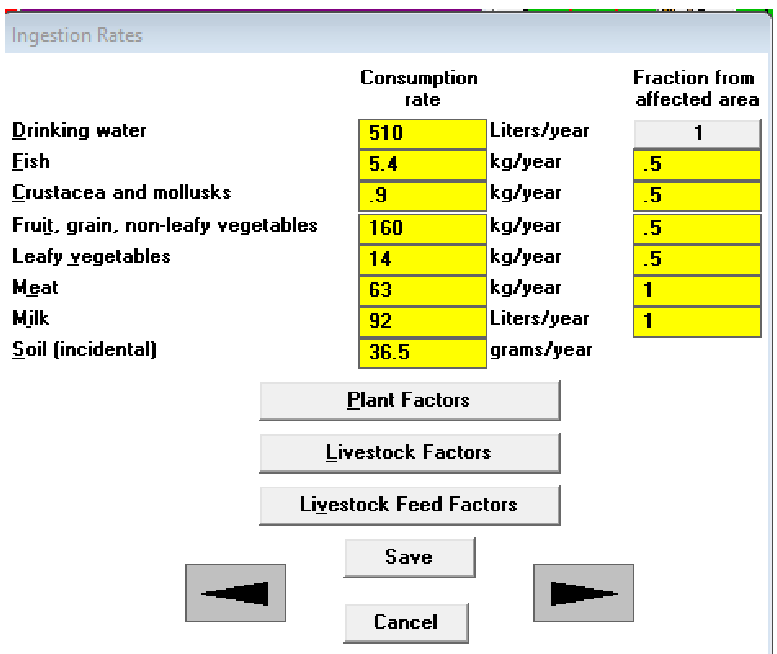
By cheng wang 2/18/2020

Objective: To test the functionality of Ingestion Rates form.

Conclusion: the code worked as expected.

Procedure:

1) Open Surface Water Body form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

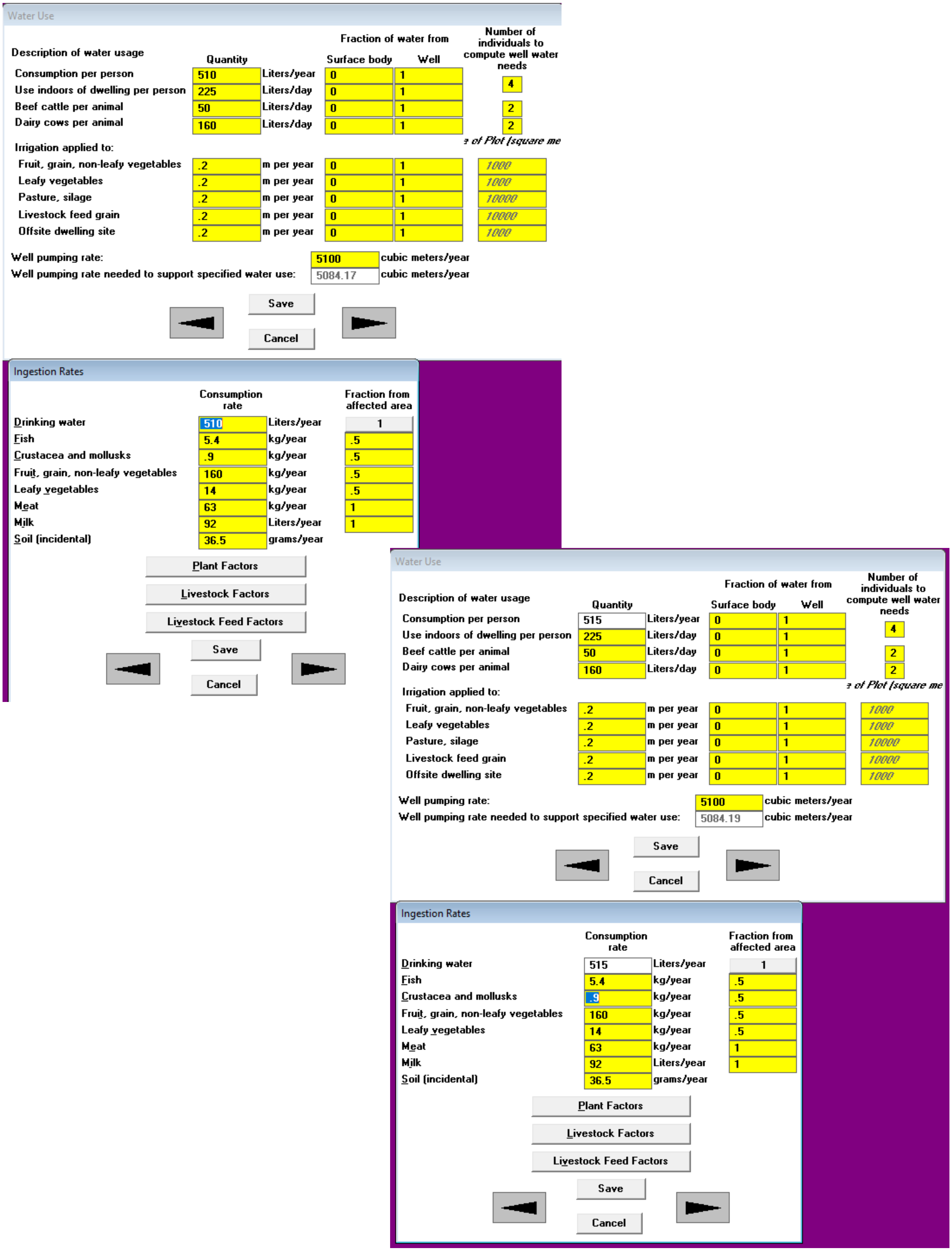


Worked as expected.

2) It should have the same input boxes as the figure has.

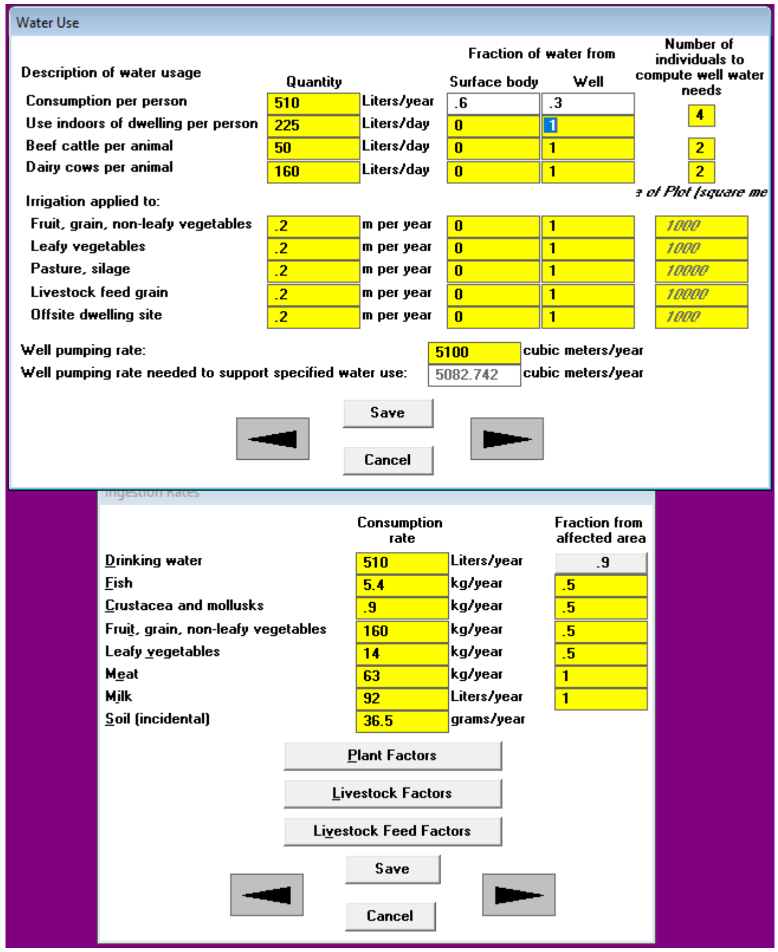
As shown in the screenshot of Step 1).

3) Check the Drinking Water Consumption rate, which should be consistent with the input in Water Use form. Medication of either one should change the other one automatically.


Water Use
Description of water usage
Quantity
Fraction of water from
Surface body
Well
Number of individuals to compute well water needs
Consumption per person
510
Liters/year
Use indoors of dwelling per person
225
Liters/day
Beef cattle per animal
50
Liters/day
Dairy cows per animal
160
Liters/day
Irrigation applied to:
Fruit, grain, non-leafy vegetables
Leafy vegetables
Pasture, silage
Livestock feed grain
Offsite dwelling site
m per year
e of Plot (square me
Well pumping rate:
5100
cubic meters/year
Well pumping rate needed to support specified water use:
5084.17
cubic meters/year
Save
Cancel
Ingestion Rates
Consumption rate
Fraction from affected area
Drinking water
510
Liters/year
Fish
5.4
kg/year
Crustacea and mollusks
.9
Fruit, grain, non-leafy vegetables
160
Leafy vegetables
14
Meat
63
Milk
92
Soil (incidental)
36.5
grams/year
Plant Factors
Livestock Factors
Livestock Feed Factors
Save
Cancel
Water Use
Consumption per person
515
Liters/year
Well pumping rate:
5100
cubic meters/year
Well pumping rate needed to support specified water use:
5084.19
cubic meters/year
Ingestion Rates
Drinking water
515
Liters/year

Worked as expected.

4) Check the Drinking water fraction from affected area, which should be consistent with the inputs from Water Use form. Clicking of this button should bring up the Water Use form.



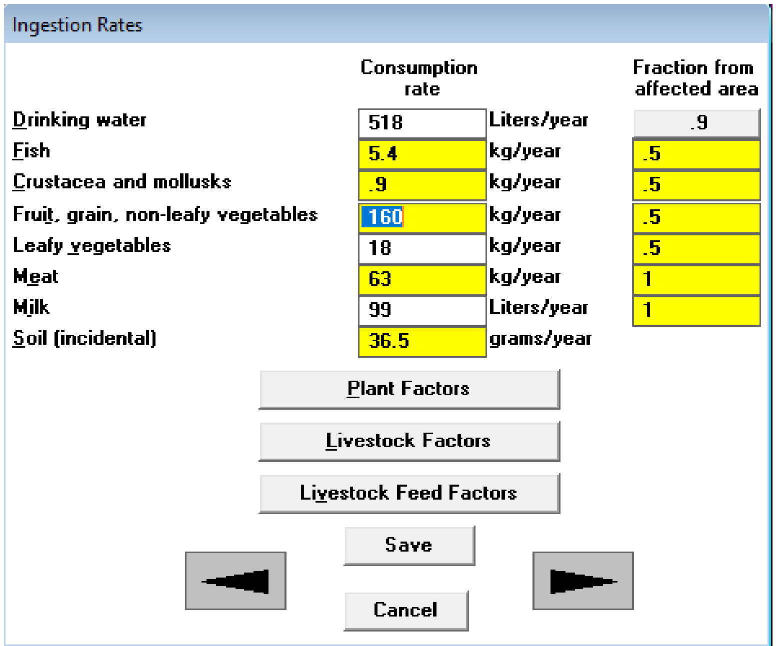
Worked as expected.

5) Check the three buttons. Clicking them should bring up forms of Plant Factors, Livestock Factors, and Livestock Feed Factors.

Worked as expected.

6) Modify at least two values in each column, save the form, and then save the project to Test36.rof.

Made the following changes.



7) Check the following variables in the generated file; they should be the same as inputs in GUI. DFI,DVI, DMI, SOIL, FFISH, FVEG, FMEMI

```
DWI = 518,
DFI(1)  = 5.4,
DFI(2)  = .9,
DVI(1)  = 160,
DVI(2)  = 18,
DMI(1)  = 63,
DMI(2)  = 99,
SOIL = 36.5,
FFISH(1)  = .5,
FFISH(2)  = .5,
FVEG(1)  = .5,
FVEG(2)  = .5,
FMEMI(1)  = 1,
FMEMI(2)  = 1,
```

Worked as expected.

12.49 TEST CASE 034-025 TESTER'S REPORT

Documented in Test-034-025_report.docx of 2/20/2020 7:39 AM

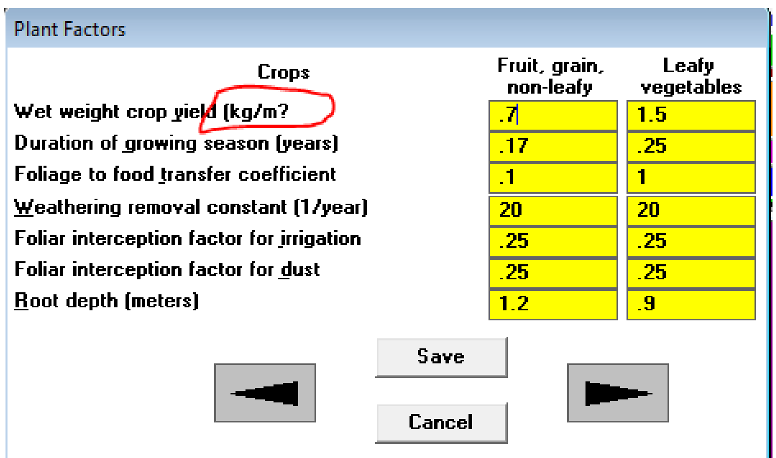
Test Case 034-025 report

By cheng wang 2/18/2020

Objective: To test the functionality of Plant Factors form.

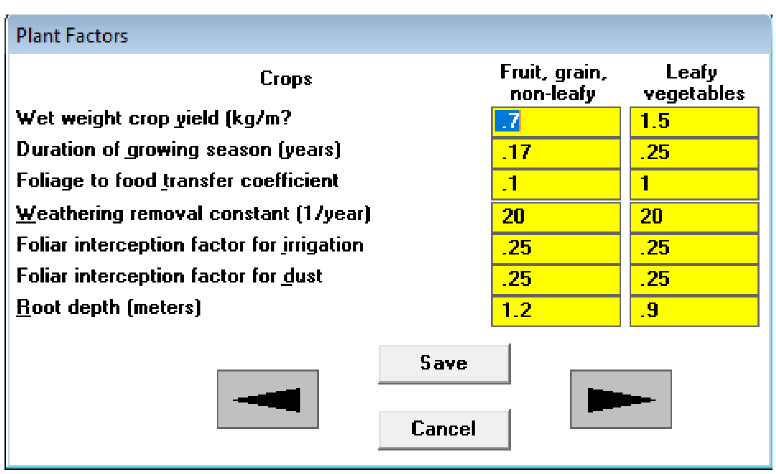
Conclusion: the code worked as expected.

Minor issue on the font format when computer system locale is Chinese; no issues when English (US) is used.



Procedure:

1) Open Plant Factors form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.



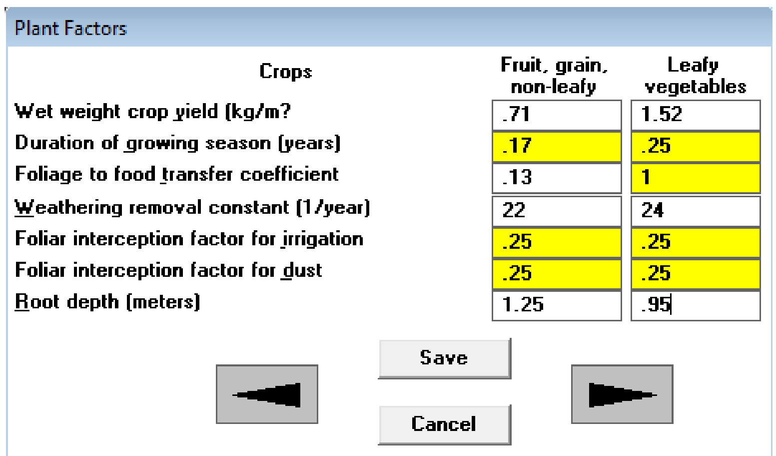
Worked as expected.

2) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

3) Modify at least two values in each column, save the form, and then save the project to Test37.rof.

Made the following changes.



4) Check the following variables in the generated file; they should be the same as inputs in GUI. YIELD, GROWTIME, FOLI_F, RWEATHER, FINTCEPT, DROOT

```
YIELD(1) = .71,
YIELD(2) = 1.52,
GROWTIME(1) = .17,
GROWTIME(2) = .25,
FOLI_F(1) = .13,
FOLI_F(2) = 1,
RWEATHER(1) = 22,
RWEATHER(2) = 24,
FINTCEPT(1,2) = .25,
FINTCEPT(2,2) = .25,
FINTCEPT(1,1) = .25,
FINTCEPT(2,1) = .25,
DROOT(1) = 1.25,
DROOT(2) = .95,
```

worked as expected.

12.50 TEST CASE 034-026 TESTER'S REPORT

Documented in Test-034-026_report.docx of 2/18/2020 10:28 PM

Test Case 034-026 report

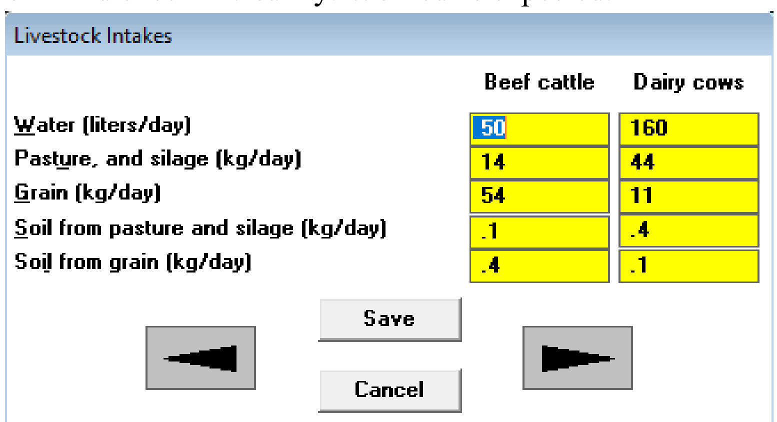
By cheng wang 2/18/2020

Objective: To test the functionality of Livestock Intakes form.

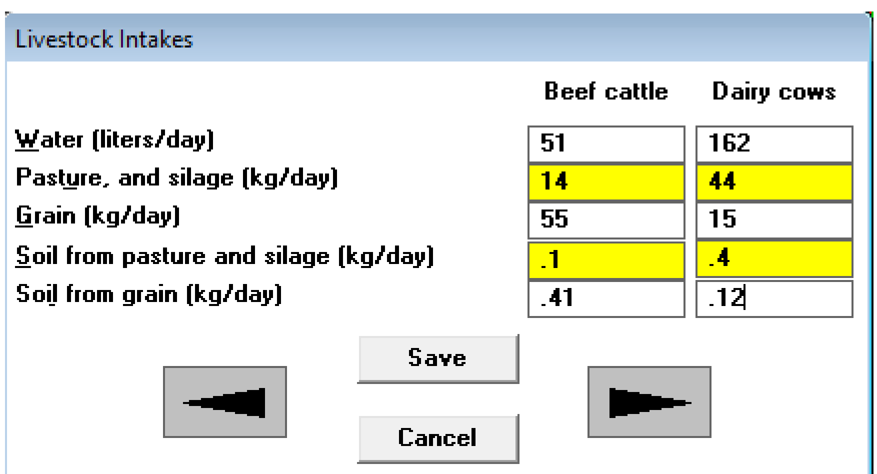
Conclusion: the code worked as expected.

Procedure:

1. Opened Livestock Intakes form and check it visually. Worked as expected.



2. made the following changes and save the project as test38.rof.



3. checked the values of LWI, LFI, LSI in the generated input file with the input values in the GUI.

Worked as expected.

```
LWI(1)  = 51,     LFI(1,1)  = 14,
LWI(2)  = 162,    LFI(1,2)  = 55,
                  LFI(2,1)  = 44,
                  LFI(2,2)  = 15,
                  LSI(1,1)  = .1,
                  LSI(1,2)  = .41,
                  LSI(2,1)  = .4,
                  LSI(2,2)  = .12,
```

12.51 TEST CASE 034-027 TESTER'S REPORT

Documented in Test-034-027_report.docx of 2/20/2020 7:40 AM

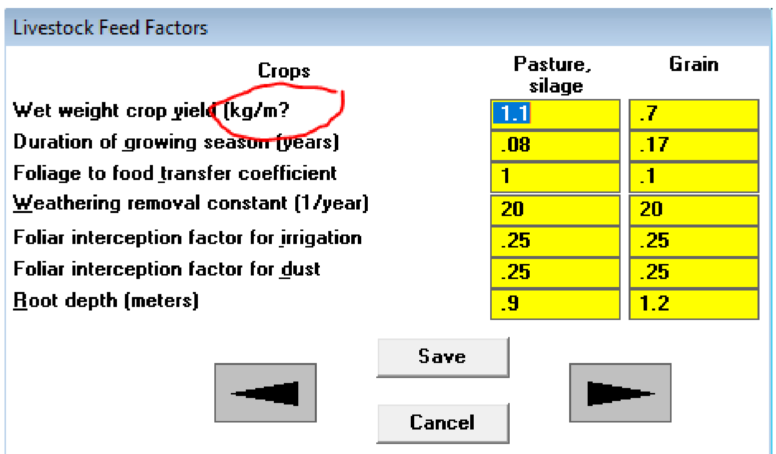
Test Case 034-027 report

By cheng wang 2/18/2019

Objective: To test the functionality of Livestock Feed Factors form.

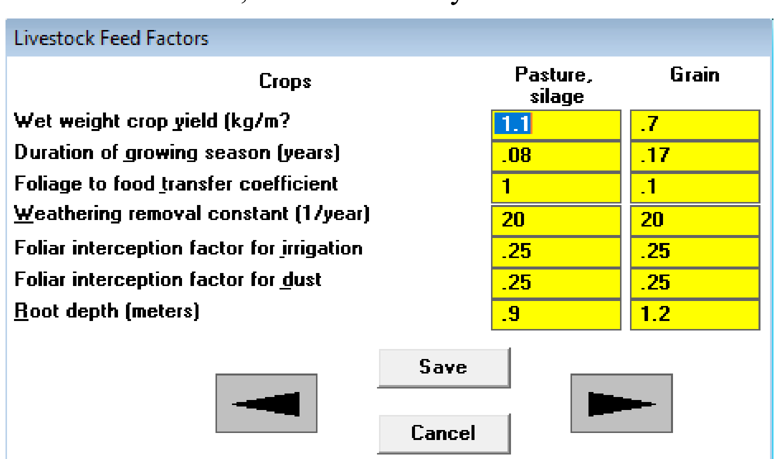
Conclusion: the code worked as expected.

Minor issue on the font format when computer system locale is Chinese; no issues when English (US) is used.



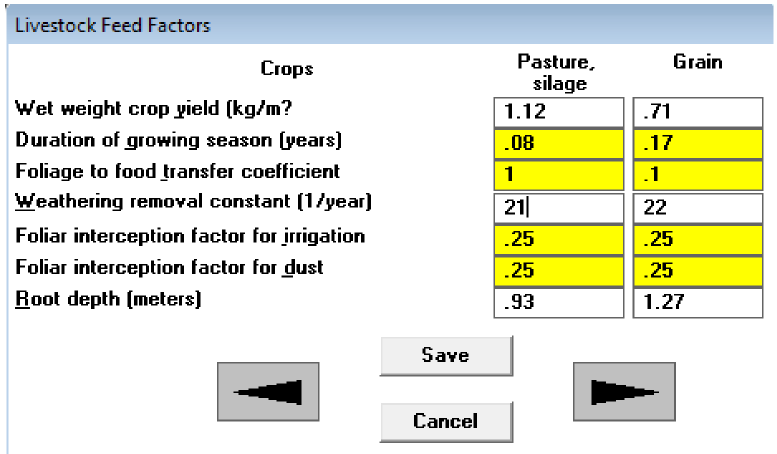
Procedure:

1. open Livestock Feed Factors form; check it visually.



Worked as expected.

2. made the following changes and save the project as test39.rof.



3. Compared the value of the following variables in the test39.rof with the input one in the form: YIELD(3), YIELD(4), GROWTIME(3), GROWTIME(4), FOLI_F(3), FOLI_F(4), RWEATHER(3), RWEATHER(4), FINTCEPT(3,2), FINTCEPT(4,2), FINTCEPT(3,1), FINTCEPT(4,1), DROOT(3), DROOT(4)

```
YIELD(3) = 1.12,
YIELD(4) = .71,
GROWTIME(3) = .08,
GROWTIME(4) = .17,
FOLI_F(3) = 1,
FOLI_F(4) = .1,
RWEATHER(3) = 21,
RWEATHER(4) = 22,
FINTCEPT(3,2) = .25,
FINTCEPT(4,2) = .25,
FINTCEPT(3,1) = .25,
FINTCEPT(4,1) = .25,
DROOT(3) = .93,
DROOT(4) = 1.27,
```

The values matched the one in the GUI.

12.52 TEST CASE 034-028 TESTER'S REPORT

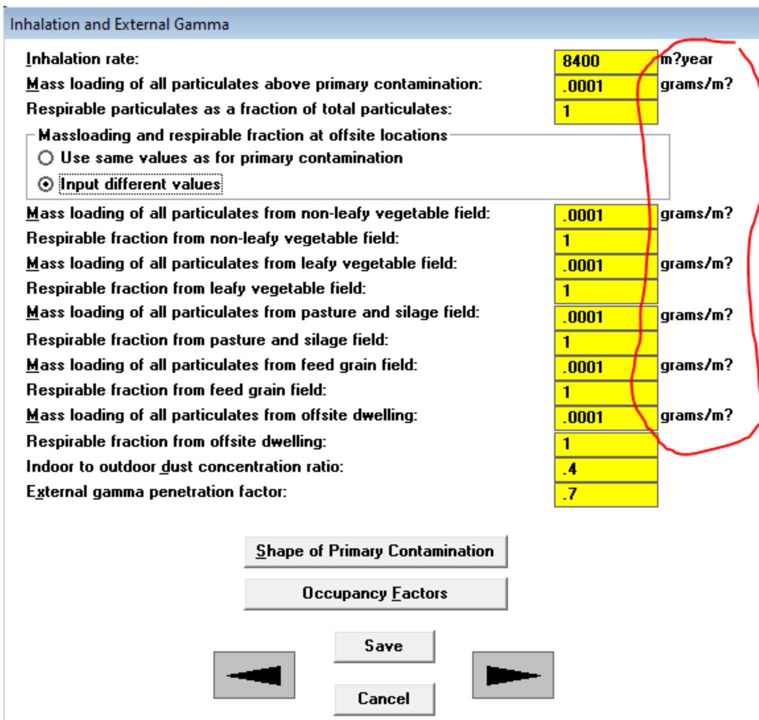
Documented in Test-034-028_report.docx of 2/20/2020 7:41 AM

By cheng Wang 2/18/2020

Objective: To test the functionality of Inhalation, Gamma form.

Conclusion: the code worked as expected.

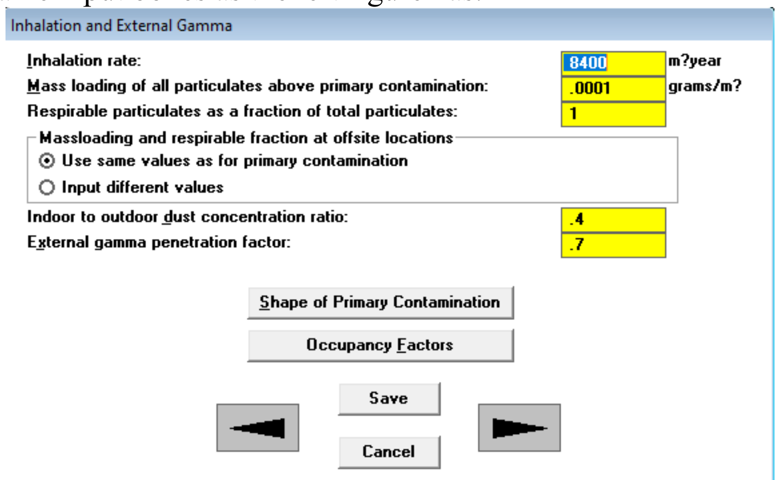
Minor font format issue when computer system locale is Chinese; no issues when English (US) is used.



Procedure:

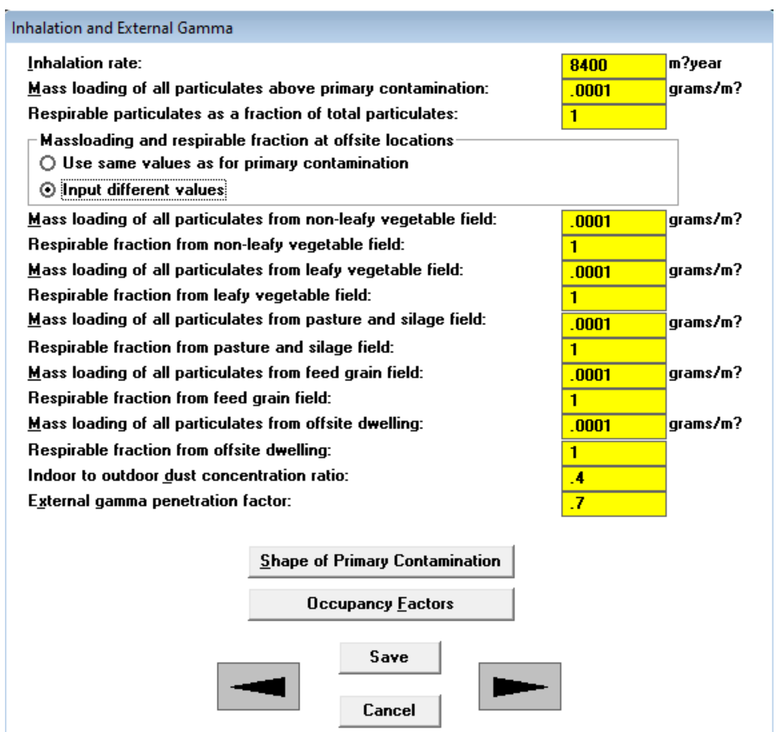
1) Open Inhalation, Gamma form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

2) It should have the same input boxes as the left figure has.



As shown in the screenshot of Step 1).

3) Selection of Input different values under Massloading and respirable fraction at offsite locations should bring more input boxes, as shown in the right figure.



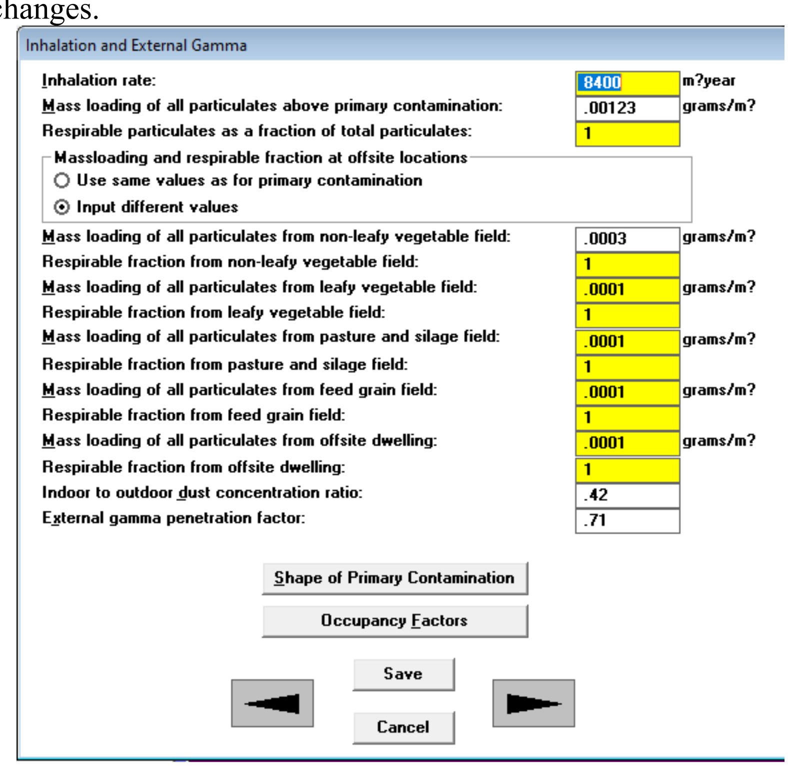
worked as expected.

4) Clicking the two buttons should bring up the forms of Shape Factors and Occupancy.

Worked as expected.

5) With Input different values selected, modify at least three inputs, save the form, and then save the project to Test40.rof.

Made the following changes.



6) Check the following variables in the input file; they should be the same as the inputs in GUI. INHALR, SAMEMLRF, MLTOTOF, RESPFRACOF, MLTOTDWELL, RESPFRACDWELL, SHF3, SHF1

```
INHALR = 8400,
SAMEMLRF = 1,
MLTOTOF(1) = .0003,
RESPFRACOF(1) = 1,
MLTOTOF(2) = .0001,
RESPFRACOF(2) = 1,
MLTOTOF(3) = .0001,
RESPFRACOF(3) = 1,
MLTOTOF(4) = .0001,
RESPFRACOF(4) = 1,
MLTOTDWELL = .0001,
RESPFRACDWELL = 1,
SHF3 = .42,
SHF1 = .71,
MLFD = .00123,
```

Worked as expected.

12.53 TEST CASE 034-029 TESTER'S REPORT

Documented in Test-034-029_report.docx of 2/20/2020 7:42 AM

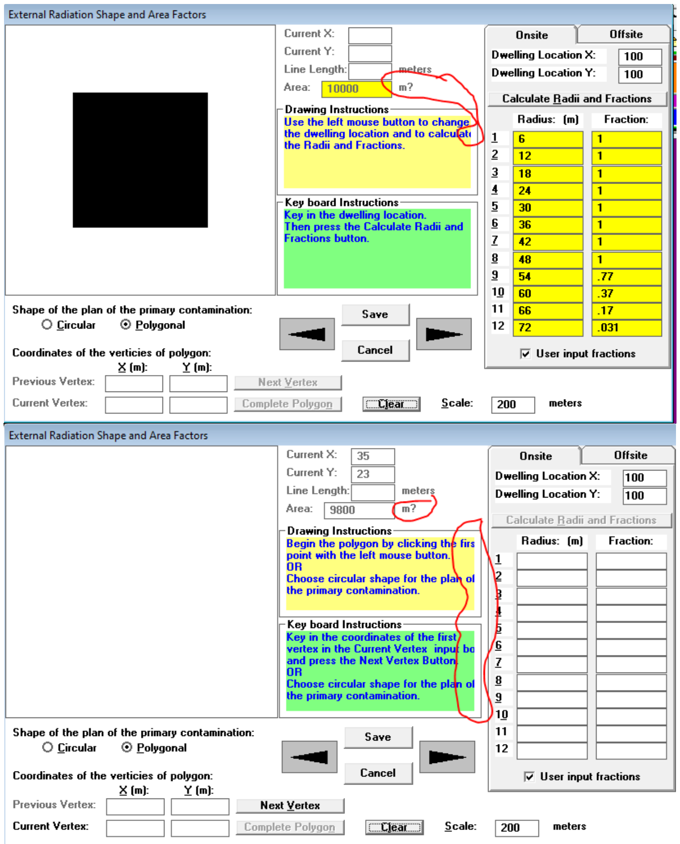
Test Case 034-029 report

By cheng wang 2/19/2020

Objective: To test the functionality of Shape Factors form.

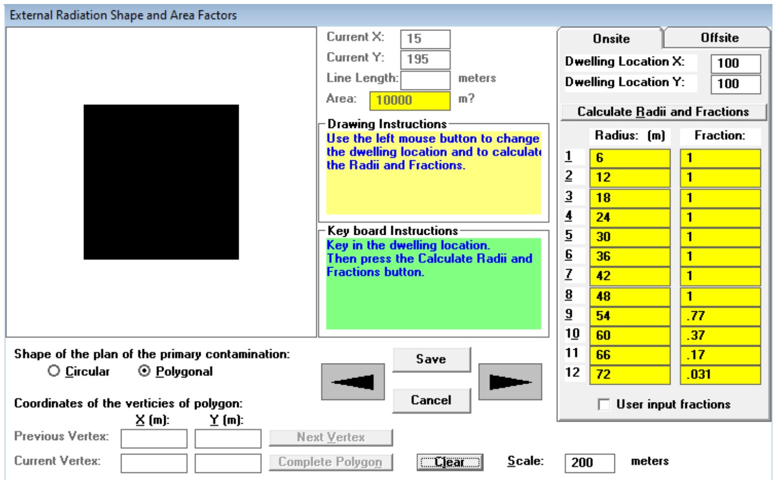
Conclusion: the code worked as expected.

Minor issue on font format when computer system locale is Chinese; no issues when English (US) is used.

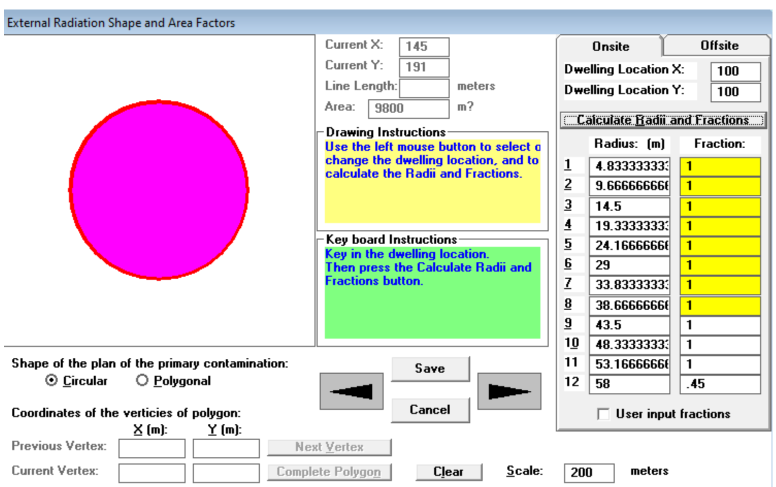


Procedure:

1) Open Shape Factors form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.
   Worked as expected.

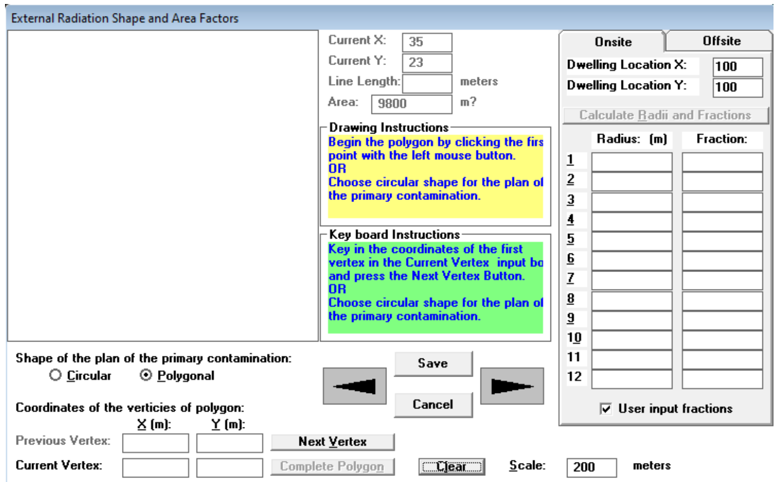


2) It should have the same input boxes as the figure has.
   As shown in the screenshot of the Step 1).
3) Select Onsite tab on the right panel.
4) Select Circular for Shape of the primary contamination, a circle should appear in the center. Click "Calculate Radii and Fractions", and the code should calculate and list the results in the table in right panel.

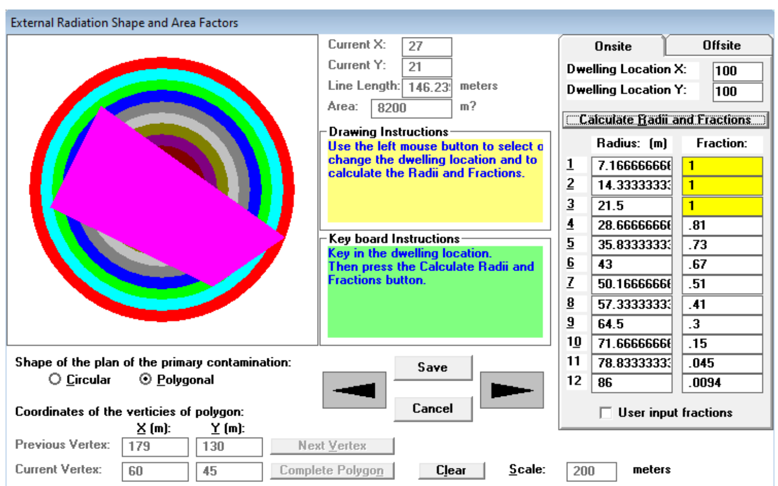


   Worked as expected.

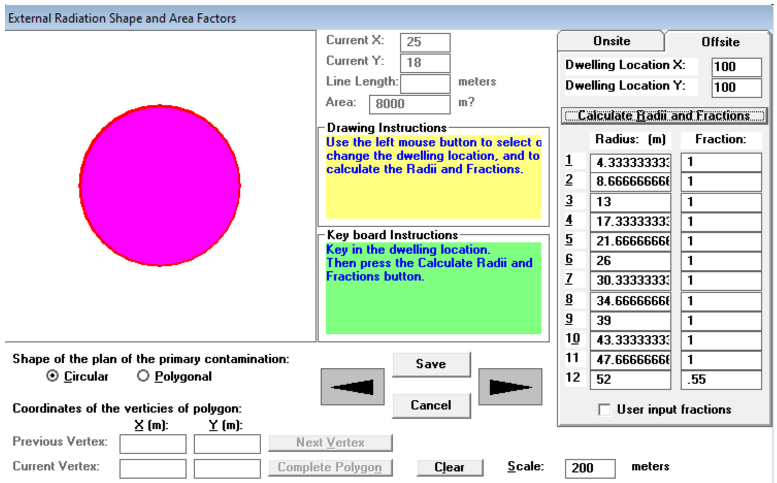
5) Click Clear. The left panel should become blank.

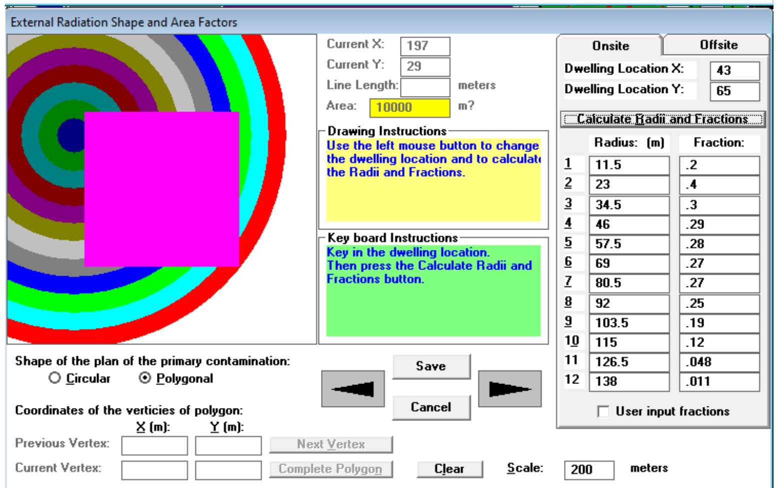


6) Select Polygonal for Shape of primary contamination. Generate a polygon on the left panel using mouse. The button "Calculate Radii and Fractions" should became available upon a polygon is generated. Click it and the results should be listed in the table. Worked as expected.



7) Select Offsite tab on the right panel, and repeat Steps 4-6.





Worked as expected.

8) Save the form, and then save the project to Test41.rof.

9) Check the variable RAD_SHAPE in the generated input file; its value should be same as the calculated ones in the GUI.

```
RAD_SHAPE(1) = 11.5,         FRACA(1) = .2,
RAD_SHAPE(2) = 23,           FRACA(2) = .4,
RAD_SHAPE(3) = 34.5,         FRACA(3) = .3,
RAD_SHAPE(4) = 46,           FRACA(4) = .29,
RAD_SHAPE(5) = 57.5,         FRACA(5) = .28,
RAD_SHAPE(6) = 69,           FRACA(6) = .27,
RAD_SHAPE(7) = 80.5,         FRACA(7) = .27,
RAD_SHAPE(8) = 92,           FRACA(8) = .25,
RAD_SHAPE(9) = 103.5,        FRACA(9) = .19,
RAD_SHAPE(10) = 115,         FRACA(10) = .12,
RAD_SHAPE(11) = 126.5,       FRACA(11) = .048,
RAD_SHAPE(12) = 138,         FRACA(12) = .011,
```

Worked as expected.

12.54 TEST CASE 034-030 TESTER'S REPORT

Documented in Test-034-030_report.docx of 2/20/2020 7:56 AM

Test Case 034-030 report

By cheng wang 2/18/2020

Objective: To test the functionality of Occupancy form.

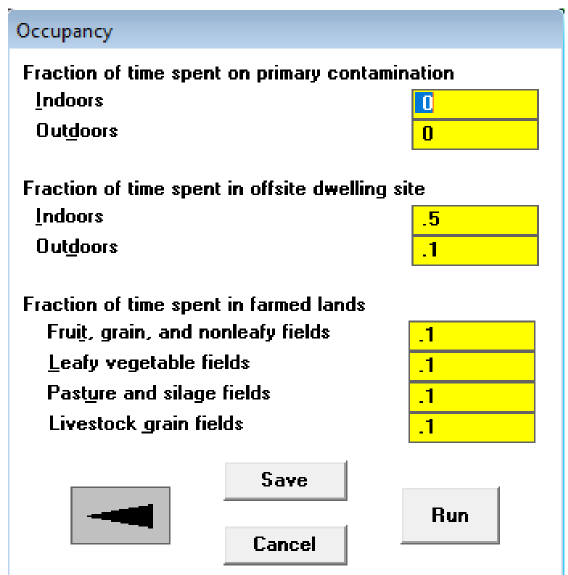
Conclusion: the code worked as expected.

Test-034-029_report

Procedure:

1) Select Ac-227 in the Initial Concentrations form.
2) Open Occupancy form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

Worked as expected.

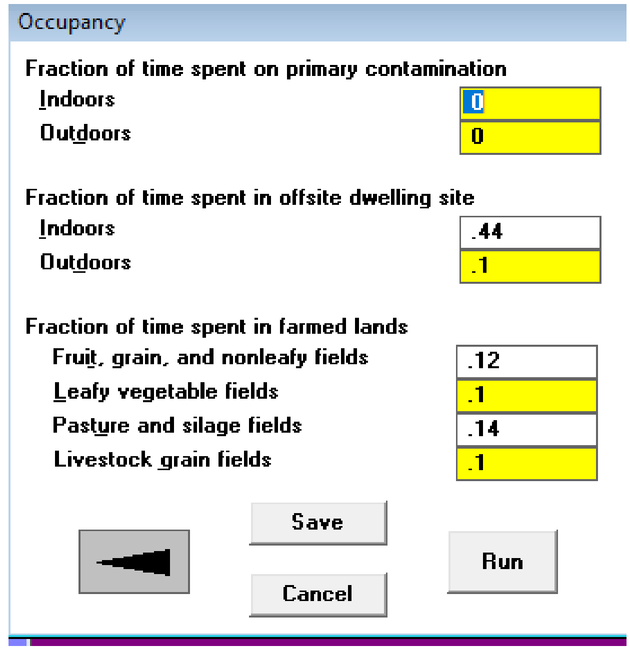


3) It should have the same input boxes as the figure has.

As shown in the screenshot of Step 1).

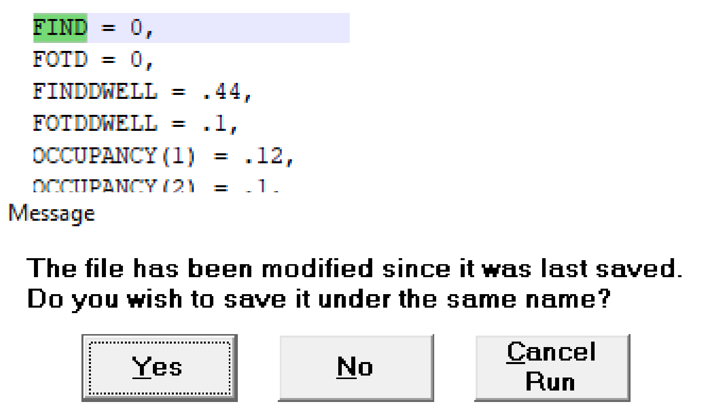
4) Modify at least three values, save the form, and then save the project as Test42.rof.

Made the following changes.



5) Check the following variables in the generated file; they should be the same as the inputs in GUI. FIND, FOTD, FINDDWELL, FOTDDWELL, OCCUPANCY(1) -(4)

Worked as expected. If the sum of fraction is over 1, error message will pop up.



6) Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.

Worked as expected.

12.55 TEST CASE 034-031 TESTER'S REPORT

Documented in Test-034-031_report.docx of 2/20/2020 7:45 AM

Test Case 034-031 report

By Cheng Wang 2/19/2020

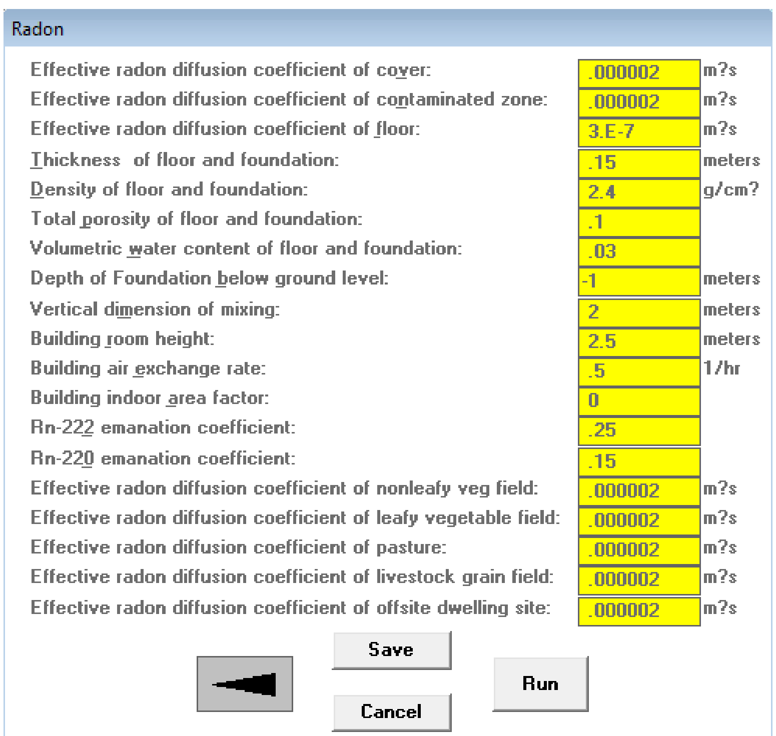
Objective: To test the functionality of Radon form.

Conclusion: the code worked as expected.

Minor font format issues were identified when computer system locale is Chinese; no issues when English (US) is used.

Procedure:

1) Open Radon form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.



Worked as expected. F6 key was checked after step 4 for at this step the textboxes are not editable.

2) It should have the same input boxes as the figure has.

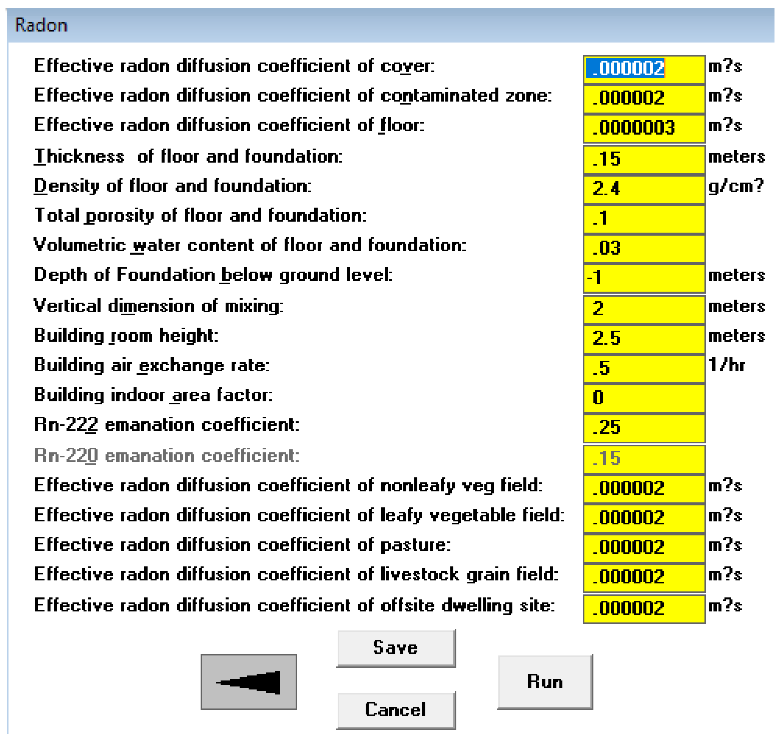
As shown in the screenshot of Step 1).

3) All the input boxes in this form should be grayed out unless a radon parent Rn-222 or Rn-220 is present in the contamination radionuclide list.

Worked as expected.

4) Close the form. Select U-238 from the Initial Concentrations form and then turn on Radon pathway.

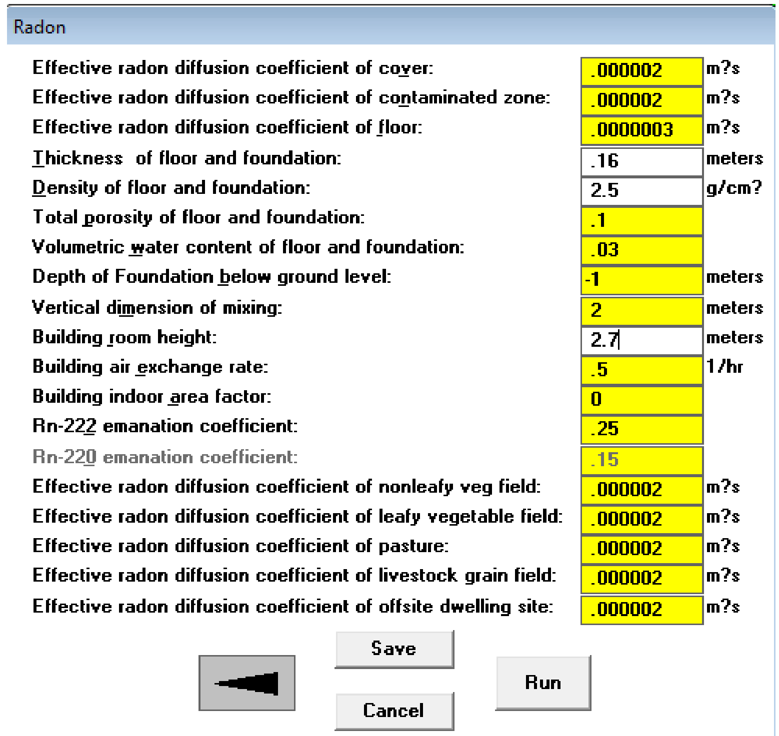
5) Open Radon form again; it should be available for modification now.



worked as expected.

6) Modify at least three values, save the form, and then the project to Test43.rof.

Made the following changes.



7) Check the following variables in the generated file; they should be the same as the inputs in GUI. DIFCV, DIFCZ, DIFOS(1), DIFOS(2), DIFOS(3), DIFOS(4), DIFOS(5), DIFFL, FLOOR1, DENSFL, TPFL, PH2OFL, DMFL, HMIX, HRM, REXG, FAI, EMANA(1), EMANA(2)

```
DIFCV = .000002,
DIFCZ = .000002,
DIFOS(1) = .000002,
DIFOS(2) = .000002,
DIFOS(3) = .000002,
DIFOS(4) = .000002,
DIFOS(5) = .000002,
DIFFL = .0000003,
FLOOR1 = .16,
DENSFL = 2.5,
TPFL = .1,
PH2OFL = .03,
DMFL =-1,
HMIX = 2,
HRM = 2.7,
REXG = .5,
FAI = 0,
EMANA(1) = .25,
EMANA(2) = .15,
```

Worked as expected.

8) Open the form again. Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.

Worked as expected.

12.56 TEST CASE 034-032 TESTER'S REPORT

Documented in Test-034-032_report.docx of 2/20/2020 7:53 AM

Test Case 034-032 report

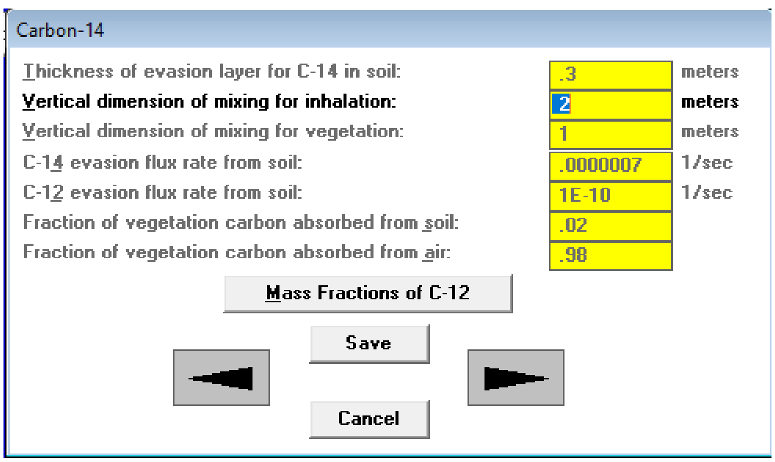
By cheng wang 2/19/2020

Objective: To test the functionality of Carbon-14 form.

Conclusion: the code worked as expected.

Procedure:

1) Open Carbon-14 form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.



Worked as expected. F6 key was checked after Step 4 for the textboxes are not editable at this point.

2) It should have the same input boxes as the figure has.

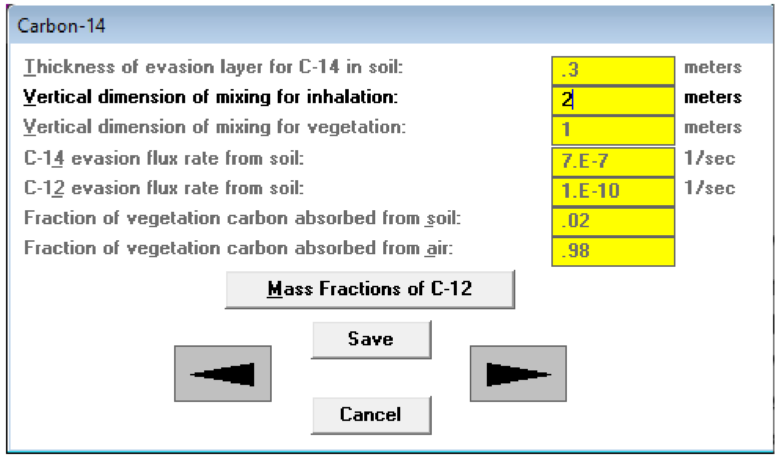
   Worked as expected.

3) All the input boxes in this form should be grayed out unless a radon parent Rn-222 or Rn-220 is present in the contamination radionuclide list.

   Worked as expected.

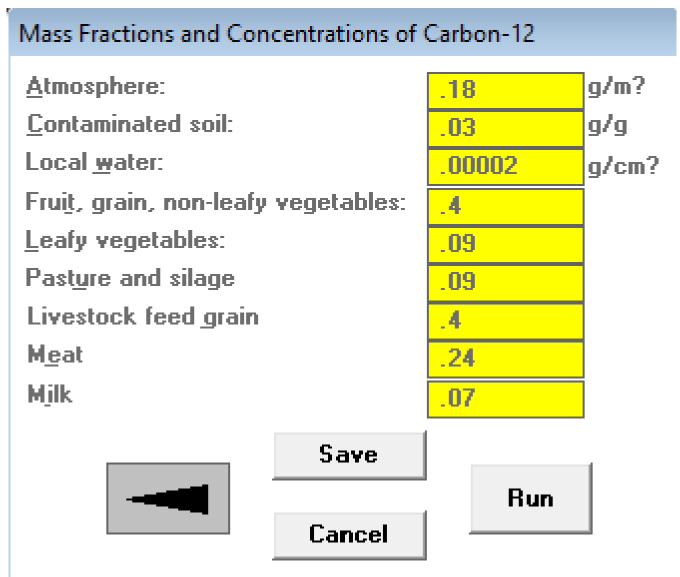
4) Select U-238 from the Initial Concentrations form and then turn on Radon pathway.

5) Open Carbon-14 form again; it should be available for modification now.



Worked as expected.

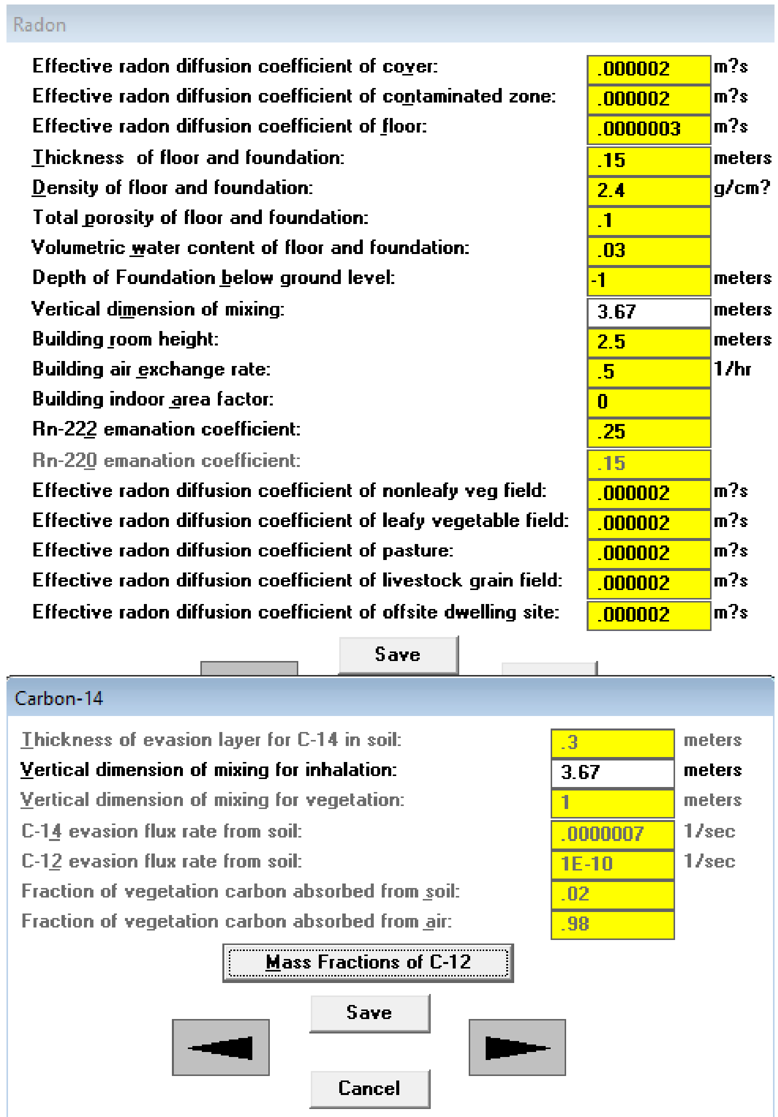
6) Clicking Mass fractions of C-12 should bring up Mass fractions of C-12 form.



Worked as expected.

7) Modify the Vertical dimension of mixing for inhalation, save the form, and then the project to Test44.rof.

Changed the value from 2 to 3.67. This change also updated the corresponding value in Radon form.



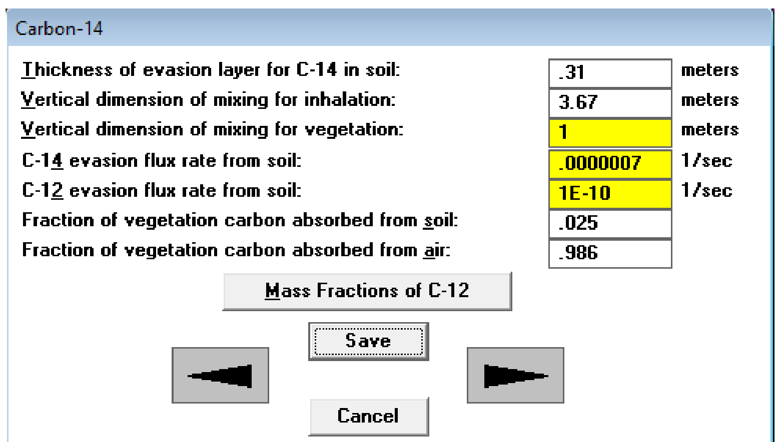
8) Check the following variables in the generated file; they should be the same as the inputs in GUI. DMC, HMIXV, C14EVSN, C12EVSN, CAIR,CSOIL

worked as expected.

```
HMIX = 3.67,
DMC = .3,
HMIXV = 1,
C14EVSN = .0000007,
C12EVSN = 1E-10,
CAIR = .98,
CSOIL = .02,
```

Worked as expected.

9) Added C-14 to nuclide list and made the following changes. Save the file as Test44-C-14.rof



10) Check the variables mentioned in Step 8) and compare with the ones input in GUI.

Worked as expected.

```
HMIX = 3.67,
DMC = .31,
HMIXV = 1,
C14EVSN = .0000007,
C12EVSN = 1E-10,
CAIR = .975,
CSOIL = .025,
```

12.57 TEST CASE 034-033 TESTER'S REPORT

Documented in Test-034-033_report_v2.docx of 2/26/2020 12:50 PM

Test Case 034-033 report

By cheng wang 2/19/2020

Objective: To test the functionality of Mass fraction of C-12 form.

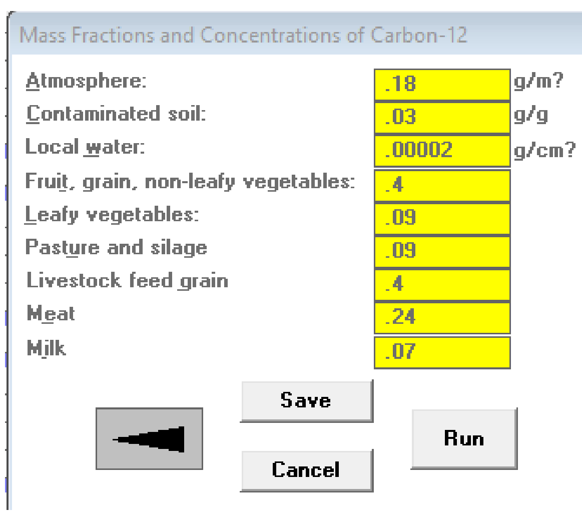
Conclusion: the code worked as expected.

> Modify Step 3) of test case description to "Select C-14 from the Initial Concentrations form".
>
> Minor font format issues were identified when computer system locale is Chinese; no issues when English (US) is used.

Procedure

1) Open Mass fraction of C-12 form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.

   Worked as expected. F6 key was checked after Step 3).



2) It should have the same input boxes as the figure has.

   Worked as expected.

3) Select C-14 from the Initial Concentrations.
4) Open Mass fraction of C-12 form again, and change values for at least two variables.

   Changed values for Atmophere textbox, Local water, and Milk to 0.28, 0.000031, and 0.072, respectively.

5) Save the form, and then the project to Test45.rof.
6) Check the following variables in the generated file; they should be the same as the inputs in GUI. C12AIR, C12CZ, C12WTR, C12PLANT(1), C12PLANT(2), C12PLANT(3), C12PLANT(4), C12MEAT_MILK(1), C12MEAT_MILK(2)

```
C12AIR = .28,
C12CZ = .03,
C12WTR = .000031,
C12PLANT(1) = .4,
C12PLANT(2) = .09,
C12PLANT(3) = .09,
C12PLANT(4) = .4,
C12MEAT_MILK(1) = .24,
C12MEAT_MILK(2) = .072,
```

   worked as expected.

7) Open the form again. Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.

   Worked as expected.

12.58 TEST CASE 034-034 TESTER'S REPORT

Documented in Test-034-034_report.docx of 2/20/2020 7:58 PM

Test Case 034-034 report

By cheng wang 2/19/2020

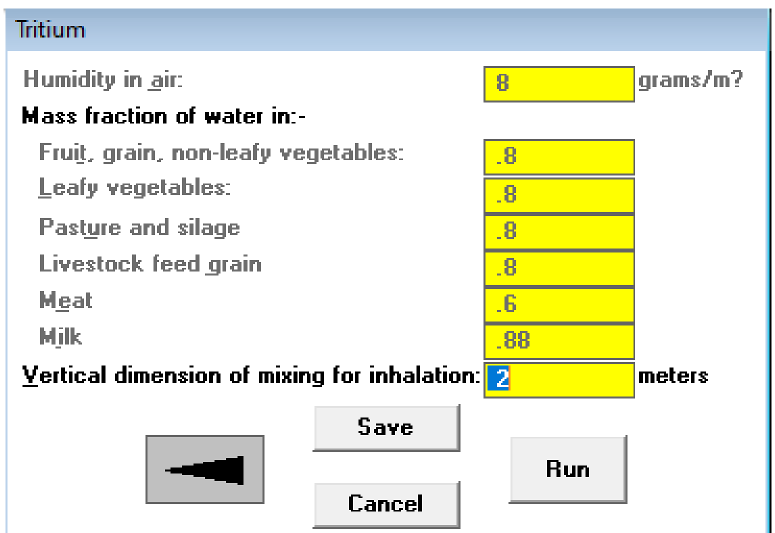
Objective: To test the functionality of H-3 form.

Conclusion: the code worked as expected.

Minor font format issues were identified when computer system locale is Chinese; no issues when English (US) is used.

Procedure:

1) Select U-238 from the Initial Concentrations.
2) Open H-3 form. Visually check the format, fonts, spelling, and default values with yellow background color. Check if F6 key can restore a change value.



Worked as expected.

3) It should have the same input boxes as the figure has.

Worked as expected.

4) Modify the Vertical dimension of mixing for inhalation, save the form, and then the project to Test46.rof.

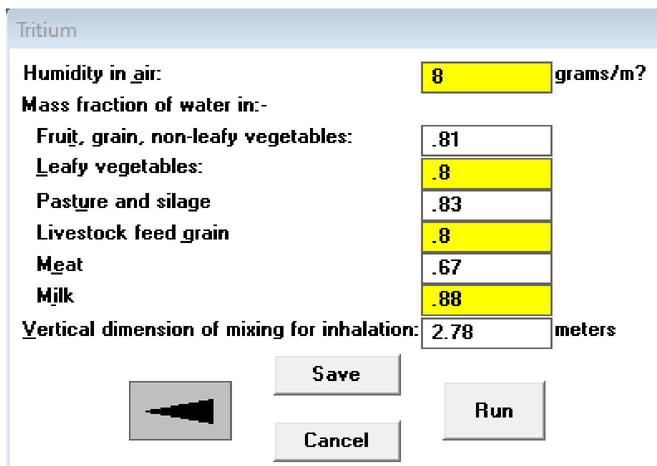
Changed the value to 2.78.

5) Check the following variables in the generated file; they should be the same as the inputs in GUI. HUMID, H2OPLANT(1), H2OPLANT(2), H2OPLANT(3), H2OPLANT(4), H2OMEAT_MILK(1), H2OMEAT_MILK(2), HMIX

```
HMIX = 2.78,
HUMID = 8,
H2OPLANT(1) = .8,
H2OPLANT(2) = .8,
H2OPLANT(3) = .8,
H2OPLANT(4) = .8,
H2OMEAT_MILK(1) = .6,
H2OMEAT_MILK(2) = .88,
```

Worked as expected.

Additional test. Added H-3, made the following change and checked the generated input file. The code worked as expected.




```
HMIX = 2.78,
HUMID = 8,
H2OPLANT(1) = .81,
H2OPLANT(2) = .8,
H2OPLANT(3) = .83,
H2OPLANT(4) = .8,
H2OMEAT_MILK(1) = .67,
H2OMEAT_MILK(2) = .88,
```

6) Open the form again. Clicking run should bring up a message window asking whether to save the changes and run the code. Click each button – Yes will run the code; No will open the Save function, Cancel Run will go back the main interface.

Worked as expected.

12.59 TEST CASE 035-001 TESTER'S REPORT

Documented in Test Case 35-1-JJCheng.docx of 2/26/2020 12:29 PM

Test Case 35-1 – Test if submenus File -> New and Save work correctly

The test was conducted following the step-by-step instructions provided in the RESOFF-TEST-001, Test Cases document. The RESRAD-OFFSITE code behaved expectedly for each step performed. The File > New and Save functions were implemented successfully.

12.60 TEST CASE 035-002 TESTER'S REPORT

Documented in Test Case 35-2-JJCheng.docx of 2/14/2020 3:37 PM

Test Case 35-2 – Test if submenu File -> Open and Save As works correctly

The following procedure was used in the testing –

1) Launch the RESRAD-OFFSITE code.

2) Click File -> Open. A new window should pop up, requesting user to select which input file to open. The default file location should be the folder from which an input file was read to run the code the last time.

3) Redirect the location to the QAFiles subfolder of the current version under testing. Select the QA input file "BASIC RESRAD-OFFSITE INSTALLATION QA.ROF," and click Open.

4) The main interface should update after loading the input file. Check to see if at the top of the interface, the input file name displayed is that of the QA file.

5) Click Modify Data from the left navigation panel and then the Initial Concentration tab on the 2nd panel. Check to see if the SI unit of Bq/g is shown in the Initial Concentrations input form. If not, the code does not read in the data in the QA input file correctly, and this test should be marked as "fail." If Bq/g is displayed, continue the test.

6) Check to see if radionuclides shown are C-14, H-3, Pb-210, Ra-226, Ra-228, and Th-228, with concentrations of 15, 200, 0, 0.01, 10, and 0, respectively.

7) Change the concentration of H-3 to 300 Bq/g. Close the input form.

8) Click File -> Save As. A new window should pop up and the default path shown at the top of the window should be the QAFiles subfolder. If not, this test should be marked as "fail."

9) Change the path to the UserFiles subfolder. Provide a new file name to save the input data, and click Save. A new file should be created in the UserFiles subfolder. Quit RESRAD-OFFSITE.

10) Open the newly saved file in the UserFiles subfolder with Notepad (or any other utility tool with similar functions) and compare it with the QA input file in the QAFiles subfolder. Except for the initial concentration of H-3, other information should be identical. If not, this test should be marked as "fail."

11) Repeat Steps 1-10 using the Open button (2nd from left) in the Tool bar to open the QA input file.

12) Repeat Steps 1-10 using the combination keys Ctrl + O to open the QA input file.

13) Copy the QAFiles subfolder to a USB drive and repeat Steps 1-10 to open the QA input file from there.

- The screenshots below show the QA input file and the new file created. The only difference between these two files is the initial concentration of H-3. It is 5404.405 in the QA input file but is 8108.108 in the created file.

Note: In RESRAD-OFFSITE input files, the values listed for initial concentrations of radionuclide are for the US unit, i.e., pCi/g. 200 Bq/g = 5404.405 pCi/g while 300 Bg/g = 8108.108 pCi/g.

BASIC RESRAD-OFFSITE INSTALLATION QA - Notepad

File Edit Format View Help

```
H2OPLANT(4) = .8,
H2OMEAT_MILK(1) = .6,
H2OMEAT_MILK(2) = .88,
NUCNAM = 'C-14', 'H-3', 'Pb-210+D', 'Ra-226+D', 'Ra-228+D',
'Th-228+D', 'LAST',
S = 405.4054, 5405.405, 0, .2702703, 270.2703, 0,
DCACTC = 2*0, 100, 2*70, 60000,
DCACTCM = 2*0, 100, 2*70, 60000,
DCACTDWE = 2*0, 2, 2*1, 10,
```

TEST 35-2 - Notepad

File Edit Format View Help

```
H2OPLANT(4) = .8,
H2OMEAT_MILK(1) = .6,
H2OMEAT_MILK(2) = .88,
NUCNAM = 'C-14', 'H-3', 'Pb-210+D', 'Ra-226+D', 'Ra-228+D',
'Th-228+D', 'LAST',
S = 405.4054, 8108.108, 0, .2702703, 270.2703, 0,
DCACTC = 2*0, 100, 2*70, 60000,
DCACTCM = 2*0, 100, 2*70, 60000,
DCACTDWE = 2*0, 2, 2*1, 10,
```

12.61 TEST CASE 035-003 TESTER'S REPORT

Documented in Test Case 35-3-JJCheng.docx of 2/26/2020 12:31 PM

Test Case 35-3 – Test if submenu File -> Title works correctly

The test was conducted following the step-by-step instructions provided in the RESOFF-TEST-001, Test Cases document. The RESRAD-OFFSITE code behaved expectedly for each step performed. The File > Title functions were implemented successfully.

12.62 TEST CASE 035-004 TESTER'S REPORT

Documented in Test Case 35-4-JJCheng.docx of 2/26/2020 12:37 PM

Test Case 35-4 – Test if the DCF Editor can be called successfully from the menu of GUI

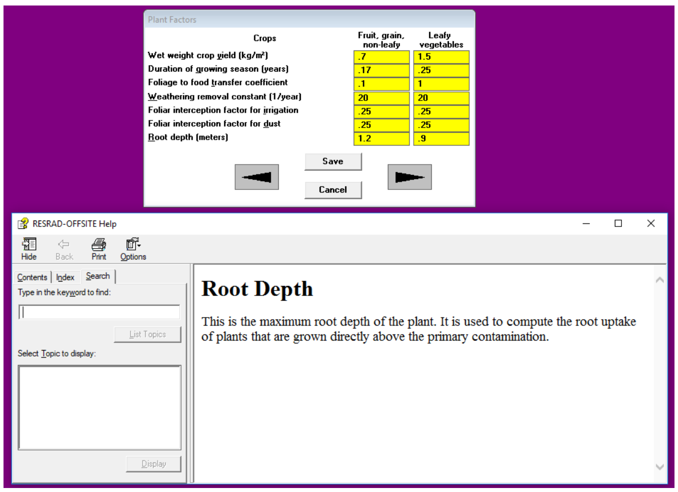
The test was conducted following the step-by-step instructions provided in the RESOFF-TEST-001, Test Cases document. In addition, the RESRAD-OFFSITE code was also tested to see if the DCF Editor could be called at any time during the maneuvering of the GUI. The DCF Editor appeared whenever called. The RESRAD-OFFSITE code behaved expectedly for each step performed.

12.63 TEST CASE 035-005 TESTER'S REPORT

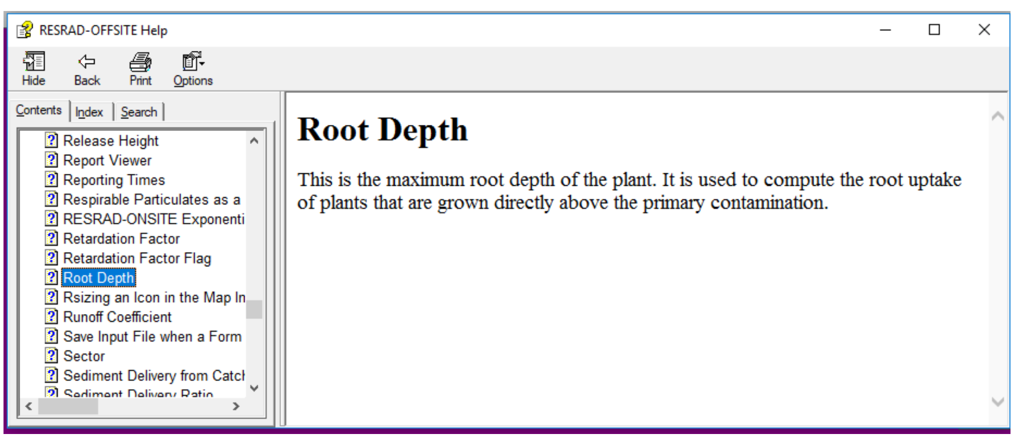
Documented in Test Case 35-5-JJCheng.docx of 2/26/2020 12:46 PM

Test Case 35-5 – Test the menu Help works appropriately.

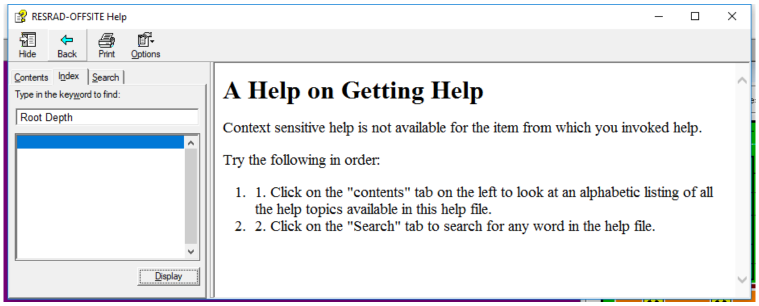
- Tested RESRAD-OFFSITE version 4.0 following the procedure described in the Test Cases document. The code behaved as exepected. For example, placing the cursor on the Root Depth parameter for fruit, grain, and non-leafy vegetables, and then clicked "F1," the context sensitive help appeared on the screen -



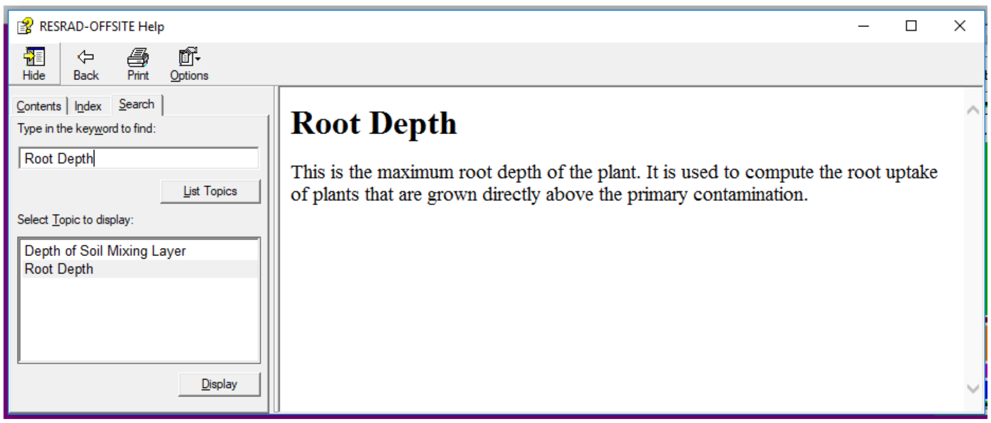
- Tested the functions of the DCF editor. Chose the "Contents" tab, selected "Root Depth," the corresponding help was displayed -



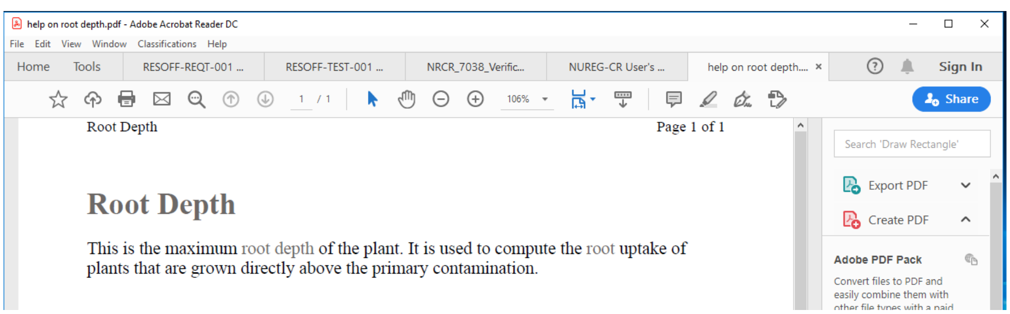
- Scrolled the contents list up to the top to show the help "A Help on Getting Help." Chose "Index," typed "Root Depth" in the input box, and then clicked the "Display" button at the bottom. The screen did not change. It seemed that a search of the help indexes was not conducted. However, this is a minor issue.



- Chose "Search," typed "Root Depth" in the input box, and then clicked "List Topics." Two topics appeared for selection. Chose "Root Depth," and saw the information on "Root Depth" appeared on the screen.



- Chose to print the information on "Root Depth" to a pdf. The DCF Editor did it successfully.



12.64 TEST CASE 035-006 TESTER'S REPORT

Documented in Test Case 35-6-JJCheng.docx of 2/26/2020 12:46 PM

Test Case 35-6 – Test the functionality of Pathway menu

The RESRAD-OFFSITE code was tested for the selection of pathways via the Pathways menu in the menu bar, the buttons in the pathway bar, the Inputs & Pathways tab in the Iconic Navigator, and the Set Pathways option in the left vertical panel. All worked without any issue.

12.65 TEST CASE 035-007 TESTER'S REPORT

Documented in Test Case 35-7-JJCheng.docx of 2/17/2020 9:56 AM

Test Case 35-7 – Test the functionality of Site Data menu

- Tested entering site data via the Site Data menu in the menu bar, the Inputs & Pathways tab in the Iconic Navigator, and the Modify Data option in the left vertical panel.
- Tested entering data with and without subforms being displayed vertically and horizontally. Tested entering data to a subform with the subform tab within a major input form.
- Tested entering data to different input forms via the right and left arrow tabs in an input form.
- Observed the grayed input parameters which were associated with inactive pathways and were not required for the dose/risk calculations.
- All the different ways tried allowed data entry of input parameters without any issue.

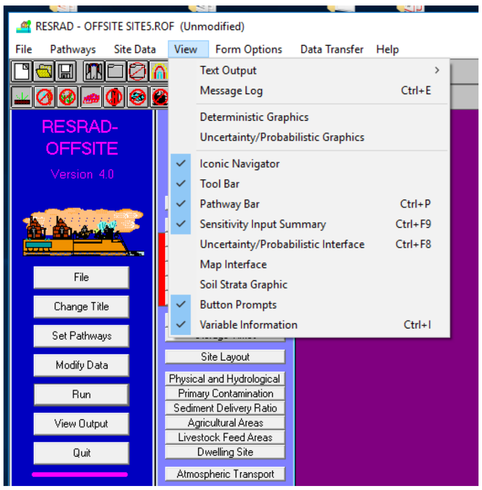
12.66 TEST CASE 035-008 TESTER'S REPORT

Documented in Test Case 35-8-JJCheng.docx of 2/17/2020 2:15 PM

Test Case 35-8 – Test the functionality of View menu

Modified the procedure described in the Test Cases document to perform the testing -

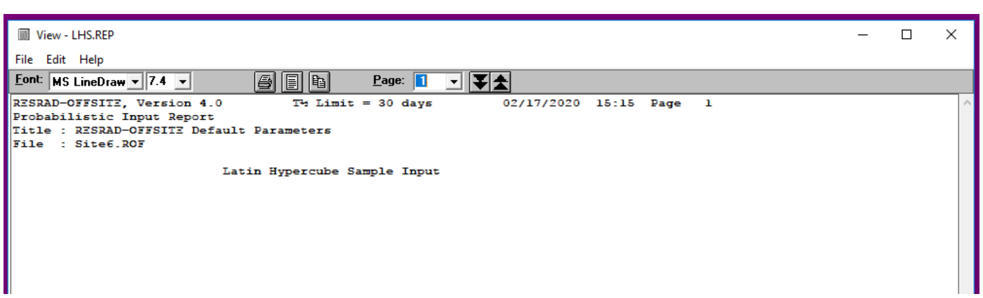
- Launch the code and click View menu. A drop down list should appear. Visually check the format, fonts, and spelling of the drop down list.



- Set cut-off to 30 days. Set the number of graphic points to 256. Select Pb-210. Choose thickness and total porosity of the contaminated zone for uncertainty analysis. Enter acceptable distribution functions and ranges. Set the number of observation to 100 and number of repetition to 1. Run the code.

- Click View -> text output to see if the following text reports are generated - Parent Dose, Risk, Progeny Dose, Uncertainty/Probabilistic Dose/Risk, Uncertainty/Probabilistic Inputs, and Linear Regression reports.

  The following shows the first page of the Uncertainty/Probabilistic Inputs report. There's no table of contents like the other text reports, which gives the illusion that the report is empty. Suggest to add table of contents to the first page or put the title "Latin Hypercube Sample Input" on the 2nd page and make the 2nd page the starting page of the report.



- Choose the Message Log option to see if OUTPUT.FIL file is available and is shown in the Viewer.

- Choose the Deterministic Graphics option to see if WRESPLOT.EXE is launched properly and the Graphics Viewer appears.

- Choose the Uncertainty/Probabilistic Graphics option to see if the Uncertainty/Probabilistic Analysis interactive Graphics Viewer appears.

- Check and uncheck the Iconic Navigator option to see if the Iconic Navigator window is turned on and off accordingly.

- Check and uncheck the tool bar option to see if the tool bar is shown or not shown accordingly.

- Check and uncheck the Pathway Bar option to see if the Pathway Bar is shown or not shown accordingly.

- Similarly, check and uncheck the Sensitivity Input Summary, the Uncertainty/Probabilistic Interface, the Map Interface, and the Soil Strata Graphics options to see if the corresponding window is shown or not shown accordingly.

- Check the Button Prompts option to see if descriptive information appears when the cursor is placed on any icon on the tool bar or on the Iconic Navigator.

- Check the Variable Information option to see if a variable information bar appears at the bottom of the interface. The variable information bar contains the name in the FORTRAN code, default value, and range of accepted input value for the input parameter that is highlighted at the moment. Try with the Area of Surface Water Body input parameter in the Surface Water Body input form. The variable information bar should display “Variable name: VLAKE Default: 150000 Range: 1 to 1E34.”

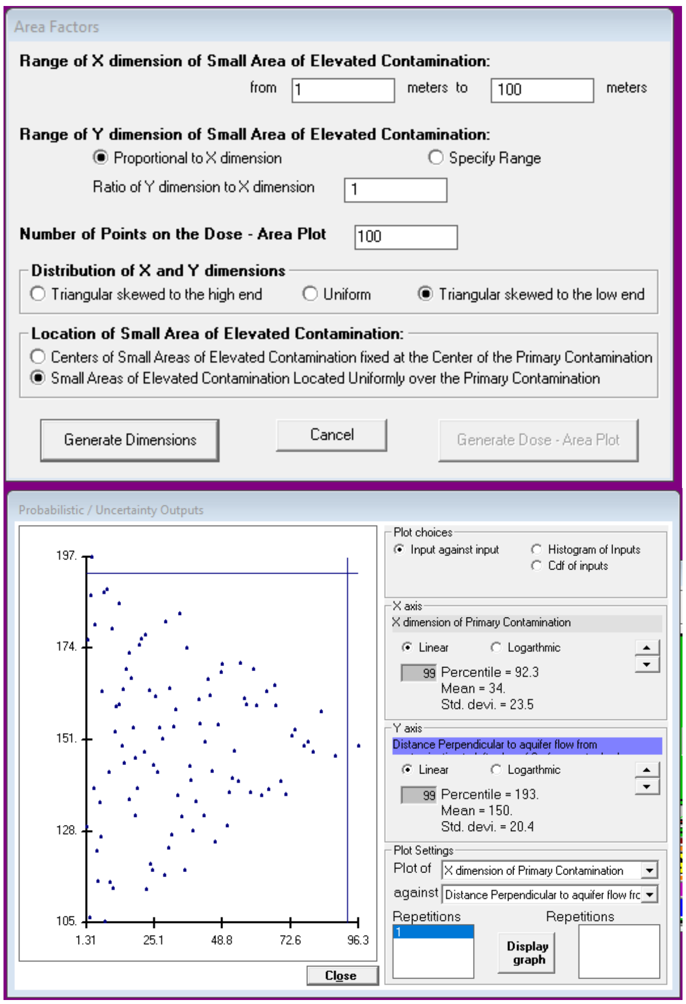
The RESRAD-OFFSITE code behaved as expected.

12.67 TEST CASE 035-009 TESTER'S REPORT

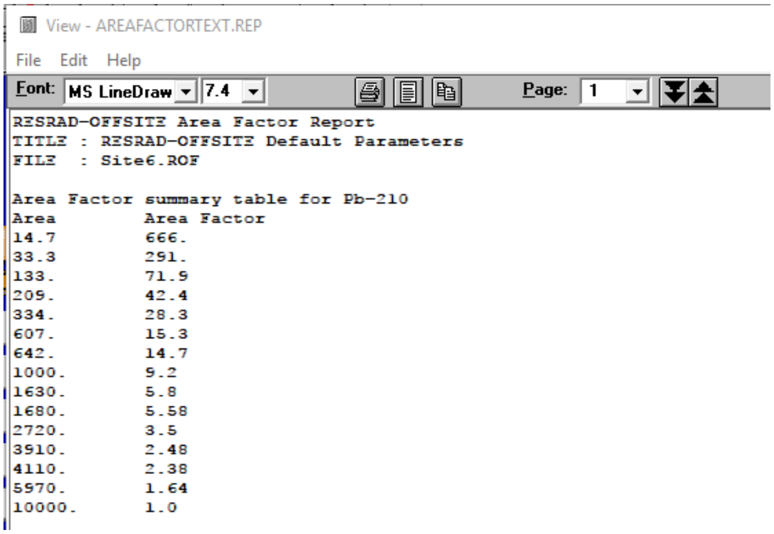
Documented in Test Case 35-9-JJCheng.docx of 2/17/2020 2:56 PM

Test Case 35-9 – Test the functionality of Text Output menu

- The test focused on the generation of the Area Factors report, because the generation of the other reports was verified with the previous test case, Test Case 35-8.
- Selected Generated Area Factors option under the File menu.
- Made changes in the Area Factors input form, and then clicked on Generate Dimensions. The X-dimension vs. Y-dimension scatter plot was generated –



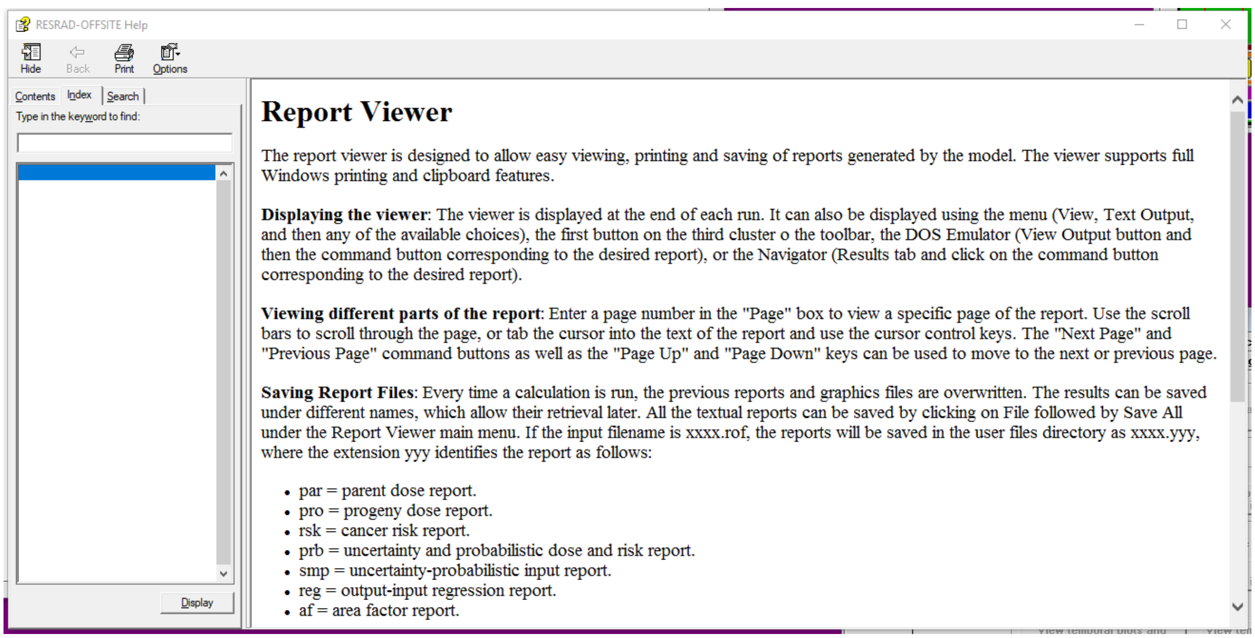
- Run uncertainty/probabilistic analysis (with a cut-off of 30 days, graphic points 256, and Pb-210 as the radionuclide of concern).
- The Area Factor report was successfully generated, which is shown below –




```
RESRAD-OFFSITE Area Factor Report
TITLE  : RESRAD-OFFSITE Default Parameters
FILE   : Site6.ROF

Area Factor summary table for Pb-210
Area         Area Factor
14.7         666.
33.3         291.
133.         71.9
209.         42.4
334.         28.3
607.         15.3
642.         14.7
1000.        9.2
1630.        5.8
1680.        5.58
2720.        3.5
3910.        2.48
4110.        2.38
5970.        1.64
10000.       1.0
```

- In the text Report Viewer, the functions of File, Edit, and Help button were tested and all worked properly. The following shows the Report Viewer instruction after clicking on the Help button -



Report Viewer

The report viewer is designed to allow easy viewing, printing and saving of reports generated by the model. The viewer supports full Windows printing and clipboard features.

Displaying the viewer: The viewer is displayed at the end of each run. It can also be displayed using the menu (View, Text Output, and then any of the available choices), the first button on the third cluster o the toolbar, the DOS Emulator (View Output button and then the command button corresponding to the desired report), or the Navigator (Results tab and click on the command button corresponding to the desired report).

Viewing different parts of the report: Enter a page number in the "Page" box to view a specific page of the report. Use the scroll bars to scroll through the page, or tab the cursor into the text of the report and use the cursor control keys. The "Next Page" and "Previous Page" command buttons as well as the "Page Up" and "Page Down" keys can be used to move to the next or previous page.

Saving Report Files: Every time a calculation is run, the previous reports and graphics files are overwritten. The results can be saved under different names, which allow their retrieval later. All the textual reports can be saved by clicking on File followed by Save All under the Report Viewer main menu. If the input filename is xxxx.rof, the reports will be saved in the user files directory as xxxx.yyy, where the extension yyy identifies the report as follows:

- par = parent dose report.
- pro = progeny dose report.
- rsk = cancer risk report.
- prb = uncertainty and probabilistic dose and risk report.
- smp = uncertainty-probabilistic input report.
- reg = output-input regression report.
- af = area factor report.

12.68 TEST CASE 035-010 TESTER'S REPORT

Documented in Test Case 35-10-JJCheng.docx of 2/17/2020 4:50 PM

Test Case 35-10 – Test the functionality of the Form Options menu

Modified the procedure described in the Test Cases document to perform the test. The procedure after modification is listed below -

- Launch the code and click the Form Options menu. Visually check the format, fonts, and spelling.

- Open the Initial Concentration input form and select Ac-227 with the default concentration. Choose the Form Options -> Save Current Form menu. The input form should be closed. Open the input form again and check if Ac-227 is selected with a concentration of 100 pCi/g.

- In the Initial Concentration input form, click the Nuclide Specific Release button and the corresponding input form should pop up. Select "Specify the First Order Leach Rate Constant," change the value from 0 to 10, and then click the Form Option -> Cancel Current Form menu. The Radionuclide Specific Release input form should be closed. Open it again and check to see if the value of the First Order Leach Rate Constant is 0 rather than 10.

- Change the First Order Leach Rate Constant to 10, then save and close the Radionuclide Specific Release input form. Open the input form again, the value for the leach rate constant should be changed to 10 now. Click the Form Option -> Cancel Current Form menu to close the input form. Open the input form and check the value of the leach rate constant again. The value should still be 10.

- Restore the value of the leach rate constant to 0 by pressing the F6 key. Click Save to close the input form. At this time, the Initial Concentration input form should still be open.

- While the cursor highlights the input field for the concentration of Ac-227, click the Form Option -> Cancel Current Form menu. A warning message "Changes to the Initial Concentration form cannot be canceled. Changes have to be reserved manually." would pop up. Click Ok and close the message window.

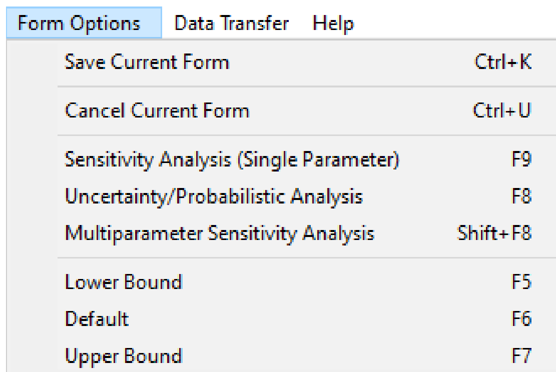
- Open the Distribution Coefficients input form, move cursor to the Contaminated zone input field, which has a default value of 20. Click the Form Options -> Sensitivity Analysis (Single Parameter) menu, the Set Sensitivity Analysis Range window should pop up. Click Cancel to close the window.

- Open the Distribution Coefficients input form, move the cursor to the Unsaturated Zone 1 input field. Click the Form Options -> Uncertainty/Probabilistic Analysis menu. The Uncertainty and Probabilistic Analysis input window should pop up. Click Ok to close the window.

- Open the Physical and Hydrological input form, put cursor on the precipitation input field. Choose the Form Options -> Uncertainty/Probabilistic Analysis menu. The Uncertainty and Probabilistic Analysis input window should pop up. There is no default distribution for the precipitation parameter. Enter 0.8 as the minimum and 1.2 as the maximum so that the uniform distribution function is accepted. Click Update Parameter Stats and Distribution to update the inputs and then OK to close the window. Choose the View -> Uncertainty/Probabilistic Interface menu again. The precipitation parameter should appear in the Uncertainty and Probabilistic Analysis input window.

- Choose Primary Contamination in the Modify Data vertical panel. In the Primary Contamination input form, move the cursor to the input field of the dry bulk density of the contaminated zone. (Make sure the variable information bar appears at the bottom of the screen. If not, choose the View -> Variable Information menu to show it. The accepted range of the dry bulk density is 0.001 – 22.5.) Choose the Form Options -> Lower Bound menu to change the input to the minimum value of 0.001. Choose the Form Options -> Upper Bound menu to change the input to the maximum value of 22.5. Choose the Form Options -> Default menu to reset the value back to the default of 0.4.

- Repeat Steps 1-10 using the hot-keys for each of the menu option (shown below).



The RESRAD-OFFSITE code behaved as expected.

12.69 TEST CASE 035-011 TESTER'S REPORT

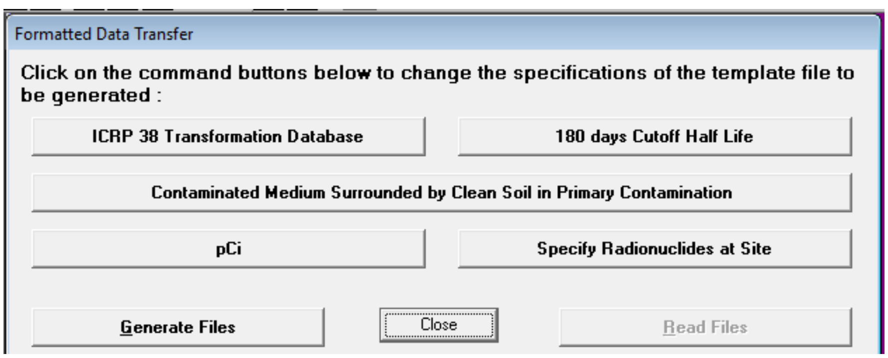
Documented in Test Case 35-11-JJCheng.docx of 2/18/2020 11:35 AM

Test Case 35-11 – Test the functionality of Data Transfer menu

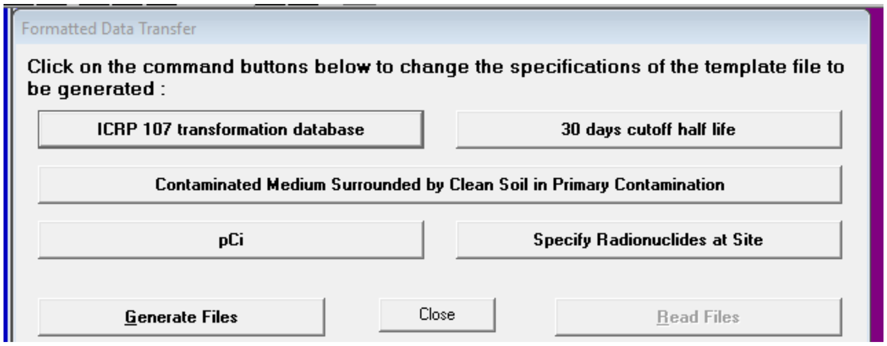
Modified the procedure described in the Test Cases document to perform the test. The modified procedure is described below –

- Launch RESRAD-OFFSITE, choose ICRP 38 database, and set the cut-off half-life to 180 days in the Title & Radiological Data input form. Choose "pCi" and "mrem" as the radiological units and "Specify initial activity based on mass of contaminated medium" as the conceptualization choice for the primary contamination in the Preliminary Inputs form. Choose U-234, U-235, and U-238 each with an initial concentration of 100 pCi/g in the Initial Concentrations input form. Click on the Distribution Coefficients tab and specify a Kd of 100 cm3/g for the contaminated zone for all three uranium isotopes.

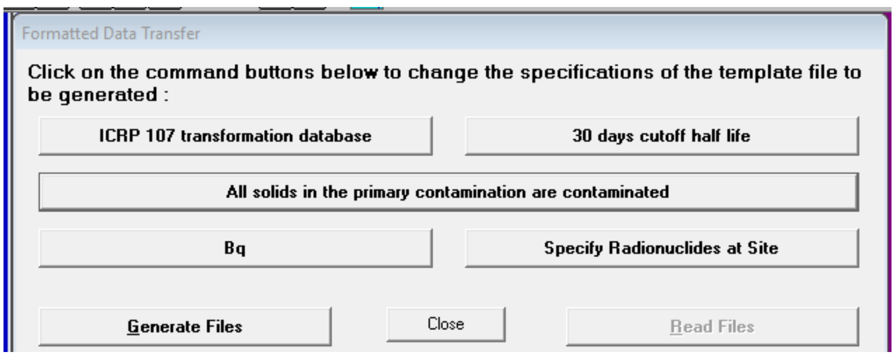
- Choose Data Transfer -> Generate Template Files from the menu bar. The selection tabs should display the specifications made in the previous step –



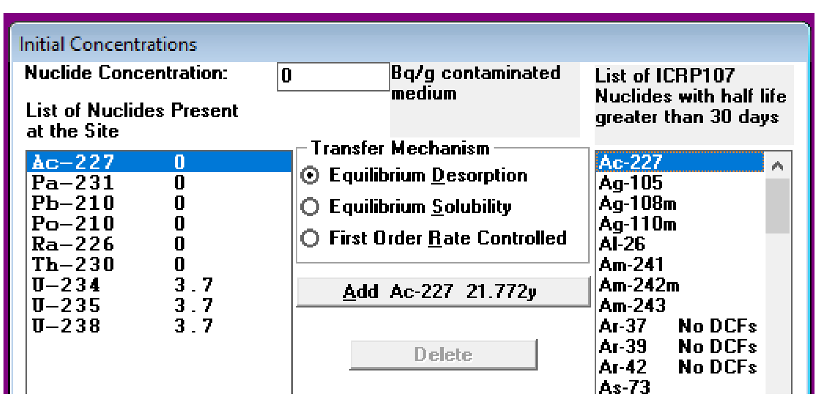
- Click on the "ICRP 38 Transformation Database" tab. The Title & Radiological Data input form should appear. Change the database from ICRP 38 to ICRP 107. Change the cut-off half-life from 180 days to 30 days. Close the input form. The tab with information on database should now show ICRP 107 as the selected transformation database, and the tab with information on cut-off half-life should now show 30 days as the selected cut-off value.



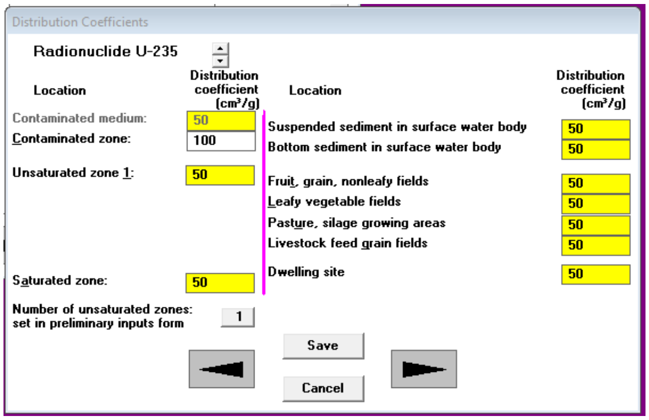
- Click the "Contaminated Medium Surrounded by Clean Soil in Primary Contamination" tab. The Preliminary Inputs input form should appear. Change the radiological units from pCi to Bq and from mrem to mSv. Change the conceptualization choice to "Specify initial activity based on mass of entire primary contamination." Save the input form. The tab with information on conceptualization choice and radiological unit should now show the choices just made with the Preliminary Inputs input form.

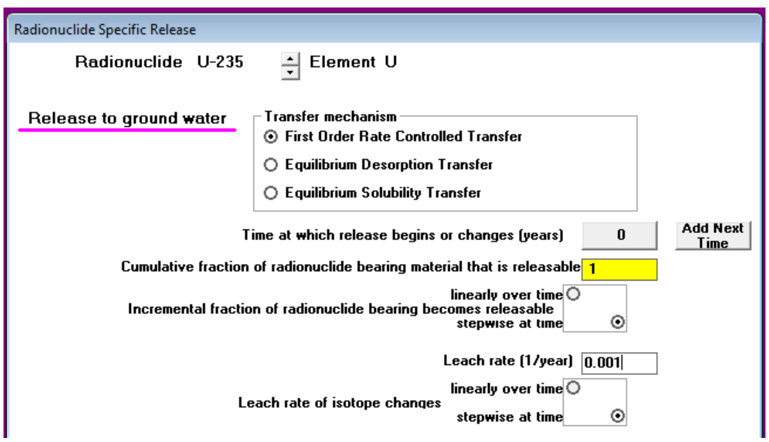


- Click on the "Specify Radionuclides at Site" tab. The Initial Concentrations input form should appear. Po-210 should appear in the nuclide list and the concentration of the three uranium isotopes should be 3.7 Bq/g. Equilibrium Desorption should be the choice of conceptualization.



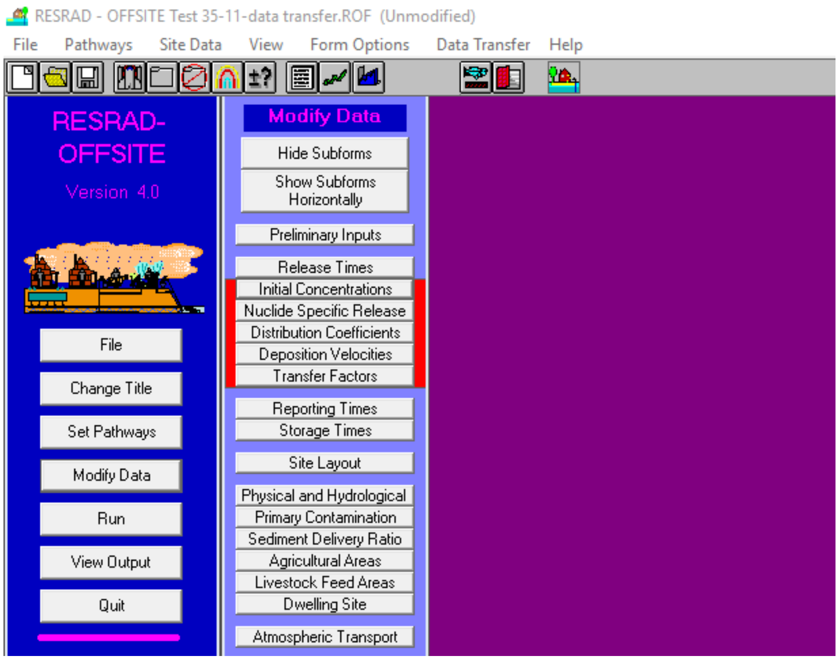
- Highlight U-235 and click the Distribution Coefficients tab. In the pop-up input form, the input field for the contaminated medium should be grayed (the value cannot be changed). Save the input form. Click the Nuclide Specific Release tab. In the pop-up input form, change the transfer mechanism to "First Order Rate Controlled Transfer" and specify a leach rate of 0.001 /yr. Save the Radionuclide Specific Release input form. Close the Initial Concentrations input form.





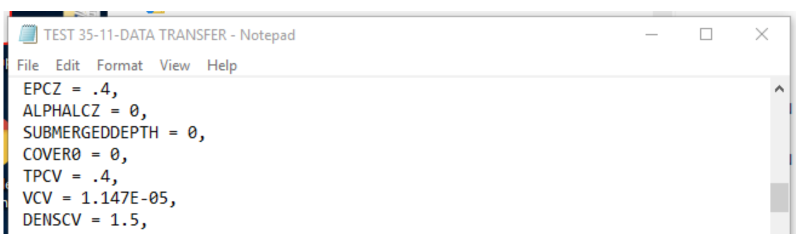
- Click on the Generate Files tab. Provide a file name, Test 35-11-data transfer, and save the file to the UserFiles subfolder. Close the Formatted Data Transfer input form.

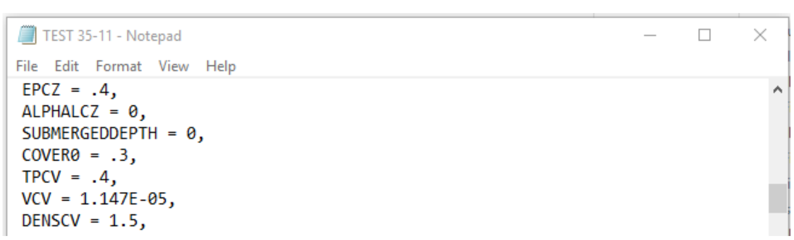
- In the main interface, the information displayed at the top should show "Test 35-11-data transfer.ROF" as the name of the input file. Open the Primary Contamination input form. Add a clean cover of 0.3 m and save the input form. Choose the File -> Save As menu and save the input data to a new file, "TEST 35-11." Exit from RESRAD-OFFSITE.



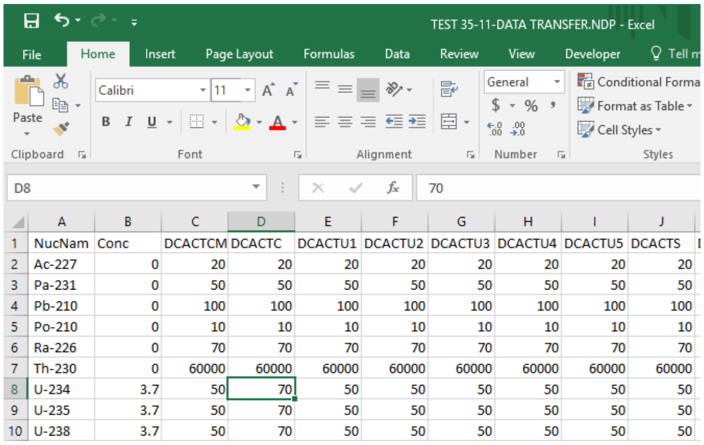
- Go to the UserFiles subfolder. Two Excel files named "TEST 35-11-DATA TRANSFER.NID" and "TEST 35-11-DATA TRANSFER.NPD" should be generated. In addition, there should be two RESRAD-OFFSITE input files, TEST 35-11.ROF and TEST 35-11-DATA TRASFER.ROF.

- Open the two *.ROF input files separately with Notepad and compare the contents. The only difference should be the value for the "COVER0" parameter. In TEST35-11-DATA TRANSFER.ROF, the value is 0, while in TEST35-11.ROF, the value is .3.

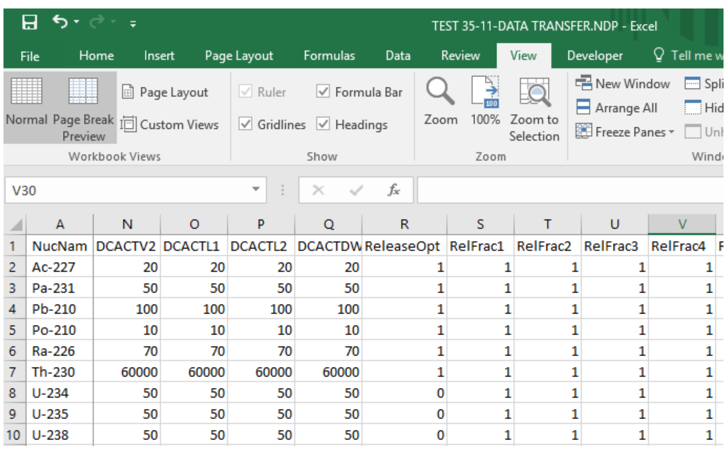




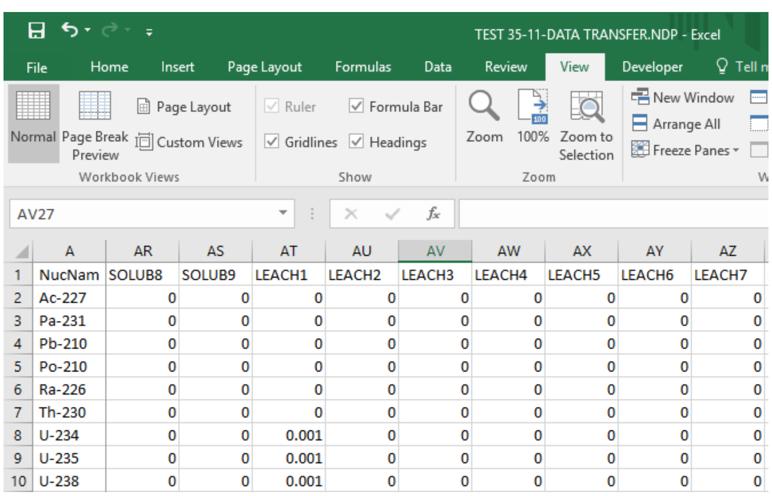
- Open TEST35-11-DATA TRANSFER.ROF with Notepad, change the COVER0 value from 0 to 0.3, and then save and close the file. Open the Excel file TEST 35-11-DATA TRASFER.NID. In row 81, change the value for THICK0 from 2 to 2.5, and then save and close the file. Note that the value for COVER0 is 0; do not change it. Open the Excel file TEST 35-11-DATA TRASFER.NDD; in column D for DCACTC, change the value for U-234, U-235, and U-238 from 100 to 70; in column R for Release Opt, change the value for U-234 and U-238 from 0 to 1 to be the same as that for U-235; and in column AT for LEACH1, change the value for U-234 and U-238 from 0 to 0.001 to be the same as the value for U-235; save and close the file.



	A	B	C	D	E	F	G	H	I	J
1	NucNam	Conc	DCACTCM	DCACTC	DCACTU1	DCACTU2	DCACTU3	DCACTU4	DCACTU5	DCACTS
2	Ac-227	0	20	20	20	20	20	20	20	20
3	Pa-231	0	50	50	50	50	50	50	50	50
4	Pb-210	0	100	100	100	100	100	100	100	100
5	Po-210	0	10	10	10	10	10	10	10	10
6	Ra-226	0	70	70	70	70	70	70	70	70
7	Th-230	0	60000	60000	60000	60000	60000	60000	60000	60000
8	U-234	3.7	50	70	50	50	50	50	50	50
9	U-235	3.7	50	70	50	50	50	50	50	50
10	U-238	3.7	50	70	50	50	50	50	50	50

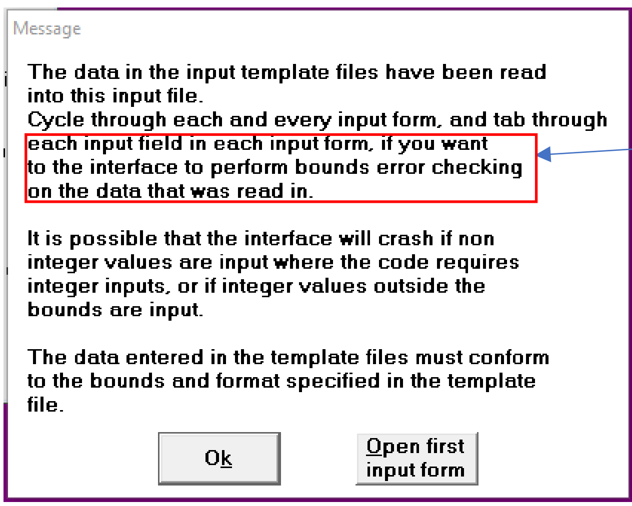


	A	N	O	P	Q	R	S	T	U	V
1	NucNam	DCACTV2	DCACTL1	DCACTL2	DCACTDW	ReleaseOpt	RelFrac1	RelFrac2	RelFrac3	RelFrac4
2	Ac-227	20	20	20	20	1	1	1	1	1
3	Pa-231	50	50	50	50	1	1	1	1	1
4	Pb-210	100	100	100	100	1	1	1	1	1
5	Po-210	10	10	10	10	1	1	1	1	1
6	Ra-226	70	70	70	70	1	1	1	1	1
7	Th-230	60000	60000	60000	60000	1	1	1	1	1
8	U-234	50	50	50	50	0	1	1	1	1
9	U-235	50	50	50	50	0	1	1	1	1
10	U-238	50	50	50	50	0	1	1	1	1



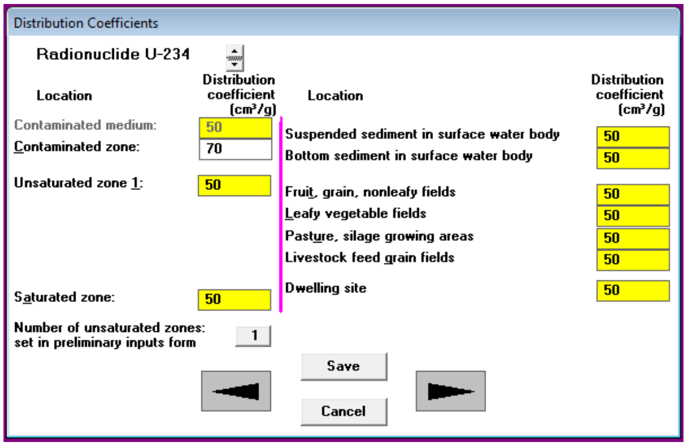
	A	AR	AS	AT	AU	AV	AW	AX	AY	AZ
1	NucNam	SOLUB8	SOLUB9	LEACH1	LEACH2	LEACH3	LEACH4	LEACH5	LEACH6	LEACH7
2	Ac-227	0	0	0	0	0	0	0	0	0
3	Pa-231	0	0	0	0	0	0	0	0	0
4	Pb-210	0	0	0	0	0	0	0	0	0
5	Po-210	0	0	0	0	0	0	0	0	0
6	Ra-226	0	0	0	0	0	0	0	0	0
7	Th-230	0	0	0	0	0	0	0	0	0
8	U-234	0	0	0.001	0	0	0	0	0	0
9	U-235	0	0	0.001	0	0	0	0	0	0
10	U-238	0	0	0.001	0	0	0	0	0	0

- Launch RESRAD-OFFSITE again. Open and read in data from the input file TEST35-11-DATA TRANSFER.ROF. In the Title & Radiological Data input form, the transformation database should be ICRP 107 and the cut-off half-life should be 30 days. In the Initial Concentrations input form, the concentration for the uranium isotopes should be 3.7 Bq/g. In the Distribution Coefficient input form, the value of U-234, U-235, and U-238 for the contaminated zone should be 100 cm3/g. In the Radionuclide Specific Release input form, for U-234 and U-238, the transfer mechanism should be Equilibrium Desorption Transfer. For U-235, the transfer mechanism should be First Order Rate Controlled Transfer, with a leach rate of 0.001/yr. In the Primary Contamination input form, the thickness of clean cover should be 0.3 m, and the thickness of the contaminated zone should be 2 m.
- Choose Data Transfer -> Read Template Files from the menu bar. Click the "Read Files" tab in the pop-up window. Choose to open TEST 35-11-DATA TRANSFER.ROF in the UserFiles subfolder. A message window should pop up giving warnings that the interface may crash and advising the user to cycle through input forms. Click OK to read in the data in the template files. Click Close to close the Formatted Data Transfer window.

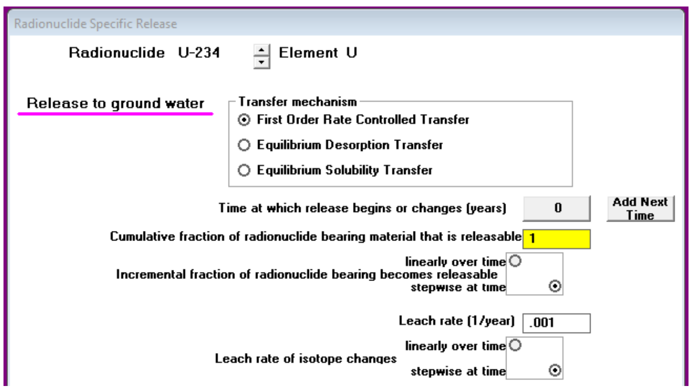


Suggestion: Revise the statement highlighted.

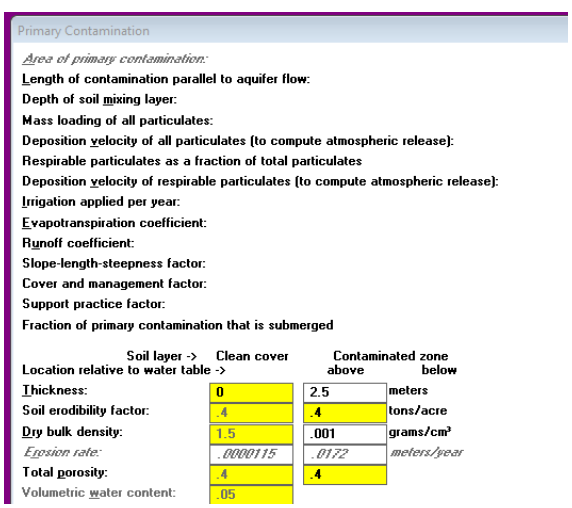
- Open the Initial Concentrations input form, then choose the Distribution Coefficients tab. The Kd of U-234, U-235, and U-238 for the contaminate zone should be changed to 70 cm3/g. Close the Distribution Coefficients input form.



- Choose the Nuclide Specific Release tab, the transfer mechanism for U-234 should be changed to First Order Rate Controlled Transfer with a leach rate of 0.001/yr. Same for U-238.



- Open the Primary Contamination input form. The input value for thickness of the clean cover should be reset to 0 m, and the thickness for the contaminated zone should be changed to 2.5 m.



During the testing, the RESRAD-OFFSITE behaved as expected.

12.70 TEST CASE 035-012 TESTER'S REPORT

Documented in Test Case 35-12-JJCheng.docx of 2/26/2020 12:53 PM

Test Case 35-12 – Test the GUI's input functionality from control level

The test was performed following the instructions in the Test Cases document. The RESRAD-OFFSITE code behaved expectedly for each step. It is noted that the functions of F5, F6, and F7 (change the input value to the min., default, and max., respectively) do not apply to the input parameters in the Nuclide Specific Release, Distribution Coefficients, Deposition Velocities, and Transfer Factors input forms as designed.

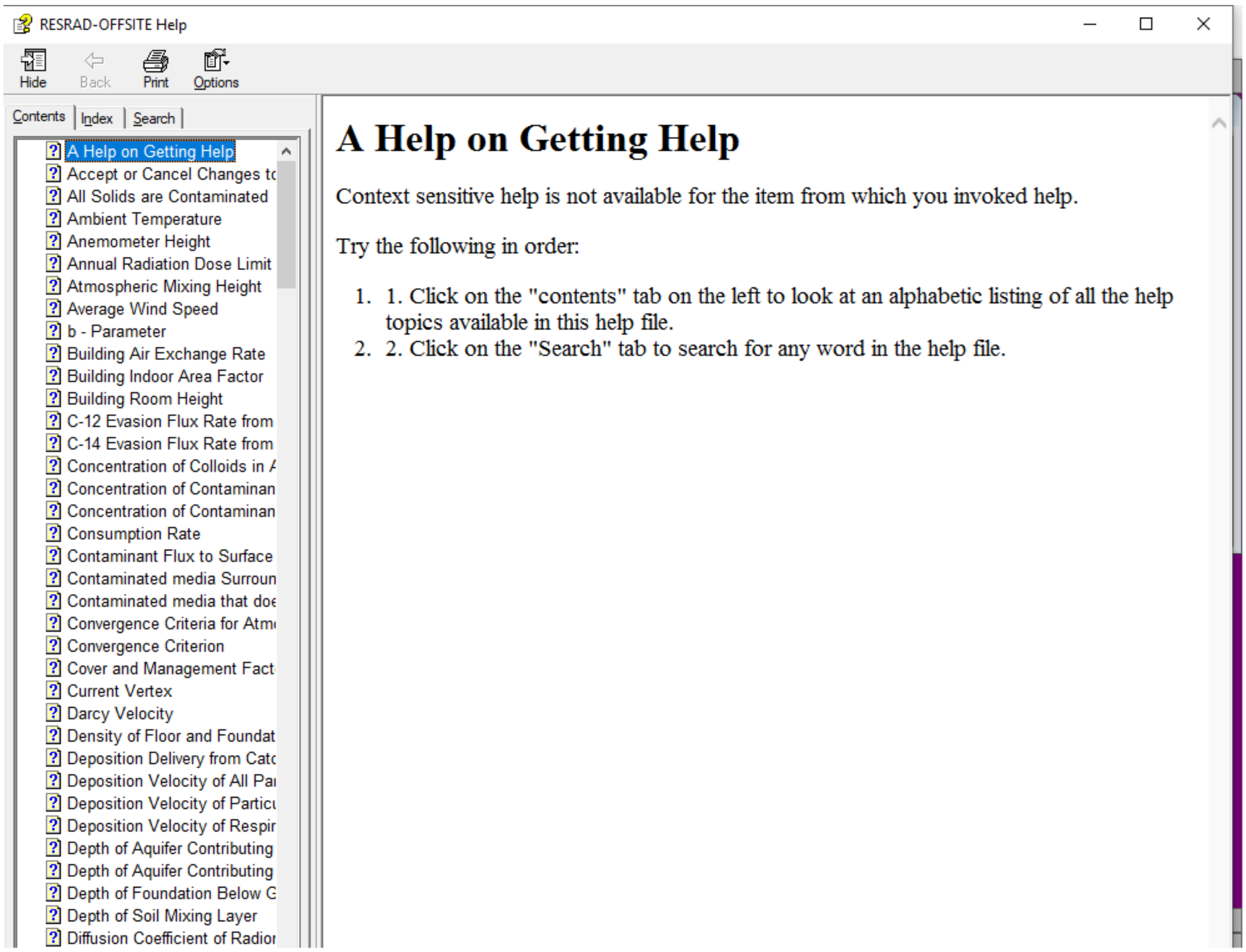
12.71 TEST CASE 036-001 TESTER'S REPORT

Documented in Test Case 036-001.msg of 2/20/2020 11:14 AM

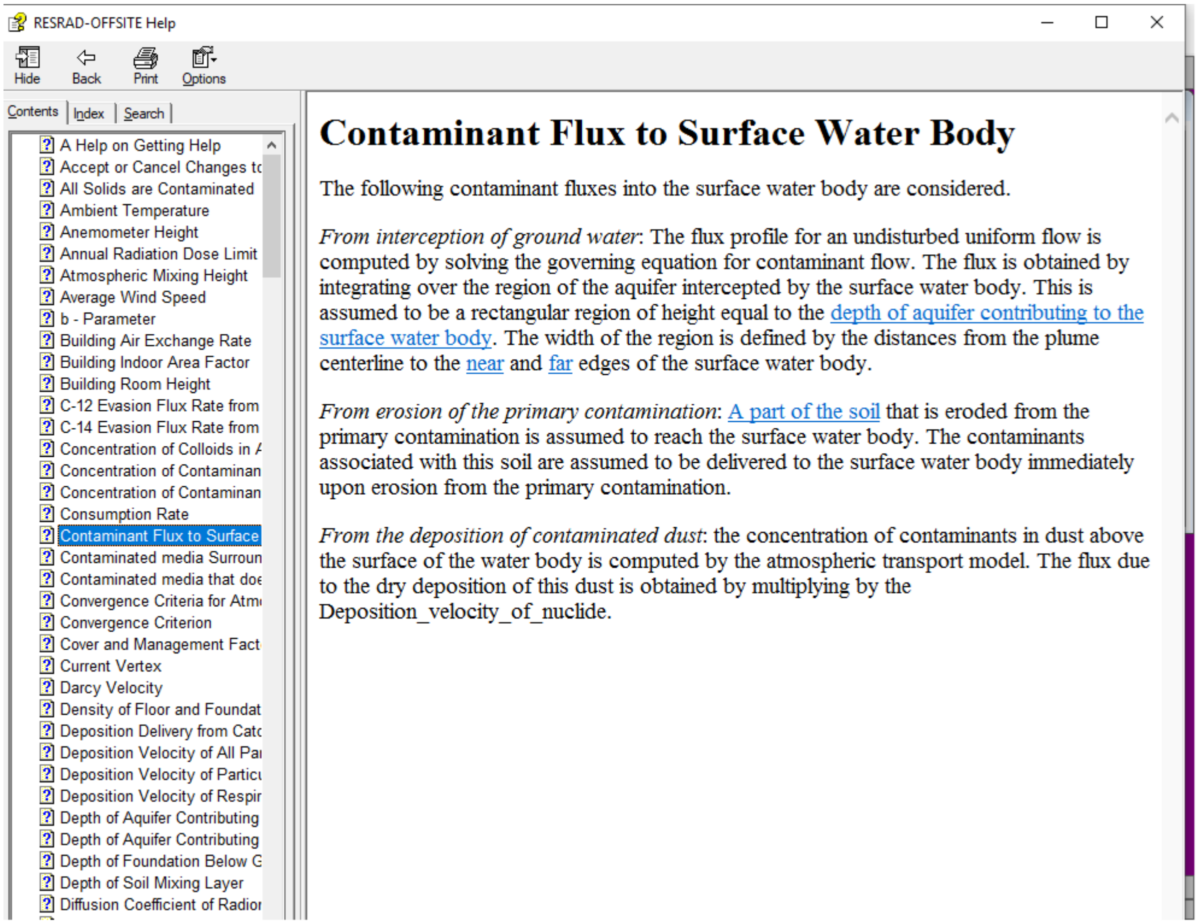
Test Case 036-001

LePoire, David J. Thu 2/19/2020 1:46 PM

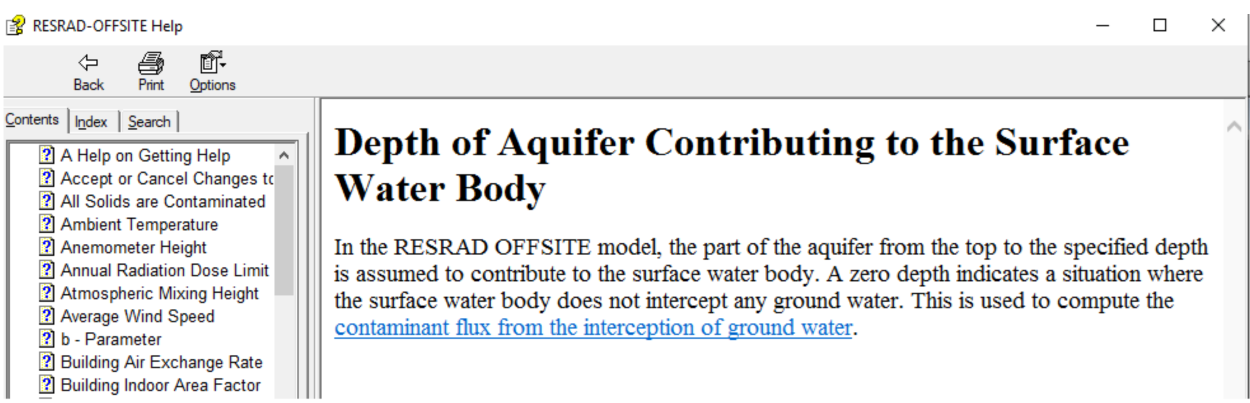
Opened Help



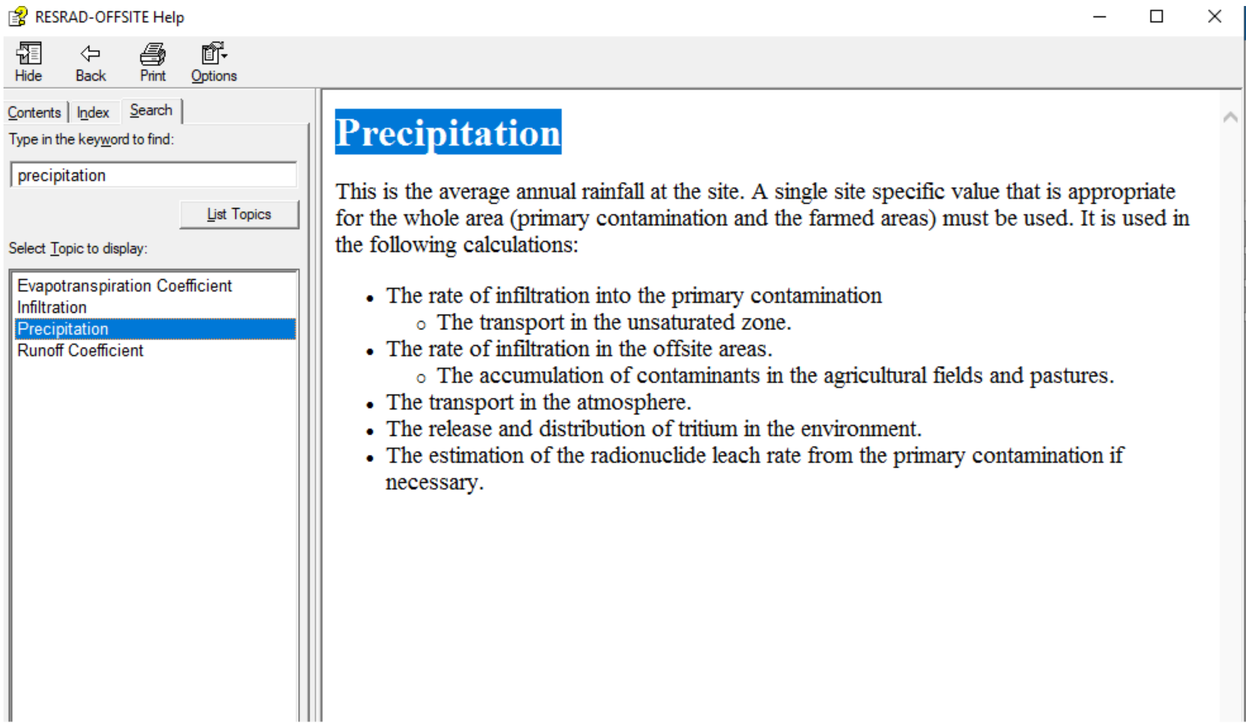
Help topic comes up

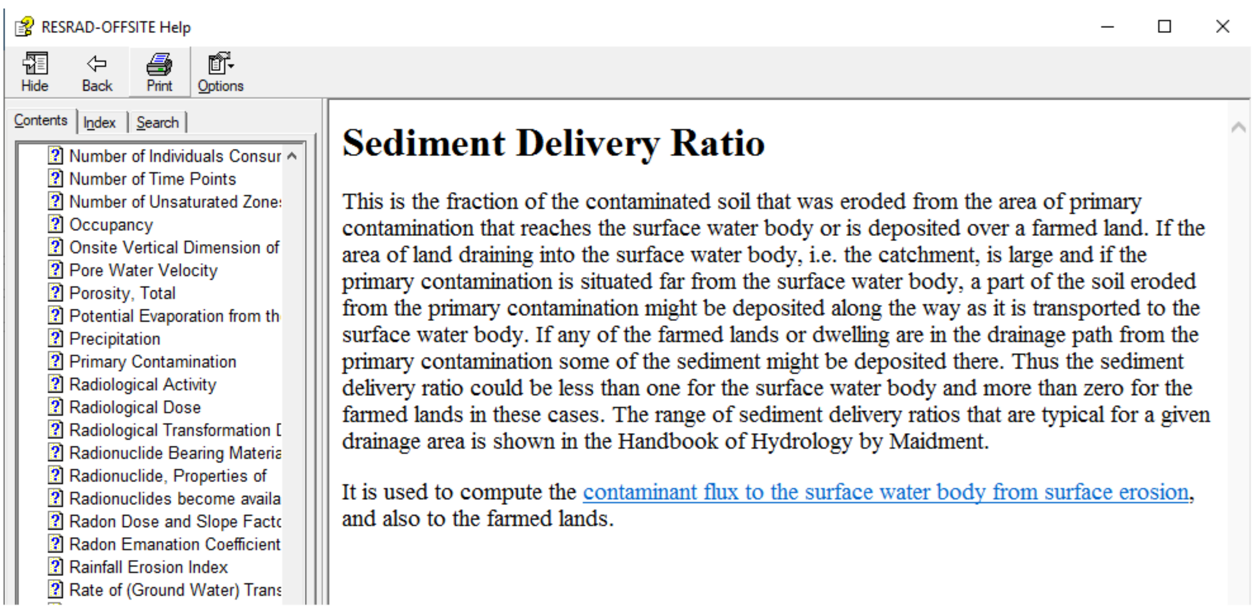


Links work:



Search works:





12.72 TEST CASE 037 TESTER'S REPORT

Documented in Test Case 037.msg of 2/20/2020 11:13 AM

Test Case 037

LePoire, David J. Thu 2/19/2020 2:24 PM

Summary: compared 4 nuclides in DCF editor, input echo and manual. All the same after putting in the same units.

Comparison of Data

	DCF Editor & input Echo			Manual (A2.1 and A2.2)			Comparison		
	mrem/pCi			mSv/Bq		A2.1			
	Ing	Inh	Ext_vol	Ing	Inh	Ext_vol			
Co-60	2.69E-05	2.19E-04	16.22	7.27E-06	5.92E-05	4.38	1.000037176	0.999817	1.000863878
Ir-192	5.74E-06	2.82E-05	4.614	1.55E-06	7.62E-06	1.25	1.00087184	1.000213	0.997621622
Ir-192m	1.57E-06	3.85E-04	0.751	4.24E-07	1.04E-04	0.203	1.000764916	1.00052	0.999866862
H-3	6.40E-08	6.40E-08	0	1.73E-08	1.73E-08	0	0.999843774	0.999844	#DIV/0!

Get PM scope:

Mon 2/17/2020 11:30 AM

YC

Yu, Charley

RE: RESRAD-OFFSITE Testing

To Kamboj, Sunita

Cc LePoire, David J.; Wang, Cheng; Cheng, Jing-Jy; Gnanapragasam, Emmanuel; Beckman, Kevin J.

Yes, pick typical radionuclides found at DOE and NRC sites.

Charley

From: Kamboj, Sunita
Sent: Monday, February 17, 2020 11:22 AM
To: Yu, Charley <cyu@anl.gov>
Cc: LePoire, David J. <dlepoire@anl.gov>; Wang, Cheng <wangcheng@anl.gov>; Cheng, Jing-Jy <jche
Kevin J. <kbeckman@anl.gov>
Subject: RESRAD-OFFSITE Testing

Charley,

For Test Cases 37-40 and Test Case 42, under Procedure it mentions

Spot check based on PM scope request

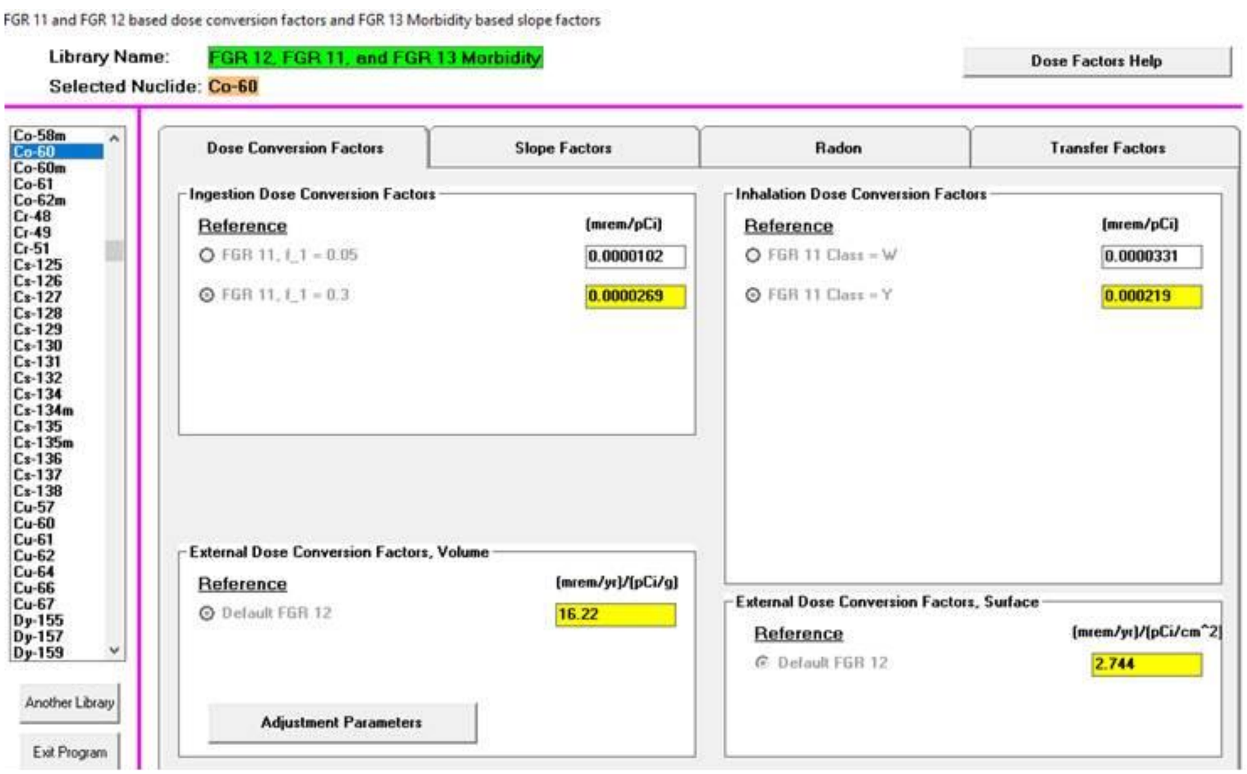
Can I pick 3 -5 radionuclides/elements for spot checking?

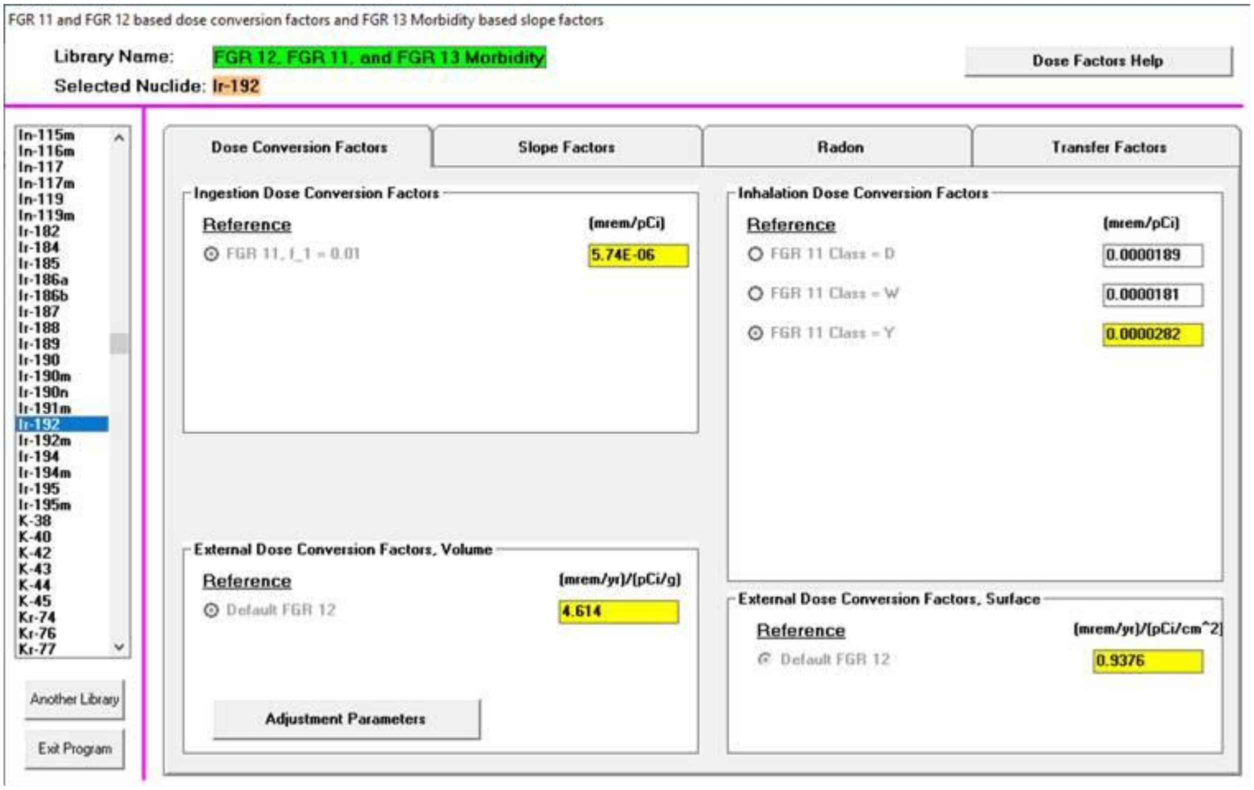
Thanks,
Sunita

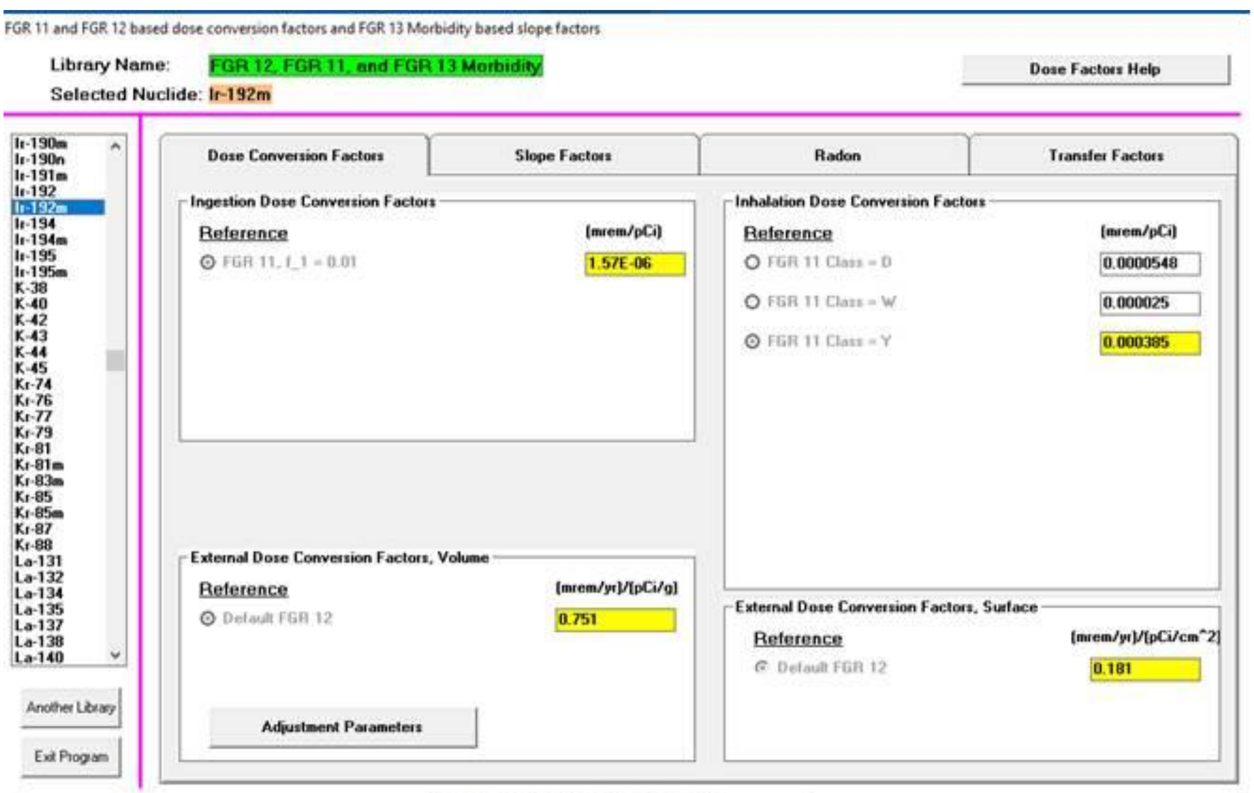
Co-60 ICRP-38 FGR11

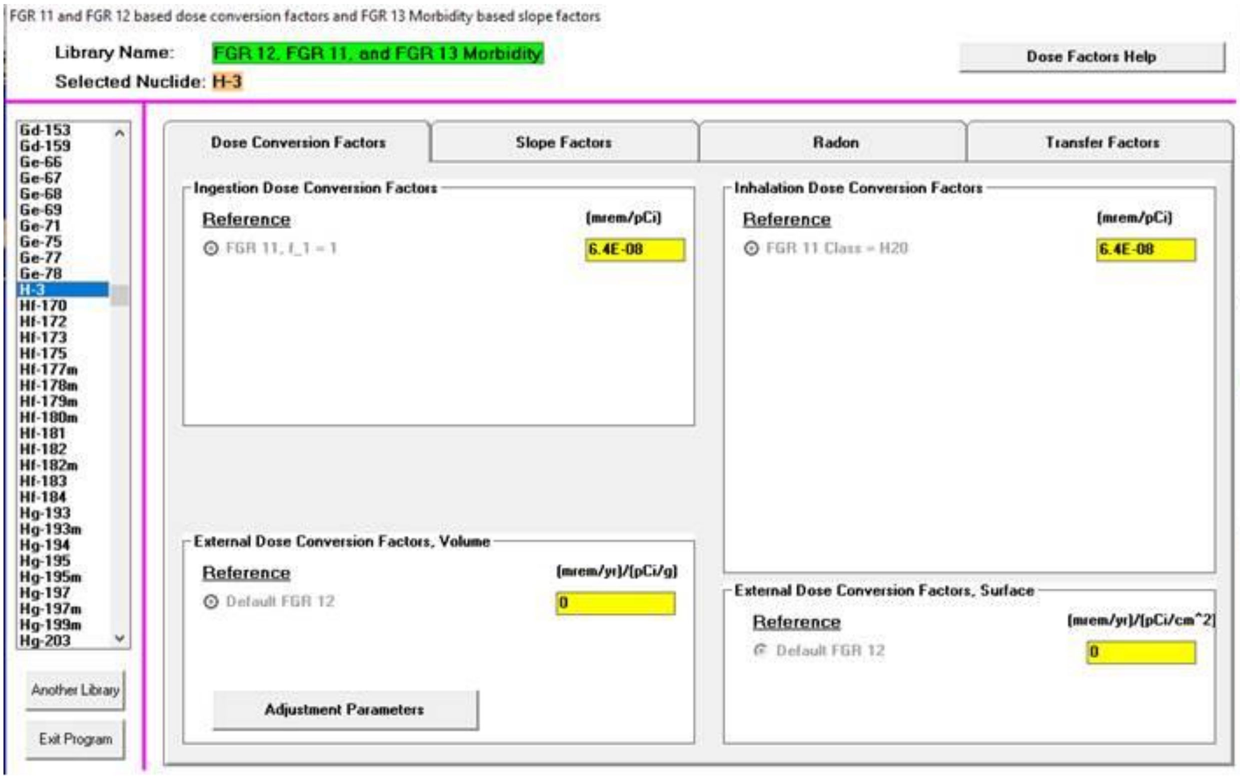
TABLE A.2-1 (Cont.)

Radionuclide	Volume Dose Coefficients[a] (mSv/yr per Bq/g)	Fitting Parameters[b]			
		CF_A	CF_B	CF_KA (cm2/g)	CF_KB (cm2/g)
Co-58	1.61E+00	0.923	0.077	9.00E-02	1.34E+00
Co-60	4.38E+00	0.076	0.924	1.28E+00	7.80E-02
Co-60m	6.67E-03	0.12	0.88	1.17E+00	7.90E-02
H-3	0.00E+00	0	0	0.00E+00	0.00E+00
Ir-192	1.25E+00	0.931	0.069	1.08E-01	1.49E+00
Ir-192m	2.03E-01	0.932	0.068	1.41E-01	1.61E+00




FGR 11 and FGR 12 based dose conversion factors and FGR 13 Morbidity based slope factors
Library Name: FGR 12, FGR 11, and FGR 13 Morbidity
Selected Nuclide: Ir-192
Dose Factors Help
In-115m
In-116m
In-117
In-117m
In-119
In-119m
Ir-182
Ir-184
Ir-185
Ir-186a
Ir-186b
Ir-187
Ir-188
Ir-189
Ir-190
Ir-190m
Ir-190n
Ir-191m
Ir-192
Ir-192m
Ir-194
Ir-194m
Ir-195
Ir-195m
K-38
K-40
K-42
K-43
K-44
K-45
Kr-74
Kr-76
Kr-77
Another Library
Exit Program
Dose Conversion Factors
Slope Factors
Radon
Transfer Factors
Ingestion Dose Conversion Factors
Reference
(mrem/pCi)
FGR 11, f_1 = 0.01
5.74E-06
Inhalation Dose Conversion Factors
Reference
(mrem/pCi)
FGR 11 Class = D
0.0000189
FGR 11 Class = W
0.0000181
FGR 11 Class = Y
0.0000282
External Dose Conversion Factors, Volume
Reference
(mrem/yr)/(pCi/g)
Default FGR 12
4.614
External Dose Conversion Factors, Surface
Reference
(mrem/yr)/(pCi/cm^2)
Default FGR 12
0.9376
Adjustment Parameters


FGR 11 and FGR 12 based dose conversion factors and FGR 13 Morbidity based slope factors
Library Name: FGR 12, FGR 11, and FGR 13 Morbidity
Selected Nuclide: Ir-192m
Dose Factors Help
Ir-190m
Ir-190n
Ir-191m
Ir-192
Ir-192m
Ir-194
Ir-194m
Ir-195
Ir-195m
K-38
K-40
K-42
K-43
K-44
K-45
Kr-74
Kr-76
Kr-77
Kr-79
Kr-81
Kr-81m
Kr-83m
Kr-85
Kr-85m
Kr-87
Kr-88
La-131
La-132
La-134
La-135
La-137
La-138
La-140
Another Library
Exit Program
Dose Conversion Factors
Slope Factors
Radon
Transfer Factors
Ingestion Dose Conversion Factors
Reference
(mrem/pCi)
FGR 11, f_1 = 0.01
1.57E-06
Inhalation Dose Conversion Factors
Reference
(mrem/pCi)
FGR 11 Class = D
0.0000548
FGR 11 Class = W
0.000025
FGR 11 Class = Y
0.000385
External Dose Conversion Factors, Volume
Reference
(mrem/yr)/(pCi/g)
Default FGR 12
0.751
External Dose Conversion Factors, Surface
Reference
(mrem/yr)/(pCi/cm^2)
Default FGR 12
0.181
Adjustment Parameters



RESRAD-OFFSITE, Version 4.0 T½ Limit = 30 days 02/19/2020 15:52 Page 2
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File : SATURATED FLUXIN KD 10_test.ROF

Dose Conversion Factor (and Related) Parameter Summary
Current Library: FGR 12
Default Library: FGR 12

Menu	Parameter	Current Value	Default	Parameter Name
DCSF	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
DCSF	Co-60 (Source: FGR 12)	1.622E+01	1.622E+01	DCFEXT(1)
DCSF	H-3 (Source: FGR 12)	0.000E+00	0.000E+00	DCFEXT(2)
DCSF	Ir-192 (Source: FGR 12)	4.614E+00	4.614E+00	DCFEXT(3)
DCSF	Ir-192m (Source: FGR 12)	7.510E-01	7.510E-01	DCFEXT(4)

Current Library: FGR 11
Default Library: FGR 11

Menu	Parameter	Current Value	Default	Parameter Name
DCSF	Dose conversion factors for inhalation, mrem/pCi:			
DCSF	Co-60	2.190E-04	2.190E-04	DCF2(1)
DCSF	H-3	6.400E-08	6.400E-08	DCF2(2)
DCSF	Ir-192	2.820E-05	2.820E-05	DCF2(3)
DCSF	Ir-192m	3.850E-04	3.850E-04	DCF2(4)
DCSF	Dose conversion factors for ingestion, mrem/pCi:			
DCSF	Co-60	2.690E-05	2.690E-05	DCF3(1)
DCSF	H-3	6.400E-08	6.400E-08	DCF3(2)
DCSF	Ir-192	5.740E-06	5.740E-06	DCF3(3)
DCSF	Ir-192m	1.570E-06	1.570E-06	DCF3(4)

12.73 TEST CASE 038 TESTER'S REPORT

Documented in Test Case 038.msg of 2/20/2020 11:13 AM

Test Case 038

LePoire, David J. Thu 2/20/2020 6:52 AM

Summary: compared the slope factors for a number of radionuclides with data from the DCF editor, the input echo, and the manual. All were consistent.

Slope Factors

	DCF Editor & input Echo			Manual (N-1 morbidity)			Comparison		
	Risk/Bq			risk/Bq		A2.1			
	Ing	Inh	Ext_vol	Ing (food)	Inh	Ext_vol			
Co-60	6.03E-10	2.73E-09	3.35E-04	6.03E-10	2.73E-09	3.35E-04	1.00E+00	1.00E+00	1.00E+00
Ir-192	2.89E-10	6.51E-10	9.19E-05	2.89E-10	6.51E-10	9.19E-05	1.00E+00	1.00E+00	1.00E+00
Ir-192m	3.57E-11	2.76E-09	1.46E-05	3.57E-11	2.76E-09	1.46E-05	9.99E-01	9.99E-01	9.98E-01
H-3	3.89E-12	2.30E-11	0	3.89E-12	2.30E-11	0	1.00E+00	1.00E+00	#DIV/0!

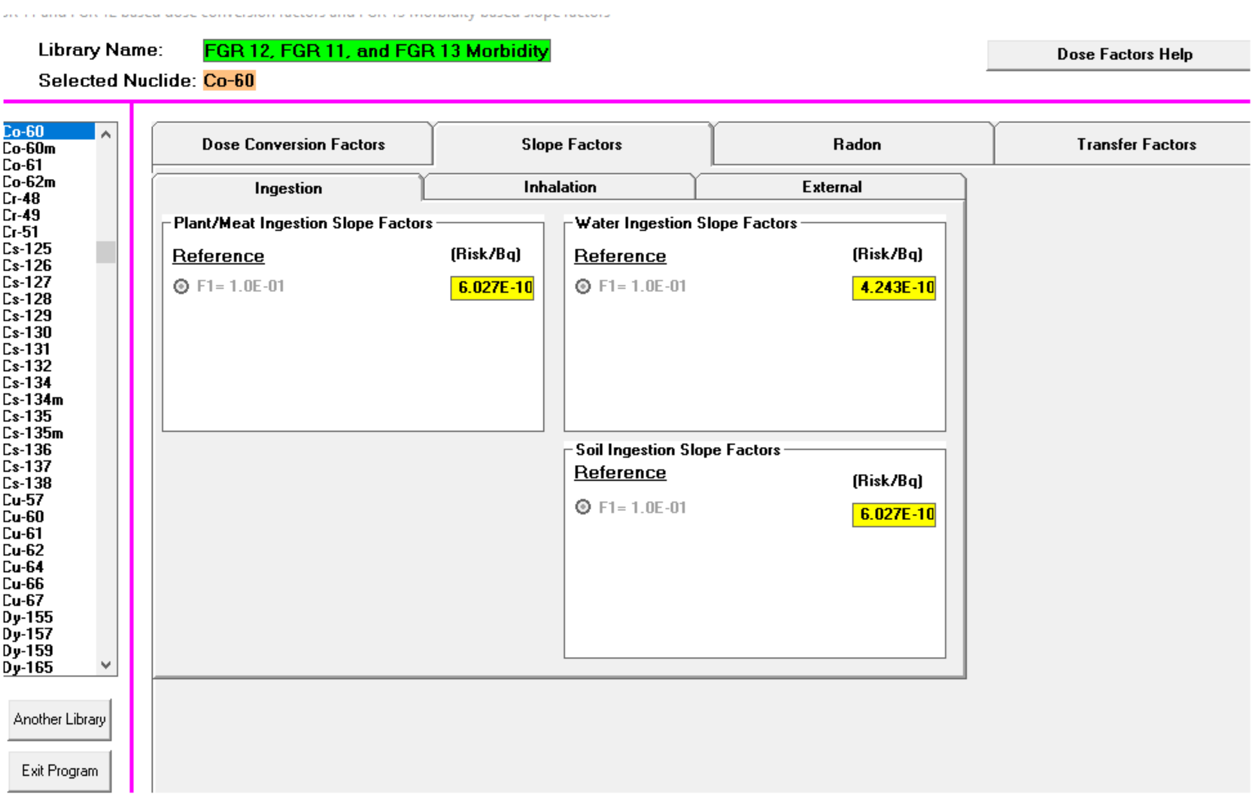


Table N-1 (Cont.)

Radionuclide[a]	External (risk/yr per Bq/g)		Inhalation (risk/Bq)		Ingestion: Food (risk/Bq)		Ingestion: Water (risk/Bq)		Ingestion: Soil[b] (risk/Bq)	
	Morbidity	Mortality	Morbidity	Mortality	Morbidity	Mortality	Morbidity	Mortality	Morbidity	Mortality
Cf-248	1.28E-09	7.54E-10	6.92E-07	6.57E-07	1.68E-09	1.03E-09	1.20E-09	7.46E-10	1.68E-09	1.03E-09
Cf-249	3.70E-05	2.50E-05	1.31E-06	1.08E-06	4.41E-09	3.27E-09	3.43E-09	2.60E-09	4.41E-09	3.27E-09
Cf-250	1.21E-09	7.16E-10	9.95E-07	9.43E-07	3.03E-09	2.15E-09	2.33E-09	1.70E-09	3.03E-09	2.15E-09
Cf-251	1.02E-05	6.92E-06	1.33E-06	1.10E-06	4.59E-09	3.41E-09	3.57E-09	2.67E-09	4.59E-09	3.41E-09
Cf-252	2.34E-09	1.49E-09	7.03E-07	2.12E-06	4.86E-09	1.46E-08	4.86E-09	1.46E-08	4.86E-09	1.46E-08
Cl-36	4.70E-08	3.22E-08	2.73E-09	2.58E-09	1.20E-10	7.92E-11	8.92E-11	5.95E-11	1.20E-10	7.92E-11
Cm-241	5.24E-05	3.57E-05	3.30E-09	3.11E-09	1.90E-10	1.06E-10	1.31E-10	7.32E-11	1.90E-10	1.06E-10
Cm-242	2.09E-09	1.29E-09	5.43E-07	5.16E-07	1.48E-09	8.65E-10	1.04E-09	6.16E-10	1.48E-09	8.65E-10
Cm-243	1.13E-05	7.70E-06	9.92E-07	9.38E-07	3.32E-09	2.30E-09	2.56E-09	1.81E-09	3.32E-09	2.30E-09
Cm-244	1.31E-09	7.76E-10	9.62E-07	9.08E-07	2.92E-09	2.02E-09	2.26E-09	1.59E-09	2.92E-09	2.02E-09
Cm-245	6.43E-06	4.38E-06	1.03E-06	8.81E-07	3.65E-09	2.57E-09	2.81E-09	2.02E-09	3.65E-09	2.57E-09
Cm-246	1.24E-09	7.35E-10	1.02E-06	8.81E-07	3.54E-09	2.51E-09	2.76E-09	1.98E-09	3.54E-09	2.51E-09
Cm-247+D	3.69E-05	2.51E-05	9.43E-07	7.86E-07	3.53E-09	2.45E-09	2.70E-09	1.93E-09	3.53E-09	2.45E-09
Cm-248	9.24E-10	5.49E-10	4.05E-06	2.23E-05	3.51E-08	1.84E-07	3.51E-08	1.84E-07	3.51E-08	1.84E-07
Co-56	4.86E-04	3.32E-04	6.92E-10	5.73E-10	3.86E-10	2.35E-10	2.73E-10	1.67E-10	3.86E-10	2.35E-10
Co-57	9.59E-06	6.54E-06	1.01E-10	8.73E-11	4.03E-11	2.43E-11	2.81E-11	1.70E-11	4.03E-11	2.43E-11
Co-58	1.21E-04	8.27E-05	2.15E-10	1.81E-10	1.13E-10	6.81E-11	7.97E-11	4.84E-11	1.13E-10	6.81E-11
Co-60	3.35E-04	2.28E-04	2.73E-09	2.32E-09	6.03E-10	3.89E-10	4.24E-10	2.76E-10	6.03E-10	3.89E-10
Cs-134	1.02E-04	1.31E-04	1.80E-09	1.66E-09	1.30E-09	9.57E-10	1.14E-09	7.02E-10	1.30E-09	9.57E-10

```
RESRAD-OFFSITE, Version 4.0         T½ Limit = 30 days        02/20/2020  08:48  Page   2
Risk Report
Title : RESRAD-OFFSITE Default Parameters
File  : Site5.ROF

                                 Cancer Risk Slope Factors Summary Table
                                   Current library: FGR 13 Morbidity
                                   Default library: FGR 13 Morbidity

     |                                                            | Current   |           | Parameter
Menu |                       Parameter                            |  Value    |  Default  |   Name
-----+------------------------------------------------------------+-----------+-----------+-----------
DCSF | Ground external radiation slope factors, 1/yr per (Bq/g):  |           |           |
DCSF | Co-60                                                      | 3.35E-04  | 3.35E-04  | SLPF(1,1)
DCSF | H-3                                                        | 0.00E+00  | 0.00E+00  | SLPF(2,1)
DCSF | Ir-192                                                     | 9.19E-05  | 9.19E-05  | SLPF(3,1)
DCSF | Ir-192m                                                    | 1.46E-05  | 1.46E-05  | SLPF(4,1)
     |                                                            |           |           |
DCSF | Inhalation, slope factors, 1/(Bq):                         |           |           |
DCSF | Co-60                                                      | 2.73E-09  | 2.73E-09  | SLPF(1,2)
DCSF | H-3                                                        | 2.30E-11  | 2.30E-11  | SLPF(2,2)
DCSF | Ir-192                                                     | 6.51E-10  | 6.51E-10  | SLPF(3,2)
DCSF | Ir-192m                                                    | 2.76E-09  | 2.76E-09  | SLPF(4,2)
     |                                                            |           |           |
DCSF | Food ingestion, slope factors, 1/(Bq):                     |           |           |
DCSF | Co-60                                                      | 6.03E-10  | 6.03E-10  | SLPF(1,3)
DCSF | H-3                                                        | 3.89E-12  | 3.89E-12  | SLPF(2,3)
DCSF | Ir-192                                                     | 2.89E-10  | 2.89E-10  | SLPF(3,3)
DCSF | Ir-192m                                                    | 3.57E-11  | 3.57E-11  | SLPF(4,3)
     |                                                            |           |           |
DCSF | Water ingestion, slope factors, 1/(Bq):                    |           |           |
DCSF | Co-60                                                      | 4.24E-10  | 4.24E-10  | SLPF(1,4)
DCSF | H-3                                                        | 3.03E-12  | 3.03E-12  | SLPF(2,4)
DCSF | Ir-192                                                     | 1.99E-10  | 1.99E-10  | SLPF(3,4)
DCSF | Ir-192m                                                    | 2.65E-11  | 2.65E-11  | SLPF(4,4)
     |                                                            |           |           |
DCSF | Soil ingestion, slope factors, 1/(Bq):                     |           |           |
DCSF | Co-60                                                      | 6.03E-10  | 6.03E-10  | SLPF(1,5)
DCSF | H-3                                                        | 3.89E-12  | 3.89E-12  | SLPF(2,5)
DCSF | Ir-192                                                     | 2.89E-10  | 2.89E-10  | SLPF(3,5)
DCSF | Ir-192m                                                    | 3.57E-11  | 3.57E-11  | SLPF(4,5)
     |                                                            |           |           |
==========================================================================================================
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12.74 TEST CASE 039 TESTER'S REPORT

Documented in Test Case 39.msg of 2/20/2020 11:13 AM

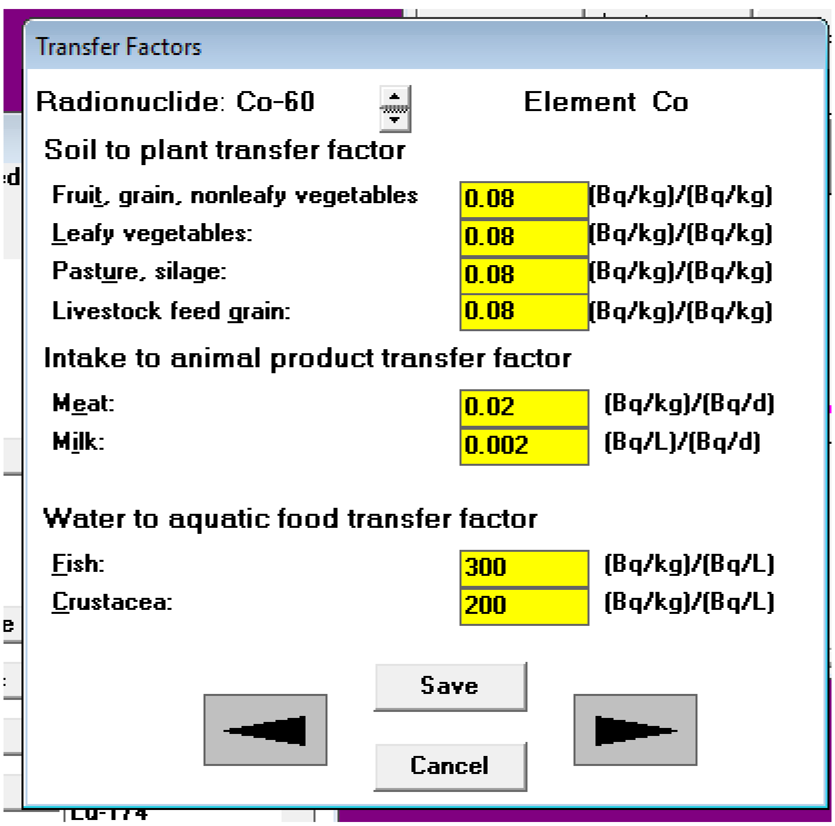
Test Case 39

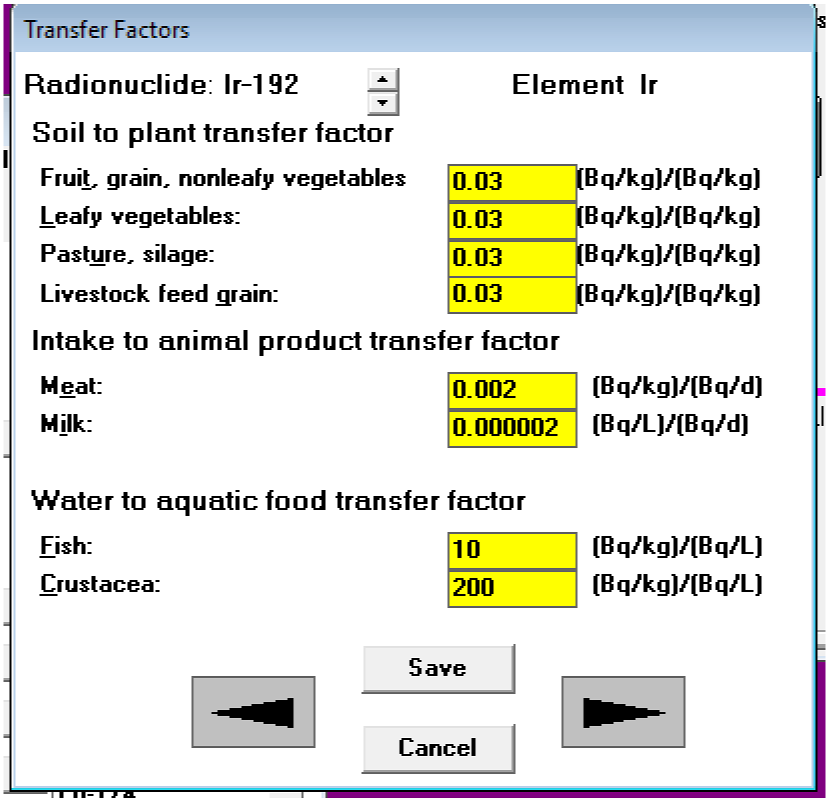
LePoire, David J. Thu 2/20/2020 7:32 AM

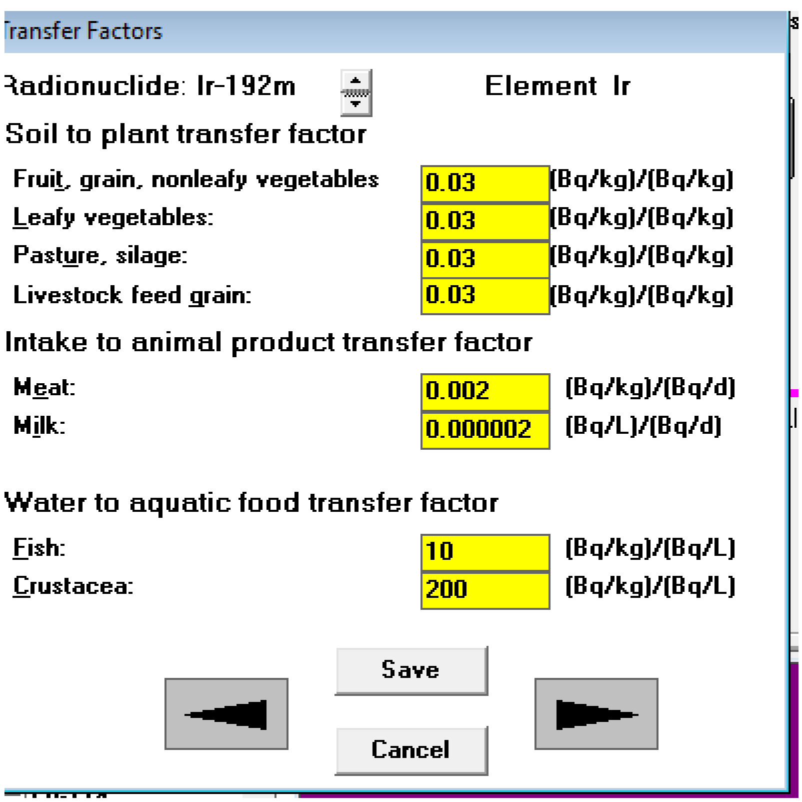
Transfer factors were compared based on input form, input echo, and V&V table. Co-60 and Ir-192 matched. The H-3 form and input echo showed that the non-aquatic transfer factors are calculated. They match.

	Fish	Crust	Plant	Meat	Milk
Co-60	3.00E+02	2.00E+02	0.08	0.02	2.00E-03
Ir-192	1.00E+01	2.00E+02	0.03	0.002	2.00E-06
Ir-192m	1.00E+01	2.00E+02	0.03	0.002	2.00E-06

The H-3 factors are calculated for plant, meat, milk. They are the same for Fish and crustacea (1).




Transfer Factors
Radionuclide: Ir-192
Element Ir
Soil to plant transfer factor
Fruit, grain, nonleafy vegetables
0.03
(Bq/kg)/(Bq/kg)
Leafy vegetables:
0.03
(Bq/kg)/(Bq/kg)
Pasture, silage:
0.03
(Bq/kg)/(Bq/kg)
Livestock feed grain:
0.03
(Bq/kg)/(Bq/kg)
Intake to animal product transfer factor
Meat:
0.002
(Bq/kg)/(Bq/d)
Milk:
0.000002
(Bq/L)/(Bq/d)
Water to aquatic food transfer factor
Fish:
10
(Bq/kg)/(Bq/L)
Crustacea:
200
(Bq/kg)/(Bq/L)
Save
Cancel


Transfer Factors
Radionuclide: Ir-192m
Element Ir
Soil to plant transfer factor
Fruit, grain, nonleafy vegetables
0.03
(Bq/kg)/(Bq/kg)
Leafy vegetables:
0.03
(Bq/kg)/(Bq/kg)
Pasture, silage:
0.03
(Bq/kg)/(Bq/kg)
Livestock feed grain:
0.03
(Bq/kg)/(Bq/kg)
Intake to animal product transfer factor
Meat:
0.002
(Bq/kg)/(Bq/d)
Milk:
0.000002
(Bq/L)/(Bq/d)
Water to aquatic food transfer factor
Fish:
10
(Bq/kg)/(Bq/L)
Crustacea:
200
(Bq/kg)/(Bq/L)
Save
Cancel

RESRAD-OFFSITE, Version 4.0 T½ Limit = 30 days 02/20/2020 08:48 Page 3
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File : Site5.ROF

Dose Conversion Factor (and Related) Parameter Summary (continued)
Current Library: RESRAD Default Transfer factors
Default Library: RESRAD Default Transfer factors

Menu	Parameter	Current Value	Default	Parameter Name
TF	Soil to plant transfer factors:			
TF	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,1)
TF	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,2)
TF	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,3)
TF	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,4)
TF				
TF	H-3 , plant/soil concentration ratio, dimensionless	4.000E+00	4.800E+00	RTF(2,1)
TF	H-3 , plant/soil concentration ratio, dimensionless	4.000E+00	4.800E+00	RTF(2,2)
TF	H-3 , plant/soil concentration ratio, dimensionless	4.000E+00	4.800E+00	RTF(2,3)
TF	H-3 , plant/soil concentration ratio, dimensionless	4.000E+00	4.800E+00	RTF(2,4)
TF				
TF	Ir-192 , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(3,1)
TF	Ir-192 , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(3,2)
TF	Ir-192 , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(3,3)
TF	Ir-192 , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(3,4)
TF				
TF	Ir-192m , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(4,1)
TF	Ir-192m , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(4,2)
TF	Ir-192m , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(4,3)
TF	Ir-192m , plant/soil concentration ratio, dimensionless	3.000E-02	3.000E-02	RTF(4,4)
TF	intake to meat/milk transfer factors:			
TF	Co-60 , beef/livestock-intake ratio, (Bq/kg)/(Bq/d)	2.000E-02	2.000E-02	I_M(1,1)
TF	Co-60 , milk/livestock-intake ratio, (Bq/L)/(Bq/d)	2.000E-03	2.000E-03	I_M(1,2)
TF				
TF	H-3 , beef/livestock-intake ratio, (Bq/kg)/(Bq/d)	5.742E-03	1.200E-02	I_M(2,1)
TF	H-3 , milk/livestock-intake ratio, (Bq/L)/(Bq/d)	4.312E-03	1.000E-02	I_M(2,2)
TF				
TF	Ir-192 , beef/livestock-intake ratio, (Bq/kg)/(Bq/d)	2.000E-03	2.000E-03	I_M(3,1)
TF	Ir-192 , milk/livestock-intake ratio, (Bq/L)/(Bq/d)	2.000E-06	2.000E-06	I_M(3,2)
TF				
TF	Ir-192m , beef/livestock-intake ratio, (Bq/kg)/(Bq/d)	2.000E-03	2.000E-03	I_M(4,1)
TF	Ir-192m , milk/livestock-intake ratio, (Bq/L)/(Bq/d)	2.000E-06	2.000E-06	I_M(4,2)
TF	Bioaccumulation factors, fresh water, L/kg:			

Menu	Parameter	Current Value	Default	Parameter Name
TF	Bioaccumulation factors, fresh water, L/kg:			
TF	Co-60 , fish	3.000E+02	3.000E+02	BIOFA(1,1)
TF	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFA(1,2)
TF				
TF	H-3 , fish	1.000E+00	1.000E+00	BIOFA(2,1)
TF	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFA(2,2)
TF				
TF	Ir-192 , fish	1.000E+01	1.000E+01	BIOFA(3,1)
TF	Ir-192 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFA(3,2)
TF				
TF	Ir-192m , fish	1.000E+01	1.000E+01	BIOFA(4,1)
TF	Ir-192m , crustacea and mollusks	2.000E+02	2.000E+02	BIOFA(4,2)

Compare to data in V&V Data Verification> transfer Factor verification (Plant Transfer Factor Comparison.xlsx is below)

TABLE 6.3.10 Comparison of RESRAD Default Plant Transfer Factors (Fresh-Weight Basis) with Those from Other References

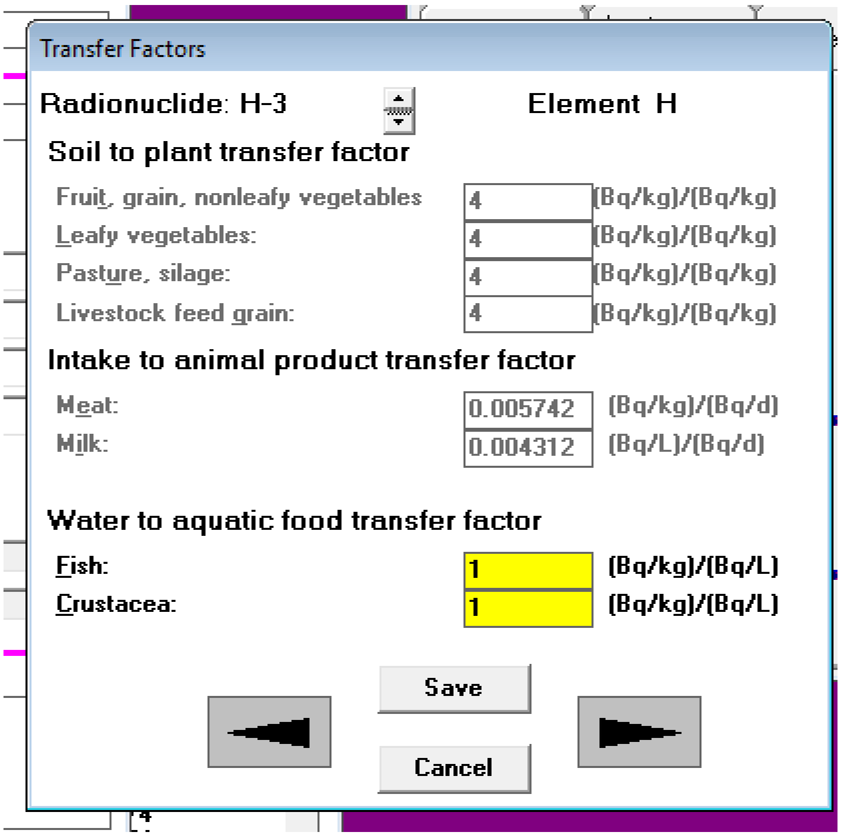
Element	RESRAD (default)	NCRP (1999)	PNNL Fresh Weight (Staven et al. 2003)[a]			
			Leafy Vegetables	Fruits	Grains	Root Vegetables
Ac	2.5×10^{-3}	1.0×10^{-3}	9.4×10^{-5}	4.5×10^{-5}	2.0×10^{-5}	8.8×10^{-5}
Ag	1.5×10^{-1}	4.0×10^{-3}	5.4×10^{-5}	1.4×10^{-4}	2.3×10^{-1}	3.3×10^{-4}
Al	4.0×10^{-3}	4.0×10^{-3}	NA[b]	NA	NA	NA
Am	1.0×10^{-3}	1.0×10^{-3}	9.4×10^{-5}	4.5×10^{-5}	2.0×10^{-5}	8.8×10^{-5}
Ar						
As	8.0×10^{-2}	8.0×10^{-2}	8.0×10^{-3}	1.1×10^{-3}	5.5×10^{-3}	1.5×10^{-3}
At	2.0×10^{-1}	2.0×10^{-1}	NA	NA	NA	NA
Au	1.0×10^{-1}	1.0×10^{-1}	2.0×10^{-3}	2.5×10^{-3}	2.3×10^{-1}	4.5×10^{-3}
B	NA	1.0×10^{-2}	NA	NA	NA	NA
Ba	5.0×10^{-3}	1.0×10^{-2}	3.0×10^{-2}	2.7×10^{-3}	1.4×10^{-2}	3.8×10^{-3}
Be	4.0×10^{-3}	4.0×10^{-3}	2.0×10^{-3}	2.7×10^{-4}	1.8×10^{-3}	3.8×10^{-4}
Bi	1.0×10^{-1}	1.0×10^{-1}	1.0×10^{-1}	9.0×10^{-2}	4.6×10^{-1}	1.3×10^{-1}
Bk	1.0×10^{-3}	1.0×10^{-3}	NA	NA	NA	NA
Br	7.6×10^{-1}	4.0×10^{-1}	3.0×10^{-1}	2.7×10^{-1}	1.4×10^{0}	3.8×10^{-1}
C	5.5×10^{0}	NA	1.4×10^{-1}	1.3×10^{-1}	6.4×10^{-1}	1.8×10^{-1}
Ca	5.0×10^{-1}	5.0×10^{-1}	7.0×10^{-1}	6.3×10^{-2}	3.2×10^{-1}	8.8×10^{-2}
Cd	3.0×10^{-1}	5.0×10^{-1}	1.1×10^{-1}	2.7×10^{-2}	1.4×10^{-1}	3.8×10^{-2}
Ce	2.0×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Cf	1.0×10^{-3}	1.0×10^{-3}	9.4×10^{-5}	4.5×10^{-5}	2.0×10^{-5}	8.8×10^{-5}
Cl	2.0×10^{1}	2.0×10^{1}	1.4×10^{1}	1.3×10^{1}	6.4×10^{1}	1.8×10^{1}
Cm	1.0×10^{-3}	1.0×10^{-3}	1.5×10^{-4}	2.7×10^{-6}	1.9×10^{-5}	1.1×10^{-4}

Co	8.0×10^{-2}	8.0×10^{-2}	4.6×10^{-2}	1.3×10^{-3}	3.4×10^{-3}	1.7×10^{-2}
Cr	2.5×10^{-4}	1.0×10^{-2}	1.5×10^{-3}	8.1×10^{-4}	4.1×10^{-3}	1.1×10^{-3}
Cs	4.0×10^{-2}	4.0×10^{-2}	9.2×10^{-2}	4.0×10^{-2}	2.4×10^{-2}	3.3×10^{-2}
Cu	1.3×10^{-1}	5.0×10^{-2}	8.0×10^{-2}	4.5×10^{-2}	2.3×10^{-1}	6.3×10^{-2}
Dy	2.0×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Er	2.0×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Es	1.0×10^{-3}	1.0×10^{-3}	NA	NA	NA	NA
Eu	2.5×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	$5. \times 10^{-3}$
F	2.0×10^{-2}	2.0×10^{-2}	1.2×10^{-2}	1.1×10^{-3}	5.5×10^{-3}	1.5×10^{-3}
Fe	1.0×10^{-3}	1.0×10^{-3}	1.0×10^{-2}	9.0×10^{-3}	4.6×10^{-2}	1.3×10^{-2}
Fm	2.0×10^{-3}	2.0×10^{-3}	NA	NA	NA	NA
Fr	3.0×10^{-2}	3.0×10^{-2}	NA	NA	NA	NA
Ga	3.0×10^{-3}	3.0×10^{-3}	8.0×10^{-4}	7.2×10^{-5}	3.6×10^{-4}	1.0×10^{-4}
Gd	2.5×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Ge	4.0×10^{-1}	4.0×10^{-1}	NA	NA	NA	NA
H	4.8×10^{0}	NA	NA	NA	NA	NA
He						
Hf	3.0×10^{-3}	3.0×10^{-3}	2.0×10^{-4}	1.8×10^{-4}	9.1×10^{-4}	2.5×10^{-4}
Hg	3.8×10^{-1}	3.0×10^{-1}	1.7×10^{-1}	6.7×10^{-2}	4.5×10^{-1}	5.0×10^{-2}
Ho	2.6×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
I	2.0×10^{-2}	2.0×10^{-2}	NA	NA	NA	NA
In	3.0×10^{-3}	3.0×10^{-3}	8.0×10^{-4}	7.2×10^{-5}	3.6×10^{-4}	1.0×10^{-4}
Ir	3.0×10^{-2}	3.0×10^{-2}	8.0×10^{-3}	7.2×10^{-3}	3.6×10^{-2}	1.0×10^{-2}
K	3.0×10^{-1}	3.0×10^{-1}	2.0×10^{-1}	9.9×10^{-2}	5.0×10^{-1}	1.4×10^{-1}
Kr						
La	2.5×10^{-3}	2.0×10^{-3}	1.0×10^{-3}	7.2×10^{-4}	3.6×10^{-3}	8.8×10^{-5}
Li	NA	1.0×10^{-3}	NA	NA	NA	NA
Lr	NA	2.0×10^{-3}	NA	NA	NA	NA

Lu	2.0×10^{-3}	2.0×10^{-3}	NA	NA	NA	NA
Md	2.0×10^{-3}	2.0×10^{-3}	NA	NA	NA	NA
Mg	3.0×10^{-2}	3.0×10^{-2}	2.0×10^{-1}	9.9×10^{-2}	5.0×10^{-1}	1.4×10^{-1}
Mn	3.0×10^{-1}	3.0×10^{-1}	1.4×10^{-1}	9.0×10^{-3}	2.7×10^{-1}	5.0×10^{-2}
Mo	1.3×10^{-1}	1.0×10^{-1}	1.6×10^{-1}	9.0×10^{-3}	7.3×10^{-1}	$2. 0\times 10^{-1}$
N	7.5×10^{0}	NA	1.1×10^{-2}	5.4×10^{-3}	1.2×10^{-1}	1.2×10^{-2}
Na	5.0×10^{-2}	5.0×10^{-2}	6.0×10^{-2}	5.4×10^{-2}	2.7×10^{-1}	7.5×10^{-2}
Nb	1.0×10^{-2}	1.0×10^{-2}	5.0×10^{-3}	4.5×10^{-3}	2.3×10^{-2}	6.3×10^{-3}
Nd	2.4×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Ne						
Ni	5.0×10^{-2}	5.0×10^{-2}	5.6×10^{-2}	1.1×10^{-2}	2.7×10^{-2}	1.5×10^{-2}
No	NA	2.0×10^{-3}	NA	NA	NA	NA
Np	2.0×10^{-2}	2.0×10^{-2}	6.4×10^{-3}	1.8×10^{-3}	2.5×10^{-3}	3.3×10^{-3}
O	6.0×10^{-1}	NA	NA	NA	NA	NA
Os	3.0×10^{-2}	3.0×10^{-2}	3.0×10^{-3}	8.1×10^{-3}	3.2×10^{-3}	8.8×10^{-4}
P	1.0×10^{0}	1.0×10^{0}	7.0×10^{-1}	6.3×10^{-1}	3.2×10^{0}	8.8×10^{-1}
Pa	1.0×10^{-2}	1.0×10^{-2}	9.4×10^{-5}	4.5×10^{-5}	2.0×10^{-5}	8.8×10^{-5}
Pb	1.0×10^{-2}	4.0×10^{-3}	2.0×10^{-3}	1.8×10^{-3}	4.3×10^{-3}	1.5×10^{-3}
Pd	1.0×10^{-1}	1.0×10^{-1}	3.0×10^{-2}	7.2×10^{-3}	3.6×10^{-2}	1.0×10^{-2}
Pm	2.5×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Po	1.0×10^{-3}	1.0×10^{-3}	2.4×10^{-4}	2.2×10^{-4}	2.1×10^{-3}	1.8×10^{-3}
Pr	2.5×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Pt	1.0×10^{-1}	1.0×10^{-1}	NA	NA	NA	NA
Pu	1.0×10^{-3}	1.0×10^{-3}	1.2×10^{-5}	8.1×10^{-6}	7.8×10^{-6}	2.8×10^{-4}
Ra	4.0×10^{-2}	4.0×10^{-2}	9.8×10^{-3}	1.1×10^{-3}	1.1×10^{-3}	5.0×10^{-4}
Rb	1.3×10^{-1}	2.0×10^{-1}	1.8×10^{-1}	1.6×10^{-1}	8.2×10^{-1}	2.3×10^{-1}
Re	2.0×10^{-1}	2.0×10^{-1}	3.0×10^{-1}	6.3×10^{-2}	3.2×10^{-1}	8.8×10^{-2}
Rh	1.3×10^{-1}	3.0×10^{-2}	3.0×10^{-2}	7.2×10^{-3}	3.6×10^{-2}	1.0×10^{-2}

Ru	3.0×10^{-2}	3.0×10^{-2}	8.0×10^{-3}	7.2×10^{-3}	4.6×10^{-3}	1.0×10^{-2}
S	6.0×10^{-1}	6.0×10^{-1}	3.0×10^{-1}	2.7×10^{-1}	1.4×10^{0}	3.8×10^{-1}
Sb	1.0×10^{-2}	1.0×10^{-2}	2.6×10^{-5}	1.4×10^{-5}	2.7×10^{-2}	1.4×10^{-4}
Sc	2.0×10^{-3}	2.0×10^{-3}	1.2×10^{-3}	1.8×10^{-4}	9.1×10^{-4}	2.5×10^{-4}
Se	1.0×10^{-1}	1.0×10^{-1}	5.0×10^{-2}	9.0×10^{-3}	2.3×10^{-1}	1.3×10^{-2}
Si	2.0×10^{-2}	2.0×10^{-2}	7.0×10^{-2}	1.3×10^{-2}	6.4×10^{-2}	1.8×10^{-2}
Sm	2.5×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Sn	2.5×10^{-3}	3.0×10^{-1}	6.0×10^{-3}	1.1×10^{-3}	5.5×10^{-3}	1.5×10^{-3}
Sr	3.0×10^{-1}	3.0×10^{-1}	6.0×10^{-1}	3.6×10^{-2}	1.9×10^{-1}	1.3×10^{-1}
Ta	2.0×10^{-2}	2.0×10^{-3}	5.0×10^{-3}	4.5×10^{-3}	2.3×10^{-2}	6.3×10^{-3}
Tb	2.6×10^{-3}	2.0×10^{-3}	4.0×10^{-3}	3.6×10^{-3}	1.8×10^{-2}	5.0×10^{-3}
Tc	5.0×10^{0}	5.0×10^{0}	4.2×10^{1}	2.7×10^{-1}	6.6×10^{-1}	6.0×10^{-2}
Te	6.0×10^{-1}	1.0×10^{-1}	5.0×10^{-3}	7.2×10^{-4}	3.6×10^{-3}	1.0×10^{-3}
Th	1.0×10^{-3}	1.0×10^{-3}	3.6×10^{-4}	4.5×10^{-5}	3.1×10^{-5}	8.3×10^{-5}
Ti	1.0×10^{-3}	5.0×10^{-4}	NA	NA	NA	NA
Tl	2.0×10^{-1}	2.0×10^{-1}	8.0×10^{-4}	7.2×10^{-5}	3.6×10^{-4}	1.0×10^{-4}
Tm	2.0×10^{-3}	2.0×10^{-3}	NA	NA	NA	NA
U	2.5×10^{-3}	2.0×10^{-3}	1.7×10^{-3}	7.2×10^{-4}	1.2×10^{-3}	3.0×10^{-3}
V	2.0×10^{-3}	2.0×10^{-3}	NA	NA	NA	NA
W	1.8×10^{-2}	8.0×10^{-1}	6.0×10^{-1}	5.4×10^{-1}	2.7×10^{0}	7.5×10^{-1}
Xe						
Y	2.5×10^{-3}	2.0×10^{-3}	2.0×10^{-3}	1.8×10^{-3}	9.1×10^{-3}	2.5×10^{-3}
Yb	2.0×10^{-3}	2.0×10^{-3}	NA	NA	NA	NA
Zn	4.0×10^{-1}	4.0×10^{-1}	2.6×10^{-1}	1.6×10^{-1}	1.5×10^{0}	8.8×10^{-2}
Zr	1.0×10^{-3}	1.0×10^{-3}	2.0×10^{-4}	1.8×10^{-4}	9.1×10^{-4}	2.5×10^{-4}

```
TF   | H-3      , beef/livestock-intake ratio, (Bq/kg)/(Bq/d)      | 5.742E-03 | 1.200E-02 | I_M(2,1)
TF   | H-3      , milk/livestock-intake ratio, (Bq/L)/(Bq/d)       | 4.312E-03 | 1.000E-02 | I_M(2,2)
TF   |                                                             |           |           |
```



12.75 TEST CASE 040 TESTER'S REPORT

Documented in Test Case 40.msg of 2/20/2020 11:13 AM

Test Case 40

LePoire, David J. Thu 2/20/2020 7:47 AM

Data was compared from V&V table below and the .CHN file for C0-60, Cs-137, and Ra-226. All matched

Extract from R:_QA_Files\OFFSITE\V&V\Data Verification\Nuclide decay and ingrowth verification.xlsx
> ICRP38-comparion tab:

Table A.1-1 Principal and Associated Radionuclides with a Cutoff Half-Life of 30 Day in ICRP-38 Dat

Principal Radionuclide[a]			Terminal Nuclide or Radionuclide[c]		
Species	Half-Life (yr	Associated Decay Chain[b]	Species	Half-life (yr)	Fraction
Co-60	5.27E+00	—	Ni-60	*	
Cs-134	2.06E+00	—	Ba-134, Xe-	*	
Cs-135	2.30E+06	—	Ba-135	*	
Cs-137+D	3.00E+01	(Ba-137m 0.946)	Ba-137	*	
Ra-226+D	1.60E+03	Rn-222,Po-218, (Pb-214 9.9980E-01), Bi-214, (Po-214 9.9980E-01), (Tl-210 2.0000E-04), (At-218 2.0000E-04)	Pb-210	2.23E+01	
Pb-210+D	2.23E+01	Bi-210	Po-210	3.79E-01	
Po-210	3.79E-01	—	Pb-206	*	

Chain file for C0-60, Cs-137, and Ra-226:
All data in Nukes(), order matches NUCNAM list in .ROF file:

```
#   Nuclide     Half-Life     AtWt      Kd Def      Fraction     nNuc  Decay Chain
001  Co-60      5.27100E+00  059.9338  1.000E+03  1.000000E+00  01  Co-60
002  Cs-137+D   3.00000E+01  136.9071  4.600E+03  1.000000E+00  01  Cs-137+D
003  Pb-210+D   2.23000E+01  209.9842  1.000E+02  1.000000E+00  02  Pb-210+D Po-210
004  Po-210     3.78864E-01  209.9829  1.000E+01  1.
Cs-137+D  : (Ba-137m 9.4600E-01)
Pb-210+D  : Bi-210000000E+00  01  Po-210
005  Ra-226+D   1.60000E+03  226.0254  7.000E+01  1.000000E+00  03  Ra-226+D Pb-210+D Po-210
--------------  DPlusAll() data:
```

Ra-226+D : Rn-222 Po-218 (Pb-214 9.9980E-01) Bi-214 (Po-214 9.9980E-01) (Tl-210 2.0000E-04) (At-218 2.0000E-04)

Decay Chain: Co-60

First Branch Second Branch Third Branch Fourth Branch

---------------------- ---------------------- ---------------------- ----------------------
Nuclide Half-Life # Nuclide Fraction # Nuclide Fraction # Nuclide Fraction # Nuclide Fraction
001 Co-60 5.271E+00 000 1.0000E+00 000 0.0000E+00 000 0.0000E+00
000 0.0000E+00

All Threads In Decay Chain: Co-60
Fraction Nuclides:
001 1.0000E+00 Co-60
Total Thread Fractions: 1.0000E+00
1 - Total Thread Fractions: 0.0000E+00

Condensed Threads In Decay Chain: Co-60 Fix Level = 0
Fraction Nuclides:
001 1.0000E+00 Co-60

Decay Chain: Cs-137
First Branch Second Branch Third Branch Fourth Branch
---------------------- ---------------------- ---------------------- ----------------------
Nuclide Half-Life # Nuclide Fraction # Nuclide Fraction # Nuclide Fraction # Nuclide Fraction
001 Cs-137 3.000E+01 000 EOCB 5.4000E-02 002 Ba-137m 9.4600E-01 000 0.0000E+00
000 0.0000E+00
002 Ba-137m 4.852E-06 000 1.0000E+00 000 0.0000E+00 000 0.0000E+00
000 0.0000E+00

All Threads In Decay Chain: Cs-137
Fraction Nuclides:
001 5.4000E-02 Cs-137
002 9.4600E-01 Cs-137 Ba-137m
Total Thread Fractions: 1.0000E+00
1 - Total Thread Fractions: 0.0000E+00

Condensed Threads In Decay Chain: Cs-137 Fix Level = 0
Fraction Nuclides:
002 1.0000E+00 Cs-137+D

Decay Chain: Ra-226
First Branch Second Branch Third Branch Fourth Branch
---------------------- ---------------------- ---------------------- ----------------------
Nuclide Half-Life # Nuclide Fraction # Nuclide Fraction # Nuclide Fraction # Nuclide Fraction
001 Ra-226 1.600E+03 002 Rn-222 1.0000E+00 000 0.0000E+00 000 0.0000E+00
000 0.0000E+00
002 Rn-222 1.047E-02 003 Po-218 1.0000E+00 000 0.0000E+00 000 0.0000E+00
000 0.0000E+00
003 Po-218 5.799E-06 004 Pb-214 9.9980E-01 005 At-218 2.0000E-04 000 0.0000E+00
000 0.0000E+00
004 Pb-214 5.095E-05 006 Bi-214 1.0000E+00 000 0.0000E+00 000 0.0000E+00
000 0.0000E+00

005 At-218 6.338E-08 006 Bi-214 1.0000E+00 000   0.0000E+00 000   0.0000E+00
000   0.0000E+00
006 Bi-214 3.784E-05 007 Po-214 9.9980E-01 008 Tl-210 2.0000E-04 000   0.0000E+00
000   0.0000E+00
007 Po-214 5.206E-12 009 Pb-210 1.0000E+00 000   0.0000E+00 000   0.0000E+00
000   0.0000E+00
008 Tl-210 2.472E-06 009 Pb-210 1.0000E+00 000   0.0000E+00 000   0.0000E+00
000   0.0000E+00
009 Pb-210 2.230E+01 010 Bi-210 1.0000E+00 000   0.0000E+00 000   0.0000E+00
000   0.0000E+00
010 Bi-210 1.372E-02 011 Po-210 1.0000E+00 000   0.0000E+00 000   0.0000E+00
000   0.0000E+00
011 Po-210 3.789E-01 000   1.0000E+00 000   0.0000E+00 000   0.0000E+00
000   0.0000E+00

All Threads In Decay Chain: Ra-226
Fraction Nuclides:
001 9.9960E-01 Ra-226 Rn-222 Po-218 Pb-214 Bi-214 Po-214 Pb-210 Bi-210 Po-210
002 1.9996E-04 Ra-226 Rn-222 Po-218 Pb-214 Bi-214 Tl-210 Pb-210 Bi-210 Po-210
003 1.9996E-04 Ra-226 Rn-222 Po-218 At-218 Bi-214 Po-214 Pb-210 Bi-210 Po-210
004 4.0000E-08 Ra-226 Rn-222 Po-218 At-218 Bi-214 Tl-210 Pb-210 Bi-210 Po-210
Total Thread Fractions: 1.0000E+00
1 - Total Thread Fractions: 0.0000E+00

Condensed Threads In Decay Chain: Ra-226   Fix Level = 0
Fraction Nuclides:
003 1.0000E+00 Ra-226+D   Pb-210+D   Po-210

12.76 TEST CASE 041 TESTER'S REPORT

Documented in Test Case 41.msg of 2/20/2020 11:13 AM

Test Case 41

LePoire, David J. Thu 2/20/2020 7:59 AM

Summary: compared external pathway results with the two input files to Table 1 in the V&V folder. Results are the same.

Table 1 Comparison of External Exposure Pathway Dose for On-site Receptor									
				Source area = 1000000 m², thickness = 50 cm			Source radius = 100 m², thickness = 5 cm		
Radionuclide	Half-life, yr	decay constant (/yr)	Yearly average concentration, pCi/g	Yearly dose (Code), mrem/yr	Calculated, mrem/yr	ANL/EAD/TM-84, mrem/yr	Yearly dose (Code), mrem/yr	Calculated, mrem/yr	ANL/EAD/TM-84, mrem/yr
Al-26	7.16E+05	9.68E-07	1.00E+00	1.73E+01	1.73E+01	1.73E+01	5.82E+00	5.92E+00	5.92E+00
Co-57	7.42E-01	9.35E-01	6.50E-01	3.31E-01	3.26E-01	5.01E-01	1.87E-01	1.84E-01	2.83E-01
Co-60	5.27E+00	1.32E-01	9.37E-01	1.51E+01	1.52E+01	1.62E+01	5.20E+00	5.20E+00	5.55E+00
Cs-137	3.00E+01	2.31E-02	9.89E-01	3.37E+00	3.37E+00	3.41E+00	1.32E+00	1.31E+00	1.33E+00
Mn-54	8.56E-01	8.10E-01	6.85E-01	3.57E+00	3.54E+00	5.16E+00	1.34E+00	1.32E+00	1.93E+00
U-234	2.45E+05	2.83E-06	1.00E+00	4.01E-04	4.02E-04	4.02E-04	2.71E-04	2.86E-04	2.86E-04
U-235	7.04E+08	9.85E-10	1.00E+00	7.57E-01	7.57E-01	7.57E-01	3.90E-01	3.85E-01	3.85E-01

Note: Used high Kd in contaminated zone (atleast 1,000 cm3/g), very less erosion (support practice factor = 0.001)

Compare fifth column to results from External-1: results are the same

RESRAD-OFFSITE, Version 4.0 T½ Limit = 30 days 02/20/2020 09:51 Page 44
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File : EXTERNAL-1_test.ROF

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
in mrem/yr and as a Percentage of Total Dose at t = 0 years

From releases to ground water and to surface water

Radio-	Ground		Fish		Radon		Plant		Meat		Milk		Soil		Water	
Nuclide	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%
Al-26	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Co-57	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Co-60	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Cs-137	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Mn-54	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
U-234	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
U-235	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Total	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
in mrem/yr and as a Percentage of Total Dose at t = 0 years

Directly from primary contamination and from release to atmosphere (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil		All Pathways*	
Nuclide	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%
Al-26	1.73E+01	43	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	1.73E+01	43
Co-57	3.31E-01	1	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	3.31E-01	1
Co-60	1.51E+01	37	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	1.51E+01	37
Cs-137	3.37E+00	8	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	3.37E+00	8
Mn-54	3.57E+00	9	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	3.57E+00	9
U-234	4.01E-04	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	4.01E-04	0
U-235	7.57E-01	2	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	7.57E-01	2
Total	4.05E+01	100	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	4.05E+01	100

*Sum of dose from all releases and from primary contamination.

Compare eighth column to results from External-2: results are the same

Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File : EXTERNAL-2_test.ROF

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
in mrem/yr and as a Percentage of Total Dose at t = 0 years

From releases to ground water and to surface water

Radio-	Ground		Fish		Radon		Plant		Meat		Milk		Soil		Water	
Nuclide	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%
Al-26	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Co-57	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Co-60	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Cs-137	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Mn-54	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
U-234	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
U-235	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Total	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
in mrem/yr and as a Percentage of Total Dose at t = 0 years

Directly from primary contamination and from release to atmosphere (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil		All Pathways*	
Nuclide	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%
Al-26	5.82E+00	41	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	5.82E+00	41
Co-57	1.87E-01	1	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	1.87E-01	1
Co-60	5.20E+00	36	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	5.20E+00	36
Cs-137	1.32E+00	9	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	1.32E+00	9
Mn-54	1.34E+00	9	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	1.34E+00	9
U-234	2.71E-04	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	2.71E-04	0
U-235	3.90E-01	3	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	3.90E-01	3
Total	1.43E+01	100	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	1.43E+01	100

*Sum of dose from all releases and from primary contamination.

12.77 TEST CASE 042 TESTER'S REPORT

Documented in Test Case 42.msg of 2/20/2020 11:13 AM

Test Case 42

LePoire, David J. Thu 2/20/2020 9:02 AM

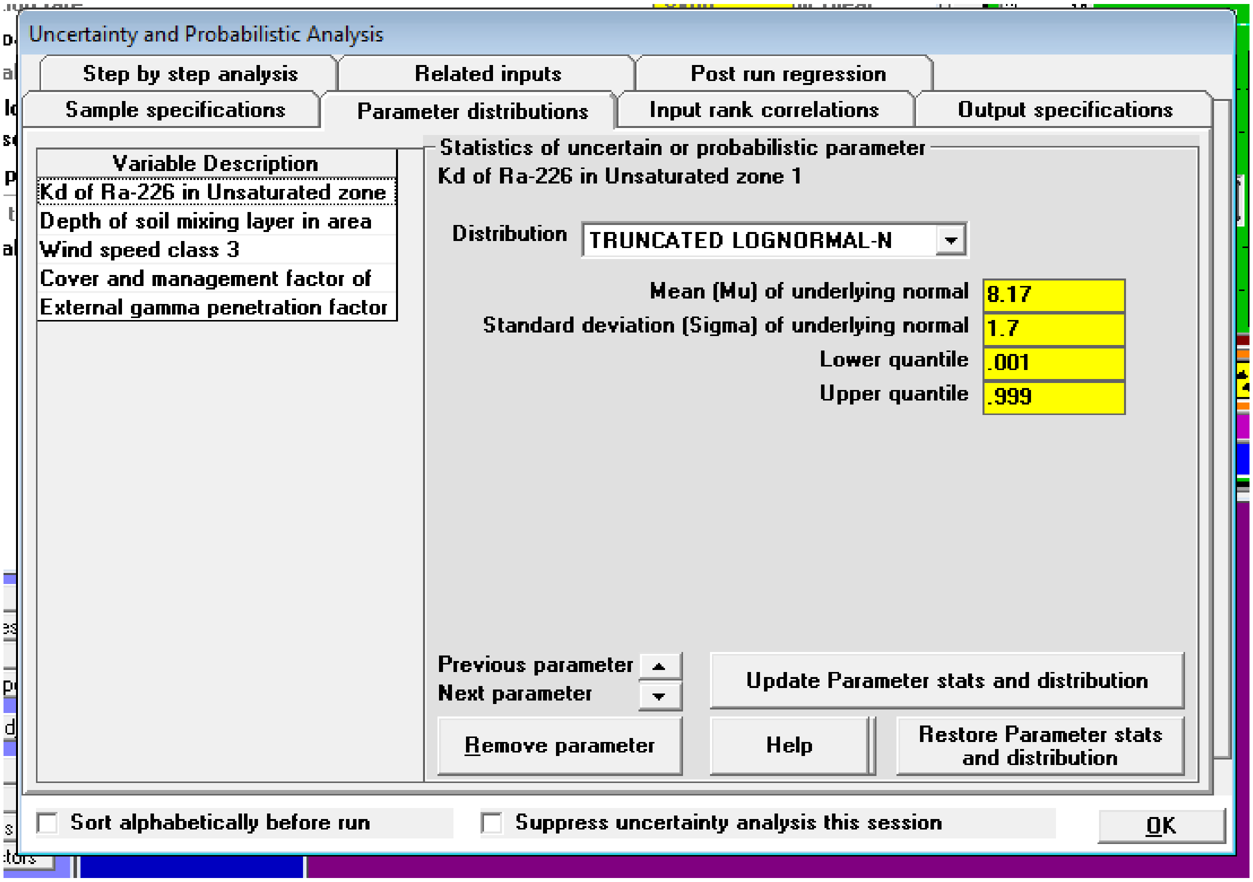
Summary : Compared 5 distributions. Four were the same as what was reported in the new parameter report. The Kd value in the softwar for Ra-266 was not consistent with the parameter report but was consistent with the latest Data Collection handbook (snippets below).

C-12 K_d Distributions Values for Different Elements (cont.)

Element	Source[a]	Exp(μ)[b]	μ[c]	σ[d]
Ra	1	2,500	7.82	2.56

TABLE 2.13.10 RESRAD Default Value and Distribution for the K_d Parameter for Different Elements

Element	Kd (cm^3/g or L/kg)	Lognormal Distribution[a] μ	Lognormal Distribution[a] σ
Ac	20	6.72	3.22
Ag	0	5.38	2.1
Al	0	6.45	3.22
Am	20	7.28	3.15
As	114	NA[b]	NA
At	0	NA	NA
Au	0	4.65	3.22
Ba	50	6.33	3.22
Be	810	NA	NA
Bi	0	4.65	3.22
Bk	70	NA	NA
Br	49	NA	NA
C	0	2.4	3.22
Ca	50	1.4	0.78
Cd	0	3.52	2.99
Ce	1,000	7.6	2.08
Cf[c]	1,380	7.23	3.22
Cl	0.1	1.68	3.22
Cm[c]	1,380	8.82	1.82
Co	1,000	5.46	2.53
Cr	30	4.63	2.76
Cs	4,600	6.1	2.33
Ra	70	8.17	1.7



C.3.12 Depth of Soil Mixing Layer

Applicable Code: RESRAD-ONSITE and RESRAD-OFFSITE

Description: The depth of soil mixing layer parameter is used in calculating the depth factor for the dust inhalation and soil ingestion pathways and for foliar deposition for the ingestion pathway.

Units: meters (m)

Probabilistic Input:

Distribution: triangular

Defining Values for Distribution:

Minimum: 0.0 Maximum: 0.6 Most likely: 0.15

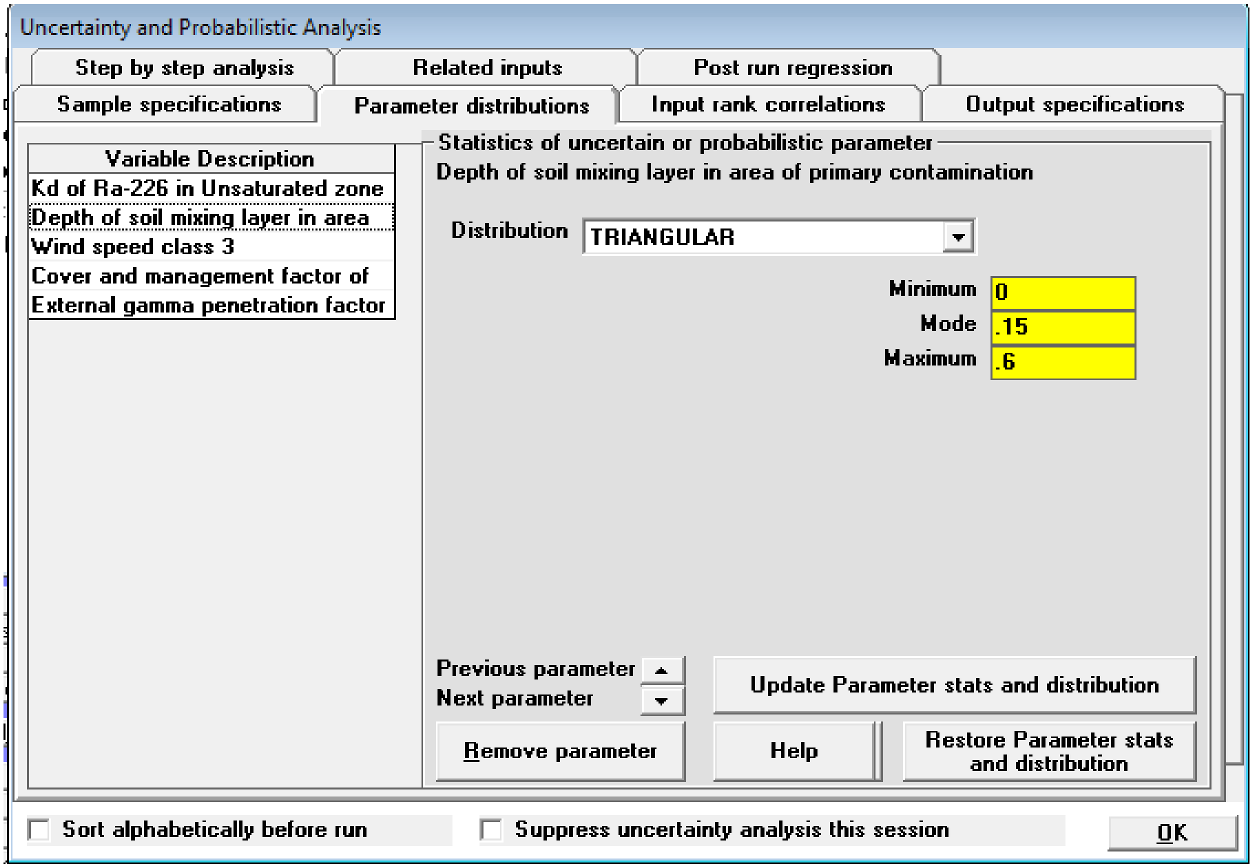


Table C-40 Uniform Distribution Limits for the Wind Speed Intervals in RESRAD-OFFSITE

Wind Speed Interval	Minimum (m/s)	Maximum (m/s)
1	0.514	1.80
2	1.81	3.34
3	3.35	5.40
4	5.41	8.49
5	8.50	11.1
6	11.2	14.1

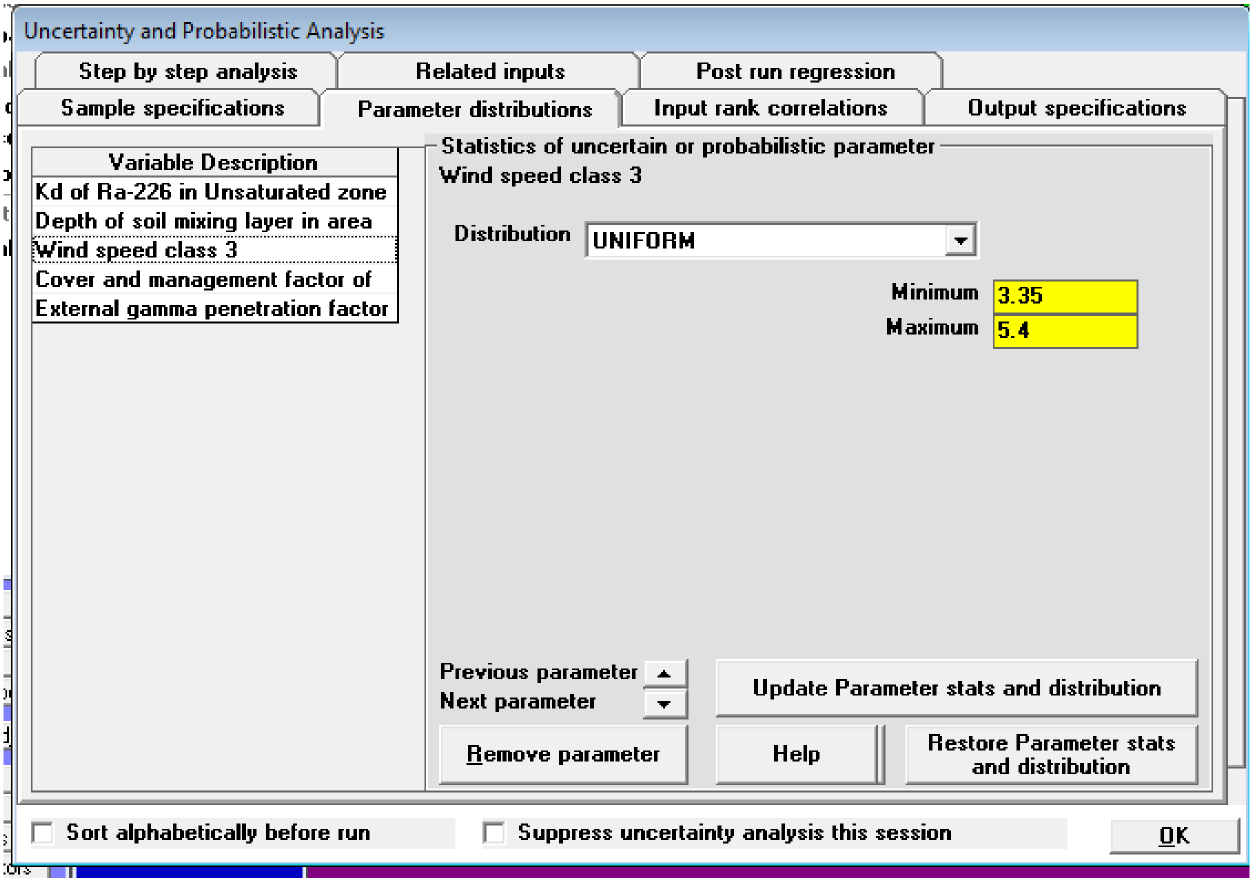
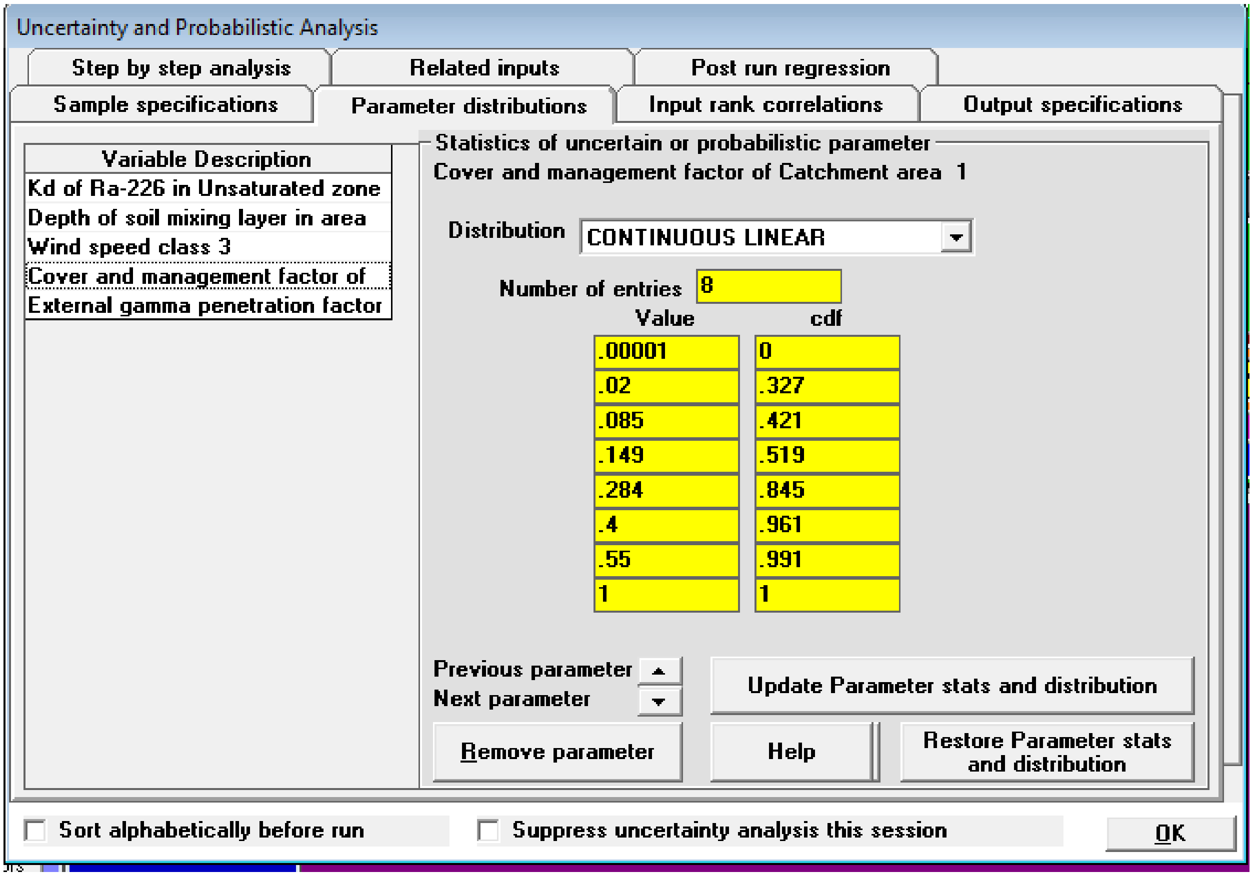
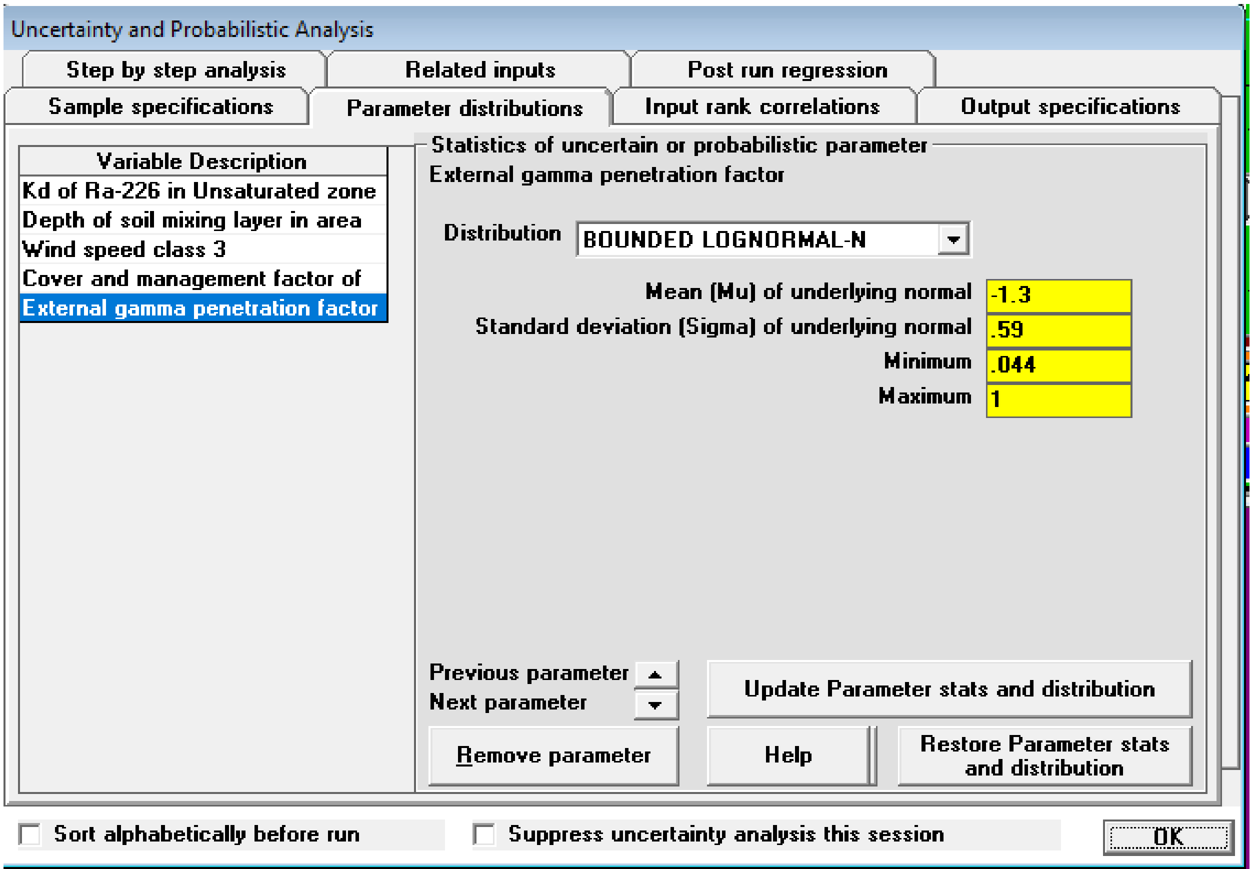


Table C-24 Cumulative Distribution for the Cover and Management Factor

Cover and Management Factor	Cumulative Probability
0.00001	3.17E-06
0.020	0.327
0.085	0.421
0.149	0.519
0.284	0.845
0.400	0.961
0.550	0.991
1.00	1.00



External gamma penetration factor	—	P	0.7	For deterministic run, base value selected is the code default. For probabilistic run, distribution from NUREG/CR-6697 is used.	Bounded Lognormal-N	-1.3	0.59	0.044	1	The penetration factor describes the effect of the building structure on the level of gamma radiation existing indoors. Specifically, the penetration factor is the fraction of outdoor gamma radiation that will be available indoors.


Uncertainty and Probabilistic Analysis
Step by step analysis
Related inputs
Post run regression
Sample specifications
Parameter distributions
Input rank correlations
Output specifications
Variable Description
Kd of Ra-226 in Unsaturated zone
Depth of soil mixing layer in area
Wind speed class 3
Cover and management factor of
External gamma penetration factor
Statistics of uncertain or probabilistic parameter
External gamma penetration factor
Distribution
BOUNDED LOGNORMAL-N
Mean (Mu) of underlying normal
-1.3
Standard deviation (Sigma) of underlying normal
.59
Minimum
.044
Maximum
1
Previous parameter
Next parameter
Update Parameter stats and distribution
Remove parameter
Help
Restore Parameter stats and distribution
Sort alphabetically before run
Suppress uncertainty analysis this session
OK

12.78 TEST CASE 044 TESTER'S REPORT

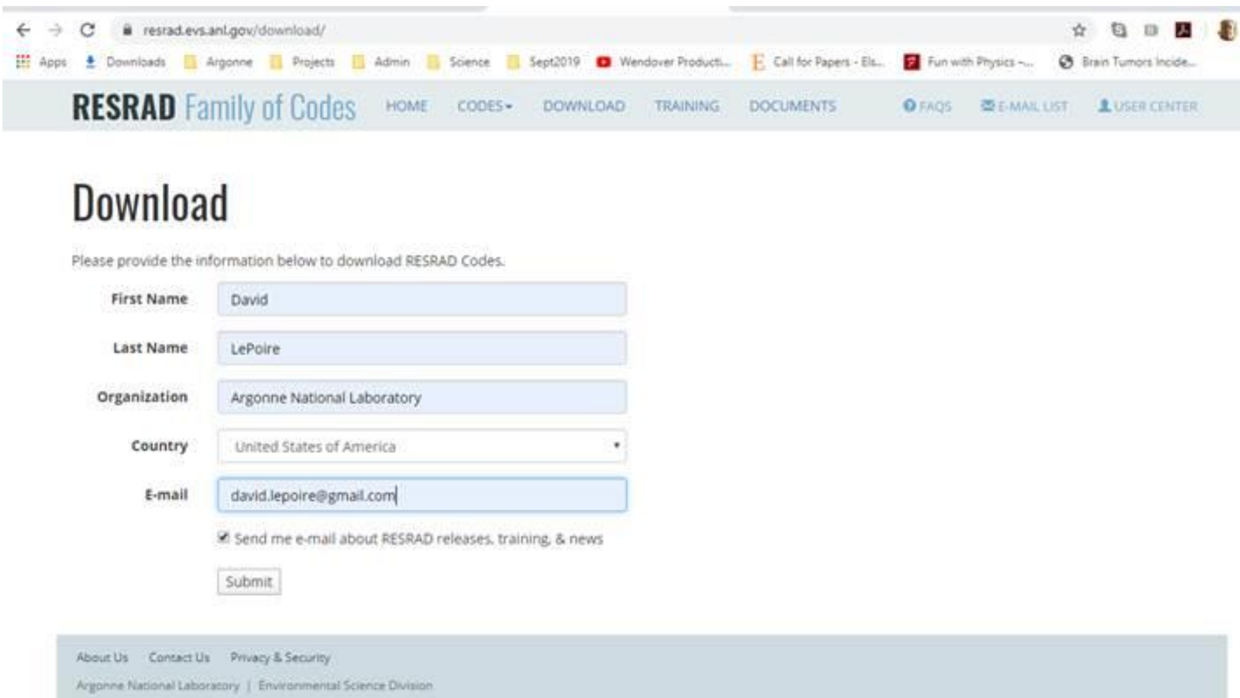
Documented in Results_ Test Case 044.msg of 2/13/2020 7:13 AM

Results: Test Case 044

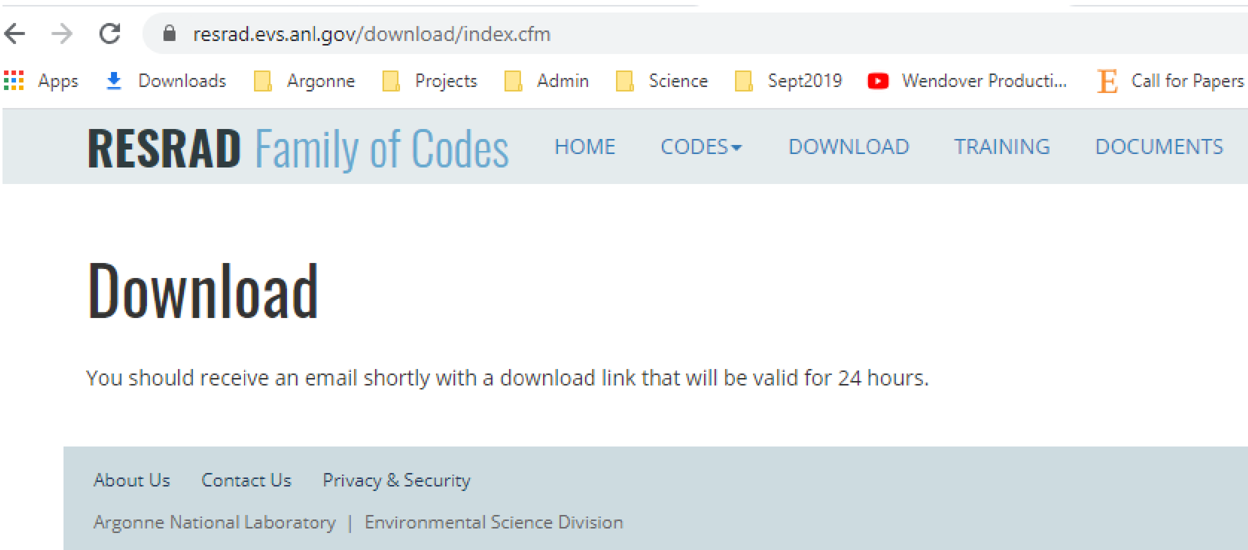
LePoire, David J. Thu 2/13/2020 7:13 AM

Summary: The 4 steps of Test Case 044 were successfully completed and documented (below).

1. **Go through download registration process on website.**



Result of "Submit"


resrad.evs.anl.gov/download/index.cfm

Apps Downloads Argonne Projects Admin Science Sept2019 Wendover Producti... Call for Papers

RESRAD Family of Codes HOME CODES DOWNLOAD TRAINING DOCUMENTS

Download

You should receive an email shortly with a download link that will be valid for 24 hours.

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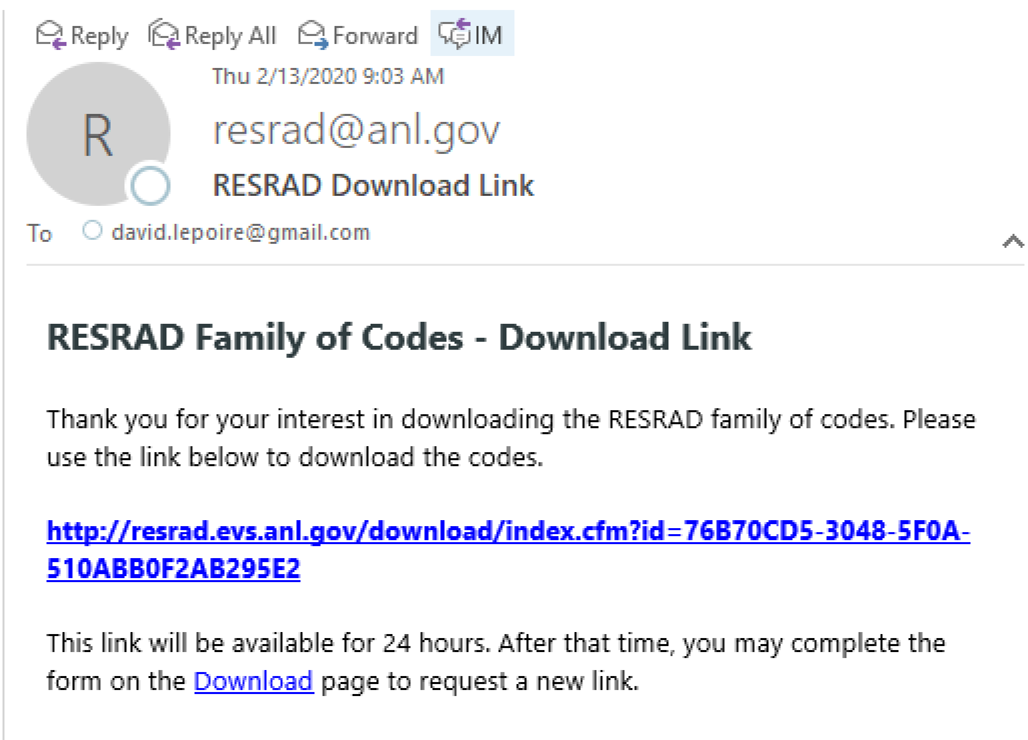
2. Verify receipt of email for access to download

Email received minutes later:


Reply Reply All Forward IM

Thu 2/13/2020 9:03 AM

resrad@anl.gov

RESRAD Download Link

To david.lepoire@gmail.com

RESRAD Family of Codes - Download Link

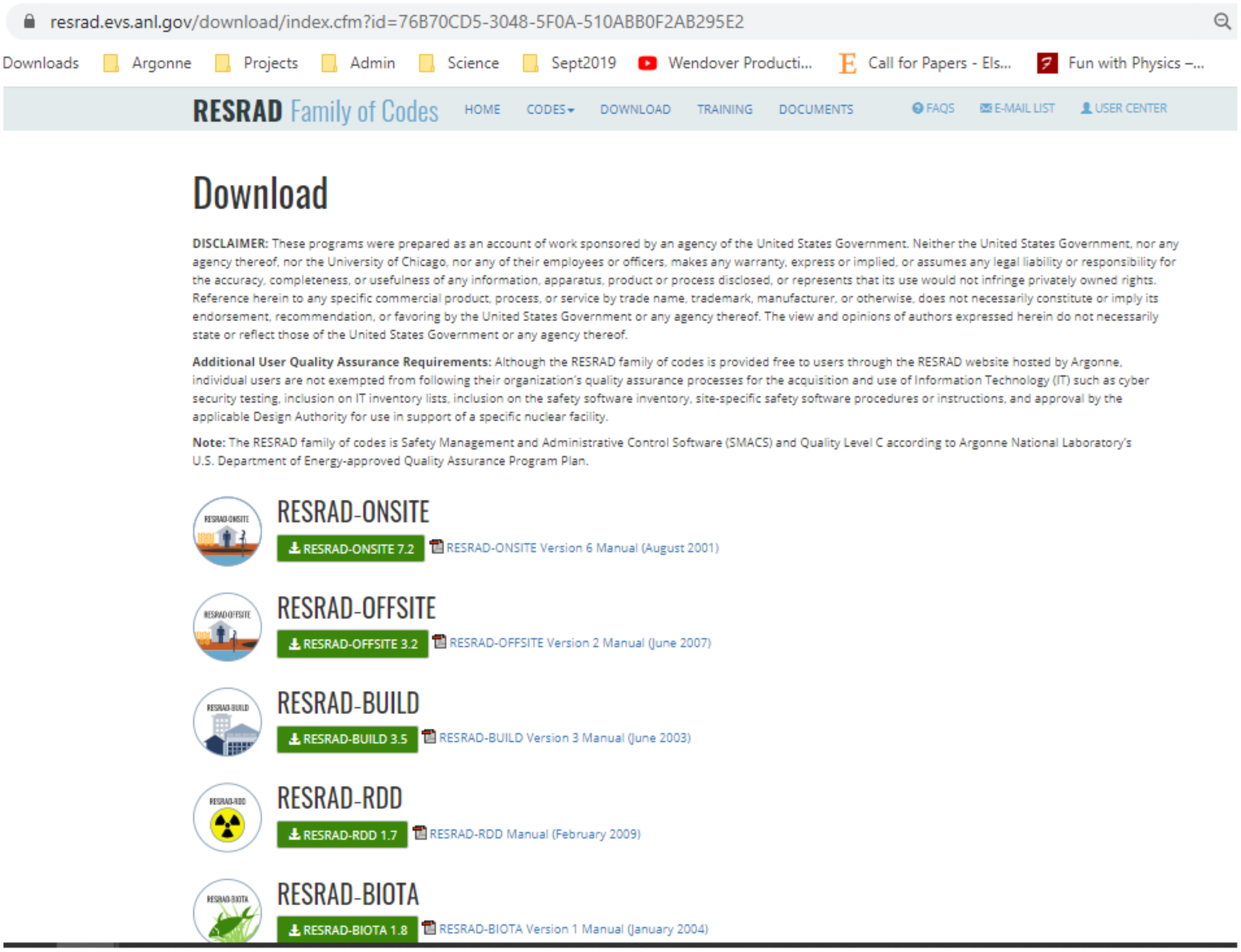
Thank you for your interest in downloading the RESRAD family of codes. Please use the link below to download the codes.

http://resrad.evs.anl.gov/download/index.cfm?id=76B70CD5-3048-5F0A-510ABB0F2AB295E2

This link will be available for 24 hours. After that time, you may complete the form on the Download page to request a new link.

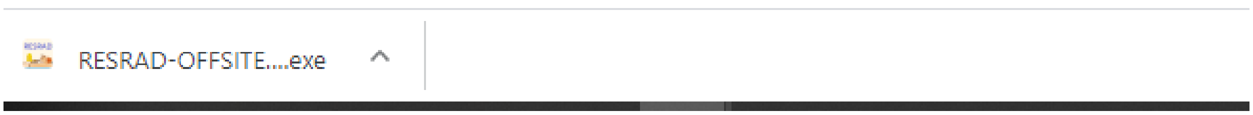
3. Verify email link allows access

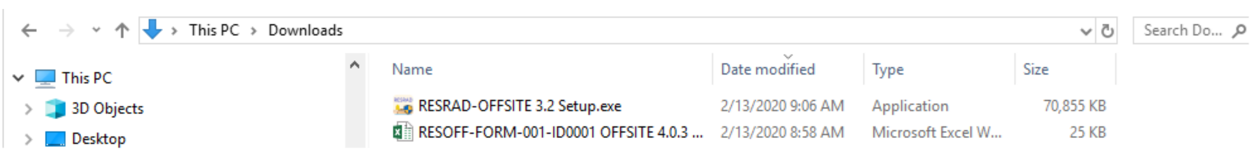
Result of clicking link:



4. Verify download

Result of clicking RESRAD-OFFSITE 3.2





12.79 TEST CASE 047 TESTER'S REPORT

Documented in Tase Case 47.msg of 2/20/2020 11:14 AM

Tase Case 47

LePoire, David J. Thu 2/20/2020 6:25 AM

Dose for wide area

View - SUMMARY.REP

File Edit Help

Font: MS LineDraw 7.4 Page: 34

```
RESRAD-OFFSITE, Version 4.0        T½ Limit = 30 days         02/19/2020  17
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File  : Site4.ROF

     Contaminated Zone Dimensions           Initial Soil Concentrations, pCi

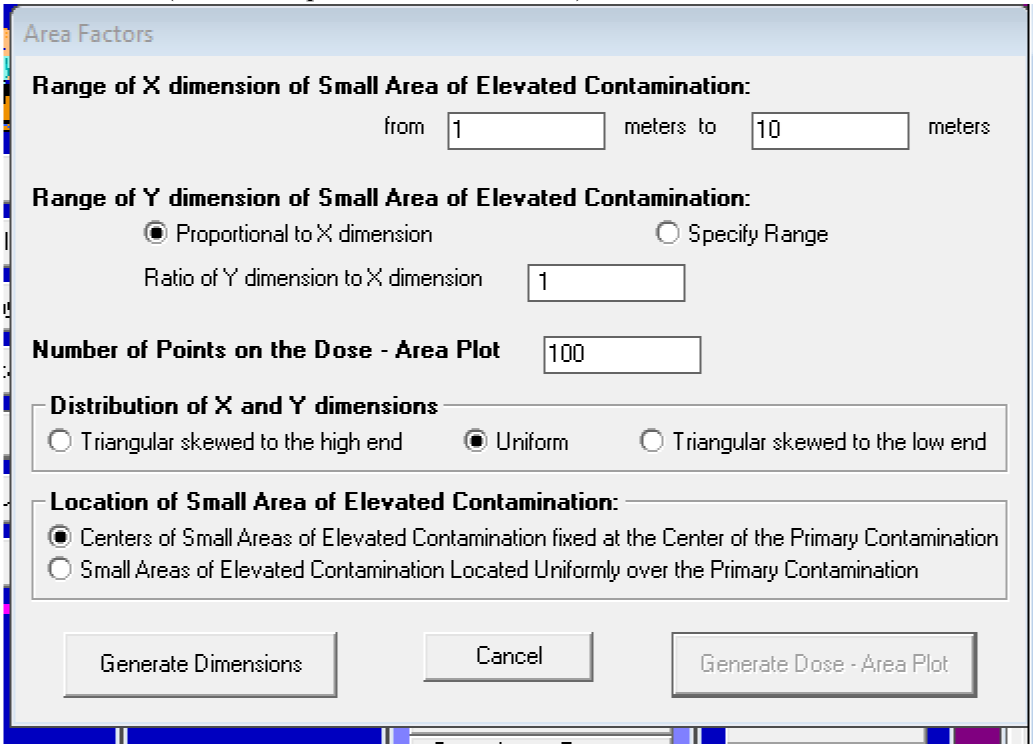
       Area:  10000.00 square meters               Co-60       1.000E+02
  Thickness:       2.00 meters
Cover Depth:       0.00 meters


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

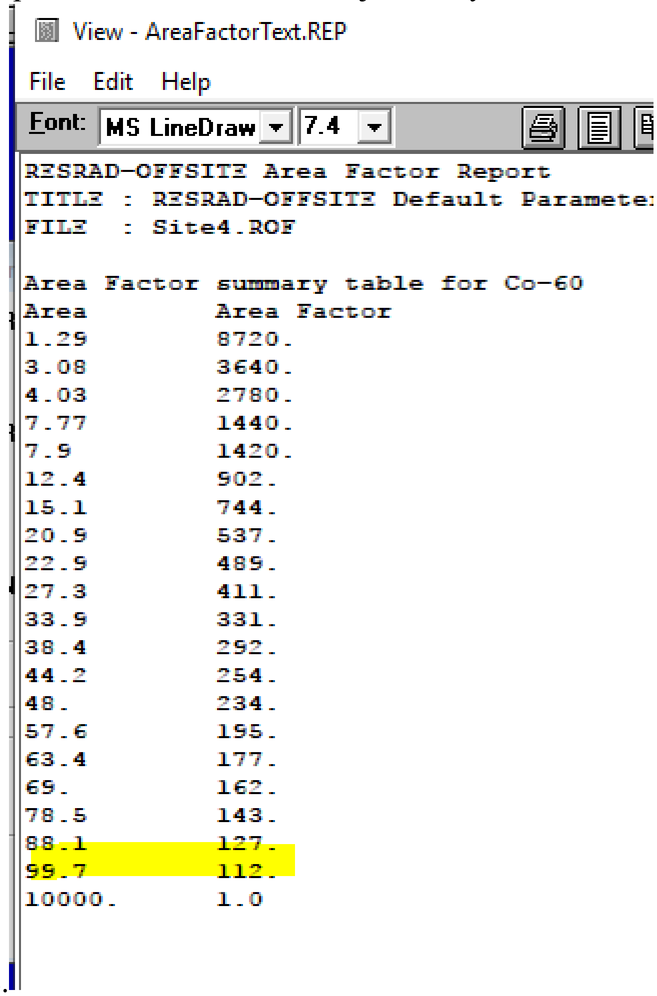
   t (years):  0.000E+00  1.000E+00  3.000E+00  6.000E+00  1.200E+01  3.000E+
    TDOSE(t):  4.012E+00  3.518E+00  2.704E+00  1.823E+00  8.276E-01  7.747E-
        M(t):  1.605E-01  1.407E-01  1.082E-01  7.290E-02  3.310E-02  3.099E-

Maximum TDOSE(t):  4.012E+00 mrem/yr at t = 0 years
```

Area Factor (consider up to 10 x 10 centered):



Summary: Area factor run for 10x10 centered case. Then doses for the full 100x100 are compared to the dose for the adjusted layout for the 10x10 area. The area factor agree to about



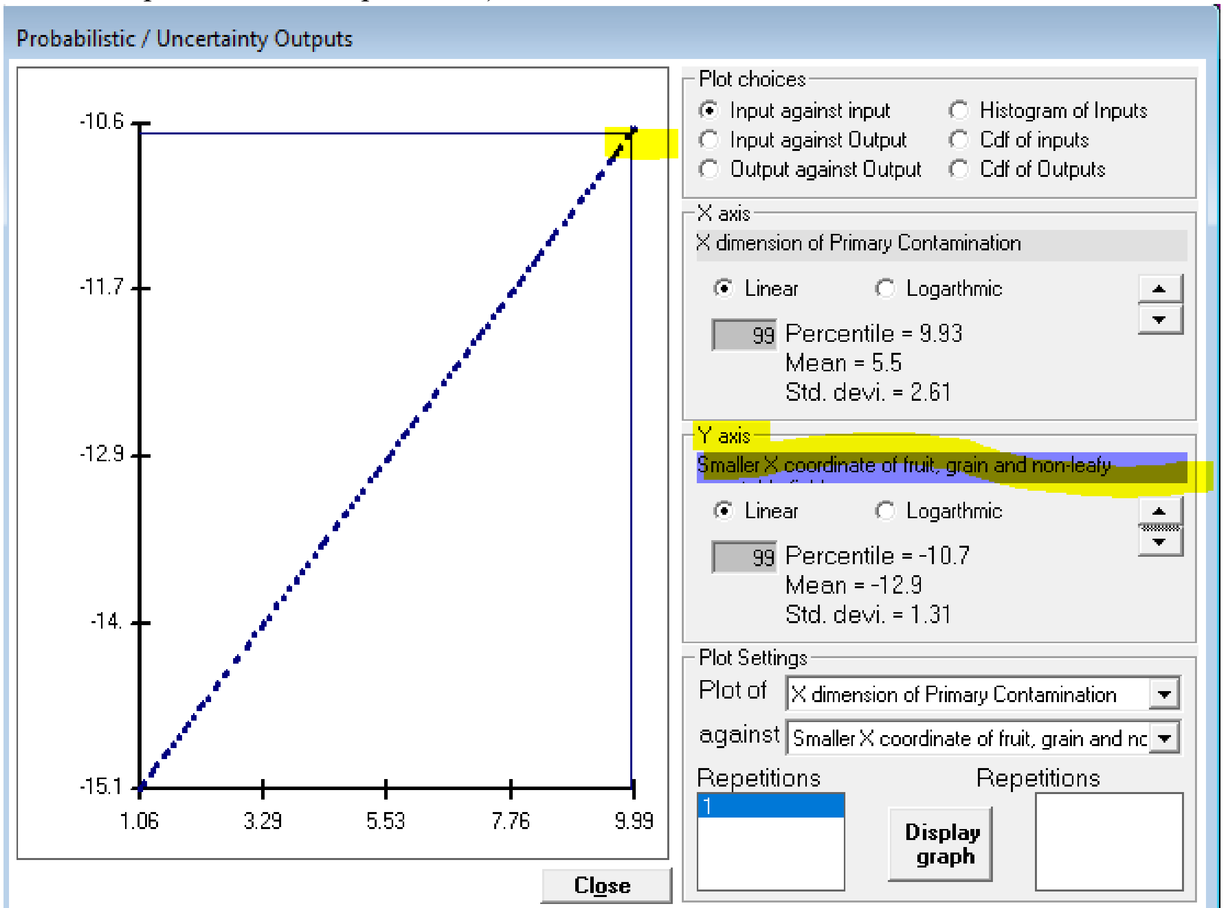
RESRAD-OFFSITE Area Factor Report
TITLE : RESRAD-OFFSITE Default Paramete
FILE : Site4.ROF

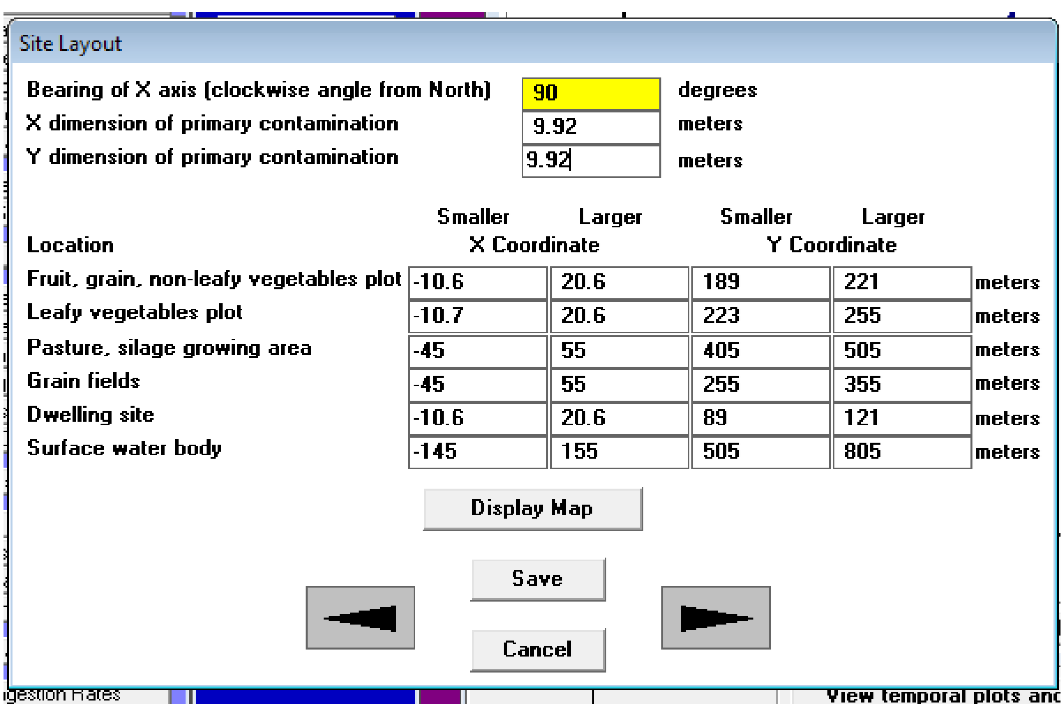
Area Factor summary table for Co-60

Area	Area Factor
1.29	8720.
3.08	3640.
4.03	2780.
7.77	1440.
7.9	1420.
12.4	902.
15.1	744.
20.9	537.
22.9	489.
27.3	411.
33.9	331.
38.4	292.
44.2	254.
48.	234.
57.6	195.
63.4	177.
69.	162.
78.5	143.
88.1	127.
99.7	112.
10000.	1.0

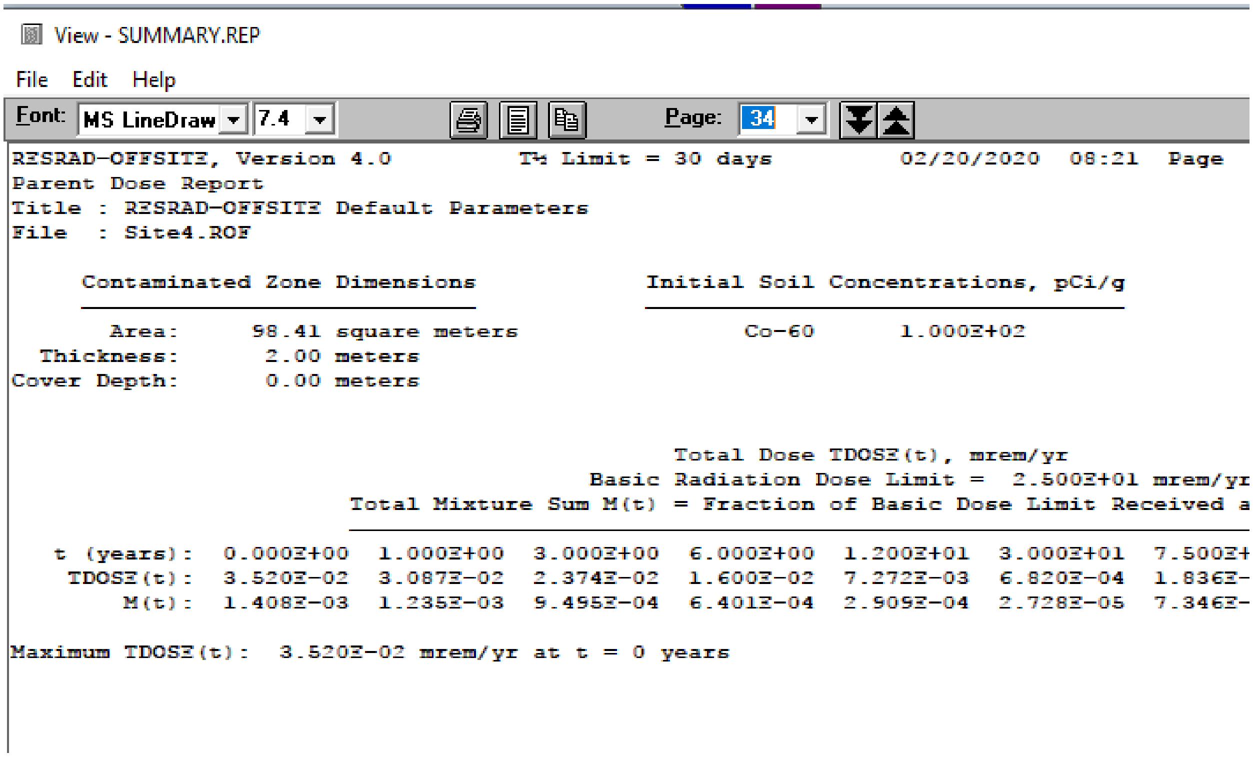
1%.

Set up deterministic setting for largest area. Find coordinates based on uncertainty distributions for related parameters example below):





Dose for small area:




```
RESRAD-OFFSITE, Version 4.0        T½ Limit = 30 days        02/20/2020  08:21  Page
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File  : Site4.ROF

     Contaminated Zone Dimensions            Initial Soil Concentrations, pCi/g

       Area:      98.41 square meters                Co-60       1.000E+02
  Thickness:       2.00 meters
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 a

   t (years):  0.000E+00  1.000E+00  3.000E+00  6.000E+00  1.200E+01  3.000E+01  7.500E+
    TDOSE(t):  3.520E-02  3.087E-02  2.374E-02  1.600E-02  7.272E-03  6.820E-04  1.836E-
        M(t):  1.408E-03  1.235E-03  9.495E-04  6.401E-04  2.909E-04  2.728E-05  7.346E-

Maximum TDOSE(t):  3.520E-02 mrem/yr at t = 0 years
```

Calculated area factor = 4.012/3.52e-2=113

12.80 TEST CASE 048 TESTER'S REPORT

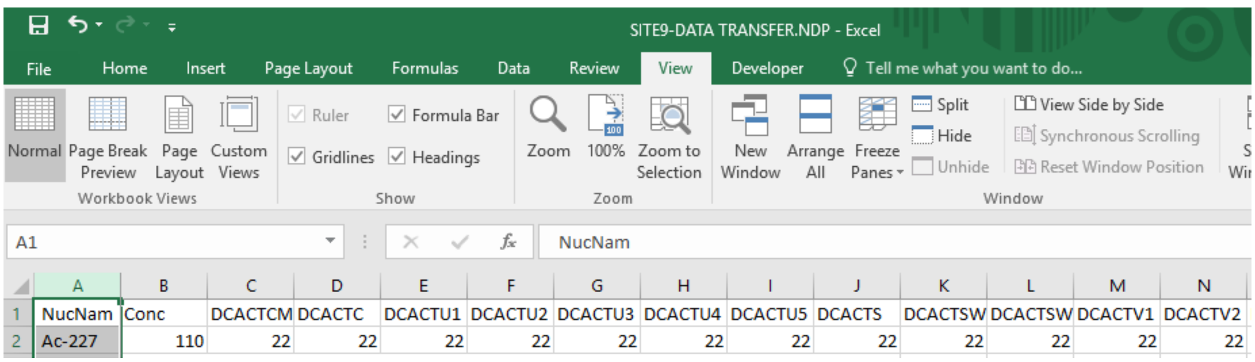
Documented in Test Case 48-JJCheng.docx of 2/18/2020 3:07 PM

Test Case 48 – Tests OFFSITE's generation of template files tool

Base on instructions of the Test Cases document, the following procedure was performed –

- Launched RESRAD-OFFSITE. Selected Ac-227 as the radionuclide of concern with an initial conc. of 100 Bq/g. Chose the Data Transfer -> Generate templet files menu to generate template files. The inputs were save to file SITE9-DATA TRANSFER.ROF.
- Opened the Excel files, SITE9-DATA TRANSFER-NDP and SITE9-DATA TRANSFER-NIP. Made changes. The following screenshots compare the values before and after the changes.

After the changes -

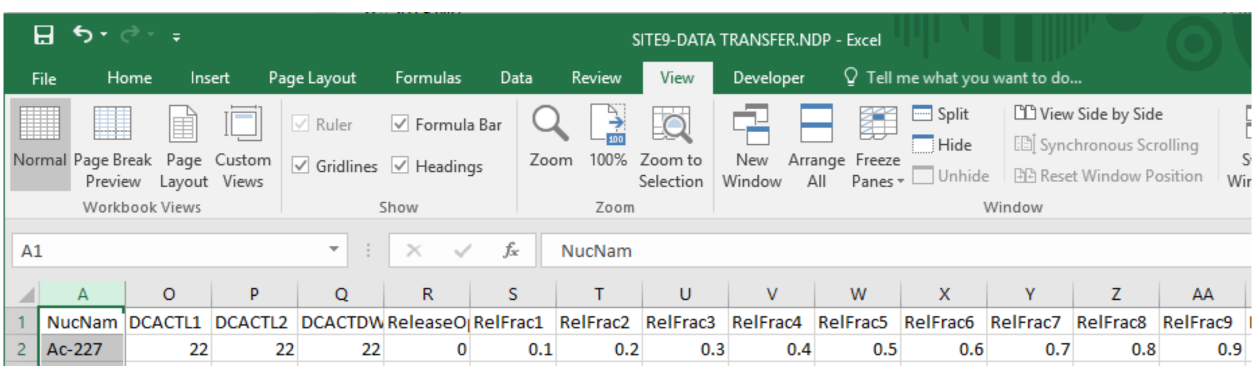


	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	NucNam	Conc	DCACTCM	DCACTC	DCACTU1	DCACTU2	DCACTU3	DCACTU4	DCACTU5	DCACTS	DCACTSW	DCACTSW	DCACTV1	DCACTV2
2	Ac-227	110	22	22	22	22	22	22	22	22	22	22	22	22

Before the changes -

2	1	NucNam	Conc	DCACTCM	DCACTC	DCACTU1	DCACTU2	DCACTU3	DCACTU4	DCACTU5	DCACTS	DCACTSW	DCACTSW	DCACTV1	DCACTV2
3	2	Ac-227	100	20	20	20	20	20	20	20	20	20	20	20	20

After the changes -



	A	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	NucNam	DCACTL1	DCACTL2	DCACTDW	ReleaseO	RelFrac1	RelFrac2	RelFrac3	RelFrac4	RelFrac5	RelFrac6	RelFrac7	RelFrac8	RelFrac9
2	Ac-227	22	22	22	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9

Before the changes -

1	NucNam	DCACTL1	DCACTL2	DCACTDW	ReleaseO	RelFrac1	RelFrac2	RelFrac3	RelFrac4	RelFrac5	RelFrac6	RelFrac7	RelFrac8	RelFrac9
2	Ac-227	20	20	20	1	1	1	1	1	1	1	1	1	1

After the changes -

	A	AT	AU	AV	AW	AX	AY	AZ	BA	BB
1	NucNam	LEACH1	LEACH2	LEACH3	LEACH4	LEACH5	LEACH6	LEACH7	LEACH8	LEACH9
2	Ac-227	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.009

Before the changes -

	A	AT	AU	AV	AW	AX	AY	AZ	BA	BB
1	NucNam	LEACH1	LEACH2	LEACH3	LEACH4	LEACH5	LEACH6	LEACH7	LEACH8	LEACH9
2	Ac-227	0	0	0	0	0	0	0	0	0

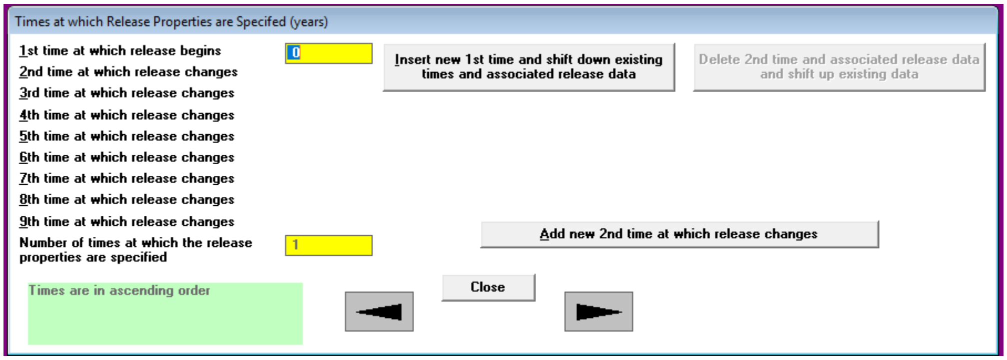
After the changes –

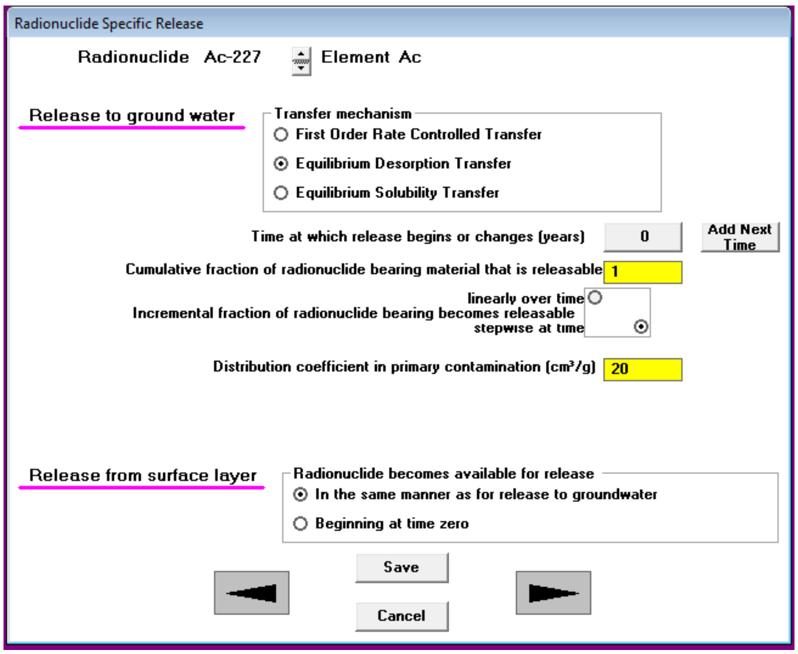
	A	B	C	D	E	F	G	H
1	Index	Variable	Value	Descriptic	Lower bou	Upper bou	Form name	
2	1	BRDL	0.25	Basic Radi	1.00E-34	1.00E+34	FSTINFRM	
3	2	ED	30	Exposure	1	1000	FSTINFRM	
4	3	NS	1	Number o	0	5	FSTINFRM	
5	4	MULTIFORM	0	Multiform	0	1	FSTINFRM	
6	5	PCOPTION	1	Conceptu	0	3	FSTINFRM	
7	6	SUBMERGEDF	0	Fraction o	0	1	FSTINFRM	
8	7	SOLUBITERL	5	Maximum	1	10	FSTINFRM	
9	8	RELTIME(1)	0	Time at w	0	100000	RELTIMEFRM	
10	9	RELTIME(2)	100	Time at w	0	100000	RELTIMEFRM	
11	10	RELTIME(3)	200	Time at w	0	100000	RELTIMEFRM	
12	11	RELTIME(4)	300	Time at w	0	100000	RELTIMEFRM	
13	12	RELTIME(5)	400	Time at w	0	100000	RELTIMEFRM	
14	13	RELTIME(6)	500	Time at w	0	100000	RELTIMEFRM	
15	14	RELTIME(7)	600	Time at w	0	100000	RELTIMEFRM	
16	15	RELTIME(8)	700	Time at w	0	100000	RELTIMEFRM	
17	16	RELTIME(9)	800	Time at w	0	100000	RELTIMEFRM	
18	17	RELTPTST	9	Number c	1	9	RELTIMEFRM	
19	18	NXBEARING	90	Bearing of	0	360	LAYOUTFRM	

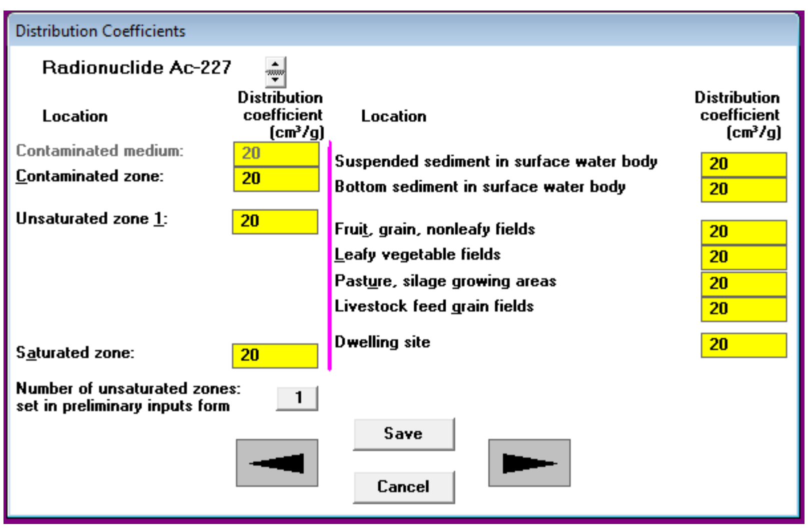
Before the changes -

	A	B	C	D	E	F	G	H
1	Index	Variable	Value	Descriptic	Lower bou	Upper bou	Form name	
2	1	BRDL	0.25	Basic Radi	1.00E-34	1.00E+34	FSTINFRM	
3	2	ED	30	Exposure	1	1000	FSTINFRM	
4	3	NS	1	Number o	0	5	FSTINFRM	
5	4	MULTIFORM	0	Multiform	0	1	FSTINFRM	
6	5	PCOPTION	1	Conceptu	0	3	FSTINFRM	
7	6	SUBMERGEDF	0	Fraction o	0	1	FSTINFRM	
8	7	SOLUBITERL	5	Maximum	1	10	FSTINFRM	
9	8	RELTIME(1)	0	Time at w	0	100000	RELTIMEFRM	
10	9	RELTIME(2)	0	Time at w	0	100000	RELTIMEFRM	
11	10	RELTIME(3)	0	Time at w	0	100000	RELTIMEFRM	
12	11	RELTIME(4)	0	Time at w	0	100000	RELTIMEFRM	
13	12	RELTIME(5)	0	Time at w	0	100000	RELTIMEFRM	
14	13	RELTIME(6)	0	Time at w	0	100000	RELTIMEFRM	
15	14	RELTIME(7)	0	Time at w	0	100000	RELTIMEFRM	
16	15	RELTIME(8)	0	Time at w	0	100000	RELTIMEFRM	
17	16	RELTIME(9)	0	Time at w	0	100000	RELTIMEFRM	
18	17	RELTPTST	1	Number o	1	9	RELTIMEFRM	
19	18	NXBEARING	90	Bearing of	0	360	LAYOUTFRM	

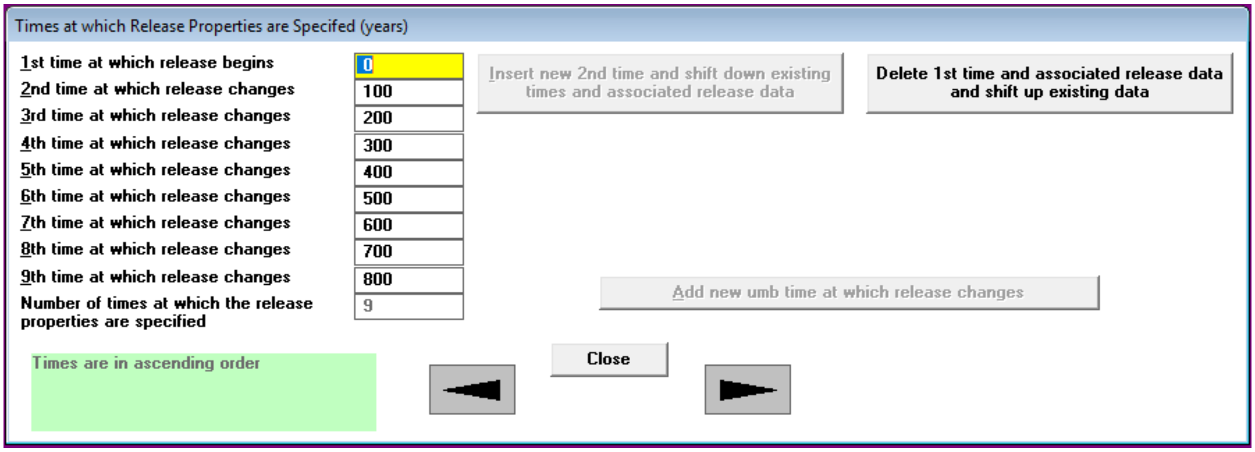
- Launched RESRAD-OFFSITE and opend input file, SITE9-DATA TRANSFER.ROF. The inputs of radionuclide release and Kds were –

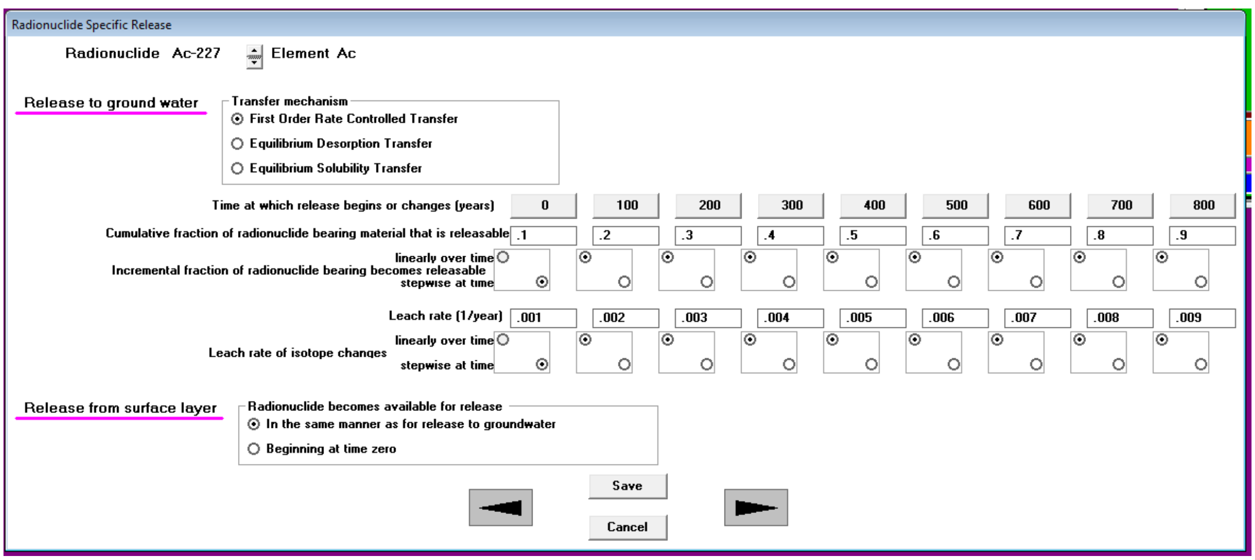


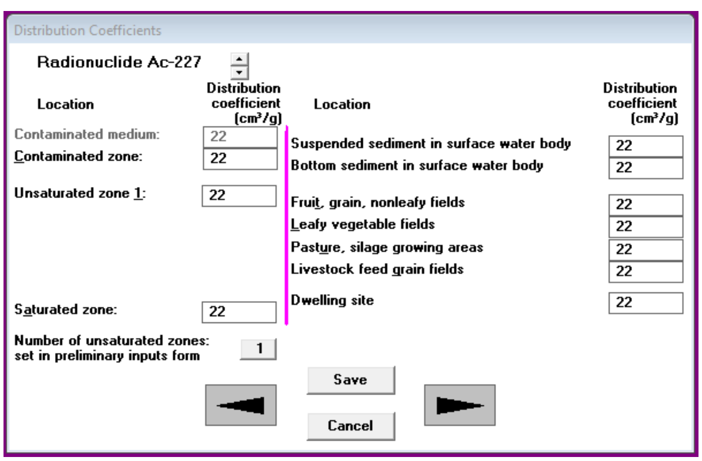




- Chose Data Transfer -> Read Template Files to read in the template files associated with the input file that were changed. After reading in data in the template files, the concentration of Ac-227 changed to 110 Bq/g, the Kds changed to 22 cm3/g, the number of release times changed to 9, and the transfer mechanism changed to First Order Rate Controlled Transfer, as shown in the screen shots below –







The Data Transfer Template files were generated and the data in them were read in successfully.

12.81 TEST CASE 049 TESTER'S REPORT

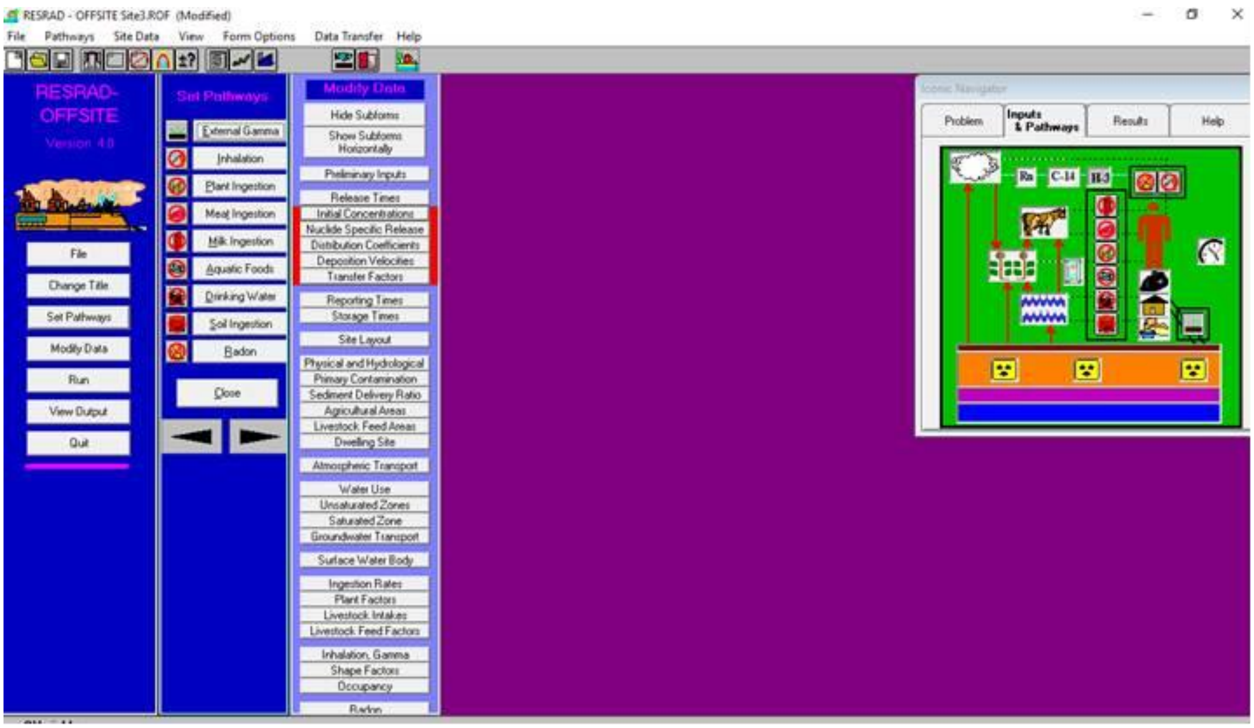
Documented in Results for Test Case 049.msg of 2/14/2020 3:06 PM

Results for Test Case 049

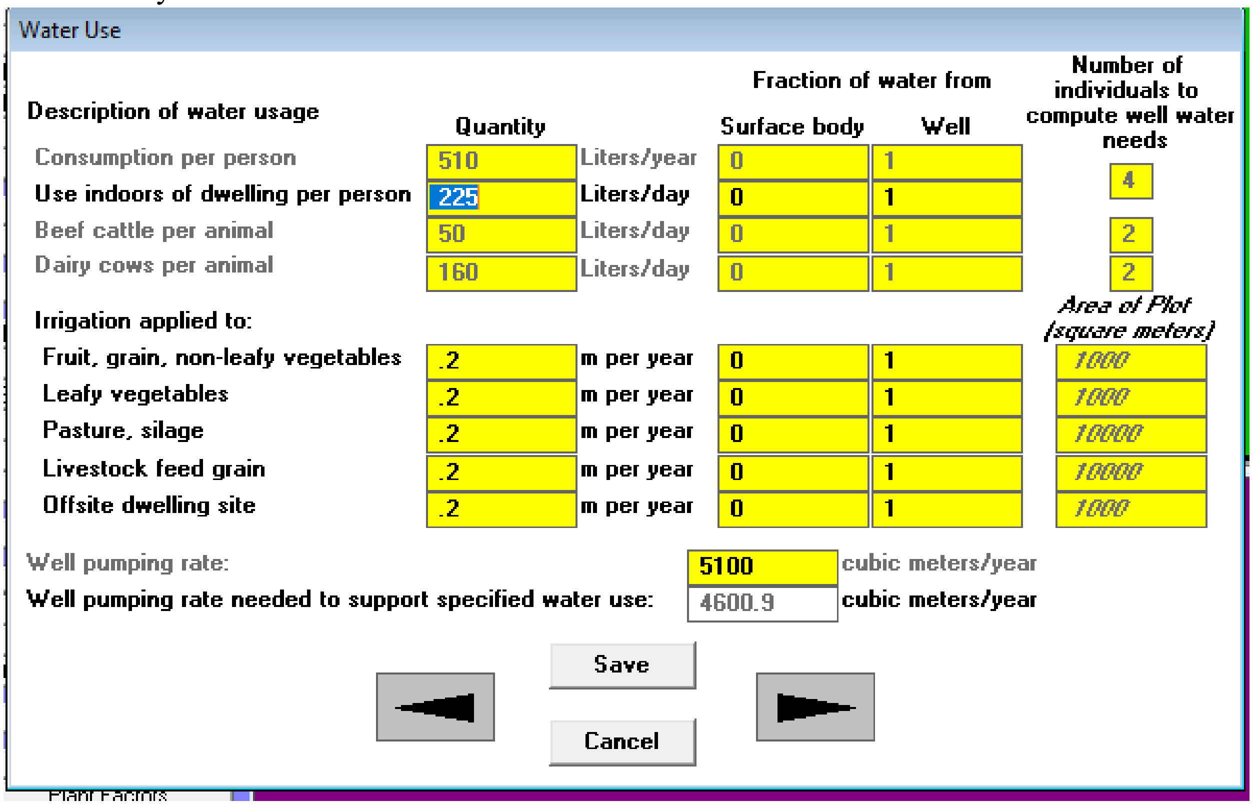
LePoire, David J. Fri 2/14/2020 3:06 PM

Added Co-60 to the default case.

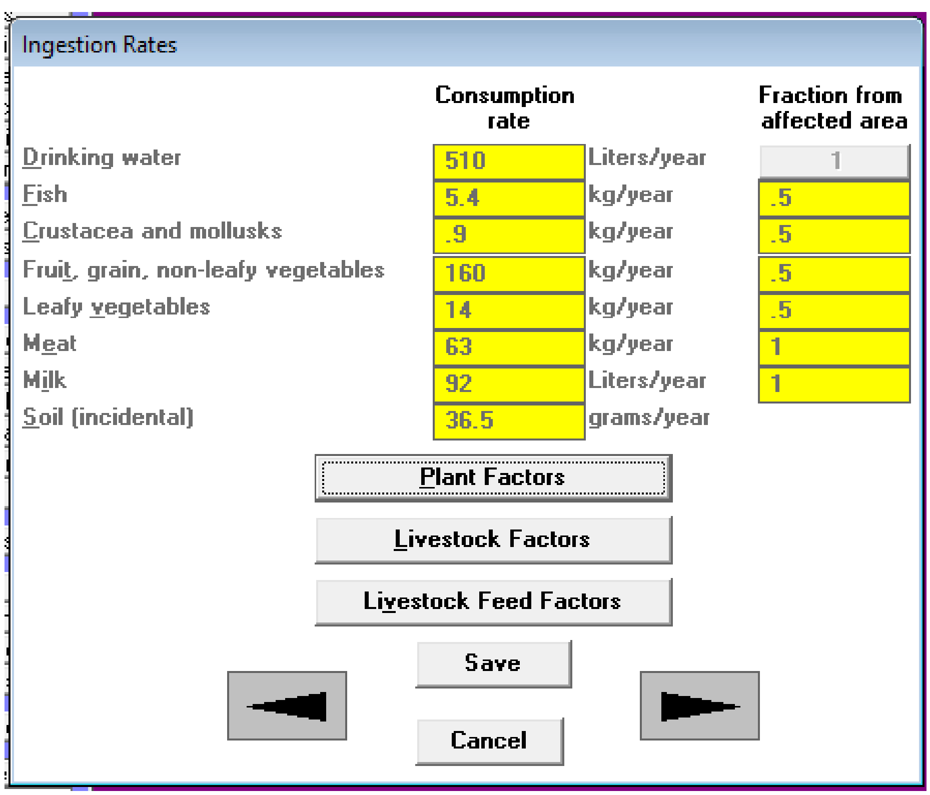
External Pathway:



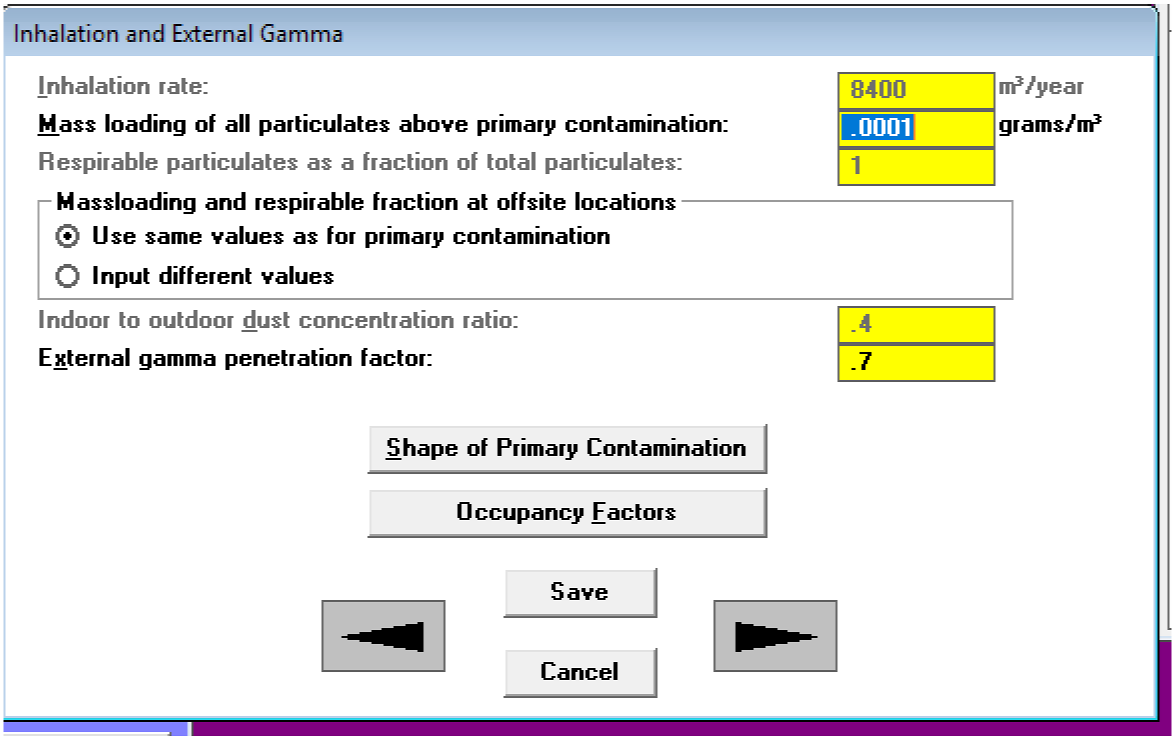
Water use by livestock is not used:



All ingestion disabled:



Inhalation parameters disabled:



Ran the case. Looked at input echo:

No ingestion pathway parameters used:

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
INGE	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DVI(2)
INGE	Fraction of vegetable 2 from affected area	not used	5.000E-01	---	FVEG(2)
INGE	Meat 1 consumption (kg/yr)	not used	6.300E+01	---	DMI(1)
INGE	Fraction of meat 1from affected area	not used	1.000E+00	---	FMEMI(1)
INGE	Milk consumption (L/yr)	not used	9.200E+01	---	DMI(2)
INGE	Fraction of milk from affected area	not used	1.000E+00	---	FMEMI(2)
INGE	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YIELD(1)
VEGE	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	GROWTIME(1)
VEGE	Translocation Factor for Non-Leafy	not used	1.000E-01	---	FOLI_F(1)
VEGE	Weathering Removal Constant for Non-Leafy	not used	2.000E+01	---	RWEATHER(1)
VEGE	Foliar Interception Fraction for dust Non-Leafy	not used	2.500E-01	---	FINTCEPT(1,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Non-Leafy	not used	2.500E-01	---	FINTCEPT(1,2)
VEGE	Depth of roots for Non-Leafy (m)	not used	1.200E+00	---	DROOT(1)
VEGE	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YIELD(2)
VEGE	Growing Season for Leafy (years)	not used	2.500E-01	---	GROWTIME(2)
VEGE	Translocation Factor for Leafy	not used	1.000E+00	---	FOLI_F(2)
VEGE	Weathering Removal Constant for Leafy	not used	2.000E+01	---	RWEATHER(2)
VEGE	Foliar Interception Fraction for dust Leafy	not used	2.500E-01	---	FINTCEPT(2,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Leafy	not used	2.500E-01	---	FINTCEPT(2,2)
VEGE	Depth of roots for Leafy (m)	not used	9.000E-01	---	DROOT(2)
VEGE	Wet weight crop yield for Pasture (kg/m**2)	not used	1.100E+00	---	YIELD(3)
VEGE	Growing Season for Pasture (years)	not used	8.000E-02	---	GROWTIME(3)
VEGE	Translocation Factor for Pasture	not used	1.000E+00	---	FOLI_F(3)
VEGE	Weathering Removal Constant for Pasture	not used	2.000E+01	---	RWEATHER(3)
VEGE	Foliar Interception Fraction for dust Pasture	not used	2.500E-01	---	FINTCEPT(3,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Pasture	not used	2.500E-01	---	FINTCEPT(3,2)
VEGE	Depth of roots for Pasture (m)	not used	9.000E-01	---	DROOT(3)
VEGE	Wet weight crop yield for Grain (kg/m**2)	not used	7.000E-01	---	YIELD(4)
VEGE	Growing Season for Grain (years)	not used	1.700E-01	---	GROWTIME(4)
VEGE	Translocation Factor for Grain	not used	1.000E-01	---	FOLI_F(4)
VEGE	Weathering Removal Constant for Grain	not used	2.000E+01	---	RWEATHER(4)
VEGE	Foliar Interception Fraction for dust Grain	not used	2.500E-01	---	FINTCEPT(4,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Grain	not used	2.500E-01	---	FINTCEPT(4,2)
VEGE	Depth of roots for Grain (m)	not used	1.200E+00	---	DROOT(4)

No inhalation parameters used:

```
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```

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
INHE	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
INHE	Mass loading of all particulates from Primary contam	1.000E-04	1.000E-04	---	MLFD
INHE	Respirable particulates as a fraction of total	not used	1.000E+00	---	RESPFRACPC
INHE	Offsite mass loading same as onsite mass loading?	not used		---	SAMEMLRF
INHE	Total mass loading at agricultural area 1 (g/m**3)	not used	1.000E-04	---	MLTOTOF(1)
INHE	Respirable fraction at agricultural area 1	not used	1.000E+00	---	RESPFRACOF(1)
INHE	Total mass loading at agricultural area 2 (g/m**3)	not used	1.000E-04	---	MLTOTOF(2)
INHE	Respirable fraction at agricultural area 2	not used	1.000E+00	---	RESPFRACOF(2)
INHE	Total mass loading at agricultural area 3 (g/m**3)	not used	1.000E-04	---	MLTOTOF(3)
INHE	Respirable fraction at agricultural area 3	not used	1.000E+00	---	RESPFRACOF(3)
INHE	Total mass loading at agricultural area 4 (g/m**3)	not used	1.000E-04	---	MLTOTOF(4)
INHE	Respirable fraction at agricultural area 4	not used	1.000E-04	---	RESPFRACOF(4)
INHE	Total mass loading at offsite dwelling(g/m**3)	not used	1.000E-04	---	MLTOTDWELL
INHE	Respirable fraction at offsite dwelling(g/m**3)	not used	1.000E+00	---	RESPFRACDWELL
INHE	Indoor dust filtration factor, inhalation	not used	4.000E-01	---	SHF3
INHE	Shielding factor, external gamma	7.000E-01	7.000E-01	---	SHF1
INHE	Shape factor flag, external gamma	-1.000E+00	1.000E+00	noncircular	FS
SEXT	Onsite shape factor array (used if non-circular):				
SEXT	Radii of shape factor array (used if non-circular):				
SEXT	Outer annular radius (m), ring 1:	6.000E+00	6.000E+00	---	RAD_SHAPE(1)
SEXT	Outer annular radius (m), ring 2:	1.200E+01	1.200E+01	---	RAD_SHAPE(2)
SEXT	Outer annular radius (m), ring 3:	1.800E+01	1.800E+01	---	RAD_SHAPE(3)
SEXT	Outer annular radius (m), ring 4:	2.400E+01	2.400E+01	---	RAD_SHAPE(4)
SEXT	Outer annular radius (m), ring 5:	3.000E+01	3.000E+01	---	RAD_SHAPE(5)
SEXT	Outer annular radius (m), ring 6:	3.600E+01	3.600E+01	---	RAD_SHAPE(6)
SEXT	Outer annular radius (m), ring 7:	4.200E+01	4.200E+01	---	RAD_SHAPE(7)
SEXT	Outer annular radius (m), ring 8:	4.800E+01	4.800E+01	---	RAD_SHAPE(8)
SEXT	Outer annular radius (m), ring 9:	5.400E+01	5.400E+01	---	RAD_SHAPE(9)
SEXT	Outer annular radius (m), ring 10:	6.000E+01	6.000E+01	---	RAD_SHAPE(10)
SEXT	Outer annular radius (m), ring 11:	6.600E+01	6.600E+01	---	RAD_SHAPE(11)
SEXT	Outer annular radius (m), ring 12:	7.200E+01	7.200E+01	---	RAD_SHAPE(12)
SEXT	Fractions of annular areas within AREA:				
SEXT	Ring 1	1.000E+00	1.000E+00	---	FRACA(1)
SEXT	Ring 2	1.000E+00	1.000E+00	---	FRACA(2)
SEXT	Ring 3	1.000E+00	1.000E+00	---	FRACA(3)
SEXT	Ring 4	1.000E+00	1.000E+00	---	FRACA(4)
SEXT	Ring 5	1.000E+00	1.000E+00	---	FRACA(5)

No Radon or c-14 parameters used:

SEXT	Ring 61	0.000E+00	0.000E+00	---	FRACA(61)
SEXT	Ring 62	3.172E-02	3.172E-02	---	FRACA(62)
SEXT	Ring 63	6.154E-02	6.154E-02	---	FRACA(63)
SEXT	Ring 64	5.911E-02	5.911E-02	---	FRACA(64)
SEXT	Ring 65	5.687E-02	5.687E-02	---	FRACA(65)
SEXT	Ring 66	5.479E-02	5.479E-02	---	FRACA(66)
SEXT	Ring 67	5.286E-02	5.286E-02	---	FRACA(67)
SEXT	Ring 68	5.106E-02	5.106E-02	---	FRACA(68)
SEXT	Ring 69	4.938E-02	4.938E-02	---	FRACA(69)
SEXT	Ring 70	4.781E-02	4.781E-02	---	FRACA(70)
SEXT	Ring 71	4.633E-02	4.633E-02	---	FRACA(71)
SEXT	Ring 72	2.270E-02	2.270E-02	---	FRACA(72)
OCCU	Fraction of time spent indoors on contaminated site	0.000E+00	0.000E+00	---	FIND
OCCU	Fraction of time spent outdoors on contaminated site	0.000E+00	0.000E+00	---	FOTD
OCCU	Fraction of time spent indoors in Offsite Dwelling	5.000E-01	5.000E-01	---	FINDDWELL
OCCU	Fraction of time spent outdoors in Offsite Dwelling	1.000E-01	1.000E-01	---	FOTDDWELL
OCCU	Fraction of time spent outdoors in agri. area 1	1.000E-01	1.000E-01	---	OCCUPANCY(1)
OCCU	Fraction of time spent outdoors in agri. area 2	1.000E-01	1.000E-01	---	OCCUPANCY(2)
OCCU	Fraction of time spent outdoors in agri. area 3	1.000E-01	1.000E-01	---	OCCUPANCY(3)
OCCU	Fraction of time spent outdoors in agri. area 4	1.000E-01	1.000E-01	---	OCCUPANCY(4)
RADN	Diffusion coefficient for radon gas (m/sec):				
RADN	in cover material	not used	2.000E-06	---	DIFCV
RADN	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
RADN	in fruit, grain and non-leafy vegetable field	not used	2.000E-06	---	DIFOS(1)
RADN	in leafy vegetable field	not used	2.000E-06	---	DIFOS(2)
RADN	in pature	not used	2.000E-06	---	DIFOS(3)
RADN	in livestock grain field	not used	2.000E-06	---	DIFOS(4)
RADN	in offsite dwelling site	not used	2.000E-06	---	DIFOS(5)
RADN	in foundation material	not used	3.000E-07	---	DIFFL
RADN	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
RADN	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
RADN	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
RADN	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
RADN	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
RADN	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
RADN	Height of the building (room) (m)	not used	2.500E+00	---	HRM
RADN	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
RADN	Building interior area factor	not used	0.000E+00	---	FAI
RADN	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
RADN	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	Vertical dimension of mixing for vegetation (m)	not used	1.000E+00	---	HMIXV
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	C14EVSN

No tritium parameters used.

Reports correct Pathway selections:

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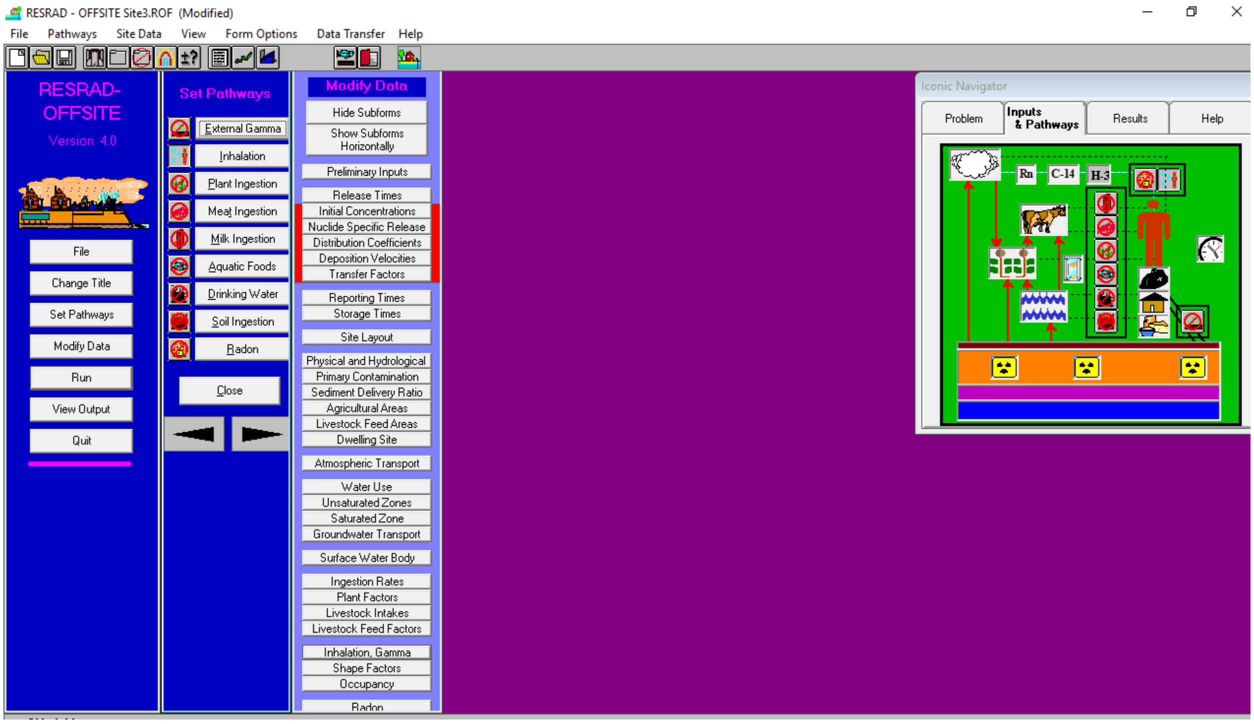
Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	C12EVSN
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C12	C-12 concentration in the atmosphere (g/m**3)	not used	1.800E-01	---	C12AIR
C12	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C12	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C12	C-12 concentration in meat 1 (g/g)	not used	2.400E-01	---	C12MEAT_MILK(1)
C12	C-12 concentration in milk (g/g)	not used	7.000E-02	---	C12MEAT_MILK(2)
C12	C-12 concentration in vegetable 1 (g/g)	not used	4.000E-01	---	C12PLANT(1)
C12	C-12 concentration in vegetable 2 (g/g)	not used	9.000E-02	---	C12PLANT(2)
C12	C-12 concentration in livestock feed 1 (g/g)	not used	9.000E-02	---	C12PLANT(3)
C12	C-12 concentration in livestock feed 2 (g/g)	not used	4.000E-01	---	C12PLANT(4)
H3	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
H3	Mass fraction of water in meat 1 (g/g)	not used	6.000E-01	---	H2OMEAT_MILK(1)
H3	Mass fraction of water in milk (g/g)	not used	8.800E-01	---	H2OMEAT_MILK(2)
H3	Mass fraction of water in vegetable 1 (g/g)	not used	8.000E-01	---	H2OPLANT(1)
H3	Mass fraction of water in vegetable 2 (g/g)	not used	8.000E-01	---	H2OPLANT(2)
H3	Mass fraction of water in livestock feed 1 (g/g)	not used	8.000E-01	---	H2OPLANT(3)
H3	Mass fraction of water in livestock feed 2 (g/g)	not used	8.000E-01	---	H2OPLANT(4)

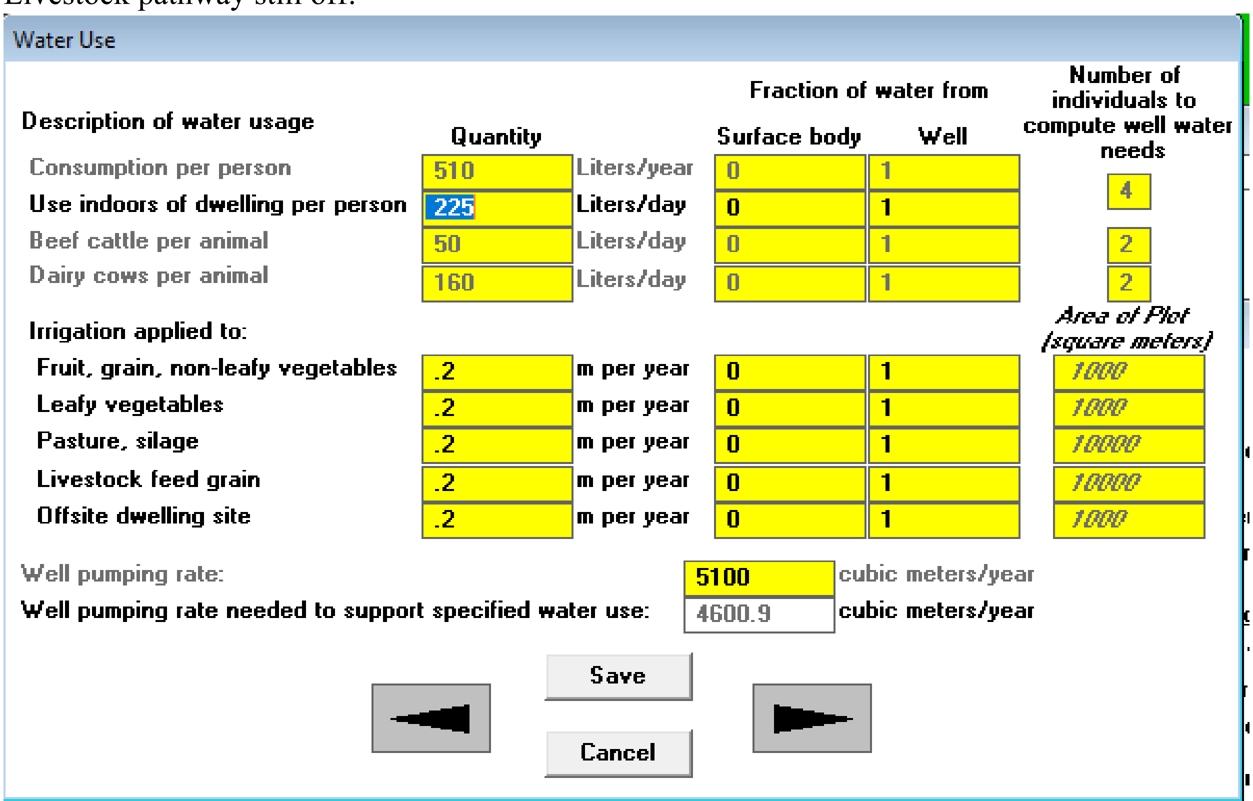
Summary of Pathway Selections

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

Now look at inhalation only pathway:



Livestock pathway still off:



Water Use

Description of water usage	Quantity		Fraction of water from Surface body	Well	Number of individuals to compute well water needs
Consumption per person	510	Liters/year	0	1	
Use indoors of dwelling per person	225	Liters/day	0	1	4
Beef cattle per animal	50	Liters/day	0	1	2
Dairy cows per animal	160	Liters/day	0	1	2
Irrigation applied to:					*Area of Plot (square meters)*
Fruit, grain, non-leafy vegetables	.2	m per year	0	1	1000
Leafy vegetables	.2	m per year	0	1	1000
Pasture, silage	.2	m per year	0	1	10000
Livestock feed grain	.2	m per year	0	1	10000
Offsite dwelling site	.2	m per year	0	1	1000

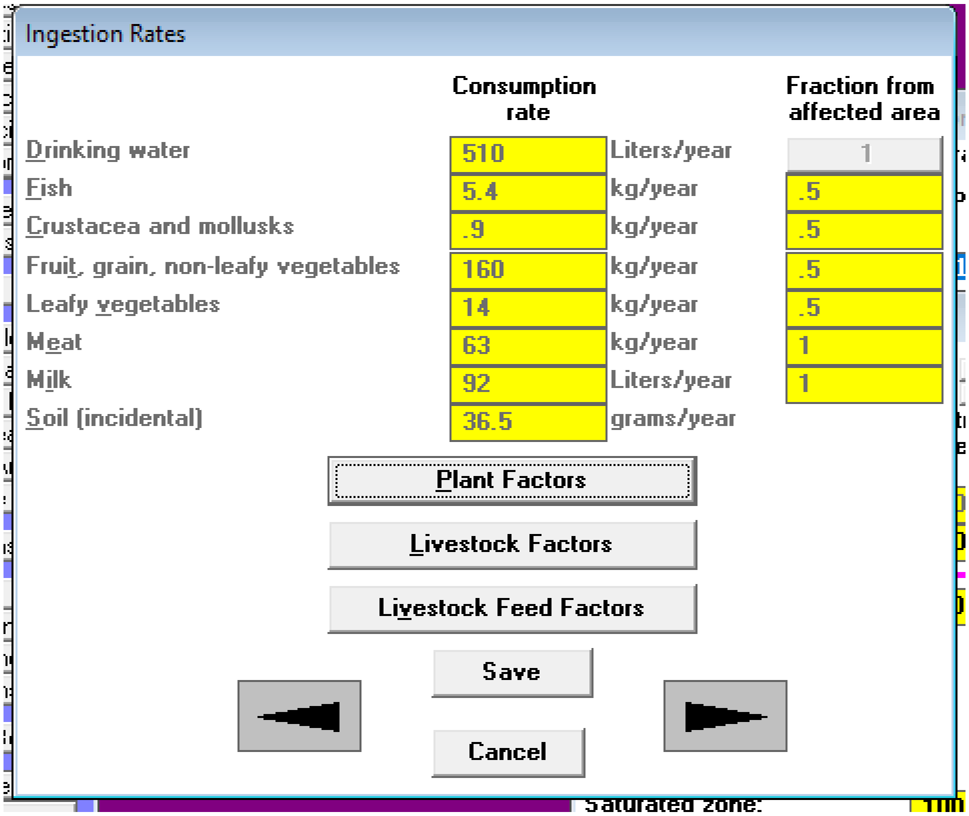
Well pumping rate: 5100 cubic meters/year

Well pumping rate needed to support specified water use: 4600.9 cubic meters/year

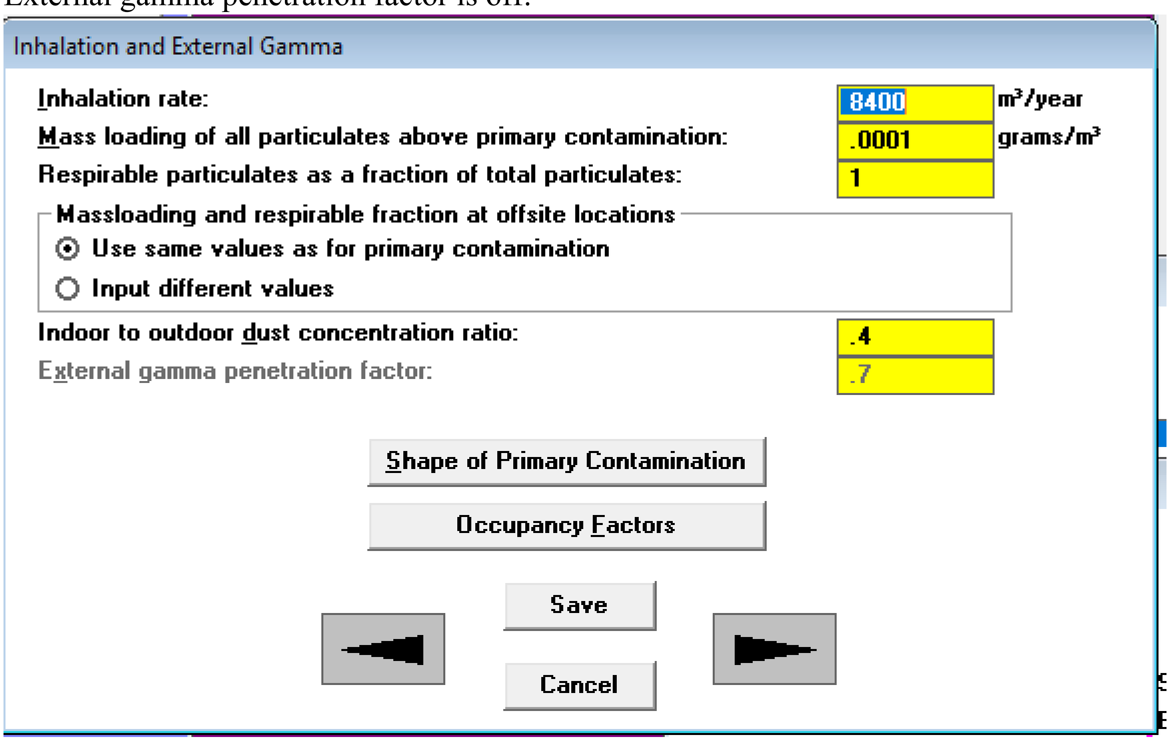
Save

Cancel

Ingestion still off



External gamma penetration factor is off:



Ran the case:

Look at Dose report:

No use of ingestion parameters:

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
INGE	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DVI(2)
INGE	Fraction of vegetable 2 from affected area	not used	5.000E-01	---	FVEG(2)
INGE	Meat 1 consumption (kg/yr)	not used	6.300E+01	---	DMI(1)
INGE	Fraction of meat 1from affected area	not used	1.000E+00	---	FMEMI(1)
INGE	Milk consumption (L/yr)	not used	9.200E+01	---	DMI(2)
INGE	Fraction of milk from affected area	not used	1.000E+00	---	FMEMI(2)
INGE	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YIELD(1)
VEGE	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	GROWTIME(1)
VEGE	Translocation Factor for Non-Leafy	not used	1.000E-01	---	FOLI_F(1)
VEGE	Weathering Removal Constant for Non-Leafy	not used	2.000E+01	---	RWEATHER(1)
VEGE	Foliar Interception Fraction for dust Non-Leafy	not used	2.500E-01	---	FINTCEPT(1,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Non-Leafy	not used	2.500E-01	---	FINTCEPT(1,2)
VEGE	Depth of roots for Non-Leafy (m)	not used	1.200E+00	---	DROOT(1)
VEGE	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YIELD(2)
VEGE	Growing Season for Leafy (years)	not used	2.500E-01	---	GROWTIME(2)
VEGE	Translocation Factor for Leafy	not used	1.000E+00	---	FOLI_F(2)
VEGE	Weathering Removal Constant for Leafy	not used	2.000E+01	---	RWEATHER(2)
VEGE	Foliar Interception Fraction for dust Leafy	not used	2.500E-01	---	FINTCEPT(2,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Leafy	not used	2.500E-01	---	FINTCEPT(2,2)
VEGE	Depth of roots for Leafy (m)	not used	9.000E-01	---	DROOT(2)
VEGE	Wet weight crop yield for Pasture (kg/m**2)	not used	1.100E+00	---	YIELD(3)
VEGE	Growing Season for Pasture (years)	not used	8.000E-02	---	GROWTIME(3)
VEGE	Translocation Factor for Pasture	not used	1.000E+00	---	FOLI_F(3)
VEGE	Weathering Removal Constant for Pasture	not used	2.000E+01	---	RWEATHER(3)
VEGE	Foliar Interception Fraction for dust Pasture	not used	2.500E-01	---	FINTCEPT(3,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Pasture	not used	2.500E-01	---	FINTCEPT(3,2)
VEGE	Depth of roots for Pasture (m)	not used	9.000E-01	---	DROOT(3)
VEGE	Wet weight crop yield for Grain (kg/m**2)	not used	7.000E-01	---	YIELD(4)
VEGE	Growing Season for Grain (years)	not used	1.700E-01	---	GROWTIME(4)
VEGE	Translocation Factor for Grain	not used	1.000E-01	---	FOLI_F(4)
VEGE	Weathering Removal Constant for Grain	not used	2.000E+01	---	RWEATHER(4)
VEGE	Foliar Interception Fraction for dust Grain	not used	2.500E-01	---	FINTCEPT(4,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Grain	not used	2.500E-01	---	FINTCEPT(4,2)

Inhalation parameters now used:

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
INHE	Inhalation rate (m**3/yr)	8.400E+03	8.400E+03	---	INHALR
INHE	Mass loading of all particulates from Primary contam	1.000E-04	1.000E-04	---	MLFD
INHE	Respirable particulates as a fraction of total	1.000E+00	1.000E+00	---	RESPFRACPC
INHE	Offsite mass loading same as onsite mass loading?	0.000E+00		---	SAMEMLRF
INHE	Total mass loading at agricultural area 1 (g/m**3)	1.000E-04	1.000E-04	---	MLTOTOF(1)
INHE	Respirable fraction at agricultural area 1	1.000E+00	1.000E+00	---	RESPFRACOF(1)
INHE	Total mass loading at agricultural area 2 (g/m**3)	1.000E-04	1.000E-04	---	MLTOTOF(2)
INHE	Respirable fraction at agricultural area 2	1.000E+00	1.000E+00	---	RESPFRACOF(2)
INHE	Total mass loading at agricultural area 3 (g/m**3)	1.000E-04	1.000E-04	---	MLTOTOF(3)
INHE	Respirable fraction at agricultural area 3	1.000E+00	1.000E+00	---	RESPFRACOF(3)
INHE	Total mass loading at agricultural area 4 (g/m**3)	1.000E-04	1.000E-04	---	MLTOTOF(4)
INHE	Respirable fraction at agricultural area 4	1.000E+00	1.000E-04	---	RESPFRACOF(4)
INHE	Total mass loading at offsite dwelling(g/m**3)	1.000E-04	1.000E-04	---	MLTOTDWELL
INHE	Respirable fraction at offsite dwelling(g/m**3)	1.000E+00	1.000E+00	---	RESPFRACDWELL
INHE	Indoor dust filtration factor, inhalation	4.000E-01	4.000E-01	---	SHF3
INHE	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
INHE	Shape factor flag, external gamma	not used	1.000E+00	noncircular	FS
SEXT	Onsite shape factor array (used if non-circular):				
SEXT	Radii of shape factor array (used if non-circular):				
SEXT	Outer annular radius (m), ring 1:	not used	6.000E+00	---	RAD_SHAPE(1)
SEXT	Outer annular radius (m), ring 2:	not used	1.200E+01	---	RAD_SHAPE(2)
SEXT	Outer annular radius (m), ring 3:	not used	1.800E+01	---	RAD_SHAPE(3)

External parameters not used:

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
SEXT	Shape factor array from offsite dwelling:				
SEXT	Radii of shape factor array (used if non-circular):				
SEXT	Outer annular radius (m), ring 13:	not used	1.325E+01	---	RAD_SHAPE(13)
SEXT	Outer annular radius (m), ring 14:	not used	2.650E+01	---	RAD_SHAPE(14)
SEXT	Outer annular radius (m), ring 15:	not used	3.975E+01	---	RAD_SHAPE(15)
SEXT	Outer annular radius (m), ring 16:	not used	5.300E+01	---	RAD_SHAPE(16)
SEXT	Outer annular radius (m), ring 17:	not used	6.625E+01	---	RAD_SHAPE(17)
SEXT	Outer annular radius (m), ring 18:	not used	7.950E+01	---	RAD_SHAPE(18)
SEXT	Outer annular radius (m), ring 19:	not used	9.275E+01	---	RAD_SHAPE(19)
SEXT	Outer annular radius (m), ring 20:	not used	1.060E+02	---	RAD_SHAPE(20)
SEXT	Outer annular radius (m), ring 21:	not used	1.192E+02	---	RAD_SHAPE(21)
SEXT	Outer annular radius (m), ring 22:	not used	1.325E+02	---	RAD_SHAPE(22)
SEXT	Outer annular radius (m), ring 23:	not used	1.458E+02	---	RAD_SHAPE(23)
SEXT	Outer annular radius (m), ring 24:	not used	1.590E+02	---	RAD_SHAPE(24)
SEXT	Fractions of annular areas within AREA:				
SEXT	Ring 13	not used	0.000E+00	---	FRACA(13)
SEXT	Ring 14	not used	0.000E+00	---	FRACA(14)
SEXT	Ring 15	not used	0.000E+00	---	FRACA(15)
SEXT	Ring 16	not used	2.400E-02	---	FRACA(16)
SEXT	Ring 17	not used	1.900E-01	---	FRACA(17)
SEXT	Ring 18	not used	2.400E-01	---	FRACA(18)
SEXT	Ring 19	not used	2.000E-01	---	FRACA(19)
SEXT	Ring 20	not used	1.700E-01	---	FRACA(20)
SEXT	Ring 21	not used	1.500E-01	---	FRACA(21)
SEXT	Ring 22	not used	1.300E-01	---	FRACA(22)
SEXT	Ring 23	not used	1.200E-01	---	FRACA(23)
SEXT	Ring 24	not used	5.200E-02	---	FRACA(24)
SEXT	Shape factor array from offsite area 1:				
SEXT	Radii of shape factor array (used if non-circular):				
SEXT	Outer annular radius (m), ring 25:	not used	1.500E+02	---	RAD_SHAPE(25)
SEXT	Outer annular radius (m), ring 26:	not used	1.581E+02	---	RAD_SHAPE(26)
SEXT	Outer annular radius (m), ring 27:	not used	1.683E+02	---	RAD_SHAPE(27)
SEXT	Outer annular radius (m), ring 28:	not used	1.785E+02	---	RAD_SHAPE(28)
SEXT	Outer annular radius (m), ring 29:	not used	1.887E+02	---	RAD_SHAPE(29)
SEXT	Outer annular radius (m), ring 30:	not used	1.990E+02	---	RAD_SHAPE(30)

Tritium and C-14 not used

Summary Pathway selections is correct

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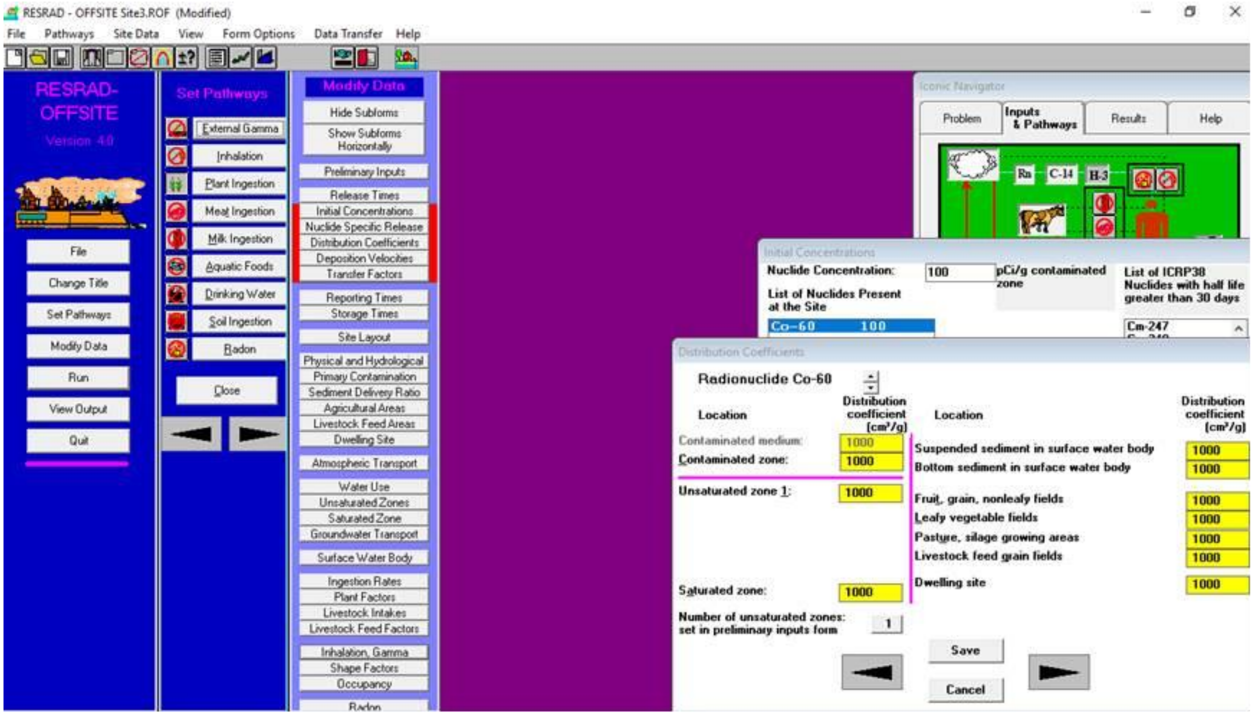
Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	C12EVSN
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C12	C-12 concentration in the atmosphere (g/m**3)	not used	1.800E-01	---	C12AIR
C12	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C12	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C12	C-12 concentration in meat 1 (g/g)	not used	2.400E-01	---	C12MEAT_MILK(1)
C12	C-12 concentration in milk (g/g)	not used	7.000E-02	---	C12MEAT_MILK(2)
C12	C-12 concentration in vegetable 1 (g/g)	not used	4.000E-01	---	C12PLANT(1)
C12	C-12 concentration in vegetable 2 (g/g)	not used	9.000E-02	---	C12PLANT(2)
C12	C-12 concentration in livestock feed 1 (g/g)	not used	9.000E-02	---	C12PLANT(3)
C12	C-12 concentration in livestock feed 2 (g/g)	not used	4.000E-01	---	C12PLANT(4)
H3	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
H3	Mass fraction of water in meat 1 (g/g)	not used	6.000E-01	---	H2OMEAT_MILK(1)
H3	Mass fraction of water in milk (g/g)	not used	8.800E-01	---	H2OMEAT_MILK(2)
H3	Mass fraction of water in vegetable 1 (g/g)	not used	8.000E-01	---	H2OPLANT(1)
H3	Mass fraction of water in vegetable 2 (g/g)	not used	8.000E-01	---	H2OPLANT(2)
H3	Mass fraction of water in livestock feed 1 (g/g)	not used	8.000E-01	---	H2OPLANT(3)
H3	Mass fraction of water in livestock feed 2 (g/g)	not used	8.000E-01	---	H2OPLANT(4)

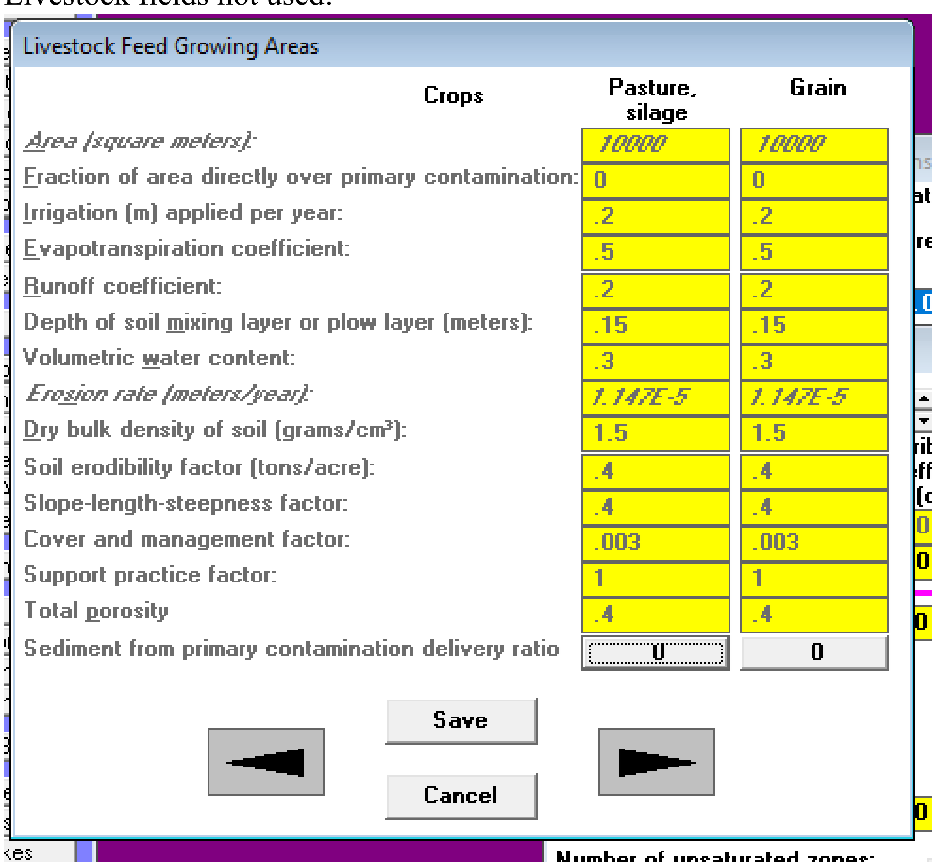
Summary of Pathway Selections

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

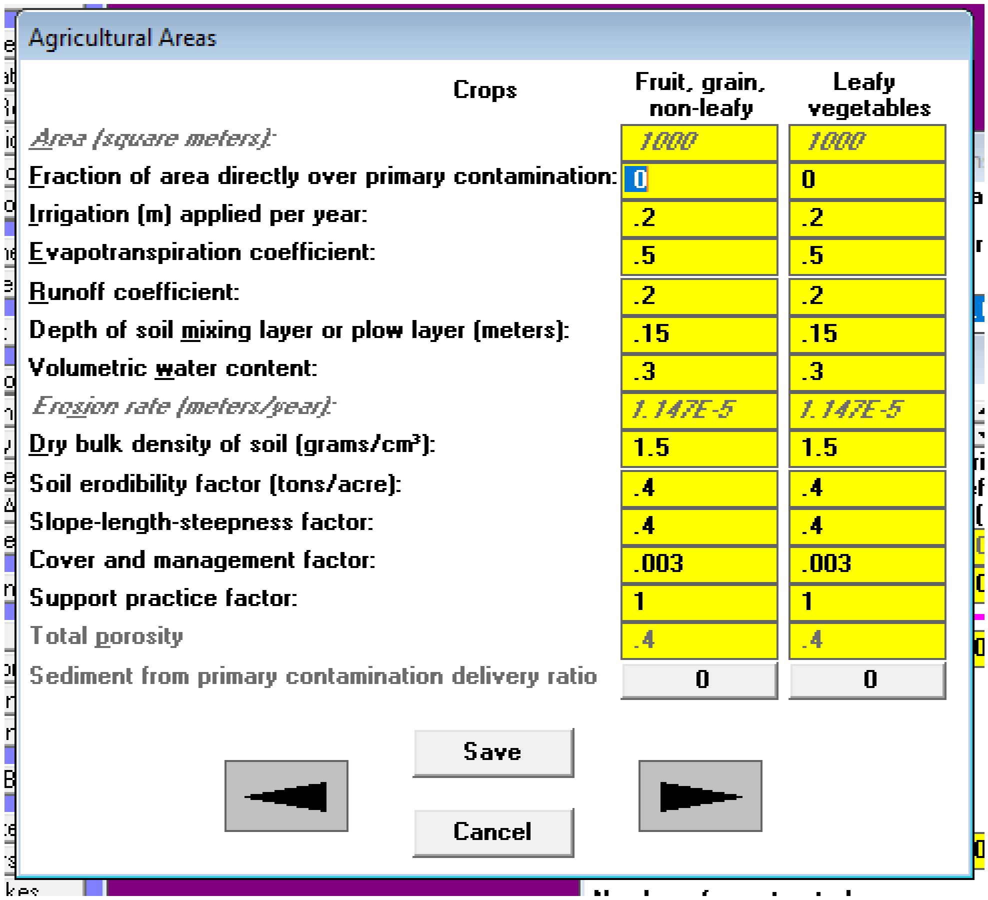
Now Switch to Plant Ingestion Pathways only:



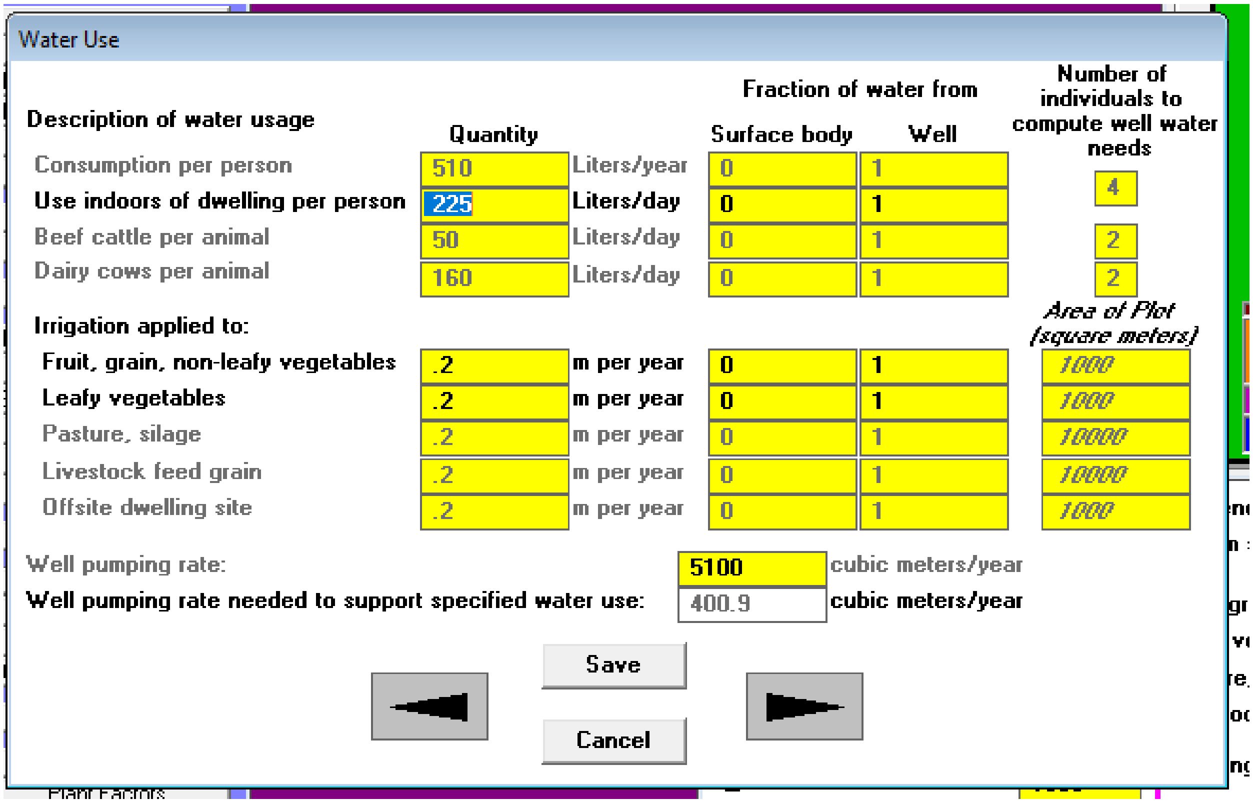
Livestock fields not used:



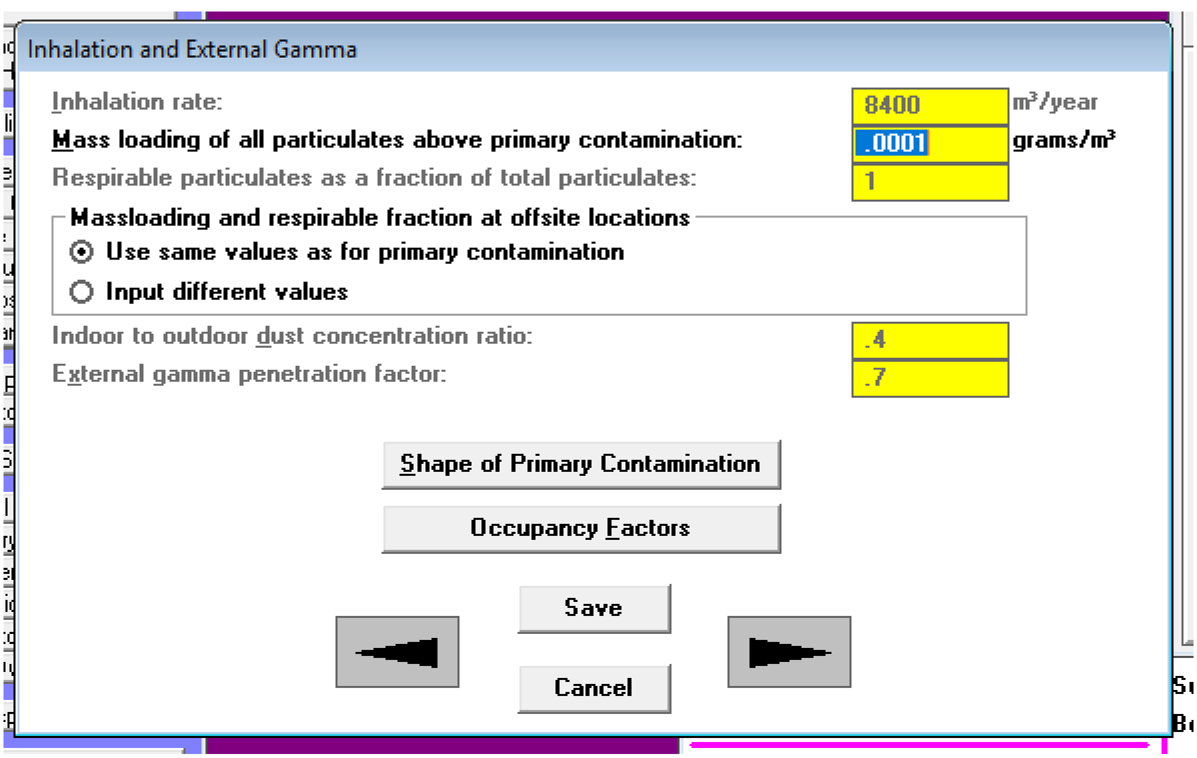
However, agricultural (human plant food) parameters are sued:



Same split in water use (plant on, livestock off)



Inhalation and External pathways off.



Ran the case

Plant fields used, livestock and dwelling site not used:

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Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
FSTI	Exposure duration for risk	3.000E+01	3.000E+01	---	ED
FSTI	Basic radiation dose limit (mrem/yr)	2.500E+01	2.500E+01	---	BRDL
RELT	1st release time (years)	0.000E+00		---	RelTime(1)
CONC	Initial concentration of Co-60 (pCi/g)	1.000E+02	0.000E+00	---	S1(1)
VDEP	Deposition velocity of Co-60 on total particulates	1.000E-03	1.000E-03	---	DEPVEL(1)
VDEP	Dep. velocity of Co-60 on respirable particulates	1.000E-03	1.000E-03	---	DEPVELT(1)
DCLR	Distribution coefficients for Co-60				
DCLR	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
DCLR	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
DCLR	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
DCLR	Bottom sediment in surface water body (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCSWB(1)
DCLR	Suspended sediment in surface water body (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCSWS(1)
DCLR	Agricultural area 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCOF(1,1)
DCLR	Agricultural area 2 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCOF(1,2)
DCLR	Agricultural area 3 (cm**3/g)	not used	1.000E+03	---	DCNUCOF(1,3)
DCLR	Agricultural area 4 (cm**3/g)	not used	1.000E+03	---	DCNUCOF(1,4)
DCLR	Offsite Dwelling (cm**3/g)	not used	1.000E+03	---	DCNUCDWE(1)
DCLR	Leach rate constant of Co-60 (/yr)	0.000E+00	0.000E+00	1.666E-04	Rleach(1,1)
LYOT	Bearing of X axis (clockwise angle N-->X in degrees)	9.000E+01	9.000E+01	---	DNXBEARING
LYOT	Length of Primary contamination in X Direction	1.000E+02	1.000E+02	---	SOURCEXY(1)
LYOT	Length of Primary contamination in Y Direction	1.000E+02	1.000E+02	---	SOURCEXY(2)
LYOT	Smaller X coordinate of Agricultural Area 1	3.438E+01	3.438E+01	---	AGRIXY(1,1)
LYOT	Larger X coordinate of Agricultural Area 1	6.562E+01	6.562E+01	---	AGRIXY(2,1)
LYOT	Smaller Y coordinate of Agricultural Area 1	2.340E+02	2.340E+02	---	AGRIXY(3,1)
LYOT	Larger Y coordinate of Agricultural Area 1	2.660E+02	2.660E+02	---	AGRIXY(4,1)
LYOT	Smaller X coordinate of Agricultural Area 2	3.438E+01	3.438E+01	---	AGRIXY(1,2)
LYOT	Larger X coordinate of Agricultural Area 2	6.562E+01	6.562E+01	---	AGRIXY(2,2)
LYOT	Smaller Y coordinate of Agricultural Area 2	2.680E+02	2.680E+02	---	AGRIXY(3,2)
LYOT	Larger Y coordinate of Agricultural Area 2	3.000E+02	3.000E+02	---	AGRIXY(4,2)
LYOT	Smaller X coordinate of Agricultural Area 3	not used	0.000E+00	---	AGRIXY(1,3)
LYOT	Larger X coordinate of Agricultural Area 3	not used	1.000E+02	---	AGRIXY(2,3)
LYOT	Smaller Y coordinate of Agricultural Area 3	not used	4.500E+02	---	AGRIXY(3,3)
LYOT	Larger Y coordinate of Agricultural Area 3	not used	5.500E+02	---	AGRIXY(4,3)

Plant fields used:

PSDR	Sediment Delivery Ratio, SDR				
PSDR	from primary contamination to surface water body	not used	0.000E+00	---	SDRDWELL
PSDR	from primary contamination to non-leafy veg. field	0.000E+00	0.000E+00	---	SDROF(1)
PSDR	from primary contamination to leafy veg. field	0.000E+00	0.000E+00	---	SDROF(2)
PSDR	from primary contamination to pasture	not used	0.000E+00	---	SDROF(3)
PSDR	from primary contamination to feed grain field	not used	0.000E+00	---	SDROF(4)
PSDR	from primary contamination to surface water body	1.000E+00	1.000E+00	---	SDR
AGRI	Areal extent of Agricultural Area 1 (m**2)	1.000E+03	1.000E+03	---	AREAO(1)
AGRI	Fraction of Agri. Area 1 directly over the c.z.	0.000E+00	0.000E+00	---	FAREA_PLANT(1)
AGRI	Evapotranspiration coefficient in Agri. Area 1	5.000E-01	5.000E-01	---	EVAPTRN(1)
AGRI	Runoff coefficient in Agricultural Area 1	2.000E-01	2.000E-01	---	RUNOF(1)
AGRI	Mixing depth/plow layer of Agricultural Area 1	1.500E-01	1.500E-01	---	DPTHMIXG(1)
AGRI	Water filled porosity of soil in Agri. Area 1	3.000E-01	3.000E-01	---	TMOF(1)
AGRI	Computed erosion rate of soil in Agri. Area 1	1.147E-05	1.147E-05	---	EROSN(1)
AGRI	Dry Bulk Density of soil in Agricultural Area 1	1.500E+00	1.500E+00	---	RHOB(1)
AGRI	Soil erodibility factor of Agricultural Area 1	4.000E-01	4.000E-01	---	ERODIBILITY(1)
AGRI	Slope-length-steepness factor, Agricultural Area 1	4.000E-01	4.000E-01	---	SLPLENSTP(1)
AGRI	Cropping-management factor of Agricultural Area 1	3.000E-03	3.000E-03	---	CRPMANG(1)
AGRI	Conservation practice factor of Agricultural Area 1	1.000E+00	1.000E+00	---	CONVPRAC(1)
AGRI	Total porosity of soil in Agricultural Area 1	not used	4.000E-01	---	TPOF(1)
AGRI	Areal extent of Agricultural Area 2 (m**2)	1.000E+03	1.000E+03	---	AREAO(2)
AGRI	Fraction of Agri. Area 2 directly over the c.z.	0.000E+00	0.000E+00	---	FAREA_PLANT(2)
AGRI	Evapotranspiration coefficient in Agri. Area 2	5.000E-01	5.000E-01	---	EVAPTRN(2)
AGRI	Runoff coefficient in Agricultural Area 2	2.000E-01	2.000E-01	---	RUNOF(2)
AGRI	Mixing depth/plow layer of Agricultural Area 2	1.500E-01	1.500E-01	---	DPTHMIXG(2)
AGRI	Water filled porosity of soil in Agri. Area 2	3.000E-01	3.000E-01	---	TMOF(2)
AGRI	Computed erosion rate of soil in Agri. Area 2	1.147E-05	1.147E-05	---	EROSN(2)
AGRI	Dry Bulk Density of soil in Agricultural Area 2	1.500E+00	1.500E+00	---	RHOB(2)
AGRI	Soil erodibility factor of Agricultural Area 2	4.000E-01	4.000E-01	---	ERODIBILITY(2)
AGRI	Slope-length-steepness factor, Agricultural Area 2	4.000E-01	4.000E-01	---	SLPLENSTP(2)
AGRI	Cropping-management factor of Agricultural Area 2	3.000E-03	3.000E-03	---	CRPMANG(2)
AGRI	Conservation practice factor of Agricultural Area 2	1.000E+00	1.000E+00	---	CONVPRAC(2)
AGRI	Total porosity of soil in Agricultural Area 2	not used	4.000E-01	---	TPOF(2)
AGRI	Areal extent of Agricultural Area 3 (m**2)	not used	1.000E+04	---	AREAO(3)

Livestock Fields not used:

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Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
AGRI	Fraction of Agri. Area 3 directly over the c.z.	not used	0.000E+00	---	FAREA_PLANT(3)
AGRI	Evapotranspiration coefficient in Agri. Area 3	not used	5.000E-01	---	EVAPTRN(3)
AGRI	Runoff coefficient in Agricultural Area 3	not used	2.000E-01	---	RUNOF(3)
AGRI	Mixing depth/plow layer of Agricultural Area 3	not used	1.500E-01	---	DPTHMIXG(3)
AGRI	Water filled porosity of soil in Agri. Area 3	not used	3.000E-01	---	TMOF(3)
AGRI	Computed erosion rate of soil in Agri. Area 3	not used	1.147E-05	---	EROSN(3)
AGRI	Dry Bulk Density of soil in Agricultural Area 3	not used	1.500E+00	---	RHOB(3)
AGRI	Soil erodibility factor of Agricultural Area 3	not used	4.000E-01	---	ERODIBILITY(3)
AGRI	Slope-length-steepness factor, Agricultural Area 3	not used	4.000E-01	---	SLPLENSTP(3)
AGRI	Cropping-management factor of Agricultural Area 3	not used	3.000E-03	---	CRPMANG(3)
AGRI	Conservation practice factor of Agricultural Area 3	not used	1.000E+00	---	CONVPRAC(3)
AGRI	Total porosity of soil in Agricultural Area 3	not used	4.000E-01	---	TPOF(3)
AGRI	Areal extent of Agricultural Area 4 (m**2)	not used	1.000E+04	---	AREAO(4)
AGRI	Fraction of Agri. Area 4 directly over the c.z.	not used	0.000E+00	---	FAREA_PLANT(4)
AGRI	Evapotranspiration coefficient in Agri. Area 4	not used	5.000E-01	---	EVAPTRN(4)
AGRI	Runoff coefficient in Agricultural Area 4	not used	2.000E-01	---	RUNOF(4)
AGRI	Mixing depth/plow layer of Agricultural Area 4	not used	1.500E-01	---	DPTHMIXG(4)
AGRI	Water filled porosity of soil in Agri. Area 4	not used	3.000E-01	---	TMOF(4)
AGRI	Computed erosion rate of soil in Agri. Area 4	not used	1.147E-05	---	EROSN(4)
AGRI	Dry Bulk Density of soil in Agricultural Area 4	not used	1.500E+00	---	RHOB(4)
AGRI	Soil erodibility factor of Agricultural Area 4	not used	4.000E-01	---	ERODIBILITY(4)
AGRI	Slope-length-steepness factor, Agricultural Area 4	not used	4.000E-01	---	SLPLENSTP(4)
AGRI	Cropping-management factor of Agricultural Area 4	not used	3.000E-03	---	CRPMANG(4)
AGRI	Conservation practice factor of Agricultural Area 4	not used	1.000E+00	---	CONVPRAC(4)
AGRI	Total porosity of soil in Agricultural Area 4	not used	4.000E-01	---	TPOF(4)
DWEL	Areal extent of Offsite dwelling site (m**2)	not used	1.000E+03	---	AREAODWELL
DWEL	Evapotranspiration coefficient in dwelling (Off)site	not used	5.000E-01	---	EVAPTRNDWELL
DWEL	Runoff coefficient in Offsite dwelling site	not used	2.000E-01	---	RUNOFDWELL
DWEL	Mixing depth of Offsite dwelling site	not used	1.500E-01	---	DPTHMIXGDWELL
DWEL	Water filled porosity of soil in Offsite Dwelling	not used	3.000E-01	---	TMOFDWELL
DWEL	Computed erosion rate of soil in Offsite Dwelling	not used	0.000E+00	---	EROSNDWELL
DWEL	Dry Bulk Density of soil in Offsite dwelling site	not used	1.500E+00	---	RHOBDWELL
DWEL	Soil erodibility factor of soil in Dwelling site	not used	0.000E+00	---	ERODIBILITYDWELL
DWEL	Slope-length-steepness factor of Dwelling site	not used	4.000E-01	---	SLPLENSTPDWELL
DWEL	Cropping-management factor of Dwelling site	not used	3.000E-03	---	CRPMANGDWELL
DWEL	Conservation practice factor of Offsite Dwelling sit	not used	1.000E+00	---	CONVPRACDWELL

Plant info used, livestock info not used:

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Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
INGE	Leafy vegetable consumption (kg/yr)	1.400E+01	1.400E+01	---	DVI(2)
INGE	Fraction of vegetable 2 from affected area	5.000E-01	5.000E-01	---	FVEG(2)
INGE	Meat 1 consumption (kg/yr)	not used	6.300E+01	---	DMI(1)
INGE	Fraction of meat 1from affected area	not used	1.000E+00	---	FMEMI(1)
INGE	Milk consumption (L/yr)	not used	9.200E+01	---	DMI(2)
INGE	Fraction of milk from affected area	not used	1.000E+00	---	FMEMI(2)
INGE	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	7.000E-01	7.000E-01	---	YIELD(1)
VEGE	Growing Season for Non-Leafy (years)	1.700E-01	1.700E-01	---	GROWTIME(1)
VEGE	Translocation Factor for Non-Leafy	1.000E-01	1.000E-01	---	FOLI_F(1)
VEGE	Weathering Removal Constant for Non-Leafy	2.000E+01	2.000E+01	---	RWEATHER(1)
VEGE	Foliar Interception Fraction for dust Non-Leafy	2.500E-01	2.500E-01	---	FINTCEPT(1,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Non-Leafy	2.500E-01	2.500E-01	---	FINTCEPT(1,2)
VEGE	Depth of roots for Non-Leafy (m)	1.200E+00	1.200E+00	---	DROOT(1)
VEGE	Wet weight crop yield for Leafy (kg/m**2)	1.500E+00	1.500E+00	---	YIELD(2)
VEGE	Growing Season for Leafy (years)	2.500E-01	2.500E-01	---	GROWTIME(2)
VEGE	Translocation Factor for Leafy	1.000E+00	1.000E+00	---	FOLI_F(2)
VEGE	Weathering Removal Constant for Leafy	2.000E+01	2.000E+01	---	RWEATHER(2)
VEGE	Foliar Interception Fraction for dust Leafy	2.500E-01	2.500E-01	---	FINTCEPT(2,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Leafy	2.500E-01	2.500E-01	---	FINTCEPT(2,2)
VEGE	Depth of roots for Leafy (m)	9.000E-01	9.000E-01	---	DROOT(2)
VEGE	Wet weight crop yield for Pasture (kg/m**2)	not used	1.100E+00	---	YIELD(3)
VEGE	Growing Season for Pasture (years)	not used	8.000E-02	---	GROWTIME(3)
VEGE	Translocation Factor for Pasture	not used	1.000E+00	---	FOLI_F(3)
VEGE	Weathering Removal Constant for Pasture	not used	2.000E+01	---	RWEATHER(3)
VEGE	Foliar Interception Fraction for dust Pasture	not used	2.500E-01	---	FINTCEPT(3,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Pasture	not used	2.500E-01	---	FINTCEPT(3,2)
VEGE	Depth of roots for Pasture (m)	not used	9.000E-01	---	DROOT(3)
VEGE	Wet weight crop yield for Grain (kg/m**2)	not used	7.000E-01	---	YIELD(4)
VEGE	Growing Season for Grain (years)	not used	1.700E-01	---	GROWTIME(4)
VEGE	Translocation Factor for Grain	not used	1.000E-01	---	FOLI_F(4)
VEGE	Weathering Removal Constant for Grain	not used	2.000E+01	---	RWEATHER(4)
VEGE	Foliar Interception Fraction for dust Grain	not used	2.500E-01	---	FINTCEPT(4,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Grain	not used	2.500E-01	---	FINTCEPT(4,2)
VEGE	Depth of roots for Grain (m)	not used	1.200E+00	---	DROOT(4)

External pathway parameters not sued:

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```
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```

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
SEXT	Shape factor array from offsite dwelling:				
SEXT	Radii of shape factor array (used if non-circular):				
SEXT	Outer annular radius (m), ring 13:	not used	1.325E+01	---	RAD_SHAPE(13)
SEXT	Outer annular radius (m), ring 14:	not used	2.650E+01	---	RAD_SHAPE(14)
SEXT	Outer annular radius (m), ring 15:	not used	3.975E+01	---	RAD_SHAPE(15)
SEXT	Outer annular radius (m), ring 16:	not used	5.300E+01	---	RAD_SHAPE(16)
SEXT	Outer annular radius (m), ring 17:	not used	6.625E+01	---	RAD_SHAPE(17)
SEXT	Outer annular radius (m), ring 18:	not used	7.950E+01	---	RAD_SHAPE(18)
SEXT	Outer annular radius (m), ring 19:	not used	9.275E+01	---	RAD_SHAPE(19)
SEXT	Outer annular radius (m), ring 20:	not used	1.060E+02	---	RAD_SHAPE(20)
SEXT	Outer annular radius (m), ring 21:	not used	1.192E+02	---	RAD_SHAPE(21)
SEXT	Outer annular radius (m), ring 22:	not used	1.325E+02	---	RAD_SHAPE(22)
SEXT	Outer annular radius (m), ring 23:	not used	1.458E+02	---	RAD_SHAPE(23)
SEXT	Outer annular radius (m), ring 24:	not used	1.590E+02	---	RAD_SHAPE(24)
SEXT	Fractions of annular areas within AREA:				
SEXT	Ring 13	not used	0.000E+00	---	FRACA(13)
SEXT	Ring 14	not used	0.000E+00	---	FRACA(14)
SEXT	Ring 15	not used	0.000E+00	---	FRACA(15)
SEXT	Ring 16	not used	2.400E-02	---	FRACA(16)
SEXT	Ring 17	not used	1.900E-01	---	FRACA(17)
SEXT	Ring 18	not used	2.400E-01	---	FRACA(18)
SEXT	Ring 19	not used	2.000E-01	---	FRACA(19)
SEXT	Ring 20	not used	1.700E-01	---	FRACA(20)
SEXT	Ring 21	not used	1.500E-01	---	FRACA(21)
SEXT	Ring 22	not used	1.300E-01	---	FRACA(22)
SEXT	Ring 23	not used	1.200E-01	---	FRACA(23)
SEXT	Ring 24	not used	5.200E-02	---	FRACA(24)
SEXT	Shape factor array from offsite area 1:				
SEXT	Radii of shape factor array (used if non-circular):				
SEXT	Outer annular radius (m), ring 25:	not used	1.500E+02	---	RAD_SHAPE(25)
SEXT	Outer annular radius (m), ring 26:	not used	1.581E+02	---	RAD_SHAPE(26)
SEXT	Outer annular radius (m), ring 27:	not used	1.683E+02	---	RAD_SHAPE(27)
SEXT	Outer annular radius (m), ring 28:	not used	1.785E+02	---	RAD_SHAPE(28)
SEXT	Outer annular radius (m), ring 29:	not used	1.887E+02	---	RAD_SHAPE(29)
SEXT	Outer annular radius (m), ring 30:	not used	1.990E+02	---	RAD_SHAPE(30)
SEXT	Outer annular radius (m), ring 31:	not used	2.092E+02	---	RAD_SHAPE(31)
SEXT	Outer annular radius (m), ring 32:	not used	2.194E+02	---	RAD_SHAPE(32)

c-14 and H-3 not used

Summary of athway selections is correct:

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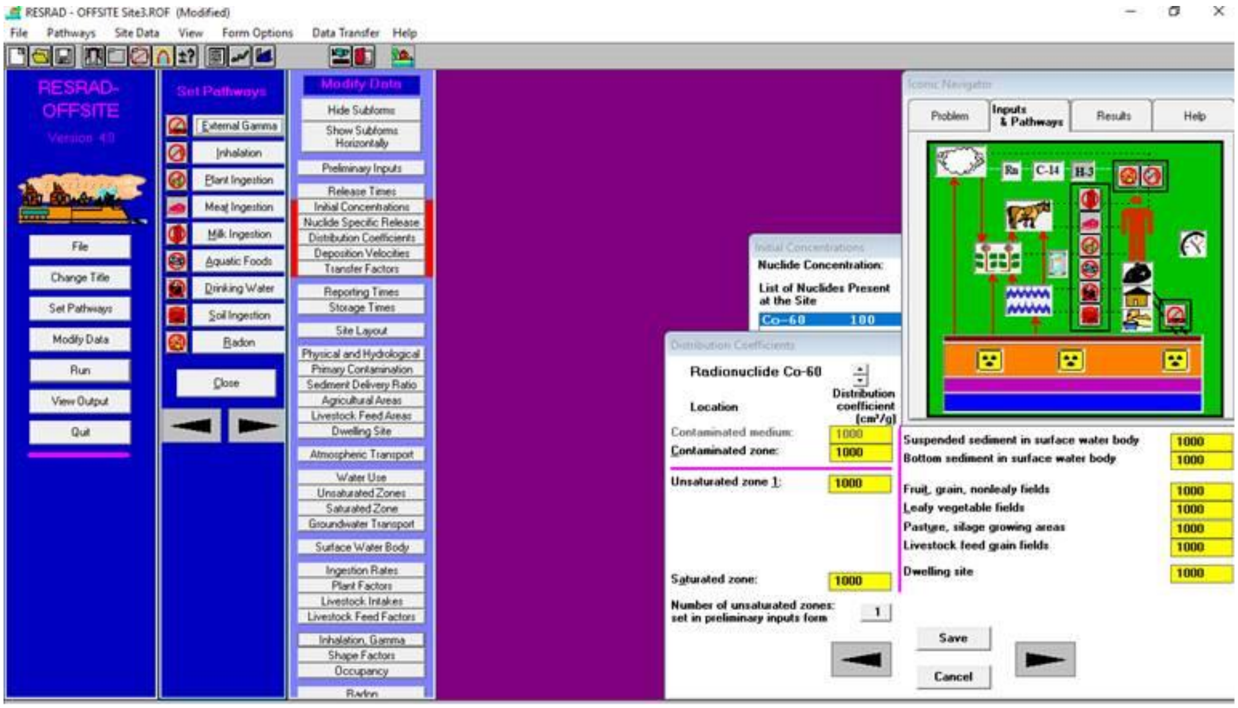
Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD comput
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---
C12	C-12 concentration in the atmosphere (g/m**3)	not used	1.800E-01	---
C12	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---
C12	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---
C12	C-12 concentration in meat 1 (g/g)	not used	2.400E-01	---
C12	C-12 concentration in milk (g/g)	not used	7.000E-02	---
C12	C-12 concentration in vegetable 1 (g/g)	not used	4.000E-01	---
C12	C-12 concentration in vegetable 2 (g/g)	not used	9.000E-02	---
C12	C-12 concentration in livestock feed 1 (g/g)	not used	9.000E-02	---
C12	C-12 concentration in livestock feed 2 (g/g)	not used	4.000E-01	---
H3	Humidity in air (g/cm**3)	not used	8.000E+00	---
H3	Mass fraction of water in meat 1 (g/g)	not used	6.000E-01	---
H3	Mass fraction of water in milk (g/g)	not used	8.800E-01	---
H3	Mass fraction of water in vegetable 1 (g/g)	not used	8.000E-01	---
H3	Mass fraction of water in vegetable 2 (g/g)	not used	8.000E-01	---
H3	Mass fraction of water in livestock feed 1 (g/g)	not used	8.000E-01	---
H3	Mass fraction of water in livestock feed 2 (g/g)	not used	8.000E-01	---

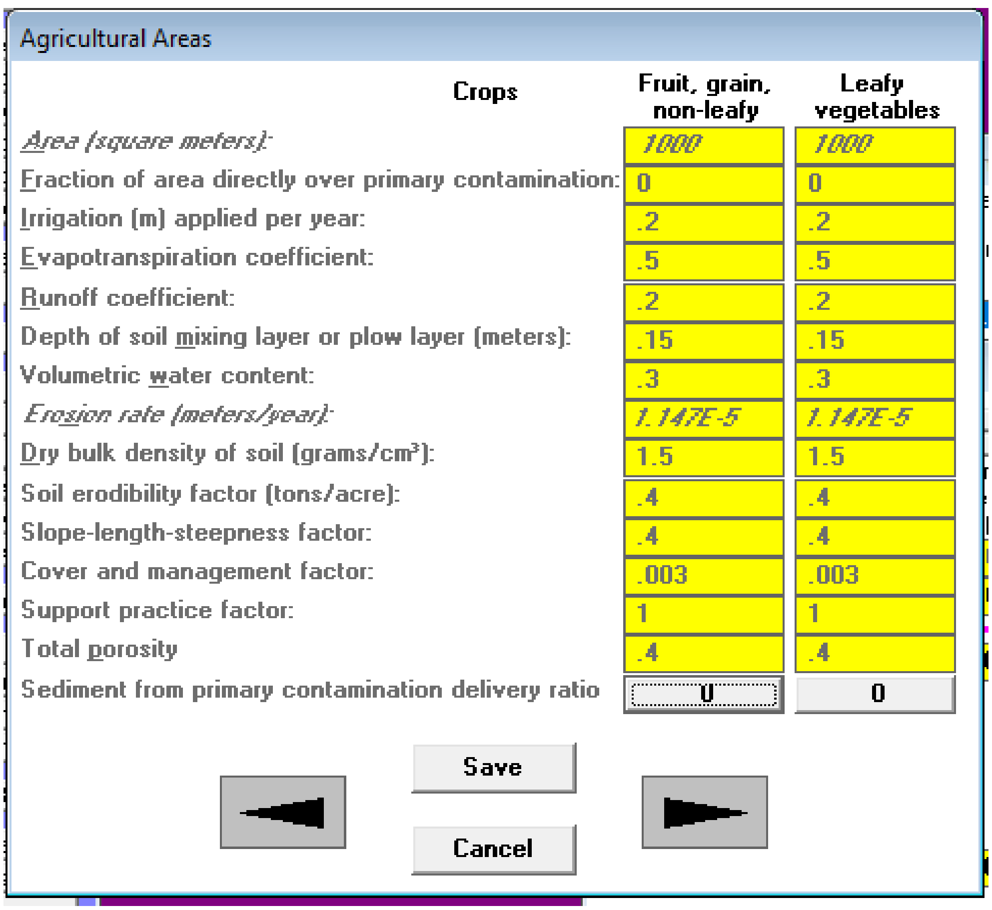
Summary of Pathway Selections

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

Now look at Meat Pathway only



Plant areas not used:

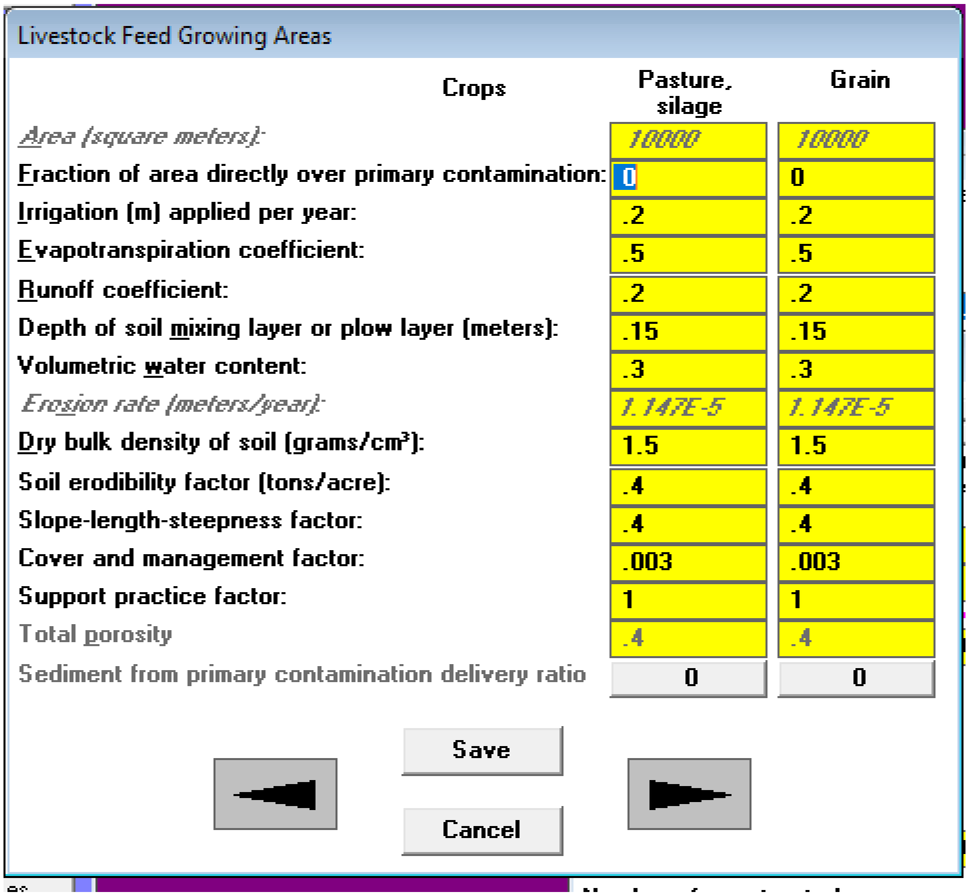

Agricultural Areas

Crops	Fruit, grain, non-leafy	Leafy vegetables
Area (square meters):	1000	1000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
Runoff coefficient:	.2	.2
Depth of soil mixing layer or plow layer (meters):	.15	.15
Volumetric water content:	.3	.3
Erosion rate (meters/year):	1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm³):	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total porosity	.4	.4
Sediment from primary contamination delivery ratio	0	0

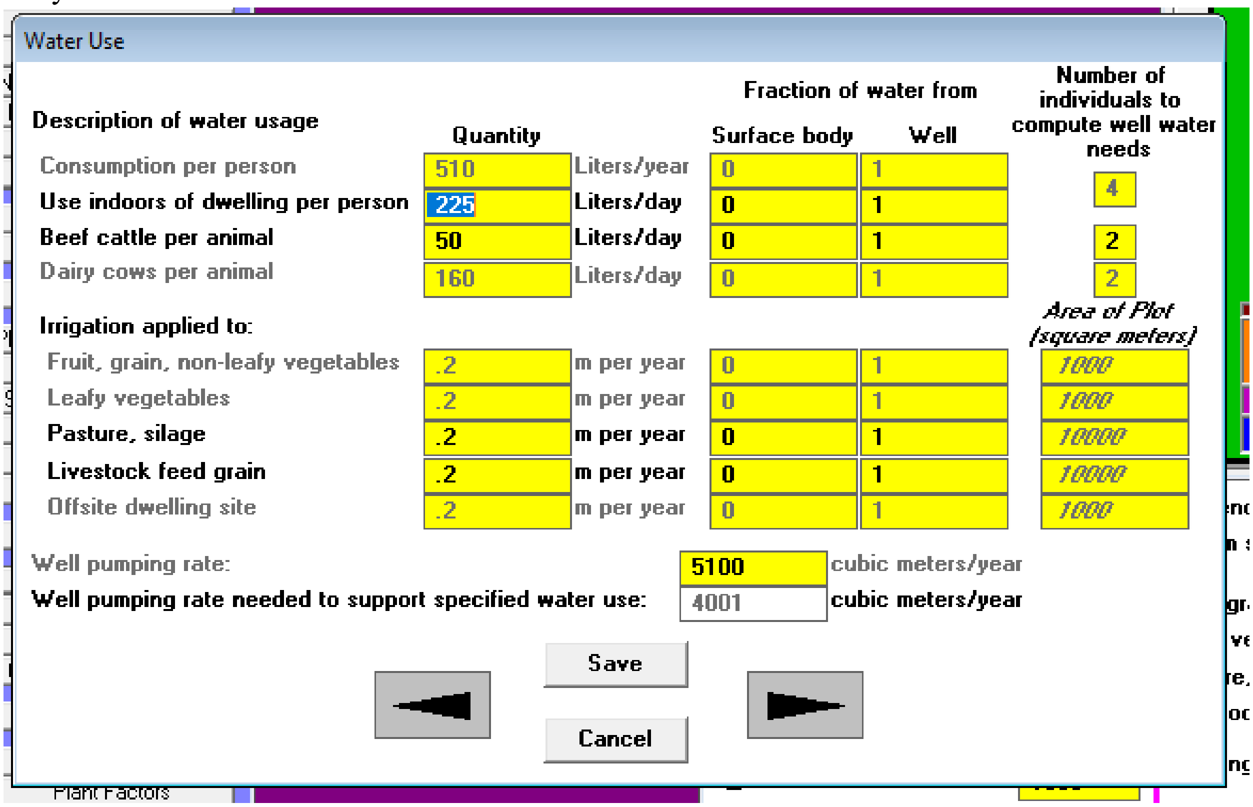
Save

Cancel

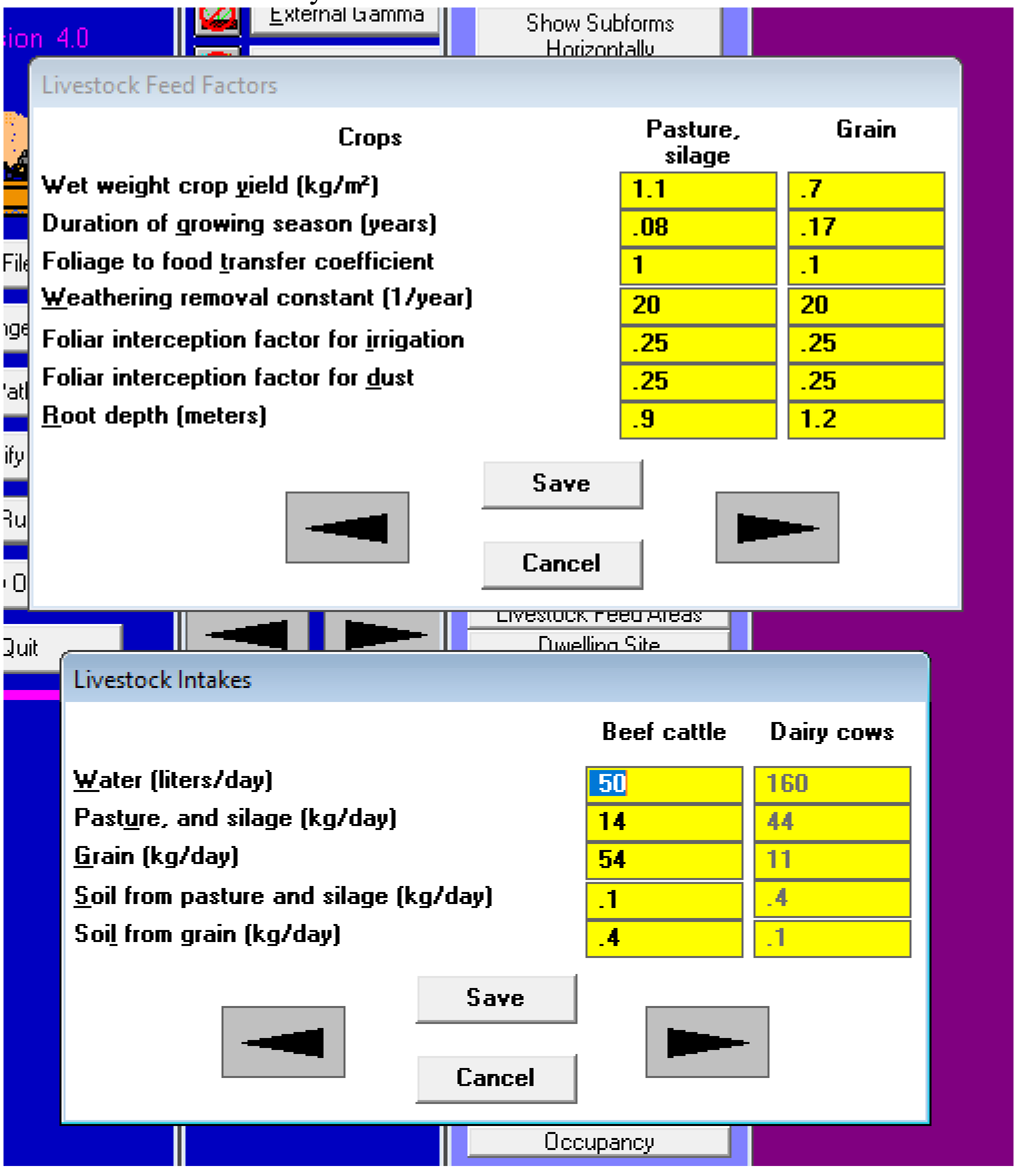
Both Livestock areas used:



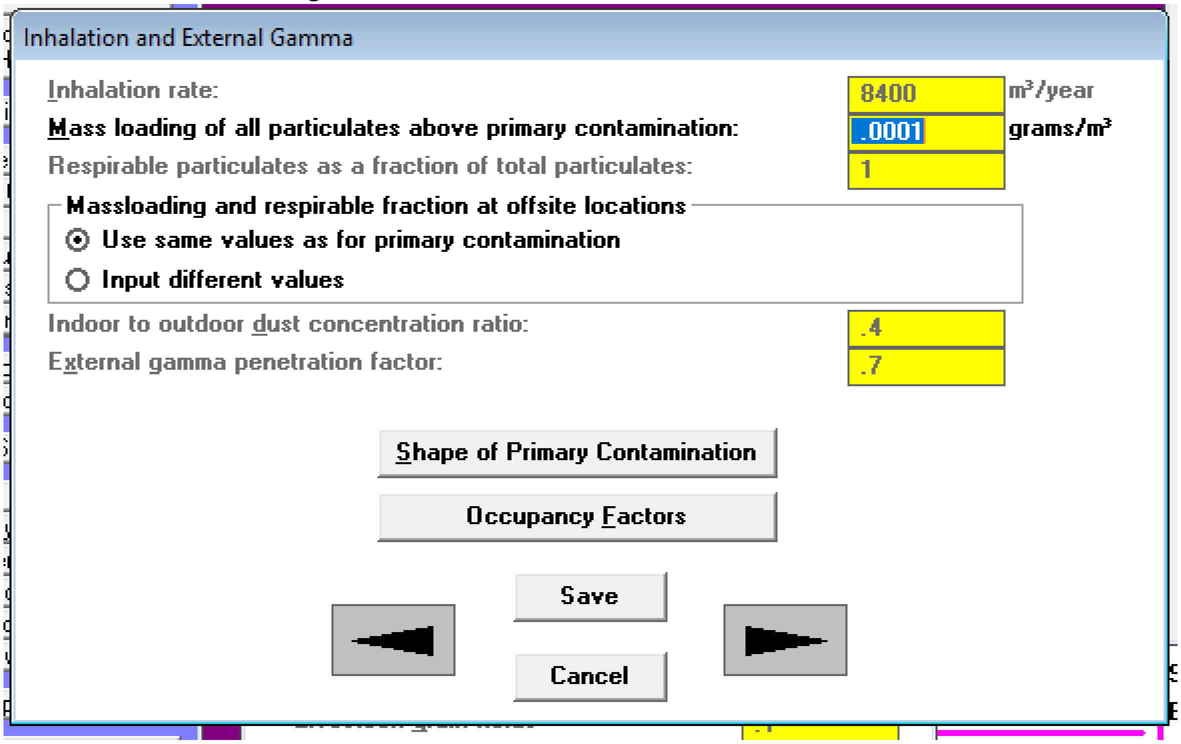
Only Beef cattle need water to drink:



Both fields used but only Beef cattle eat:



Inhalation and external gamma not used:



Ran the case

Ag areas 1&2 not used but 3&4 for livestock are used:

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Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
FSTI	Exposure duration for risk	3.000E+01	3.000E+01	---	ED
FSTI	Basic radiation dose limit (mrem/yr)	2.500E+01	2.500E+01	---	BRDL
RELT	1st release time (years)	0.000E+00		---	RelTime(1)
CONC	Initial concentration of Co-60 (pCi/g)	1.000E+02	0.000E+00	---	S1(1)
VDEP	Deposition velocity of Co-60 on total particulates	1.000E-03	1.000E-03	---	DEPVEL(1)
VDEP	Dep. velocity of Co-60 on respirable particulates	1.000E-03	1.000E-03	---	DEPVELT(1)
DCLR	Distribution coefficients for Co-60				
DCLR	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
DCLR	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
DCLR	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
DCLR	Bottom sediment in surface water body (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCSWB(1)
DCLR	Suspended sediment in surface water body (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCSWS(1)
DCLR	Agricultural area 1 (cm**3/g)	not used	1.000E+03	---	DCNUCOF(1,1)
DCLR	Agricultural area 2 (cm**3/g)	not used	1.000E+03	---	DCNUCOF(1,2)
DCLR	Agricultural area 3 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCOF(1,3)
DCLR	Agricultural area 4 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCOF(1,4)
DCLR	Offsite Dwelling (cm**3/g)	not used	1.000E+03	---	DCNUCDWE(1)
DCLR	Leach rate constant of Co-60 (/yr)	0.000E+00	0.000E+00	1.666E-04	Rleach(1,1)
LYOT	Bearing of X axis (clockwise angle N-->X in degrees)	9.000E+01	9.000E+01	---	DNXBEARING
LYOT	Length of Primary contamination in X Direction	1.000E+02	1.000E+02	---	SOURCEXY(1)
LYOT	Length of Primary contamination in Y Direction	1.000E+02	1.000E+02	---	SOURCEXY(2)
LYOT	Smaller X coordinate of Agricultural Area 1	not used	3.438E+01	---	AGRIXY(1,1)
LYOT	Larger X coordinate of Agricultural Area 1	not used	6.562E+01	---	AGRIXY(2,1)
LYOT	Smaller Y coordinate of Agricultural Area 1	not used	2.340E+02	---	AGRIXY(3,1)
LYOT	Larger Y coordinate of Agricultural Area 1	not used	2.660E+02	---	AGRIXY(4,1)
LYOT	Smaller X coordinate of Agricultural Area 2	not used	3.438E+01	---	AGRIXY(1,2)
LYOT	Larger X coordinate of Agricultural Area 2	not used	6.562E+01	---	AGRIXY(2,2)
LYOT	Smaller Y coordinate of Agricultural Area 2	not used	2.680E+02	---	AGRIXY(3,2)
LYOT	Larger Y coordinate of Agricultural Area 2	not used	3.000E+02	---	AGRIXY(4,2)
LYOT	Smaller X coordinate of Agricultural Area 3	0.000E+00	0.000E+00	---	AGRIXY(1,3)
LYOT	Larger X coordinate of Agricultural Area 3	1.000E+02	1.000E+02	---	AGRIXY(2,3)
LYOT	Smaller Y coordinate of Agricultural Area 3	4.500E+02	4.500E+02	---	AGRIXY(3,3)
LYOT	Larger Y coordinate of Agricultural Area 3	5.500E+02	5.500E+02	---	AGRIXY(4,3)
LYOT	Smaller X coordinate of Agricultural Area 4	0.000E+00	0.000E+00	---	AGRIXY(1,4)
LYOT	Larger X coordinate of Agricultural Area 4	1.000E+02	1.000E+02	---	AGRIXY(2,4)
LYOT	Smaller Y coordinate of Agricultural Area 4	3.000E+02	3.000E+02	---	AGRIXY(3,4)
LYOT	Larger Y coordinate of Agricultural Area 4	4.000E+02	4.000E+02	---	AGRIXY(4,4)
LYOT	Smaller X coordinate of Dwelling Area	not used	3.438E+01	---	DWELLXY(1)

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
INGE	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DVI(2)
INGE	Fraction of vegetable 2 from affected area	not used	5.000E-01	---	FVEG(2)
INGE	Meat 1 consumption (kg/yr)	6.300E+01	6.300E+01	---	DMI(1)
INGE	Fraction of meat 1from affected area	1.000E+00	1.000E+00	---	FMEMI(1)
INGE	Milk consumption (L/yr)	not used	9.200E+01	---	DMI(2)
INGE	Fraction of milk from affected area	not used	1.000E+00	---	FMEMI(2)
INGE	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YIELD(1)
VEGE	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	GROWTIME(1)
VEGE	Translocation Factor for Non-Leafy	not used	1.000E-01	---	FOLI_F(1)
VEGE	Weathering Removal Constant for Non-Leafy	not used	2.000E+01	---	RWEATHER(1)
VEGE	Foliar Interception Fraction for dust Non-Leafy	not used	2.500E-01	---	FINTCEPT(1,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Non-Leafy	not used	2.500E-01	---	FINTCEPT(1,2)
VEGE	Depth of roots for Non-Leafy (m)	not used	1.200E+00	---	DROOT(1)
VEGE	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YIELD(2)
VEGE	Growing Season for Leafy (years)	not used	2.500E-01	---	GROWTIME(2)
VEGE	Translocation Factor for Leafy	not used	1.000E+00	---	FOLI_F(2)
VEGE	Weathering Removal Constant for Leafy	not used	2.000E+01	---	RWEATHER(2)
VEGE	Foliar Interception Fraction for dust Leafy	not used	2.500E-01	---	FINTCEPT(2,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Leafy	not used	2.500E-01	---	FINTCEPT(2,2)
VEGE	Depth of roots for Leafy (m)	not used	9.000E-01	---	DROOT(2)
VEGE	Wet weight crop yield for Pasture (kg/m**2)	1.100E+00	1.100E+00	---	YIELD(3)
VEGE	Growing Season for Pasture (years)	8.000E-02	8.000E-02	---	GROWTIME(3)
VEGE	Translocation Factor for Pasture	1.000E+00	1.000E+00	---	FOLI_F(3)
VEGE	Weathering Removal Constant for Pasture	2.000E+01	2.000E+01	---	RWEATHER(3)
VEGE	Foliar Interception Fraction for dust Pasture	2.500E-01	2.500E-01	---	FINTCEPT(3,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Pasture	2.500E-01	2.500E-01	---	FINTCEPT(3,2)
VEGE	Depth of roots for Pasture (m)	9.000E-01	9.000E-01	---	DROOT(3)
VEGE	Wet weight crop yield for Grain (kg/m**2)	7.000E-01	7.000E-01	---	YIELD(4)
VEGE	Growing Season for Grain (years)	1.700E-01	1.700E-01	---	GROWTIME(4)
VEGE	Translocation Factor for Grain	1.000E-01	1.000E-01	---	FOLI_F(4)
VEGE	Weathering Removal Constant for Grain	2.000E+01	2.000E+01	---	RWEATHER(4)
VEGE	Foliar Interception Fraction for dust Grain	2.500E-01	2.500E-01	---	FINTCEPT(4,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Grain	2.500E-01	2.500E-01	---	FINTCEPT(4,2)

Inhalation not used:

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
INHE	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
INHE	Mass loading of all particulates from Primary contam	1.000E-04	1.000E-04	---	MLFD
INHE	Respirable particulates as a fraction of total	not used	1.000E+00	---	RESPFRACPC
INHE	Offsite mass loading same as onsite mass loading?	not used		---	SAMEMLRF
INHE	Total mass loading at agricultural area 1 (g/m**3)	not used	1.000E-04	---	MLTOTOF(1)
INHE	Respirable fraction at agricultural area 1	not used	1.000E+00	---	RESPFRACOF(1)
INHE	Total mass loading at agricultural area 2 (g/m**3)	not used	1.000E-04	---	MLTOTOF(2)
INHE	Respirable fraction at agricultural area 2	not used	1.000E+00	---	RESPFRACOF(2)
INHE	Total mass loading at agricultural area 3 (g/m**3)	not used	1.000E-04	---	MLTOTOF(3)
INHE	Respirable fraction at agricultural area 3	not used	1.000E+00	---	RESPFRACOF(3)
INHE	Total mass loading at agricultural area 4 (g/m**3)	not used	1.000E-04	---	MLTOTOF(4)
INHE	Respirable fraction at agricultural area 4	not used	1.000E-04	---	RESPFRACOF(4)
INHE	Total mass loading at offsite dwelling(g/m**3)	not used	1.000E-04	---	MLTOTDWELL
INHE	Respirable fraction at offsite dwelling(g/m**3)	not used	1.000E+00	---	RESPFRACDWELL
INHE	Indoor dust filtration factor, inhalation	not used	4.000E-01	---	SHF3
INHE	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
INHE	Shape factor flag, external gamma	not used	1.000E+00	noncircular	FS
SEXT	Onsite shape factor array (used if non-circular):				
SEXT	Radii of shape factor array (used if non-circular):				
SEXT	Outer annular radius (m), ring 1:	not used	6.000E+00	---	RAD_SHAPE(1)
SEXT	Outer annular radius (m), ring 2:	not used	1.200E+01	---	RAD_SHAPE(2)
SEXT	Outer annular radius (m), ring 3:	not used	1.800E+01	---	RAD_SHAPE(3)
SEXT	Outer annular radius (m), ring 4:	not used	2.400E+01	---	RAD_SHAPE(4)
SEXT	Outer annular radius (m), ring 5:	not used	3.000E+01	---	RAD_SHAPE(5)
SEXT	Outer annular radius (m), ring 6:	not used	3.600E+01	---	RAD_SHAPE(6)
SEXT	Outer annular radius (m), ring 7:	not used	4.200E+01	---	RAD_SHAPE(7)
SEXT	Outer annular radius (m), ring 8:	not used	4.800E+01	---	RAD_SHAPE(8)
SEXT	Outer annular radius (m), ring 9:	not used	5.400E+01	---	RAD_SHAPE(9)
SEXT	Outer annular radius (m), ring 10:	not used	6.000E+01	---	RAD_SHAPE(10)
SEXT	Outer annular radius (m), ring 11:	not used	6.600E+01	---	RAD_SHAPE(11)
SEXT	Outer annular radius (m), ring 12:	not used	7.200E+01	---	RAD_SHAPE(12)
SEXT	Fractions of annular areas within AREA:				
SEXT	Ring 1	not used	1.000E+00	---	FRACA(1)
SEXT	Ring 2	not used	1.000E+00	---	FRACA(2)

External not used:

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Parent Dose Report
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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
SEXT	Shape factor array from offsite dwelling:				
SEXT	Radii of shape factor array (used if non-circular):				
SEXT	Outer annular radius (m), ring 13:	not used	1.325E+01	---	RAD_SHAPE(13)
SEXT	Outer annular radius (m), ring 14:	not used	2.650E+01	---	RAD_SHAPE(14)
SEXT	Outer annular radius (m), ring 15:	not used	3.975E+01	---	RAD_SHAPE(15)
SEXT	Outer annular radius (m), ring 16:	not used	5.300E+01	---	RAD_SHAPE(16)
SEXT	Outer annular radius (m), ring 17:	not used	6.625E+01	---	RAD_SHAPE(17)
SEXT	Outer annular radius (m), ring 18:	not used	7.950E+01	---	RAD_SHAPE(18)
SEXT	Outer annular radius (m), ring 19:	not used	9.275E+01	---	RAD_SHAPE(19)
SEXT	Outer annular radius (m), ring 20:	not used	1.060E+02	---	RAD_SHAPE(20)
SEXT	Outer annular radius (m), ring 21:	not used	1.192E+02	---	RAD_SHAPE(21)
SEXT	Outer annular radius (m), ring 22:	not used	1.325E+02	---	RAD_SHAPE(22)
SEXT	Outer annular radius (m), ring 23:	not used	1.458E+02	---	RAD_SHAPE(23)
SEXT	Outer annular radius (m), ring 24:	not used	1.590E+02	---	RAD_SHAPE(24)
SEXT	Fractions of annular areas within AREA:				
SEXT	Ring 13	not used	0.000E+00	---	FRACA(13)
SEXT	Ring 14	not used	0.000E+00	---	FRACA(14)
SEXT	Ring 15	not used	0.000E+00	---	FRACA(15)
SEXT	Ring 16	not used	2.400E-02	---	FRACA(16)
SEXT	Ring 17	not used	1.900E-01	---	FRACA(17)
SEXT	Ring 18	not used	2.400E-01	---	FRACA(18)
SEXT	Ring 19	not used	2.000E-01	---	FRACA(19)
SEXT	Ring 20	not used	1.700E-01	---	FRACA(20)
SEXT	Ring 21	not used	1.500E-01	---	FRACA(21)
SEXT	Ring 22	not used	1.300E-01	---	FRACA(22)
SEXT	Ring 23	not used	1.200E-01	---	FRACA(23)
SEXT	Ring 24	not used	5.200E-02	---	FRACA(24)
SEXT	Shape factor array from offsite area 1:				
SEXT	Radii of shape factor array (used if non-circular):				
SEXT	Outer annular radius (m), ring 25:	not used	1.500E+02	---	RAD_SHAPE(25)
SEXT	Outer annular radius (m), ring 26:	not used	1.581E+02	---	RAD_SHAPE(26)
SEXT	Outer annular radius (m), ring 27:	not used	1.683E+02	---	RAD_SHAPE(27)
SEXT	Outer annular radius (m), ring 28:	not used	1.785E+02	---	RAD_SHAPE(28)
SEXT	Outer annular radius (m), ring 29:	not used	1.887E+02	---	RAD_SHAPE(29)

C-14 and H-3 not used

Summary Pathway selection is correct:

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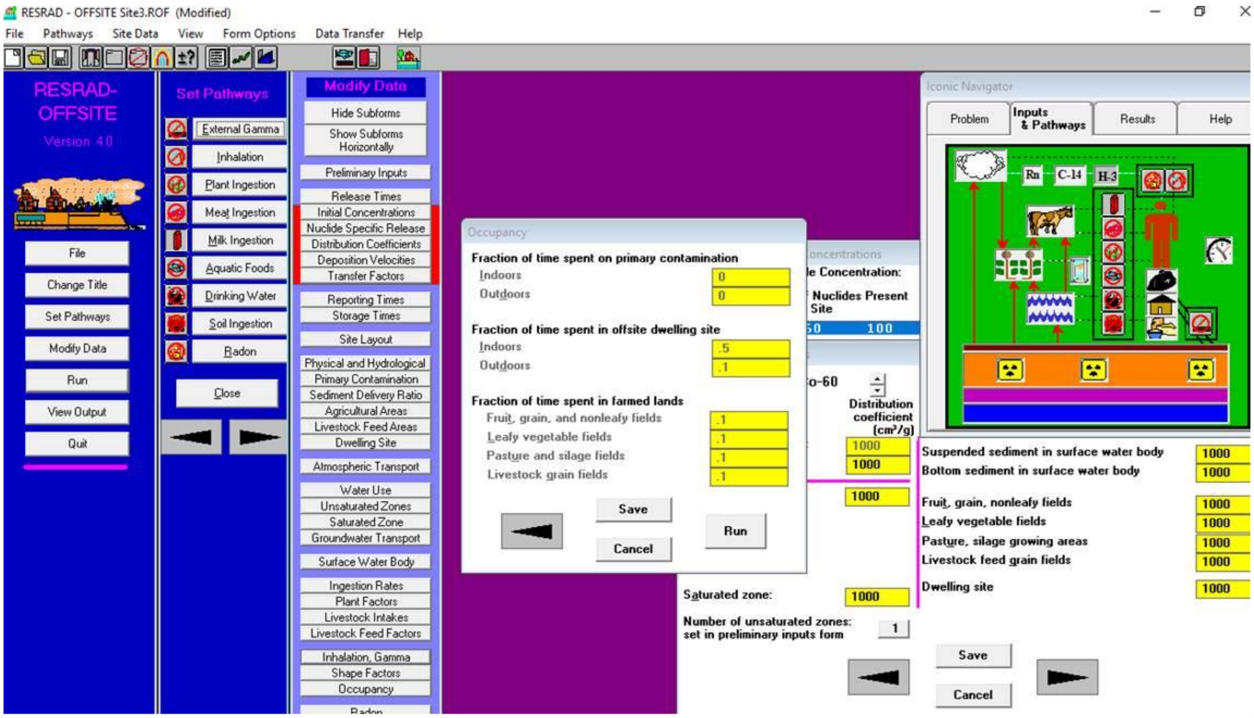
Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	C12EVSN
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C12	C-12 concentration in the atmosphere (g/m**3)	not used	1.800E-01	---	C12AIR
C12	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C12	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C12	C-12 concentration in meat 1 (g/g)	not used	2.400E-01	---	C12MEAT_MILK(1)
C12	C-12 concentration in milk (g/g)	not used	7.000E-02	---	C12MEAT_MILK(2)
C12	C-12 concentration in vegetable 1 (g/g)	not used	4.000E-01	---	C12PLANT(1)
C12	C-12 concentration in vegetable 2 (g/g)	not used	9.000E-02	---	C12PLANT(2)
C12	C-12 concentration in livestock feed 1 (g/g)	not used	9.000E-02	---	C12PLANT(3)
C12	C-12 concentration in livestock feed 2 (g/g)	not used	4.000E-01	---	C12PLANT(4)
H3	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
H3	Mass fraction of water in meat 1 (g/g)	not used	6.000E-01	---	H2OMEAT_MILK(1)
H3	Mass fraction of water in milk (g/g)	not used	8.800E-01	---	H2OMEAT_MILK(2)
H3	Mass fraction of water in vegetable 1 (g/g)	not used	8.000E-01	---	H2OPLANT(1)
H3	Mass fraction of water in vegetable 2 (g/g)	not used	8.000E-01	---	H2OPLANT(2)
H3	Mass fraction of water in livestock feed 1 (g/g)	not used	8.000E-01	---	H2OPLANT(3)
H3	Mass fraction of water in livestock feed 2 (g/g)	not used	8.000E-01	---	H2OPLANT(4)

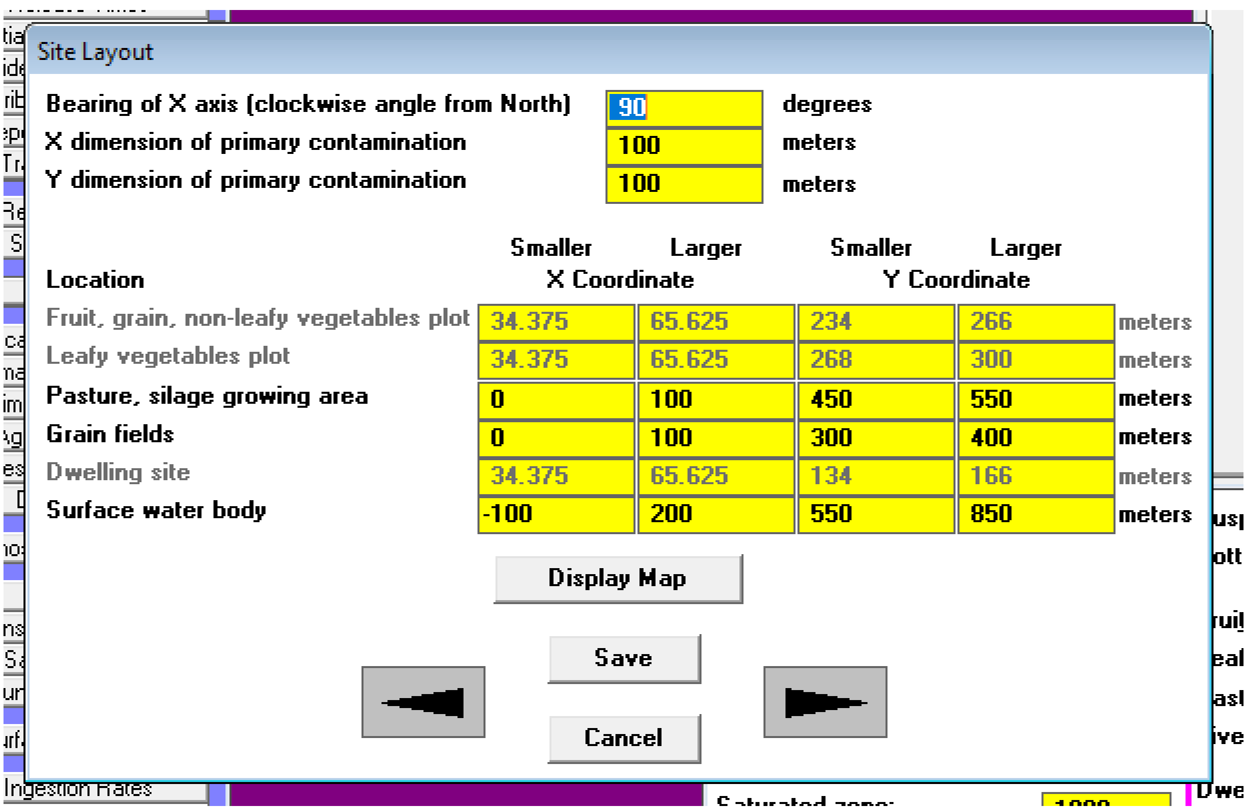
Summary of Pathway Selections

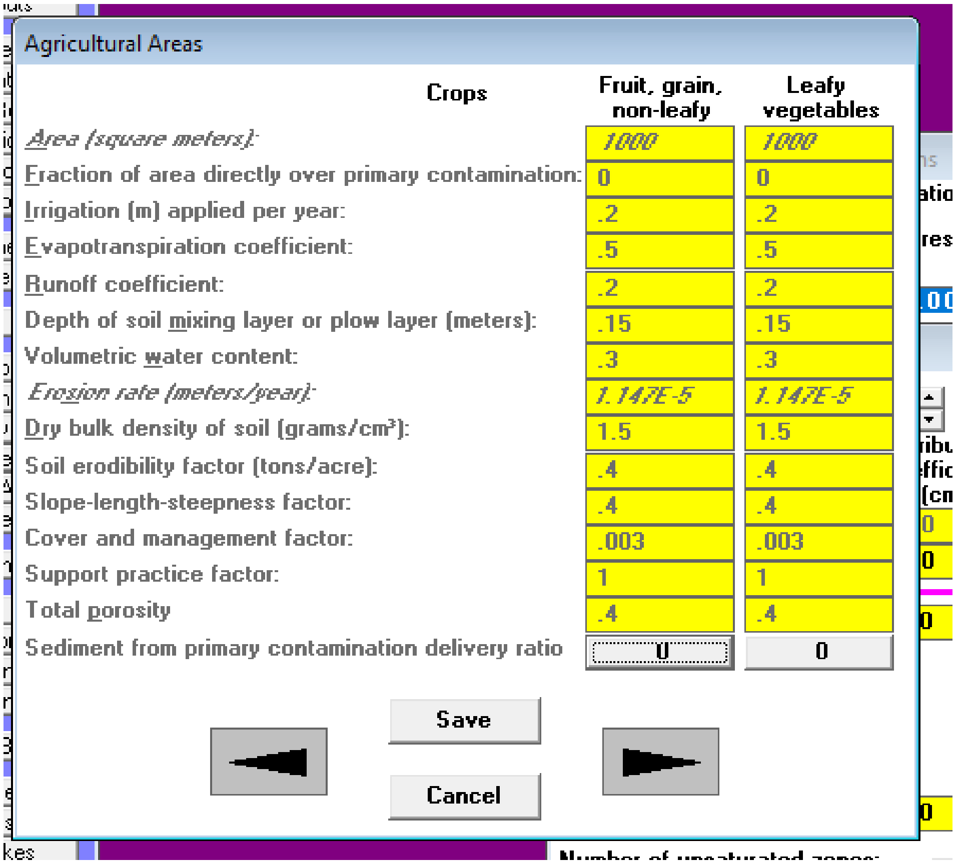
Pathway	User Selection
1 -- external gamma	suppressed
2 -- inhalation (w/o radon)	suppressed
3 -- plant ingestion	suppressed
4 -- meat ingestion	active
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	suppressed
9 -- radon	suppressed

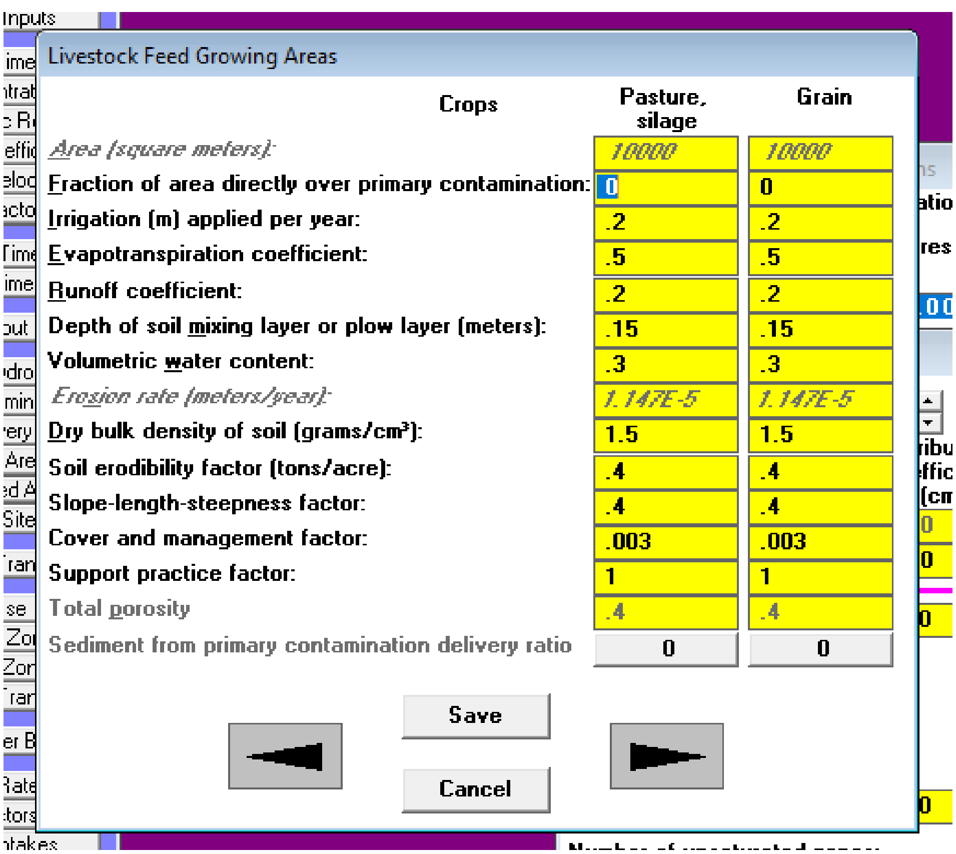
Now look at Milk Pathway only

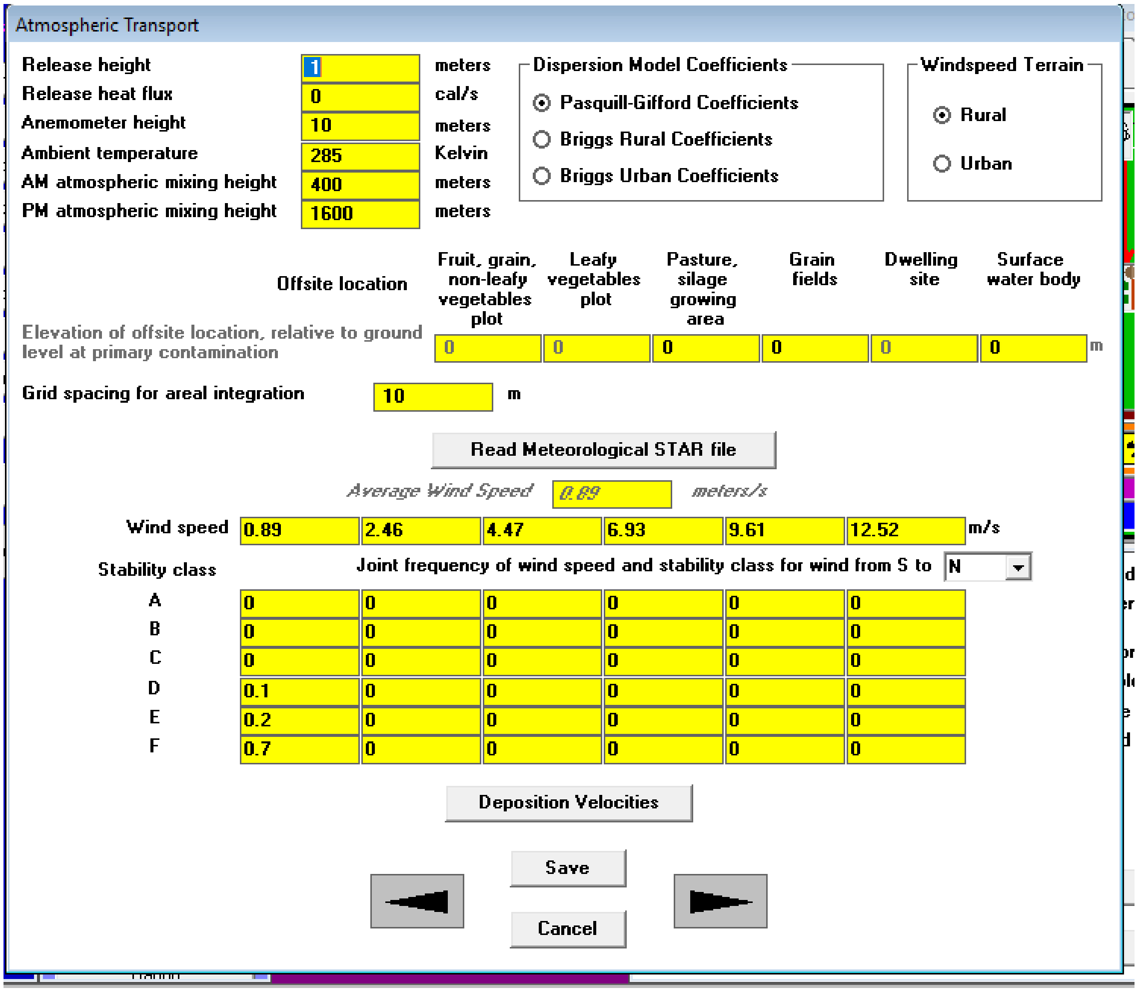


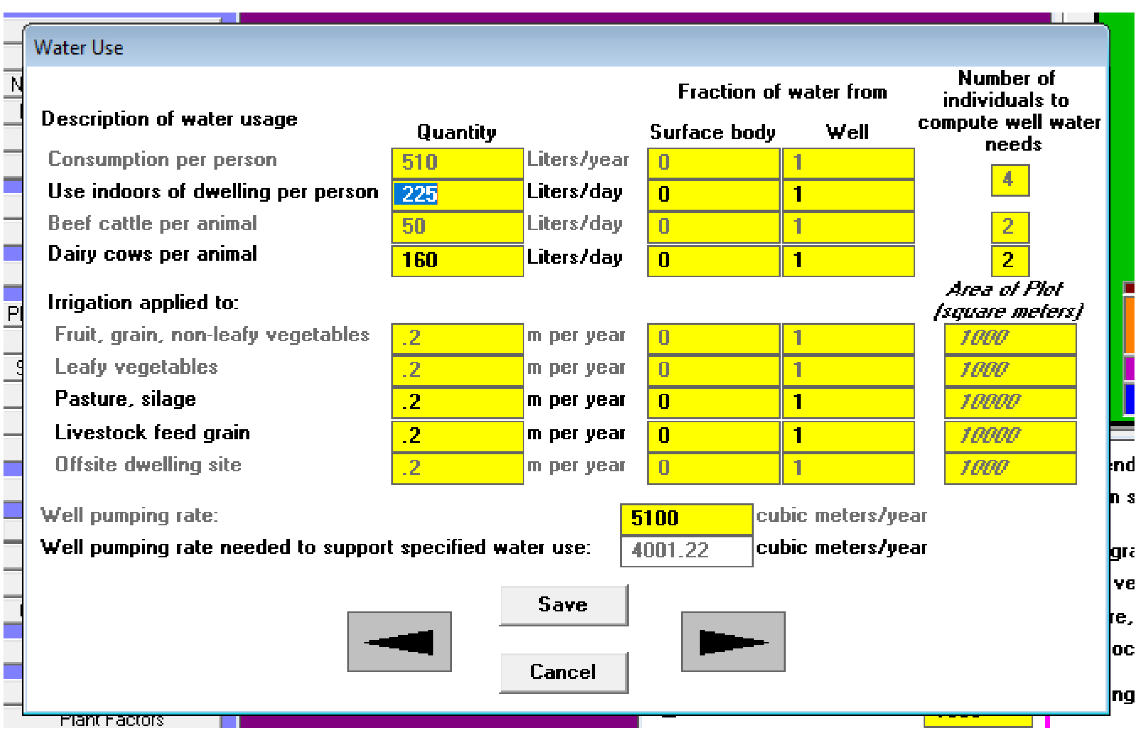
Only livestock feed fields are used:



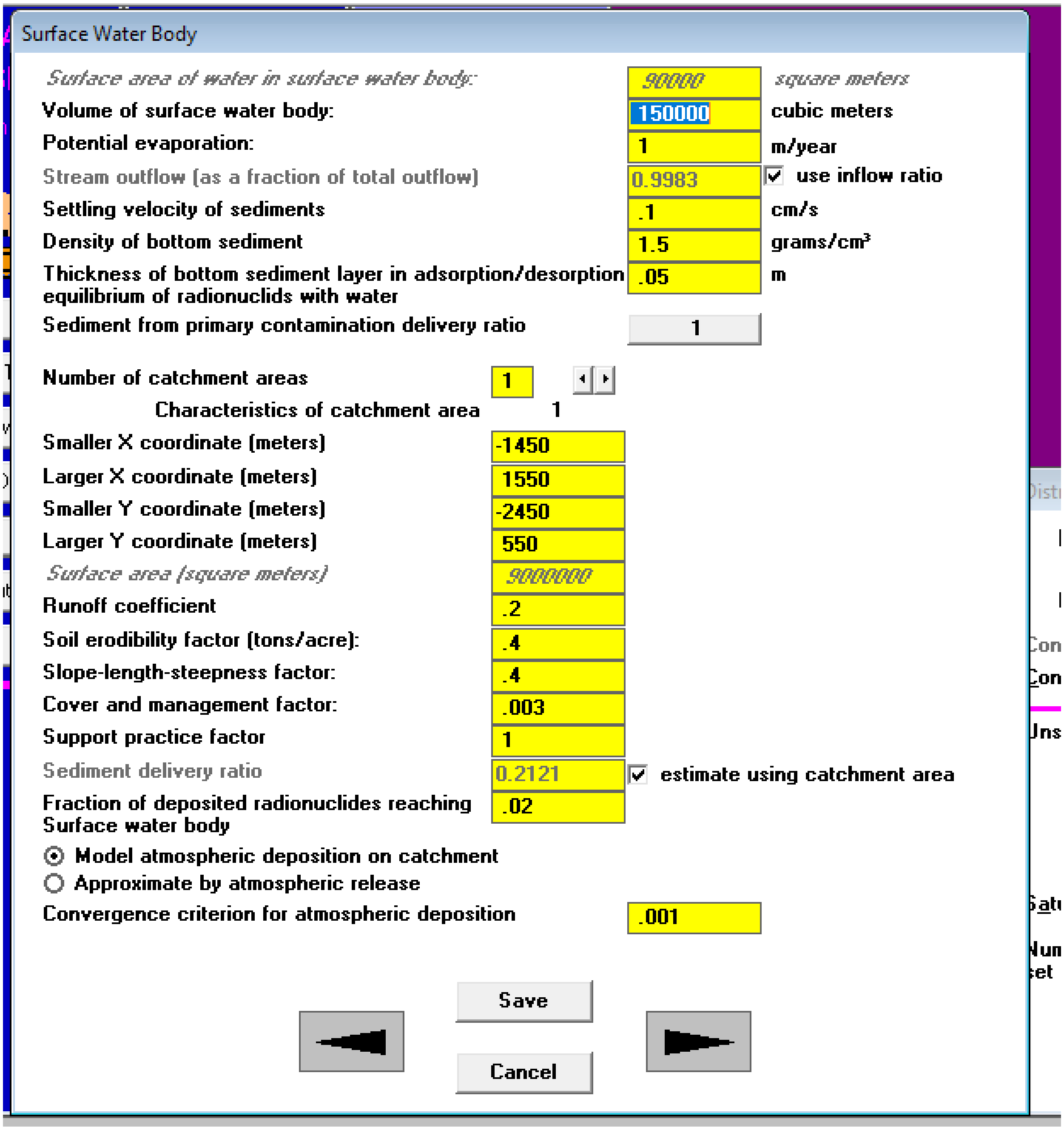

Agricultural Areas
Crops
Fruit, grain, non-leafy
Leafy vegetables
Area (square meters): 1000 1000
Fraction of area directly over primary contamination: 0 0
Irrigation (m) applied per year: .2 .2
Evapotranspiration coefficient: .5 .5
Runoff coefficient: .2 .2
Depth of soil mixing layer or plow layer (meters): .15 .15
Volumetric water content: .3 .3
Erosion rate (meters/year): 1.147E-5 1.147E-5
Dry bulk density of soil (grams/cm³): 1.5 1.5
Soil erodibility factor (tons/acre): .4 .4
Slope-length-steepness factor: .4 .4
Cover and management factor: .003 .003
Support practice factor: 1 1
Total porosity .4 .4
Sediment from primary contamination delivery ratio 0 0
Save
Cancel
Number of unsaturated zones:


Inputs
Livestock Feed Growing Areas
Crops
Pasture, silage
Grain
Area (square meters): 10000 10000
Fraction of area directly over primary contamination: 0 0
Irrigation (m) applied per year: .2 .2
Evapotranspiration coefficient: .5 .5
Runoff coefficient: .2 .2
Depth of soil mixing layer or plow layer (meters): .15 .15
Volumetric water content: .3 .3
Erosion rate (meters/year): 1.147E-5 1.147E-5
Dry bulk density of soil (grams/cm³): 1.5 1.5
Soil erodibility factor (tons/acre): .4 .4
Slope-length-steepness factor: .4 .4
Cover and management factor: .003 .003
Support practice factor: 1 1
Total porosity .4 .4
Sediment from primary contamination delivery ratio 0 0
Save
Cancel
Number of unsaturated zones:

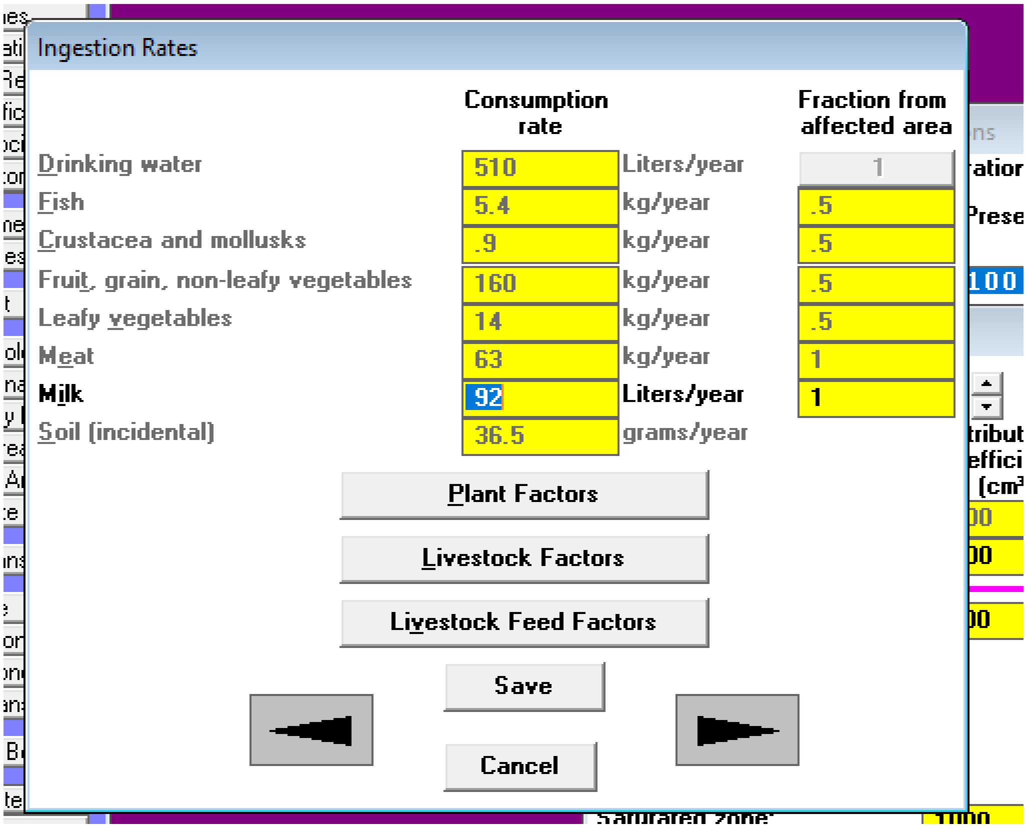

Atmospheric Transport
Release height 1 meters
Release heat flux 0 cal/s
Anemometer height 10 meters
Ambient temperature 285 Kelvin
AM atmospheric mixing height 400 meters
PM atmospheric mixing height 1600 meters
Dispersion Model Coefficients
Pasquill-Gifford Coefficients
Briggs Rural Coefficients
Briggs Urban Coefficients
Windspeed Terrain
Rural
Urban
Offsite location
Fruit, grain, non-leafy vegetables plot
Leafy vegetables plot
Pasture, silage growing area
Grain fields
Dwelling site
Surface water body
Elevation of offsite location, relative to ground level at primary contamination
0 0 0 0 0 0 m
Grid spacing for areal integration 10 m
Read Meteorological STAR file
Average Wind Speed 0.89 meters/s
Wind speed 0.89 2.46 4.47 6.93 9.61 12.52 m/s
Stability class
Joint frequency of wind speed and stability class for wind from S to N
A 0 0 0 0 0 0
B 0 0 0 0 0 0
C 0 0 0 0 0 0
D 0.1 0 0 0 0 0
E 0.2 0 0 0 0 0
F 0.7 0 0 0 0 0
Deposition Velocities
Save
Cancel


Water Use
Description of water usage
Quantity
Fraction of water from
Surface body
Well
Number of individuals to compute well water needs
Consumption per person 510 Liters/year 0 1
Use indoors of dwelling per person 225 Liters/day 0 1 4
Beef cattle per animal 50 Liters/day 0 1 2
Dairy cows per animal 160 Liters/day 0 1 2
Irrigation applied to:
Area of Plot (square meters)
Fruit, grain, non-leafy vegetables .2 m per year 0 1 1000
Leafy vegetables .2 m per year 0 1 1000
Pasture, silage .2 m per year 0 1 10000
Livestock feed grain .2 m per year 0 1 10000
Offsite dwelling site .2 m per year 0 1 1000
Well pumping rate: 5100 cubic meters/year
Well pumping rate needed to support specified water use: 4001.22 cubic meters/year
Save
Cancel

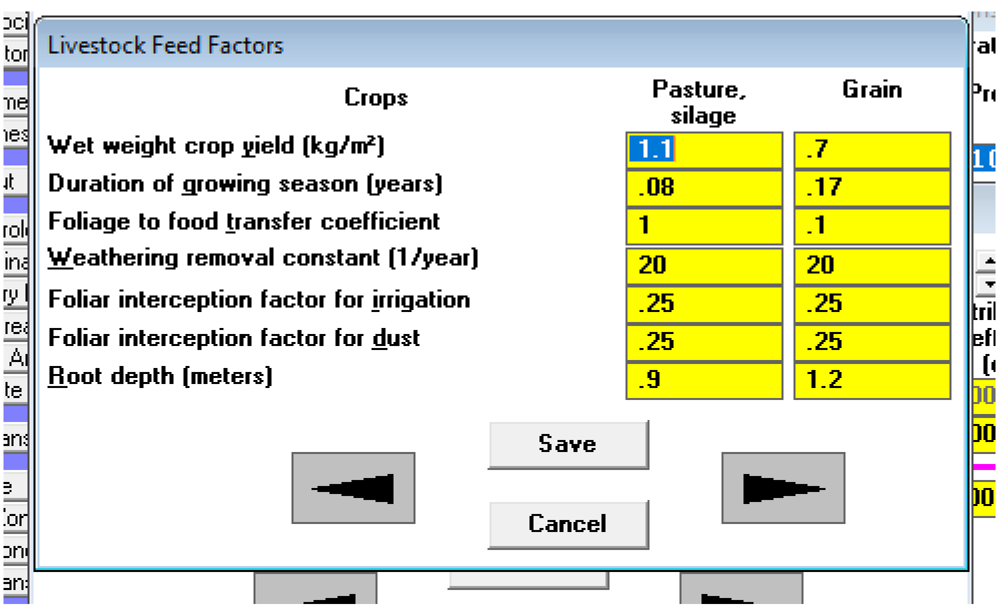
Surface Water Body still used:



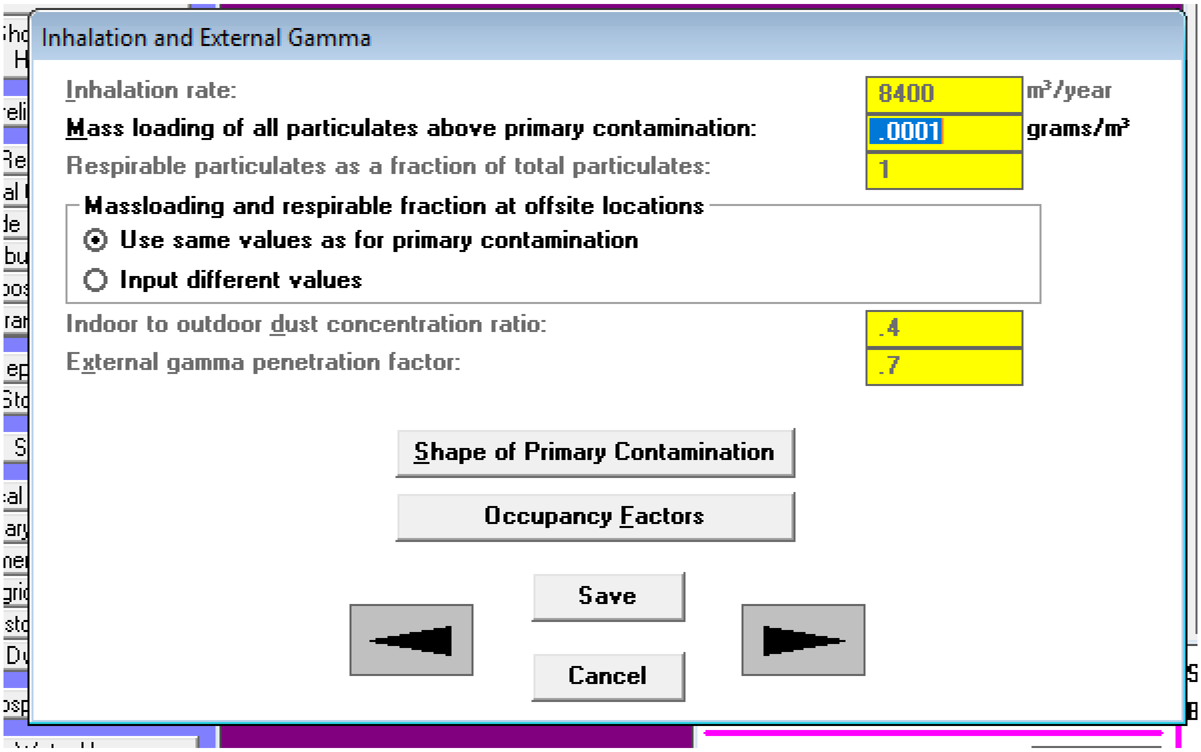
Only milk ingestion used:



Livestock Feed Factors used:



Inhalation and External not used:



Ran the Case

Areas 1&2 not used; 3&4 used:

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Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
FSTI	Exposure duration for risk	3.000E+01	3.000E+01	---	ED
FSTI	Basic radiation dose limit (mrem/yr)	2.500E+01	2.500E+01	---	BRDL
RELT	1st release time (years)	0.000E+00		---	RelTime(1)
CONC	Initial concentration of Co-60 (pCi/g)	1.000E+02	0.000E+00	---	S1(1)
VDEP	Deposition velocity of Co-60 on total particulates	1.000E-03	1.000E-03	---	DEPVEL(1)
VDEP	Dep. velocity of Co-60 on respirable particulates	1.000E-03	1.000E-03	---	DEPVELT(1)
DCLR	Distribution coefficients for Co-60				
DCLR	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCC(1)
DCLR	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCU(1,1)
DCLR	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCS(1)
DCLR	Bottom sediment in surface water body (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCSWB(1)
DCLR	Suspended sediment in surface water body (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCSWS(1)
DCLR	Agricultural area 1 (cm**3/g)	not used	1.000E+03	---	DCNUCOF(1,1)
DCLR	Agricultural area 2 (cm**3/g)	not used	1.000E+03	---	DCNUCOF(1,2)
DCLR	Agricultural area 3 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCOF(1,3)
DCLR	Agricultural area 4 (cm**3/g)	1.000E+03	1.000E+03	---	DCNUCOF(1,4)
DCLR	Offsite Dwelling (cm**3/g)	not used	1.000E+03	---	DCNUCDWE(1)
DCLR	Leach rate constant of Co-60 (/yr)	0.000E+00	0.000E+00	1.666E-04	Rleach(1,1)
LYOT	Bearing of X axis (clockwise angle N-->X in degrees)	9.000E+01	9.000E+01	---	DNXBEARING
LYOT	Length of Primary contamination in X Direction	1.000E+02	1.000E+02	---	SOURCEXY(1)
LYOT	Length of Primary contamination in Y Direction	1.000E+02	1.000E+02	---	SOURCEXY(2)
LYOT	Smaller X coordinate of Agricultural Area 1	not used	3.438E+01	---	AGRIXY(1,1)
LYOT	Larger X coordinate of Agricultural Area 1	not used	6.562E+01	---	AGRIXY(2,1)
LYOT	Smaller Y coordinate of Agricultural Area 1	not used	2.340E+02	---	AGRIXY(3,1)
LYOT	Larger Y coordinate of Agricultural Area 1	not used	2.660E+02	---	AGRIXY(4,1)
LYOT	Smaller X coordinate of Agricultural Area 2	not used	3.438E+01	---	AGRIXY(1,2)
LYOT	Larger X coordinate of Agricultural Area 2	not used	6.562E+01	---	AGRIXY(2,2)
LYOT	Smaller Y coordinate of Agricultural Area 2	not used	2.680E+02	---	AGRIXY(3,2)
LYOT	Larger Y coordinate of Agricultural Area 2	not used	3.000E+02	---	AGRIXY(4,2)
LYOT	Smaller X coordinate of Agricultural Area 3	0.000E+00	0.000E+00	---	AGRIXY(1,3)
LYOT	Larger X coordinate of Agricultural Area 3	1.000E+02	1.000E+02	---	AGRIXY(2,3)
LYOT	Smaller Y coordinate of Agricultural Area 3	4.500E+02	4.500E+02	---	AGRIXY(3,3)
LYOT	Larger Y coordinate of Agricultural Area 3	5.500E+02	5.500E+02	---	AGRIXY(4,3)

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
LYOT	Smaller Y coordinate of Surface water body	5.500E+02	5.500E+02	---	SWXY(3)
LYOT	Larger Y coordinate of Surface water body	8.500E+02	8.500E+02	---	SWXY(4)
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(1)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(3)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(4)
STOR	Livestock feed - pasture or silage	1.000E+00	1.000E+00	---	STOR_T(5)
STOR	Livestock feed - grain	4.500E+01	4.500E+01	---	STOR_T(6)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(7)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(9)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(10)
TIME	Times at which dose/risk are to be reported (yr)	1.000E+00	1.000E+00	---	T(2)
TIME	Times at which dose/risk are to be reported (yr)	3.000E+00	3.000E+00	---	T(3)
TIME	Times at which dose/risk are to be reported (yr)	6.000E+00	6.000E+00	---	T(4)
TIME	Times at which dose/risk are to be reported (yr)	1.200E+01	1.200E+01	---	T(5)
TIME	Times at which dose/risk are to be reported (yr)	3.000E+01	3.000E+01	---	T(6)
TIME	Times at which dose/risk are to be reported (yr)	7.500E+01	7.500E+01	---	T(7)
TIME	Times at which dose/risk are to be reported (yr)	1.750E+02	1.750E+02	---	T(8)
TIME	Times at which dose/risk are to be reported (yr)	4.200E+02	4.200E+02	---	T(9)
TIME	Times at which dose/risk are to be reported (yr)	9.700E+02	9.700E+02	---	T(10)
SITE	Precipitation (m/yr)	1.000E+00	1.000E+00	---	PRECIP
SITE	Rainfall Erosion Index	1.600E+02	1.600E+02	---	RAINEROS
PRCZ	Area of primary contamination (m**2)	1.000E+04	1.000E+04	---	AREA
PRCZ	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---	LCZPAQ
PRCZ	Depth of soil mixing layer (m)	1.500E-01	1.500E-01	---	DM
PRCZ	Mass loading of all particulates for release(g/m**3)	1.000E-04	1.000E-04	---	MLFD
PRCZ	DepositionVelocityOfAllParticulates for release(m/s)	1.000E-03	1.000E-03	---	DEPVEL_DUSTT
PRCZ	Respirable particulates as a fraction of total	not used	1.000E+00	---	RESPFRACPC
PRCZ	DepositionVelocityOfRespirableParticulatesForRe(m/s)	not used	1.000E-03	---	DEPVEL_DUST
PRCZ	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
PRCZ	Evapotranspiration coefficient	5.000E-01	5.000E-01	---	EVAPTR

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
AGRI	Fraction of Agri. Area 3 directly over the c.z.	0.000E+00	0.000E+00	---	FAREA_PLANT(3)
AGRI	Evapotranspiration coefficient in Agri. Area 3	5.000E-01	5.000E-01	---	EVAPTRN(3)
AGRI	Runoff coefficient in Agricultural Area 3	2.000E-01	2.000E-01	---	RUNOF(3)
AGRI	Mixing depth/plow layer of Agricultural Area 3	1.500E-01	1.500E-01	---	DPTHMIXG(3)
AGRI	Water filled porosity of soil in Agri. Area 3	3.000E-01	3.000E-01	---	TMOF(3)
AGRI	Computed erosion rate of soil in Agri. Area 3	1.147E-05	1.147E-05	---	EROSN(3)
AGRI	Dry Bulk Density of soil in Agricultural Area 3	1.500E+00	1.500E+00	---	RHOB(3)
AGRI	Soil erodibility factor of Agricultural Area 3	4.000E-01	4.000E-01	---	ERODIBILITY(3)
AGRI	Slope-length-steepness factor, Agricultural Area 3	4.000E-01	4.000E-01	---	SLPLENSTP(3)
AGRI	Cropping-management factor of Agricultural Area 3	3.000E-03	3.000E-03	---	CRPMANG(3)
AGRI	Conservation practice factor of Agricultural Area 3	1.000E+00	1.000E+00	---	CONVPRAC(3)
AGRI	Total porosity of soil in Agricultural Area 3	not used	4.000E-01	---	TPOF(3)
AGRI	Areal extent of Agricultural Area 4 (m**2)	1.000E+04	1.000E+04	---	AREAO(4)
AGRI	Fraction of Agri. Area 4 directly over the c.z.	0.000E+00	0.000E+00	---	FAREA_PLANT(4)
AGRI	Evapotranspiration coefficient in Agri. Area 4	5.000E-01	5.000E-01	---	EVAPTRN(4)
AGRI	Runoff coefficient in Agricultural Area 4	2.000E-01	2.000E-01	---	RUNOF(4)
AGRI	Mixing depth/plow layer of Agricultural Area 4	1.500E-01	1.500E-01	---	DPTHMIXG(4)
AGRI	Water filled porosity of soil in Agri. Area 4	3.000E-01	3.000E-01	---	TMOF(4)
AGRI	Computed erosion rate of soil in Agri. Area 4	1.147E-05	1.147E-05	---	EROSN(4)
AGRI	Dry Bulk Density of soil in Agricultural Area 4	1.500E+00	1.500E+00	---	RHOB(4)
AGRI	Soil erodibility factor of Agricultural Area 4	4.000E-01	4.000E-01	---	ERODIBILITY(4)
AGRI	Slope-length-steepness factor, Agricultural Area 4	4.000E-01	4.000E-01	---	SLPLENSTP(4)
AGRI	Cropping-management factor of Agricultural Area 4	3.000E-03	3.000E-03	---	CRPMANG(4)
AGRI	Conservation practice factor of Agricultural Area 4	1.000E+00	1.000E+00	---	CONVPRAC(4)
AGRI	Total porosity of soil in Agricultural Area 4	not used	4.000E-01	---	TPOF(4)
DWEL	Areal extent of Offsite dwelling site (m**2)	not used	1.000E+03	---	AREAODWELL
DWEL	Evapotranspiration coefficient in dwelling (Off)site	not used	5.000E-01	---	EVAPTRNDWELL
DWEL	Runoff coefficient in Offsite dwelling site	not used	2.000E-01	---	RUNOFDWELL
DWEL	Mixing depth of Offsite dwelling site	not used	1.500E-01	---	DPTHMIXGDWELL
DWEL	Water filled porosity of soil in Offsite Dwelling	not used	3.000E-01	---	TMOFDWELL
DWEL	Computed erosion rate of soil in Offsite Dwelling	not used	0.000E+00	---	EROSNDWELL
DWEL	Dry Bulk Density of soil in Offsite dwelling site	not used	1.500E+00	---	RHOBDWELL
DWEL	Soil erodibility factor of soil in Dwelling site	not used	0.000E+00	---	ERODIBILITYDWELL
DWEL	Slope-length-steepness factor of Dwelling site	not used	4.000E-01	---	SLPLENSTPDWELL
DWEL	Cropping-management factor of Dwelling site	not used	3.000E-03	---	CRPMANGDWELL
DWEL	Conservation practice factor of Offsite Dwelling sit	not used	1.000E+00	---	CONVPRACDWELL

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Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
WTRU	Fraction of irrigation water 1 from surface water	not used	0.000E+00	---	FSWIR(1)
WTRU	Fraction of irrigation water 1 from well water	not used	1.000E+00	---	FWWIR(1)
WTRU	Irrigation rate in Agricultural Area 2 (m/yr)	not used	2.000E-01	---	RIRRIG(2)
WTRU	Fraction of irrigation water 2 from surface water	not used	0.000E+00	---	FSWIR(2)
WTRU	Fraction of irrigation water 2 from well water	not used	1.000E+00	---	FWWIR(2)
WTRU	Irrigation rate in Agricultural Area 3 (m/yr)	2.000E-01	2.000E-01	---	RIRRIG(3)
WTRU	Fraction of irrigation water 3 from surface water	0.000E+00	0.000E+00	---	FSWIR(3)
WTRU	Fraction of irrigation water 3 from well water	1.000E+00	1.000E+00	---	FWWIR(3)
WTRU	Irrigation rate in Agricultural Area 4 (m/yr)	2.000E-01	2.000E-01	---	RIRRIG(4)
WTRU	Fraction of irrigation water 4 from surface water	0.000E+00	0.000E+00	---	FSWIR(4)
WTRU	Fraction of irrigation water 4 from well water	1.000E+00	1.000E+00	---	FWWIR(4)
WTRU	Irrigation rate in Offsite dwelling site (m/yr)	not used	2.000E-01	---	RIRRIGDWELL
WTRU	Fraction of irrigation water from surface water	not used	0.000E+00	---	FSWIRDWELL
WTRU	Fraction of irrigation water from well water	not used	1.000E+00	---	FWWIRDWELL
WTRU	Well pumping rate (m**3/yr)	5.100E+03	5.100E+03	---	UW
SWBY	Surface area of water in surface water body, m**2	9.000E+04	9.000E+04	---	ALAKE
SWBY	Volume of surface water body, m**3	1.500E+05	1.500E+05	---	VLAKE
SWBY	Potential evaporation, m/y	1.000E+00	1.000E+00	---	EVAPOT
SWBY	Stream outflow as a fraction of seepage+stm outflows	9.983E-01	9.983E-01	---	FSTMFLOW
SWBY	Use inflow ratio for outflow ratio, 1 yes, 0 no	1	1	---	FSTMFLOWIN
SWBY	Settling velocity of suspended sediments, cm/s	1.000E-01	1.000E-01	---	Vsettle
SWBY	Dry bulk density of bottom sediments, g/cm**3	1.500E+00	1.500E+00	---	RhobSed
SWBY	Thickness of bottom sediment absorbing nuclides, m	5.000E-02	5.000E-02	---	ThickSed
SWBY	Number of distinct catchments	1	1	---	NCATCH
SWBY	Catchment 1, smaller X coordinate (m)	-1.450E+03	-1.450E+03	---	CATCHXY(1,1)
SWBY	Catchment 1, larger X coordinate (m)	1.550E+03	1.550E+03	---	CATCHXY(2,1)
SWBY	Catchment 1, smaller Y coordinate (m)	-2.450E+03	-2.450E+03	---	CATCHXY(3,1)
SWBY	Catchment 1, larger Y coordinate (m)	5.500E+02	5.500E+02	---	CATCHXY(4,1)
SWBY	Catchment 1, area, m**2	9.000E+06	9.000E+06	---	AREACA(1)
SWBY	Catchment 1, runoff coefficient	2.000E-01	2.000E-01	---	RUNOFFCA(1)
SWBY	Catchment 1, soil erodibility factor, tons/acre	4.000E-01	4.000E-01	---	ERODIBILITYCA(1)
SWBY	Catchment 1, Slope-length-steepness factor	4.000E-01	4.000E-01	---	SLPLENSTPCA(1)
SWBY	Catchment 1, Cover and management factor	3.000E-03	3.000E-03	---	CRPMANGCA(1)
SWBY	Catchment 1, support practice factor	1.000E+00	1.000E+00	---	CONVPRACCA(1)
SWBY	Catchment 1, sediment delivery ratio	2.121E-01	2.121E-01	---	SDRCA(1)

Inhalation and external not used:

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Site-Specific Parameter Summary (continued)

enu	Parameter	User Input	Default	RESRAD computed	Parameter Name
NHE	Inhalation rate (m**3/yr)	not used	8.400E+03	---	INHALR
NHE	Mass loading of all particulates from Primary contam	1.000E-04	1.000E-04	---	MLFD
NHE	Respirable particulates as a fraction of total	not used	1.000E+00	---	RESPFRACPC
NHE	Offsite mass loading same as onsite mass loading?	not used		---	SAMEMLRF
NHE	Total mass loading at agricultural area 1 (g/m**3)	not used	1.000E-04	---	MLTOTOF(1)
NHE	Respirable fraction at agricultural area 1	not used	1.000E+00	---	RESPFRACOF(1)
NHE	Total mass loading at agricultural area 2 (g/m**3)	not used	1.000E-04	---	MLTOTOF(2)
NHE	Respirable fraction at agricultural area 2	not used	1.000E+00	---	RESPFRACOF(2)
NHE	Total mass loading at agricultural area 3 (g/m**3)	not used	1.000E-04	---	MLTOTOF(3)
NHE	Respirable fraction at agricultural area 3	not used	1.000E+00	---	RESPFRACOF(3)
NHE	Total mass loading at agricultural area 4 (g/m**3)	not used	1.000E-04	---	MLTOTOF(4)
NHE	Respirable fraction at agricultural area 4	not used	1.000E-04	---	RESPFRACOF(4)
NHE	Total mass loading at offsite dwelling(g/m**3)	not used	1.000E-04	---	MLTOTDWELL
NHE	Respirable fraction at offsite dwelling(g/m**3)	not used	1.000E+00	---	RESPFRACDWELL
NHE	Indoor dust filtration factor, inhalation	not used	4.000E-01	---	SHF3
NHE	Shielding factor, external gamma	not used	7.000E-01	---	SHF1
NHE	Shape factor flag, external gamma	not used	1.000E+00	noncircular	FS
EXT	Onsite shape factor array (used if non-circular):				
EXT	Radii of shape factor array (used if non-circular):				
EXT	Outer annular radius (m), ring 1:	not used	6.000E+00	---	RAD_SHAPE(1)
EXT	Outer annular radius (m), ring 2:	not used	1.200E+01	---	RAD_SHAPE(2)
EXT	Outer annular radius (m), ring 3:	not used	1.800E+01	---	RAD_SHAPE(3)
EXT	Outer annular radius (m), ring 4:	not used	2.400E+01	---	RAD_SHAPE(4)
EXT	Outer annular radius (m), ring 5:	not used	3.000E+01	---	RAD_SHAPE(5)
EXT	Outer annular radius (m), ring 6:	not used	3.600E+01	---	RAD_SHAPE(6)
EXT	Outer annular radius (m), ring 7:	not used	4.200E+01	---	RAD_SHAPE(7)
EXT	Outer annular radius (m), ring 8:	not used	4.800E+01	---	RAD_SHAPE(8)
EXT	Outer annular radius (m), ring 9:	not used	5.400E+01	---	RAD_SHAPE(9)
EXT	Outer annular radius (m), ring 10:	not used	6.000E+01	---	RAD_SHAPE(10)
EXT	Outer annular radius (m), ring 11:	not used	6.600E+01	---	RAD_SHAPE(11)
EXT	Outer annular radius (m), ring 12:	not used	7.200E+01	---	RAD_SHAPE(12)
EXT	Fractions of annular areas within AREA:				
EXT	Ring 1	not used	1.000E+00	---	FRACA(1)
EXT	Ring 2	not used	1.000E+00	---	FRACA(2)
EXT	Ring 3	not used	1.000E+00	---	FRACA(3)
EXT	Ring 4	not used	1.000E+00	---	FRACA(4)
EXT	Ring 5	not used	1.000E+00	---	FRACA(5)

C-14 and H-3 not used

Summary of Pathway selection is correct

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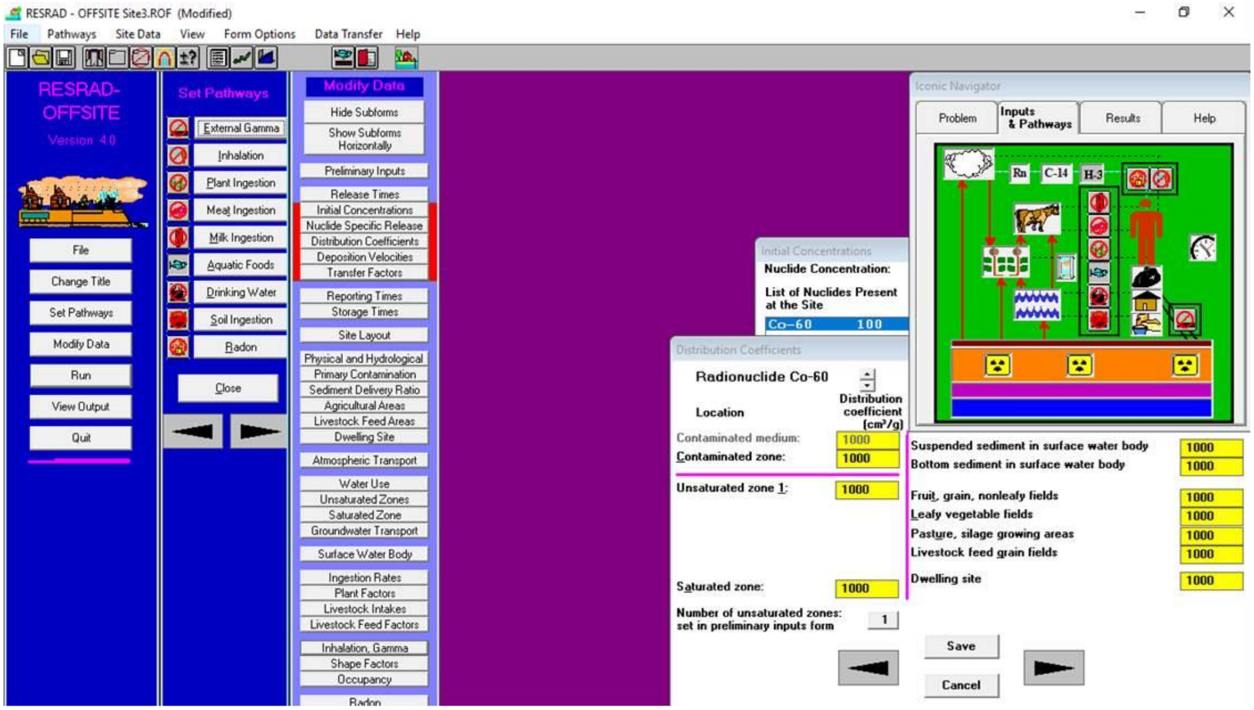
Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	C12EVSN
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C12	C-12 concentration in the atmosphere (g/m**3)	not used	1.800E-01	---	C12AIR
C12	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C12	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C12	C-12 concentration in meat 1 (g/g)	not used	2.400E-01	---	C12MEAT_MILK(1)
C12	C-12 concentration in milk (g/g)	not used	7.000E-02	---	C12MEAT_MILK(2)
C12	C-12 concentration in vegetable 1 (g/g)	not used	4.000E-01	---	C12PLANT(1)
C12	C-12 concentration in vegetable 2 (g/g)	not used	9.000E-02	---	C12PLANT(2)
C12	C-12 concentration in livestock feed 1 (g/g)	not used	9.000E-02	---	C12PLANT(3)
C12	C-12 concentration in livestock feed 2 (g/g)	not used	4.000E-01	---	C12PLANT(4)
H3	Humidity in air (g/cm**3)	not used	8.000E+00	---	HUMID
H3	Mass fraction of water in meat 1 (g/g)	not used	6.000E-01	---	H2OMEAT_MILK(1)
H3	Mass fraction of water in milk (g/g)	not used	8.800E-01	---	H2OMEAT_MILK(2)
H3	Mass fraction of water in vegetable 1 (g/g)	not used	8.000E-01	---	H2OPLANT(1)
H3	Mass fraction of water in vegetable 2 (g/g)	not used	8.000E-01	---	H2OPLANT(2)
H3	Mass fraction of water in livestock feed 1 (g/g)	not used	8.000E-01	---	H2OPLANT(3)
H3	Mass fraction of water in livestock feed 2 (g/g)	not used	8.000E-01	---	H2OPLANT(4)

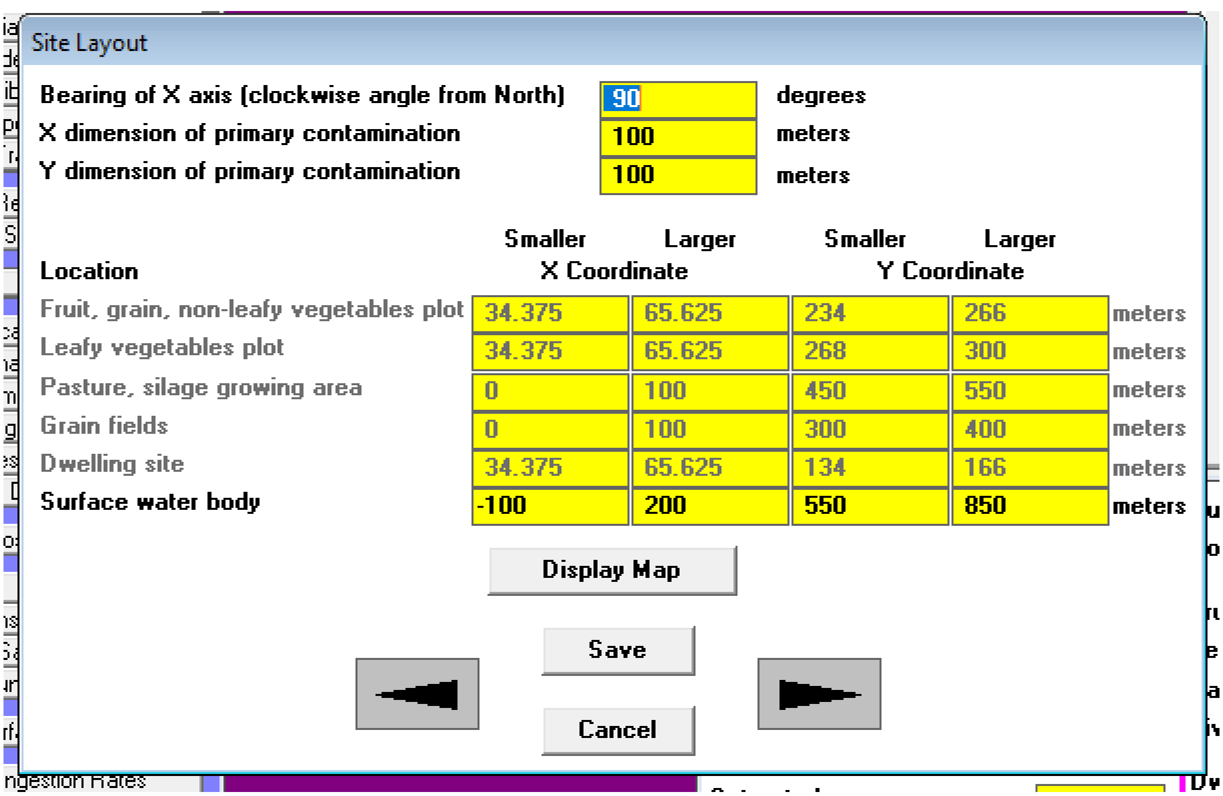
Summary of Pathway Selections

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

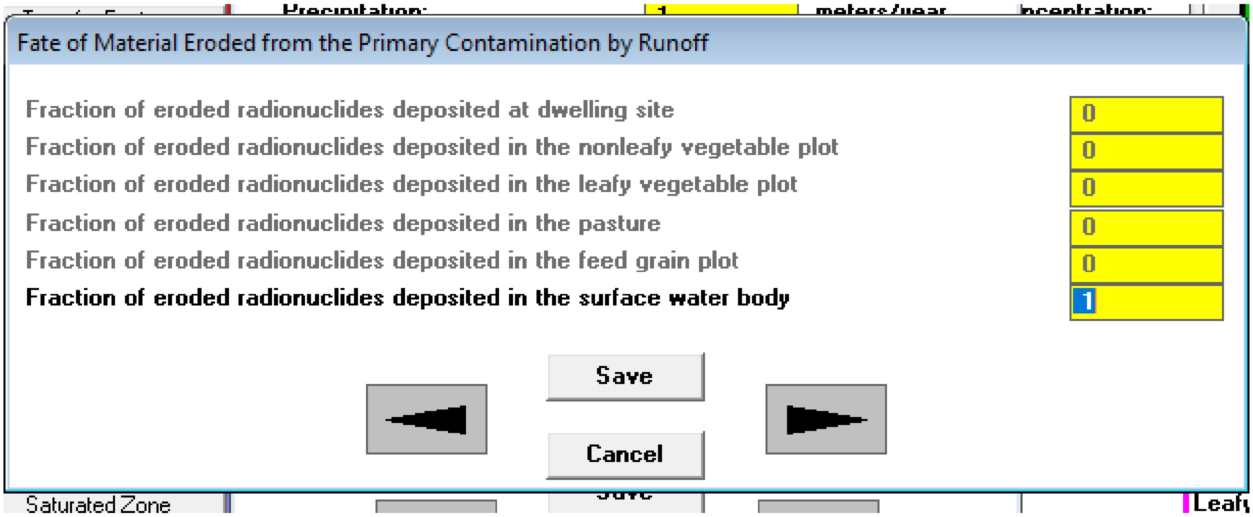
Now Switch to Aquatic Pathway only:



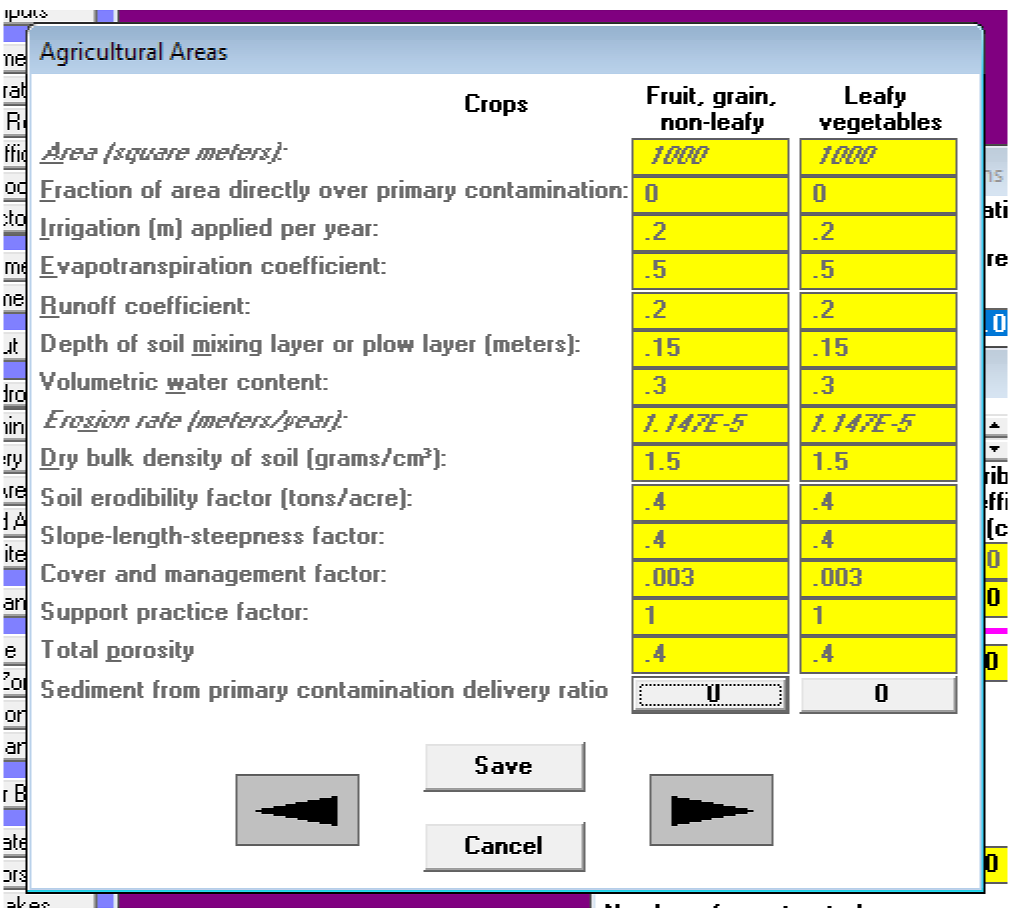
Only Pond location matters beside contamination:

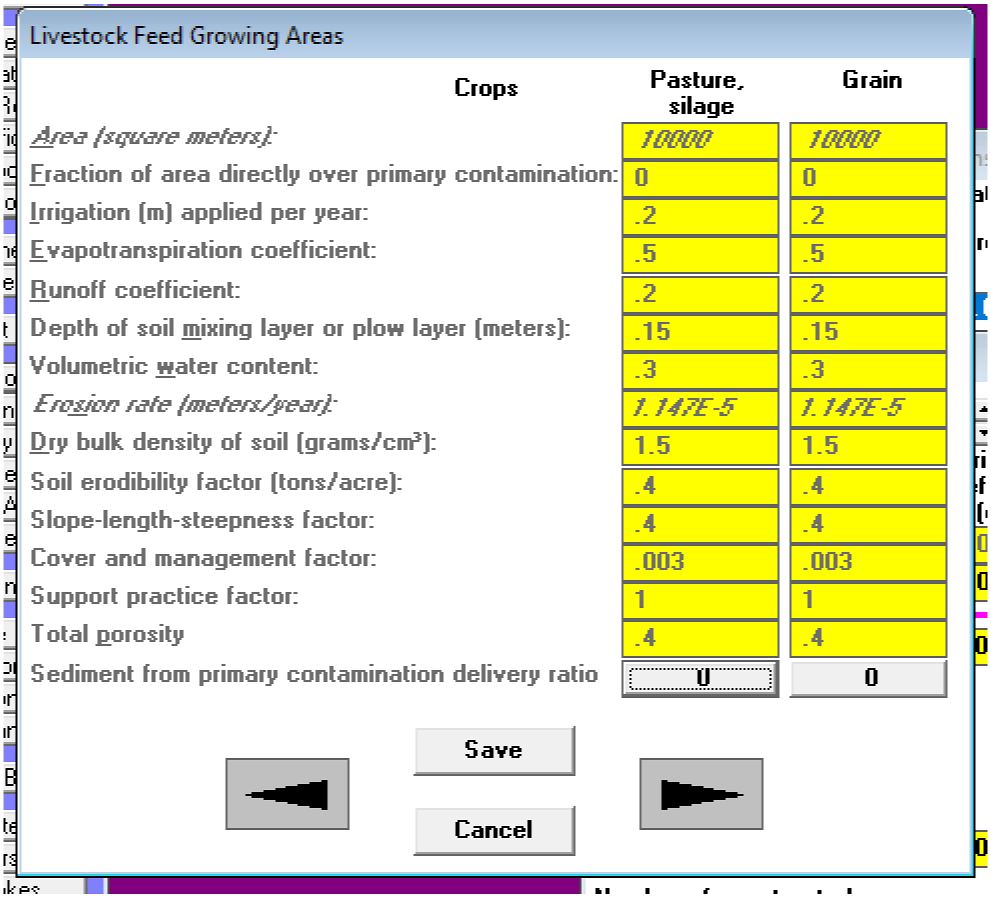


Only need to know how much erosion goes to pond:



No Ag areas used:





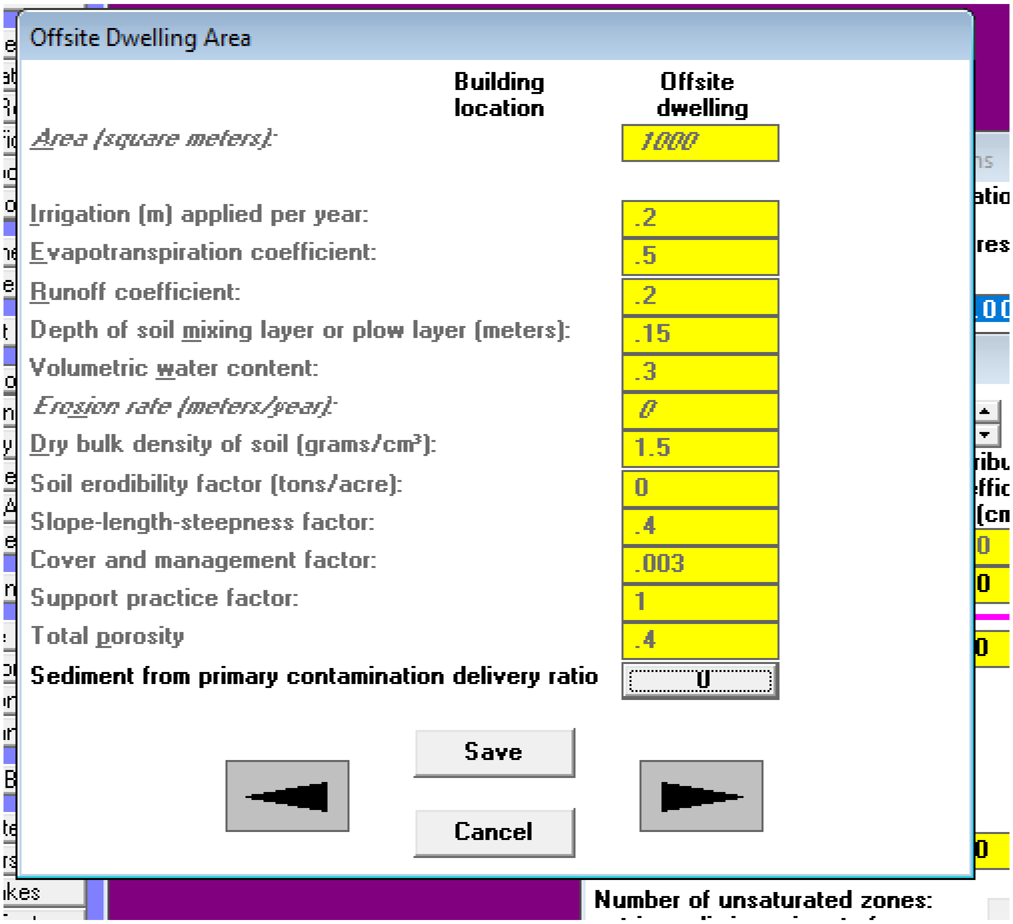
Livestock Feed Growing Areas

Crops	Pasture, silage	Grain
Area (square meters):	10000	10000
Fraction of area directly over primary contamination:	0	0
Irrigation (m) applied per year:	.2	.2
Evapotranspiration coefficient:	.5	.5
Runoff coefficient:	.2	.2
Depth of soil mixing layer or plow layer (meters):	.15	.15
Volumetric water content:	.3	.3
Erosion rate (meters/year):	1.147E-5	1.147E-5
Dry bulk density of soil (grams/cm³):	1.5	1.5
Soil erodibility factor (tons/acre):	.4	.4
Slope-length-steepness factor:	.4	.4
Cover and management factor:	.003	.003
Support practice factor:	1	1
Total porosity	.4	.4
Sediment from primary contamination delivery ratio	0	0

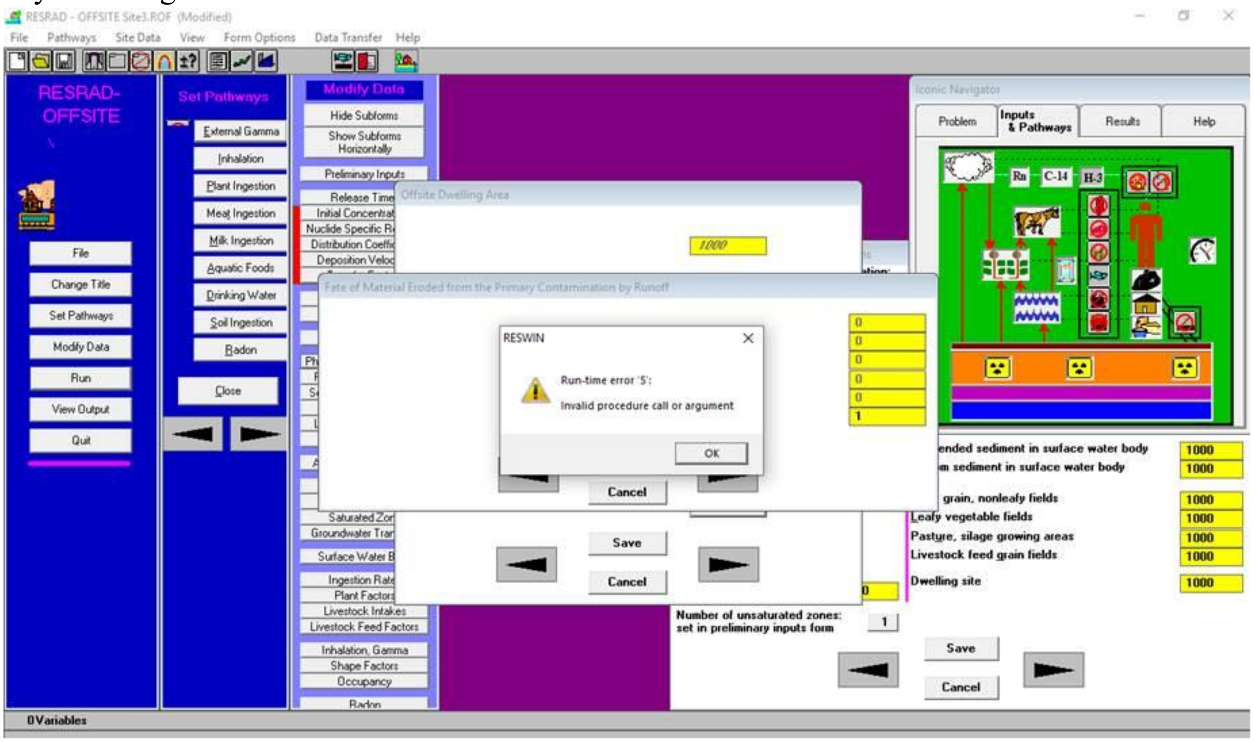
Save

Cancel

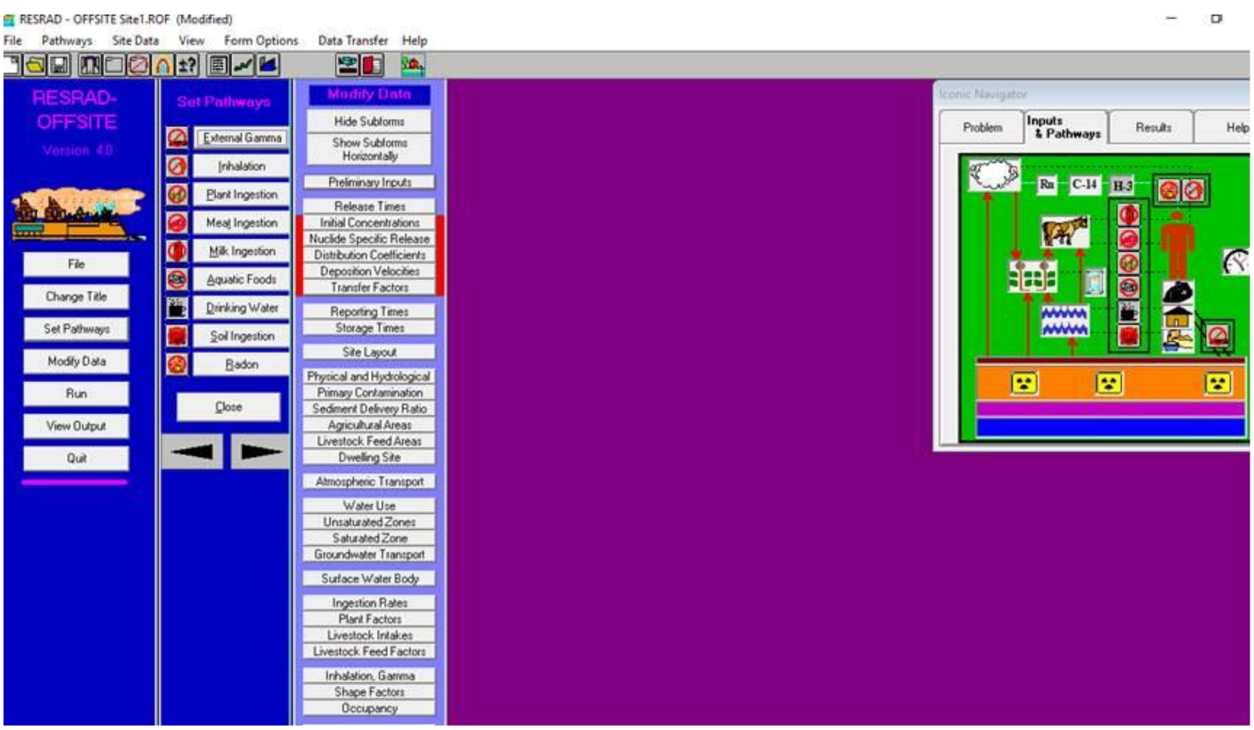
Sediment from primary contamination delivery ratio is on??



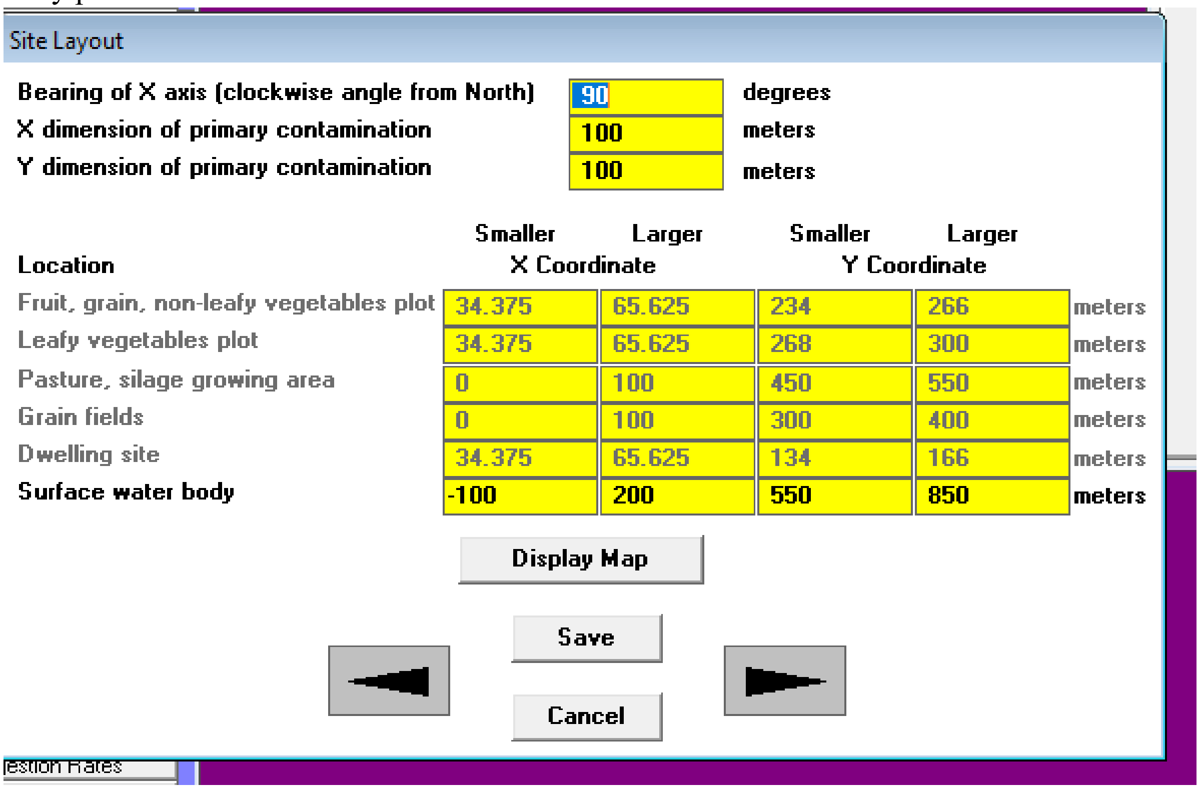
Try to set it give and Run-time Error 5

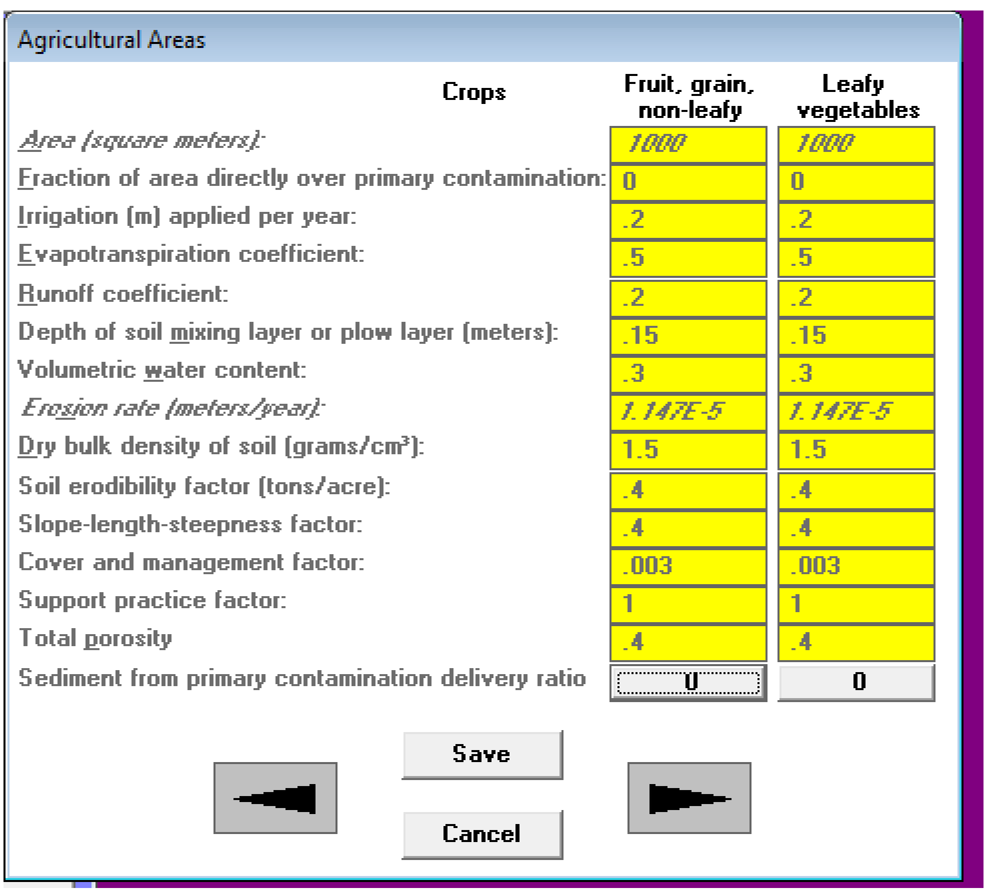


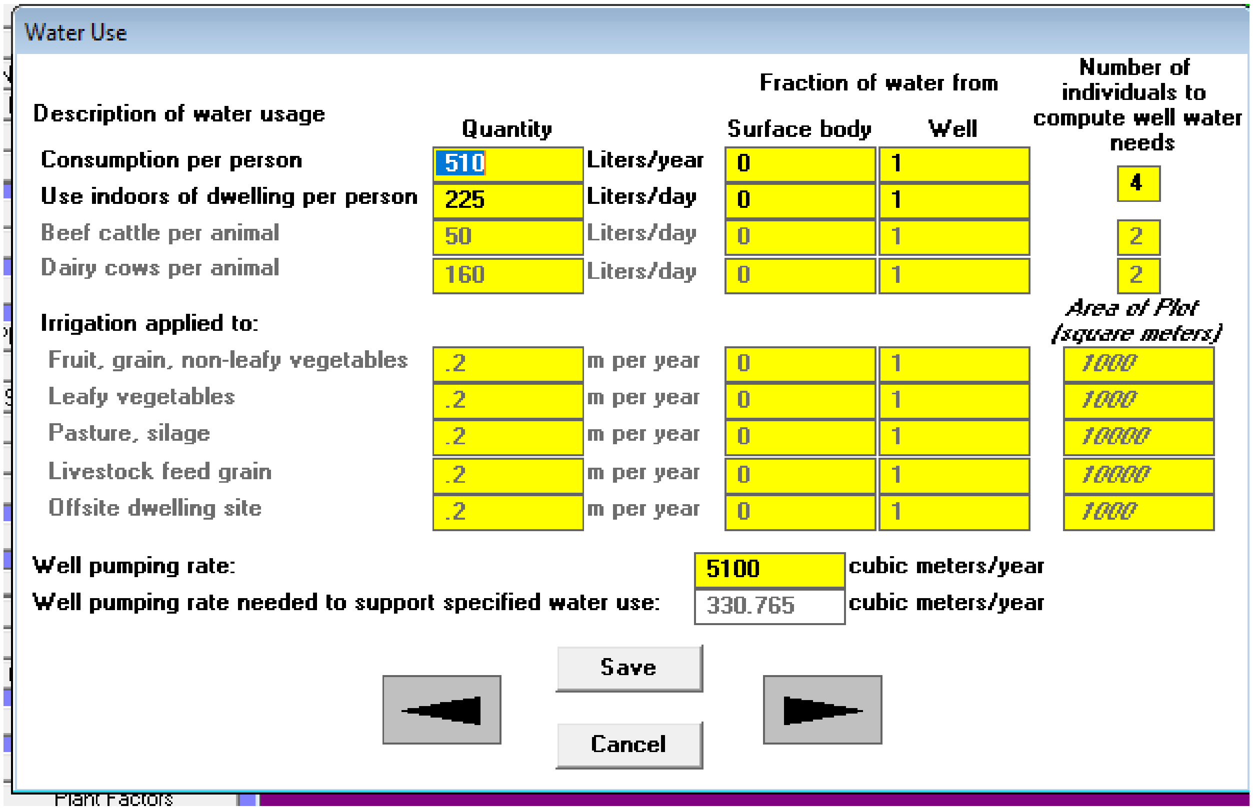
Now Switch to Drinking Water Pathway only:

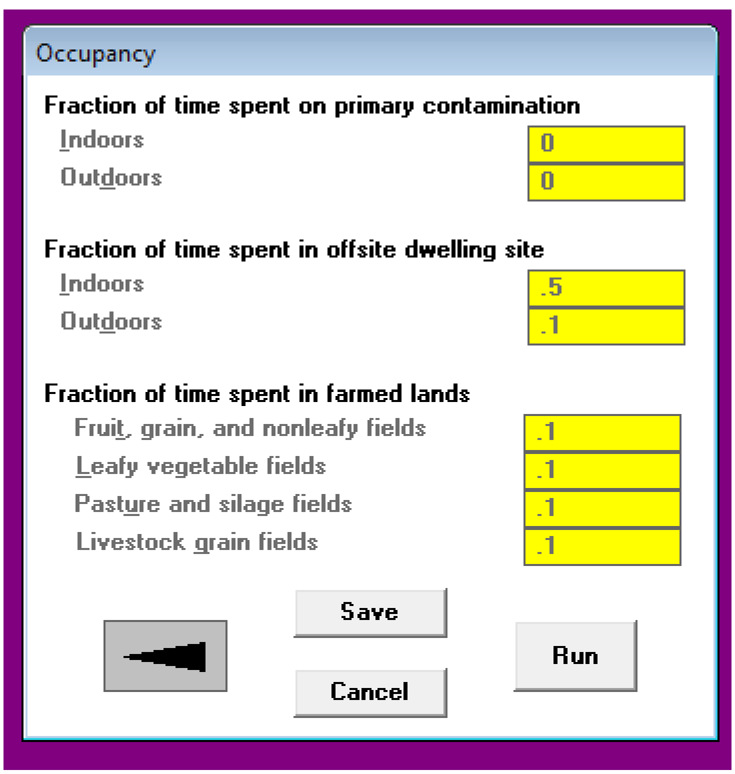


Only pond area location matters






Water Use
Description of water usage
Quantity
Fraction of water from
Surface body
Well
Number of individuals to compute well water needs
Consumption per person
510
Liters/year
0
1
4
Use indoors of dwelling per person
225
Liters/day
0
1
Beef cattle per animal
50
Liters/day
0
1
2
Dairy cows per animal
160
Liters/day
0
1
2
Irrigation applied to:
Area of Plot (square meters)
Fruit, grain, non-leafy vegetables
.2
m per year
0
1
1000
Leafy vegetables
.2
m per year
0
1
1000
Pasture, silage
.2
m per year
0
1
10000
Livestock feed grain
.2
m per year
0
1
10000
Offsite dwelling site
.2
m per year
0
1
1000
Well pumping rate:
5100
cubic meters/year
Well pumping rate needed to support specified water use:
330.765
cubic meters/year
Save
Cancel
Plant Factors


Occupancy
Fraction of time spent on primary contamination
Indoors
0
Outdoors
0
Fraction of time spent in offsite dwelling site
Indoors
.5
Outdoors
.1
Fraction of time spent in farmed lands
Fruit, grain, and nonleafy fields
.1
Leafy vegetable fields
.1
Pasture and silage fields
.1
Livestock grain fields
.1
Save
Cancel
Run

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Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
FSTI	Exposure duration for risk	3.000E+01	3.000E+01	---	ED
FSTI	Basic radiation dose limit (mSv/yr)	2.500E-01	2.500E-01	---	BRDL
RELT	1st release time (years)	0.000E+00		---	RelTime(1)
CONC	Initial concentration of Ac-227 (Bq/g)	1.000E+02	0.000E+00	---	S1(1)
VDEP	Deposition velocity of Ac-227 on total particulates	1.000E-03	1.000E-03	---	DEPVEL(1)
VDEP	Dep. velocity of Ac-227 on respirable particulates	1.000E-03	1.000E-03	---	DEPVELT(1)
DCLR	Distribution coefficients for Ac-227				
DCLR	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
DCLR	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
DCLR	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
DCLR	Bottom sediment in surface water body (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCSWB(1)
DCLR	Suspended sediment in surface water body (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCSWS(1)
DCLR	Agricultural area 1 (cm**3/g)	not used	2.000E+01	---	DCNUCOF(1,1)
DCLR	Agricultural area 2 (cm**3/g)	not used	2.000E+01	---	DCNUCOF(1,2)
DCLR	Agricultural area 3 (cm**3/g)	not used	2.000E+01	---	DCNUCOF(1,3)
DCLR	Agricultural area 4 (cm**3/g)	not used	2.000E+01	---	DCNUCOF(1,4)
DCLR	Offsite Dwelling (cm**3/g)	not used	2.000E+01	---	DCNUCDWE(1)
DCLR	Leach rate constant of Ac-227 (/yr)	0.000E+00	0.000E+00	8.245E-03	Rleach(1,1)
LYOT	Bearing of X axis (clockwise angle N-->X in degrees)	9.000E+01	9.000E+01	---	DNXBEARING
LYOT	Length of Primary contamination in X Direction	1.000E+02	1.000E+02	---	SOURCEXY(1)
LYOT	Length of Primary contamination in Y Direction	1.000E+02	1.000E+02	---	SOURCEXY(2)
LYOT	Smaller X coordinate of Agricultural Area 1	not used	3.438E+01	---	AGRIXY(1,1)
LYOT	Larger X coordinate of Agricultural Area 1	not used	6.562E+01	---	AGRIXY(2,1)
LYOT	Smaller Y coordinate of Agricultural Area 1	not used	2.340E+02	---	AGRIXY(3,1)
LYOT	Larger Y coordinate of Agricultural Area 1	not used	2.660E+02	---	AGRIXY(4,1)
LYOT	Smaller X coordinate of Agricultural Area 2	not used	3.438E+01	---	AGRIXY(1,2)
LYOT	Larger X coordinate of Agricultural Area 2	not used	6.562E+01	---	AGRIXY(2,2)
LYOT	Smaller Y coordinate of Agricultural Area 2	not used	2.680E+02	---	AGRIXY(3,2)
LYOT	Larger Y coordinate of Agricultural Area 2	not used	3.000E+02	---	AGRIXY(4,2)
LYOT	Smaller X coordinate of Agricultural Area 3	not used	0.000E+00	---	AGRIXY(1,3)
LYOT	Larger X coordinate of Agricultural Area 3	not used	1.000E+02	---	AGRIXY(2,3)
LYOT	Smaller Y coordinate of Agricultural Area 3	not used	4.500E+02	---	AGRIXY(3,3)
LYOT	Larger Y coordinate of Agricultural Area 3	not used	5.500E+02	---	AGRIXY(4,3)
LYOT	Smaller X coordinate of Agricultural Area 4	not used	0.000E+00	---	AGRIXY(1,4)
LYOT	Larger X coordinate of Agricultural Area 4	not used	1.000E+02	---	AGRIXY(2,4)
LYOT	Smaller Y coordinate of Agricultural Area 4	not used	3.000E+02	---	AGRIXY(3,4)
LYOT	Larger Y coordinate of Agricultural Area 4	not used	4.000E+02	---	AGRIXY(4,4)
LYOT	Smaller X coordinate of Dwelling Area	not used	3.438E+01	---	DWELLXY(1)

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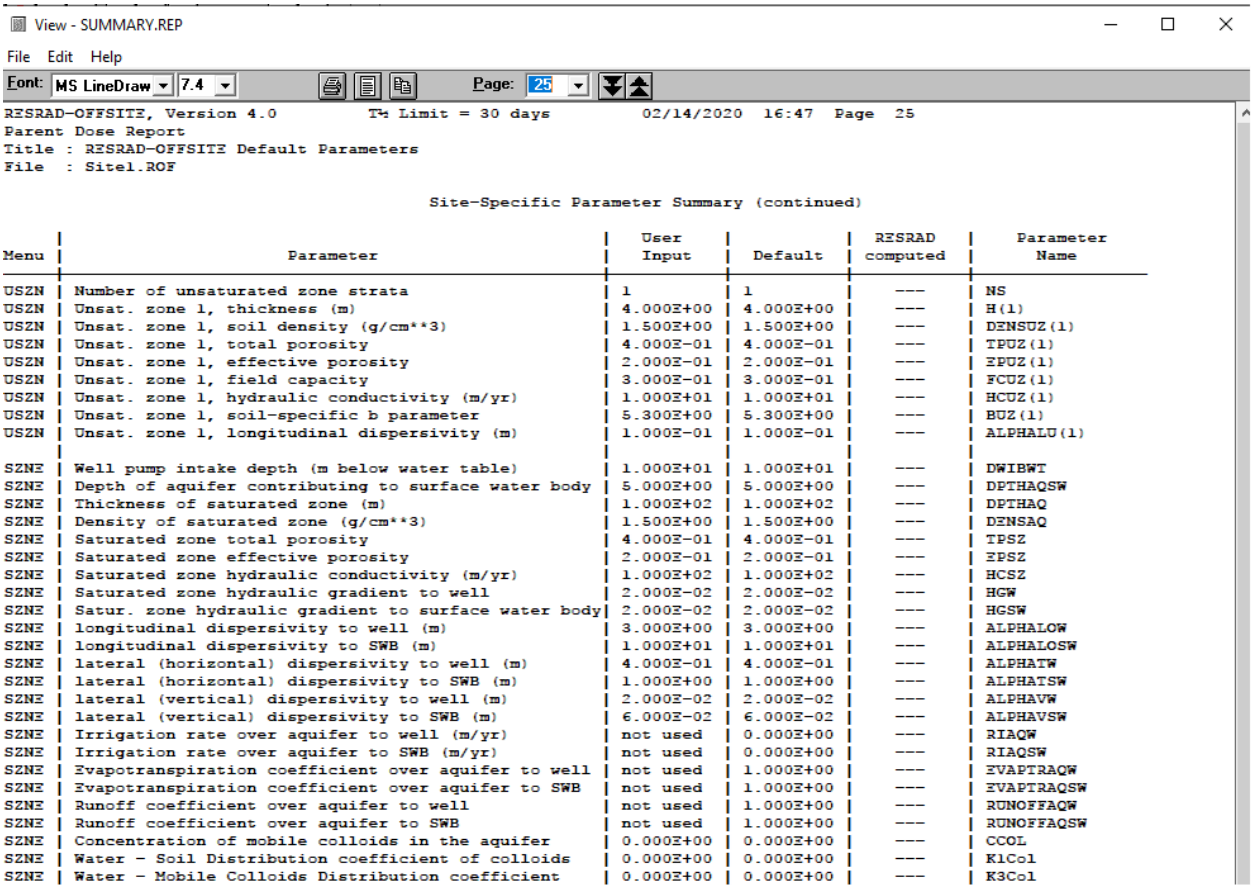
Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
AGRI	Fraction of Agri. Area 3 directly over the c.z.	not used	0.000E+00	---	FAREA_PLANT(3)
AGRI	Evapotranspiration coefficient in Agri. Area 3	not used	5.000E-01	---	EVAPTRN(3)
AGRI	Runoff coefficient in Agricultural Area 3	not used	2.000E-01	---	RUNOF(3)
AGRI	Mixing depth/plow layer of Agricultural Area 3	not used	1.500E-01	---	DPTHMIXG(3)
AGRI	Water filled porosity of soil in Agri. Area 3	not used	3.000E-01	---	TMOF(3)
AGRI	Computed erosion rate of soil in Agri. Area 3	not used	1.147E-05	---	EROSN(3)
AGRI	Dry Bulk Density of soil in Agricultural Area 3	not used	1.500E+00	---	RHOB(3)
AGRI	Soil erodibility factor of Agricultural Area 3	not used	4.000E-01	---	ERODIBILITY(3)
AGRI	Slope-length-steepness factor, Agricultural Area 3	not used	4.000E-01	---	SLPLENSTP(3)
AGRI	Cropping-management factor of Agricultural Area 3	not used	3.000E-03	---	CRPMANG(3)
AGRI	Conservation practice factor of Agricultural Area 3	not used	1.000E+00	---	CONVPRAC(3)
AGRI	Total porosity of soil in Agricultural Area 3	not used	4.000E-01	---	TPOF(3)
AGRI	Areal extent of Agricultural Area 4 (m**2)	not used	1.000E+04	---	AREAO(4)
AGRI	Fraction of Agri. Area 4 directly over the c.z.	not used	0.000E+00	---	FAREA_PLANT(4)
AGRI	Evapotranspiration coefficient in Agri. Area 4	not used	5.000E-01	---	EVAPTRN(4)
AGRI	Runoff coefficient in Agricultural Area 4	not used	2.000E-01	---	RUNOF(4)
AGRI	Mixing depth/plow layer of Agricultural Area 4	not used	1.500E-01	---	DPTHMIXG(4)
AGRI	Water filled porosity of soil in Agri. Area 4	not used	3.000E-01	---	TMOF(4)
AGRI	Computed erosion rate of soil in Agri. Area 4	not used	1.147E-05	---	EROSN(4)
AGRI	Dry Bulk Density of soil in Agricultural Area 4	not used	1.500E+00	---	RHOB(4)
AGRI	Soil erodibility factor of Agricultural Area 4	not used	4.000E-01	---	ERODIBILITY(4)
AGRI	Slope-length-steepness factor, Agricultural Area 4	not used	4.000E-01	---	SLPLENSTP(4)
AGRI	Cropping-management factor of Agricultural Area 4	not used	3.000E-03	---	CRPMANG(4)
AGRI	Conservation practice factor of Agricultural Area 4	not used	1.000E+00	---	CONVPRAC(4)
AGRI	Total porosity of soil in Agricultural Area 4	not used	4.000E-01	---	TPOF(4)
DWEL	Areal extent of Offsite dwelling site (m**2)	not used	1.000E+03	---	AREAODWELL
DWEL	Evapotranspiration coefficient in dwelling (Off)site	not used	5.000E-01	---	EVAPTRNDWELL
DWEL	Runoff coefficient in Offsite dwelling site	not used	2.000E-01	---	RUNOFDWELL
DWEL	Mixing depth of Offsite dwelling site	not used	1.500E-01	---	DPTHMIXGDWELL
DWEL	Water filled porosity of soil in Offsite Dwelling	not used	3.000E-01	---	TMOFDWELL
DWEL	Computed erosion rate of soil in Offsite Dwelling	not used	0.000E+00	---	EROSNDWELL
DWEL	Dry Bulk Density of soil in Offsite dwelling site	not used	1.500E+00	---	RHOBDWELL
DWEL	Soil erodibility factor of soil in Dwelling site	not used	0.000E+00	---	ERODIBILITYDWELL



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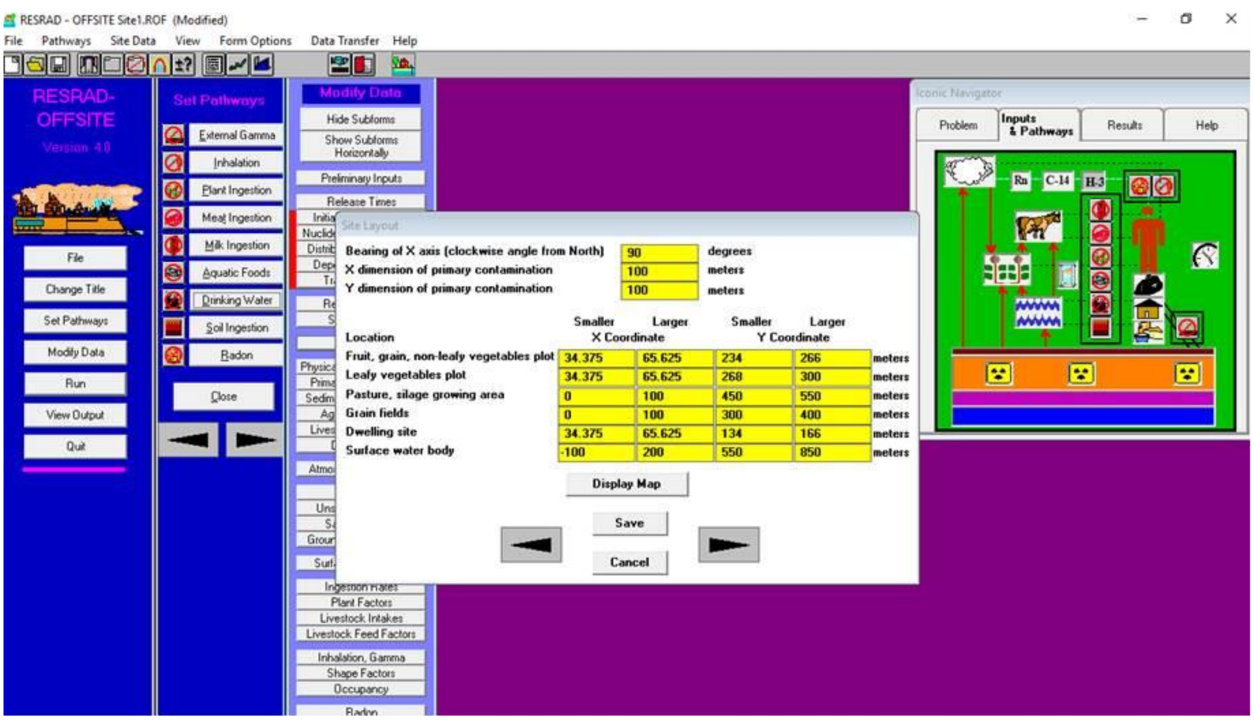
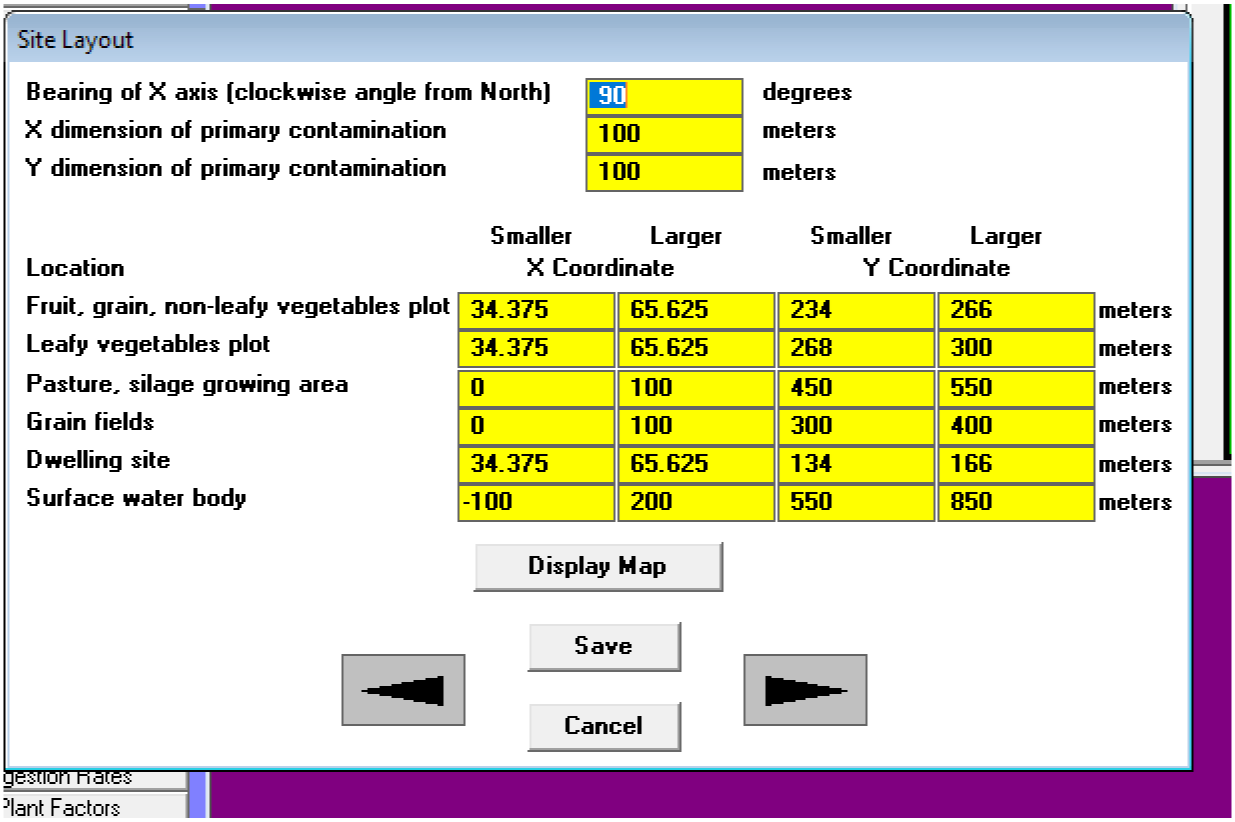
Site-Specific Parameter Summary (continued)

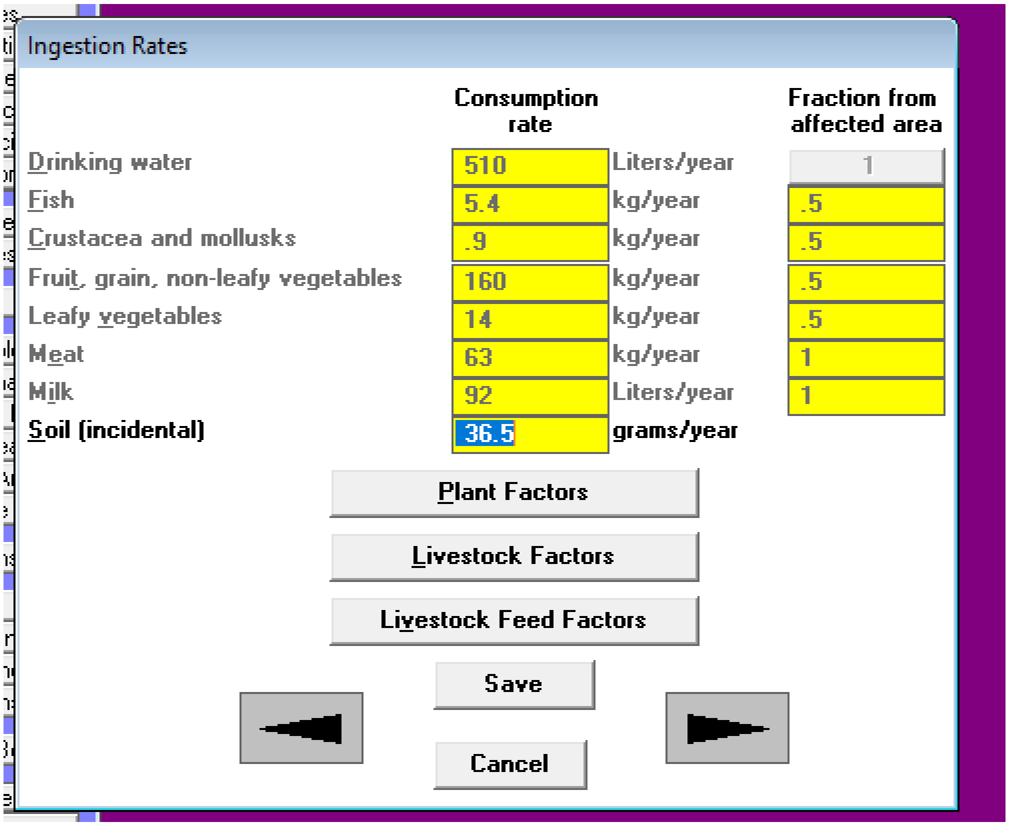
Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
USZN	Number of unsaturated zone strata	1	1	---	NS
USZN	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
USZN	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
USZN	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
USZN	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
USZN	Unsat. zone 1, field capacity	3.000E-01	3.000E-01	---	FCUZ(1)
USZN	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
USZN	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
USZN	Unsat. zone 1, longitudinal dispersivity (m)	1.000E-01	1.000E-01	---	ALPHALU(1)
SZNE	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
SZNE	Depth of aquifer contributing to surface water body	5.000E+00	5.000E+00	---	DPTHAQSW
SZNE	Thickness of saturated zone (m)	1.000E+02	1.000E+02	---	DPTHAQ
SZNE	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
SZNE	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
SZNE	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
SZNE	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
SZNE	Saturated zone hydraulic gradient to well	2.000E-02	2.000E-02	---	HGW
SZNE	Satur. zone hydraulic gradient to surface water body	2.000E-02	2.000E-02	---	HGSW
SZNE	longitudinal dispersivity to well (m)	3.000E+00	3.000E+00	---	ALPHALOW
SZNE	longitudinal dispersivity to SWB (m)	1.000E+01	1.000E+01	---	ALPHALOSW
SZNE	lateral (horizontal) dispersivity to well (m)	4.000E-01	4.000E-01	---	ALPHATW
SZNE	lateral (horizontal) dispersivity to SWB (m)	1.000E+00	1.000E+00	---	ALPHATSW
SZNE	lateral (vertical) dispersivity to well (m)	2.000E-02	2.000E-02	---	ALPHAVW
SZNE	lateral (vertical) dispersivity to SWB (m)	6.000E-02	6.000E-02	---	ALPHAVSW
SZNE	Irrigation rate over aquifer to well (m/yr)	not used	0.000E+00	---	RIAQW
SZNE	Irrigation rate over aquifer to SWB (m/yr)	not used	0.000E+00	---	RIAQSW
SZNE	Evapotranspiration coefficient over aquifer to well	not used	1.000E+00	---	EVAPTRAQW
SZNE	Evapotranspiration coefficient over aquifer to SWB	not used	1.000E+00	---	EVAPTRAQSW
SZNE	Runoff coefficient over aquifer to well	not used	1.000E+00	---	RUNOFFAQW
SZNE	Runoff coefficient over aquifer to SWB	not used	1.000E+00	---	RUNOFFAQSW
SZNE	Concentration of mobile colloids in the aquifer	0.000E+00	0.000E+00	---	CCOL
SZNE	Water - Soil Distribution coefficient of colloids	0.000E+00	0.000E+00	---	K1Col
SZNE	Water - Mobile Colloids Distribution coefficient	0.000E+00	0.000E+00	---	K3Col

Now Switch to Soil Ingestion Pathway only:

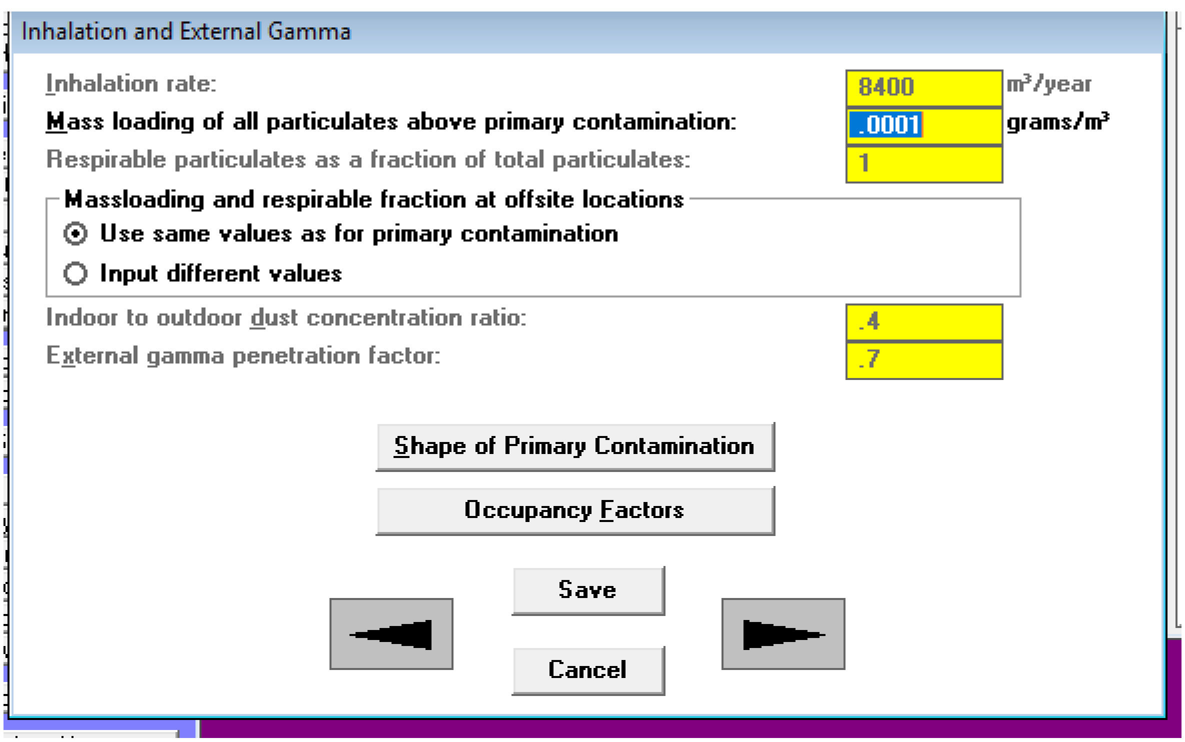



Site Layout
Bearing of X axis (clockwise angle from North)
90
degrees
X dimension of primary contamination
100
meters
Y dimension of primary contamination
100
meters
Smaller
Larger
Smaller
Larger
Location
X Coordinate
Y Coordinate
Fruit, grain, non-leafy vegetables plot
34.375
65.625
234
266
meters
Leafy vegetables plot
34.375
65.625
268
300
meters
Pasture, silage growing area
0
100
450
550
meters
Grain fields
0
100
300
400
meters
Dwelling site
34.375
65.625
134
166
meters
Surface water body
-100
200
550
850
meters
Display Map
Save
Cancel

Only soil ingestion is considered:



External and inhalation parameters not used:



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Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
FSTI	Exposure duration for risk	3.000E+01	3.000E+01	---	ED
FSTI	Basic radiation dose limit (mSv/yr)	2.500E-01	2.500E-01	---	BRDL
RELT	1st release time (years)	0.000E+00		---	RelTime(1)
CONC	Initial concentration of Ac-227 (Bq/g)	1.000E+02	0.000E+00	---	S1(1)
VDEP	Deposition velocity of Ac-227 on total particulates	1.000E-03	1.000E-03	---	DEPVEL(1)
VDEP	Dep. velocity of Ac-227 on respirable particulates	1.000E-03	1.000E-03	---	DEPVELT(1)
DCLR	Distribution coefficients for Ac-227				
DCLR	Contaminated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCC(1)
DCLR	Unsaturated zone 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCU(1,1)
DCLR	Saturated zone (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCS(1)
DCLR	Bottom sediment in surface water body (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCSWB(1)
DCLR	Suspended sediment in surface water body (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCSWS(1)
DCLR	Agricultural area 1 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCOF(1,1)
DCLR	Agricultural area 2 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCOF(1,2)
DCLR	Agricultural area 3 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCOF(1,3)
DCLR	Agricultural area 4 (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCOF(1,4)
DCLR	Offsite Dwelling (cm**3/g)	2.000E+01	2.000E+01	---	DCNUCDWE(1)
DCLR	Leach rate constant of Ac-227 (/yr)	0.000E+00	0.000E+00	8.245E-03	Rleach(1,1)
LYOT	Bearing of X axis (clockwise angle N-->X in degrees)	9.000E+01	9.000E+01	---	DNXBEARING
LYOT	Length of Primary contamination in X Direction	1.000E+02	1.000E+02	---	SOURCEXY(1)
LYOT	Length of Primary contamination in Y Direction	1.000E+02	1.000E+02	---	SOURCEXY(2)
LYOT	Smaller X coordinate of Agricultural Area 1	3.438E+01	3.438E+01	---	AGRIXY(1,1)
LYOT	Larger X coordinate of Agricultural Area 1	6.562E+01	6.562E+01	---	AGRIXY(2,1)
LYOT	Smaller Y coordinate of Agricultural Area 1	2.340E+02	2.340E+02	---	AGRIXY(3,1)
LYOT	Larger Y coordinate of Agricultural Area 1	2.660E+02	2.660E+02	---	AGRIXY(4,1)
LYOT	Smaller X coordinate of Agricultural Area 2	3.438E+01	3.438E+01	---	AGRIXY(1,2)
LYOT	Larger X coordinate of Agricultural Area 2	6.562E+01	6.562E+01	---	AGRIXY(2,2)
LYOT	Smaller Y coordinate of Agricultural Area 2	2.680E+02	2.680E+02	---	AGRIXY(3,2)
LYOT	Larger Y coordinate of Agricultural Area 2	3.000E+02	3.000E+02	---	AGRIXY(4,2)
LYOT	Smaller X coordinate of Agricultural Area 3	0.000E+00	0.000E+00	---	AGRIXY(1,3)
LYOT	Larger X coordinate of Agricultural Area 3	1.000E+02	1.000E+02	---	AGRIXY(2,3)

Irrigation not used:

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Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
USZN	Number of unsaturated zone strata	1	1	---	NS
USZN	Unsat. zone 1, thickness (m)	4.000E+00	4.000E+00	---	H(1)
USZN	Unsat. zone 1, soil density (g/cm**3)	1.500E+00	1.500E+00	---	DENSUZ(1)
USZN	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---	TPUZ(1)
USZN	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---	EPUZ(1)
USZN	Unsat. zone 1, field capacity	3.000E-01	3.000E-01	---	FCUZ(1)
USZN	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+01	1.000E+01	---	HCUZ(1)
USZN	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---	BUZ(1)
USZN	Unsat. zone 1, longitudinal dispersivity (m)	1.000E-01	1.000E-01	---	ALPHALU(1)
SZNE	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---	DWIBWT
SZNE	Depth of aquifer contributing to surface water body	5.000E+00	5.000E+00	---	DPTHAQSW
SZNE	Thickness of saturated zone (m)	1.000E+02	1.000E+02	---	DPTHAQ
SZNE	Density of saturated zone (g/cm**3)	1.500E+00	1.500E+00	---	DENSAQ
SZNE	Saturated zone total porosity	4.000E-01	4.000E-01	---	TPSZ
SZNE	Saturated zone effective porosity	2.000E-01	2.000E-01	---	EPSZ
SZNE	Saturated zone hydraulic conductivity (m/yr)	1.000E+02	1.000E+02	---	HCSZ
SZNE	Saturated zone hydraulic gradient to well	2.000E-02	2.000E-02	---	HGW
SZNE	Satur. zone hydraulic gradient to surface water body	2.000E-02	2.000E-02	---	HGSW
SZNE	longitudinal dispersivity to well (m)	3.000E+00	3.000E+00	---	ALPHALOW
SZNE	longitudinal dispersivity to SWB (m)	1.000E+01	1.000E+01	---	ALPHALOSW
SZNE	lateral (horizontal) dispersivity to well (m)	4.000E-01	4.000E-01	---	ALPHATW
SZNE	lateral (horizontal) dispersivity to SWB (m)	1.000E+00	1.000E+00	---	ALPHATSW
SZNE	lateral (vertical) dispersivity to well (m)	2.000E-02	2.000E-02	---	ALPHAVW
SZNE	lateral (vertical) dispersivity to SWB (m)	6.000E-02	6.000E-02	---	ALPHAVSW
SZNE	Irrigation rate over aquifer to well (m/yr)	not used	0.000E+00	---	RIAQW
SZNE	Irrigation rate over aquifer to SWB (m/yr)	not used	0.000E+00	---	RIAQSW
SZNE	Evapotranspiration coefficient over aquifer to well	not used	1.000E+00	---	EVAPTRAQW
SZNE	Evapotranspiration coefficient over aquifer to SWB	not used	1.000E+00	---	EVAPTRAQSW
SZNE	Runoff coefficient over aquifer to well	not used	1.000E+00	---	RUNOFFAQW
SZNE	Runoff coefficient over aquifer to SWB	not used	1.000E+00	---	RUNOFFAQSW
SZNE	Concentration of mobile colloids in the aquifer	0.000E+00	0.000E+00	---	CCOL
SZNE	Water - Soil Distribution coefficient of colloids	0.000E+00	0.000E+00	---	K1Col
SZNE	Water - Mobile Colloids Distribution coefficient	0.000E+00	0.000E+00	---	K3Col

No Vegetables considered

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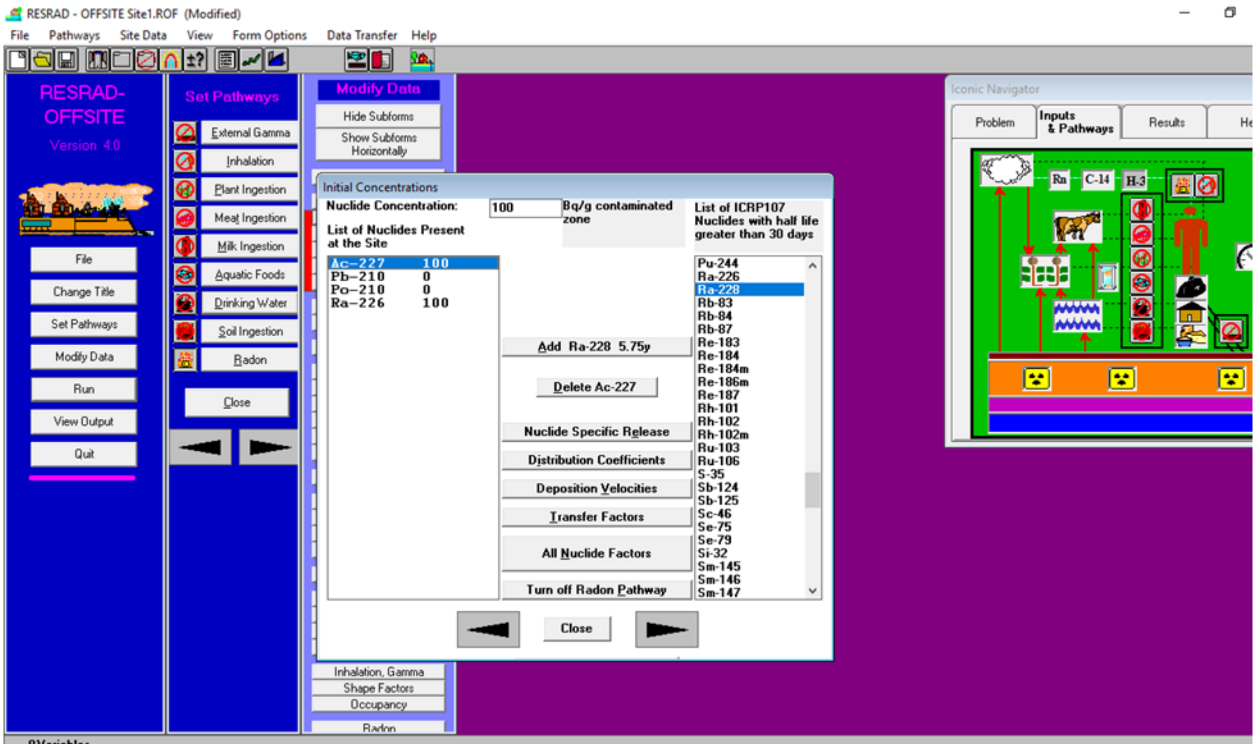
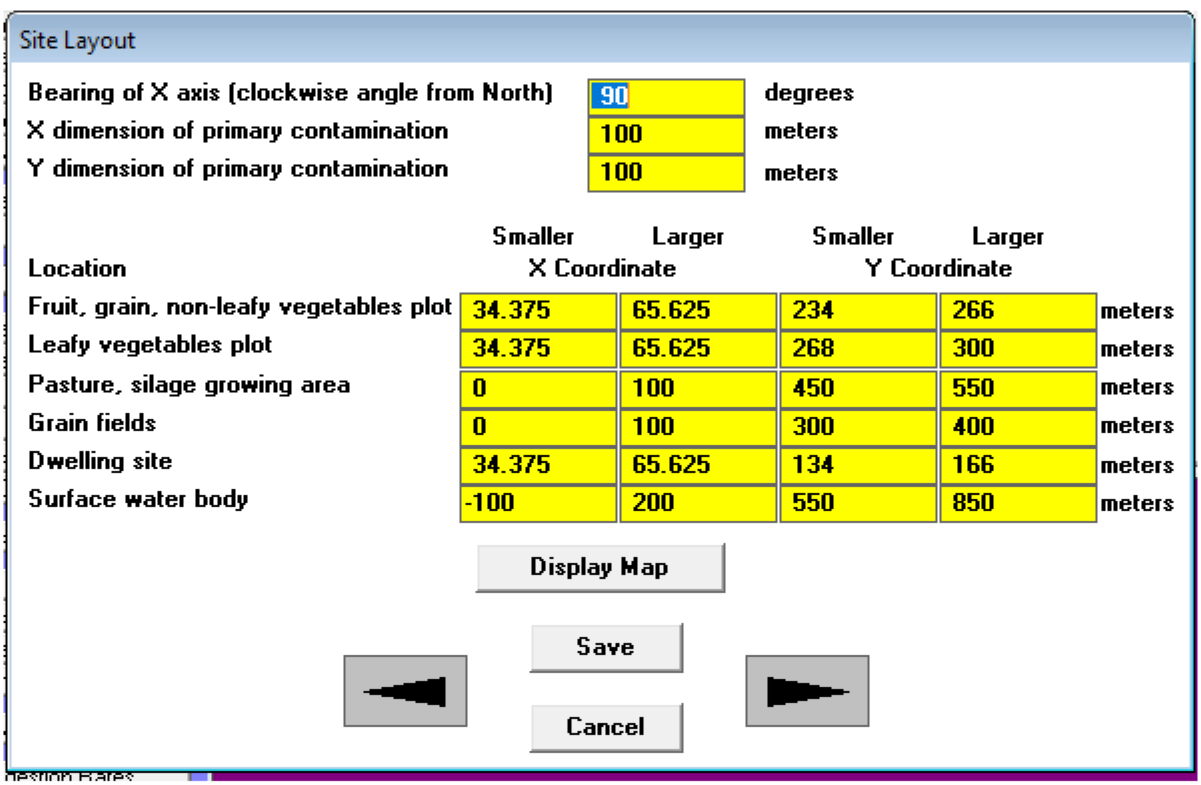
Site-Specific Parameter Summary (continued)

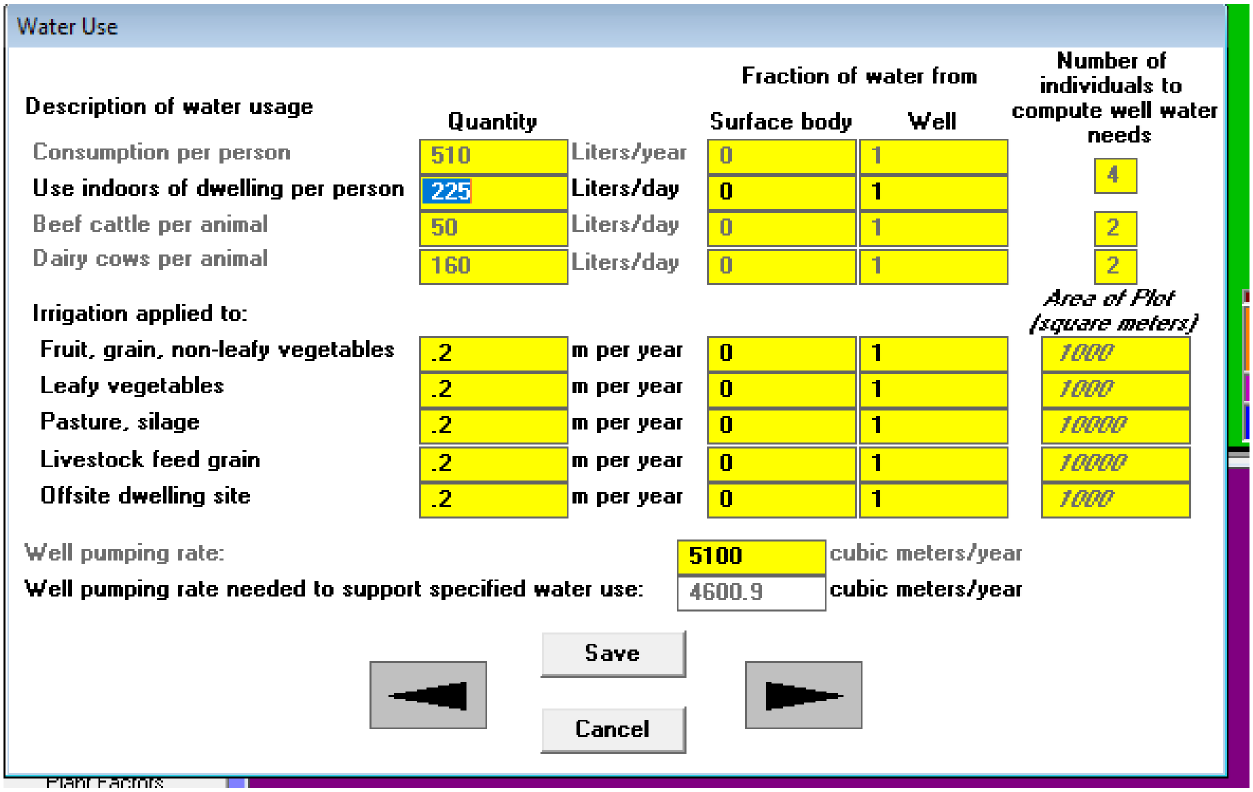
Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
INGE	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DVI(2)
INGE	Fraction of vegetable 2 from affected area	not used	5.000E-01	---	FVEG(2)
INGE	Meat 1 consumption (kg/yr)	not used	6.300E+01	---	DMI(1)
INGE	Fraction of meat 1from affected area	not used	1.000E+00	---	FMEMI(1)
INGE	Milk consumption (L/yr)	not used	9.200E+01	---	DMI(2)
INGE	Fraction of milk from affected area	not used	1.000E+00	---	FMEMI(2)
INGE	Soil ingestion rate (g/yr)	3.650E+01	3.650E+01	---	SOIL
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YIELD(1)
VEGE	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	GROWTIME(1)
VEGE	Translocation Factor for Non-Leafy	not used	1.000E-01	---	FOLI_F(1)
VEGE	Weathering Removal Constant for Non-Leafy	not used	2.000E+01	---	RWEATHER(1)
VEGE	Foliar Interception Fraction for dust Non-Leafy	not used	2.500E-01	---	FINTCEPT(1,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Non-Leafy	not used	2.500E-01	---	FINTCEPT(1,2)
VEGE	Depth of roots for Non-Leafy (m)	not used	1.200E+00	---	DROOT(1)
VEGE	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YIELD(2)
VEGE	Growing Season for Leafy (years)	not used	2.500E-01	---	GROWTIME(2)
VEGE	Translocation Factor for Leafy	not used	1.000E+00	---	FOLI_F(2)
VEGE	Weathering Removal Constant for Leafy	not used	2.000E+01	---	RWEATHER(2)
VEGE	Foliar Interception Fraction for dust Leafy	not used	2.500E-01	---	FINTCEPT(2,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Leafy	not used	2.500E-01	---	FINTCEPT(2,2)
VEGE	Depth of roots for Leafy (m)	not used	9.000E-01	---	DROOT(2)
VEGE	Wet weight crop yield for Pasture (kg/m**2)	not used	1.100E+00	---	YIELD(3)
VEGE	Growing Season for Pasture (years)	not used	8.000E-02	---	GROWTIME(3)
VEGE	Translocation Factor for Pasture	not used	1.000E+00	---	FOLI_F(3)
VEGE	Weathering Removal Constant for Pasture	not used	2.000E+01	---	RWEATHER(3)
VEGE	Foliar Interception Fraction for dust Pasture	not used	2.500E-01	---	FINTCEPT(3,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Pasture	not used	2.500E-01	---	FINTCEPT(3,2)
VEGE	Depth of roots for Pasture (m)	not used	9.000E-01	---	DROOT(3)
VEGE	Wet weight crop yield for Grain (kg/m**2)	not used	7.000E-01	---	YIELD(4)
VEGE	Growing Season for Grain (years)	not used	1.700E-01	---	GROWTIME(4)
VEGE	Translocation Factor for Grain	not used	1.000E-01	---	FOLI_F(4)
VEGE	Weathering Removal Constant for Grain	not used	2.000E+01	---	RWEATHER(4)
VEGE	Foliar Interception Fraction for dust Grain	not used	2.500E-01	---	FINTCEPT(4,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Grain	not used	2.500E-01	---	FINTCEPT(4,2)

Now Switch to Radon only:

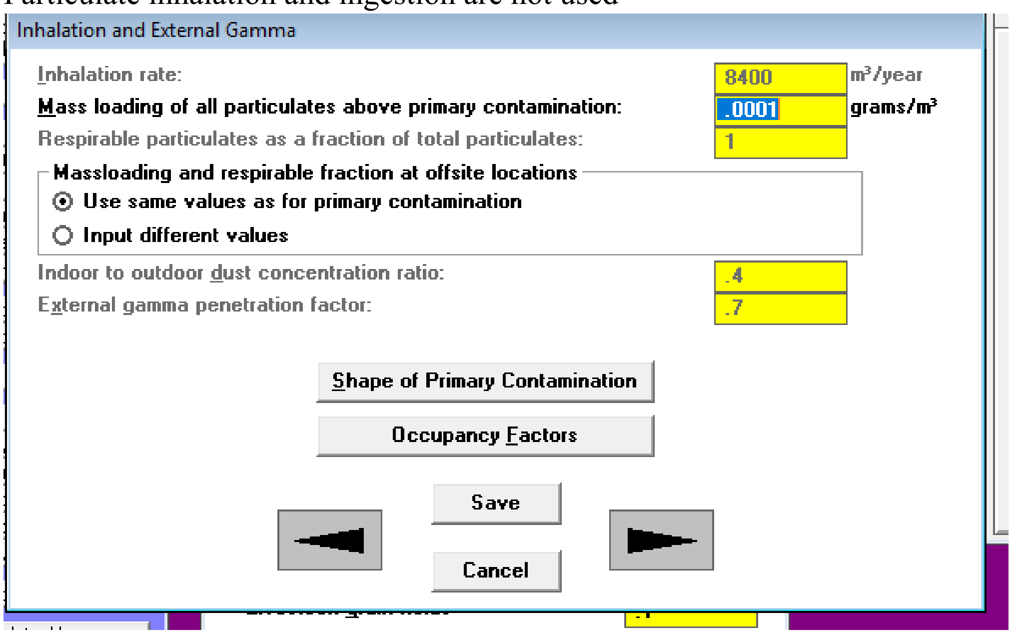


All locations matter

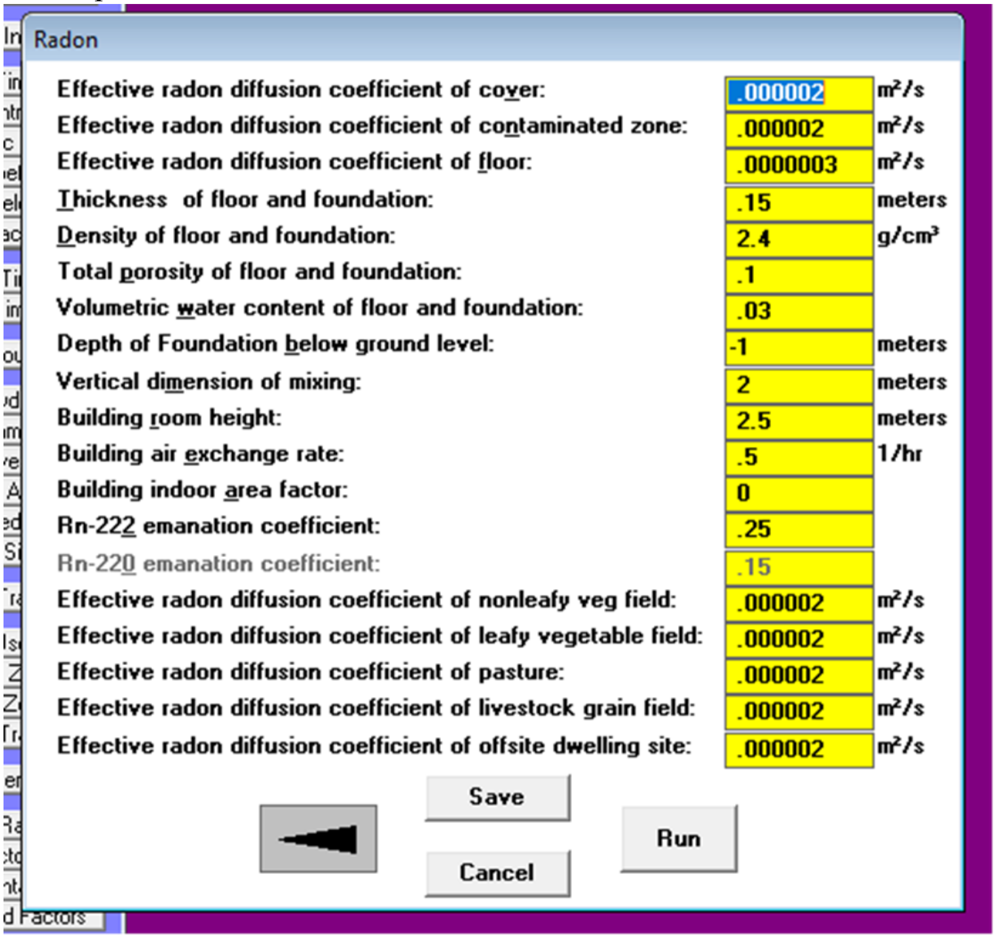




Particulate inhalation and ingestion are not used



Radon parameters are now accessible and editable



Vegetable ingestion is off

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Title : RESRAD-OFFSITE Default Parameters
File : Site1.ROF

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	RESRAD computed	Parameter Name
INGE	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DVI(2)
INGE	Fraction of vegetable 2 from affected area	not used	5.000E-01	---	FVEG(2)
INGE	Meat 1 consumption (kg/yr)	not used	6.300E+01	---	DMI(1)
INGE	Fraction of meat 1from affected area	not used	1.000E+00	---	FMEMI(1)
INGE	Milk consumption (L/yr)	not used	9.200E+01	---	DMI(2)
INGE	Fraction of milk from affected area	not used	1.000E+00	---	FMEMI(2)
INGE	Soil ingestion rate (g/yr)	not used	3.650E+01	---	SOIL
VEGE	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YIELD(1)
VEGE	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	GROWTIME(1)
VEGE	Translocation Factor for Non-Leafy	not used	1.000E-01	---	FOLI_F(1)
VEGE	Weathering Removal Constant for Non-Leafy	not used	2.000E+01	---	RWEATHER(1)
VEGE	Foliar Interception Fraction for dust Non-Leafy	not used	2.500E-01	---	FINTCEPT(1,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Non-Leafy	not used	2.500E-01	---	FINTCEPT(1,2)
VEGE	Depth of roots for Non-Leafy (m)	not used	1.200E+00	---	DROOT(1)
VEGE	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YIELD(2)
VEGE	Growing Season for Leafy (years)	not used	2.500E-01	---	GROWTIME(2)
VEGE	Translocation Factor for Leafy	not used	1.000E+00	---	FOLI_F(2)
VEGE	Weathering Removal Constant for Leafy	not used	2.000E+01	---	RWEATHER(2)
VEGE	Foliar Interception Fraction for dust Leafy	not used	2.500E-01	---	FINTCEPT(2,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Leafy	not used	2.500E-01	---	FINTCEPT(2,2)
VEGE	Depth of roots for Leafy (m)	not used	9.000E-01	---	DROOT(2)
VEGE	Wet weight crop yield for Pasture (kg/m**2)	not used	1.100E+00	---	YIELD(3)
VEGE	Growing Season for Pasture (years)	not used	8.000E-02	---	GROWTIME(3)
VEGE	Translocation Factor for Pasture	not used	1.000E+00	---	FOLI_F(3)
VEGE	Weathering Removal Constant for Pasture	not used	2.000E+01	---	RWEATHER(3)
VEGE	Foliar Interception Fraction for dust Pasture	not used	2.500E-01	---	FINTCEPT(3,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Pasture	not used	2.500E-01	---	FINTCEPT(3,2)
VEGE	Depth of roots for Pasture (m)	not used	9.000E-01	---	DROOT(3)
VEGE	Wet weight crop yield for Grain (kg/m**2)	not used	7.000E-01	---	YIELD(4)
VEGE	Growing Season for Grain (years)	not used	1.700E-01	---	GROWTIME(4)
VEGE	Translocation Factor for Grain	not used	1.000E-01	---	FOLI_F(4)
VEGE	Weathering Removal Constant for Grain	not used	2.000E+01	---	RWEATHER(4)
VEGE	Foliar Interception Fraction for dust Grain	not used	2.500E-01	---	FINTCEPT(4,1)
VEGE	Foliar Intercept-n Fract-n for irrigation Grain	not used	2.500E-01	---	FINTCEPT(4,2)

Applicable Radon parameters used.

SEXT	Ring 71	not used	4.633E-02	---	FRACA(71)
SEXT	Ring 72	not used	2.270E-02	---	FRACA(72)
OCCU	Fraction of time spent indoors on contaminated site	0.000E+00	0.000E+00	---	FIND
OCCU	Fraction of time spent outdoors on contaminated site	0.000E+00	0.000E+00	---	FOTD
OCCU	Fraction of time spent indoors in Offsite Dwelling	5.000E-01	5.000E-01	---	FINDDWELL
OCCU	Fraction of time spent outdoors in Offsite Dwelling	1.000E-01	1.000E-01	---	FOTDDWELL
OCCU	Fraction of time spent outdoors in agri. area 1	1.000E-01	1.000E-01	---	OCCUPANCY(1)
OCCU	Fraction of time spent outdoors in agri. area 2	1.000E-01	1.000E-01	---	OCCUPANCY(2)
OCCU	Fraction of time spent outdoors in agri. area 3	1.000E-01	1.000E-01	---	OCCUPANCY(3)
OCCU	Fraction of time spent outdoors in agri. area 4	1.000E-01	1.000E-01	---	OCCUPANCY(4)
RADN	Diffusion coefficient for radon gas (m/sec):				
RADN	in cover material	not used	2.000E-06	---	DIFCV
RADN	in contaminated zone soil	2.000E-06	2.000E-06	---	DIFCZ
RADN	in fruit, grain and non-leafy vegetable field	2.000E-06	2.000E-06	---	DIFOS(1)
RADN	in leafy vegetable field	2.000E-06	2.000E-06	---	DIFOS(2)
RADN	in pature	2.000E-06	2.000E-06	---	DIFOS(3)
RADN	in livestock grain field	2.000E-06	2.000E-06	---	DIFOS(4)
RADN	in offsite dwelling site	2.000E-06	2.000E-06	---	DIFOS(5)
RADN	in foundation material	not used	3.000E-07	---	DIFFL
RADN	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
RADN	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
RADN	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
RADN	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
RADN	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
RADN	Radon vertical dimension of mixing (m)	2.000E+00	2.000E+00	---	HMIX
RADN	Height of the building (room) (m)	not used	2.500E+00	---	HRM
RADN	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
RADN	Building interior area factor	not used	0.000E+00	---	FAI
RADN	Emanating power of Rn-222 gas	2.500E-01	2.500E-01	---	EMANA(1)
RADN	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	Vertical dimension of mixing for vegetation (m)	not used	1.000E+00	---	HMIXV
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	C14EVSN

Bug: Test 049

Documented in Bug_ Test 049.msg of 2/14/2020 3:09 PM

LePoire, David J. Thu 2/13/2020 9:32 AM

If the aquatic pathway is the only one on, the “Sediment from Primary Contamination delivery ratio” on the Offsite Dwelling Area is still enabled.

It is set to zero, but if I click on the button, I get a run-time error 5 and the code crashes.

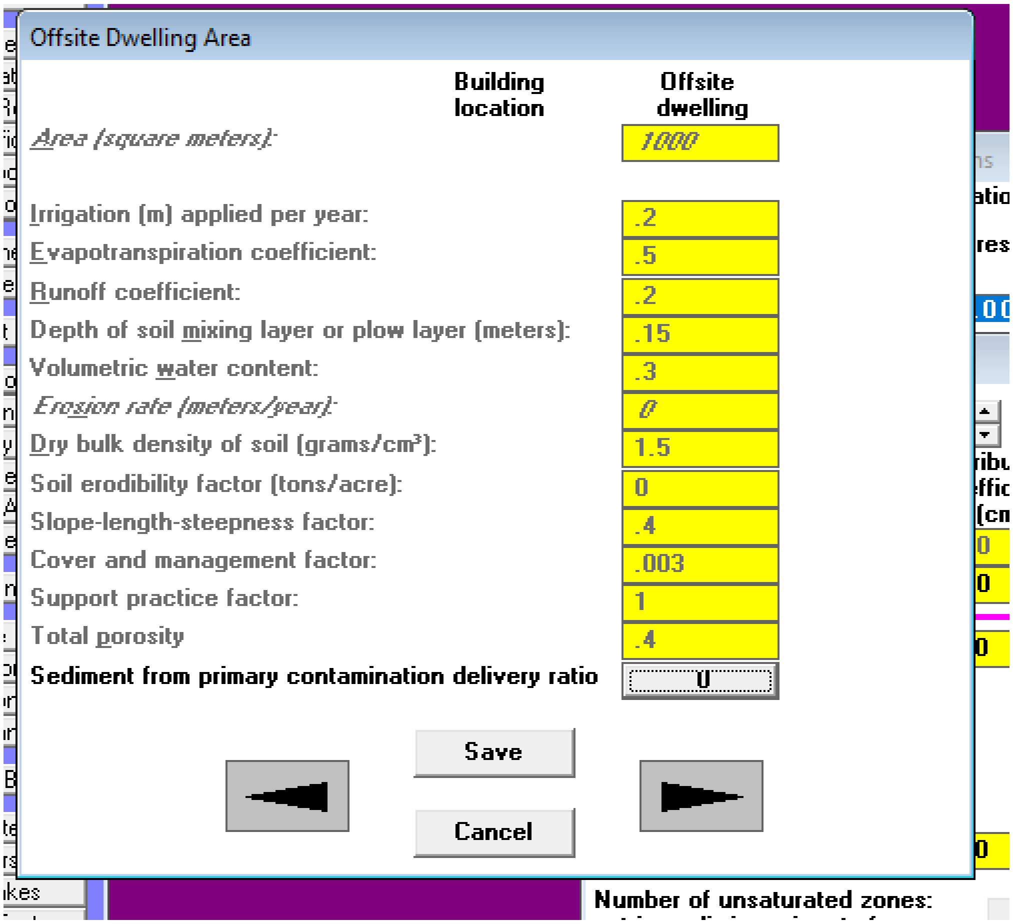
I repeated this and also made sure the button works when all pathways are enabled.

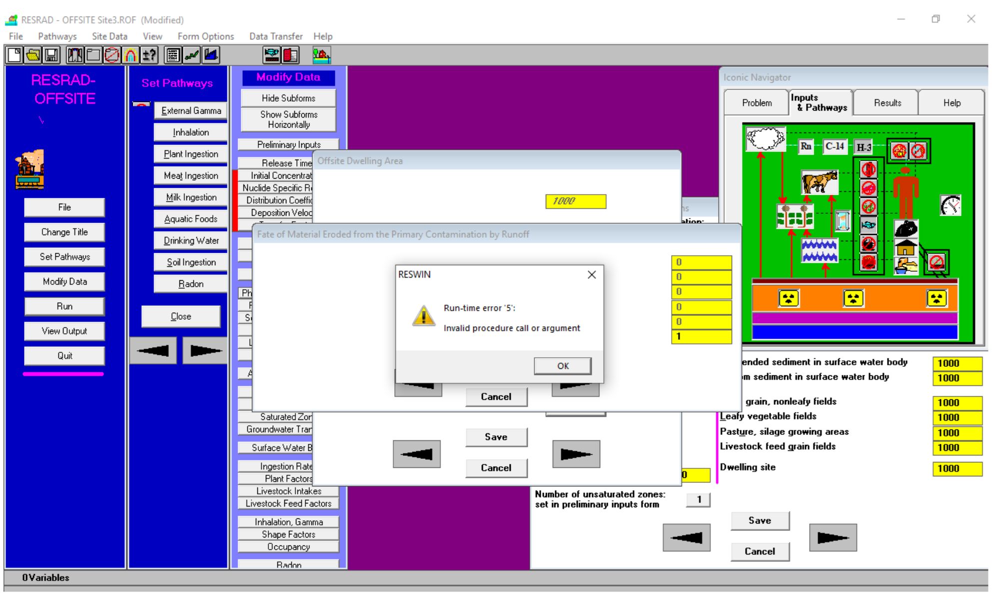
I do not think this is a show-stopper since it is rare since the user would not think to go here, it has the correct default, and stops the program (i.e., does not give wrong results).

Please let us know your decision on this issue.

Thanks,

Dave


Offsite Dwelling Area
Building location
Offsite dwelling
Area (square meters):
1000
Irrigation (m) applied per year:
.2
Evapotranspiration coefficient:
.5
Runoff coefficient:
.2
Depth of soil mixing layer or plow layer (meters):
.15
Volumetric water content:
.3
Erosion rate (meters/year):
0
Dry bulk density of soil (grams/cm³):
1.5
Soil erodibility factor (tons/acre):
0
Slope-length-steepness factor:
.4
Cover and management factor:
.003
Support practice factor:
1
Total porosity
.4
Sediment from primary contamination delivery ratio
0
Save
Cancel
Number of unsaturated zones:


RESRAD - OFFSITE Site3.ROF (Modified)
RESRAD-OFFSITE
Set Pathways
Modify Data
Offsite Dwelling Area
Fate of Material Eroded from the Primary Contamination by Runoff
RESWIN
Run-time error '5':
Invalid procedure call or argument
OK
Cancel
Save
Number of unsaturated zones: set in preliminary inputs form
Dwelling site
Iconic Navigator

12.82 TEST CASE 050 TESTER'S REPORT

Documented in Results Test Case 050.msg of 2/14/2020 3:08 PM

Results Test Case 050

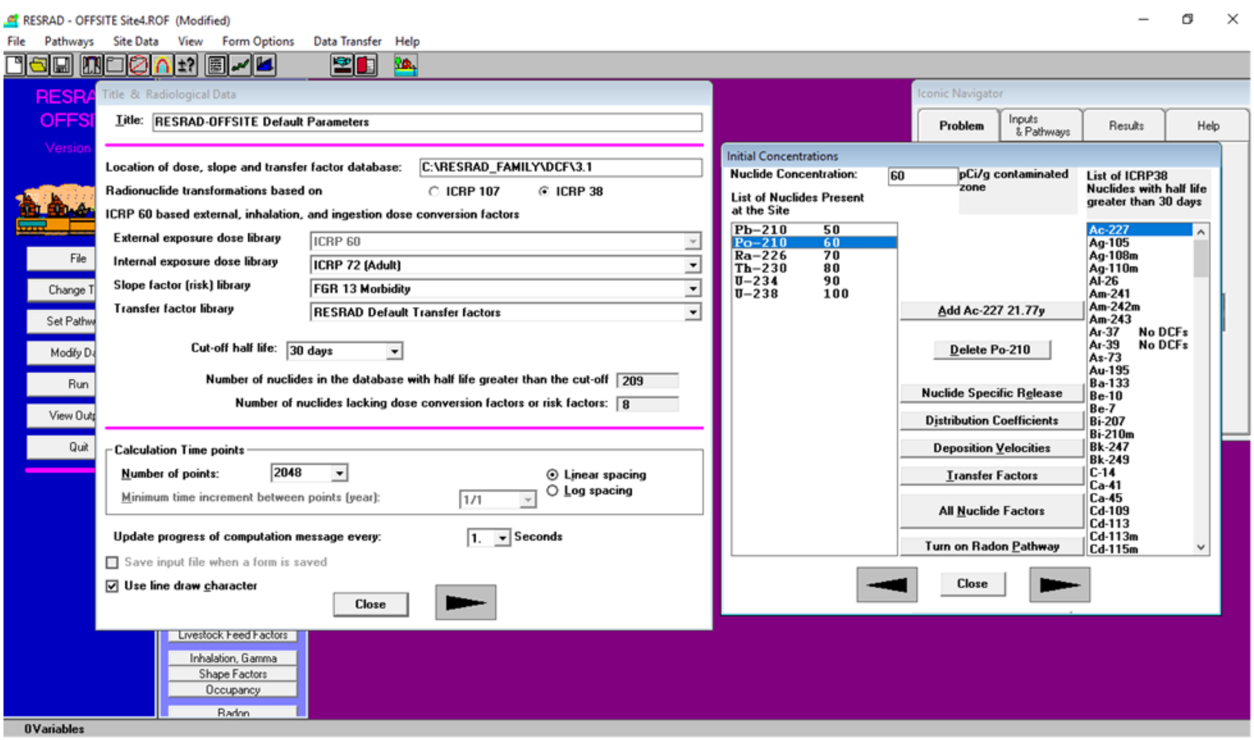
LePoire, David J. Thu 2/13/2020 1:14 PM

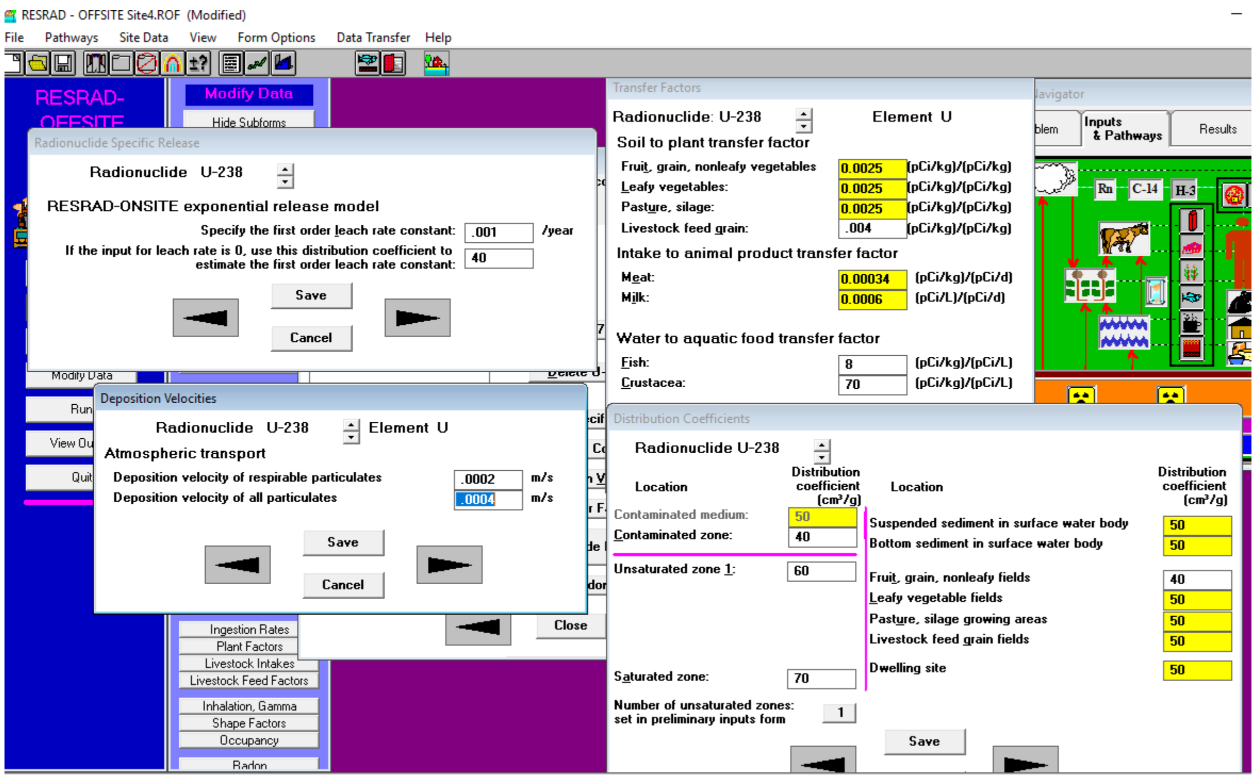
Summary: Passed by maintaining a set of nuclide-specfic properties under a change from one radionculdie transformaton database (ICRP-38) to another (ICRP-107)

Add U-238 at 100 pCi/g and Po-210 at 60 pCi/g

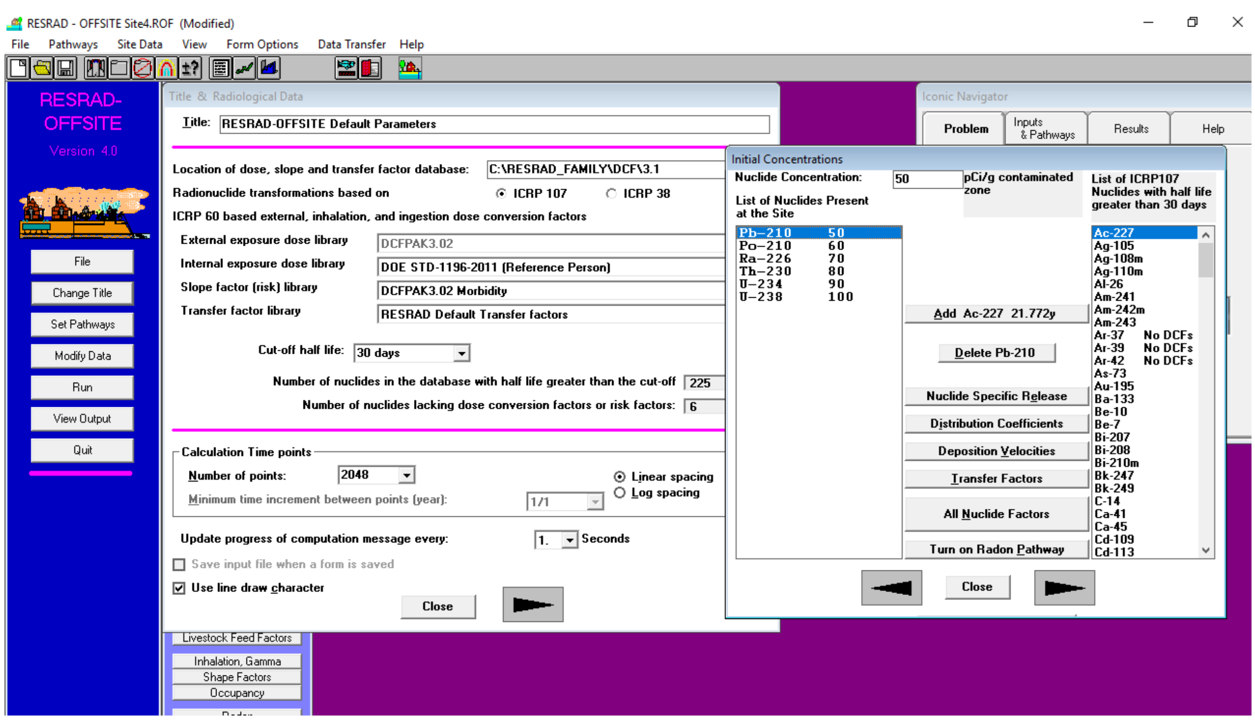
Change some nuclide and element specific parameters for U-238

Start with ICRP-38 and then change to ICRP-107 to see if the radionculide specific properties are maintained.

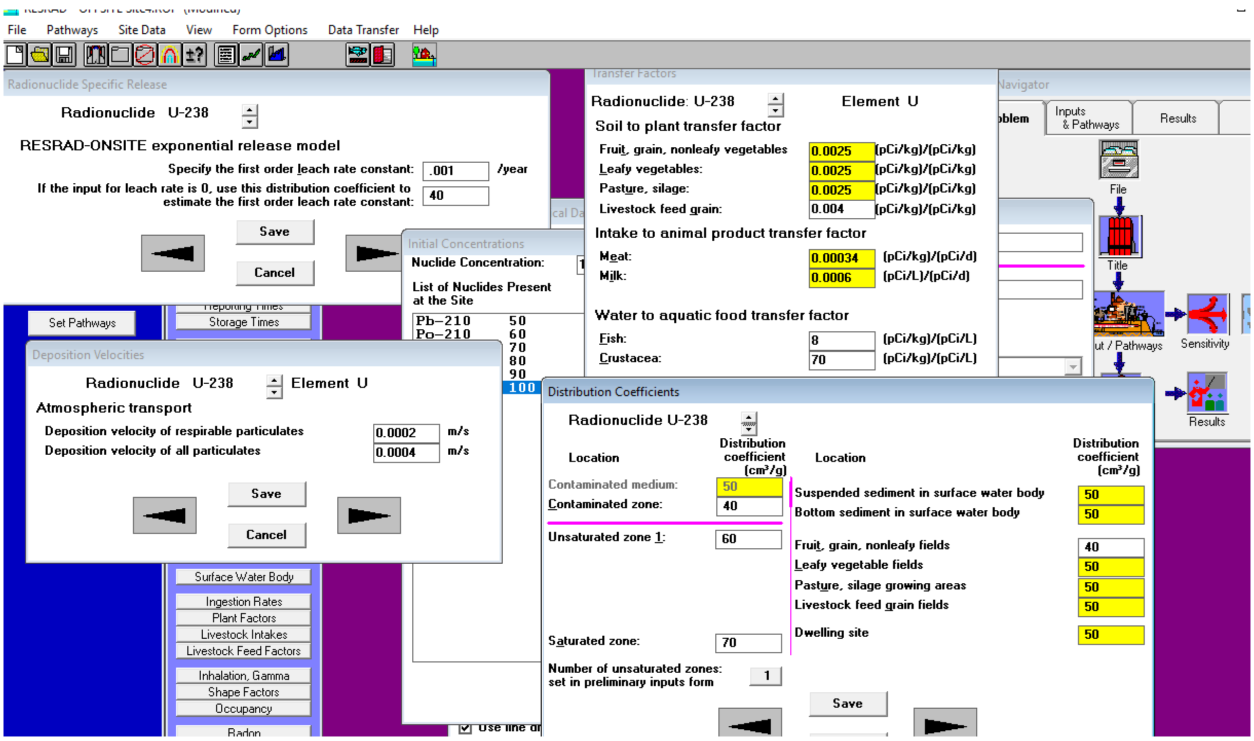




Then Change to ICRP-107



Values were maintained:



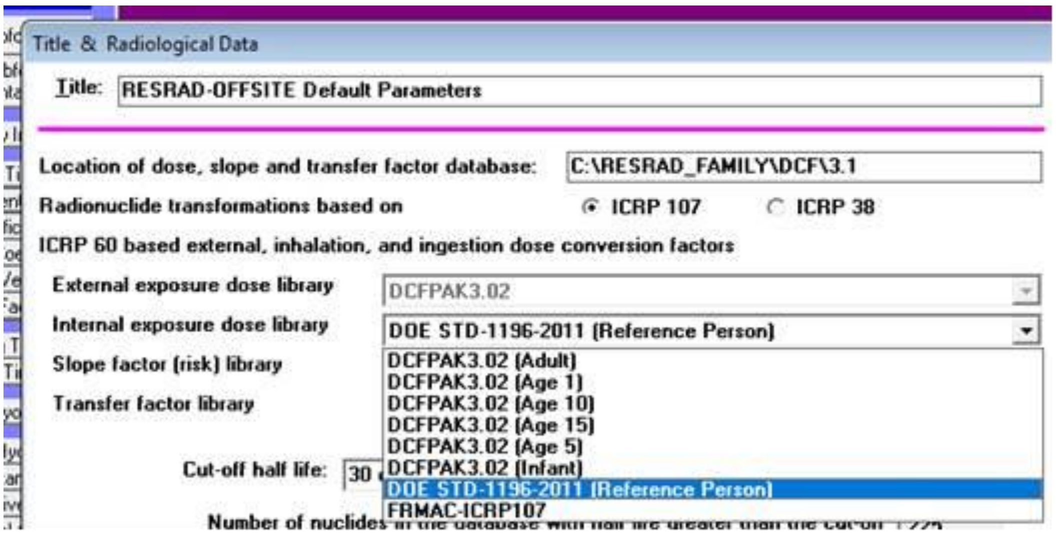
12.83 TEST CASE 051 TESTER'S REPORT

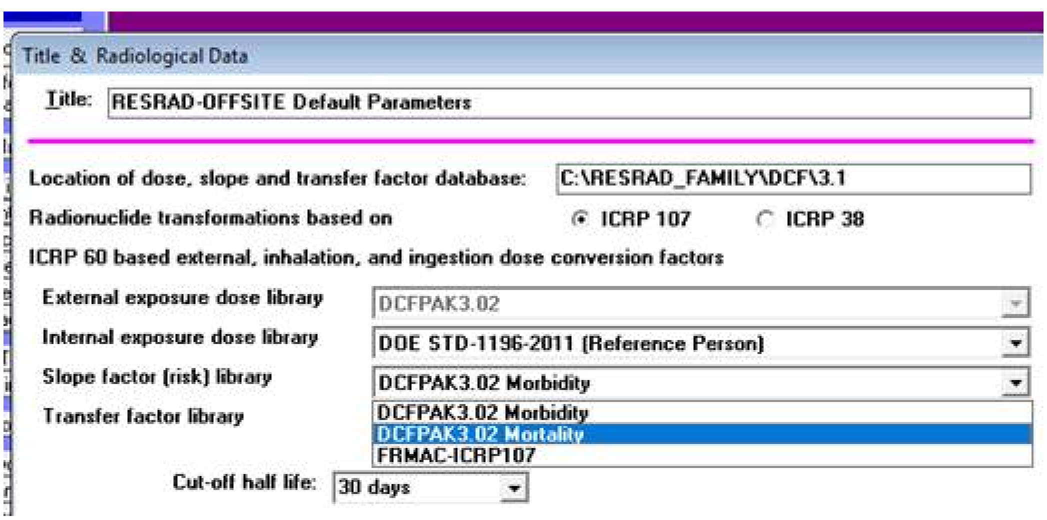
Documented in Results_ Test Case 051.msg of 2/14/2020 3:08 PM

Results: Test Case 051

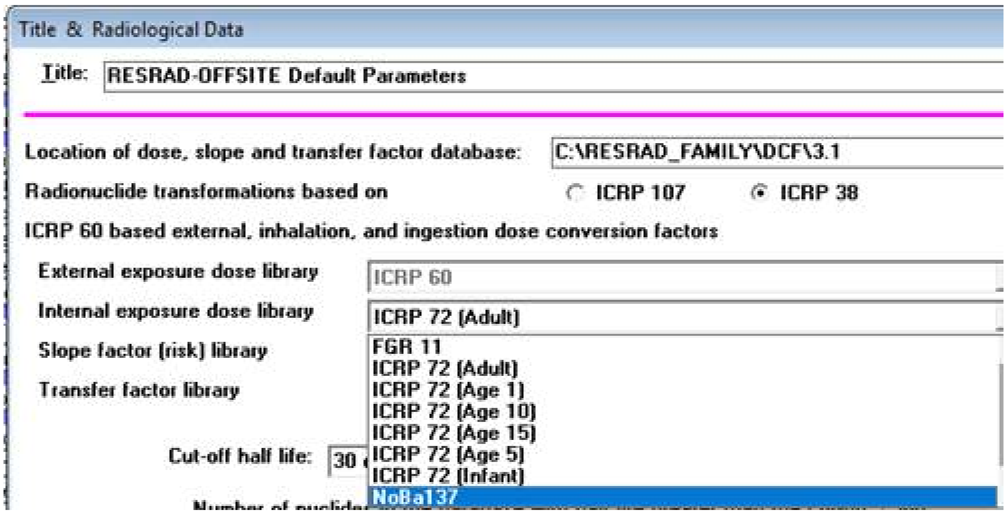
LePoire, David J. Thu 2/13/2020 2:01 PM

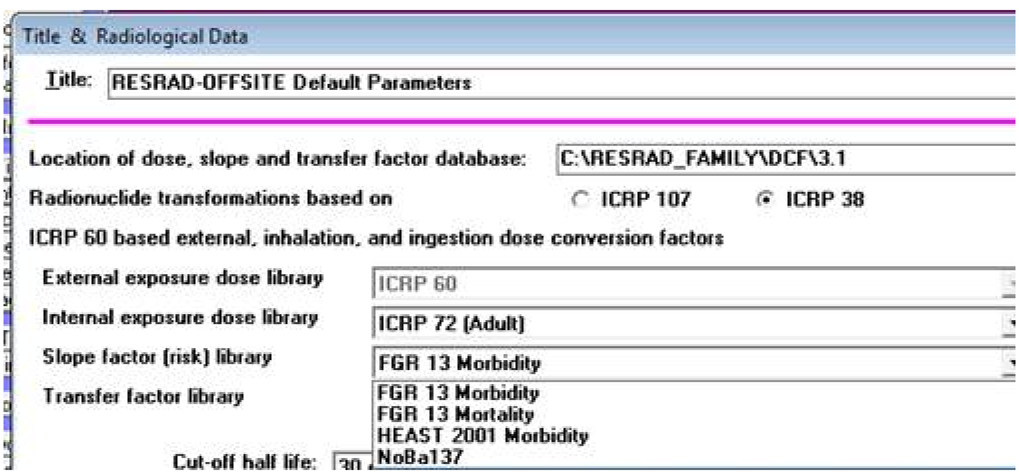
Libraries available for ICRP-107



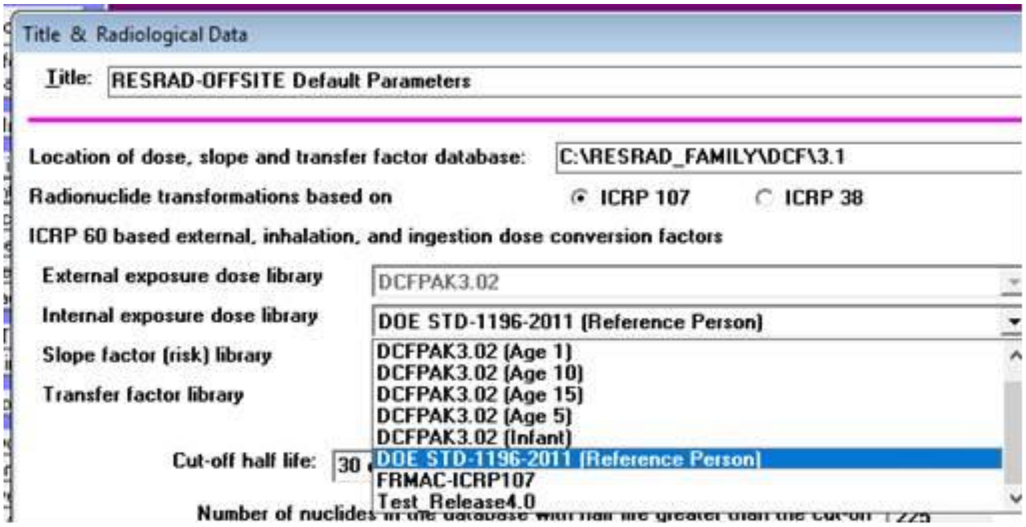


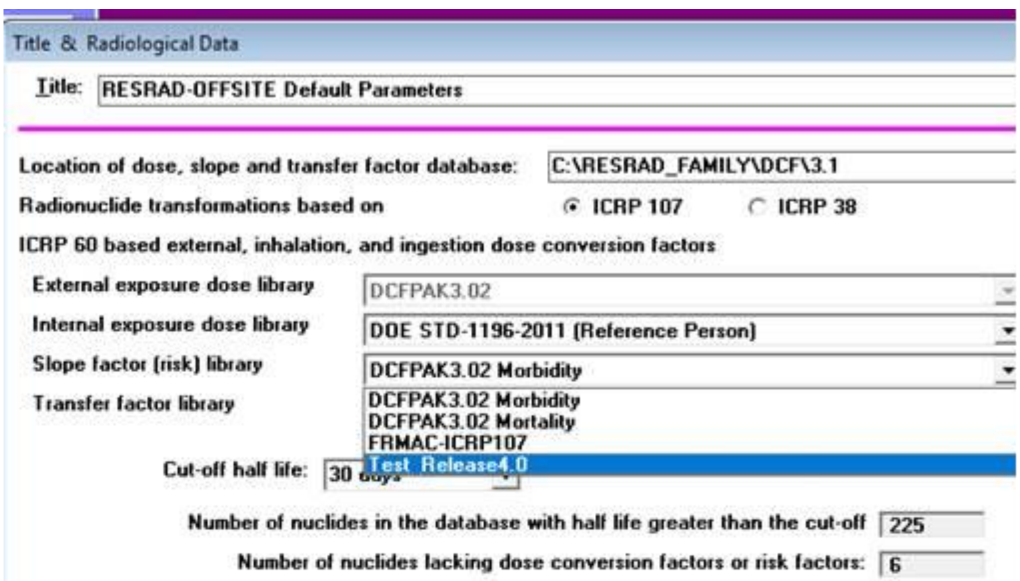
With ICRP-38 after creating NoBa137





ICRP-107 after adding library "Test-Release 4.0





12.84 TEST CASE 052 TESTER'S REPORT

Documented in Results_ Test Case 052.msg of 2/14/2020 3:46 PM

Results: Test Case 052

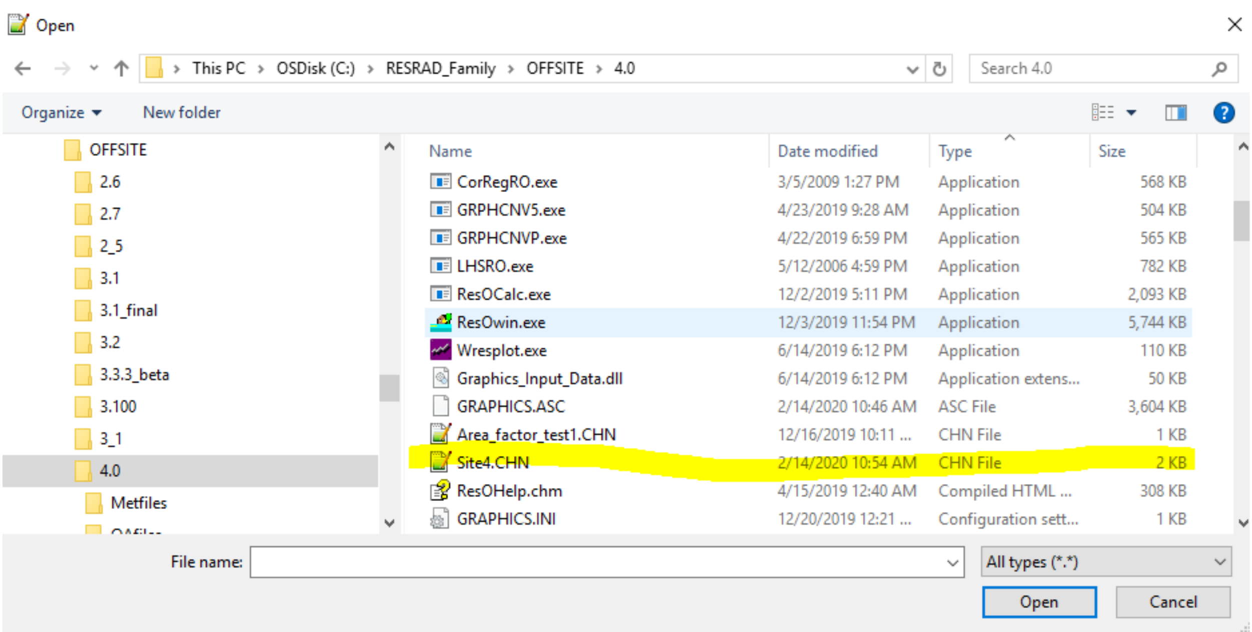
LePoire, David J. Fri 2/14/2020 2:38 PM

Summary: Pass, the numbers are the same in the manual and in the files after running the application

Follow instructions in E.4 of the manual (volume 1)

E.4.1 Pb-210 under ICRP-38

Summary: the numbers are the same in the manual and in the files after running the application

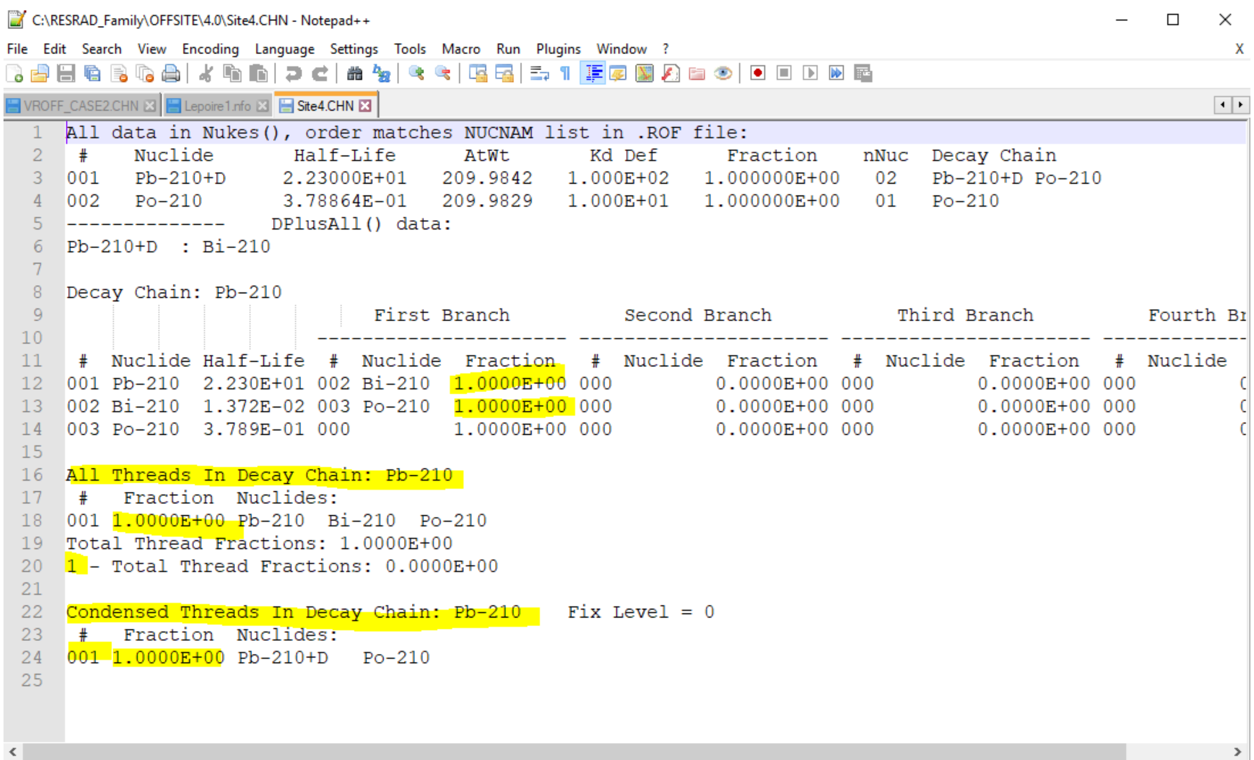


Compare information in the .CHN file to steps 1-4 on page E-5

E.4.1 ^{210}Pb under the ICRP-38 Transformation Database

The ^{210}Pb(22.3y) transforms to ^{210}Bi(0.01372y) which transforms to ^{210}Po(0.3789y) which transforms to the stable isotope ^{206}Pb. When using a 30 day (0.082136y) cut-off half-life with the ICRP 72 (adult) internal exposure library and the FGR13 morbidity risk library, the five steps above yield:-

1. thread 1, fraction = 1.0000, thread ^{210}Pb, ^{210}Bi, ^{210}Po;
2. thread 1, fraction = 1.0000, thread ^{210}Pb, ^{210}Po;
3. condensed thread 1, fraction = 1.0000, condensed thread ^{210}Pb+D, ^{210}Po;
4. ^{210}Pb+D = ^{210}Pb + 1.0000 ^{210}Bi;



```
All data in Nukes(), order matches NUCNAM list in .ROF file:
 #     Nuclide       Half-Life      AtWt        Kd Def       Fraction      nNuc  Decay Chain
001    Pb-210+D      2.23000E+01   209.9842   1.000E+02   1.000000E+00    02   Pb-210+D Po-210
002    Po-210        3.78864E-01   209.9829   1.000E+01   1.000000E+00    01   Po-210
--------------       DPlusAll() data:
Pb-210+D   : Bi-210

Decay Chain: Pb-210
                                           First Branch           Second Branch           Third Branch           Fourth Br
                                     ----------------------  ----------------------  ----------------------  ------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide
001 Pb-210  2.230E+01 002 Bi-210  1.0000E+00 000          0.0000E+00 000          0.0000E+00 000          (
002 Bi-210  1.372E-02 003 Po-210  1.0000E+00 000          0.0000E+00 000          0.0000E+00 000          (
003 Po-210  3.789E-01 000         1.0000E+00 000          0.0000E+00 000          0.0000E+00 000          (

All Threads In Decay Chain: Pb-210
 #   Fraction   Nuclides:
001 1.0000E+00 Pb-210  Bi-210  Po-210
Total Thread Fractions: 1.0000E+00
1 - Total Thread Fractions: 0.0000E+00

Condensed Threads In Decay Chain: Pb-210     Fix Level = 0
 #   Fraction   Nuclides:
001 1.0000E+00 Pb-210+D   Po-210
```

Compare DCF results to step 5 on page E-6: They are the same

5. Dose Coefficient, in mSv/Bq, for
   ingestion 210Pb +D = $6.9\ 10^{-4} + 1.0 \times 1.3\ 10^{-6} = 6.913\ 10^{-4}$,
   inhalation 210Pb +D = $5.6\ 10^{-3} + 1.0 \times 9.3\ 10^{-5} = 5.693\ 10^{-3}$,
   Slope Factor, in risk/Bq, for
   ingestion of food 210Pb +D = $3.189\ 10^{-8} + 1.0 \times 3.514\ 10^{-10} = 3.22\ 10^{-8}$,
   ingestion of water 210Pb +D = $2.381\ 10^{-8} + 1.0 \times 2.411\ 10^{-10} =$
   $2.41\ 10^{-8}$,
   ingestion of soil 210Pb +D = $3.189\ 10^{-8} + 1.0 \times 3.514\ 10^{-10} = 3.22\ 10^{-8}$,
   inhalation ^{210}Pb +D = $4.27\ 10^{-7} + 1.0 \times 1.23\ 10^{-8} = 4.393\ 10^{-7}$,

View - SUMMARY.REP

File Edit Help

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```
RESRAD-OFFSITE, Version 4.0         T½ Limit = 30 days         02/14/2020  10:46  Page   2
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File  : Site4.ROF

                          Dose Conversion Factor (and Related) Parameter Summary
                                       Current Library: ICRP 60
                                       Default Library: ICRP 60

     |                                                              | Current  |          | Parameter
Menu |                         Parameter                            |  Value   | Default  |   Name
-----+--------------------------------------------------------------+----------+----------+-----------
DCSF | DCF's for external ground radiation, (mSv/yr)/(Bq/g)         |          |          |
DCSF | Bi-210     (Source: ICRP 60)                                 | 1.480E-03| 1.480E-03| DCFEXT(  1)
DCSF | Pb-210     (Source: ICRP 60)                                 | 5.354E-04| 5.354E-04| DCFEXT(  2)
DCSF | Po-210     (Source: ICRP 60)                                 | 1.334E-05| 1.334E-05| DCFEXT(  3)
     |                                                              |          |          |

                                   Current Library: ICRP 72 (Adult)
                                   Default Library: ICRP 72 (Adult)

     |                                                              | Current  |          | Parameter
Menu |                         Parameter                            |  Value   | Default  |   Name
-----+--------------------------------------------------------------+----------+----------+-----------
DCSF | Dose conversion factors for inhalation, mSv/Bq:              |          |          |
DCSF | Pb-210+D                                                     | 5.693E-03| 5.693E-03| DCF2(1)
DCSF | Po-210                                                       | 4.300E-03| 4.300E-03| DCF2(2)
     |                                                              |          |          |
DCSF | Dose conversion factors for ingestion, mSv/Bq:               |          |          |
DCSF | Pb-210+D                                                     | 6.913E-04| 6.913E-04| DCF3(1)
DCSF | Po-210                                                       | 1.200E-03| 1.200E-03| DCF3(2)
     |                                                              |          |          |
```

Compare Slope Factor results to step 5 on page E-5: They are the same

View - INTRISK.REP

File Edit Help

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```
RESRAD-OFFSITE, Version 4.0        T½ Limit = 30 days        02/14/2020  10:46  Page   2
Risk Report
Title : RESRAD-OFFSITE Default Parameters
File  : Site4.ROF

                              Cancer Risk Slope Factors Summary Table
                                Current library: FGR 13 Morbidity
                                Default library: FGR 13 Morbidity
```

Menu	Parameter	Current Value	Default	Parameter Name
DCSF	Ground external radiation slope factors, 1/yr per (Bq/g):			
DCSF	Pb-210+D	1.13E-07	1.13E-07	SLPF(1,1)
DCSF	Po-210	1.07E-09	1.07E-09	SLPF(2,1)
DCSF	Inhalation, slope factors, 1/(Bq):			
DCSF	Pb-210+D	4.39E-07	4.39E-07	SLPF(1,2)
DCSF	Po-210	3.92E-07	3.92E-07	SLPF(2,2)
DCSF	Food ingestion, slope factors, 1/(Bq):			
DCSF	Pb-210+D	3.22E-08	3.22E-08	SLPF(1,3)
DCSF	Po-210	6.08E-08	6.08E-08	SLPF(2,3)
DCSF	Water ingestion, slope factors, 1/(Bq):			
DCSF	Pb-210+D	2.41E-08	2.41E-08	SLPF(1,4)
DCSF	Po-210	4.78E-08	4.78E-08	SLPF(2,4)
DCSF	Soil ingestion, slope factors, 1/(Bq):			
DCSF	Pb-210+D	3.22E-08	3.22E-08	SLPF(1,5)
DCSF	Po-210	6.08E-08	6.08E-08	SLPF(2,5)

E.4.2 Pb-210 under ICRP-107

Summary: the numbers are the same in the manual and in the files after running the application

From E.4.2 page E-6

(Note: There was a minor typo identified in the manual. The ^{210}Hg should have been ^{206}Hg

1. thread 1, fraction = 1.0000, ^{210}Pb, ^{210}Bi, ^{210}Po,
   thread 2, fraction = $1.32\ 10^{-6}$, ^{210}Pb, ^{210}Bi, ^{206}Tl,
   thread 3, fraction = $1.9\ 10^{-8}$, ^{210}Pb, ^{210}Hg, ^{206}Tl;

2. thread 1, fraction = 1.0000, ^{210}Pb, ^{210}Po,
   thread 2, fraction = $1.32\ 10^{-6}$, ^{210}Pb,
   thread 3, fraction = $1.9\ 10^{-8}$, ^{210}Pb;

3. condensed thread 1, fraction = 1.0000, ^{210}Pb+D, ^{210}Po,
   condensed thread 2, fraction = $1.339\ 10^{-6}$, ^{210}Pb+D1;

4. ^{210}Pb+D = ^{210}Pb + 1.0000 ^{210}Bi,
   ^{210}Pb+D1 = ^{210}Pb + 1.32/1.339 ^{210}Bi + 0.019/1.339 ^{210}Hg + 1.0000 ^{206}Tl;

```
All data in Nukes(), order matches NUCNAM list in .ROF file:
 #     Nuclide        Half-Life      AtWt      Kd Def      Fraction     nNuc  Decay Chain
001    Pb-210+D      2.22000E+01   210.9887   1.000E+02   9.999987E-01   02   Pb-210+D Po-210
002    Pb-210+D1     2.22000E+01   210.9887   1.000E+02   1.339000E-06   01   Pb-210+D1
003    Po-210        3.78853E-01   210.9866   1.000E+01   1.000000E+00   01   Po-210
--------------      DPlusAll() data:
Pb-210+D   : Bi-210
Pb-210+D1 :  (Bi-210 9.8581E-01) Tl-206 (Hg-206 1.4190E-02)

Decay Chain: Pb-210
                                 First Branch          Second Branch           Third Branch          Fourth Branch
                          ---------------------- ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Pb-210  2.220E+01 002 Bi-210  1.0000E+00 004 Hg-206  1.9000E-08 000         0.0000E+00 000         0.0000E+00
002 Bi-210  1.372E-02 003 Po-210  1.0000E+00 005 Tl-206  1.3200E-06 000         0.0000E+00 000         0.0000E+00
003 Po-210  3.789E-01 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00 000         0.0000E+00
004 Hg-206  1.550E-05 005 Tl-206  1.0000E+00 000         0.0000E+00 000         0.0000E+00 000         0.0000E+00
005 Tl-206  7.985E-06 000         1.0000E+00 000         0.0000E+00 000         0.0000E+00 000         0.0000E+00

All Threads In Decay Chain: Pb-210
 #    Fraction   Nuclides:
001 1.0000E+00 Pb-210   Bi-210   Po-210
002 1.3200E-06 Pb-210   Bi-210   Tl-206
003 1.9000E-08 Pb-210   Hg-206   Tl-206
Total Thread Fractions: 1.0000E+00
1 - Total Thread Fractions: 2.2204E-16

Condensed Threads In Decay Chain: Pb-210    Fix Level = 0
 #    Fraction   Nuclides:
001 1.0000E+00 Pb-210+D    Po-210
002 1.3390E-06 Pb-210+D1
```

Compare DCF's:

5. Dose Coefficient, in mSv/Bq, for

ingestion ^{210}Pb +D $= 6.96\ 10^{-4} + 1.0 \times 1.31\ 10^{-6} = 6.973\ 10^{-4}$,

ingestion ^{210}Pb +D1 $= 6.96\ 10^{-4} + 0.98581 \times 1.31\ 10^{-6} + 0.01419 \times 0 + 1.0 \times 0 = 6.972\ 10^{-4}$,

inhalation ^{210}Pb +D $= 5.61\ 10^{-3} + 1.0 \times 1.33\ 10^{-4} = 5.746\ 10^{-3}$,

View - SUMMARY.REP

File Edit Help

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RESRAD-OFFSITE, Version 4.0 T½ Limit = 30 days 02/14/2020 11:03 Page 2
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File : Site4.ROF

Dose Conversion Factor (and Related) Parameter Summary
Current Library: DCFPAK3.02
Default Library: DCFPAK3.02

Menu	Parameter	Current Value	Default	Parameter Name
DCSF	DCF's for external ground radiation, (mSv/yr)/(Bq/g)			
DCSF	Bi-210 (Source: DCFPAK3.02)	1.479E-03	1.479E-03	DCFEXT(1)
DCSF	Hg-206 (Source: DCFPAK3.02)	1.656E-01	1.656E-01	DCFEXT(2)
DCSF	Pb-210 (Source: DCFPAK3.02)	5.654E-04	5.654E-04	DCFEXT(3)
DCSF	Po-210 (Source: DCFPAK3.02)	1.525E-05	1.525E-05	DCFEXT(4)
DCSF	Tl-206 (Source: DCFPAK3.02)	3.454E-03	3.454E-03	DCFEXT(5)

Current Library: DCFPAK3.02 (Adult)
Default Library: DCFPAK3.02 (Adult)

Menu	Parameter	Current Value	Default	Parameter Name
DCSF	Dose conversion factors for inhalation, mSv/Bq:			
DCSF	Pb-210+D	5.746E-03	5.746E-03	DCF2(1)
DCSF	Pb-210+D1	5.745E-03	5.745E-03	DCF2(2)
DCSF	Po-210	4.276E-03	4.276E-03	DCF2(3)
DCSF	Dose conversion factors for ingestion, mSv/Bq:			
DCSF	Pb-210+D	6.973E-04	6.973E-04	DCF3(1)
DCSF	Pb-210+D1	6.972E-04	6.972E-04	DCF3(2)
DCSF	Po-210	1.210E-03	1.210E-03	DCF3(3)

Compare Slope Factors

$1.0 \times 0 = 5.745\ 10^{-}$,

Slope Factor, in risk/Bq, for

ingestion of food $^{210}Pb + D = 3.178\ 10^{-8} + 1.0 \times 3.519\ 10^{-10} = 3.21\ 10^{-8}$,

ingestion of food $^{210}Pb + D1 = 3.178\ 10^{-8} + 0.98581 \times 3.519\ 10^{-10} + 0.01419 \times 0 + 1.0 \times 1.3\ 10^{-6} = 3.21\ 10^{-8}$,

ingestion of water $^{210}Pb + D = 2.39\ 10^{-8} + 1.0 \times 2.41\ 10^{-10} = 2.41\ 10^{-8}$,

ingestion of water $^{210}Pb + D1 = 2.39\ 10^{-8} + +0.98581 \times 2.41\ 10^{-10} + 0.01419 \times 0 + 1.0 \times 1.3\ 10^{-6} = 2.41\ 10^{-8}$,

ingestion of soil $^{210}Pb + D = 3.178\ 10^{-8} + 1.0 \times 3.519\ 10^{-10} = 3.21\ 10^{-8}$,

ingestion of soil $^{210}Pb + D1 = 3.178\ 10^{-8} + 0.98581 \times 3.519\ 10^{-10} + 0.01419 \times 0 + 1.0 \times 1.3\ 10^{-6} = 3.21\ 10^{-8}$,

inhalation $^{210}Pb + D = 4.289\ 10^{-7} + 1.0 \times 1.23\ 10^{-8} = 4.41\ 10^{-7}$,

inhalation $^{210}Pb + D1 = 4.289\ 10^{-7} + 0.98581 \times 1.23\ 10^{-8} + 0.01419 \times 0 + 1.0 \times 1.3\ 10^{-6} = 4.41\ 10^{-7}$,

View - INTRISK.REP

File Edit Help

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```
RESRAD-OFFSITE, Version 4.0          T½ Limit = 30 days        02/14/2020  11:03  Page   2
Risk Report
Title : RESRAD-OFFSITE Default Parameters
File  : Site4.ROF

                                    Cancer Risk Slope Factors Summary Table
                                    Current library: DCFPAK3.02 Morbidity
                                    Default library: DCFPAK3.02 Morbidity

      |                                                             | Current  |          | Parameter
 Menu |                         Parameter                           |  Value   | Default  |   Name
------+-------------------------------------------------------------+----------+----------+-----------
DCSF  | Ground external radiation slope factors, 1/yr per (Bq/g):   |          |          |
DCSF  | Pb-210+D                                                    | 1.15E-07 | 1.15E-07 | SLPF(1,1)
DCSF  | Pb-210+D1                                                   | 4.64E-07 | 4.64E-07 | SLPF(2,1)
DCSF  | Po-210                                                      | 1.22E-09 | 1.22E-09 | SLPF(3,1)
      |                                                             |          |          |
DCSF  | Inhalation, slope factors, 1/(Bq):                          |          |          |
DCSF  | Pb-210+D                                                    | 4.41E-07 | 4.41E-07 | SLPF(1,2)
DCSF  | Pb-210+D1                                                   | 4.41E-07 | 4.41E-07 | SLPF(2,2)
DCSF  | Po-210                                                      | 3.92E-07 | 3.92E-07 | SLPF(3,2)
      |                                                             |          |          |
DCSF  | Food ingestion, slope factors, 1/(Bq):                      |          |          |
DCSF  | Pb-210+D                                                    | 3.21E-08 | 3.21E-08 | SLPF(1,3)
DCSF  | Pb-210+D1                                                   | 3.21E-08 | 3.21E-08 | SLPF(2,3)
DCSF  | Po-210                                                      | 6.09E-08 | 6.09E-08 | SLPF(3,3)
      |                                                             |          |          |
DCSF  | Water ingestion, slope factors, 1/(Bq):                     |          |          |
DCSF  | Pb-210+D                                                    | 2.41E-08 | 2.41E-08 | SLPF(1,4)
DCSF  | Pb-210+D1                                                   | 2.41E-08 | 2.41E-08 | SLPF(2,4)
DCSF  | Po-210                                                      | 4.80E-08 | 4.80E-08 | SLPF(3,4)
      |                                                             |          |          |
DCSF  | Soil ingestion, slope factors, 1/(Bq):                      |          |          |
DCSF  | Pb-210+D                                                    | 3.21E-08 | 3.21E-08 | SLPF(1,5)
DCSF  | Pb-210+D1                                                   | 3.21E-08 | 3.21E-08 | SLPF(2,5)
DCSF  | Po-210                                                      | 6.09E-08 | 6.09E-08 | SLPF(3,5)
      |                                                             |          |          |
```

E.4.3 Ac-227 under ICRP-107

Summary: the numbers are the same in the manual and in the files after running the application

2. T# 1, f = 9.8348 10^{-1} ^{227}Ac,
   T# 2, f = 2.7219 10^{-3} ^{227}Ac,
   T# 3, f = 1.3761 10^{-2} ^{227}Ac,
   T# 4, f = 3.8086 10^{-5} ^{227}Ac,
   T# 5, f = 8.2571 10^{-7} ^{227}Ac,
   T# 6, f = 2.2853 10^{-9} ^{227}Ac;

3. condensed thread 1, fraction = 1.0000, ^{227}Ac+D;

4. ^{227}Ac+D = ^{227}Ac + 9.8620 10^{-1} ^{227}Th + ^{223}Ra + ^{219}Rn + ^{215}Po + ^{211}Pb + ^{211}Bi + 9.9724 10^{-1} ^{207}Tl + 2.7600 10^{-3} ^{211}Po + 1.3800 10^{-2} ^{223}Fr + 8.2800 10^{-7} ^{219}At + 8.2800 10^{-7} ^{215}Bi;

```
All data in Nukes(), order matches NUCNAM list in .ROF file:
 #    Nuclide       Half-Life      AtWt       Kd Def      Fraction     nNuc  Decay Chain
001   Ac-227+D     2.17720E+01   227.0278   2.000E+01   1.000000E+00   01   Ac-227+D
--------------     DPlusAll() data:
Ac-227+D  : (Th-227 9.8620E-01) (Ra-223 1.0000E+00) (Rn-219 1.0000E+00) Po-215 Pb-211 Bi-211 (Tl-207 9.9724E-01) (Po-211 2.7600E-03) (Fr-223 1.3800E-02)

Decay Chain: Ac-227
                           First Branch          Second Branch          Third Branch          Fourth Branch
                      ---------------------- ---------------------- ---------------------- ----------------------
 #  Nuclide Half-Life  #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction   #  Nuclide  Fraction
001 Ac-227  2.177E+01 002 Th-227  9.8620E-01 003 Fr-223  1.3800E-02 000          0.0000E+00 000          0.0000E+00
002 Th-227  5.114E-02 004 Ra-223  1.0000E+00 000          0.0000E+00 000          0.0000E+00 000          0.0000E+00
003 Fr-223  4.183E-05 004 Ra-223  9.9994E-01 006 At-219  6.0000E-05 000          0.0000E+00 000          0.0000E+00
004 Ra-223  3.129E-02 005 Rn-219  1.0000E+00 000          0.0000E+00 000          0.0000E+00 000          0.0000E+00
005 Rn-219  1.255E-07 008 Po-215  1.0000E+00 000          0.0000E+00 000          0.0000E+00 000          0.0000E+00
006 At-219  1.775E-06 007 Bi-215  1.0000E+00 000          0.0000E+00 000          0.0000E+00 000          0.0000E+00
007 Bi-215  1.445E-05 008 Po-215  1.0000E+00 000          0.0000E+00 000          0.0000E+00 000          0.0000E+00
008 Po-215  5.644E-11 009 Pb-211  1.0000E+00 000          0.0000E+00 000          0.0000E+00 000          0.0000E+00
009 Pb-211  6.864E-05 010 Bi-211  1.0000E+00 000          0.0000E+00 000          0.0000E+00 000          0.0000E+00
010 Bi-211  4.069E-06 011 Tl-207  9.9724E-01 012 Po-211  2.7600E-03 000          0.0000E+00 000          0.0000E+00
011 Tl-207  9.069E-06 000         1.0000E+00 000          0.0000E+00 000          0.0000E+00 000          0.0000E+00
012 Po-211  1.635E-08 000         1.0000E+00 000          0.0000E+00 000          0.0000E+00 000          0.0000E+00

All Threads In Decay Chain: Ac-227
 #   Fraction  Nuclides:
001 9.8348E-01 Ac-227  Th-227  Ra-223  Rn-219  Po-215  Pb-211  Bi-211  Tl-207
002 2.7219E-03 Ac-227  Th-227  Ra-223  Rn-219  Po-215  Pb-211  Bi-211  Po-211
003 1.3761E-02 Ac-227  Fr-223  Ra-223  Rn-219  Po-215  Pb-211  Bi-211  Tl-207
004 3.8086E-05 Ac-227  Fr-223  Ra-223  Rn-219  Po-215  Pb-211  Bi-211  Po-211
005 8.2571E-07 Ac-227  Fr-223  At-219  Bi-215  Po-215  Pb-211  Bi-211  Tl-207
006 2.2853E-09 Ac-227  Fr-223  At-219  Bi-215  Po-215  Pb-211  Bi-211  Po-211
Total Thread Fractions: 1.0000E+00
1 - Total Thread Fractions: 1.5946E-10

Condensed Threads In Decay Chain: Ac-227    Fix Level = 0
 #   Fraction  Nuclides:
001 1.0000E+00 Ac-227+D
```

RESRAD-OFFSITE, Version 4.0 T½ Limit = 30 days 02/14/2020 16:25 Page 2
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File : Site1.ROF

Dose Conversion Factor (and Related) Parameter Summary
Current Library: DCFPAK3.02
Default Library: DCFPAK3.02

Menu	Parameter	Current Value	Default	Parameter Name
DCSF	DCF's for external ground radiation, (mSv/yr)/(Bq/g)			
DCSF	Ac-227 (Source: DCFPAK3.02)	7.068E-05	7.068E-05	DCFEXT(1)
DCSF	At-219 (Source: DCFPAK3.02)	0.000E+00	0.000E+00	DCFEXT(2)
DCSF	Bi-211 (Source: DCFPAK3.02)	6.514E-02	6.514E-02	DCFEXT(3)
DCSF	Bi-215 (Source: DCFPAK3.02)	3.700E-01	3.700E-01	DCFEXT(4)
DCSF	Fr-223 (Source: DCFPAK3.02)	4.751E-02	4.751E-02	DCFEXT(5)
DCSF	Pb-211 (Source: DCFPAK3.02)	9.946E-02	9.946E-02	DCFEXT(6)
DCSF	Po-211 (Source: DCFPAK3.02)	1.272E-02	1.272E-02	DCFEXT(7)
DCSF	Po-215 (Source: DCFPAK3.02)	2.555E-04	2.555E-04	DCFEXT(8)
DCSF	Ra-223 (Source: DCFPAK3.02)	1.565E-01	1.565E-01	DCFEXT(9)
DCSF	Rn-219 (Source: DCFPAK3.02)	8.027E-02	8.027E-02	DCFEXT(10)
DCSF	Th-227 (Source: DCFPAK3.02)	1.525E-01	1.525E-01	DCFEXT(11)
DCSF	Tl-207 (Source: DCFPAK3.02)	6.462E-03	6.462E-03	DCFEXT(12)

Current Library: DCFPAK3.02 (Adult)
Default Library: DCFPAK3.02 (Adult)

Menu	Parameter	Current Value	Default	Parameter Name
DCSF	Dose conversion factors for inhalation, mSv/Bq:			
DCSF	Ac-227+D	1.746E-01	1.746E-01	DCF2(1)
DCSF	Dose conversion factors for ingestion, mSv/Bq:			
DCSF	Ac-227+D	4.341E-04	4.341E-04	DCF3(1)

8.28 10 × 0 = 1.748 10 ,

Slope Factor, in risk/Bq for

ingestion of food ^{227}Ac+D $= 6.63\ 10^{-9} + 9.8620\ 10^{-1} \times 1.9\ 10^{-9} + 9.149\ 10^{-9} + 0 + 0 + 1.57\ 10^{-11} + 0 + 9.9724\ 10^{-1} \times 0 + 2.76\ 10^{-3} \times 0 + 1.38\ 10^{-2} \times 2.73\ 10^{-10} + 8.28\ 10^{-7} \times 0 + 8.28\ 10^{-7} \times 0 = 1.77\ 10^{-8}$,

ingestion of water $5.43\ 10^{-9} + 9.8620\ 10^{-1} \times 1.3\ 10^{-9} + 6.441\ 10^{-9} + 0 + +0 + 1.11\ 10^{-11} + 0 + 9.9724\ 10^{-1} \times 0 + 2.76\ 10^{-3} \times 0 + 1.38\ 10^{-2} \times 1.99\ 10^{-10} + 8.28\ 10^{-7} \times 0 + 8.28\ 10^{-7} \times 0 = 1.32\ 10^{-8}$

ingestion of soil ^{227}Ac+D $= 6.63\ 10^{-9} + 9.8620\ 10^{-1} \times 1{,}9\ 10^{-9} + 9.149\ 10^{-9} + 0 + 0 + 1.57\ 10^{-11} + 0 + 9.9724\ 10^{-1} \times 0 + 2.76\ 10^{-3} \times 0 + 1.38\ 10^{-2} \times 2.73\ 10^{-10} + 8.28\ 10^{-7} \times 0 + 8.28\ 10^{-7} \times 0 = 1.77\ 10^{-8}$,

inhalation ^{227}Ac+D $= 4.041\ 10^{-6} + 9.8620\ 10^{-1} \times 9.459\ 10^{-7} + 7.889\ 10^{-7} + 0 + 0 + 1.09\ 10^{-9} + 0 + 9.9724\ 10^{-1} \times 0 + 2.76\ 10^{-3} \times 0 + 1.38\ 10^{-2} \times 1.1\ 10^{-9} + 8.28\ 10^{-7} \times 0 + 8.28\ 10^{-7} \times 0 = 5.76\ 10^{-6}$,

View - INTRISK.REP

File Edit Help

Font: MS LineDraw 7.4 Page: 2

```
RESRAD-OFFSITE, Version 4.0          T½ Limit = 30 days          02/14/2020  16:25  Page   2
Risk Report
Title : RESRAD-OFFSITE Default Parameters
File  : Site1.ROF

                                  Cancer Risk Slope Factors Summary Table
                                  Current library: DCFPAK3.02 Morbidity
                                  Default library: DCFPAK3.02 Morbidity
```

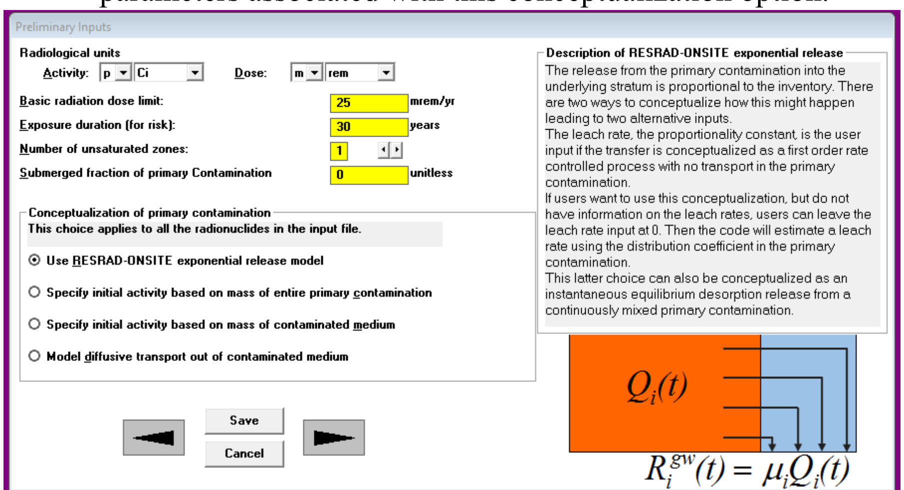
Menu	Parameter	Current Value	Default	Parameter Name
DCSF	Ground external radiation slope factors, 1/yr per (Bq/g):			
DCSF	Ac-227+D	4.40E-05	4.40E-05	SLPF(1,1)
DCSF	Inhalation, slope factors, 1/(Bq):			
DCSF	Ac-227+D	5.76E-06	5.76E-06	SLPF(1,2)
DCSF	Food ingestion, slope factors, 1/(Bq):			
DCSF	Ac-227+D	1.77E-08	1.77E-08	SLPF(1,3)
DCSF	Water ingestion, slope factors, 1/(Bq):			
DCSF	Ac-227+D	1.32E-08	1.32E-08	SLPF(1,4)
DCSF	Soil ingestion, slope factors, 1/(Bq):			
DCSF	Ac-227+D	1.77E-08	1.77E-08	SLPF(1,5)

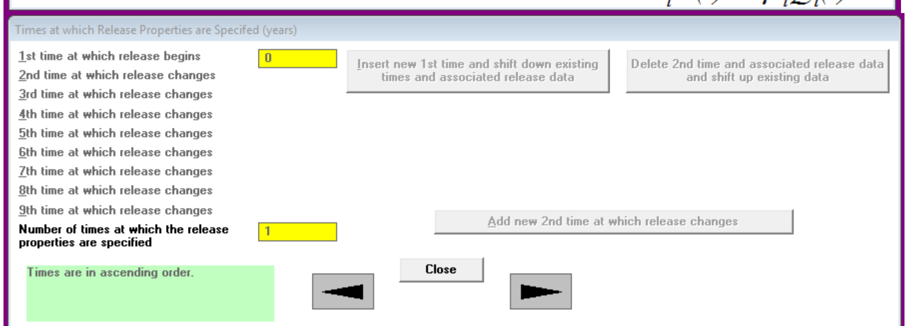
12.85 TEST CASE 053 TESTER'S REPORT

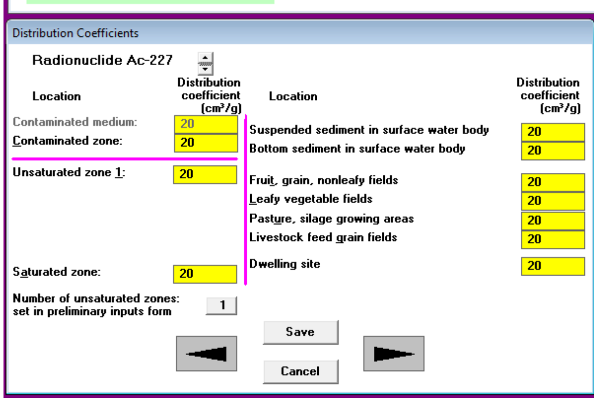
Documented in Test Case 53-JJCheng.docx of 2/19/2020 4:34 PM

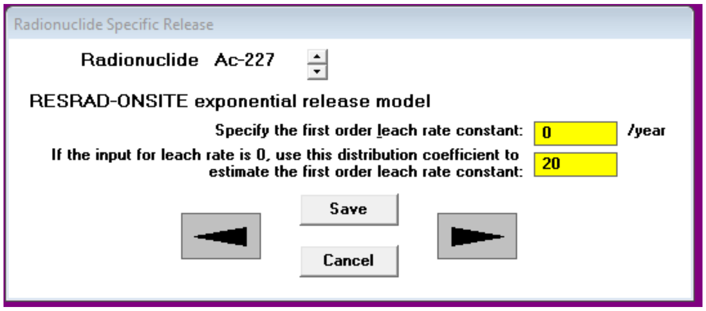
Test Case – 53 – Tests OFFSITE's source conceptualization options tool

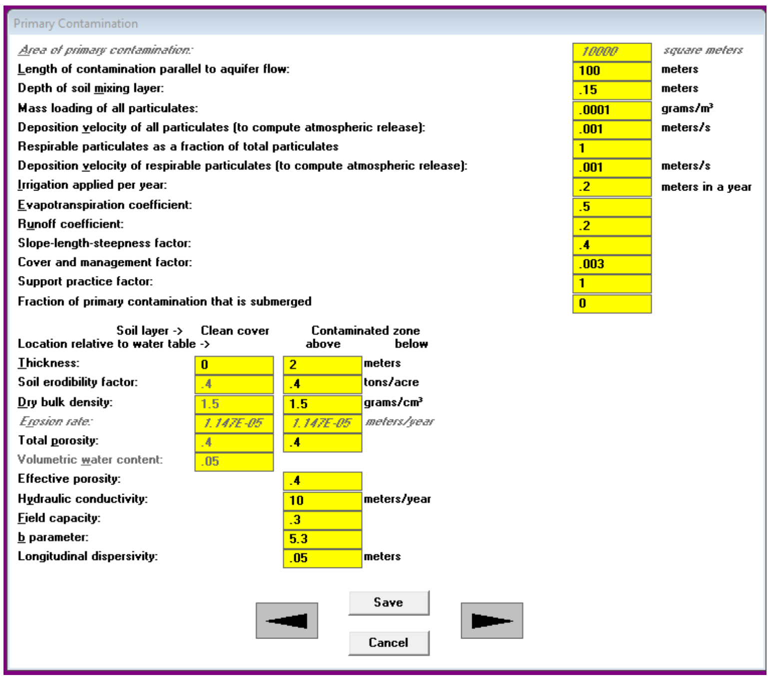
- Launched RESRAD-OFFSITE. Specified Ac-227 as the radionuclide of concern, and then selected "Use RESRAD-ONSITE exponential release model" as the conceptualization of primary contamination in the Preliminary Inputs form. The Times at which Release Properties are Specified, Distribution Coefficients, Radionuclide Specific Release, and the Primary Contamination input forms all displayed expectedly with input parameters associated with this conceptualization option.



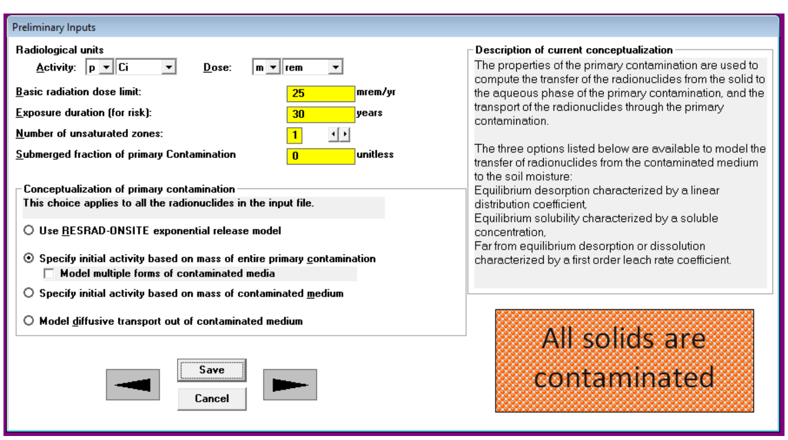


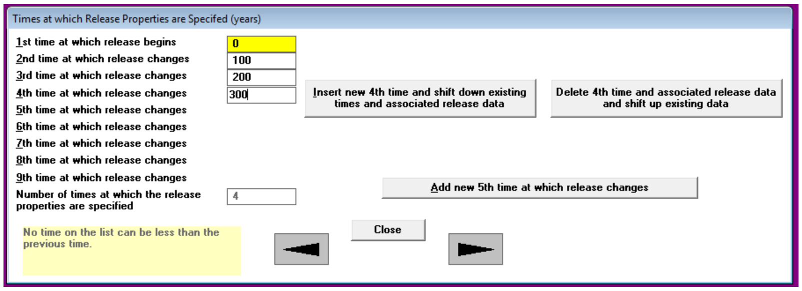


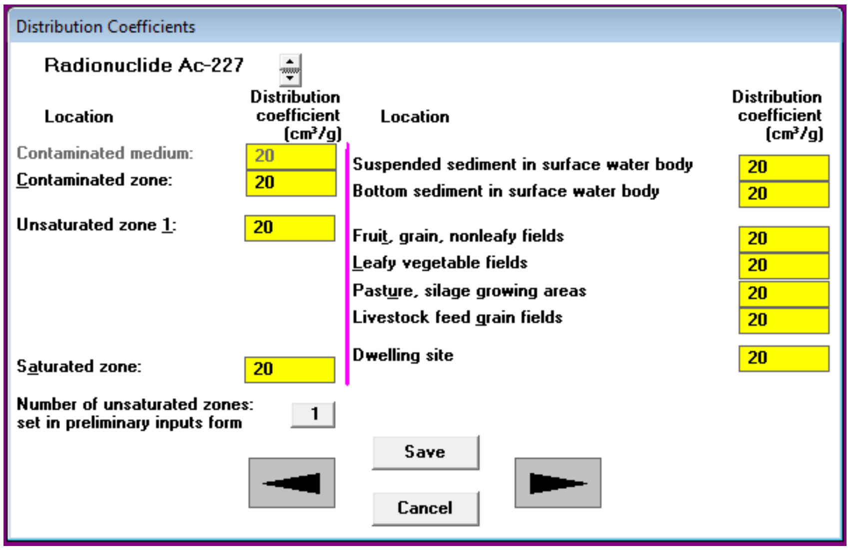


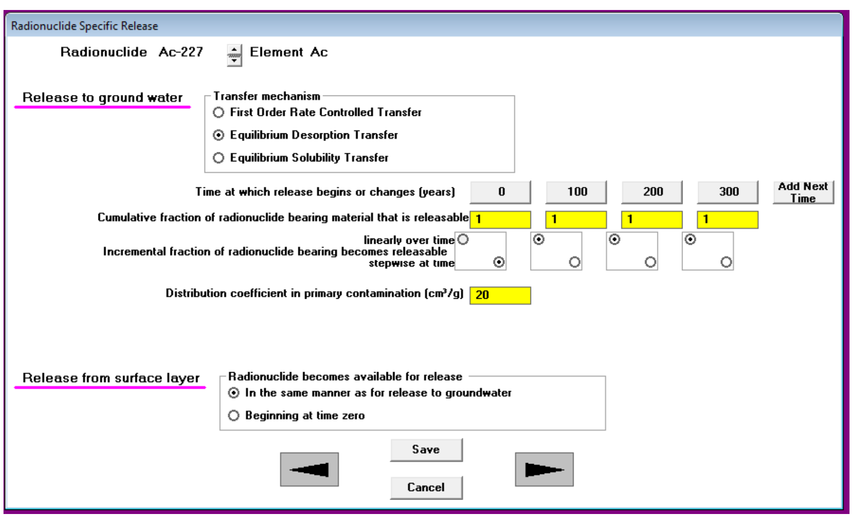


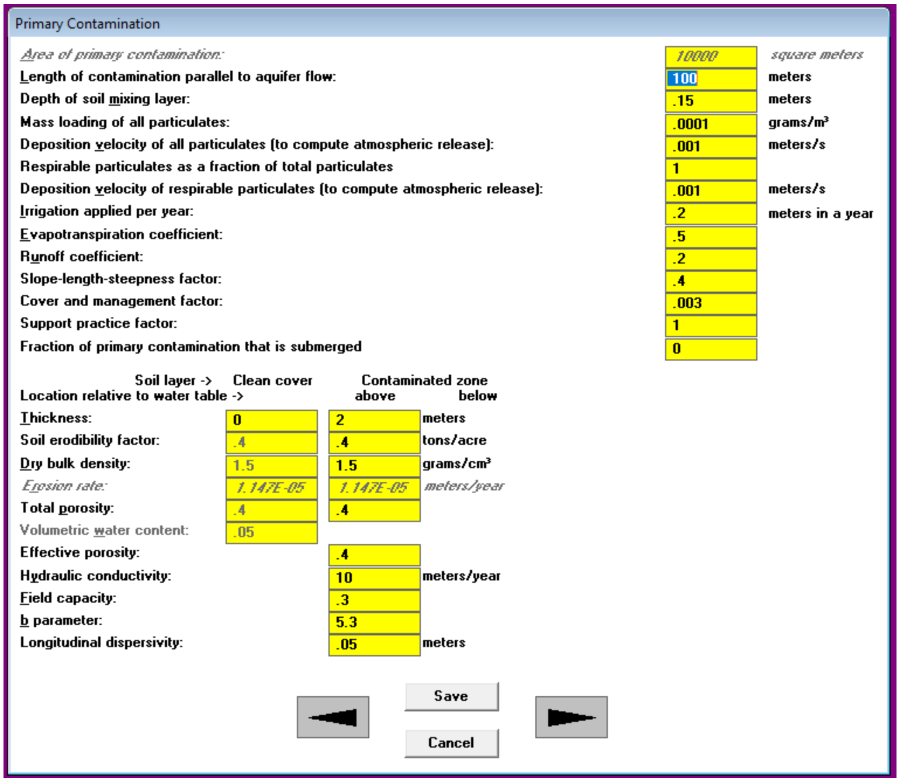
- Selected "Specify initial activity based on mass of entire primary contamination" as the conceptualization of primary contamination in the Preliminary Inputs form. The Times at which Release Properties are Specified input form allowed the specification of up to 9th time periods. The Distribution Coefficients, Radionuclide Specific Release, and the Primary Contamination input forms all displayed expectedly with input parameters associated with this conceptualization option.



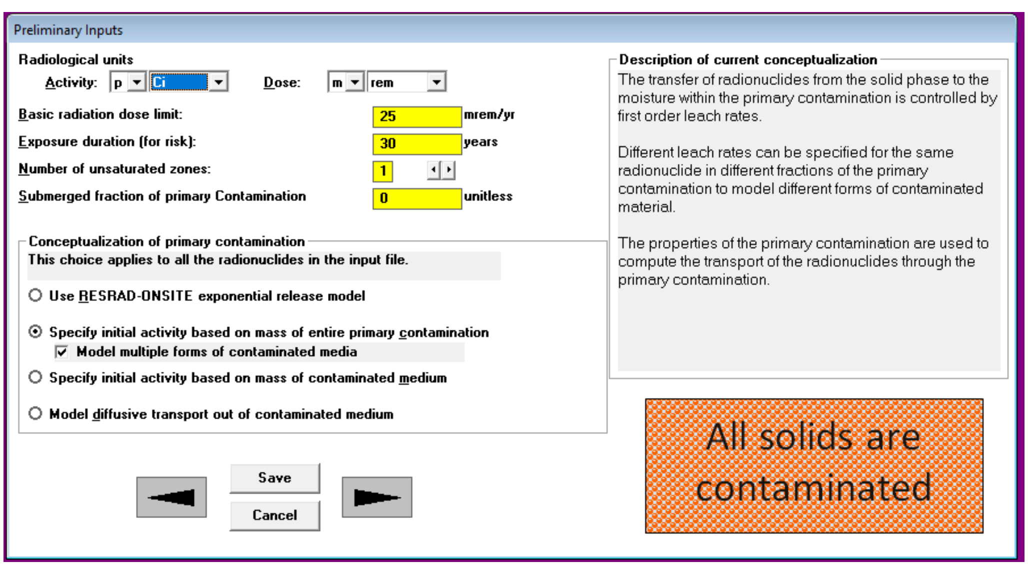

Times at which Release Properties are Specifed (years)
1st time at which release begins
0
2nd time at which release changes
100
3rd time at which release changes
200
4th time at which release changes
300
5th time at which release changes
6th time at which release changes
7th time at which release changes
8th time at which release changes
9th time at which release changes
Number of times at which the release properties are specified
4
Insert new 4th time and shift down existing times and associated release data
Delete 4th time and associated release data and shift up existing data
Add new 5th time at which release changes
No time on the list can be less than the previous time.
Close

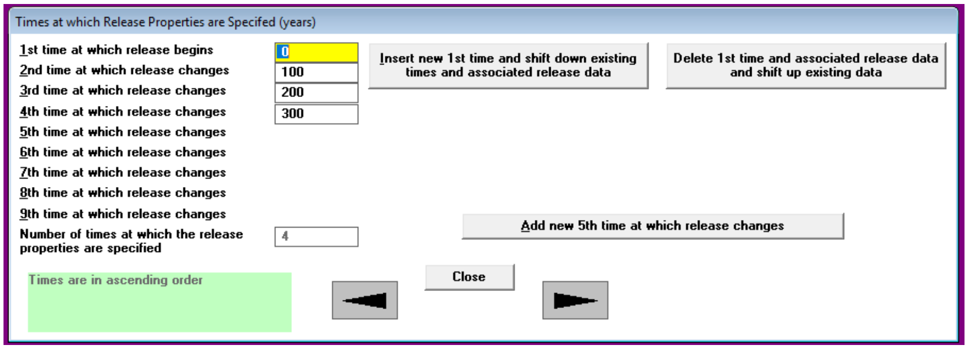

Distribution Coefficients
Radionuclide Ac-227
Location
Distribution coefficient (cm³/g)
Contaminated medium:
20
Contaminated zone:
20
Unsaturated zone 1:
20
Saturated zone:
20
Number of unsaturated zones: set in preliminary inputs form
1
Location
Distribution coefficient (cm³/g)
Suspended sediment in surface water body
20
Bottom sediment in surface water body
20
Fruit, grain, nonleafy fields
20
Leafy vegetable fields
20
Pasture, silage growing areas
20
Livestock feed grain fields
20
Dwelling site
20
Save
Cancel

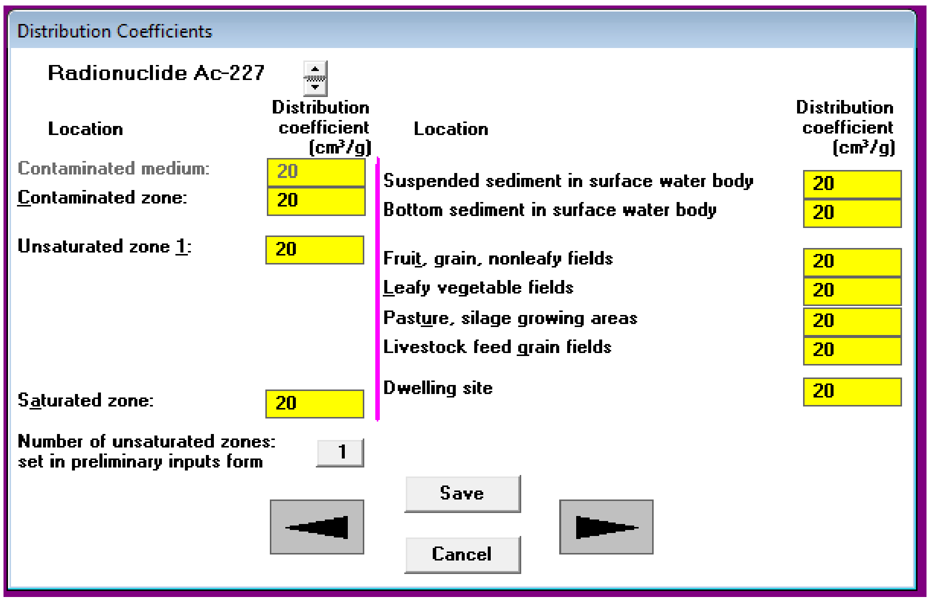

Radionuclide Specific Release
Radionuclide Ac-227
Element Ac
Release to ground water
Transfer mechanism
First Order Rate Controlled Transfer
Equilibrium Desorption Transfer
Equilibrium Solubility Transfer
Time at which release begins or changes (years)
0
100
200
300
Add Next Time
Cumulative fraction of radionuclide bearing material that is releasable
1
1
1
1
linearly over time
Incremental fraction of radionuclide bearing becomes releasable
stepwise at time
Distribution coefficient in primary contamination (cm³/g)
20
Release from surface layer
Radionuclide becomes available for release
In the same manner as for release to groundwater
Beginning at time zero
Save
Cancel

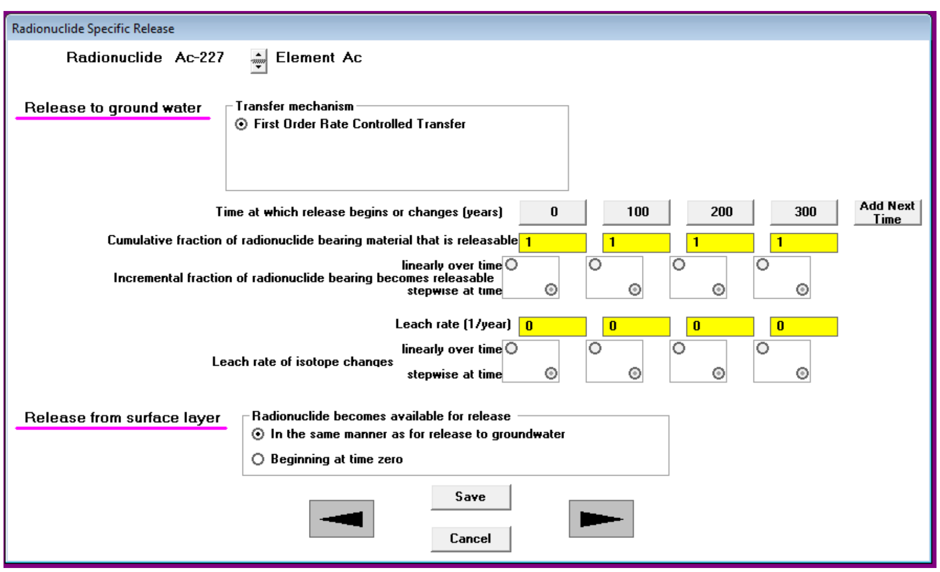


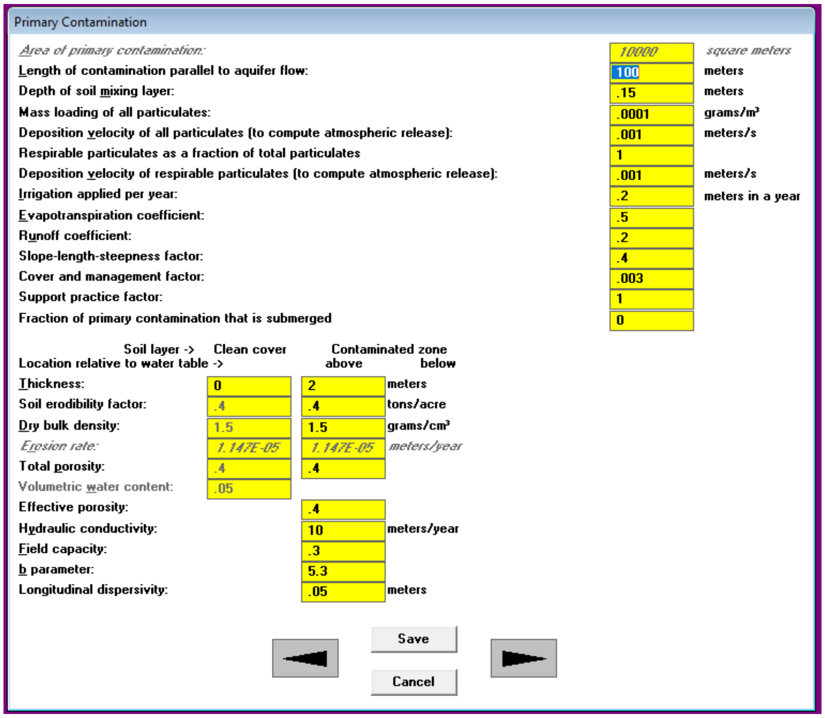
- Selected "Specify initial activity based on mass of entire primary contamination" as the conceptualization of primary contamination and checked "Model multiple forms of contaminated media" in the Preliminary Inputs form. The Times at which Release Properties are Specified input form allowed the specification of up to 9th time periods. The Distribution Coefficients, Radionuclide Specific Release (fixed the change pattern of releasable fraction and leach rate as stepwise between release time periods), and the Primary Contamination input forms all displayed expectedly with input parameters associated with this conceptualization option.



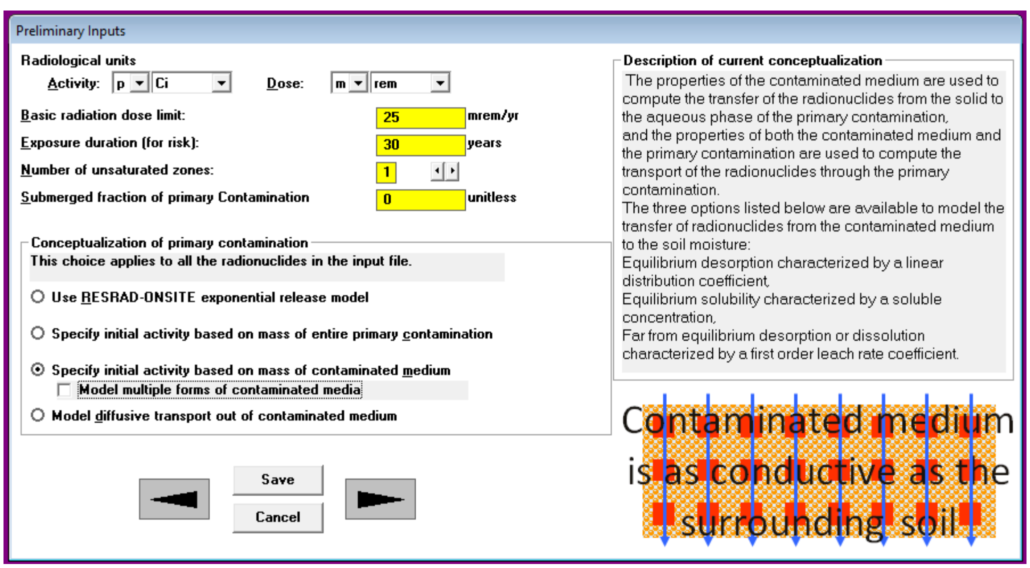

Times at which Release Properties are Specifed (years)
1st time at which release begins
2nd time at which release changes
3rd time at which release changes
4th time at which release changes
5th time at which release changes
6th time at which release changes
7th time at which release changes
8th time at which release changes
9th time at which release changes
Number of times at which the release properties are specified
0
100
200
300
4
Insert new 1st time and shift down existing times and associated release data
Delete 1st time and associated release data and shift up existing data
Add new 5th time at which release changes
Times are in ascending order
Close

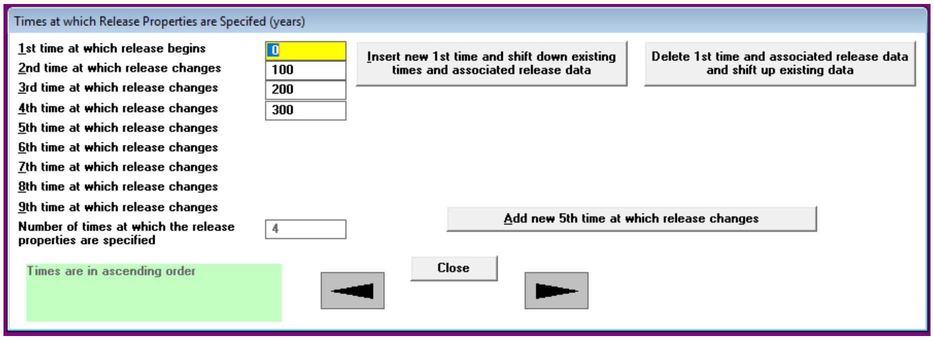

Distribution Coefficients
Radionuclide Ac-227
Location
Distribution coefficient (cm³/g)
Contaminated medium: 20
Contaminated zone: 20
Unsaturated zone 1: 20
Saturated zone: 20
Number of unsaturated zones: set in preliminary inputs form 1
Location
Distribution coefficient (cm³/g)
Suspended sediment in surface water body 20
Bottom sediment in surface water body 20
Fruit, grain, nonleafy fields 20
Leafy vegetable fields 20
Pasture, silage growing areas 20
Livestock feed grain fields 20
Dwelling site 20
Save
Cancel

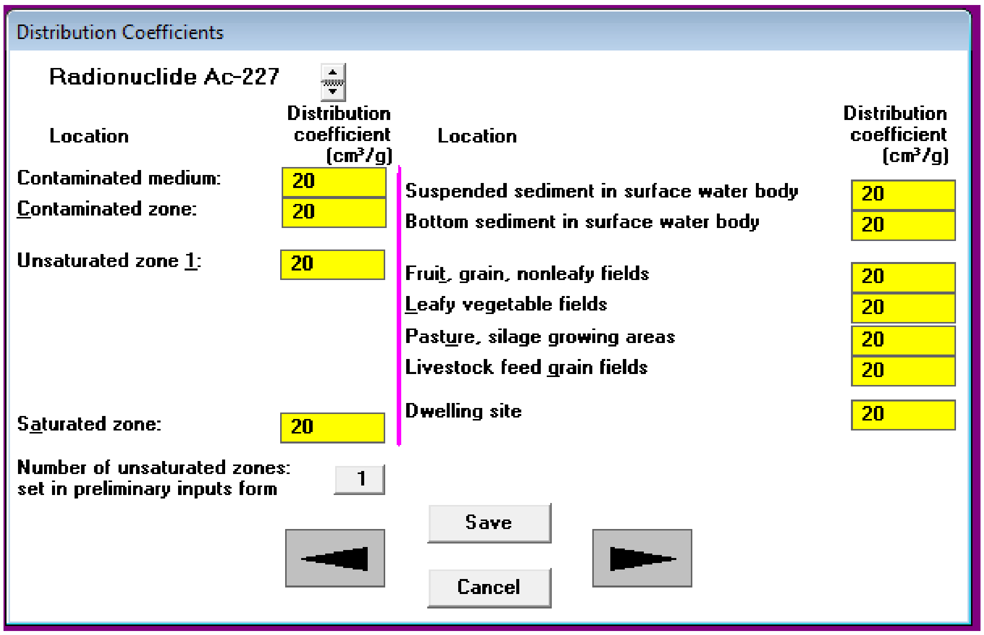

Radionuclide Specific Release
Radionuclide Ac-227
Element Ac
Release to ground water
Transfer mechanism
First Order Rate Controlled Transfer
Time at which release begins or changes (years) 0 100 200 300
Add Next Time
Cumulative fraction of radionuclide bearing material that is releasable 1 1 1 1
linearly over time
Incremental fraction of radionuclide bearing becomes releasable
stepwise at time
Leach rate (1/year) 0 0 0 0
linearly over time
Leach rate of isotope changes
stepwise at time
Release from surface layer
Radionuclide becomes available for release
In the same manner as for release to groundwater
Beginning at time zero
Save
Cancel

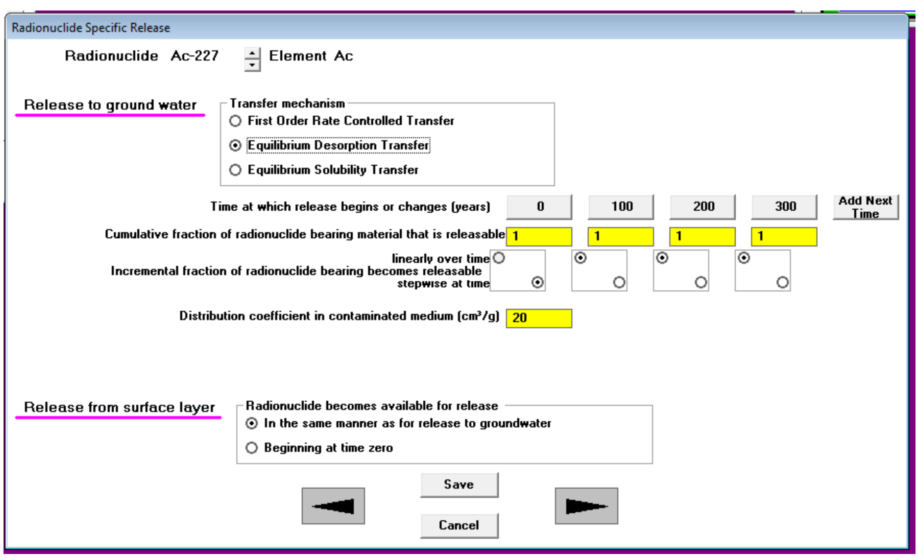


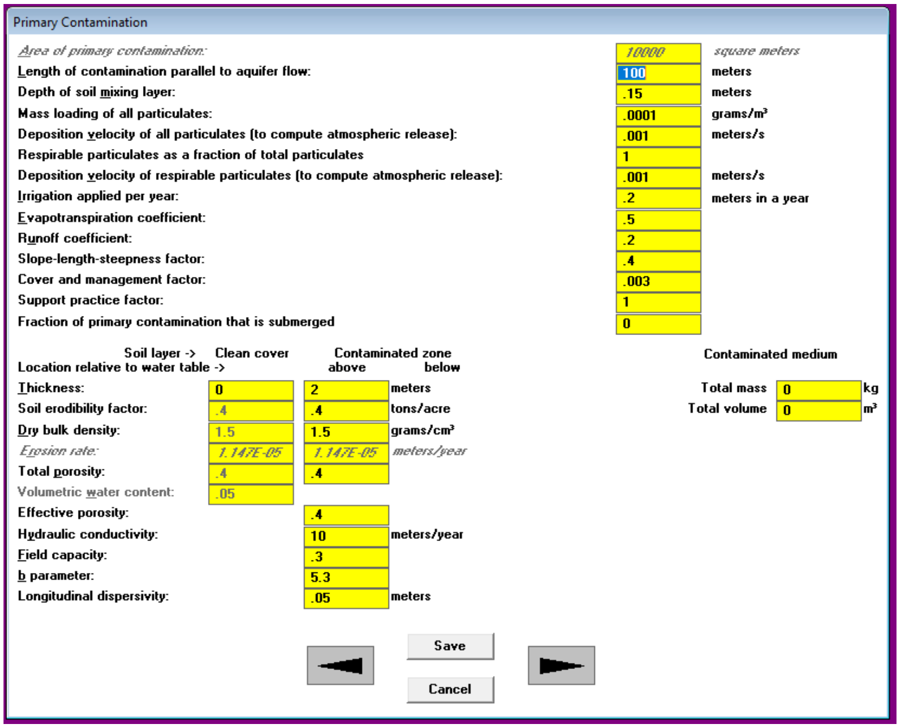
- Selected "Specify initial activity based on mass of contaminated medium" as the conceptualization of primary contamination in the Preliminary Inputs form. The Times at which Release Properties are Specified input form allowed the specification of up to 9th time periods. The Distribution Coefficients (allowed the specification of Kd for the contaminated medium), Radionuclide Specific Release, and the Primary Contamination (allowed the specification of total mass and volume of the contaminated medium) input forms all displayed expectedly with input parameters associated with this conceptualization option.



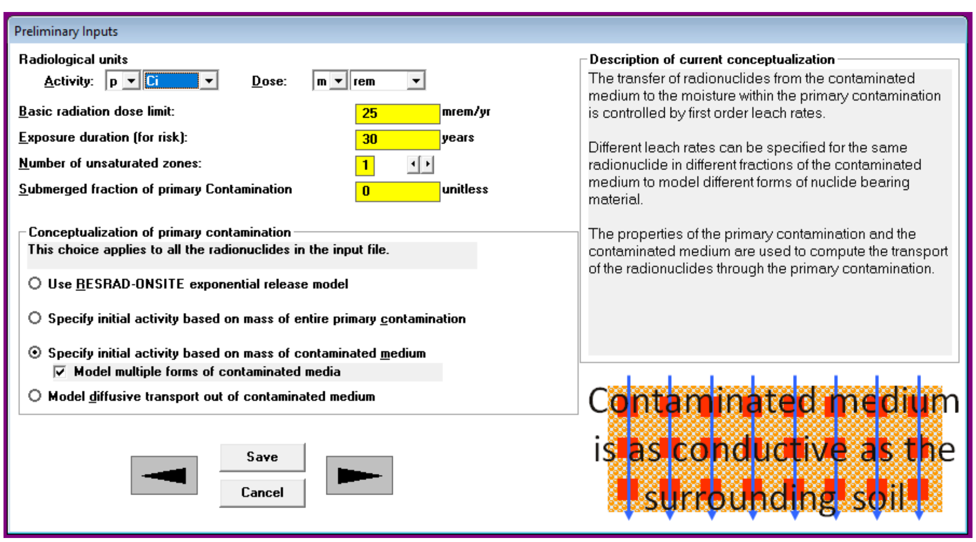

Times at which Release Properties are Specifed (years)
1st time at which release begins
2nd time at which release changes
3rd time at which release changes
4th time at which release changes
5th time at which release changes
6th time at which release changes
7th time at which release changes
8th time at which release changes
9th time at which release changes
Number of times at which the release properties are specified
0
100
200
300
4
Insert new 1st time and shift down existing times and associated release data
Delete 1st time and associated release data and shift up existing data
Add new 5th time at which release changes
Times are in ascending order
Close

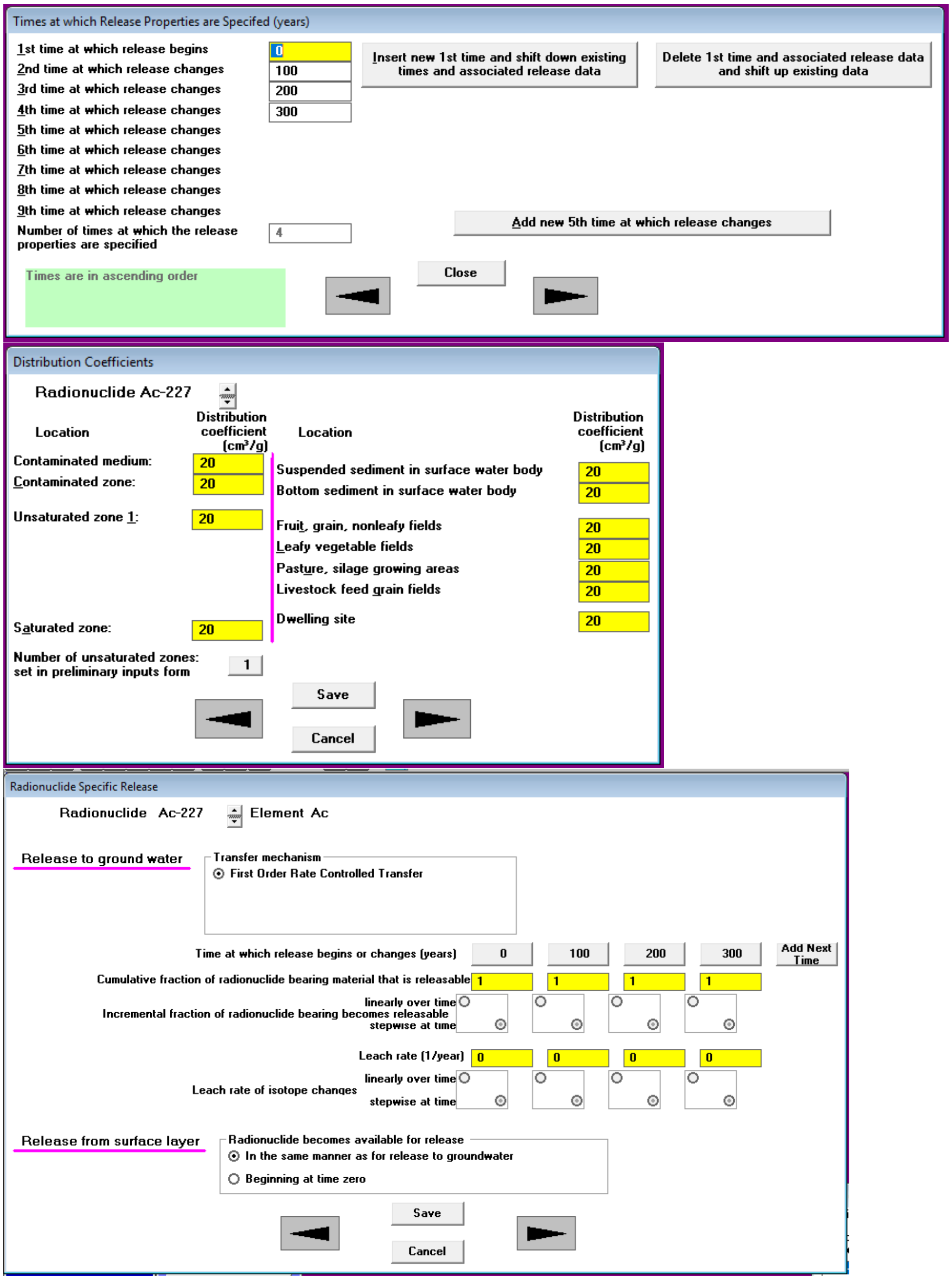

Distribution Coefficients
Radionuclide Ac-227
Location
Distribution coefficient (cm³/g)
Contaminated medium: 20
Contaminated zone: 20
Unsaturated zone 1: 20
Saturated zone: 20
Number of unsaturated zones: set in preliminary inputs form 1
Location
Distribution coefficient (cm³/g)
Suspended sediment in surface water body 20
Bottom sediment in surface water body 20
Fruit, grain, nonleafy fields 20
Leafy vegetable fields 20
Pasture, silage growing areas 20
Livestock feed grain fields 20
Dwelling site 20
Save
Cancel


Radionuclide Specific Release
Radionuclide Ac-227
Element Ac
Release to ground water
Transfer mechanism
First Order Rate Controlled Transfer
Equilibrium Desorption Transfer
Equilibrium Solubility Transfer
Time at which release begins or changes (years) 0 100 200 300
Add Next Time
Cumulative fraction of radionuclide bearing material that is releasable 1 1 1 1
Incremental fraction of radionuclide bearing becomes releasable
linearly over time
stepwise at time
Distribution coefficient in contaminated medium (cm³/g) 20
Release from surface layer
Radionuclide becomes available for release
In the same manner as for release to groundwater
Beginning at time zero
Save
Cancel

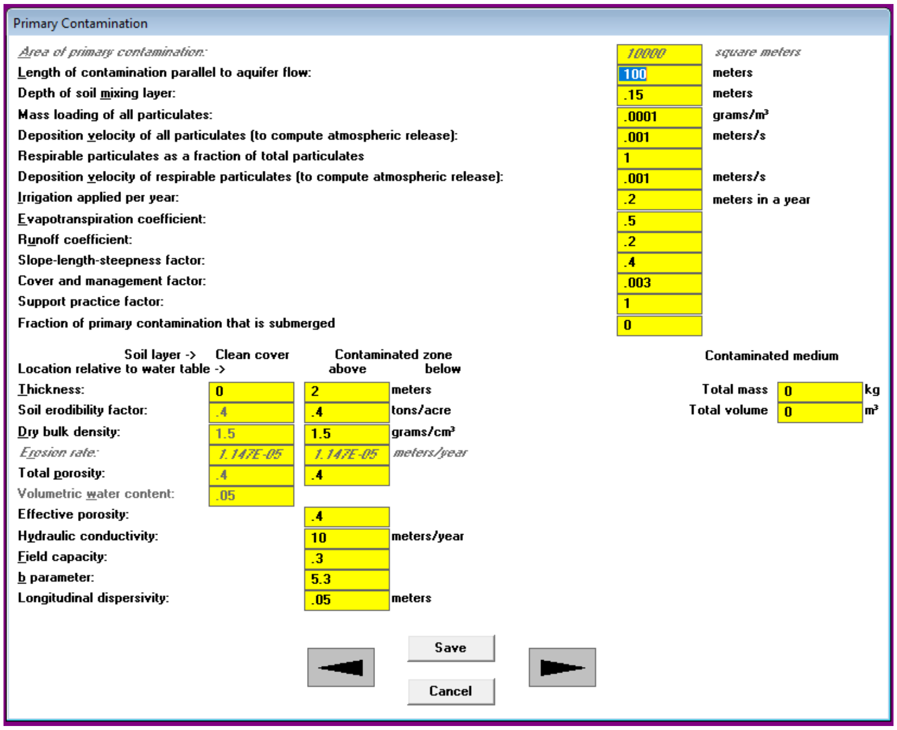


- Selected "Specify initial activity based on mass of contaminated medium" as the conceptualization of primary contamination and checked "Model multiple forms of contaminated media" in the Preliminary Inputs form. The Times at which Release Properties are Specified input form allowed the specification of up to 9th time periods. The Distribution Coefficients (allowed the specification of Kd for the contaminated medium), Radionuclide Specific Release (fixed the change pattern of releasable fraction and leach rate as stepwise between release time periods), and the Primary Contamination (allowed the specification of total mass and volume of the contaminated medium) input forms all displayed expectedly with input parameters associated with this conceptualization option.





Times at which Release Properties are Specifed (years)
1st time at which release begins
2nd time at which release changes
3rd time at which release changes
4th time at which release changes
5th time at which release changes
6th time at which release changes
7th time at which release changes
8th time at which release changes
9th time at which release changes
Number of times at which the release properties are specified
0
100
200
300
4
Insert new 1st time and shift down existing times and associated release data
Delete 1st time and associated release data and shift up existing data
Add new 5th time at which release changes
Times are in ascending order
Close
Distribution Coefficients
Radionuclide Ac-227
Location
Distribution coefficient (cm³/g)
Contaminated medium: 20
Contaminated zone: 20
Unsaturated zone 1: 20
Saturated zone: 20
Number of unsaturated zones: set in preliminary inputs form 1
Suspended sediment in surface water body 20
Bottom sediment in surface water body 20
Fruit, grain, nonleafy fields 20
Leafy vegetable fields 20
Pasture, silage growing areas 20
Livestock feed grain fields 20
Dwelling site 20
Save
Cancel
Radionuclide Specific Release
Radionuclide Ac-227
Element Ac
Release to ground water
Transfer mechanism
First Order Rate Controlled Transfer
Time at which release begins or changes (years) 0 100 200 300
Add Next Time
Cumulative fraction of radionuclide bearing material that is releasable 1 1 1 1
Incremental fraction of radionuclide bearing becomes releasable
linearly over time
stepwise at time
Leach rate (1/year) 0 0 0 0
Leach rate of isotope changes
linearly over time
stepwise at time
Release from surface layer
Radionuclide becomes available for release
In the same manner as for release to groundwater
Beginning at time zero
Save
Cancel


Primary Contamination

Area of primary contamination:	10000	square meters
Length of contamination parallel to aquifer flow:	100	meters
Depth of soil mixing layer:	.15	meters
Mass loading of all particulates:	.0001	grams/m³
Deposition velocity of all particulates (to compute atmospheric release):	.001	meters/s
Respirable particulates as a fraction of total particulates	1	
Deposition velocity of respirable particulates (to compute atmospheric release):	.001	meters/s
Irrigation applied per year:	.2	meters in a year
Evapotranspiration coefficient:	.5	
Runoff coefficient:	.2	
Slope-length-steepness factor:	.4	
Cover and management factor:	.003	
Support practice factor:	1	
Fraction of primary contamination that is submerged	0	

Soil layer -> / Location relative to water table ->	Clean cover above	Contaminated zone below	
Thickness:	0	2	meters
Soil erodibility factor:	.4	.4	tons/acre
Dry bulk density:	1.5	1.5	grams/cm³
Erosion rate:	1.147E-05	1.147E-05	meters/year
Total porosity:	.4	.4	
Volumetric water content:	.05		
Effective porosity:		.4	
Hydraulic conductivity:		10	meters/year
Field capacity:		.3	
b parameter:		5.3	
Longitudinal dispersivity:		.05	meters

Contaminated medium

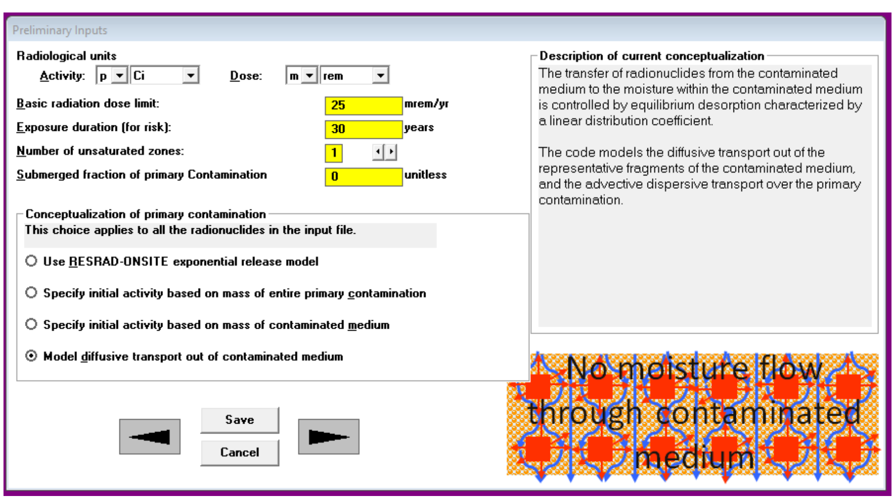
Total mass 0 kg

Total volume 0 m³

Save

Cancel

- Selected “Model diffusive transport out of contaminated medium” as the conceptualization of primary contamination in the Preliminary Inputs form. The Times at which Release Properties are Specified input form allowed the specification of up to 9th time periods. The Distribution Coefficients (allowed the specification of Kd for the contaminated medium), Radionuclide Specific Release (fixed the transfer mechanism as Equilibrium Desorption Transfer and allowed the specification of diffusion coefficient in the contaminate medium), and the Primary Contamination (allowed the specification of total mass, volume, and volumetric water content of the contaminated medium, and length, width, and breadth of the individual fragment) input forms all displayed expectedly with input parameters associated with this conceptualization option.


Preliminary Inputs

Radiological units

Activity: p Ci Dose: m rem

Basic radiation dose limit: 25 mrem/yr

Exposure duration (for risk): 30 years

Number of unsaturated zones: 1

Submerged fraction of primary Contamination 0 unitless

Conceptualization of primary contamination

This choice applies to all the radionuclides in the input file.

- Use RESRAD-ONSITE exponential release model
- Specify initial activity based on mass of entire primary contamination
- Specify initial activity based on mass of contaminated medium
- Model diffusive transport out of contaminated medium

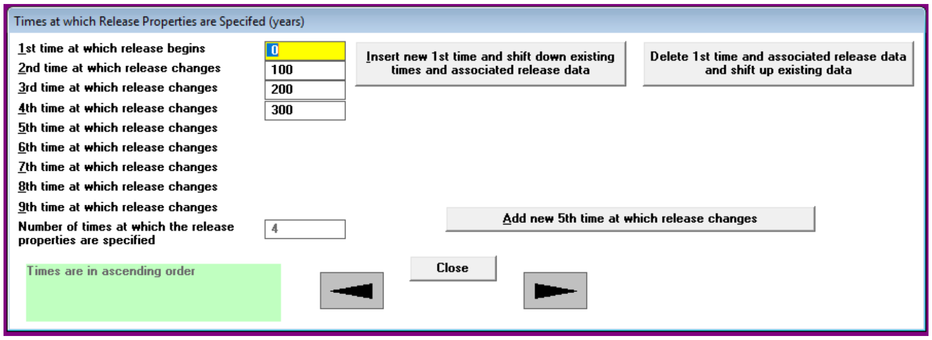
Description of current conceptualization

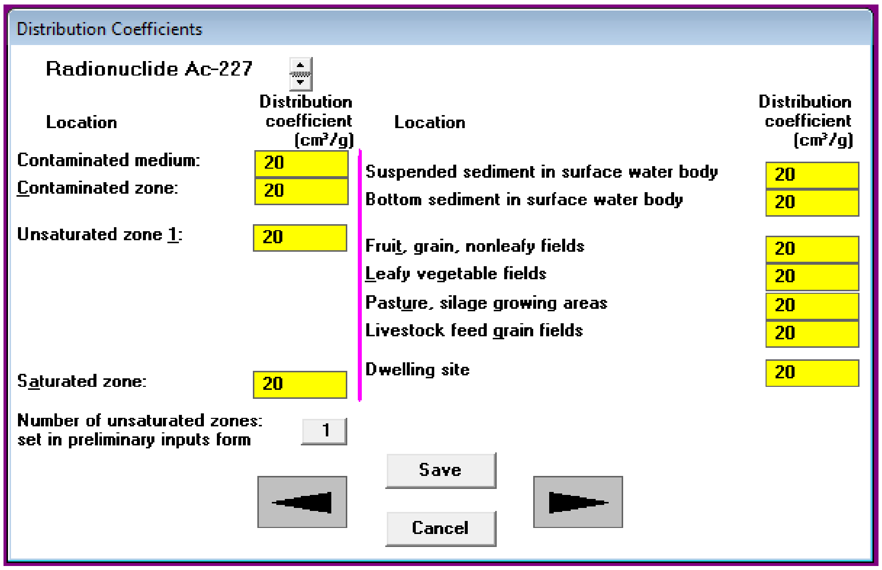
The transfer of radionuclides from the contaminated medium to the moisture within the contaminated medium is controlled by equilibrium desorption characterized by a linear distribution coefficient.

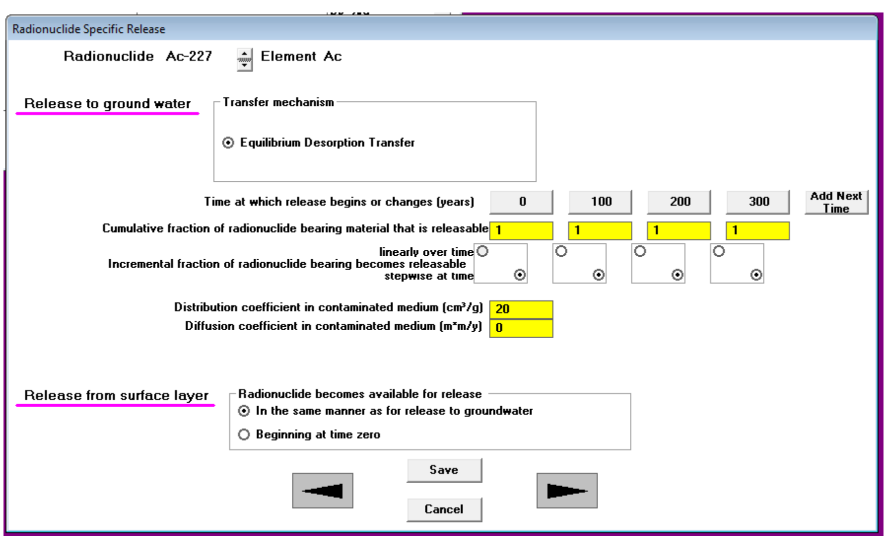
The code models the diffusive transport out of the representative fragments of the contaminated medium, and the advective dispersive transport over the primary contamination.

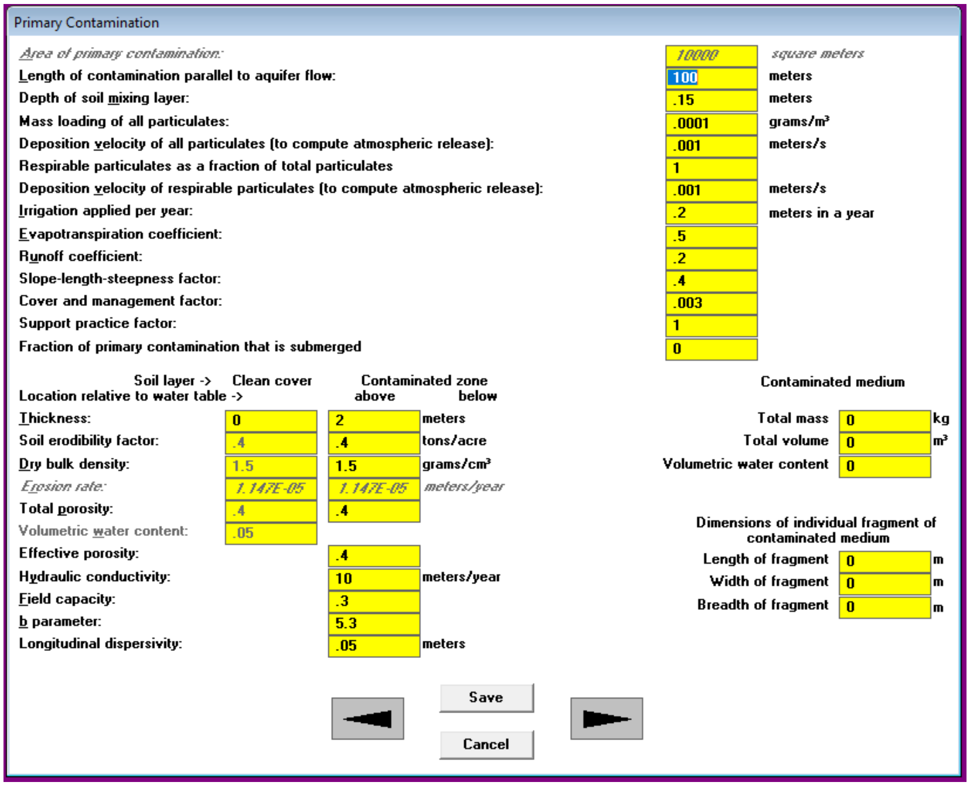
Save

Cancel


Times at which Release Properties are Specifed (years)
1st time at which release begins
2nd time at which release changes
3rd time at which release changes
4th time at which release changes
5th time at which release changes
6th time at which release changes
7th time at which release changes
8th time at which release changes
9th time at which release changes
Number of times at which the release properties are specified
0
100
200
300
4
Insert new 1st time and shift down existing times and associated release data
Delete 1st time and associated release data and shift up existing data
Add new 5th time at which release changes
Times are in ascending order
Close


Distribution Coefficients
Radionuclide Ac-227
Location
Distribution coefficient (cm³/g)
Contaminated medium: 20
Contaminated zone: 20
Unsaturated zone 1: 20
Saturated zone: 20
Number of unsaturated zones: set in preliminary inputs form 1
Location
Distribution coefficient (cm³/g)
Suspended sediment in surface water body 20
Bottom sediment in surface water body 20
Fruit, grain, nonleafy fields 20
Leafy vegetable fields 20
Pasture, silage growing areas 20
Livestock feed grain fields 20
Dwelling site 20
Save
Cancel


Radionuclide Specific Release
Radionuclide Ac-227
Element Ac
Release to ground water
Transfer mechanism
Equilibrium Desorption Transfer
Time at which release begins or changes (years) 0 100 200 300
Add Next Time
Cumulative fraction of radionuclide bearing material that is releasable 1 1 1 1
linearly over time
Incremental fraction of radionuclide bearing becomes releasable
stepwise at time
Distribution coefficient in contaminated medium (cm³/g) 20
Diffusion coefficient in contaminated medium (m*m/y) 0
Release from surface layer
Radionuclide becomes available for release
In the same manner as for release to groundwater
Beginning at time zero
Save
Cancel


Primary Contamination

Area of primary contamination:	*10000*	*square meters*
Length of contamination parallel to aquifer flow:	100	meters
Depth of soil mixing layer:	.15	meters
Mass loading of all particulates:	.0001	grams/m³
Deposition velocity of all particulates (to compute atmospheric release):	.001	meters/s
Respirable particulates as a fraction of total particulates	1	
Deposition velocity of respirable particulates (to compute atmospheric release):	.001	meters/s
Irrigation applied per year:	.2	meters in a year
Evapotranspiration coefficient:	.5	
Runoff coefficient:	.2	
Slope-length-steepness factor:	.4	
Cover and management factor:	.003	
Support practice factor:	1	
Fraction of primary contamination that is submerged	0	

Soil layer -> / Location relative to water table ->	Clean cover	Contaminated zone above / below	
Thickness:	0	2	meters
Soil erodibility factor:	.4	.4	tons/acre
Dry bulk density:	1.5	1.5	grams/cm³
Erosion rate:	*1.147E-05*	*1.147E-05*	*meters/year*
Total porosity:	.4	.4	
Volumetric water content:	.05		
Effective porosity:		.4	
Hydraulic conductivity:		10	meters/year
Field capacity:		.3	
b parameter:		5.3	
Longitudinal dispersivity:		.05	meters

Contaminated medium

Total mass	0	kg
Total volume	0	m³
Volumetric water content	0	

Dimensions of individual fragment of contaminated medium

Length of fragment	0	m
Width of fragment	0	m
Breadth of fragment	0	m

Save

Cancel

12.86 TEST CASE 054-001 TESTER'S REPORT

Documented in graph_primary_contamination_c14.csv of 2/18/2020 7:35 AM

CONCENTRATION: C-14, Primary Contamination		CONCENTRATION: C-14, Primary Contamination		
CARBON-14_test.ROF 02/17/2020 16:40		CARBON-14.ROF 01/10/2020 15:37		
Graphics.Asc		Graphics.Asc		
Year	Value	Year	Value	
0	100	0	100	1
0.0625	80.14947	0.0625	80.14947	1
0.125	64.23934	0.125	64.23934	1
0.1875	51.48744	0.1875	51.48744	1
0.25	41.26685	0.25	41.26685	1
0.3125	33.07509	0.3125	33.07509	1
0.375	26.50945	0.375	26.50945	1
0.4375	21.24711	0.4375	21.24711	1
0.5	17.02939	0.5	17.02939	1
0.5625	13.64891	0.5625	13.64891	1
0.625	10.93948	0.625	10.93948	1
0.6875	8.767893	0.6875	8.767893	1
0.75	7.027381	0.75	7.027381	1
0.8125	5.632375	0.8125	5.632375	1
0.875	4.514289	0.875	4.514289	1
0.9375	3.618154	0.9375	3.618154	1
1	2.899909	1	2.899909	1
1.0625	2.324244	1.0625	2.324244	1
1.125	1.862853	1.125	1.862853	1
1.1875	1.493054	1.1875	1.493054	1
1.25	1.196663	1.25	1.196663	1
1.3125	0.95911	1.3125	0.95911	1
1.375	0.768713	1.375	0.768713	1
1.4375	0.616113	1.4375	0.616113	1
1.5	0.493806	1.5	0.493806	1
1.5625	0.395778	1.5625	0.395778	1
1.625	0.31721	1.625	0.31721	1
1.6875	0.254239	1.6875	0.254239	1
1.75	0.203768	1.75	0.203768	1
1.8125	0.163317	1.8125	0.163317	1
1.875	0.130896	1.875	0.130896	1
1.9375	0.104911	1.9375	0.104911	1
2	0.084084	2	0.084084	1
2.0625	0.067392	2.0625	0.067392	1
2.125	0.054013	2.125	0.054013	1

12.87 TEST CASE 054-002 TESTER'S REPORT

Documented in graph_non_leafy_C14.csv of 2/18/2020 7:36 AM

CONCENTRATION: C-14, Fruit, grain, non-leafy vegetables CARBON-14_test.ROF 02/17/2020 16:40 Graphics.Asc		CONCENTRATION: C-14, Fruit, grain, non-leafy vegetables CARBON-14.ROF 01/10/2020 15:37 Graphics.Asc		
Year	Value	Year	Value	
0	1088160	0	1088160	1
0.0625	872156.9	0.0625	872156.9	1
0.125	699030.9	0.125	699030.9	1
0.1875	560270.6	0.1875	560270.6	1
0.25	449054.5	0.25	449054.5	1
0.3125	359915.1	0.3125	359915.1	1
0.375	288470.1	0.375	288470.1	1
0.4375	231207.2	0.4375	231207.2	1
0.5	185311.3	0.5	185311.3	1
0.5625	148525.8	0.5625	148525.8	1
0.625	119042.5	0.625	119042.5	1
0.6875	95411.7	0.6875	95411.7	1
0.75	76471.77	0.75	76471.77	1
0.8125	61291.53	0.8125	61291.53	1
0.875	49124.66	0.875	49124.66	1
0.9375	39373	0.9375	39373	1
1	31557.1	1	31557.1	1
1.0625	25292.72	1.0625	25292.72	1
1.125	20271.87	1.125	20271.87	1
1.1875	16247.7	1.1875	16247.7	1
1.25	13022.36	1.25	13022.36	1
1.3125	10437.28	1.3125	10437.28	1
1.375	8365.359	1.375	8365.359	1
1.4375	6704.736	1.4375	6704.736	1
1.5	5373.765	1.5	5373.765	1
1.5625	4307.005	1.5625	4307.005	1
1.625	3452.009	1.625	3452.009	1
1.6875	2766.739	1.6875	2766.739	1
1.75	2217.503	1.75	2217.503	1
1.8125	1777.297	1.8125	1777.297	1
1.875	1424.478	1.875	1424.478	1
1.9375	1141.698	1.9375	1141.698	1
2	915.0533	2	915.0533	1
2.0625	733.4008	2.0625	733.4008	1
2.125	587.809	2.125	587.809	1

Documented in Graph_leafy_vegetable_c14.csv of 2/18/2020 7:37 AM

CONCENTRATION: C-14, Leafy vegetable		CONCENTRATION: C-14, Leafy vegetable		
CARBON-14_test.ROF 02/17/2020 16:40		CARBON-14.ROF 01/10/2020 15:37		
Graphics.Asc		Graphics.Asc		
Year	Value	Year	Value	
0	208495.3	0	208495.3	1
0.0625	167108.3	0.0625	167108.3	1
0.125	133936.8	0.125	133936.8	1
0.1875	107349.8	0.1875	107349.8	1
0.25	86040.41	0.25	86040.41	1
0.3125	68960.99	0.3125	68960.99	1
0.375	55271.89	0.375	55271.89	1
0.4375	44300.11	0.4375	44300.11	1
0.5	35506.29	0.5	35506.29	1
0.5625	28458.07	0.5625	28458.07	1
0.625	22808.95	0.625	22808.95	1
0.6875	18281.22	0.6875	18281.22	1
0.75	14652.26	0.75	14652.26	1
0.8125	11743.67	0.8125	11743.67	1
0.875	9412.457	0.875	9412.457	1
0.9375	7544.004	0.9375	7544.004	1
1	6046.451	1	6046.451	1
1.0625	4846.174	1.0625	4846.174	1
1.125	3884.161	1.125	3884.161	1
1.1875	3113.115	1.1875	3113.115	1
1.25	2495.129	1.25	2495.129	1
1.3125	1999.819	1.3125	1999.819	1
1.375	1602.832	1.375	1602.832	1
1.4375	1284.651	1.4375	1284.651	1
1.5	1029.632	1.5	1029.632	1
1.5625	825.2372	1.5625	825.2372	1
1.625	661.417	1.625	661.417	1
1.6875	530.1169	1.6875	530.1169	1
1.75	424.8814	1.75	424.8814	1
1.8125	340.5364	1.8125	340.5364	1
1.875	272.935	1.875	272.935	1
1.9375	218.7533	1.9375	218.7533	1
2	175.3274	2	175.3274	1
2.0625	140.5222	2.0625	140.5222	1
2.125	112.6263	2.125	112.6263	1

12.88 TEST CASE 054-003 TESTER'S REPORT

Documented in graph_meat_c14.csv of 2/18/2020 7:38 AM

CONCENTRATION: C-14, Meat		CONCENTRATION: C-14, Meat		
CARBON-14_test.ROF 02/17/2020 16:40		CARBON-14.ROF 01/10/2020 15:37		
Graphics.Asc		Graphics.Asc		
Year	Value	Year	Value	
0	330987.8	0	330987.8	1
0.0625	265285.7	0.0625	265285.7	1
0.125	212625.6	0.125	212625.6	1
0.1875	170418.6	0.1875	170418.6	1
0.25	136589.8	0.25	136589.8	1
0.3125	109476.1	0.3125	109476.1	1
0.375	87744.52	0.375	87744.52	1
0.4375	70326.75	0.4375	70326.75	1
0.5	56366.48	0.5	56366.48	1
0.5625	45177.38	0.5625	45177.38	1
0.625	36209.38	0.625	36209.38	1
0.6875	29021.56	0.6875	29021.56	1
0.75	23260.57	0.75	23260.57	1
0.8125	18643.16	0.8125	18643.16	1
0.875	14942.34	0.875	14942.34	1
0.9375	11976.16	0.9375	11976.16	1
1	9598.785	1	9598.785	1
1.0625	7693.335	1.0625	7693.335	1
1.125	6166.134	1.125	6166.134	1
1.1875	4942.093	1.1875	4942.093	1
1.25	3961.036	1.25	3961.036	1
1.3125	3174.727	1.3125	3174.727	1
1.375	2544.507	1.375	2544.507	1
1.4375	2039.393	1.4375	2039.393	1
1.5	1634.548	1.5	1634.548	1
1.5625	1310.07	1.5625	1310.07	1
1.625	1050.004	1.625	1050.004	1
1.6875	841.5643	1.6875	841.5643	1
1.75	674.5023	1.75	674.5023	1
1.8125	540.604	1.8125	540.604	1
1.875	433.2862	1.875	433.2862	1
1.9375	347.2724	1.9375	347.2724	1
2	278.3336	2	278.3336	1
2.0625	223.08	2.0625	223.08	1
2.125	178.795	2.125	178.795	1

Documented in graph_Milk_c14.csv of 2/18/2020 7:39 AM

CONCENTRATION: C-14, Milk CARBON-14_test.ROF 02/17/2020 16:40 Graphics.Asc		CONCENTRATION: C-14, Milk CARBON-14.ROF 01/10/2020 15:37 Graphics.Asc		
Year	Value	Year	Value	
0	78818.34	0	78818.34	1
0.0625	63172.66	0.0625	63172.66	1
0.125	50632.68	0.125	50632.68	1
0.1875	40581.89	0.1875	40581.89	1
0.25	32526.22	0.25	32526.22	1
0.3125	26069.61	0.3125	26069.61	1
0.375	20894.66	0.375	20894.66	1
0.4375	16746.96	0.4375	16746.96	1
0.5	13422.59	0.5	13422.59	1
0.5625	10758.12	0.5625	10758.12	1
0.625	8622.565	0.625	8622.565	1
0.6875	6910.925	0.6875	6910.925	1
0.75	5539.056	0.75	5539.056	1
0.8125	4439.51	0.8125	4439.51	1
0.875	3558.231	0.875	3558.231	1
0.9375	2851.892	0.9375	2851.892	1
1	2285.765	1	2285.765	1
1.0625	1832.019	1.0625	1832.019	1
1.125	1468.346	1.125	1468.346	1
1.1875	1176.864	1.1875	1176.864	1
1.25	943.2442	1.25	943.2442	1
1.3125	755.9999	1.3125	755.9999	1
1.375	605.9253	1.375	605.9253	1
1.4375	485.642	1.4375	485.642	1
1.5	389.2361	1.5	389.2361	1
1.5625	311.9679	1.5625	311.9679	1
1.625	250.0383	1.625	250.0383	1
1.6875	200.4023	1.6875	200.4023	1
1.75	160.6197	1.75	160.6197	1
1.8125	128.7344	1.8125	128.7344	1
1.875	103.1788	1.875	103.1788	1
1.9375	82.69623	1.9375	82.69623	1
2	66.27976	2	66.27976	1
2.0625	53.12218	2.0625	53.12218	1
2.125	42.57657	2.125	42.57657	1

12.89 TEST CASE 054-004 TESTER'S REPORT

Documented in graph_primary_Contamination_H3.csv of 2/18/2020 7:44 AM

CONCENTRATION: H-3, Primary Contamination		CONCENTRATION: H-3, Primary Contamination		
HYDROGEN-3_test.ROF 02/17/2020 16:53		Hydrogen-3.ROF 01/12/2020 18:07		
Graphics.Asc		Graphics.Asc		
Year	Value	Year	Value	
0	100	0	100	1
0.0625	91.13956	0.0625	91.13956	1
0.125	83.06419	0.125	83.06419	1
0.1875	75.70432	0.1875	75.70432	1
0.25	68.99655	0.25	68.99655	1
0.3125	62.88312	0.3125	62.88312	1
0.375	57.31136	0.375	57.31136	1
0.4375	52.23329	0.4375	52.23329	1
0.5	47.60515	0.5	47.60515	1
0.5625	43.38708	0.5625	43.38708	1
0.625	39.54275	0.625	39.54275	1
0.6875	36.03905	0.6875	36.03905	1
0.75	32.84579	0.75	32.84579	1
0.8125	29.93546	0.8125	29.93546	1
0.875	27.28301	0.875	27.28301	1
0.9375	24.86557	0.9375	24.86557	1
1	22.66233	1	22.66233	1
1.0625	20.65431	1.0625	20.65431	1
1.125	18.82421	1.125	18.82421	1
1.1875	17.15627	1.1875	17.15627	1
1.25	15.63611	1.25	15.63611	1
1.3125	14.25065	1.3125	14.25065	1
1.375	12.98795	1.375	12.98795	1
1.4375	11.83713	1.4375	11.83713	1
1.5	10.78828	1.5	10.78828	1
1.5625	9.832363	1.5625	9.832363	1
1.625	8.961145	1.625	8.961145	1
1.6875	8.167124	1.6875	8.167124	1
1.75	7.443457	1.75	7.443457	1
1.8125	6.783911	1.8125	6.783911	1
1.875	6.182806	1.875	6.182806	1
1.9375	5.634963	1.9375	5.634963	1
2	5.135662	2	5.135662	1
2.0625	4.680602	2.0625	4.680602	1
2.125	4.265863	2.125	4.265863	1

12.90 TEST CASE 054-005 TESTER'S REPORT

Documented in Graph_leafy_vegetable_h3.csv of 2/18/2020 7:42 AM

CONCENTRATION: H-3, Leafy vegetable		CONCENTRATION: H-3, Leafy vegetable		
HYDROGEN-3_test.ROF 02/17/2020 16:53		Hydrogen-3.ROF 01/12/2020 18:07		
Graphics.Asc		Graphics.Asc		
Year	Value	Year	Value	
0	0.026339	0	0.026339	1
0.0625	0.026394	0.0625	0.026394	1
0.125	0.025244	0.125	0.025244	1
0.1875	0.023599	0.1875	0.023599	1
0.25	0.021803	0.25	0.021803	1
0.3125	0.020017	0.3125	0.020017	1
0.375	0.018317	0.375	0.018317	1
0.4375	0.01673	0.4375	0.01673	1
0.5	0.015266	0.5	0.015266	1
0.5625	0.013922	0.5625	0.013922	1
0.625	0.012693	0.625	0.012693	1
0.6875	0.011571	0.6875	0.011571	1
0.75	0.010547	0.75	0.010547	1
0.8125	0.009613	0.8125	0.009613	1
0.875	0.008761	0.875	0.008761	1
0.9375	0.007985	0.9375	0.007985	1
1	0.007278	1	0.007278	1
1.0625	0.006633	1.0625	0.006633	1
1.125	0.006045	1.125	0.006045	1
1.1875	0.00551	1.1875	0.00551	1
1.25	0.005021	1.25	0.005021	1
1.3125	0.004576	1.3125	0.004576	1
1.375	0.004171	1.375	0.004171	1
1.4375	0.003801	1.4375	0.003801	1
1.5	0.003465	1.5	0.003465	1
1.5625	0.003158	1.5625	0.003158	1
1.625	0.002878	1.625	0.002878	1
1.6875	0.002623	1.6875	0.002623	1
1.75	0.00239	1.75	0.00239	1
1.8125	0.002179	1.8125	0.002179	1
1.875	0.001986	1.875	0.001986	1
1.9375	0.00181	1.9375	0.00181	1
2	0.001649	2	0.001649	1
2.0625	0.001503	2.0625	0.001503	1
2.125	0.00137	2.125	0.00137	1

Documented in graph_non_leafy_h3.csv of 2/18/2020 7:43 AM

CONCENTRATION: H-3, Fruit, grain, non-leafy vegetables		CONCENTRATION: H-3, Fruit, grain, non-leafy vegetables		
HYDROGEN-3_test.ROF 02/17/2020 16:53		Hydrogen-3.ROF 01/12/2020 18:07		
Graphics.Asc		Graphics.Asc		
Year	Value	Year	Value	
0	0.006495	0	0.006495	1
0.0625	0.008745	0.0625	0.008745	1
0.125	0.009377	0.125	0.009377	1
0.1875	0.009246	0.1875	0.009246	1
0.25	0.008775	0.25	0.008775	1
0.3125	0.008171	0.3125	0.008171	1
0.375	0.007533	0.375	0.007533	1
0.4375	0.006908	0.4375	0.006908	1
0.5	0.006318	0.5	0.006318	1
0.5625	0.005768	0.5625	0.005768	1
0.625	0.005263	0.625	0.005263	1
0.6875	0.004799	0.6875	0.004799	1
0.75	0.004375	0.75	0.004375	1
0.8125	0.003988	0.8125	0.003988	1
0.875	0.003635	0.875	0.003635	1
0.9375	0.003313	0.9375	0.003313	1
1	0.00302	1	0.00302	1
1.0625	0.002752	1.0625	0.002752	1
1.125	0.002508	1.125	0.002508	1
1.1875	0.002286	1.1875	0.002286	1
1.25	0.002084	1.25	0.002084	1
1.3125	0.001899	1.3125	0.001899	1
1.375	0.001731	1.375	0.001731	1
1.4375	0.001577	1.4375	0.001577	1
1.5	0.001438	1.5	0.001438	1
1.5625	0.00131	1.5625	0.00131	1
1.625	0.001194	1.625	0.001194	1
1.6875	0.001088	1.6875	0.001088	1
1.75	0.000992	1.75	0.000992	1
1.8125	0.000904	1.8125	0.000904	1
1.875	0.000824	1.875	0.000824	1
1.9375	0.000751	1.9375	0.000751	1
2	0.000684	2	0.000684	1
2.0625	0.000624	2.0625	0.000624	1
2.125	0.000568	2.125	0.000568	1

12.91 TEST CASE 054-006 TESTER'S REPORT

Documented in graph_Milk_h3.csv of 2/18/2020 7:41 AM

CONCENTRATION: H-3, Milk		CONCENTRATION: H-3, Milk		
HYDROGEN-3_test.ROF 02/17/2020 16:53		Hydrogen-3.ROF 01/12/2020 18:07		
Graphics.Asc		Graphics.Asc		
Year	Value	Year	Value	
0	0.002015	0	0.002015	1
0.0625	0.002059	0.0625	0.002059	1
0.125	0.001988	0.125	0.001988	1
0.1875	0.001867	0.1875	0.001867	1
0.25	0.001729	0.25	0.001729	1
0.3125	0.00159	0.3125	0.00159	1
0.375	0.001456	0.375	0.001456	1
0.4375	0.00133	0.4375	0.00133	1
0.5	0.001214	0.5	0.001214	1
0.5625	0.001107	0.5625	0.001107	1
0.625	0.001009	0.625	0.001009	1
0.6875	0.00092	0.6875	0.00092	1
0.75	0.000839	0.75	0.000839	1
0.8125	0.000764	0.8125	0.000764	1
0.875	0.000697	0.875	0.000697	1
0.9375	0.000635	0.9375	0.000635	1
1	0.000579	1	0.000579	1
1.0625	0.000528	1.0625	0.000528	1
1.125	0.000481	1.125	0.000481	1
1.1875	0.000438	1.1875	0.000438	1
1.25	0.000399	1.25	0.000399	1
1.3125	0.000364	1.3125	0.000364	1
1.375	0.000332	1.375	0.000332	1
1.4375	0.000302	1.4375	0.000302	1
1.5	0.000276	1.5	0.000276	1
1.5625	0.000251	1.5625	0.000251	1
1.625	0.000229	1.625	0.000229	1
1.6875	0.000209	1.6875	0.000209	1
1.75	0.00019	1.75	0.00019	1
1.8125	0.000173	1.8125	0.000173	1
1.875	0.000158	1.875	0.000158	1
1.9375	0.000144	1.9375	0.000144	1
2	0.000131	2	0.000131	1
2.0625	0.00012	2.0625	0.00012	1
2.125	0.000109	2.125	0.000109	1

Documented in graph_meat_h3.csv of 2/18/2020 7:42 AM

CONCENTRATION: H-3, Meat		CONCENTRATION: H-3, Meat		
HYDROGEN-3_test.ROF 02/17/2020 16:53		Hydrogen-3.ROF 01/12/2020 18:07		
Graphics.Asc		Graphics.Asc		
Year	Value	Year	Value	
0	0.001814	0	0.001814	1
0.0625	0.002167	0.0625	0.002167	1
0.125	0.00223	0.125	0.00223	1
0.1875	0.00216	0.1875	0.00216	1
0.25	0.002032	0.25	0.002032	1
0.3125	0.001883	0.3125	0.001883	1
0.375	0.001732	0.375	0.001732	1
0.4375	0.001586	0.4375	0.001586	1
0.5	0.00145	0.5	0.00145	1
0.5625	0.001323	0.5625	0.001323	1
0.625	0.001207	0.625	0.001207	1
0.6875	0.0011	0.6875	0.0011	1
0.75	0.001003	0.75	0.001003	1
0.8125	0.000914	0.8125	0.000914	1
0.875	0.000833	0.875	0.000833	1
0.9375	0.00076	0.9375	0.00076	1
1	0.000692	1	0.000692	1
1.0625	0.000631	1.0625	0.000631	1
1.125	0.000575	1.125	0.000575	1
1.1875	0.000524	1.1875	0.000524	1
1.25	0.000478	1.25	0.000478	1
1.3125	0.000435	1.3125	0.000435	1
1.375	0.000397	1.375	0.000397	1
1.4375	0.000362	1.4375	0.000362	1
1.5	0.00033	1.5	0.00033	1
1.5625	0.0003	1.5625	0.0003	1
1.625	0.000274	1.625	0.000274	1
1.6875	0.00025	1.6875	0.00025	1
1.75	0.000227	1.75	0.000227	1
1.8125	0.000207	1.8125	0.000207	1
1.875	0.000189	1.875	0.000189	1
1.9375	0.000172	1.9375	0.000172	1
2	0.000157	2	0.000157	1
2.0625	0.000143	2.0625	0.000143	1
2.125	0.00013	2.125	0.00013	1

12.92 TEST CASE 111 TESTER'S REPORT

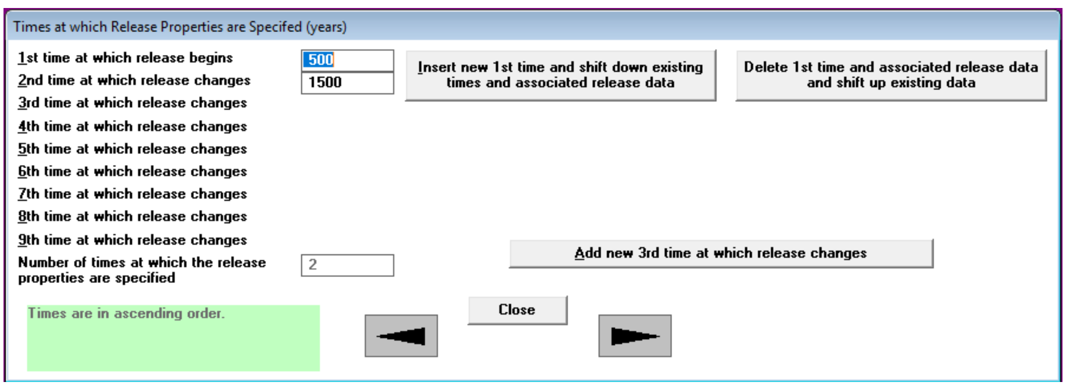
Documented in Test Case 111-JJCheng.docx of 2/20/2020 8:23 AM

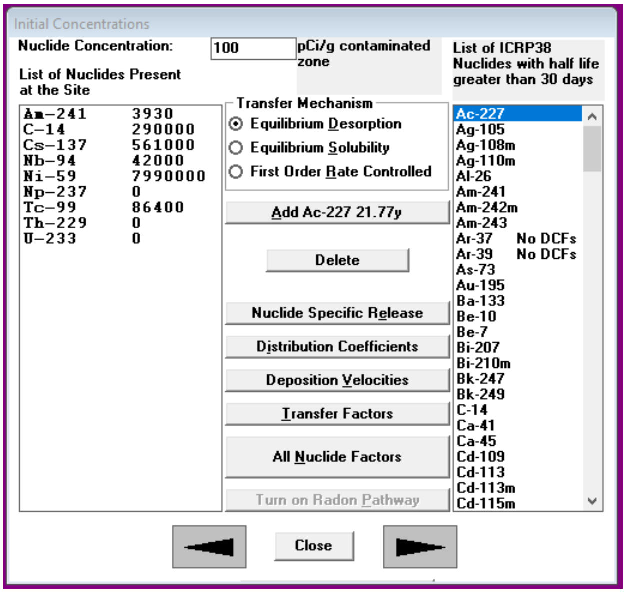
Test Case – 111 – Tests Offsite Activated Metal Case I: new source term

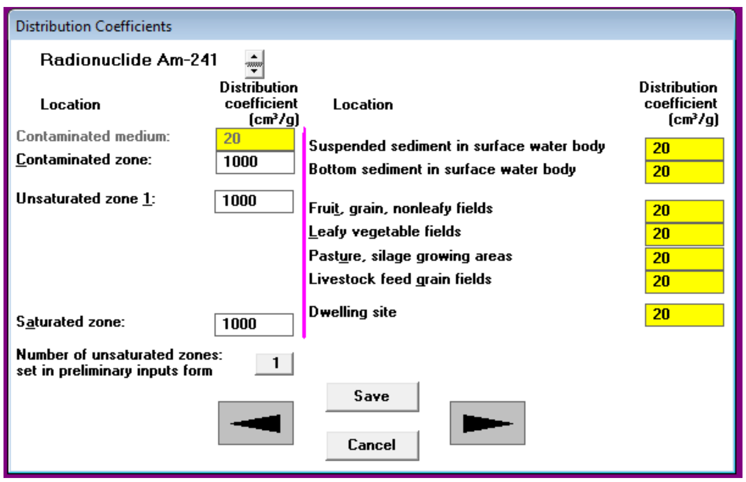
- Suggestions for revising the test descriptions in the Test Cases document -

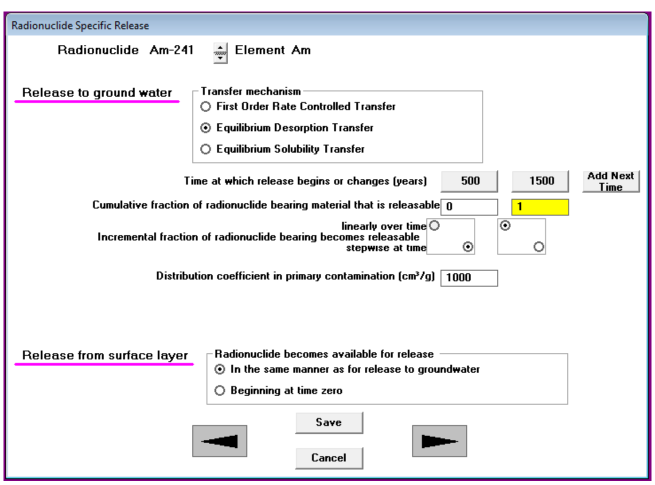
Test Summary	Test OFFSITE's new source term model: Case I - activated metal with uniform release for 1000 years
Test Objective	Test features of OFFSITE new source term model to simulate uniform release for 1000 years after delay for 500 years
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.3

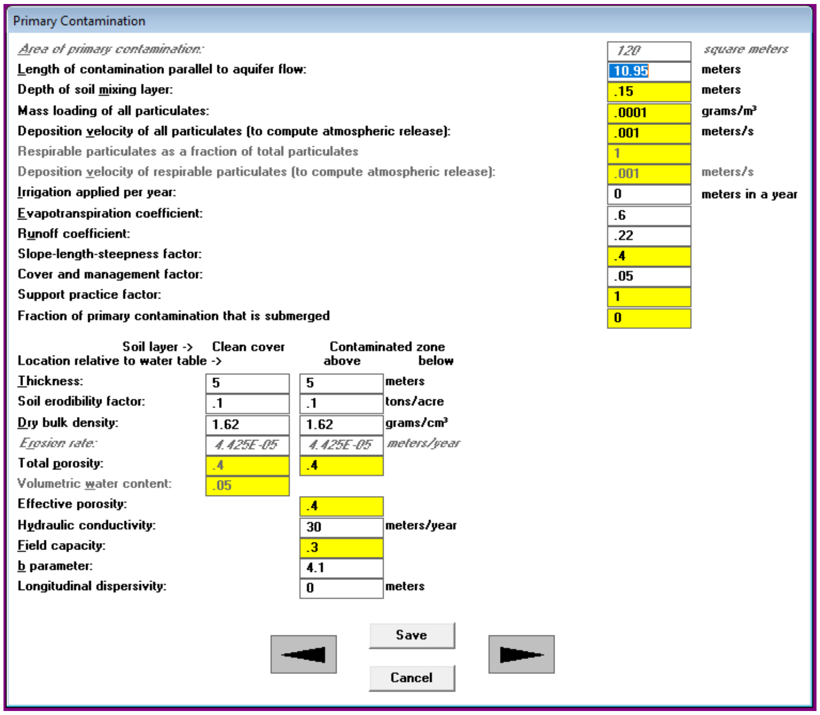
- Launched RESRAD-OFFSITE. Opened the input file, ACTIVATED METAL-500_1000 CONSTANT.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -




Initial Concentrations
Nuclide Concentration:
100
pCi/g contaminated zone
List of ICRP38 Nuclides with half life greater than 30 days
List of Nuclides Present at the Site
Am-241 3930
C-14 290000
Cs-137 561000
Nb-94 42000
Ni-59 7990000
Np-237 0
Tc-99 86400
Th-229 0
U-233 0
Transfer Mechanism
Equilibrium Desorption
Equilibrium Solubility
First Order Rate Controlled
Add Ac-227 21.77y
Delete
Nuclide Specific Release
Distribution Coefficients
Deposition Velocities
Transfer Factors
All Nuclide Factors
Turn on Radon Pathway
Ac-227
Ag-105
Ag-108m
Ag-110m
Al-26
Am-241
Am-242m
Am-243
Ar-37 No DCFs
Ar-39 No DCFs
As-73
Au-195
Ba-133
Be-10
Be-7
Bi-207
Bi-210m
Bk-247
Bk-249
C-14
Ca-41
Ca-45
Cd-109
Cd-113
Cd-113m
Cd-115m
Close


Distribution Coefficients
Radionuclide Am-241
Location
Distribution coefficient (cm³/g)
Contaminated medium: 20
Contaminated zone: 1000
Unsaturated zone 1: 1000
Saturated zone: 1000
Number of unsaturated zones: set in preliminary inputs form 1
Suspended sediment in surface water body 20
Bottom sediment in surface water body 20
Fruit, grain, nonleafy fields 20
Leafy vegetable fields 20
Pasture, silage growing areas 20
Livestock feed grain fields 20
Dwelling site 20
Save
Cancel


Radionuclide Specific Release
Radionuclide Am-241
Element Am
Release to ground water
Transfer mechanism
First Order Rate Controlled Transfer
Equilibrium Desorption Transfer
Equilibrium Solubility Transfer
Time at which release begins or changes (years) 500 1500
Add Next Time
Cumulative fraction of radionuclide bearing material that is releasable 0 1
linearly over time
Incremental fraction of radionuclide bearing becomes releasable
stepwise at time
Distribution coefficient in primary contamination (cm³/g) 1000
Release from surface layer
Radionuclide becomes available for release
In the same manner as for release to groundwater
Beginning at time zero
Save
Cancel



- Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-3 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test case used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)

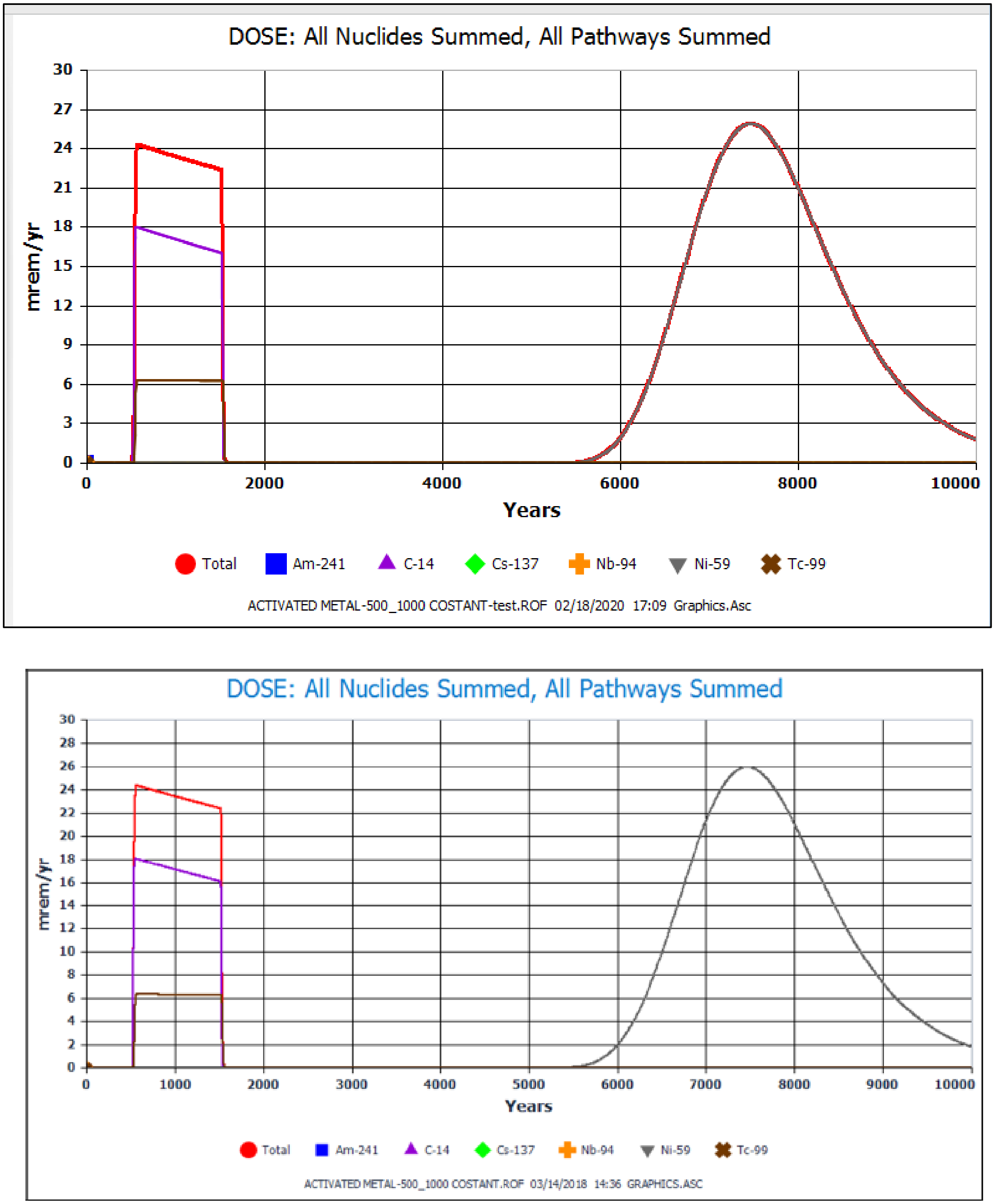


Figure M-3 Potential Radiation Dose Associated with Disposal of Activated Metals—Delayed Releases for 500 years

12.93 TEST CASE 112 TESTER'S REPORT

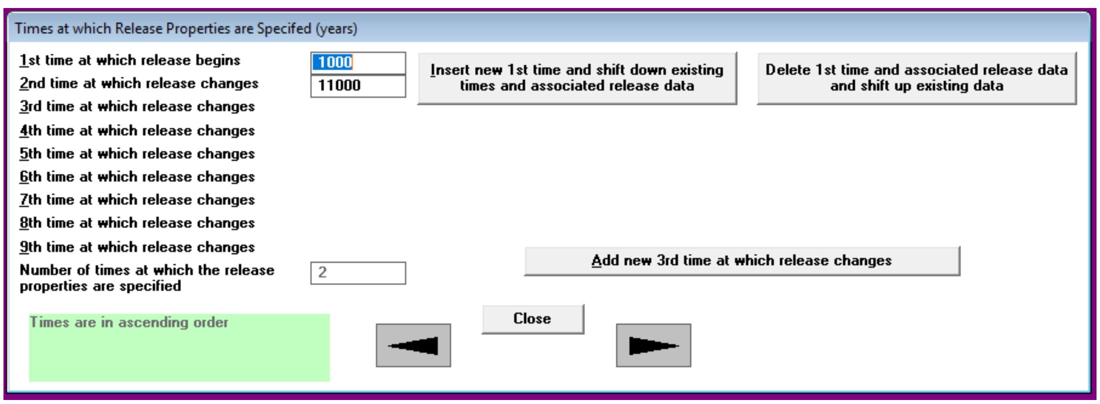
Documented in Test Case 112-JJCheng.docx of 2/20/2020 8:09 AM

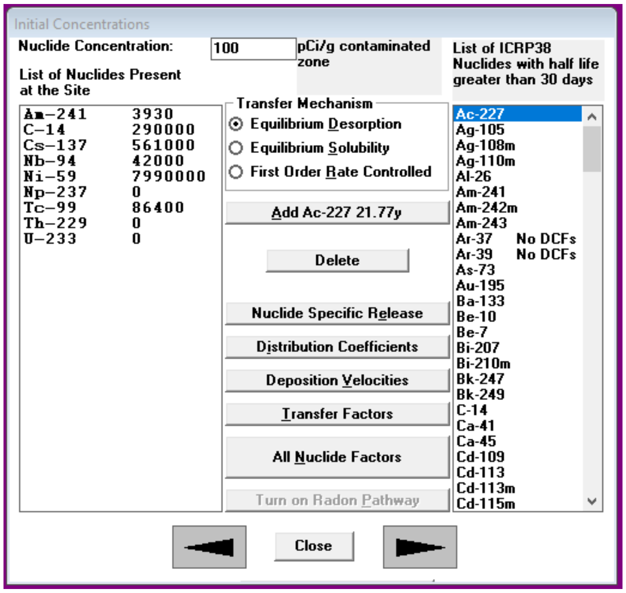
Test Case – 112 – Tests Offsite Activated Metal Case II: new source term

- Suggestions for revising the test descriptions in the Test Cases document -

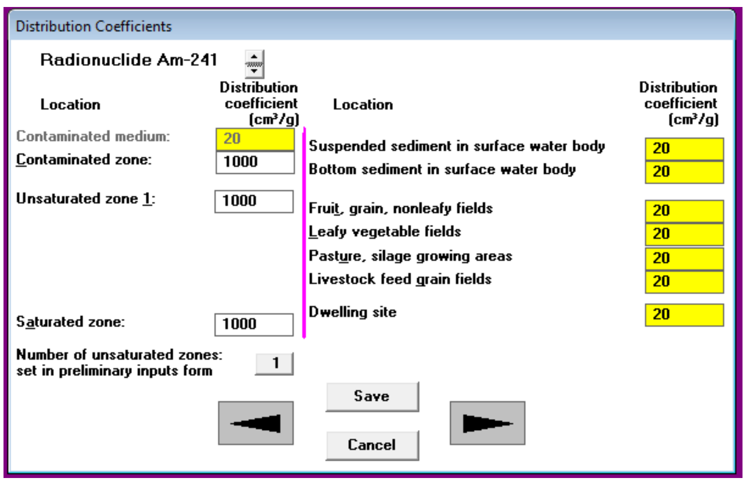
Test Summary	Test OFFSITE's new source term model: Case II - activated metal with uniform release for 10,000 years
Test Objective	Test features of OFFSITE new source term model to simulate uniform release for 10,000 years after delay for 1000 years
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.13

- Launched RESRAD-OFFSITE. Opened the input file, ACTIVATED METAL-1000_10000 CONSTANT.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -

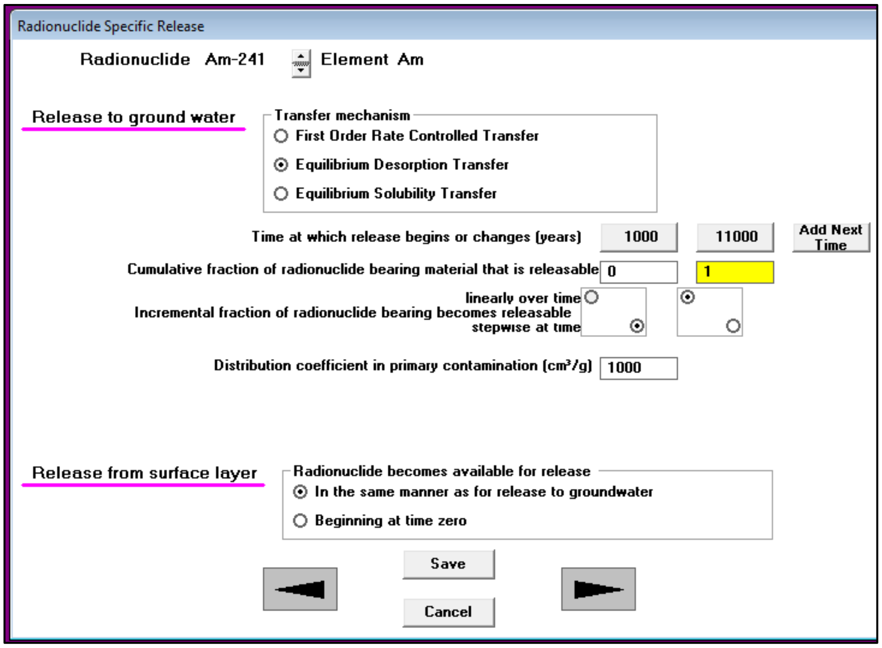


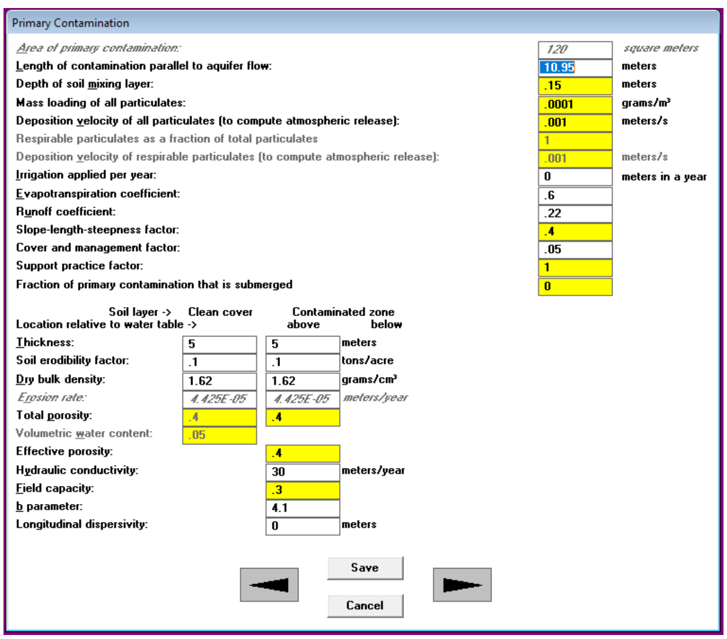


Initial Concentrations
Nuclide Concentration:
100
pCi/g contaminated zone
List of ICRP38 Nuclides with half life greater than 30 days
List of Nuclides Present at the Site
Am-241 3930
C-14 290000
Cs-137 561000
Nb-94 42000
Ni-59 7990000
Np-237 0
Tc-99 86400
Th-229 0
U-233 0
Transfer Mechanism
Equilibrium Desorption
Equilibrium Solubility
First Order Rate Controlled
Add Ac-227 21.77y
Delete
Nuclide Specific Release
Distribution Coefficients
Deposition Velocities
Transfer Factors
All Nuclide Factors
Turn on Radon Pathway
Ac-227
Ag-105
Ag-108m
Ag-110m
Al-26
Am-241
Am-242m
Am-243
Ar-37 No DCFs
Ar-39 No DCFs
As-73
Au-195
Ba-133
Be-10
Be-7
Bi-207
Bi-210m
Bk-247
Bk-249
C-14
Ca-41
Ca-45
Cd-109
Cd-113
Cd-113m
Cd-115m
Close



Distribution Coefficients
Radionuclide Am-241
Location
Distribution coefficient (cm³/g)
Location
Distribution coefficient (cm³/g)
Contaminated medium: 20
Contaminated zone: 1000
Unsaturated zone 1: 1000
Saturated zone: 1000
Number of unsaturated zones: set in preliminary inputs form 1
Suspended sediment in surface water body 20
Bottom sediment in surface water body 20
Fruit, grain, nonleafy fields 20
Leafy vegetable fields 20
Pasture, silage growing areas 20
Livestock feed grain fields 20
Dwelling site 20
Save
Cancel

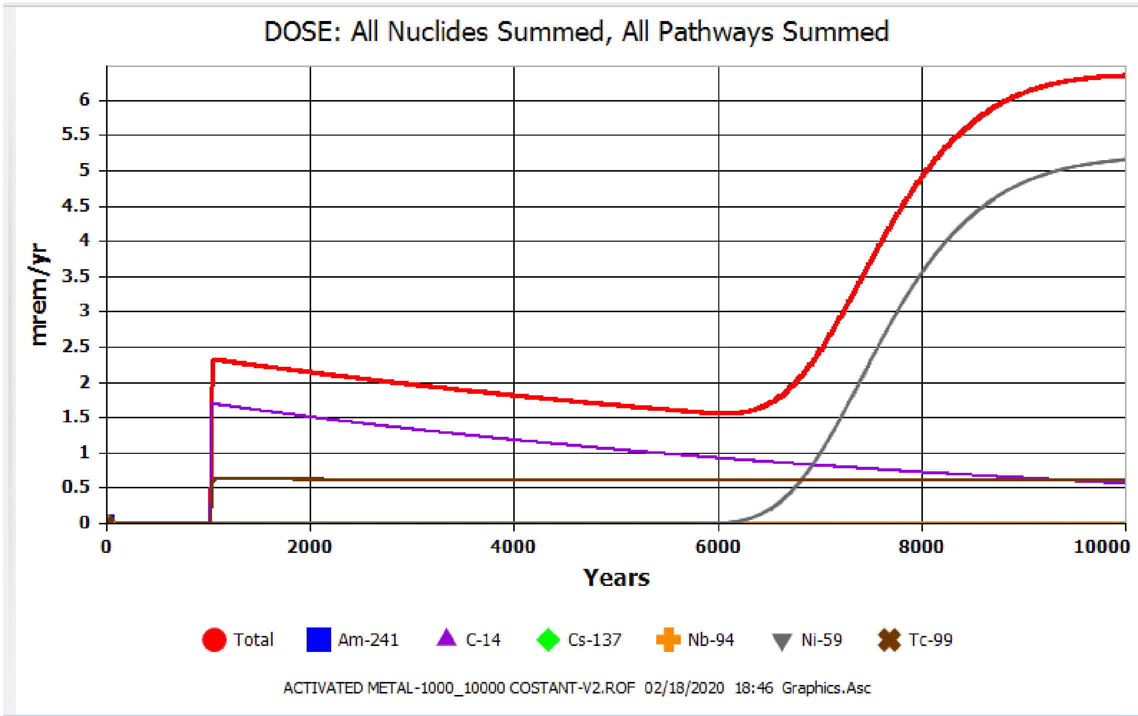




- Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-24 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix

M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)



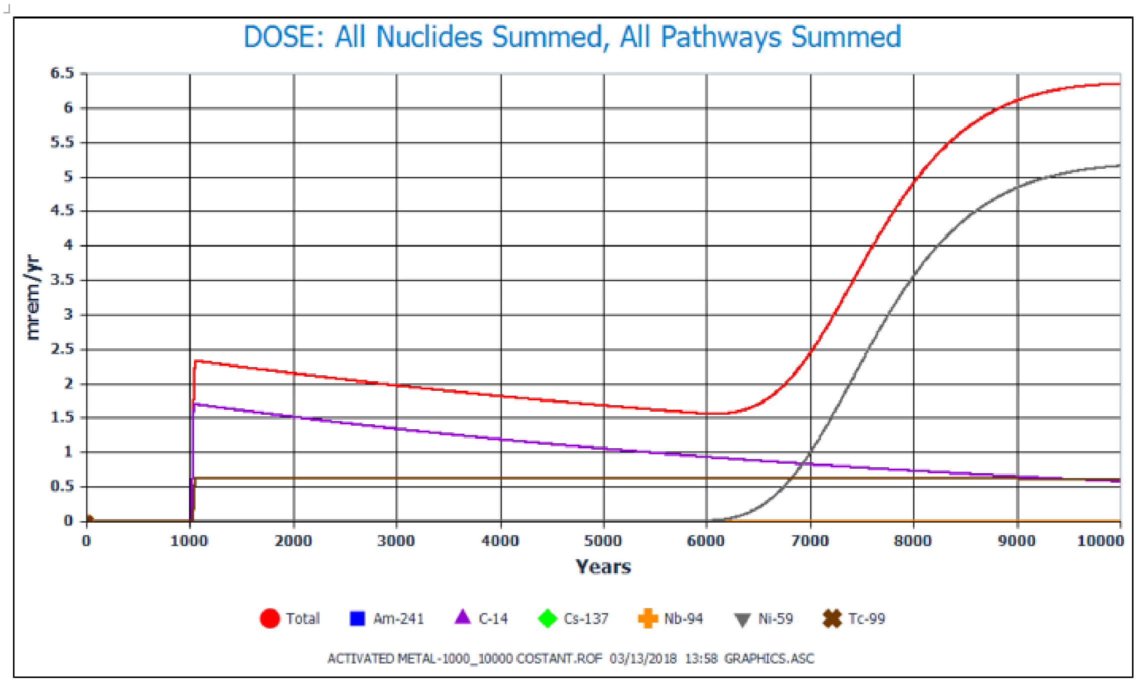


Figure M-13 Potential Radiation Dose Associated with Disposal of Activated Metals—Delayed Releases for 1,000 years

12.94 TEST CASE 113 TESTER'S REPORT

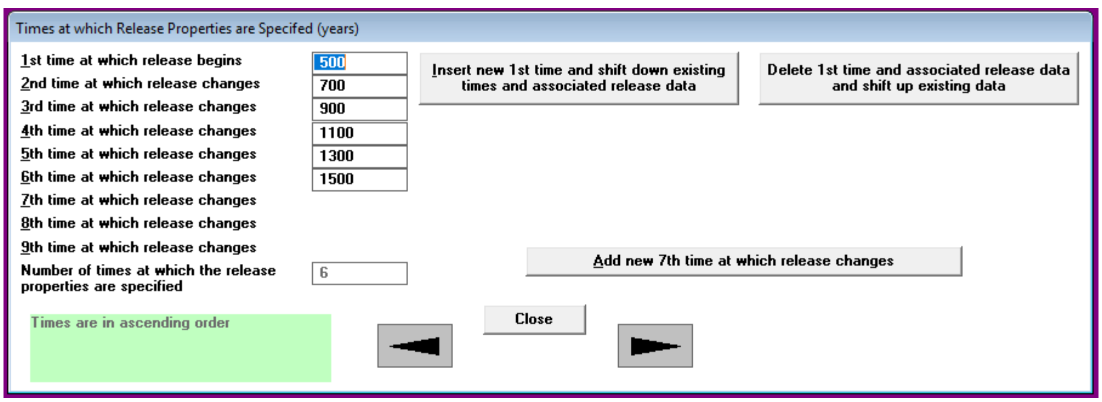
Documented in Test Case 113-JJCheng.docx of 2/20/2020 8:15 AM

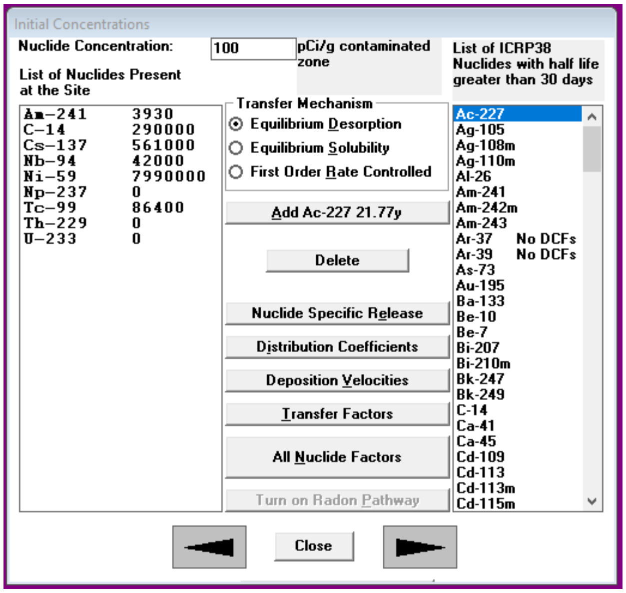
Test Case – 113 – Tests Offsite Activated Metal Case III: increasing corrosion rate

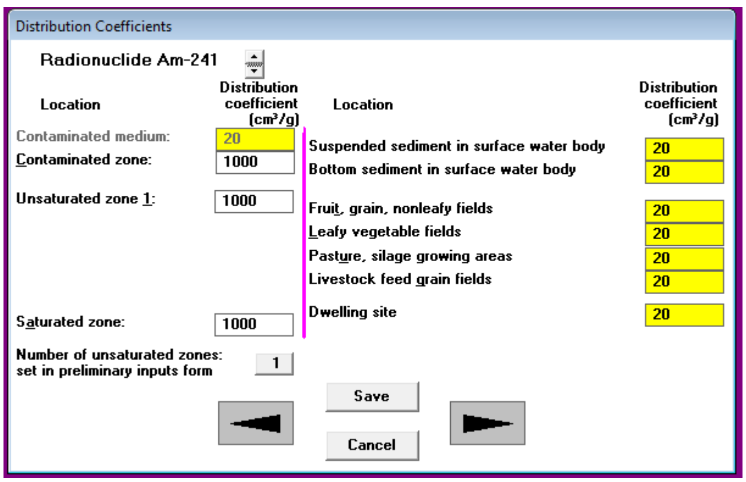
- Suggestions for revising the test descriptions in the Test Cases document -

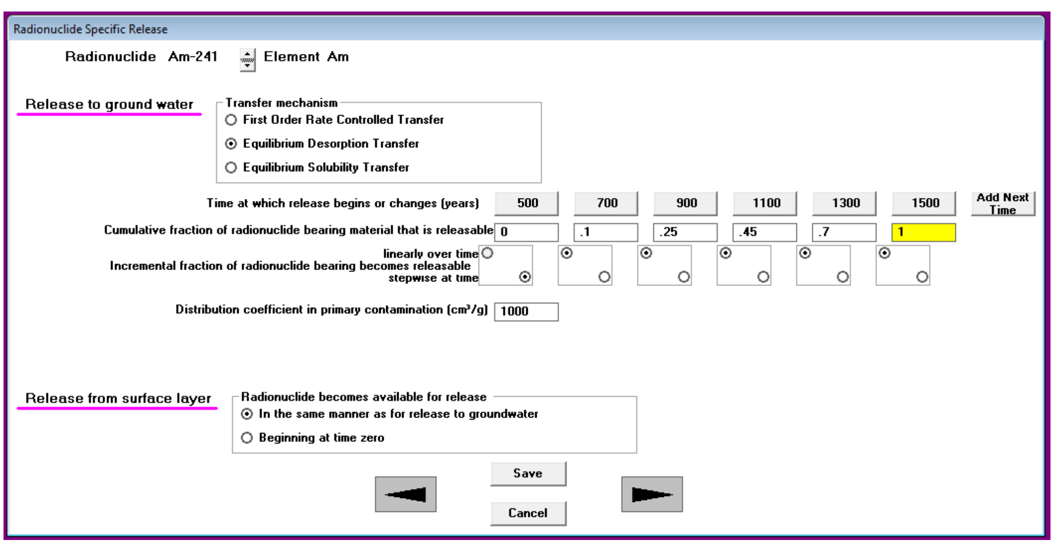
Test Summary	Test OFFSITE's new source term model: Case III - activated metal with increasing uniform release
Test Objective	Test features of OFFSITE new source term model to simulate uniform release with an increasing release rate over time
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.24

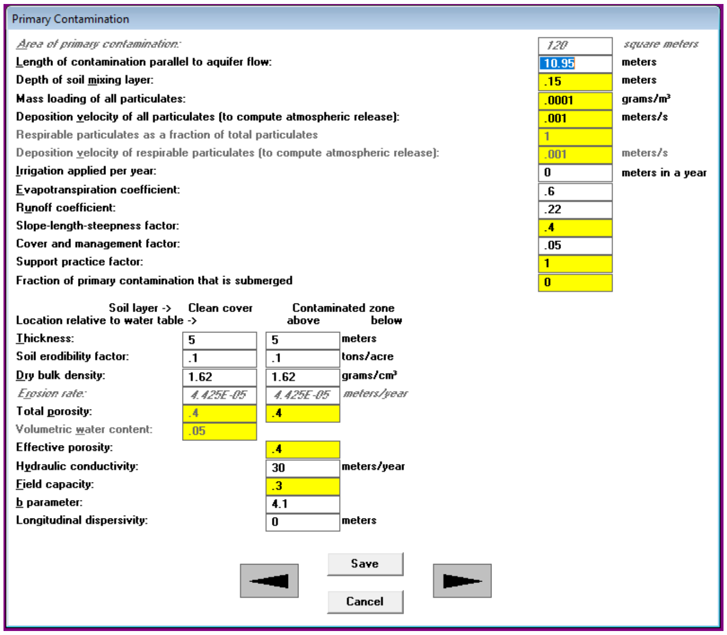
- Launched RESRAD-OFFSITE. Opened the input file, ACTIVATED METAL-500_1000 INCREASE.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -




Initial Concentrations
Nuclide Concentration:
100
pCi/g contaminated zone
List of ICRP38 Nuclides with half life greater than 30 days
List of Nuclides Present at the Site
Am-241 3930
C-14 290000
Cs-137 561000
Nb-94 42000
Ni-59 7990000
Np-237 0
Tc-99 86400
Th-229 0
U-233 0
Transfer Mechanism
Equilibrium Desorption
Equilibrium Solubility
First Order Rate Controlled
Add Ac-227 21.77y
Delete
Nuclide Specific Release
Distribution Coefficients
Deposition Velocities
Transfer Factors
All Nuclide Factors
Turn on Radon Pathway
Ac-227
Ag-105
Ag-108m
Ag-110m
Al-26
Am-241
Am-242m
Am-243
Ar-37 No DCFs
Ar-39 No DCFs
As-73
Au-195
Ba-133
Be-10
Be-7
Bi-207
Bi-210m
Bk-247
Bk-249
C-14
Ca-41
Ca-45
Cd-109
Cd-113
Cd-113m
Cd-115m
Close


Distribution Coefficients
Radionuclide Am-241
Location
Distribution coefficient (cm³/g)
Location
Distribution coefficient (cm³/g)
Contaminated medium: 20
Contaminated zone: 1000
Unsaturated zone 1: 1000
Saturated zone: 1000
Number of unsaturated zones: set in preliminary inputs form 1
Suspended sediment in surface water body 20
Bottom sediment in surface water body 20
Fruit, grain, nonleafy fields 20
Leafy vegetable fields 20
Pasture, silage growing areas 20
Livestock feed grain fields 20
Dwelling site 20
Save
Cancel


Radionuclide Specific Release
Radionuclide Am-241
Element Am
Release to ground water
Transfer mechanism
First Order Rate Controlled Transfer
Equilibrium Desorption Transfer
Equilibrium Solubility Transfer
Time at which release begins or changes (years)
500
700
900
1100
1300
1500
Add Next Time
Cumulative fraction of radionuclide bearing material that is releasable
0
.1
.25
.45
.7
1
linearly over time
Incremental fraction of radionuclide bearing becomes releasable
stepwise at time
Distribution coefficient in primary contamination (cm³/g)
1000
Release from surface layer
Radionuclide becomes available for release
In the same manner as for release to groundwater
Beginning at time zero
Save
Cancel



- Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-24 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)

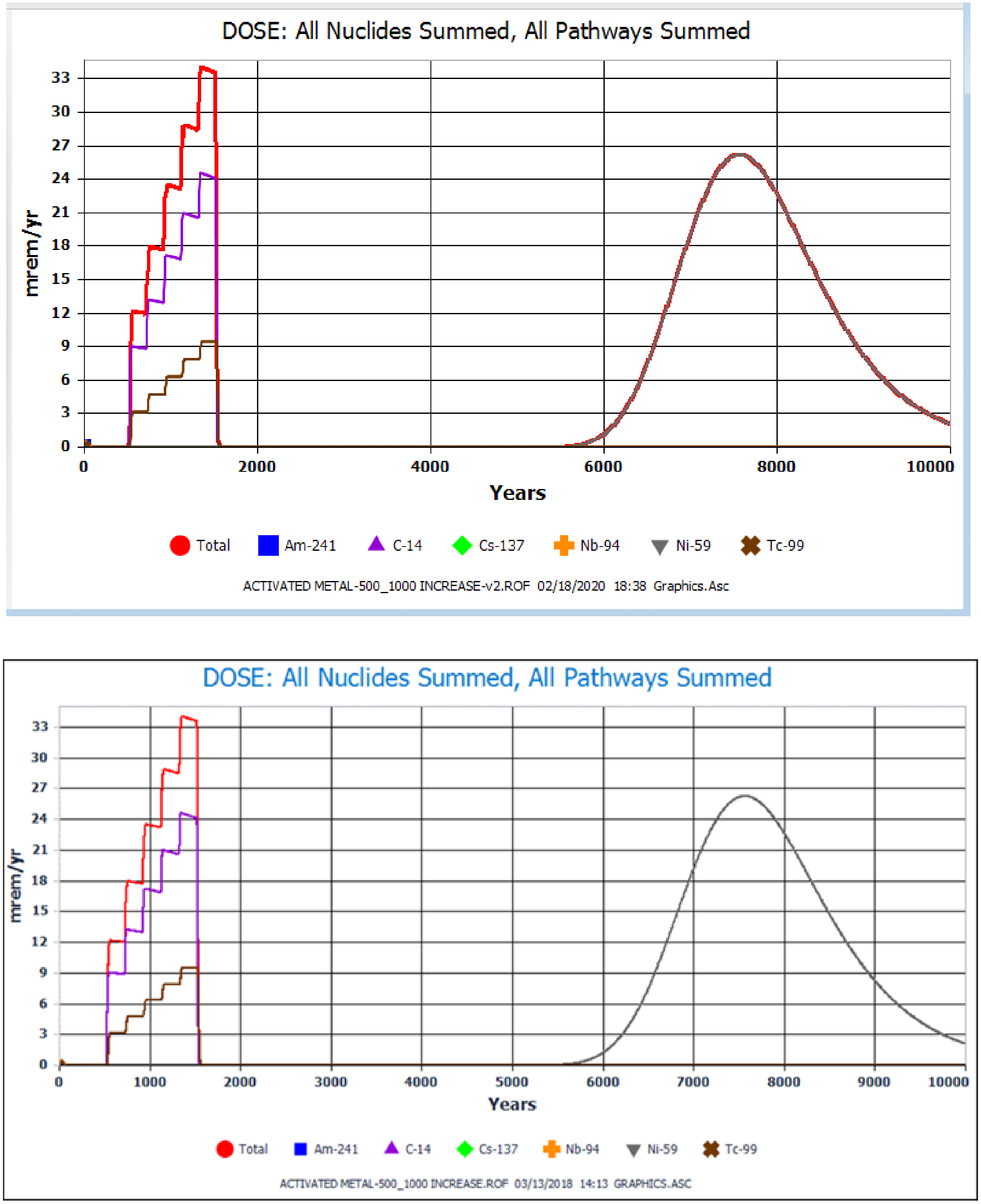


Figure M-24 Potential Radiation Dose Associated with Disposal of Activated Metals—Delayed Releases for 500 Years with an Increasing Corrosion Rate

12.95 TEST CASE 114 TESTER'S REPORT

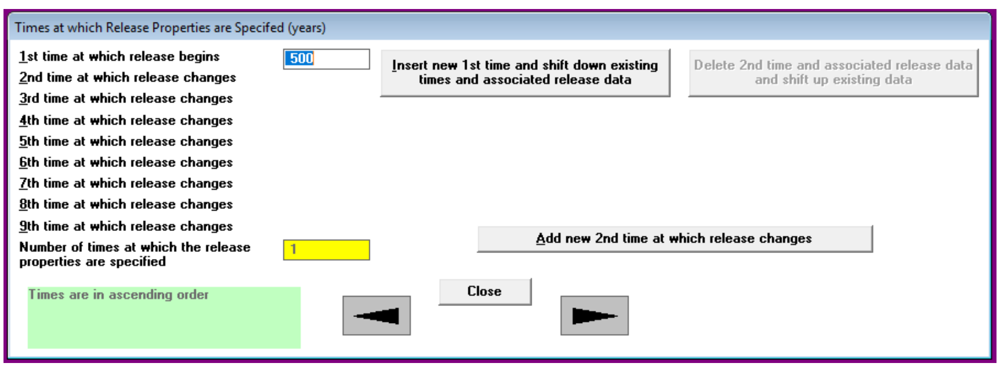
Documented in Test Case 114-JJCheng.docx of 2/20/2020 8:19 AM

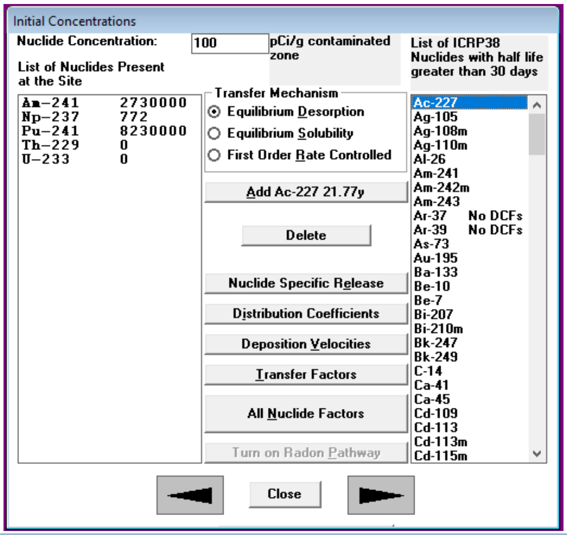
Test Case – 114 – Tests Offsite Activated Metal Case IV: TRU Waste

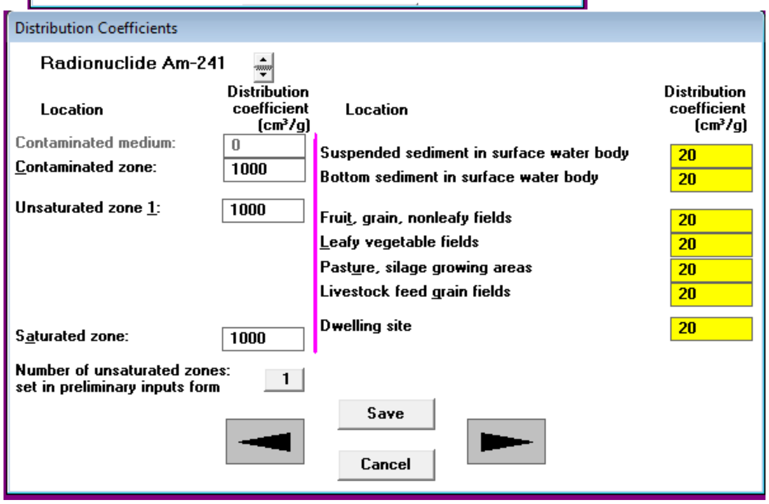
- Suggestions for revising the test descriptions in the Test Cases document -

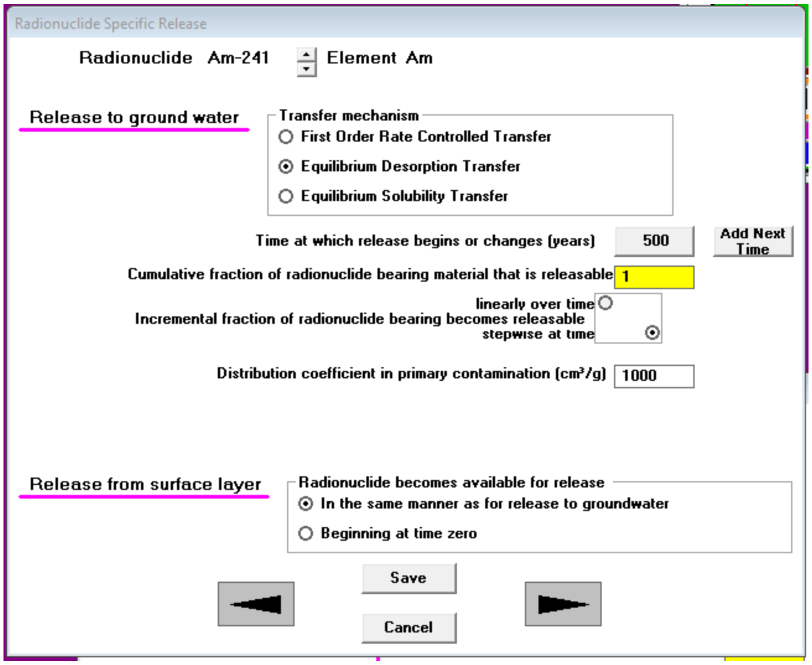
Test Summary	Test OFFSITE's new source term model: Case IV - TRU waste with equilibrium desorption release
Test Objective	Test features of OFFSITE new source term model to simulate equilibrium desorption release with no retardation from the contaminated medium
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.35

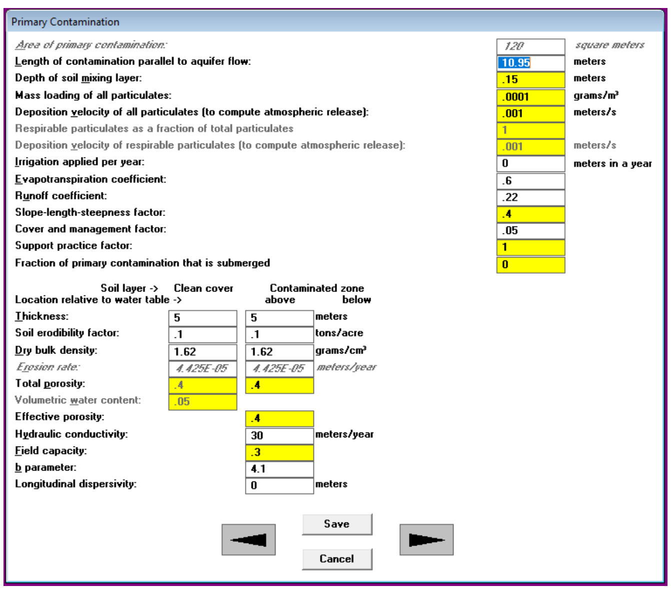
- Launched RESRAD-OFFSITE. Opened the input file, OTHER WASTE-KD=0_500-V2_DT2.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -




Initial Concentrations
Nuclide Concentration:
100
pCi/g contaminated zone
List of ICRP38 Nuclides with half life greater than 30 days
List of Nuclides Present at the Site
Am-241 2730000
Np-237 772
Pu-241 8230000
Th-229 0
U-233 0
Transfer Mechanism
Equilibrium Desorption
Equilibrium Solubility
First Order Rate Controlled
Add Ac-227 21.77y
Delete
Nuclide Specific Release
Distribution Coefficients
Deposition Velocities
Transfer Factors
All Nuclide Factors
Turn on Radon Pathway
Ac-227
Ag-105
Ag-108m
Ag-110m
Al-26
Am-241
Am-242m
Am-243
Ar-37 No DCFs
Ar-39 No DCFs
As-73
Au-195
Ba-133
Be-10
Be-7
Bi-207
Bi-210m
Bk-247
Bk-249
C-14
Ca-41
Ca-45
Cd-109
Cd-113
Cd-113m
Cd-115m
Close


Distribution Coefficients
Radionuclide Am-241
Location
Distribution coefficient (cm³/g)
Location
Distribution coefficient (cm³/g)
Contaminated medium: 0
Contaminated zone: 1000
Unsaturated zone 1: 1000
Saturated zone: 1000
Number of unsaturated zones: set in preliminary inputs form 1
Suspended sediment in surface water body 20
Bottom sediment in surface water body 20
Fruit, grain, nonleafy fields 20
Leafy vegetable fields 20
Pasture, silage growing areas 20
Livestock feed grain fields 20
Dwelling site 20
Save
Cancel

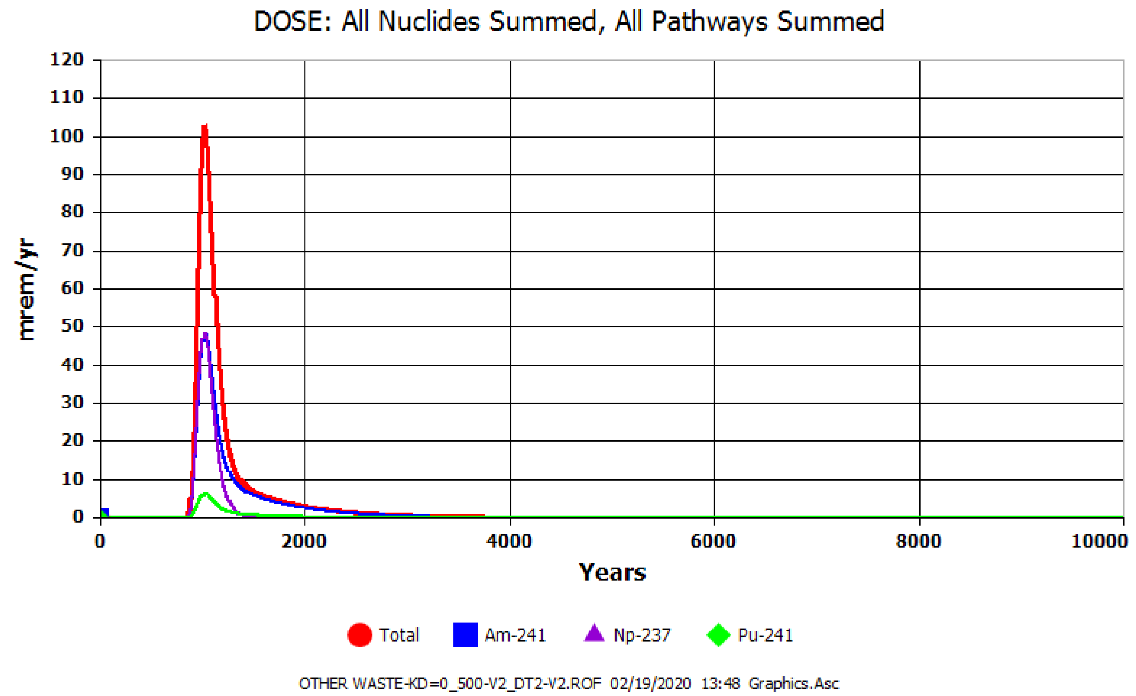




- Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-35 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix

M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)



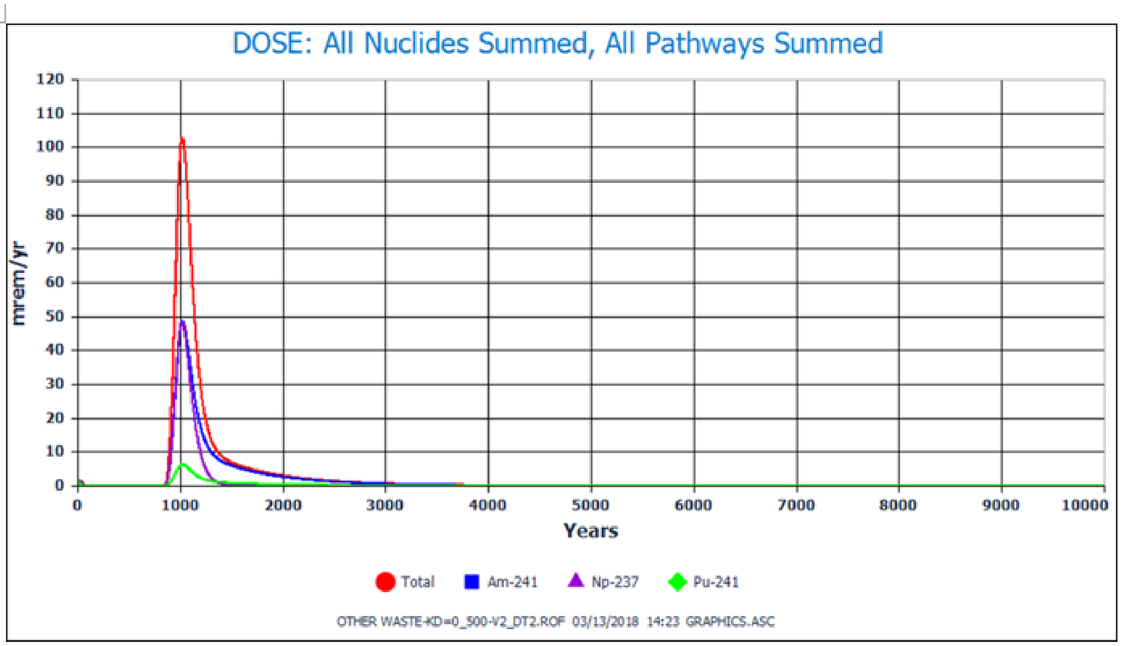


Figure M-35 Potential Radiation Dose Associated with Disposal of TRU Waste—Delayed Releases for 500 Years

12.96 TEST CASE 115 TESTER'S REPORT

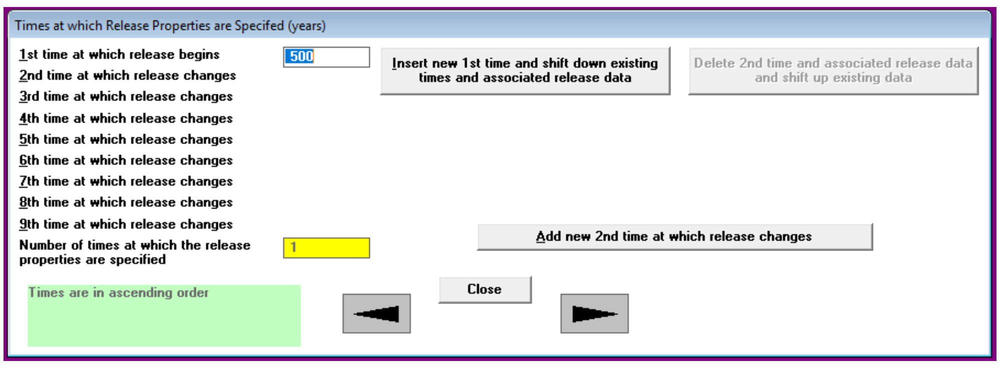
Documented in Test Case 115-JJCheng.docx of 2/20/2020 8:23 AM

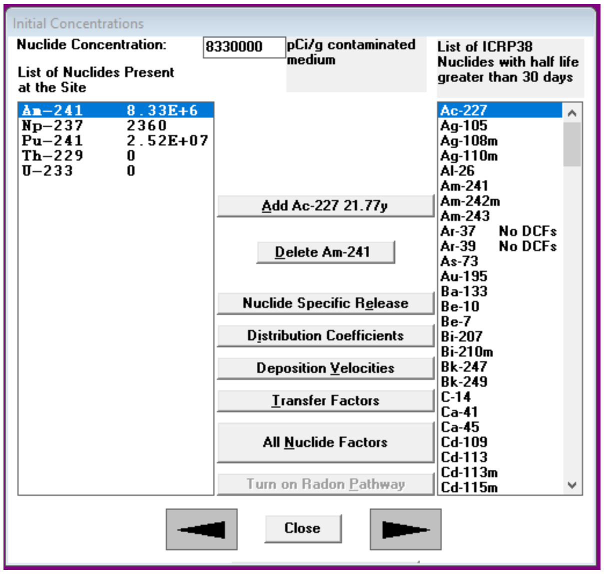
Test Case – 115 – Tests Offsite Activated Metal Case V: Grouted TRU Waste

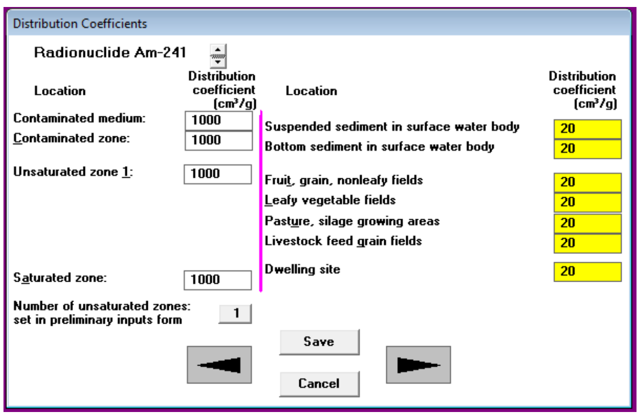
- Suggestions for revising the test descriptions in the Test Cases document -

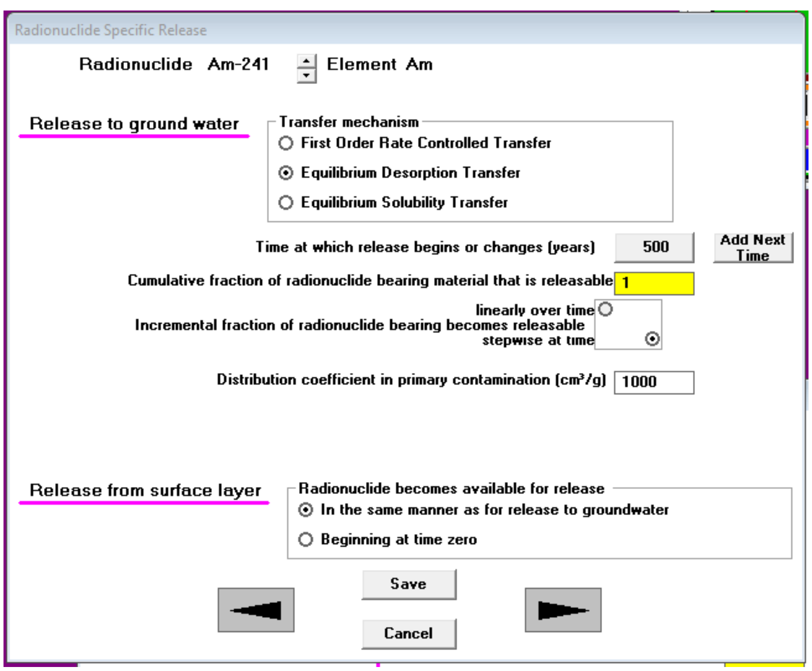
Test Summary	Test OFFSITE's new source term model: Case V - Grouted TRU waste with equilibrium desorption release
Test Objective	Test features of OFFSITE new source term model to simulate equilibrium desorption release with retardation from the contaminated medium
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.42

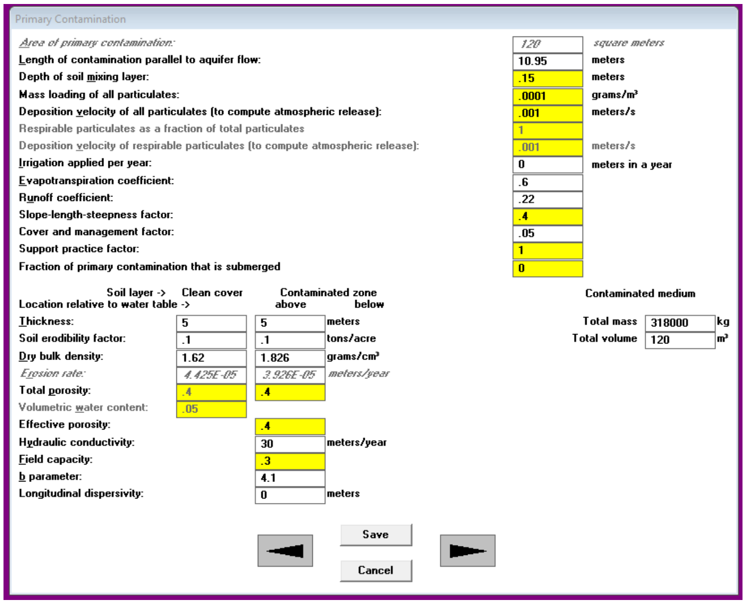
- Launched RESRAD-OFFSITE. Opened the input file, OTHER WASTE-KD=CEMENT_500_DT2-DUST-REVISED.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -




Initial Concentrations
Nuclide Concentration:
8330000
pCi/g contaminated medium
List of ICRP38 Nuclides with half life greater than 30 days
List of Nuclides Present at the Site
Am-241 8.33E+6
Np-237 2360
Pu-241 2.52E+07
Th-229 0
U-233 0
Add Ac-227 21.77y
Delete Am-241
Nuclide Specific Release
Distribution Coefficients
Deposition Velocities
Transfer Factors
All Nuclide Factors
Turn on Radon Pathway
Ac-227
Ag-105
Ag-108m
Ag-110m
Al-26
Am-241
Am-242m
Am-243
Ar-37 No DCFs
Ar-39 No DCFs
As-73
Au-195
Ba-133
Be-10
Be-7
Bi-207
Bi-210m
Bk-247
Bk-249
C-14
Ca-41
Ca-45
Cd-109
Cd-113
Cd-113m
Cd-115m
Close

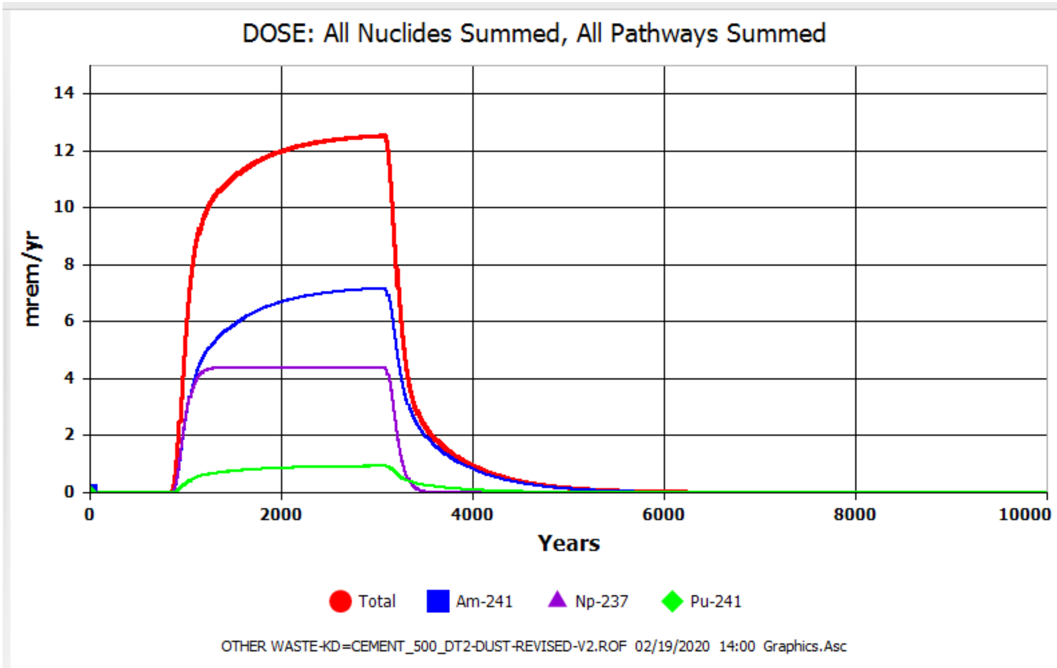

Distribution Coefficients
Radionuclide Am-241
Location
Distribution coefficient (cm³/g)
Contaminated medium: 1000
Contaminated zone: 1000
Unsaturated zone 1: 1000
Saturated zone: 1000
Number of unsaturated zones: set in preliminary inputs form 1
Location
Distribution coefficient (cm³/g)
Suspended sediment in surface water body 20
Bottom sediment in surface water body 20
Fruit, grain, nonleafy fields 20
Leafy vegetable fields 20
Pasture, silage growing areas 20
Livestock feed grain fields 20
Dwelling site 20
Save
Cancel


Radionuclide Specific Release
Radionuclide Am-241
Element Am
Release to ground water
Transfer mechanism
First Order Rate Controlled Transfer
Equilibrium Desorption Transfer
Equilibrium Solubility Transfer
Time at which release begins or changes (years) 500
Add Next Time
Cumulative fraction of radionuclide bearing material that is releasable 1
linearly over time
Incremental fraction of radionuclide bearing becomes releasable
stepwise at time
Distribution coefficient in primary contamination (cm³/g) 1000
Release from surface layer
Radionuclide becomes available for release
In the same manner as for release to groundwater
Beginning at time zero
Save
Cancel



- Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-35 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test case used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)



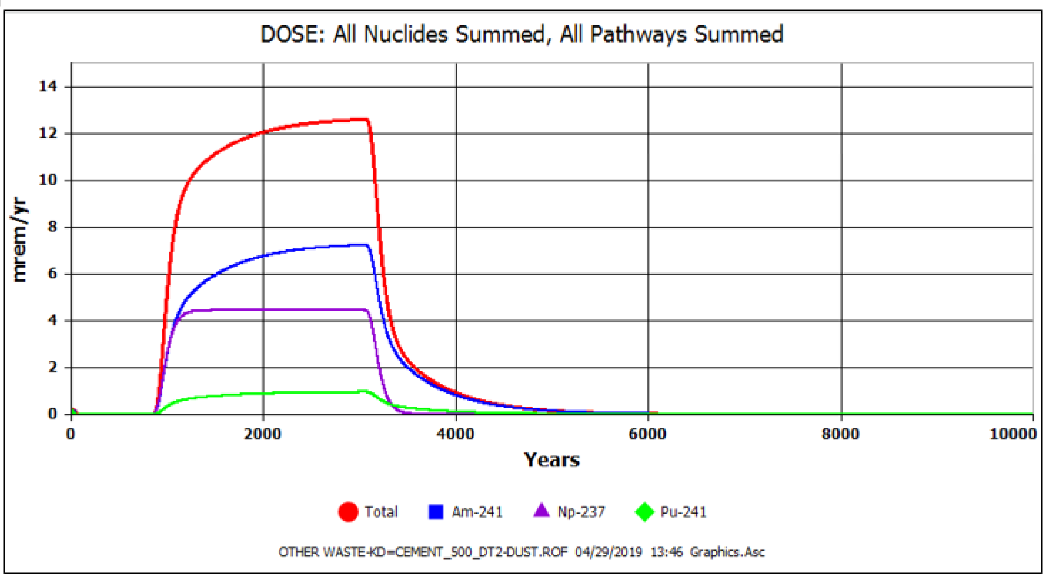


Figure M-42 Potential Radiation Dose Associated with Disposal of Grouted TRU Waste

12.97 TEST CASE 116 TESTER'S REPORT

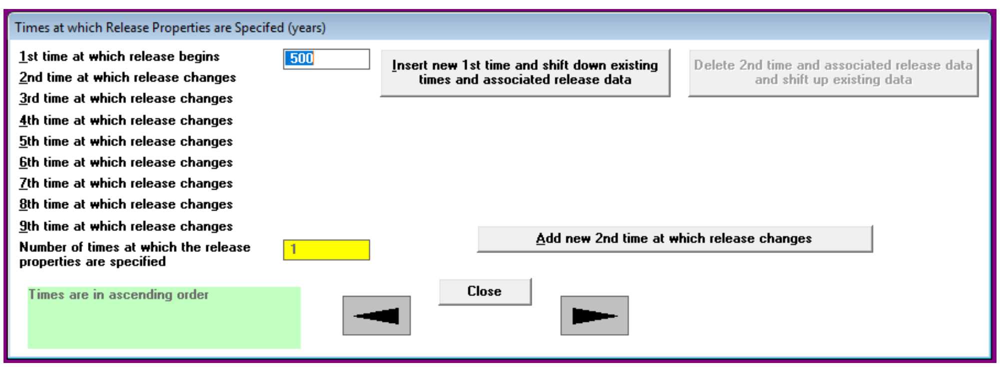
Documented in Test Case 116-JJCheng.docx of 2/20/2020 8:26 AM

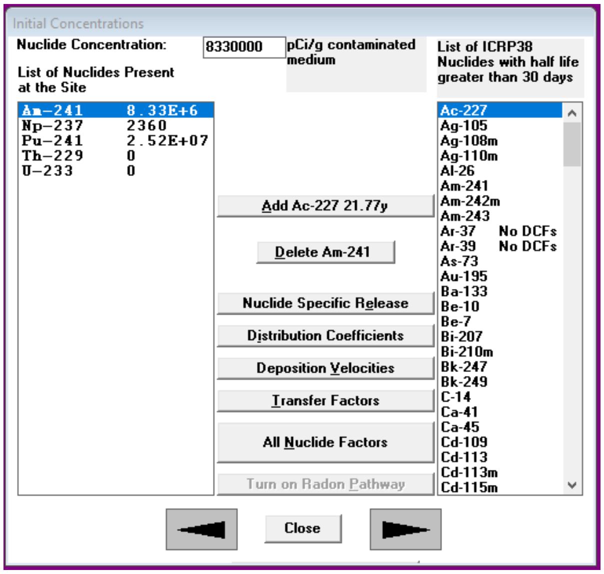
Test Case – 116 – Tests Offsite Activated Metal Case VI: Grouted TRU Waste

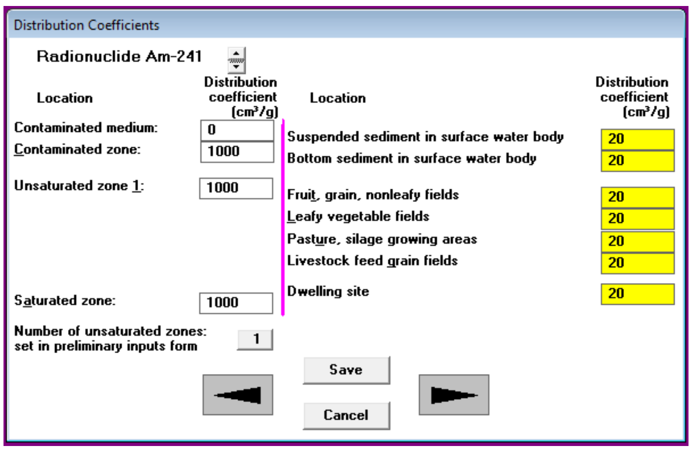
- Suggestions for revising the test descriptions in the Test Cases document -

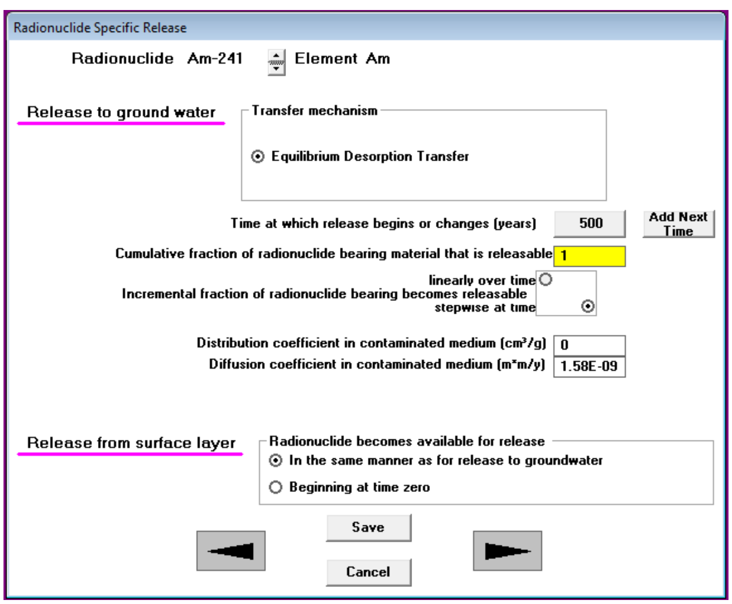
Test Summary	Test OFFSITE's new source term model: Case VI - Grouted TRU waste with diffusion controlled release
Test Objective	Test features of OFFSITE new source term model to simulate diffusion controlled release
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.49

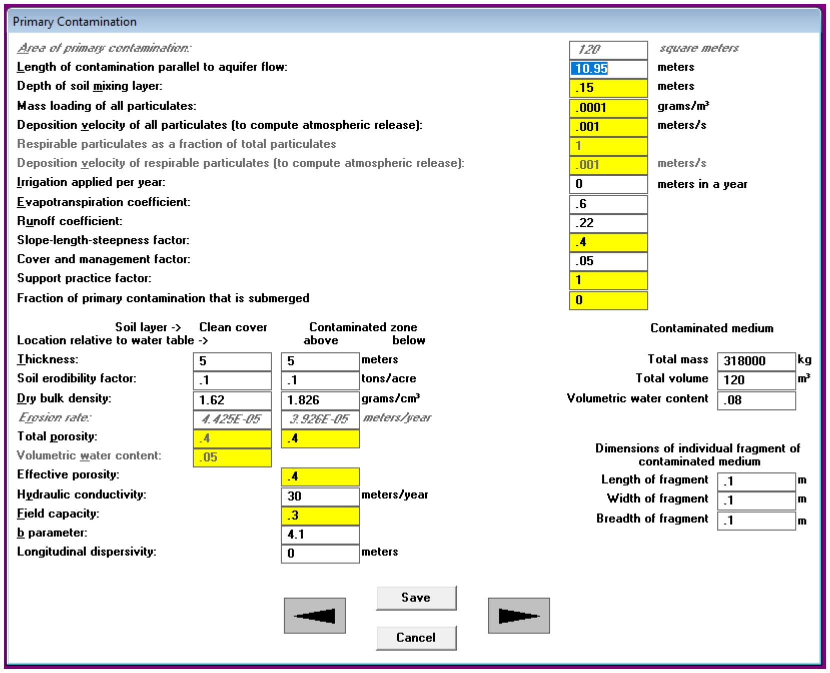
- Launched RESRAD-OFFSITE. Opened the input file, OTHER WASTE-KD=0_500_DT1-DIF-DUST-REVISED.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -




Initial Concentrations
Nuclide Concentration:
8330000
pCi/g contaminated medium
List of Nuclides Present at the Site
List of ICRP38 Nuclides with half life greater than 30 days
Am-241 8.33E+6
Np-237 2360
Pu-241 2.52E+07
Th-229 0
U-233 0
Add Ac-227 21.77y
Delete Am-241
Nuclide Specific Release
Distribution Coefficients
Deposition Velocities
Transfer Factors
All Nuclide Factors
Turn on Radon Pathway
Ac-227
Ag-105
Ag-108m
Ag-110m
Al-26
Am-241
Am-242m
Am-243
Ar-37 No DCFs
Ar-39 No DCFs
As-73
Au-195
Ba-133
Be-10
Be-7
Bi-207
Bi-210m
Bk-247
Bk-249
C-14
Ca-41
Ca-45
Cd-109
Cd-113
Cd-113m
Cd-115m
Close


Distribution Coefficients
Radionuclide Am-241
Location
Distribution coefficient (cm³/g)
Contaminated medium: 0
Contaminated zone: 1000
Unsaturated zone 1: 1000
Saturated zone: 1000
Number of unsaturated zones: set in preliminary inputs form 1
Location
Distribution coefficient (cm³/g)
Suspended sediment in surface water body 20
Bottom sediment in surface water body 20
Fruit, grain, nonleafy fields 20
Leafy vegetable fields 20
Pasture, silage growing areas 20
Livestock feed grain fields 20
Dwelling site 20
Save
Cancel


Radionuclide Specific Release
Radionuclide Am-241
Element Am
Release to ground water
Transfer mechanism
Equilibrium Desorption Transfer
Time at which release begins or changes (years) 500
Add Next Time
Cumulative fraction of radionuclide bearing material that is releasable 1
Incremental fraction of radionuclide bearing becomes releasable
linearly over time
stepwise at time
Distribution coefficient in contaminated medium (cm³/g) 0
Diffusion coefficient in contaminated medium (m*m/y) 1.58E-09
Release from surface layer
Radionuclide becomes available for release
In the same manner as for release to groundwater
Beginning at time zero
Save
Cancel



- Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-49 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test case used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)

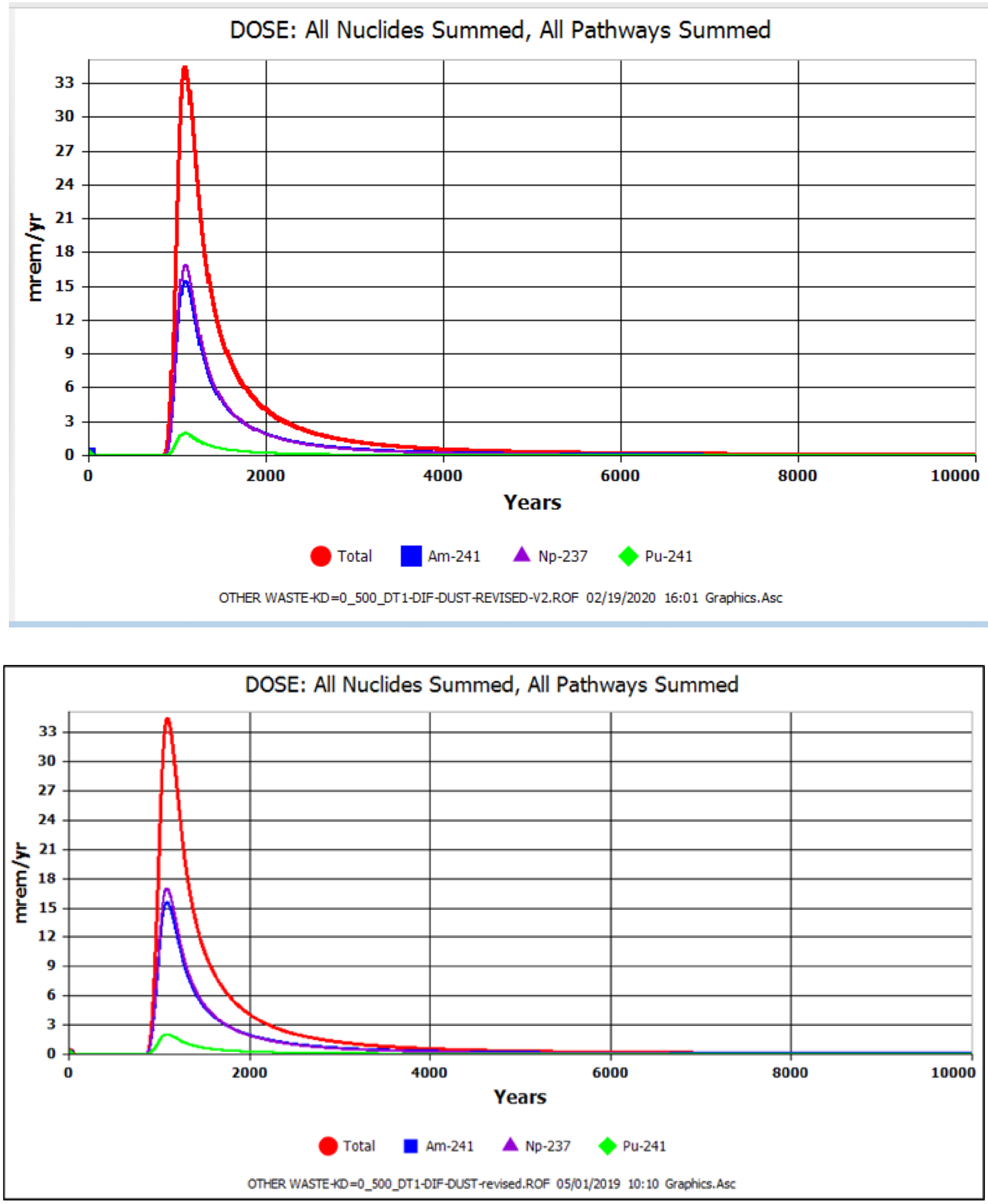


Figure M-49 Potential Radiation Dose Associated with Disposal of TRU Waste—Diffusion Controlled Release with 10-cm Fragments

12.98 TEST CASE 117 TESTER'S REPORT

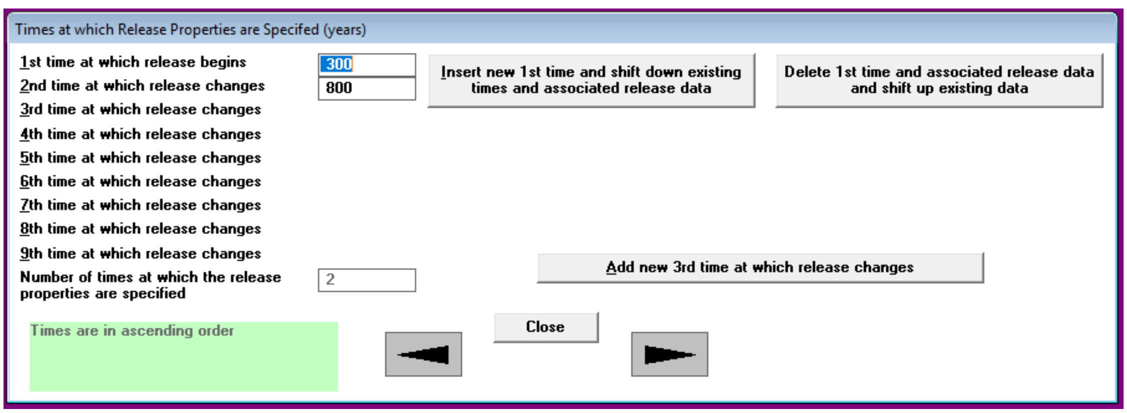
Documented in Test Case 117-JJCheng.docx of 2/20/2020 8:33 AM

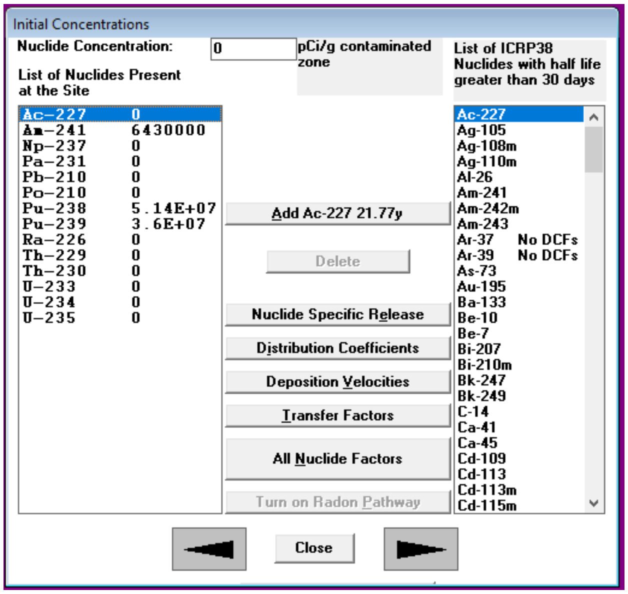
Test Case – 117 – Tests Offsite Activated Metal Case VI: Grouted TRU Waste with diffusion

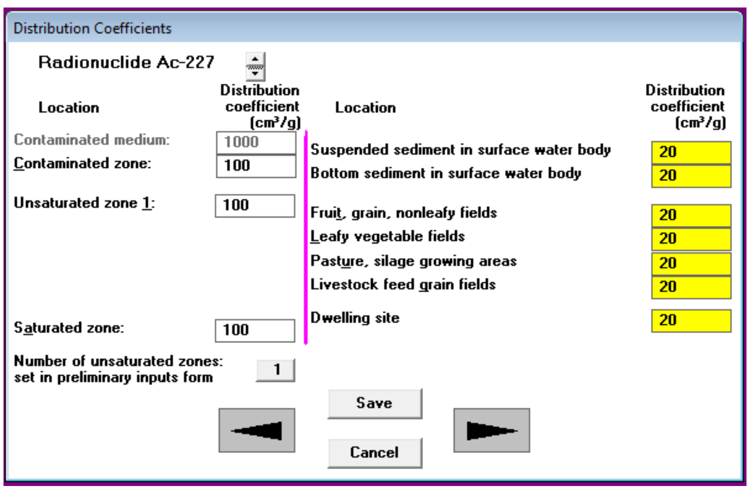
- Suggestions for revising the test descriptions in the Test Cases document -

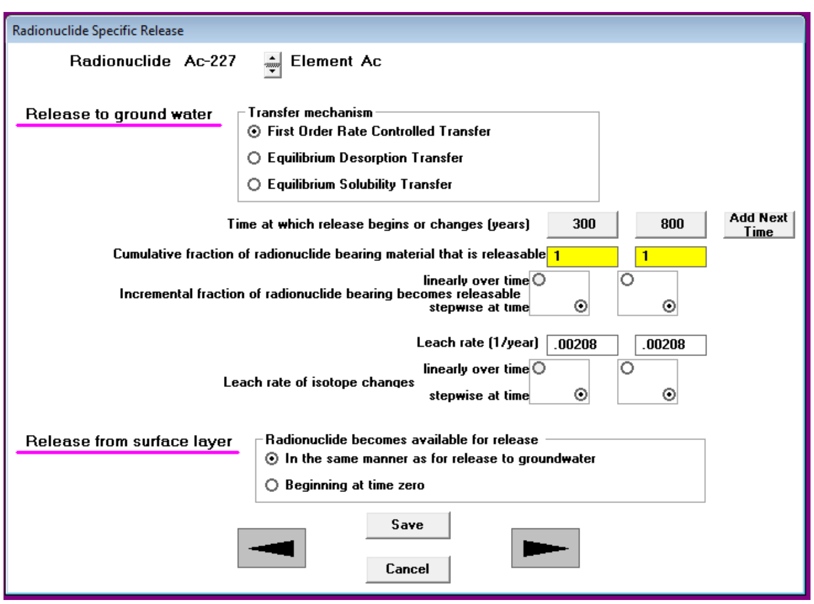
Test Summary	Test OFFSITE's new source term model: Case VII - Sealed sources with 1st order rate controlled release
Test Objective	Test features of OFFSITE new source term model to simulate 1st order rate controlled release
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.56

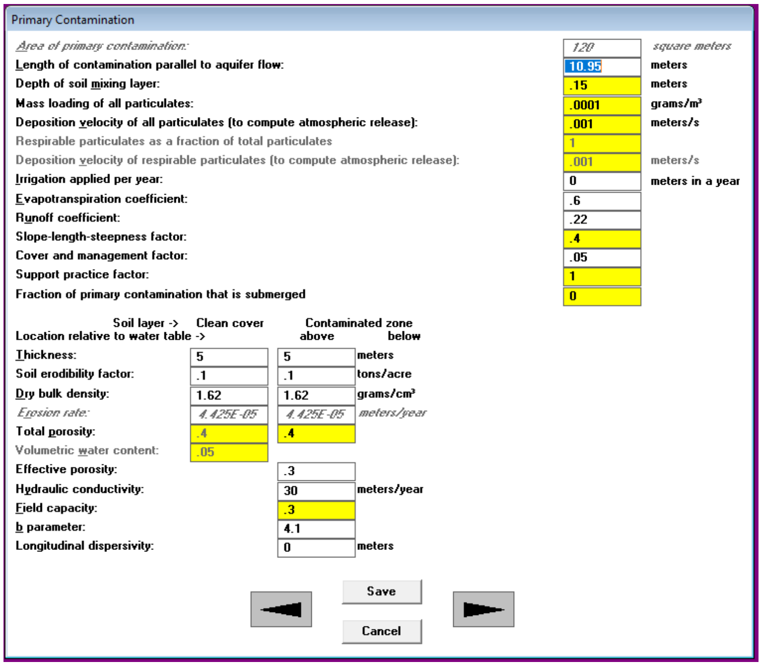
- Launched RESRAD-OFFSITE. Opened the input file, SEALED SOURCES-TRENCH-LEACH_300-800-V2.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -




Initial Concentrations
Nuclide Concentration:
0
pCi/g contaminated zone
List of ICRP38 Nuclides with half life greater than 30 days
List of Nuclides Present at the Site
Ac-227 0
Am-241 6430000
Np-237 0
Pa-231 0
Pb-210 0
Po-210 0
Pu-238 5.14E+07
Pu-239 3.6E+07
Ra-226 0
Th-229 0
Th-230 0
U-233 0
U-234 0
U-235 0
Add Ac-227 21.77y
Delete
Nuclide Specific Release
Distribution Coefficients
Deposition Velocities
Transfer Factors
All Nuclide Factors
Turn on Radon Pathway
Ac-227
Ag-105
Ag-108m
Ag-110m
Al-26
Am-241
Am-242m
Am-243
Ar-37 No DCFs
Ar-39 No DCFs
As-73
Au-195
Ba-133
Be-10
Be-7
Bi-207
Bi-210m
Bk-247
Bk-249
C-14
Ca-41
Ca-45
Cd-109
Cd-113
Cd-113m
Cd-115m
Close

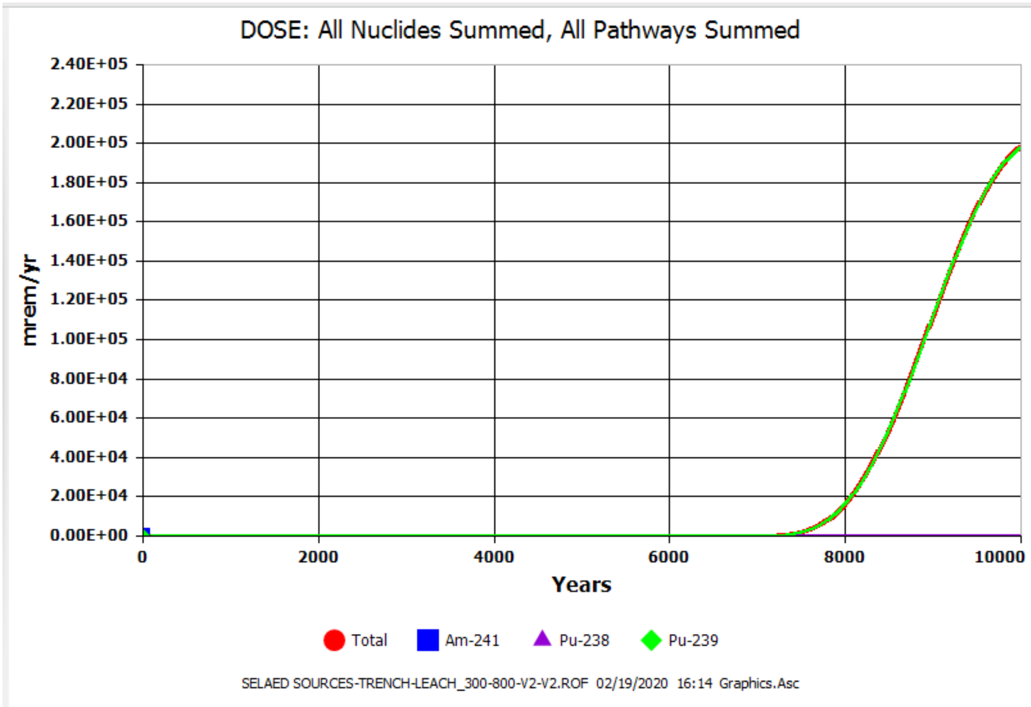

Distribution Coefficients
Radionuclide Ac-227
Location
Distribution coefficient (cm³/g)
Location
Distribution coefficient (cm³/g)
Contaminated medium: 1000
Contaminated zone: 100
Unsaturated zone 1: 100
Saturated zone: 100
Number of unsaturated zones: set in preliminary inputs form 1
Suspended sediment in surface water body 20
Bottom sediment in surface water body 20
Fruit, grain, nonleafy fields 20
Leafy vegetable fields 20
Pasture, silage growing areas 20
Livestock feed grain fields 20
Dwelling site 20
Save
Cancel


Radionuclide Specific Release
Radionuclide Ac-227
Element Ac
Release to ground water
Transfer mechanism
First Order Rate Controlled Transfer
Equilibrium Desorption Transfer
Equilibrium Solubility Transfer
Time at which release begins or changes (years) 300 800
Add Next Time
Cumulative fraction of radionuclide bearing material that is releasable 1 1
linearly over time
Incremental fraction of radionuclide bearing becomes releasable
stepwise at time
Leach rate (1/year) .00208 .00208
linearly over time
Leach rate of isotope changes
stepwise at time
Release from surface layer
Radionuclide becomes available for release
In the same manner as for release to groundwater
Beginning at time zero
Save
Cancel



- Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-49 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test case used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match.)



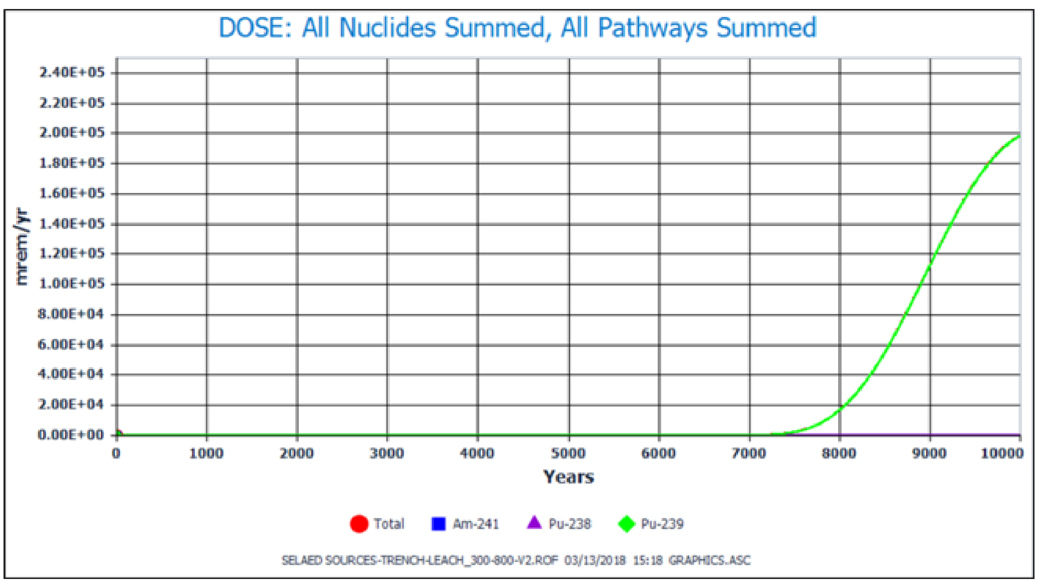


Figure M-56 Potential Radiation Dose Associated with Disposal of Sealed Sources Waste—First-Order Rate-Controlled Release

12.99 TEST CASE 118 TESTER'S REPORT

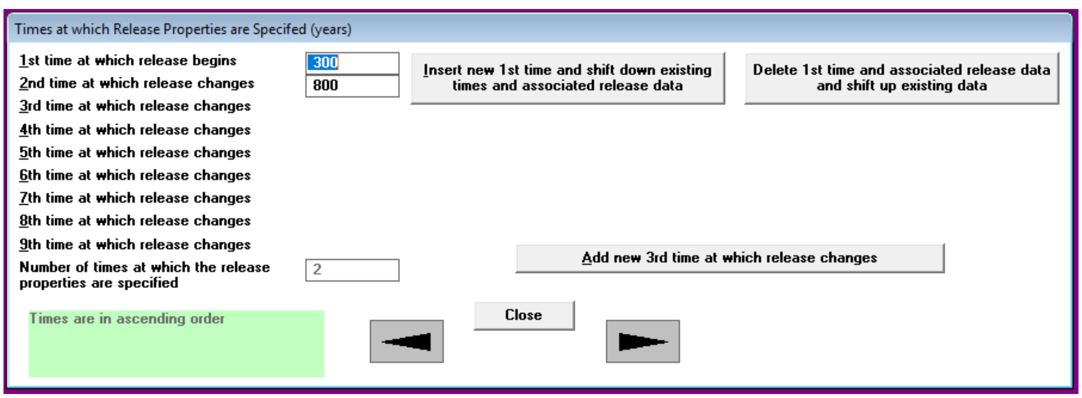
Documented in Test Case 118-JJCheng.docx of 2/20/2020 8:35 AM

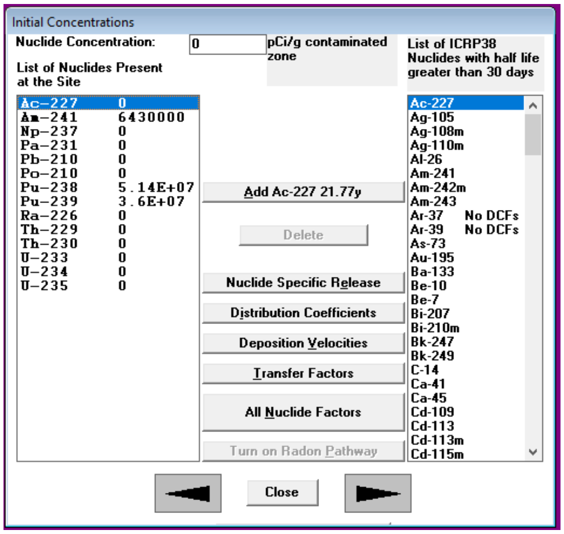
Test Case – 118 – Tests Offsite Activated Metal Case VI: Grouted TRU Waste with solubility-controlled release

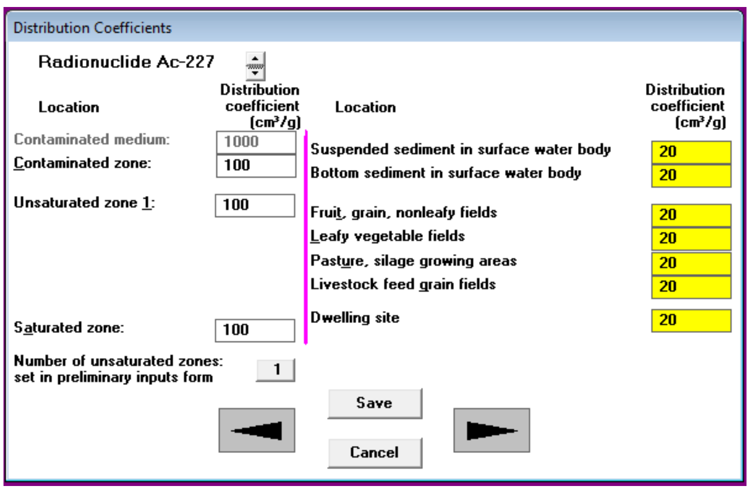
- Suggestions for revising the test descriptions in the Test Cases document -

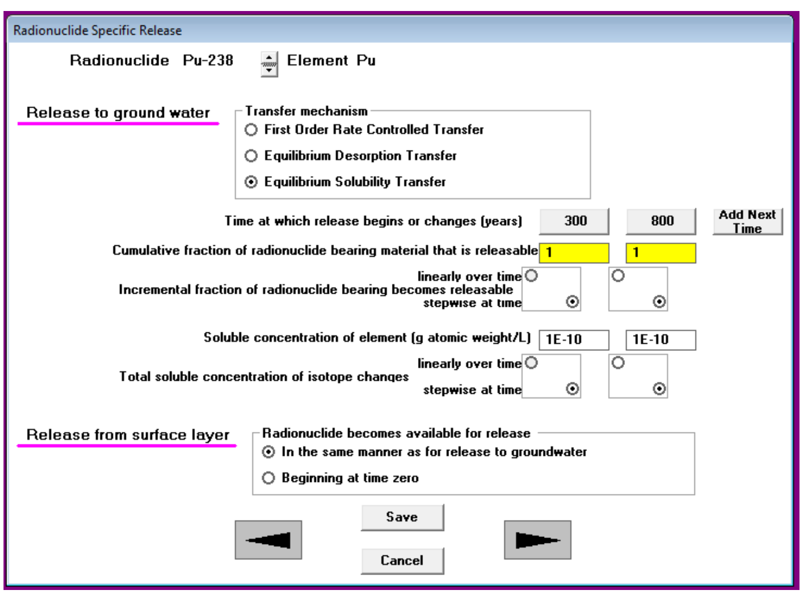
Test Summary	Test OFFSITE's new source term model: Case VIII - Sealed sources with solubility controlled release
Test Objective	Test features of OFFSITE new source term model to simulate solubility controlled release
Expected Results	Compare with NUREG/CR 7268, User's Manual for RESRAD-OFFSITE Code Version 4.0, Vol. 1, App M, Figure M.59

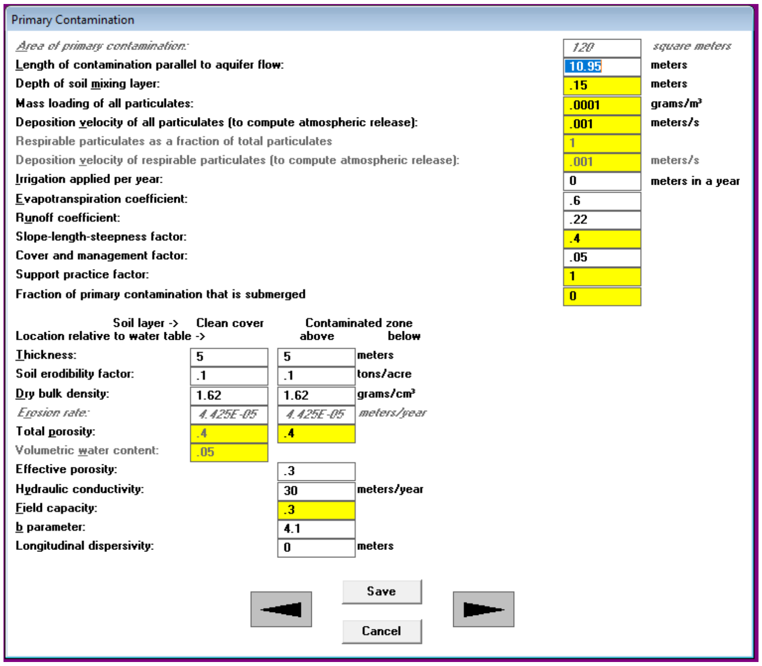
- Launched RESRAD-OFFSITE. Opened the input file, SEALED SOURCES-TRENCH-SOLUBILITY_300-800-V2.ROF, according to the instructions in the Test Cases document. The following screen shots show the inputs related to the modeling of source release -




Initial Concentrations
Nuclide Concentration:
0
pCi/g contaminated zone
List of Nuclides Present at the Site
List of ICRP38 Nuclides with half life greater than 30 days
Ac-227 0
Am-241 6430000
Np-237 0
Pa-231 0
Pb-210 0
Po-210 0
Pu-238 5.14E+07
Pu-239 3.6E+07
Ra-226 0
Th-229 0
Th-230 0
U-233 0
U-234 0
U-235 0
Add Ac-227 21.77y
Delete
Nuclide Specific Release
Distribution Coefficients
Deposition Velocities
Transfer Factors
All Nuclide Factors
Turn on Radon Pathway
Ac-227
Ag-105
Ag-108m
Ag-110m
Al-26
Am-241
Am-242m
Am-243
Ar-37 No DCFs
Ar-39 No DCFs
As-73
Au-195
Ba-133
Be-10
Be-7
Bi-207
Bi-210m
Bk-247
Bk-249
C-14
Ca-41
Ca-45
Cd-109
Cd-113
Cd-113m
Cd-115m
Close

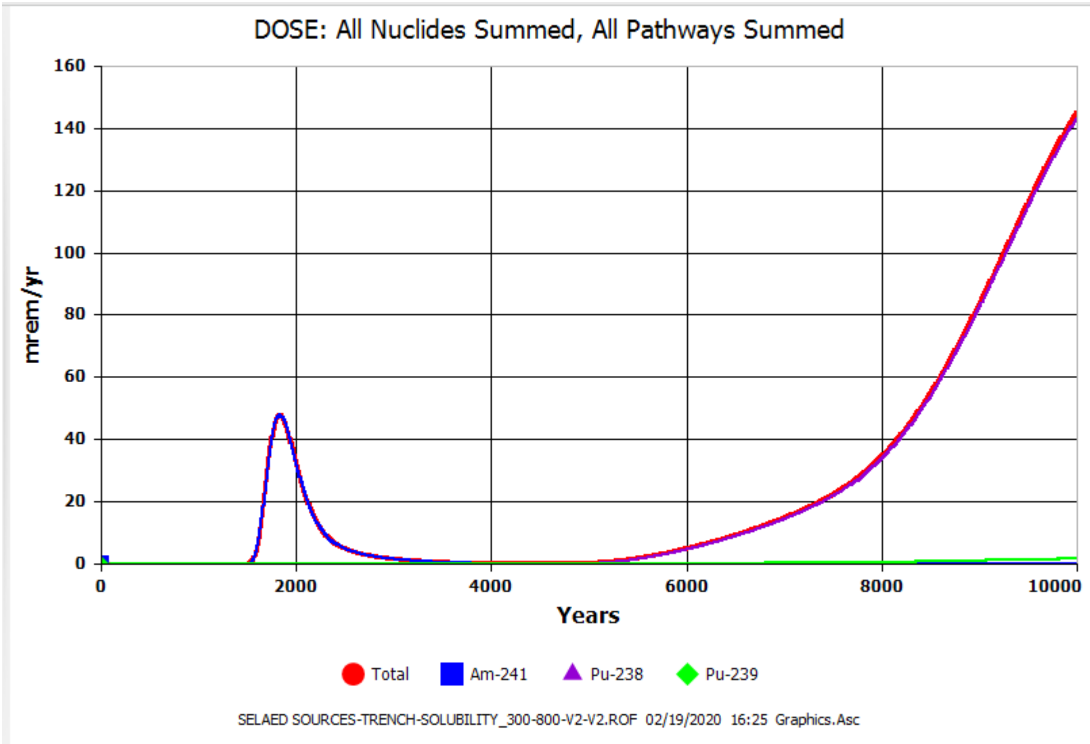

Distribution Coefficients
Radionuclide Ac-227
Location
Distribution coefficient (cm³/g)
Location
Distribution coefficient (cm³/g)
Contaminated medium: 1000
Contaminated zone: 100
Unsaturated zone 1: 100
Saturated zone: 100
Number of unsaturated zones: set in preliminary inputs form 1
Suspended sediment in surface water body 20
Bottom sediment in surface water body 20
Fruit, grain, nonleafy fields 20
Leafy vegetable fields 20
Pasture, silage growing areas 20
Livestock feed grain fields 20
Dwelling site 20
Save
Cancel


Radionuclide Specific Release
Radionuclide Pu-238
Element Pu
Release to ground water
Transfer mechanism
First Order Rate Controlled Transfer
Equilibrium Desorption Transfer
Equilibrium Solubility Transfer
Time at which release begins or changes (years) 300 800
Add Next Time
Cumulative fraction of radionuclide bearing material that is releasable 1 1
linearly over time
Incremental fraction of radionuclide bearing becomes releasable
stepwise at time
Soluble concentration of element (g atomic weight/L) 1E-10 1E-10
linearly over time
Total soluble concentration of isotope changes
stepwise at time
Release from surface layer
Radionuclide becomes available for release
In the same manner as for release to groundwater
Beginning at time zero
Save
Cancel



- Saved the inputs to a different file. Ran the code. Viewed the deterministic graphic results. The total dose as a function of time (1st figure below) matches Figure M-59 of the NUREG/CR-7268 Vol. 1 report (2nd figure below).

(Note: Appendix M of NUREG/CR-7268 Vol. 1, *User's Manual for RESRAD-OFFSITE Code Version 4, Vol. 1 – Methodology and Models Used in RESRAD-OFFSITE Code*, discusses benchmarking of the RESRAD-OFFSITE results with the results of DUST-MS, based on the release rates of radionuclide to infiltration water that leaves the contaminated zone, i.e., the waste disposal area. This test case used the same input file employed in the benchmarking. The match of the RESRAD-OFFSITE graphic dose results obtained in this testing to the one shown in Appendix M indicates that the radionuclide release rates to infiltration water that leaves the contaminated zone would also match and would agree well with those calculated by DUST-MS.)



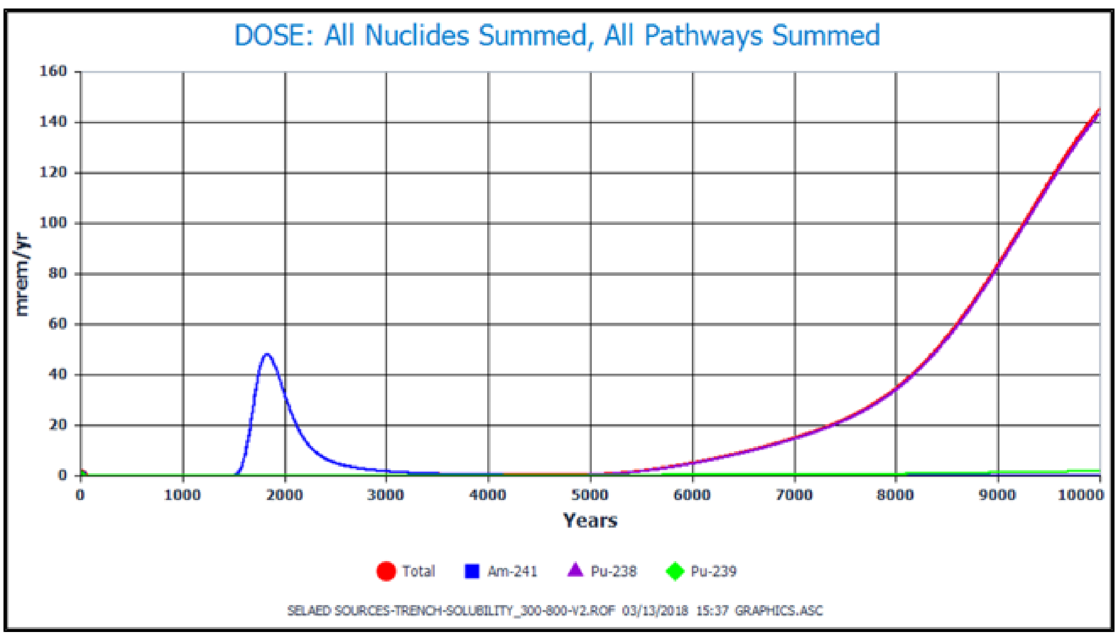


Figure M-59 Potential Radiation Dose Associated with Disposal of Sealed Sources Waste—Solubility Controlled Release for Pu

12.100 TEST CASE 401 TESTER'S REPORT

Documented in Results-Test-401.docx of 2/18/2020 2:48 AM

RESOFF-TEST-401

Objective: Test offsite plant concentrations

The following steps were taken for Test-401

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-401.ROF

Step 3 Ran Test-401.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Selected different plant type Media Concentration

Step 7 Compared different plant type concentrations with the values in Figure 1 -4 in the V&V report

Result: Test Passes

Plant concentrations for different plant types in V&V Report matched with Test-401 plant concentrations as shown in the following figures.

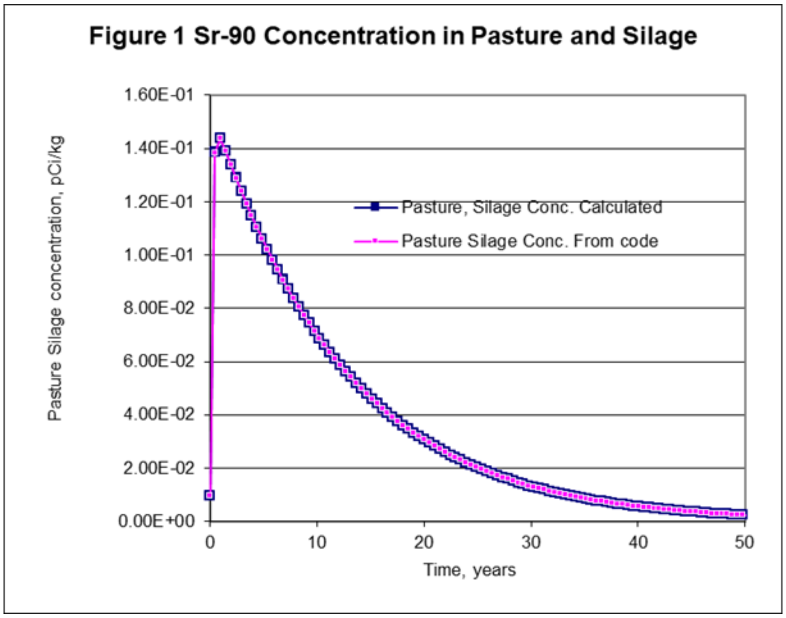


Figure Concentrations in Pasture and Silage Plant Type from V&V Report

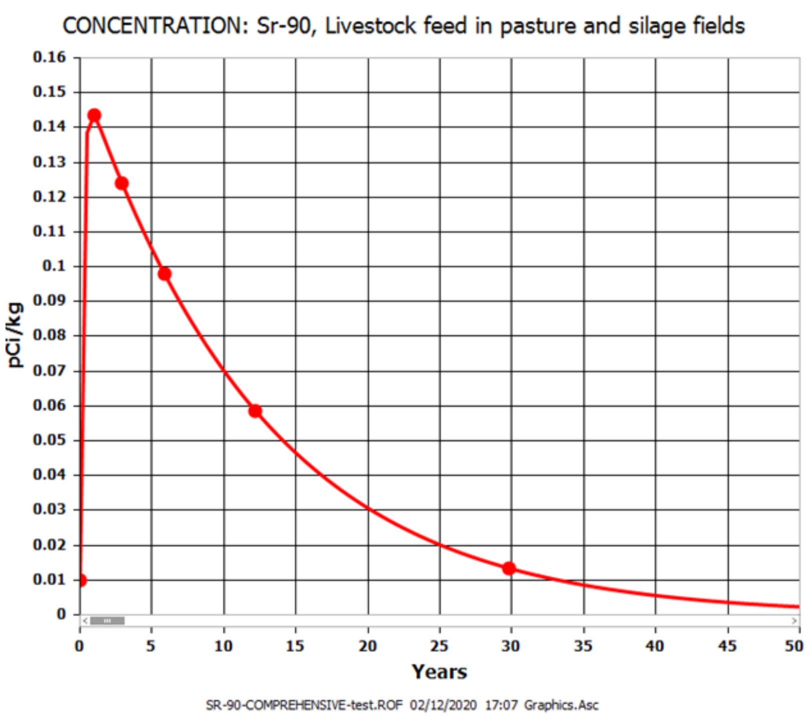


Figure Concentration in Pasture and Silage Plant Type from Test-401

Practically no difference in V&V results for pasture and silage concentrations and Test 401 results

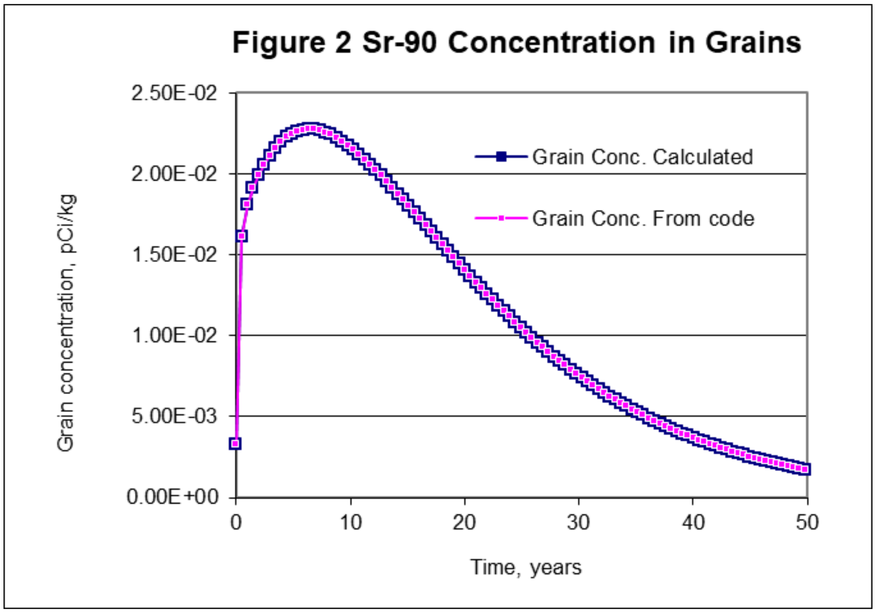


Figure Concentration in Grain Plant Type from V&V Report

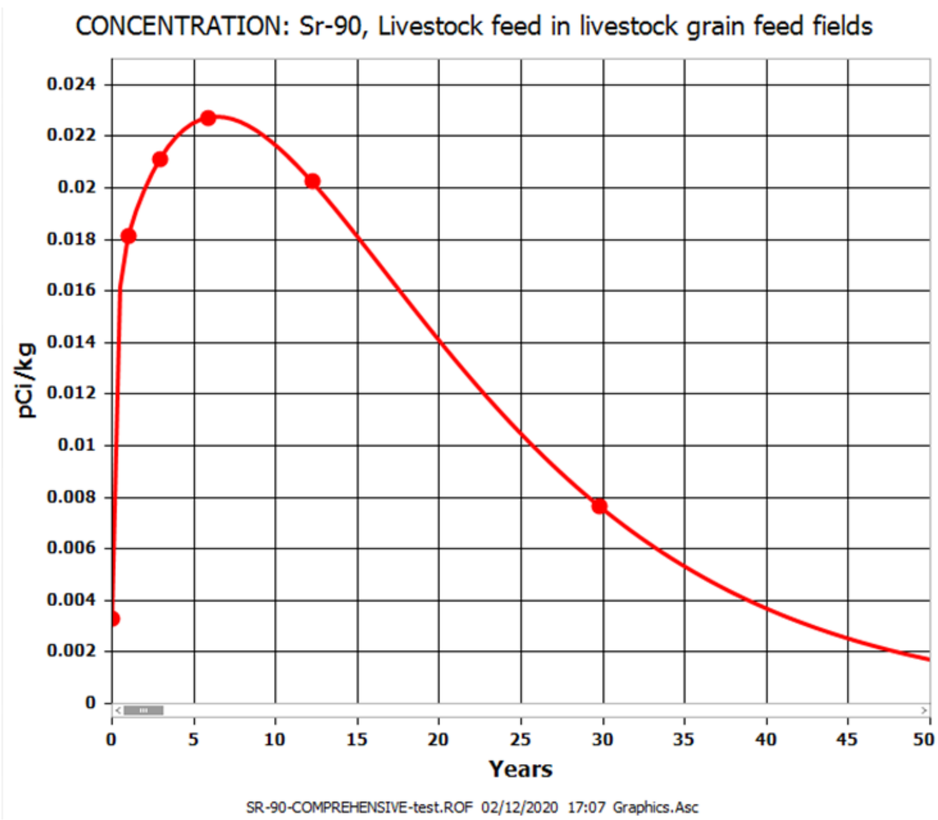


Figure Concentration in Grain Plant Type from Test-401

Practically no difference in V&V results for grain concentration and Test 401 results

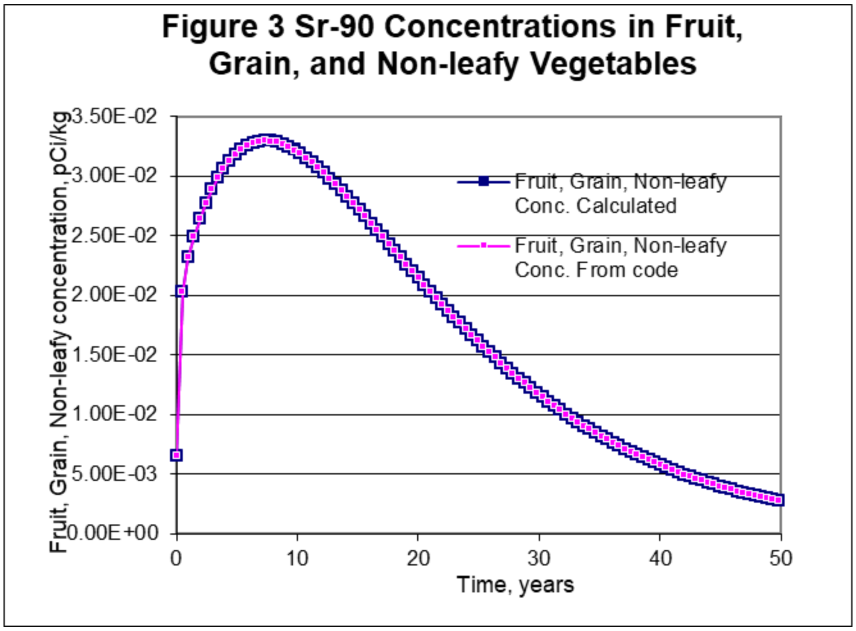


Figure Concentration in Fruit, Grain, Non-leafy Vegetables Plant Type from V&V Report

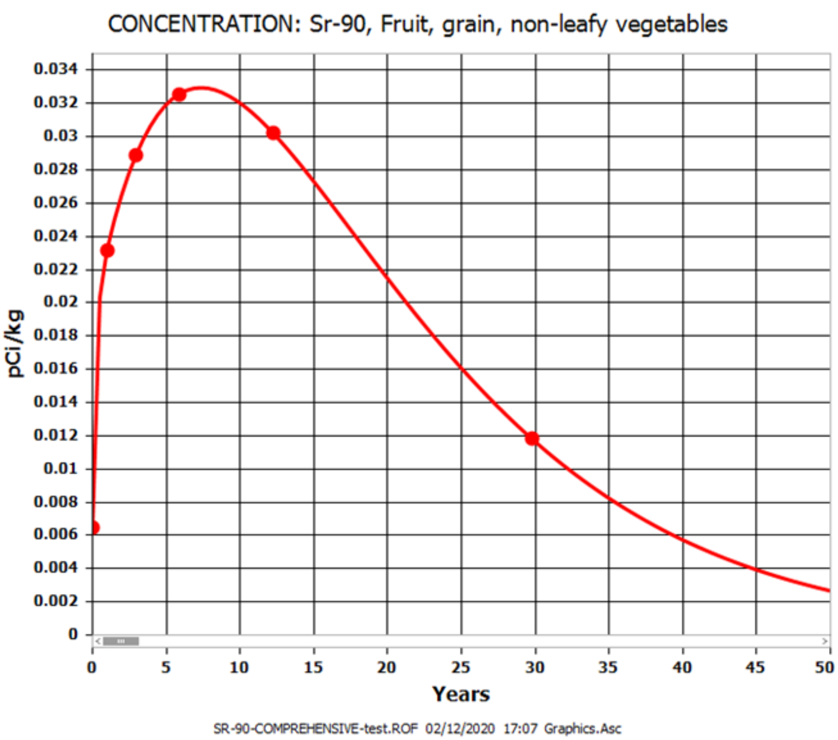


Figure Concentration in Fruit, Grain, Non-leafy Vegetables Plant Type from Test-401

Practically no difference in V&V results for fruit, grain, non-leafy vegetable concentrations and Test 401 results

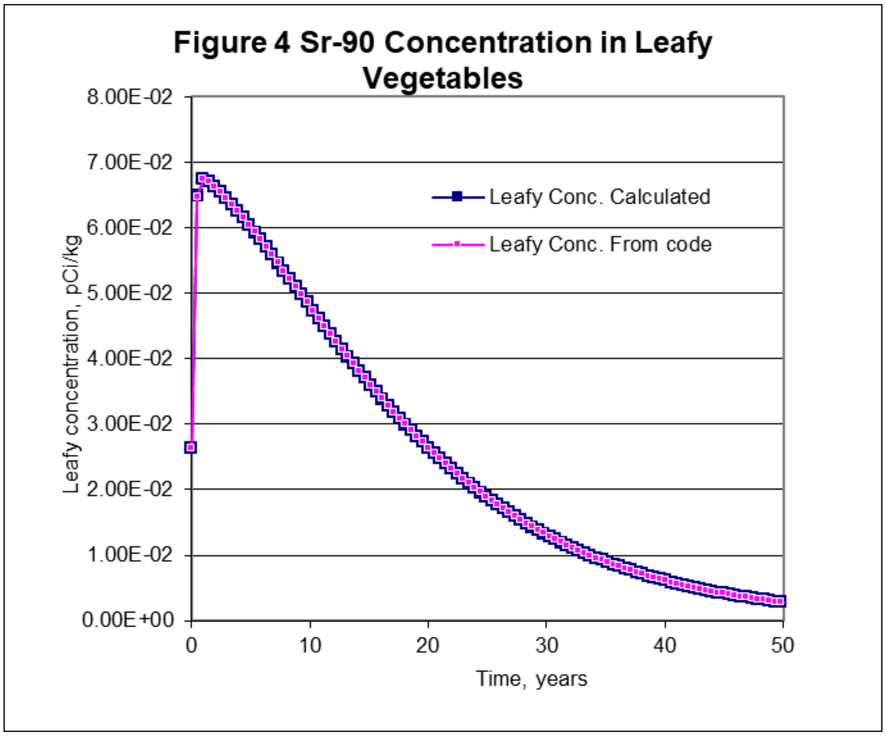


Figure Concentration in Leafy Vegetables Plant Type from V&V Report

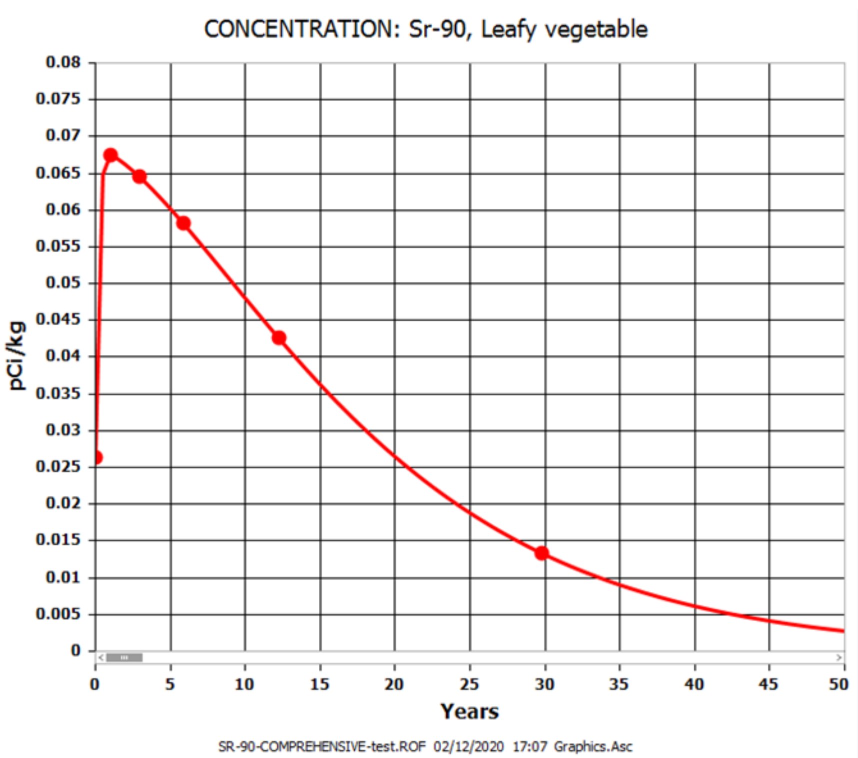


Figure Concentration in Leafy Vegetables Plant Type from Test-401

Practically no difference in V&V results for leafy vegetable concentrations and Test 401 results

12.101 TEST CASE 402 TESTER'S REPORT

Documented in Results-Test-402.docx of 2/17/2020 1:46 PM

RESOFF-TEST-402

Objective: Test offsite meat and milk concentrations

The following steps were taken for Test-402

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-402.ROF

Step 3 Ran Test-402.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Selected Meat Media Concentration

Step 7 Compared meat concentration with the values in Figure 5 in the V&V report

Step 8 Selected Milk Media Concentration

Step 9 Compared milk concentration with the values in Figure 6 in the V&V report

Result: Test Passes

Meat and milk concentrations in V&V Report matched with Test-402 meat and milk concentration as shown in the following figures.

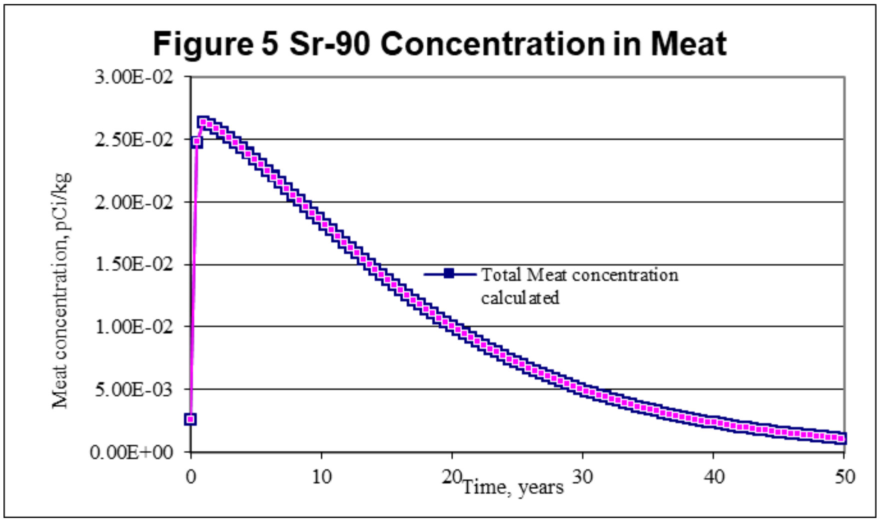


Figure Meat Concentration from V&V

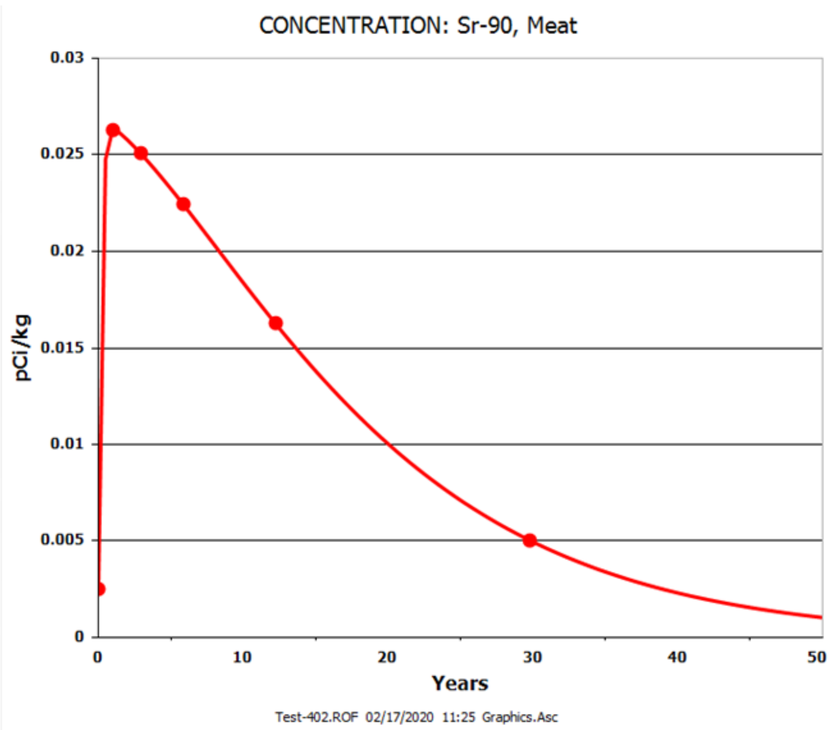


Figure Meat Concentration from Test-402

Practically no difference in V&V results for meat concentration and Test 402 meat concentration results

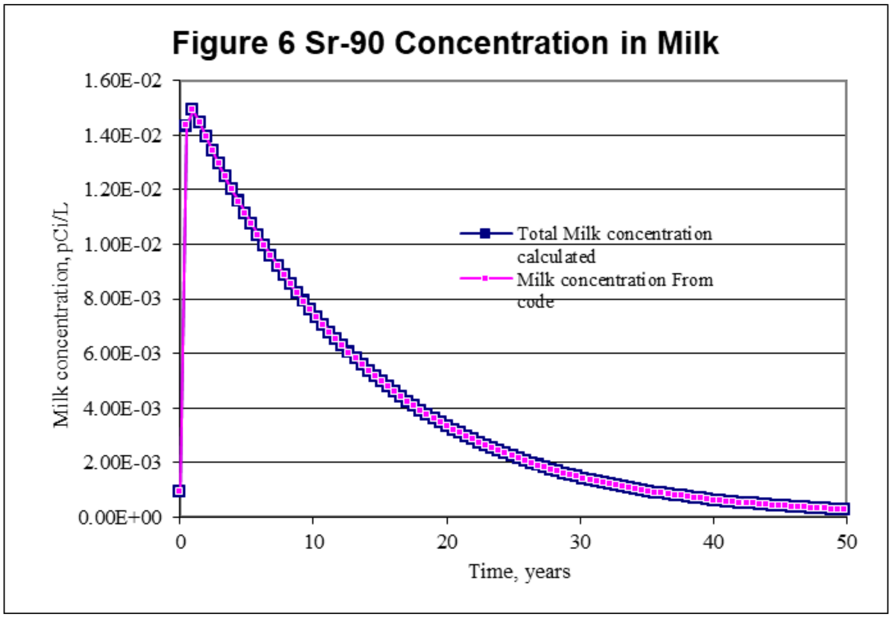


Figure Milk Concentration from V&V Report

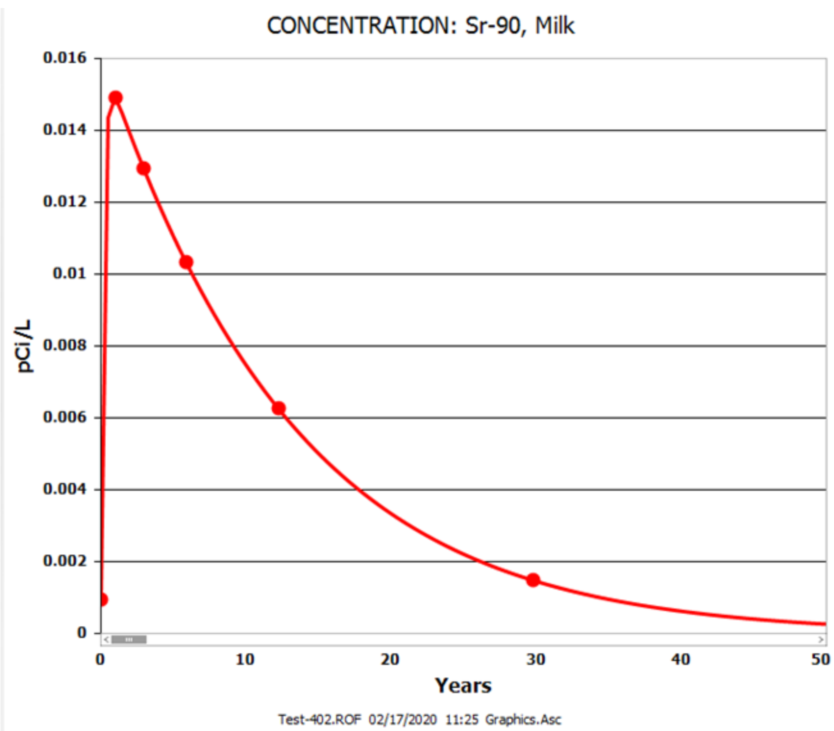


Figure Milk Concentration from Test-402

Practically no difference in V&V results for milk concentration and Test 402 milk concentration results

12.102 TEST CASE 403 TESTER'S REPORT

Documented in Results-Test-403.docx of 2/17/2020 1:39 PM

RESOFF-TEST-403

Objective: Test offsite aquatic food concentrations

The following steps were taken for Test-403

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-403.ROF

Step 3 Ran Test-403.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Selected Fish Media Concentration

Step 7 Compared Fish concentration with the values in Figure 7 in the V&V report

Step 8 Selected Crustacean Media Concentration

Step 9 Compared crustacean concentration with the values in Figure 8 in the V&V report

Result: Test Passes

Aquatic food concentrations in V&V Report matched with Test-403 aquatic food concentrations as shown in the following figures.

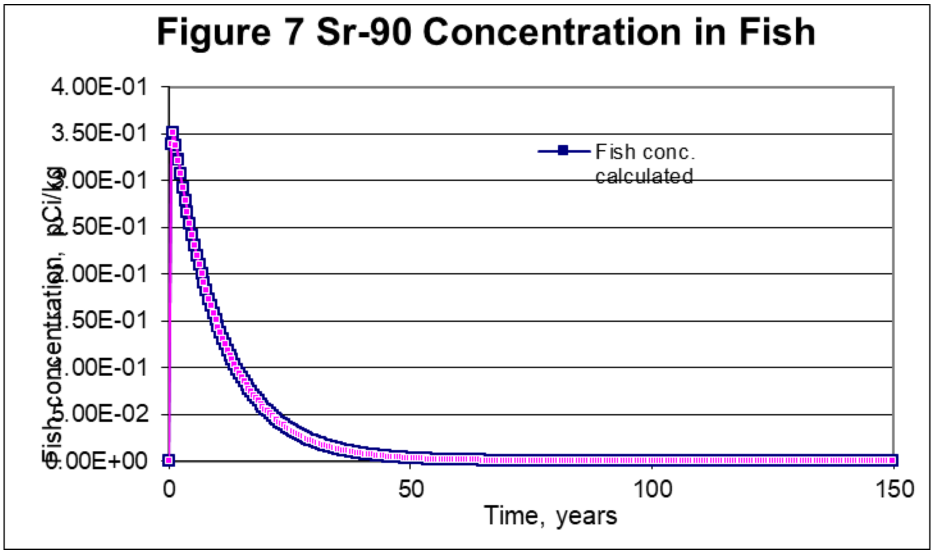


Figure Fish Concentration from V&V Report

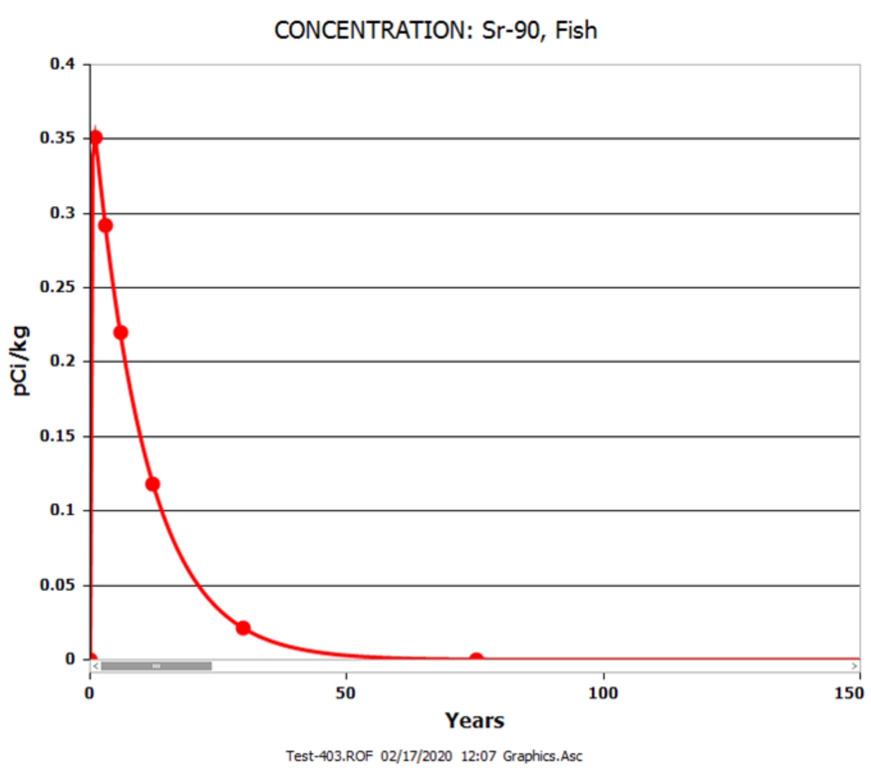


Figure Fish Concentration from Test-403

Practically no difference in V&V results for fish concentrations and Test 403 fish concentration results

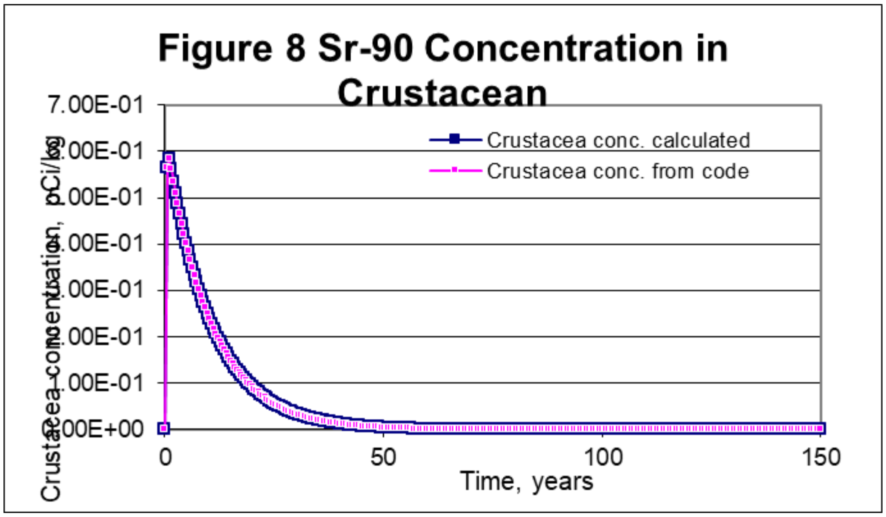


Figure Crustacean Concentration from V&V Report

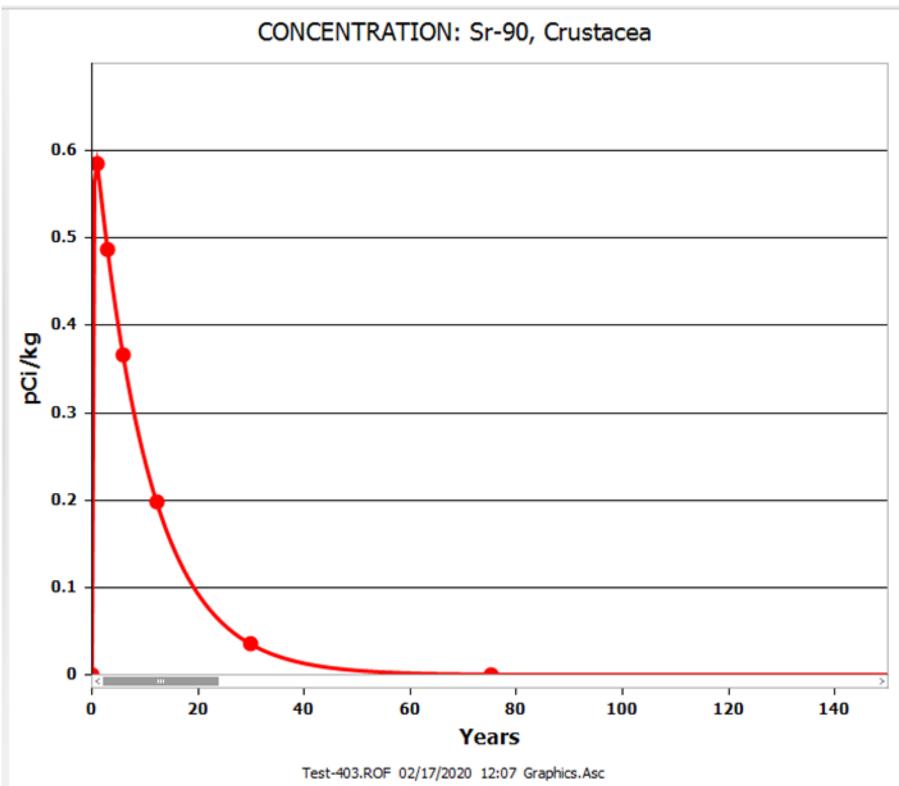


Figure Crustacean Concentration from Test-403

Practically no difference in V&V results for crustacean concentrations and Test 403 crustacean concentration results

12.103 TEST CASE 404 TESTER'S REPORT

Documented in Results-Test-404.docx of 2/17/2020 1:25 PM

RESOFF-TEST-404

Objective: Test offsite plant ingestion dose

The following steps were taken for Test-404

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-404.ROF

Step 3 Selected Set Pathways from the left Navigation Panel

Step 4 Only kept Plant Ingestion pathway active

Step 4 Saved File

Step 5 Ran Test-404.ROF file

Step 6 Viewed Deterministic Graphic

Step 7 Compared summed pathway dose with the values in Figure 9 in the V&V report (Since only plant ingestion pathway was active summed pathways gave plant ingestion dose)

Result: Test Passes

Plant ingestion pathway dose in V&V Report matched with Test-404 plant ingestion pathway dose as shown in the following figures.

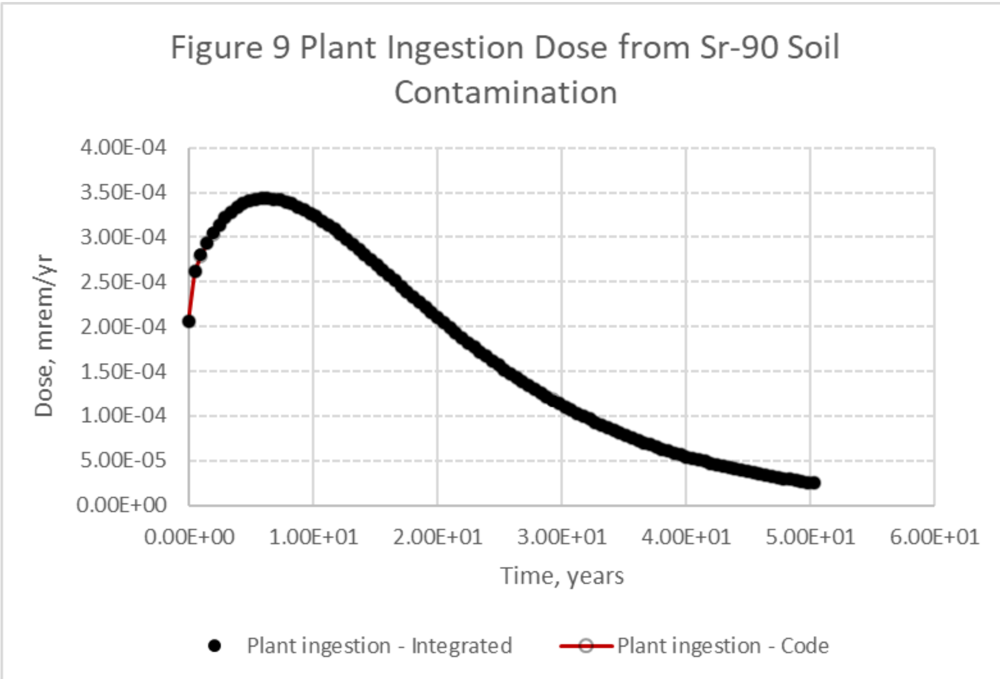


Figure Plant Ingestion Dose from V&V Report

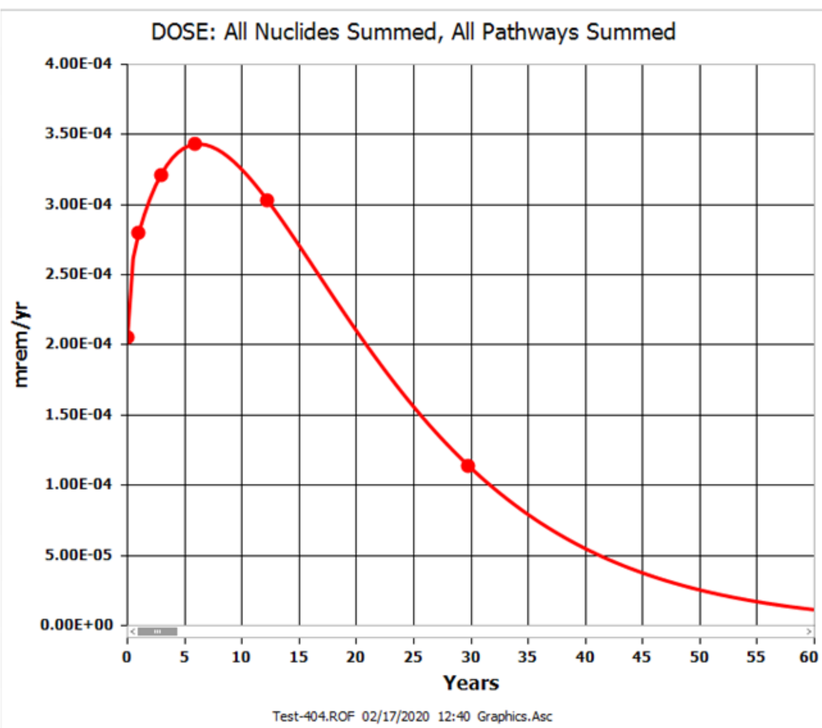


Figure Plant Ingestion Dose from Test-404

Practically no difference in V&V results for plant ingestion dose and Test 404 plant ingestion dose results

12.104 TEST CASE 405 TESTER'S REPORT

Documented in Results-Test-405.docx of 2/17/2020 1:32 PM

RESOFF-TEST-405

Objective: Test offsite meat and milk dose

The following steps were taken for Test-405

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-405-meat.ROF

Step 3 Selected Set Pathways from the left Navigation Panel

Step 4 Only kept Meat Ingestion pathway active and Saved File

Step 5 Ran Test-405-meat.ROF file

Step 6 Viewed Deterministic Graphic

Step 7 Compared summed pathway dose with the values in Figure 10 in the V&V report (Since only meat ingestion pathway was active summed pathways gave meat ingestion dose)

Step 8 Opened SR-90-COMPREHENSIVE.ROF

Step 9 Saved as Test-405-milk.ROF

Step 10 Selected Set Pathways from the left Navigation Panel

Step 11 Only kept Milk Ingestion pathway active

Step 12 Saved File

Step 13 Ran Test-405-milk.ROF file

Step 14 Viewed Deterministic Graphic

Step 15 Compared summed pathway dose with the values in Figure 11 in the V&V report (Since only milk ingestion pathway was active summed pathways gave milk ingestion dose)

Result: Test Passes

Meat and milk doses in V&V Report matched with Test-405 meat and milk doses as shown in the following figures.

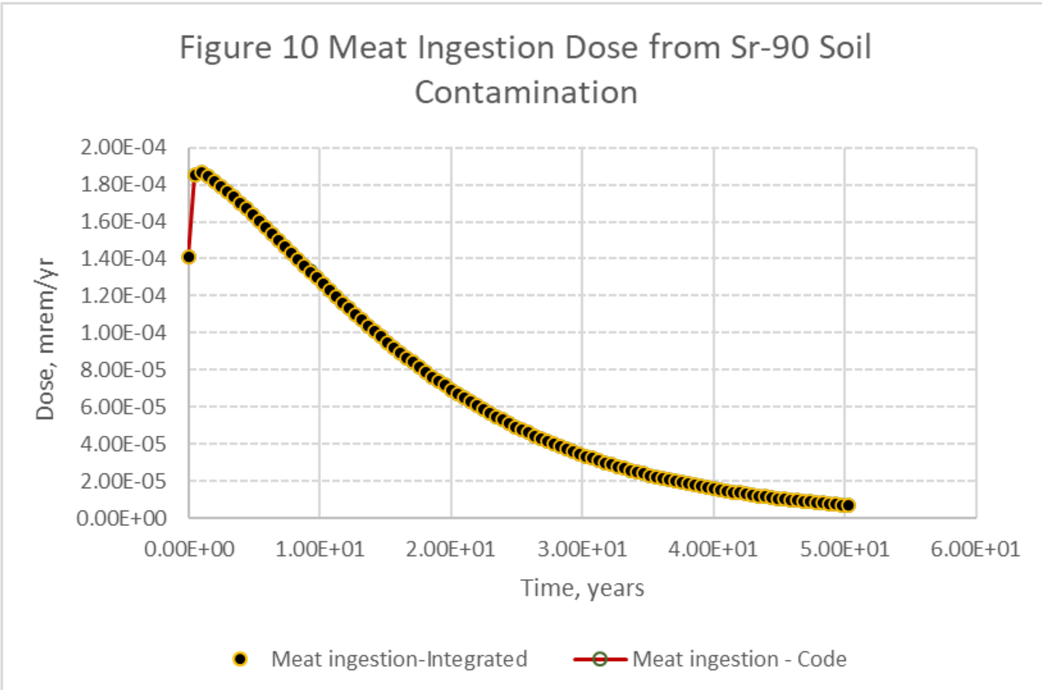


Figure Meat Ingestion Dose from V&V Report

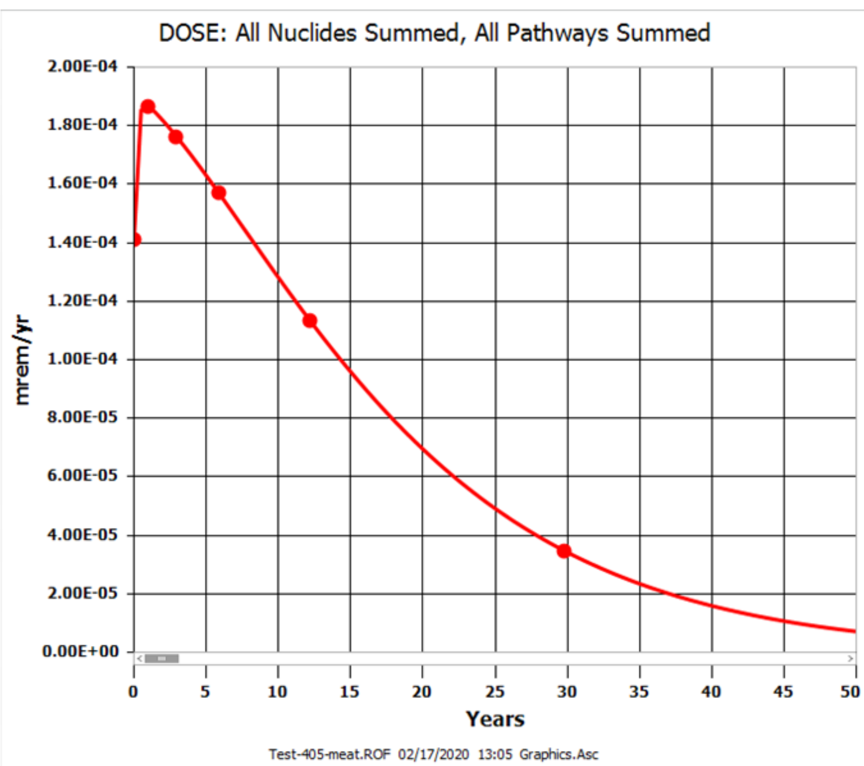


Figure Meat Ingestion Dose from Test-405-Meat

Practically no difference in V&V results for meat dose and Test 405 meat dose results

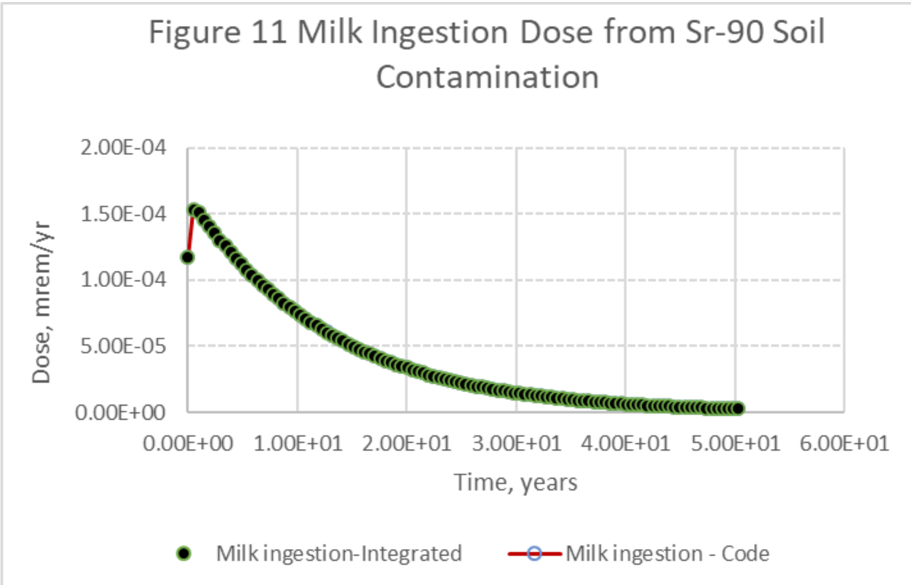


Figure Milk Ingestion Dose from V&V Report

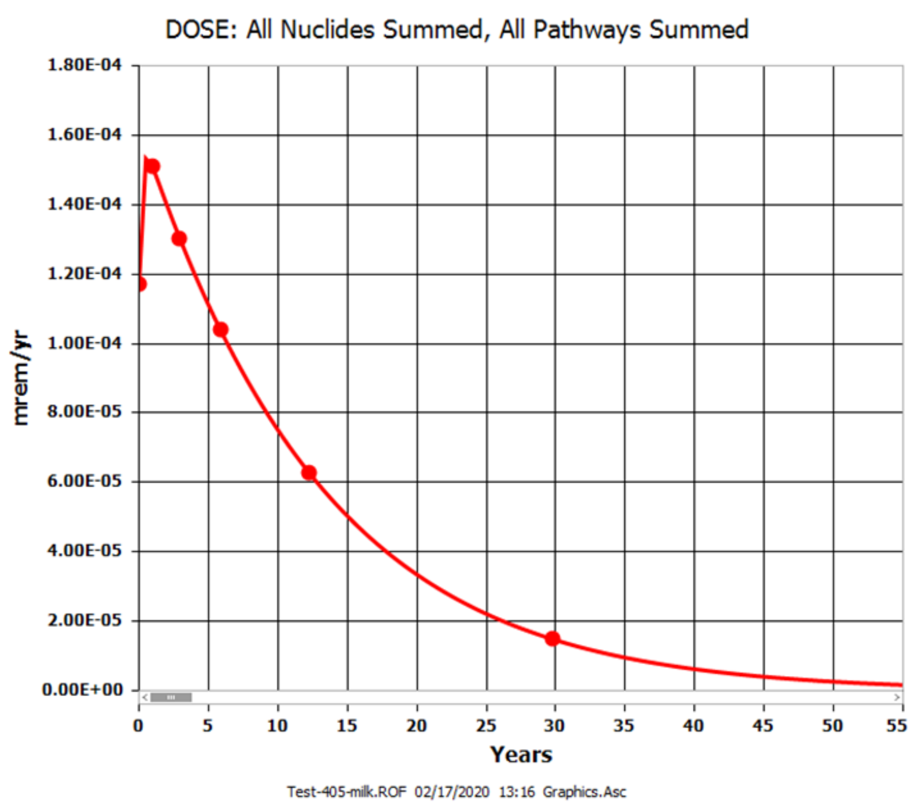


Figure Milk Ingestion Dose from Test-405-Milk

Practically no difference in V&V results for milk dose and Test 405 milk dose results

12.105 TEST CASE 406 TESTER'S REPORT

Documented in Results-Test-406.docx of 2/17/2020 1:18 PM

RESOFF-TEST-406

Objective: Test offsite aquatic pathway doses

The following steps were taken for Test-406

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-406.ROF

Step 3 Selected Set Pathways from the left Navigation Panel

Step 4 Only kept Aquatic Foods pathway active

Step 4 Saved File

Step 5 Ran Test-406.ROF

Step 6 Viewed Deterministic Graphic

Step 7 Compared summed pathway dose with the values in Figure 12 in the V&V report (Since only aquatic foods pathway was active summed pathways gave aquatic foods dose)

Result: Test Passes

Aquatic pathway dose in V&V Report matched with Test-406 aquatic pathway dose as shown in the following figures.

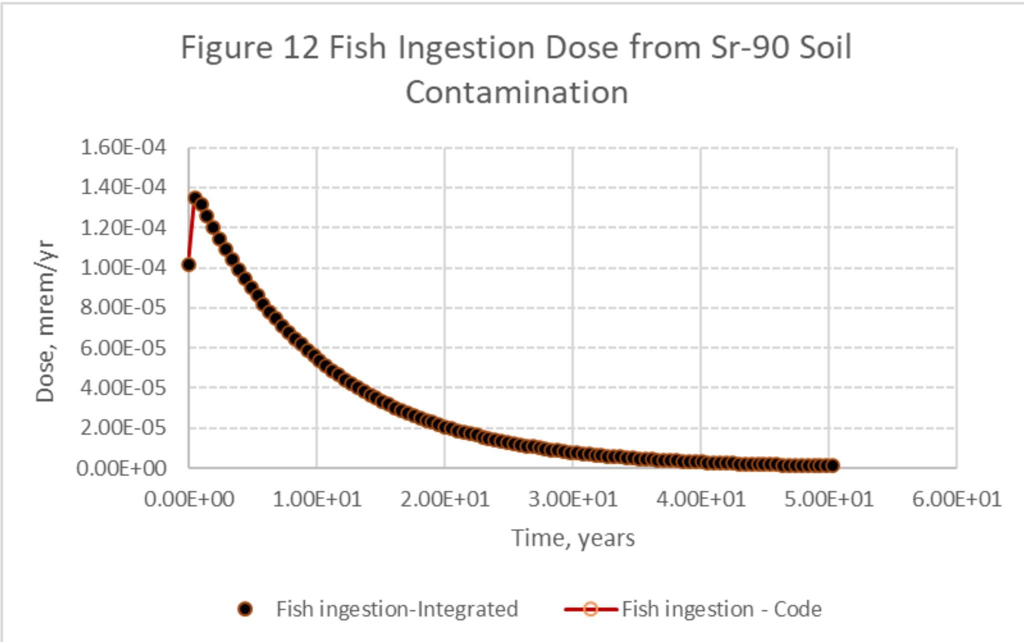


Figure Aquatic Foods Ingestion Dose from V&V Report

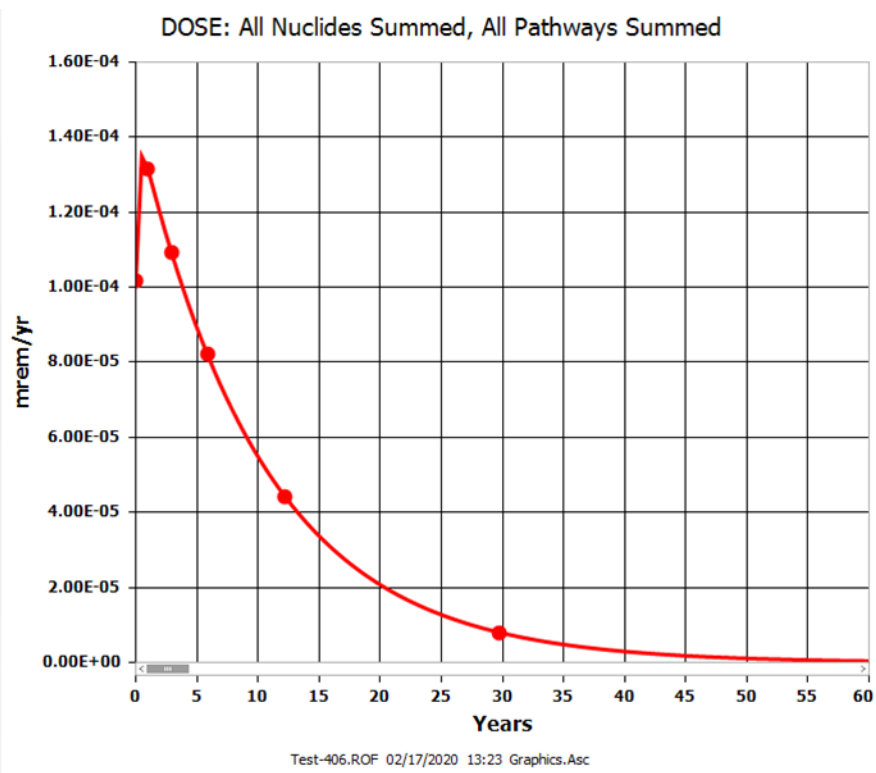


Figure Aquatic Foods Ingestion Dose from Test-406

Practically no difference in V&V aquatic food ingestion dose results and Test 406 dose results

12.106 TEST CASE 407 TESTER'S REPORT

Documented in Results-Test-407.docx of 2/17/2020 1:57 PM

RESOFF-TEST-407

Objective: Test offsite drinking water pathway doses

The following steps were taken for Test-407

Step 1 Opened SR-90-COMPREHENSIVE.ROF

Step 2 Saved as Test-407.ROF

Step 3 Selected Set Pathways from the left Navigation Panel

Step 4 Only kept Drinking water pathway active

Step 4 Saved File

Step 5 Ran Test-407.ROF

Step 6 Viewed Deterministic Graphic

Step 7 Compared summed pathway dose with the values in Figure 13 in the V&V report (Since only drinking water pathway was active summed pathways gave drinking water dose)

Result: Test Passes

Drinking water pathway dose in V&V Report matched with Test-407 drinking pathway dose as shown in the following figures.

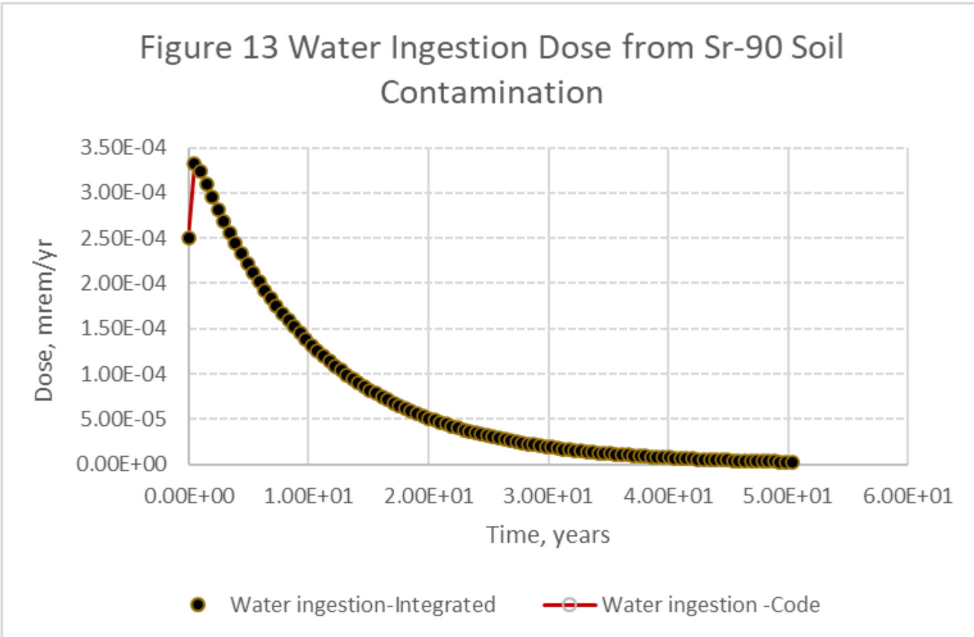


Figure Drinking Water Ingestion Dose from V&V Report

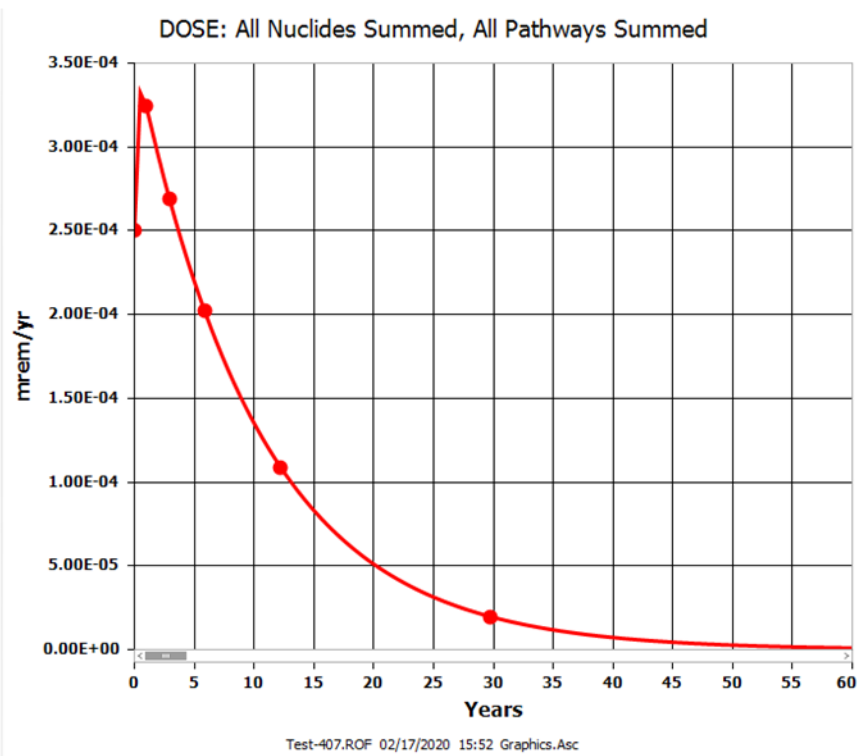


Figure Drinking Water Ingestion Dose from Test-407

Practically no difference in V&V drinking water dose results and Test 407 dose results

12.107 TEST CASE 411 TESTER'S REPORT

Documented in Results-Test-411.docx of 2/17/2020 2:19 PM

RESOFF-TEST-411

Objective: Test offsite soil concentration in leafy vegetable agricultural field

The following steps were taken for Test-411

Step 1 Opened offsite-accumulation-test1.ROF

Step 2 Saved as Test-411.ROF

Step 3 Ran Test-411.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in leafy vegetable field with the values in Figure 1 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in leafy vegetable field in V&V Report matched with Test-411 soil concentration as shown in the following figures.

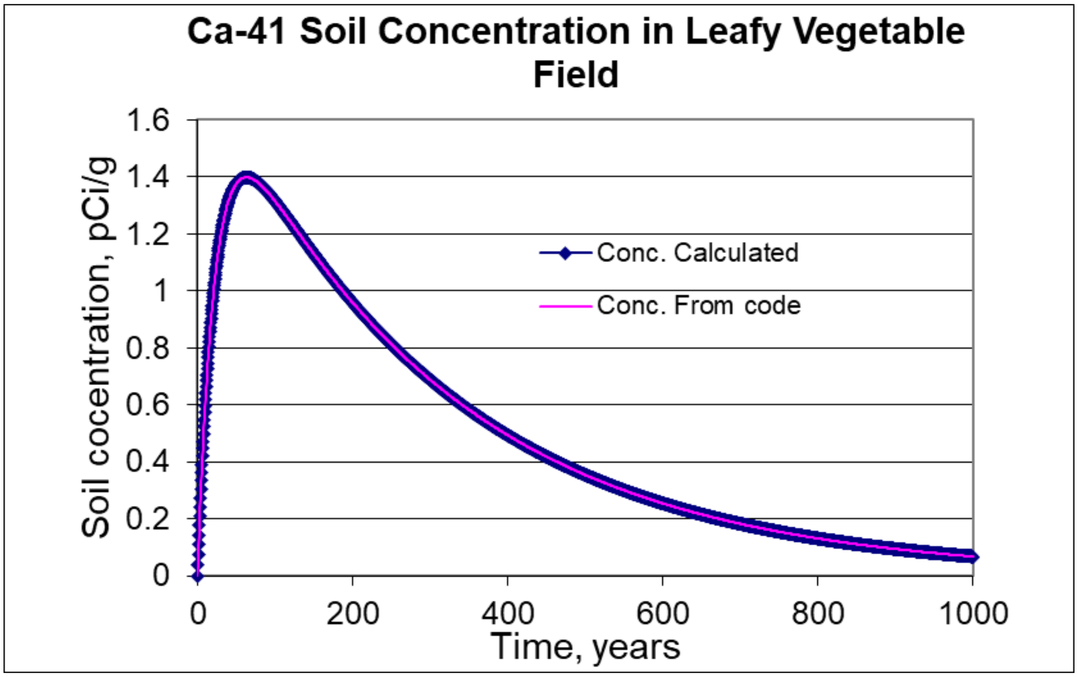


Figure Surface soil Concentration in Leafy Vegetable Field from V&V Report

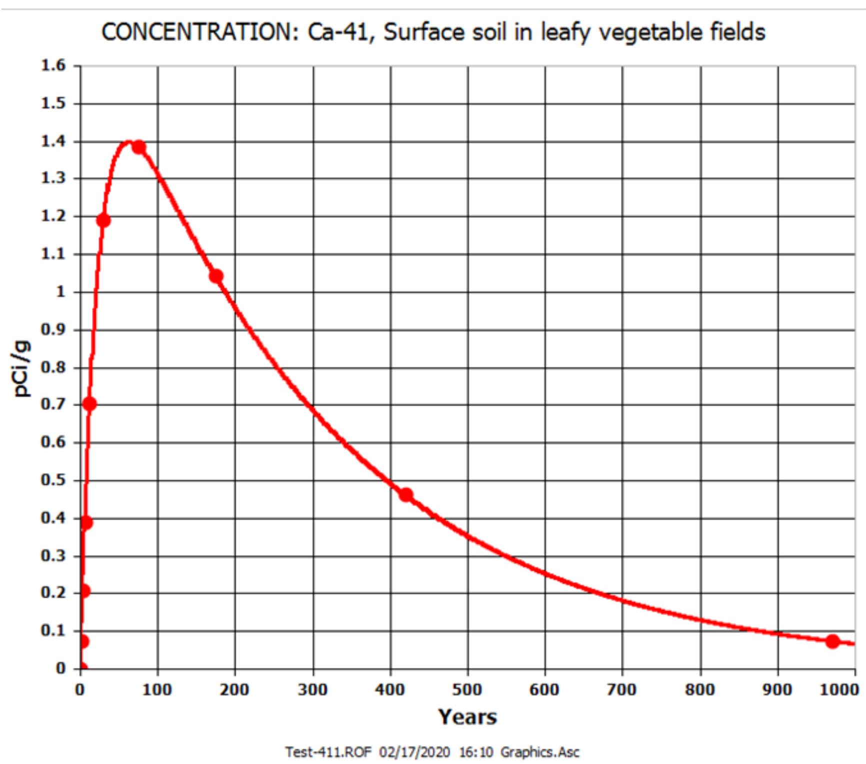


Figure Surface Soil Concentration in Leafy Vegetable Field from Test-411

Practically no difference in V&V results for surface soil concentration in leafy vegetable field and Test 411 results

12.108 TEST CASE 412 TESTER'S REPORT

Documented in Results-Test-412.docx of 2/17/2020 2:43 PM

RESOFF-TEST-412

Objective: Test offsite soil concentration in pasture agricultural field

The following steps were taken for Test-412

Step 1 Opened offsite-accumulation-test2.ROF

Step 2 Saved as Test-412.ROF

Step 3 Ran Test-412.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in pasture field with the values in Figure 2 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in pasture field in V&V Report matched with Test-412 soil concentration as shown in the following figures.

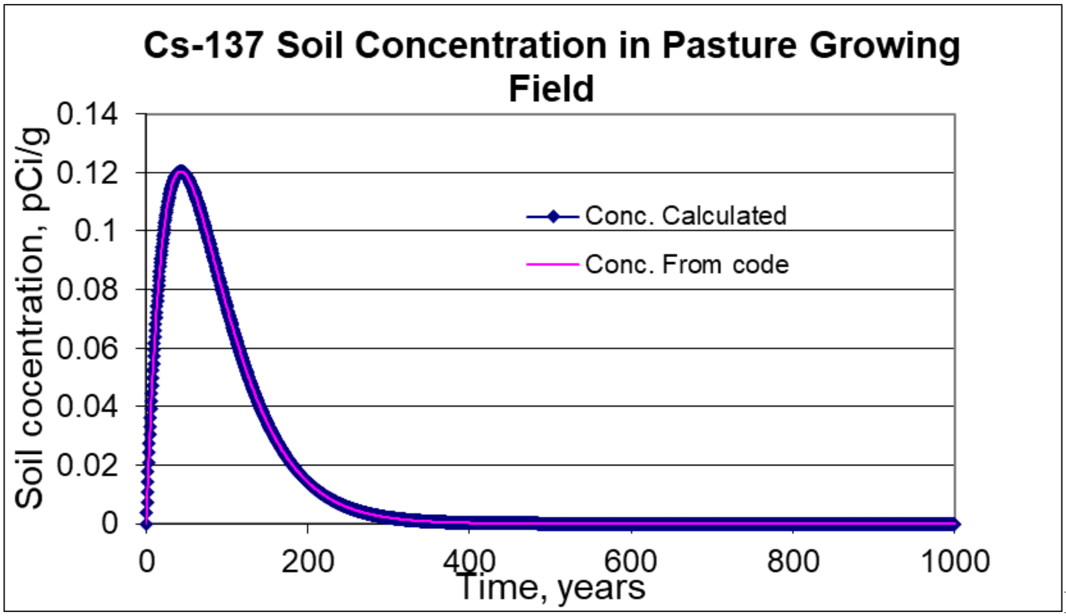


Figure Surface soil Concentration in Pasture Growing Field from V&V Report

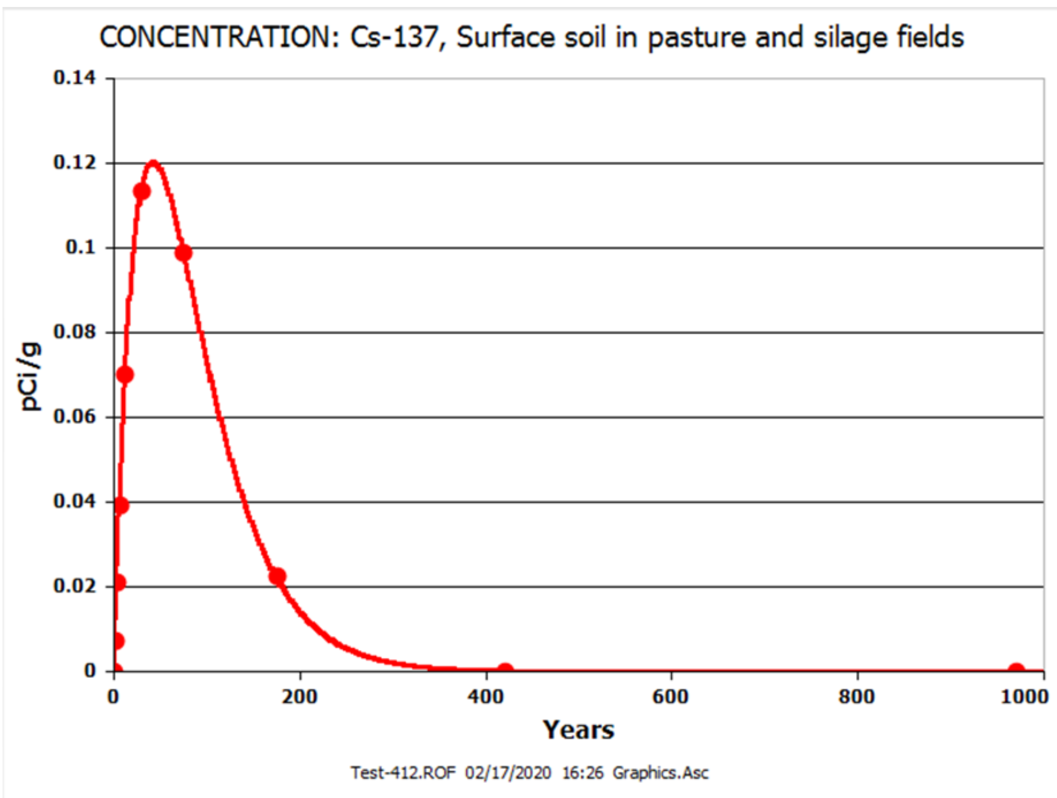


Figure Surface Soil Concentration in Pasture and Silage Field from Test-412

Practically no difference in V&V results for surface soil concentration in pasture and silage field and Test 412 results

12.109 TEST CASE 413 TESTER'S REPORT

Documented in Results-Test-413.docx of 2/17/2020 2:41 PM

RESOFF-TEST-413

Objective: Test offsite soil concentration in grain agricultural field

The following steps were taken for Test-413

Step 1 Opened offsite-accumulation-test3.ROF

Step 2 Saved as Test-413.ROF

Step 3 Ran Test-413.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in grain field with the values in Figure 3 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in grain field in V&V Report matched with Test-413 soil concentration as shown in the following figures.

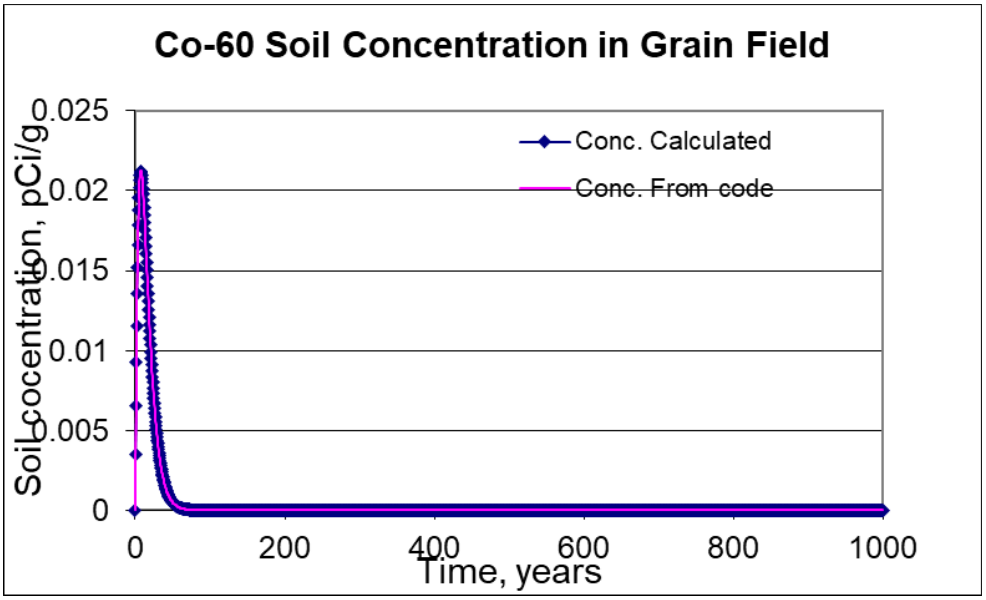


Figure Surface soil Concentration in Grain Field from V&V Report

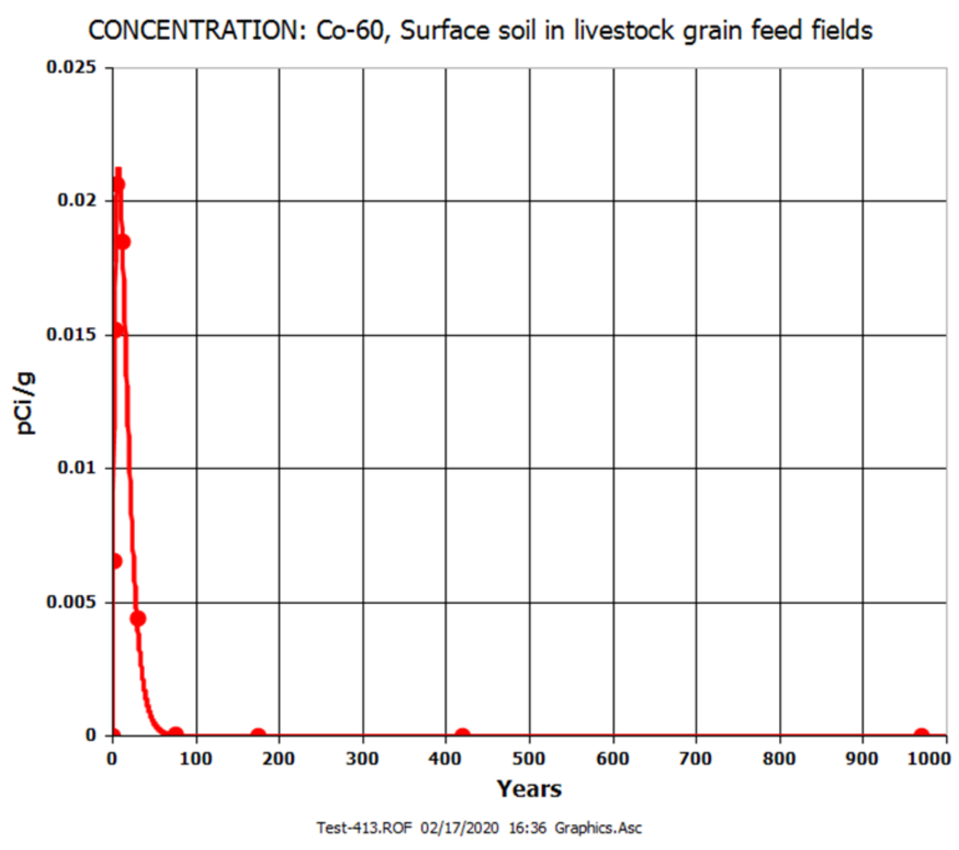


Figure Surface Soil Concentration in Grain Field from Test-413

Practically no difference in V&V results for surface soil concentration in livestock grain field and Test 413 results

12.110 TEST CASE 414 TESTER'S REPORT

Documented in Results-Test-414.docx of 2/17/2020 3:05 PM

RESOFF-TEST-414

Objective: Test offsite soil concentration in non-leafy vegetable field

The following steps were taken for Test-414

Step 1 Opened offsite-accumulation-test4.ROF

Step 2 Saved as Test-414.ROF

Step 3 Ran Test-414.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in non-leafy vegetable field with the values in Figure 4 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in non-leafy vegetable field in V&V Report matched with Test-414 soil concentration as shown in the following figures.

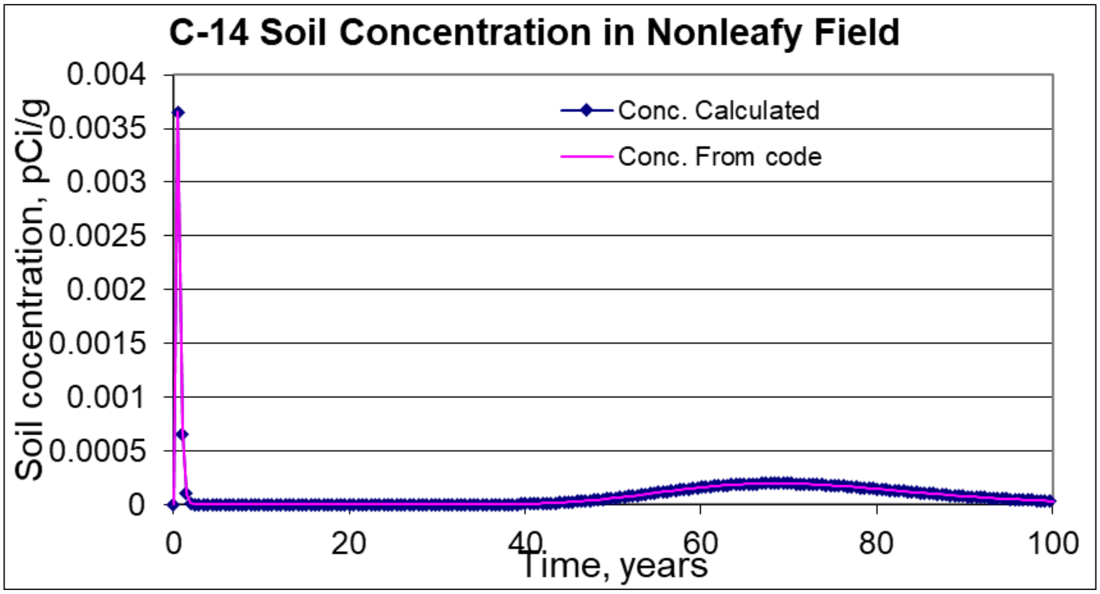


Figure Surface soil Concentration in Non-leafy Field from V&V Report

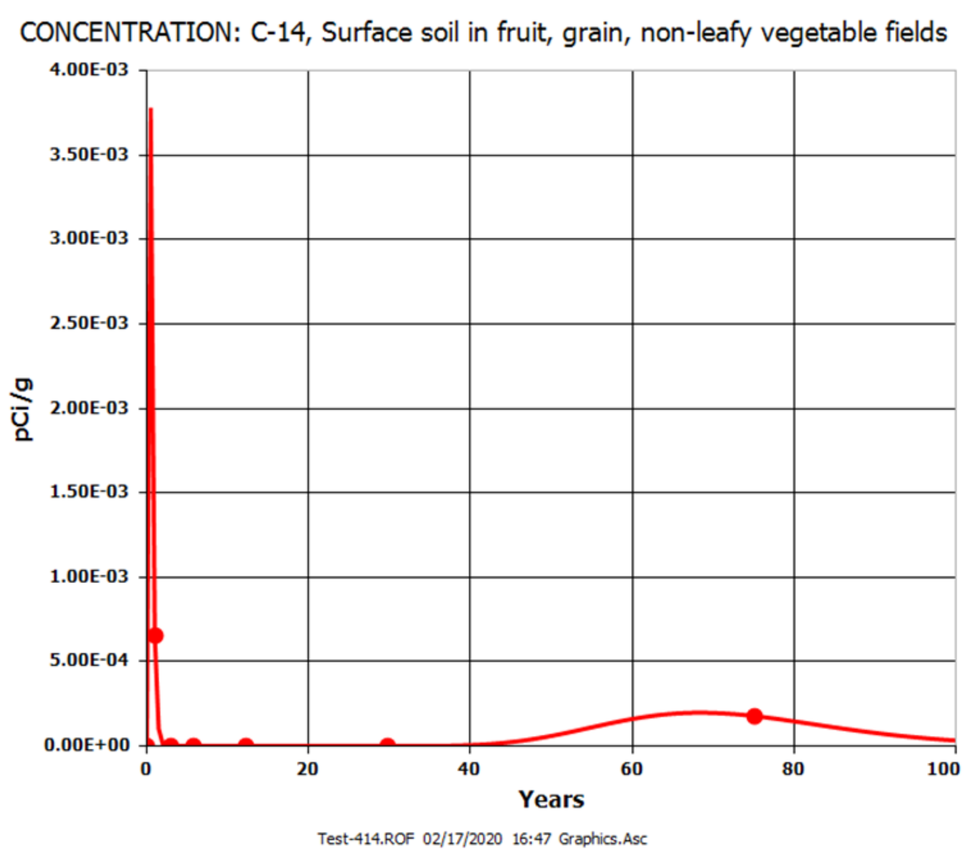


Figure Surface Soil Concentration in Non-leafy Field from Test-414

Practically no difference in V&V results for surface soil concentration in non-leafy vegetable field and Test 414 results

12.111 TEST CASE 415 TESTER'S REPORT

Documented in Results-Test-415.docx of 2/17/2020 3:04 PM

RESOFF-TEST-415

Objective: Test features of offsite soil concentration in non-leafy vegetable agricultural field contributed by erosion

The following steps were taken for Test-415

Step 1 Opened offsite-accumulation-test4-erosion-only.ROF

Step 2 Saved as Test-415.ROF

Step 3 Ran Test-415.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in non-leafy vegetable field with the values in Figure 5 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in non-leafy vegetable field in V&V Report matched with Test-415 soil concentration as shown in the following figures.

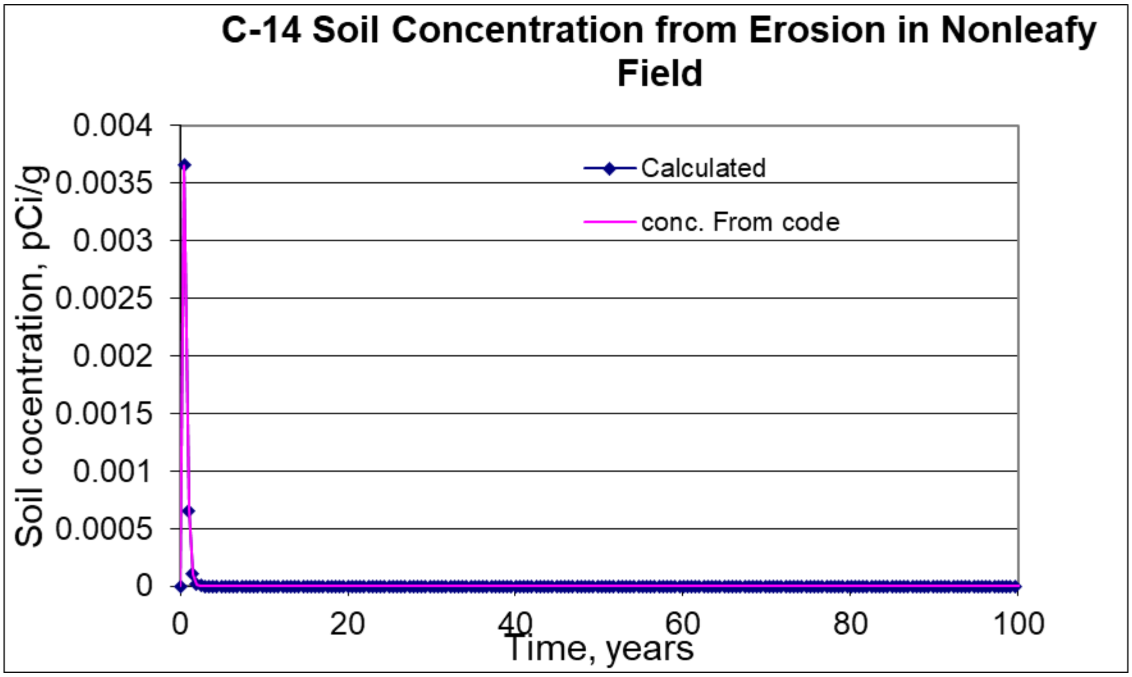


Figure Surface soil Concentration in Non-leafy Field from Erosion in V&V Report

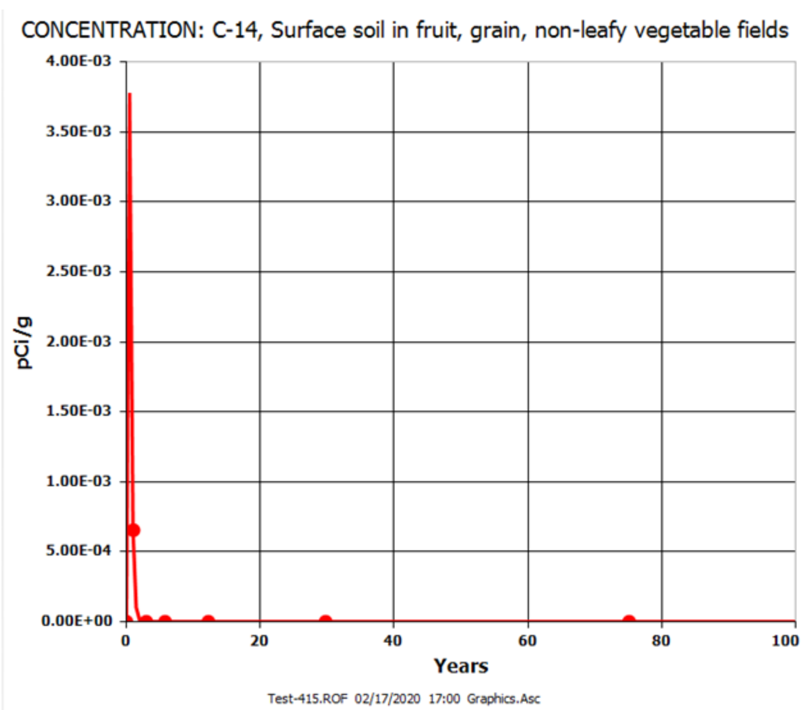


Figure Surface Soil Concentration in Non-leafy Field from Test-415

Practically no difference in V&V results for surface soil concentration in non-leafy vegetable field from erosion and Test 415 results

12.112 TEST CASE 416 TESTER'S REPORT

Documented in Results-Test-416.docx of 2/17/2020 6:39 PM

RESOFF-TEST-416

Objective: Test features of offsite soil concentration in non-leafy vegetable agricultural field contributed by air deposition

The following steps were taken for Test-416

Step 1 Opened offsite-accumulation-test4-air-dep-only.ROF

Step 2 Saved as Test-416.ROF

Step 3 Ran Test-416.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in non-leafy vegetable field with the values in Figure 6 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in non-leafy vegetable field in V&V Report matched with Test-416 soil concentration as shown in the following figures.

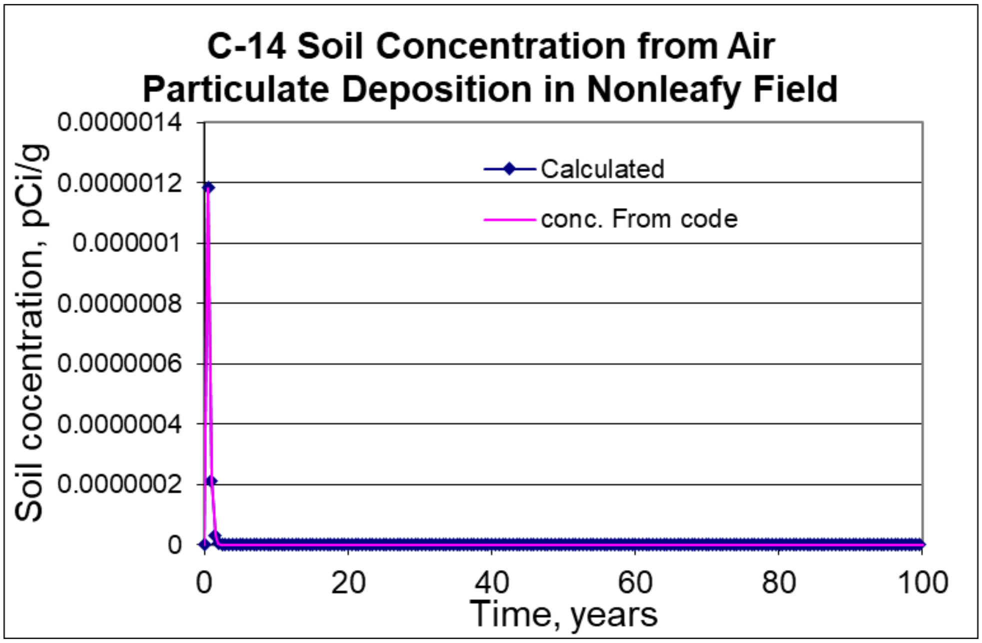


Figure Surface soil Concentration in Non-leafy Field from Air Particulate Deposition in V&V Report

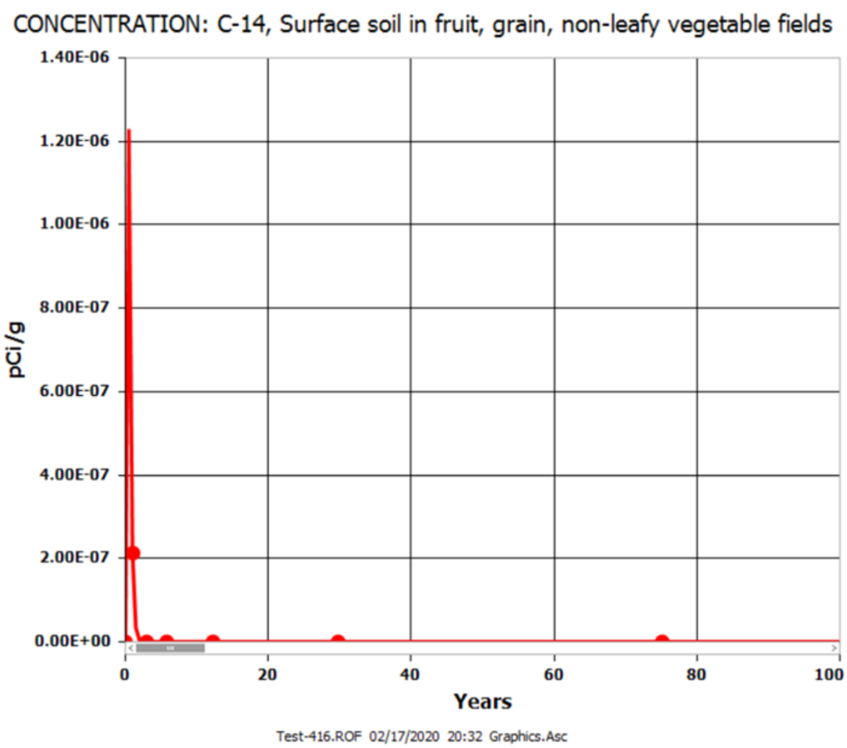


Figure Surface Soil Concentration in Non-leafy Field from Test-416

Practically no difference in V&V results for surface soil concentration in non-leafy vegetable field from air deposition and Test 416 results

12.113 TEST CASE 417 TESTER'S REPORT

Documented in Results-Test-417.docx of 2/17/2020 6:58 PM

RESOFF-TEST-417

Objective: Test features of offsite soil concentration in non-leafy vegetable agricultural field contributed by surface water irrigation

The following steps were taken for Test-417

Step 1 Opened offsite-accumulation-test4-irrigation-only.ROF

Step 2 Saved as Test-417.ROF

Step 3 Ran Test-417.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface soil concentration in non-leafy vegetable field with the values in Figure 7 in the V&V report (Verification of Accumulation at offsite location.docx)

Result: Test Passes

Surface soil concentration in non-leafy vegetable field in V&V Report matched with Test-417 soil concentration as shown in the following figures.

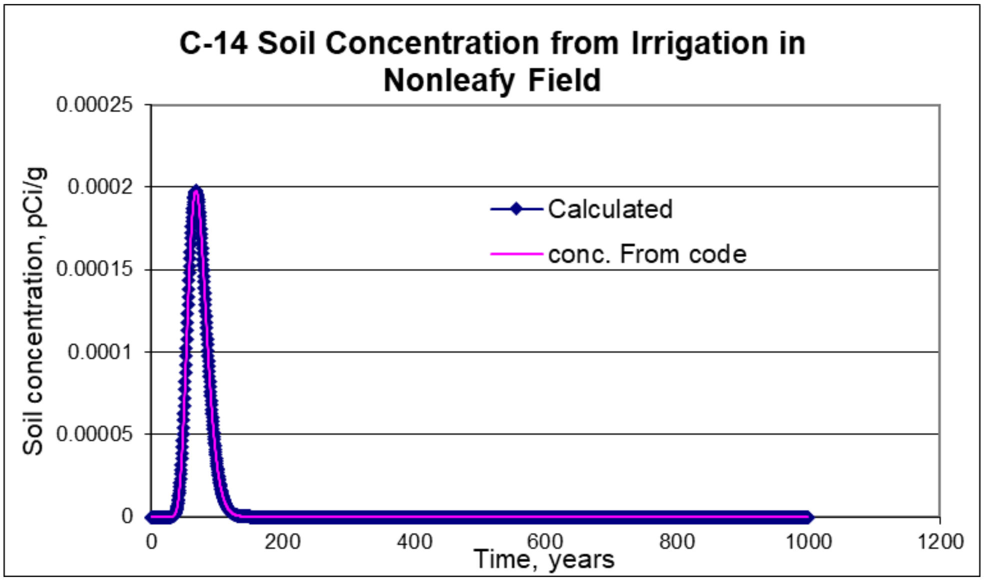


Figure Surface soil Concentration in Non-leafy Field from Irrigation in V&V Report

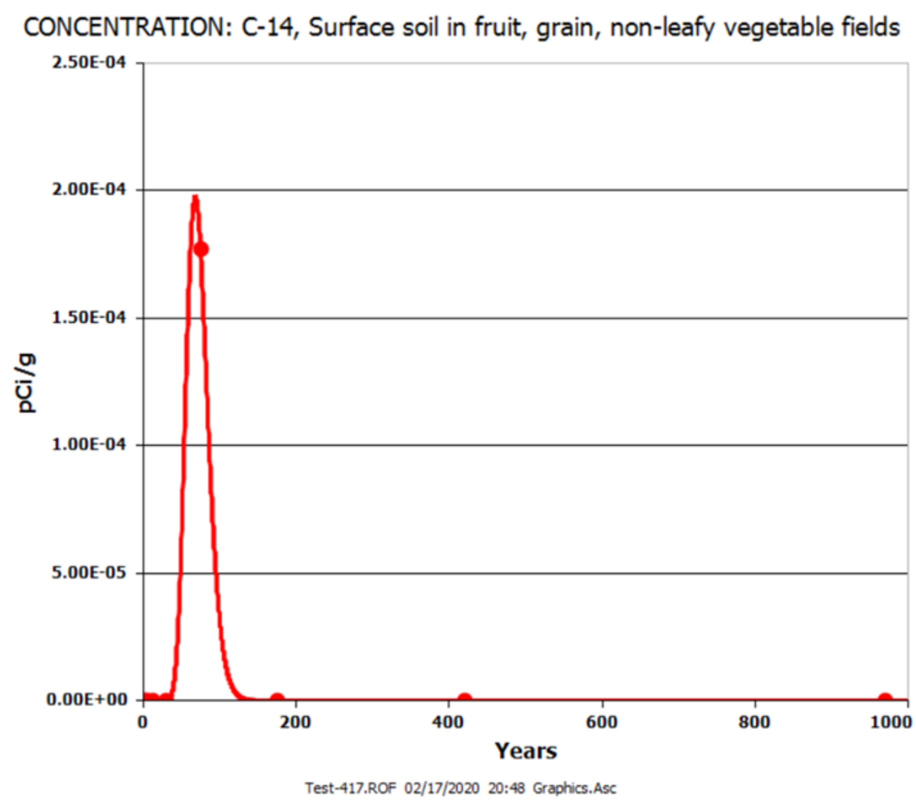


Figure Surface Soil Concentration in Non-leafy Field from Test-417

Practically no difference in V&V results for surface soil concentration in non-leafy vegetable field from irrigation and Test 417 results

12.114 TEST CASE 421 TESTER'S REPORT

Documented in Results-Test-421.docx of 2/18/2020 3:12 AM

RESOFF-TEST-421

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Briggs Rural Coefficients Based on Rural Windspeed Terrain

The following steps were taken for Test-421

Step 1 Opened Air Dispersion Run1.ROF

Step 2 Saved as Test-421.ROF

Step 3 Ran Test-421.ROF file

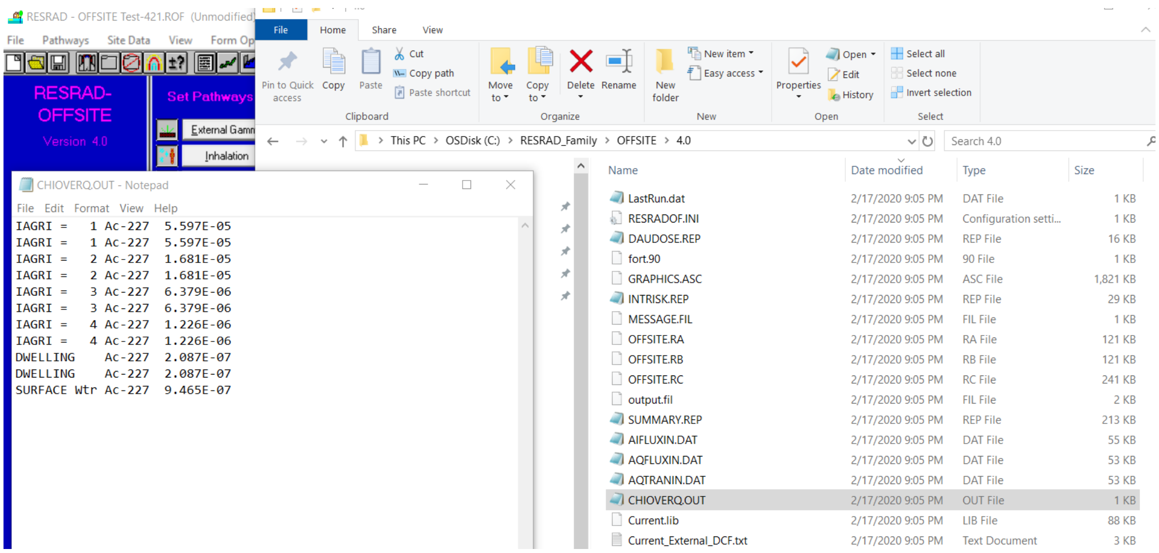
Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 1 listed in last column of Table 2 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 1 in Table 2 matched with Test-421 normalized air concentrations as shown in the following screenshots.

Table 2 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m^3) in V&V Report (with Plume Rise) with RESRAD-OFFSITE Version 4				
	Values from V&V Report Table 4-2			
	Spreadsheet	Spreadsheet x directional frequency	Previous OFFSITE	OFFSITE Version 4
Run 1 - Briggs rural dispersion coefficients, no dry or wet deposition				
Fruit grain non-leafy vegetable plot	1.12E-03	5.60E-05	5.68E-05	5.60E-05
Leafy vegetables plot	1.70E-04	1.70E-05	1.69E-05	1.69E-05
Pasture, silage growing area	2.55E-05	6.38E-06	6.39E-06	6.38E-06
Grain Field	6.14E-06	1.23E-06	1.23E-06	1.23E-06
Dwelling site	5.22E-07	2.09E-07	2.09E-07	2.09E-07
Run 2 - Pasquill-Gifford dispersion coefficient with dry deposition, no wet deposition				
Fruit grain non-leafy vegetable plot	1.54E-03	7.69E-05	7.81E-05	7.69E-05
Leafy vegetables plot	2.00E-04	2.00E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain Field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.34E-07	1.74E-07	1.74E-07	1.74E-07
Run 3 - Pasquill-Gifford dispersion coefficient with dry deposition and wet deposition				
Fruit grain non-leafy vegetable plot	1.51E-03	7.56E-05	7.68E-05	7.56E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.71E-06	7.70E-06
Grain Field	7.02E-06	1.40E-06	1.40E-06	1.40E-06
Dwelling site	4.27E-07	1.71E-07	1.71E-07	1.72E-07
Note: The spreadsheet calculations do not include the directional wind frequency.				



Look normalized air concentrations in CHIOVERQ.OUT file on the left side of the screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

12.115 TEST CASE 422 TESTER'S REPORT

Documented in Results-Test-422.docx of 2/18/2020 6:04 AM

RESOFF-TEST-422

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Pasquill Gifford Coefficients Based on Rural Windspeed Terrain with Release heat flux of 90 cal/s and with only dry deposition

The following steps were taken for Test-422

Step 1 Opened Air Dispersion Run2.ROF

Step 2 Saved as Test-422.ROF

Step 3 Ran Test-422.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 2 listed in last column of Table 2 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 2 in Table 2 matched with Test-422 normalized air concentrations as shown in the following screenshots.

Table 2 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m^3) in V&V Report (with Plume Rise) with RESRAD-OFFSITE Version 4				
	Values from V&V Report Table 4-2			
	Spreadsheet	Spreadsheet x directional frequency	Previous OFFSITE	OFFSITE Version 4
Run 1 - Briggs rural dispersion coefficients, no dry or wet deposition				
Fruit grain non-leafy vegetable plot	1.12E-03	5.60E-05	5.68E-05	5.60E-05
Leafy vegetables plot	1.70E-04	1.70E-05	1.69E-05	1.69E-05
Pasture, silage growing area	2.55E-05	6.38E-06	6.39E-06	6.38E-06
Grain Field	6.14E-06	1.23E-06	1.23E-06	1.23E-06
Dwelling site	5.22E-07	2.09E-07	2.09E-07	2.09E-07
Run 2 - Pasquill-Gifford dispersion coefficient with dry deposition, no wet deposition				
Fruit grain non-leafy vegetable plot	1.54E-03	7.69E-05	7.81E-05	7.69E-05
Leafy vegetables plot	2.00E-04	2.00E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain Field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.34E-07	1.74E-07	1.74E-07	1.74E-07
Run 3 - Pasquill-Gifford dispersion coefficient with dry deposition and wet deposition				
Fruit grain non-leafy vegetable plot	1.51E-03	7.56E-05	7.68E-05	7.56E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.71E-06	7.70E-06
Grain Field	7.02E-06	1.40E-06	1.40E-06	1.40E-06
Dwelling site	4.27E-07	1.71E-07	1.71E-07	1.72E-07
Note: The spreadsheet calculations do not include the directional wind frequency.				

CHIOVERQ.OUT - Notepad

File Edit Format View Help

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IAGRI =    1 Ac-227  7.688E-05
IAGRI =    1 Ac-227  7.688E-05
IAGRI =    2 Ac-227  1.984E-05
IAGRI =    2 Ac-227  1.984E-05
IAGRI =    3 Ac-227  7.785E-06
IAGRI =    3 Ac-227  7.785E-06
IAGRI =    4 Ac-227  1.448E-06
IAGRI =    4 Ac-227  1.448E-06
DWELLING     Ac-227  1.743E-07
DWELLING     Ac-227  1.743E-07
SURFACE Wtr Ac-227  5.837E-07
```

Look normalized air concentrations in CHIOVERQ.OUT file in the above screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

The normalized air concentrations in Table 2 for run 2 matched with air concentrations in CHIOVERQ.OUT file.

12.116 TEST CASE 423 TESTER'S REPORT

Documented in Results-Test-423.docx of 2/18/2020 6:03 AM

RESOFF-TEST-423

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Pasquill-Gilford Coefficients Based on Rural Windspeed Terrain and Release heat flux of 90 cal/s for Dry and Wet Deposition

The following steps were taken for Test-423

Step 1 Opened Air Dispersion Run3.ROF

Step 2 Saved as Test-423.ROF

Step 3 Ran Test-423.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 3 listed in last column of Table 2 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 3 in Table 2 matched with Test-423 normalized air concentrations as shown in the following screenshots.

Table 2 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m^3) in V&V Report (with Plume Rise) with RESRAD-OFFSITE Version 4				
	Values from V&V Report Table 4-2			
	Spreadsheet	Spreadsheet x directional frequency	Previous OFFSITE	OFFSITE Version 4
Run 1 - Briggs rural dispersion coefficients, no dry or wet deposition				
Fruit grain non-leafy vegetable plot	1.12E-03	5.60E-05	5.68E-05	5.60E-05
Leafy vegetables plot	1.70E-04	1.70E-05	1.69E-05	1.69E-05
Pasture, silage growing area	2.55E-05	6.38E-06	6.39E-06	6.38E-06
Grain Field	6.14E-06	1.23E-06	1.23E-06	1.23E-06
Dwelling site	5.22E-07	2.09E-07	2.09E-07	2.09E-07
Run 2 - Pasquill-Gifford dispersion coefficient with dry deposition, no wet deposition				
Fruit grain non-leafy vegetable plot	1.54E-03	7.69E-05	7.81E-05	7.69E-05
Leafy vegetables plot	2.00E-04	2.00E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain Field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.34E-07	1.74E-07	1.74E-07	1.74E-07
Run 3 - Pasquill-Gifford dispersion coefficient with dry deposition and wet deposition				
Fruit grain non-leafy vegetable plot	1.51E-03	7.56E-05	7.68E-05	7.56E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.71E-06	7.70E-06
Grain Field	7.02E-06	1.40E-06	1.40E-06	1.40E-06
Dwelling site	4.27E-07	1.71E-07	1.71E-07	1.72E-07
Note: The spreadsheet calculations do not include the directional wind frequency.				

CHIOVERQ.OUT - Notepad

File Edit Format View Help

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IAGRI =    1 Ac-227  7.561E-05
IAGRI =    1 Ac-227  7.561E-05
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IAGRI =    3 Ac-227  7.702E-06
IAGRI =    3 Ac-227  7.702E-06
IAGRI =    4 Ac-227  1.401E-06
IAGRI =    4 Ac-227  1.401E-06
DWELLING     Ac-227  1.717E-07
DWELLING     Ac-227  1.717E-07
SURFACE Wtr  Ac-227  5.217E-07
```

Looked normalized air concentrations in CHIOVERQ.OUT file in the above screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

The normalized air concentrations in Table 2 for run 3 matched with air concentrations in CHIOVERQ.OUT file.

12.117 TEST CASE 424 TESTER'S REPORT

Documented in Results-Test-424.docx of 2/18/2020 3:44 AM

RESOFF-TEST-424

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Pasquill-Gilford Coefficients Based on Rural Windspeed Terrain and Release heat flux of 90 cal/s for Dry and Wet Deposition

The following steps were taken for Test-424

Step 1 Opened Air Dispersion Run4.ROF

Step 2 Saved as Test-424.ROF

Step 3 Ran Test-424.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 4 listed in last column of Table 3 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 4 in Table 3 matched with Test-424 normalized air concentrations as shown in the following screenshots.

Table 3 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m^3) in V&V Report (without Plume Rise) with Version 4				
	Values from V&V Report Table 4-3			
	Spreadsheet	Spreadsheet x directional frequency	Previous OFFSITE	OFFSITE Version 4
Run 4 - Pasquill-Gifford rural dispersion coefficients, no dry or wet deposition				
Fruit grain non-leafy vegetable plot	1.57E-03	7.86E-05	7.94E-05	7.86E-05
Leafy vegetables plot	2.02E-04	2.02E-05	2.01E-05	2.00E-05
Pasture, silage growing area	3.14E-05	7.86E-06	7.87E-06	7.86E-06
Grain Field	7.34E-06	1.47E-06	1.47E-06	1.47E-06
Dwelling site	4.52E-07	1.81E-07	1.81E-07	1.81E-07
Run 5 - Pasquill-Gifford dispersion coefficient with dry deposition, no wet deposition				
Fruit grain non-leafy vegetable plot	1.55E-03	7.73E-05	7.81E-05	7.73E-05
Leafy vegetables plot	2.01E-04	2.01E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain Field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.36E-07	1.74E-07	1.74E-07	1.74E-07
Run 6 - Pasquill-Gifford dispersion coefficient with dry deposition and wet deposition				
Fruit grain non-leafy vegetable plot	1.52E-03	7.61E-05	7.68E-05	7.60E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.72E-06	7.70E-06
Grain Field	7.03E-06	1.41E-06	1.40E-06	1.40E-06
Dwelling site	4.29E-07	1.72E-07	1.72E-07	1.72E-07

CHIOVERQ.OUT - Notepad

File Edit Format View Help

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IAGRI =    3 Ac-227   7.855E-06
IAGRI =    3 Ac-227   7.855E-06
IAGRI =    4 Ac-227   1.466E-06
IAGRI =    4 Ac-227   1.466E-06
DWELLING     Ac-227   1.809E-07
DWELLING     Ac-227   1.809E-07
SURFACE Wtr  Ac-227   5.971E-07
```

Looked normalized air concentrations in CHIOVERQ.OUT file in the above screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

The normalized air concentrations in Table 3 for run 4 match with air concentrations in CHIOVERQ.OUT file.

12.118 TEST CASE 425 TESTER'S REPORT

Documented in Results-Test-425.docx of 2/18/2020 3:52 AM

RESOFF-TEST-425

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Pasquill-Gilford Coefficients Based on Rural Windspeed Terrain for Dry Deposition

The following steps were taken for Test-425

Step 1 Opened Air Dispersion Run5.ROF

Step 2 Saved as Test-425.ROF

Step 3 Ran Test-425.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 5 listed in last column of Table 3 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 5 in Table 3 matched with Test-425 normalized air concentrations as shown in the following screenshots.

Table 3 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m^3) in V&V Report (without Plume Rise) with Version 4				
	Values from V&V Report Table 4-3			
	Spreadsheet	Spreadsheet x directional frequency	Previous OFFSITE	OFFSITE Version 4
Run 4 - Pasquill-Gifford rural dispersion coefficients, no dry or wet deposition				
Fruit grain non-leafy vegetable plot	1.57E-03	7.86E-05	7.94E-05	7.86E-05
Leafy vegetables plot	2.02E-04	2.02E-05	2.01E-05	2.00E-05
Pasture, silage growing area	3.14E-05	7.86E-06	7.87E-06	7.86E-06
Grain Field	7.34E-06	1.47E-06	1.47E-06	1.47E-06
Dwelling site	4.52E-07	1.81E-07	1.81E-07	1.81E-07
Run 5 - Pasquill-Gifford dispersion coefficient with dry deposition, no wet deposition				
Fruit grain non-leafy vegetable plot	1.55E-03	7.73E-05	7.81E-05	7.73E-05
Leafy vegetables plot	2.01E-04	2.01E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain Field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.36E-07	1.74E-07	1.74E-07	1.74E-07
Run 6 - Pasquill-Gifford dispersion coefficient with dry deposition and wet deposition				
Fruit grain non-leafy vegetable plot	1.52E-03	7.61E-05	7.68E-05	7.60E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.72E-06	7.70E-06
Grain Field	7.03E-06	1.41E-06	1.40E-06	1.40E-06
Dwelling site	4.29E-07	1.72E-07	1.72E-07	1.72E-07

```
CHIOVERQ.OUT - Notepad
File  Edit  Format  View  Help
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IAGRI =    1 Ac-227  7.731E-05
IAGRI =    2 Ac-227  1.984E-05
IAGRI =    2 Ac-227  1.984E-05
IAGRI =    3 Ac-227  7.787E-06
IAGRI =    3 Ac-227  7.787E-06
IAGRI =    4 Ac-227  1.449E-06
IAGRI =    4 Ac-227  1.449E-06
DWELLING     Ac-227  1.744E-07
DWELLING     Ac-227  1.744E-07
SURFACE Wtr  Ac-227  5.811E-07
```

Looked normalized air concentrations in CHIOVERQ.OUT file in the above screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

The normalized air concentrations in Table 3 for run 5 match with air concentrations in CHIOVERQ.OUT file.

12.119 TEST CASE 426 TESTER'S REPORT

Documented in Results-Test-426.docx of 2/18/2020 3:57 AM

RESOFF-TEST-426

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Pasquill-Gilford Coefficients Based on Rural Windspeed Terrain for Dry and Wet Deposition

The following steps were taken for Test-426

Step 1 Opened Air Dispersion Run6.ROF

Step 2 Saved as Test-426.ROF

Step 3 Ran Test-426.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 6 listed in last column of Table 3 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 6 in Table 3 matched with Test-426 normalized air concentrations as shown in the following screenshots.

Table 3 Comparison of RESRAD-OFFSITE Normalized Air Concentrations (s/m^3) in V&V Report (without Plume Rise) with Version 4				
	Values from V&V Report Table 4-3			
	Spreadsheet	Spreadsheet x directional frequency	Previous OFFSITE	OFFSITE Version 4
Run 4 - Pasquill-Gifford rural dispersion coefficients, no dry or wet deposition				
Fruit grain non-leafy vegetable plot	1.57E-03	7.86E-05	7.94E-05	7.86E-05
Leafy vegetables plot	2.02E-04	2.02E-05	2.01E-05	2.00E-05
Pasture, silage growing area	3.14E-05	7.86E-06	7.87E-06	7.86E-06
Grain Field	7.34E-06	1.47E-06	1.47E-06	1.47E-06
Dwelling site	4.52E-07	1.81E-07	1.81E-07	1.81E-07
Run 5 - Pasquill-Gifford dispersion coefficient with dry deposition, no wet deposition				
Fruit grain non-leafy vegetable plot	1.55E-03	7.73E-05	7.81E-05	7.73E-05
Leafy vegetables plot	2.01E-04	2.01E-05	1.99E-05	1.98E-05
Pasture, silage growing area	3.12E-05	7.79E-06	7.80E-06	7.79E-06
Grain Field	7.26E-06	1.45E-06	1.45E-06	1.45E-06
Dwelling site	4.36E-07	1.74E-07	1.74E-07	1.74E-07
Run 6 - Pasquill-Gifford dispersion coefficient with dry deposition and wet deposition				
Fruit grain non-leafy vegetable plot	1.52E-03	7.61E-05	7.68E-05	7.60E-05
Leafy vegetables plot	1.98E-04	1.98E-05	1.97E-05	1.96E-05
Pasture, silage growing area	3.08E-05	7.71E-06	7.72E-06	7.70E-06
Grain Field	7.03E-06	1.41E-06	1.40E-06	1.40E-06
Dwelling site	4.29E-07	1.72E-07	1.72E-07	1.72E-07

CHIOVERQ.OUT - Notepad

File Edit Format View Help

```
IAGRI =    1 Ac-227   7.603E-05
IAGRI =    1 Ac-227   7.603E-05
IAGRI =    2 Ac-227   1.960E-05
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IAGRI =    3 Ac-227   7.704E-06
IAGRI =    3 Ac-227   7.704E-06
IAGRI =    4 Ac-227   1.402E-06
IAGRI =    4 Ac-227   1.402E-06
DWELLING     Ac-227   1.717E-07
DWELLING     Ac-227   1.717E-07
SURFACE Wtr Ac-227   5.193E-07
```

Looked normalized air concentrations in CHIOVERQ.OUT file in the above screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

The normalized air concentrations in Table 3 for run 6 match with air concentrations in CHIOVERQ.OUT file.

12.120 TEST CASE 427 TESTER'S REPORT

Documented in Results-Test-427.docx of 2/18/2020 4:05 AM

RESOFF-TEST-427

Objective: Test offsite air concentration by selecting Dispersion Model Coefficients from Pasquill-Gilford Coefficients Based on Rural Windspeed Terrain for Wet Deposition

The following steps were taken for Test-427

Step 1 Opened Air Dispersion Run7.ROF

Step 2 Saved as Test-427.ROF

Step 3 Ran Test-427.ROF file

Step 4 Opened CHIOVERQ.OUT file

Step 5 Compared normalized air concentrations in different fields for Run 7 listed in last column of Table 4 of the V&V report (Verification of atmospheric transport model.docx) with values in CHIOVERQ.OUT file

Result: Test Passes

Normalized air concentrations in different fields in V&V Report for Run 7 in Table 4 matched with Test-427 normalized air concentrations as shown in the following screenshots.

Table 4 Comparison of RESRAD-OFFSITE (Version 4) Normalized Air Concentration with New Spreadsheet Calculations			
	New Spreadsheet	Spreadsheet x directional frequency	Version 4.0
Run 1 - Briggs rural dispersion coefficients, no dry or wet deposition			
Fruit grain non-leafy vegetable plot	1.12E-03	5.60E-05	5.60E-05
Leafy vegetables plot	1.69E-04	1.69E-05	1.69E-05
Pasture, silage growing area	2.55E-05	6.38E-06	6.38E-06
Grain Field	6.14E-06	1.23E-06	1.23E-06
Dwelling site	5.21E-07	2.09E-07	2.09E-07
Run 4 - Pasquill-Gifford rural dispersion coefficients, no dry or wet deposition			
Fruit grain non-leafy vegetable plot	1.57E-03	7.86E-05	7.86E-05
Leafy vegetables plot	2.02E-04	2.02E-05	2.00E-05
Pasture, silage growing area	3.14E-05	7.85E-06	7.86E-06
Grain Field	7.34E-06	1.47E-06	1.47E-06
Dwelling site	4.52E-07	1.81E-07	1.81E-07
Run 7 - Pasquill-Gifford dispersion coefficient with wet deposition			
Fruit grain non-leafy vegetable plot	1.55E-03	7.73E-05	7.73E-05
Leafy vegetables plot	2.00E-04	2.00E-05	1.98E-05
Pasture, silage growing area	3.11E-05	7.77E-06	7.77E-06
Grain Field	7.10E-06	1.42E-06	1.42E-06
Dwelling site	4.45E-07	1.78E-07	1.78E-07

CHIOVERQ.OUT - Notepad

File Edit Format View Help

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IAGRI =    1 Ac-227  7.730E-05
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IAGRI =    2 Ac-227  1.979E-05
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IAGRI =    3 Ac-227  7.771E-06
IAGRI =    3 Ac-227  7.771E-06
IAGRI =    4 Ac-227  1.418E-06
IAGRI =    4 Ac-227  1.418E-06
DWELLING     Ac-227  1.782E-07
DWELLING     Ac-227  1.782E-07
SURFACE Wtr Ac-227  5.336E-07
```

Looked normalized air concentrations in CHIOVERQ.OUT file in the above screenshot (Note: IAGRI #1 represents non-leafy vegetable plot, IAGRI #2 represents leafy vegetable plot, IAGRI #3 represents pasture silage growing area, and IAGRI #4 represents grain field)

The normalized air concentrations in Table 4 for run 7 match with air concentrations in CHIOVERQ.OUT file.

12.121 TEST CASE 428 TESTER’S REPORT

Documented in FW_ Test Case 428.msg of 2/26/2020 12:40 PM

FW: Test Case 428

LePoire, David J. Wed 2/26/2020 12:40 PM

(Table copied from test spreadsheet because the tester’s email report could not be reformatted to fit on this page.)

	Dist\time	5.00E-02	0.4	0.25	0.1	0.2	Calc depletion					North - A (0.89 m/s)	North East - F (9.61 m/s)	East - D (6.93 m/s)	South - B (2.46 m/s)	West - C (4.47 m/s)	Comparison of V&V to current run				
	20.29988	4.96E-02	0.399916	0.249801	9.97E-02	0.199697	0.993	1.000	0.999	0.997	0.998	9.93E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	1.00	1.00	1.00	1.00	1.00
	52.19969	4.94E-02	0.399308	0.24937	9.95E-02	0.199323	0.988	0.998	0.997	0.995	0.997	9.88E-01	9.98E-01	9.97E-01	9.95E-01	9.97E-01	1.00	1.00	1.00	1.00	1.00
	101.4994	4.92E-02	0.39853	0.248984	9.93E-02	0.199022	0.984	0.996	0.996	0.993	0.995	9.84E-01	9.96E-01	9.96E-01	9.93E-01	9.95E-01	1.00	1.00	1.00	1.00	1.00
Dry	200.0988	4.90E-02	0.39753	0.248555	9.91E-02	0.198692	0.979	0.994	0.994	0.991	0.993	9.79E-01	9.94E-01	9.94E-01	9.91E-01	9.93E-01	1.00	1.00	1.00	1.00	1.00
run 5	501.6971	4.87E-02	0.395883	0.247901	9.88E-02	0.198211	0.975	0.990	0.992	0.988	0.991	9.75E-01	9.90E-01	9.92E-01	9.88E-01	9.91E-01	1.00	1.00	1.00	1.00	1.00
	1000.494	4.86E-02	0.394389	0.247324	9.86E-02	0.197824	0.973	0.986	0.989	0.986	0.989	9.73E-01	9.86E-01	9.89E-01	9.86E-01	9.89E-01	1.00	1.00	1.00	1.00	1.00
	1499.291	4.86E-02	0.393395	0.246936	9.85E-02	0.197586	0.972	0.983	0.988	0.985	0.988	9.72E-01	9.83E-01	9.88E-01	9.85E-01	9.88E-01	1.00	1.00	1.00	1.00	1.00
	2000.988	4.86E-02	0.392598	0.246628	9.84E-02	0.197411	0.972	0.981	0.987	0.984	0.987	9.72E-01	9.81E-01	9.87E-01	9.84E-01	9.87E-01	1.00	1.00	1.00	1.00	1.00
												North - A (0.89 m/s)	North East - F (9.61 m/s)	East - D (6.93 m/s)	South - B (2.46 m/s)	West - C (4.47 m/s)					
	20.29988	4.98E-02	0.399987	0.249891	9.99E-02	0.199865	0.997	1.000	1.000	0.999	0.999	9.97E-01	1.00E+00	1.00E+00	9.99E-01	9.99E-01	1.00	1.00	1.00	1.00	1.00
	52.19969	4.96E-02	0.399968	0.249721	9.97E-02	0.199654	0.991	1.000	0.999	0.997	0.998	9.91E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	1.00	1.00	1.00	1.00	1.00
	101.4994	4.92E-02	0.399937	0.249458	9.94E-02	0.199328	0.983	1.000	0.998	0.994	0.997	9.83E-01	1.00E+00	9.98E-01	9.94E-01	9.97E-01	1.00	1.00	1.00	1.00	1.00
Wet	200.0988	4.84E-02	0.399877	0.248932	9.88E-02	0.198677	0.967	1.000	0.996	0.988	0.993	9.67E-01	1.00E+00	9.96E-01	9.88E-01	9.93E-01	1.00	1.00	1.00	1.00	1.00
Run6	498.7971	4.60E-02	0.399692	0.247346	9.70E-02	0.196718	0.920	0.999	0.989	0.970	0.984	9.20E-01	9.99E-01	9.89E-01	9.70E-01	9.83E-01	1.00	1.00	1.00	1.00	1.00
	1000.494	4.23E-02	0.399383	0.244704	9.41E-02	0.19347	0.846	0.998	0.979	0.941	0.967	8.46E-01	9.98E-01	9.79E-01	9.41E-01	9.67E-01	1.00	1.00	1.00	1.00	1.00
	1499.291	3.89E-02	0.399076	0.242106	9.14E-02	0.190295	0.779	0.998	0.968	0.914	0.951	7.79E-01	9.98E-01	9.68E-01	9.14E-01	9.51E-01	1.00	1.00	1.00	1.00	1.00
	2000.988	3.58E-02	3.99E-01	2.40E-01	8.86E-02	1.87E-01	0.716	0.997	0.958	0.886	0.936	7.16E-01	9.97E-01	9.58E-01	8.86E-01	9.36E-01	1.00	1.00	1.00	1.00	1.00

Revised 2/26/2020: Results from using input file ...Run7.ROF instead of ...Run6.ROF. This input file should be stated in the test case.

Test Case 428.msg of 2/20/2020 11:12 AM

Test Case 428

LePoire, David J. Thu 2/20/2020 11:06 AM

Test Case 428

LePoire, David J.

Ran the two cases (note that the second part requires run6). The results from the specified files (for he distances and directions) were compared to table 5 & 6 of the report. The Dry deposition matched perfectly. The wet deposition compared to within 3%.

	Dist\time	5.00E-02	0.4	0.25	0.1	0.2	Calc depletion					North - A (0.89 m/s)	North East - F (9.61 m/s)	East - D (6.93 m/s)	South - B (2.46 m/s)	West - C (4.47 m/s)	Comparison of V&V to current run				
	20.29988	4.96E-02	0.399916	0.249801	9.97E-02	0.199697	9.93E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	9.93E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
	52.19969	4.94E-02	0.399308	0.24937	9.95E-02	0.199323	9.88E-01	9.98E-01	9.97E-01	9.95E-01	9.97E-01	9.88E-01	9.98E-01	9.97E-01	9.95E-01	9.97E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
	101.4994	4.92E-02	0.39853	0.248984	9.93E-02	0.199022	9.84E-01	9.96E-01	9.96E-01	9.93E-01	9.95E-01	9.84E-01	9.96E-01	9.96E-01	9.93E-01	9.95E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
Dry	200.0988	4.90E-02	0.39753	0.248555	9.91E-02	0.198692	9.79E-01	9.94E-01	9.94E-01	9.91E-01	9.93E-01	9.79E-01	9.94E-01	9.94E-01	9.91E-01	9.93E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
run 5	501.6971	4.87E-02	0.395883	0.247901	9.88E-02	0.198211	9.75E-01	9.90E-01	9.92E-01	9.88E-01	9.91E-01	9.75E-01	9.90E-01	9.92E-01	9.88E-01	9.91E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
	1000.494	4.86E-02	0.394389	0.247324	9.86E-02	0.197824	9.73E-01	9.86E-01	9.89E-01	9.86E-01	9.89E-01	9.73E-01	9.86E-01	9.89E-01	9.86E-01	9.89E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
	1499.291	4.86E-02	0.393395	0.246936	9.85E-02	0.197586	9.72E-01	9.83E-01	9.88E-01	9.85E-01	9.88E-01	9.72E-01	9.83E-01	9.88E-01	9.85E-01	9.88E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
	2000.988	4.86E-02	0.392598	0.246628	9.84E-02	0.197411	9.72E-01	9.81E-01	9.87E-01	9.84E-01	9.87E-01	9.72E-01	9.81E-01	9.87E-01	9.84E-01	9.87E-01	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
												North - A (0.89 m/s)	North East - F (9.61 m/s)	East - D (6.93 m/s)	South - B (2.46 m/s)	West - C (4.47 m/s)					
	20.29988	4.95E-02	0.399903	0.249692	9.96E-02	0.199563	9.90E-01	1.00E+00	9.99E-01	9.96E-01	9.98E-01	9.97E-01	1.00E+00	1.00E+00	9.99E-01	9.99E-01	9.92E-01	1.00E+00	9.99E-01	9.97E-01	9.99E-01
	52.19969	4.89E-02	0.399276	0.249091	9.92E-02	0.198978	9.79E-01	9.98E-01	9.96E-01	9.92E-01	9.95E-01	9.91E-01	1.00E+00	9.99E-01	9.97E-01	9.98E-01	9.88E-01	9.98E-01	9.97E-01	9.95E-01	9.97E-01
	101.4994	4.84E-02	0.398467	0.248444	9.87E-02	0.198353	9.67E-01	9.96E-01	9.94E-01	9.87E-01	9.92E-01	9.83E-01	1.00E+00	9.98E-01	9.94E-01	9.97E-01	9.84E-01	9.96E-01	9.96E-01	9.93E-01	9.95E-01
Wet	200.0988	4.74E-02	0.397407	0.247493	9.79E-02	0.197377	9.47E-01	9.94E-01	9.90E-01	9.79E-01	9.87E-01	9.67E-01	1.00E+00	9.96E-01	9.88E-01	9.93E-01	9.79E-01	9.94E-01	9.94E-01	9.91E-01	9.94E-01
Run6	498.7971	4.48E-02	0.395589	0.245273	9.59E-02	0.194961	8.97E-01	9.89E-01	9.81E-01	9.59E-01	9.75E-01	9.20E-01	9.99E-01	9.89E-01	9.70E-01	9.83E-01	9.75E-01	9.90E-01	9.92E-01	9.88E-01	9.92E-01
	1000.494	4.12E-02	0.393781	0.242085	9.28E-02	0.191365	8.23E-01	9.84E-01	9.68E-01	9.28E-01	9.57E-01	8.46E-01	9.98E-01	9.79E-01	9.41E-01	9.67E-01	9.73E-01	9.86E-01	9.89E-01	9.86E-01	9.89E-01
	1499.291	3.79E-02	0.392486	0.239139	9.00E-02	0.187998	7.57E-01	9.81E-01	9.57E-01	9.00E-01	9.40E-01	7.79E-01	9.98E-01	9.68E-01	9.14E-01	9.51E-01	9.72E-01	9.83E-01	9.88E-01	9.84E-01	9.88E-01
	2000.988	3.48E-02	0.391388	0.23629	8.72E-02	0.184731	6.96E-01	9.78E-01	9.45E-01	8.72E-01	9.24E-01	7.16E-01	9.97E-01	9.58E-01	8.86E-01	9.36E-01	9.73E-01	9.81E-01	9.87E-01	9.84E-01	9.87E-01

12.122 TEST CASE 431 TESTER'S REPORT

Documented in Results-Test-431.docx of 2/18/2020 6:34 PM

Objective: Test offsite surface water body accumulation with cover for Tc-99

The following steps were taken for Test-431

Step 1 Opened SURF-WATER-CHECK-TC99-TEST1.ROF

Step 2 Saved as Test-431.ROF

Step 3 Ran Test-431.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface water concentration with the values in Figure 1 in the V&V report (Verification of Surface Water Model.docx)

Result: Test Passes

Surface water concentration in V&V Report matched with Test-431 surface water concentration as shown in the following figures.

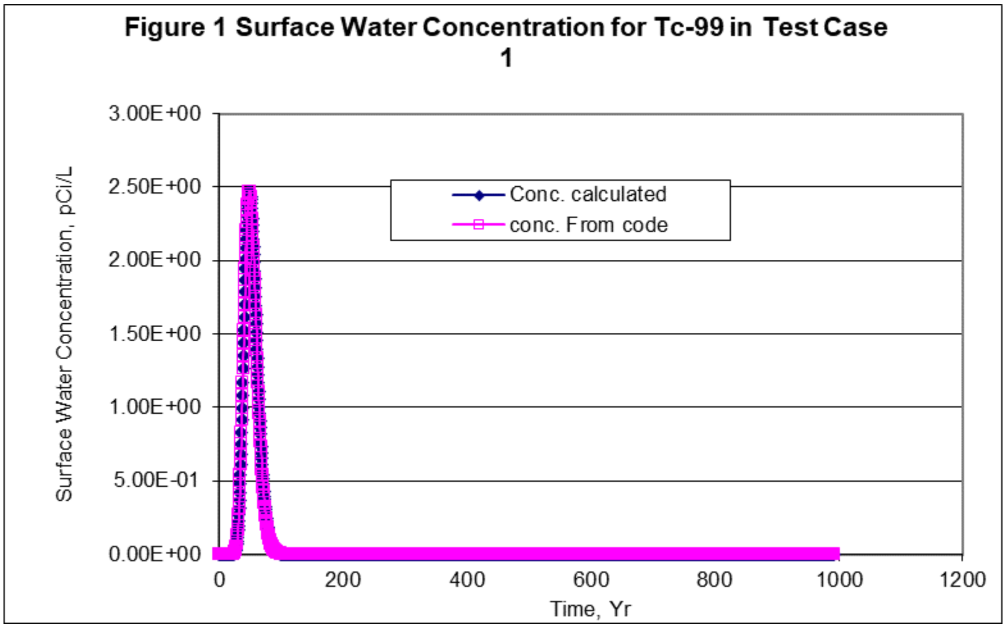

Figure Surface Water Concentration from V&V Report

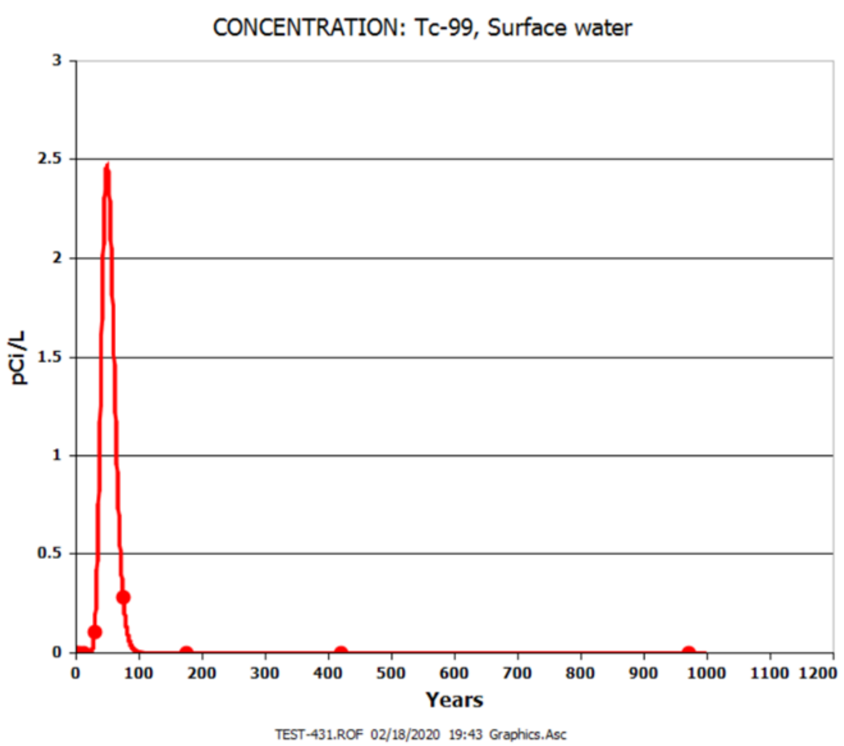

Figure Surface Water Concentration from Test-431

Practically no difference in V&V results for surface water concentration and Test 431 results

12.123 TEST CASE 432 TESTER'S REPORT

Documented in Results-Test-432.docx of 2/18/2020 6:34 PM

RESOFF-TEST-432

Objective: Test offsite surface water body accumulation without cover for Tc-99

The following steps were taken for Test-432

Step 1 Opened SURF-WATER-CHECK-TC99-TEST2.ROF

Step 2 Saved as Test-432.ROF

Step 3 Ran Test-432.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface water concentration with the values in Figure 2 in the V&V report (Verification of Surface Water Model.docx)

Result: Test Passes

Surface water concentration in V&V Report matched with Test-432 surface water concentration as shown in the following figures.

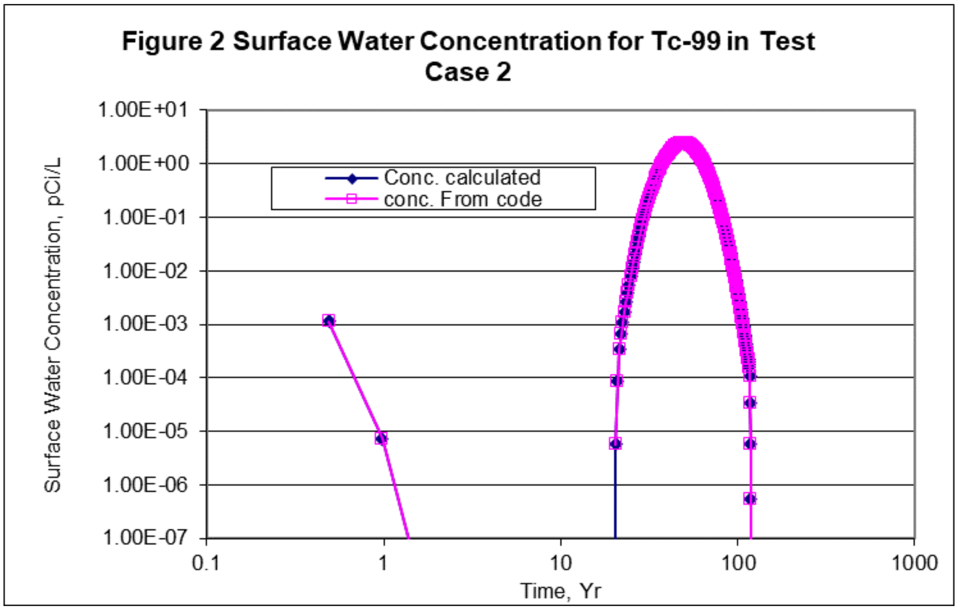

Figure Surface Water Concentration from V&V Report

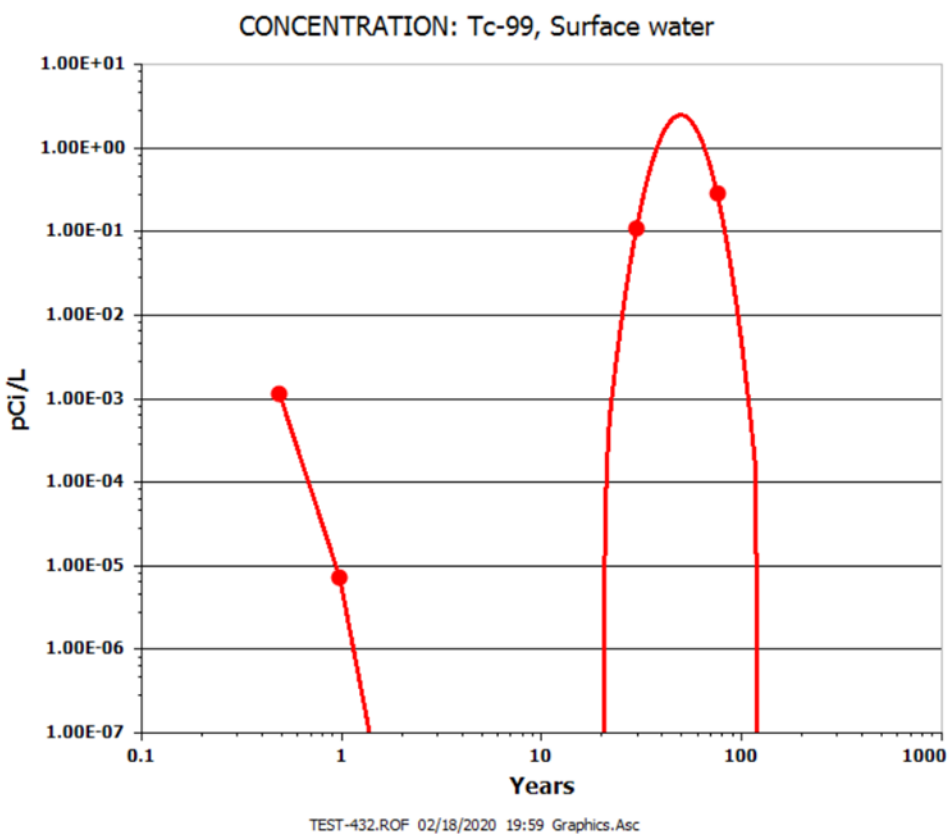

Figure Surface Water Concentration from Test-432

Practically no difference in V&V results for surface water concentration and Test 432 results

12.124 TEST CASE 433 TESTER'S REPORT

Documented in Results-Test-433.docx of 2/18/2020 6:22 PM

RESOFF-TEST-433

Objective: Test offsite surface water body accumulation with cover for U-234

The following steps were taken for Test-433

Step 1 Opened SURF-WATER-CHECK-U234-TEST1.ROF

Step 2 Saved as Test-433.ROF

Step 3 Ran Test-433.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface water concentration with the values in Figure 3 in the V&V report (Verification of Surface Water Model.docx)

Result: Test Passes

Surface water concentration in V&V Report matched with Test-433 surface water concentration as shown in the following figures.

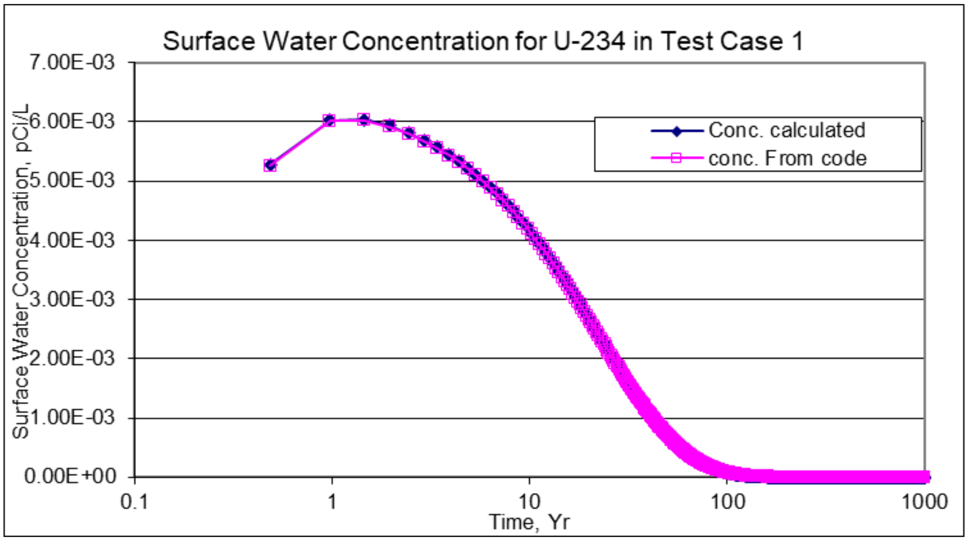

Figure Surface Water Concentration from V&V Report

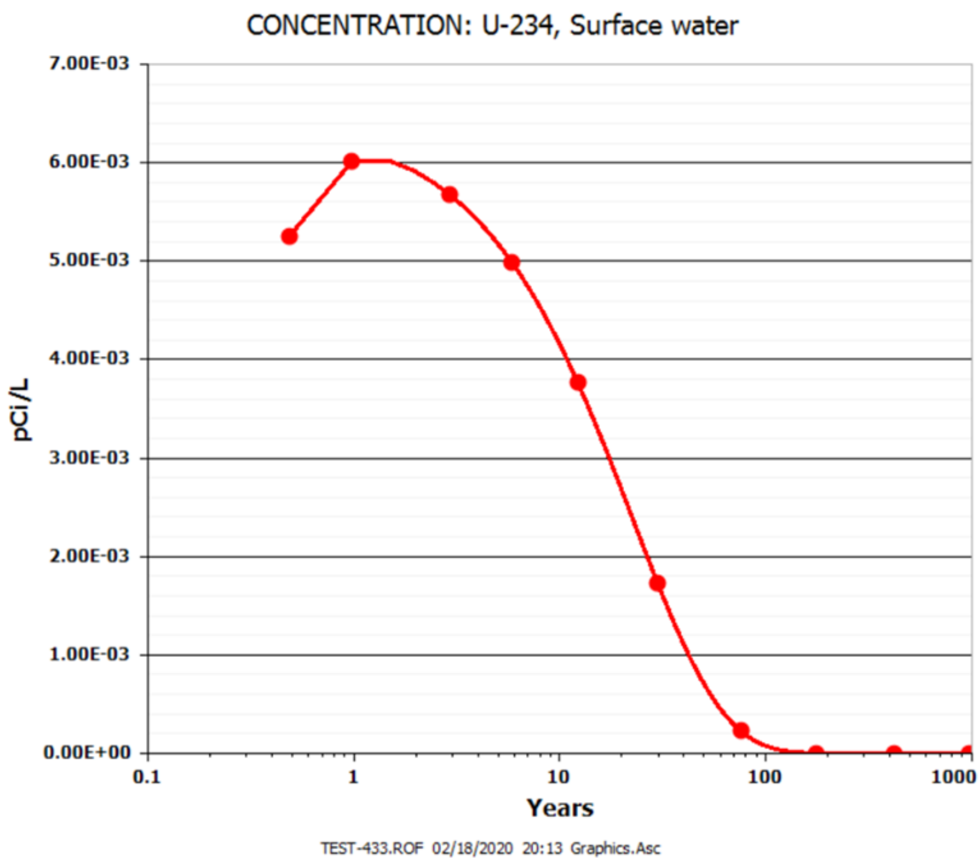

Figure Surface Water Concentration from Test-433

Practically no difference in V&V results for surface water concentration and Test 433 results

12.125 TEST CASE 434 TESTER'S REPORT

Documented in Results-Test-434.docx of 2/18/2020 6:31 PM

RESOFF-TEST-434

Objective: Test offsite surface water body accumulation with no cover for U-234

The following steps were taken for Test-434

Step 1 Opened SURF-WATER-CHECK-U234-TEST2.ROF

Step 2 Saved as Test-434.ROF

Step 3 Ran Test-434.ROF file

Step 4 Viewed Deterministic Graphic

Step 5 Selected Concentration Plot Type

Step 6 Compared surface water concentration with the values in Figure 4 in the V&V report (Verification of Surface Water Model.docx)

Result: Test Passes

Surface water concentration in V&V Report matched with Test-434 surface water concentration as shown in the following figures.

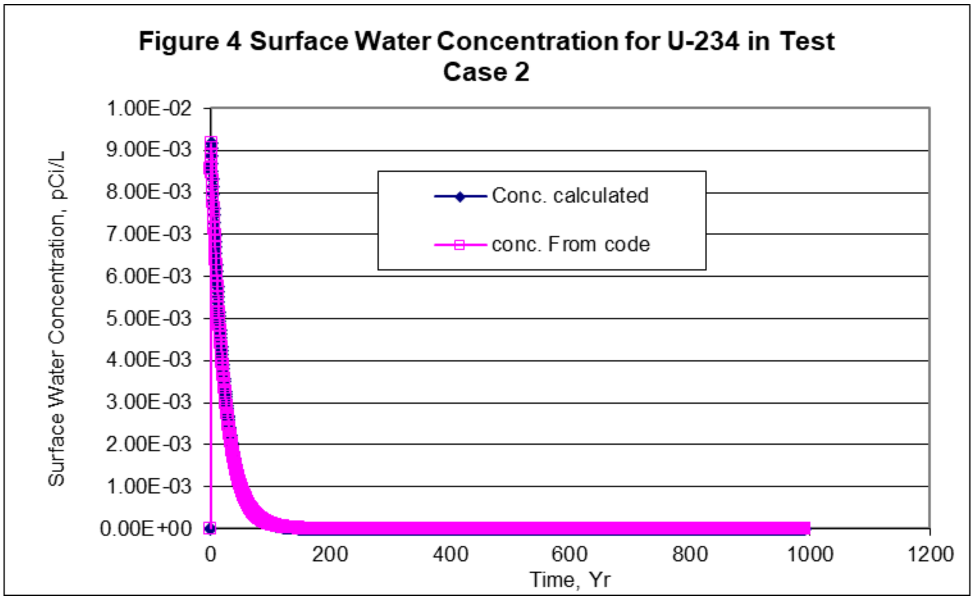

Figure Surface Water Concentration from V&V Report

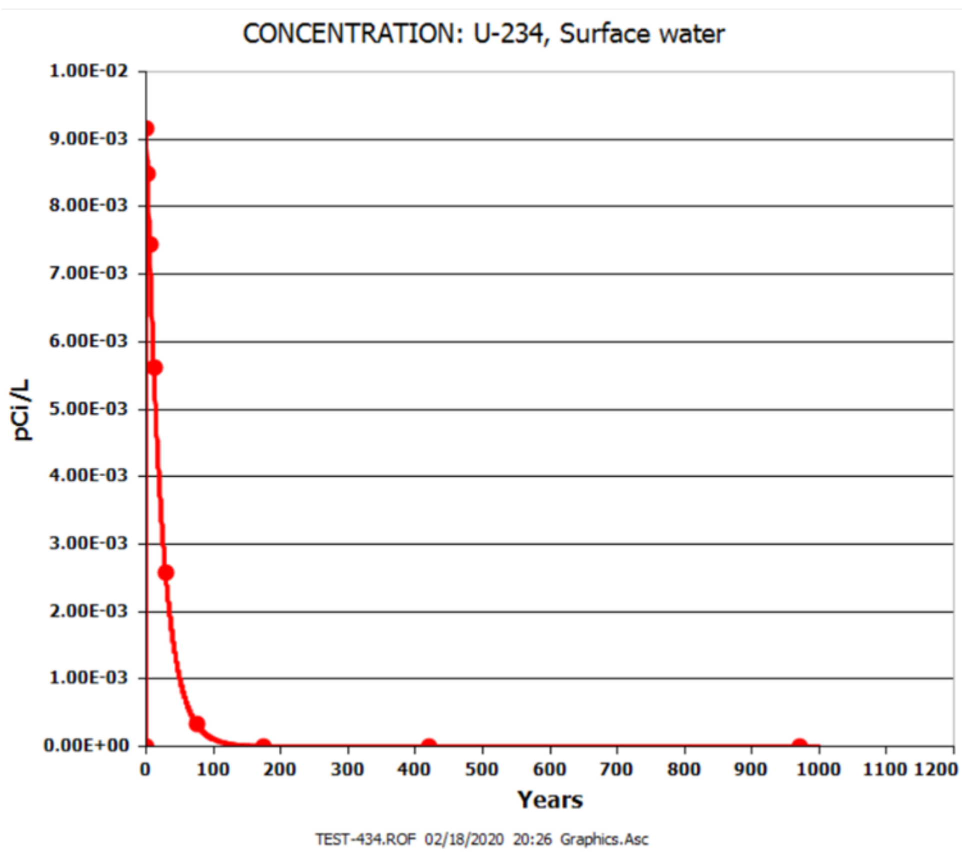

Figure Surface Water Concentration from Test-434

Practically no difference in V&V results for surface water concentration and Test 434 results

12.126 TEST CASE 435 TESTER'S REPORT

Documented in Results-Test-435.docx of 2/19/2020 7:33 AM

RESOFF-TEST-435

Objective: Test features of offsite's release to air

The following steps were taken for Test-435

Step 1 Opened AIR RELEASE COMP CASE1.ROF

Step 2 Saved as Test-435-1.ROF

Step 3 Ran Test-435-1.ROF file

Step 4 Opened AIFLUXIN.DAT file from the main RESRAD-OFFSITE directory

Step 5 Saved as AIFLUXIN-Test435-1.DAT

Step 6 Compared with AIFLUXIN-case1.DAT file in the V&V\Air release folder

Step 7 Opened AIR RELEASE COMP CASE2.ROF

Step 8 Saved as Test-435-2.ROF

Step 9 Ran Test-435-2.ROF file

Step 10 Opened AIFLUXIN.DAT file from the main RESRAD-OFFSITE directory

Step 11 Saved as AIFLUXIN-Test435-2.DAT

Step 12 Compared with AIFLUXIN-case2.DAT file in the V&V\Air release folder

Step 13 Saved AIFLUXIN-Test435-1.DAT and AIFLUXIN-Test435-2.DAT in the results folder

Step 14 Saved Test435-1-FC and Test435-2-FC in the results folder

Result: Test Passes

Offsite release to air in V&V Report matched with Test-435 air release.

12.127 TEST CASE 436 TESTER'S REPORT

Documented in Results-Test-436.docx of 2/19/2020 7:33 AM

RESOFF-TEST-436

Objective: Test features of offsite's release to erosion

The following steps were taken for Test-436

Step 1 Opened EROSION RELEASE COMP CASE1.ROF

Step 2 Saved as Test-436-1.ROF

Step 3 Ran Test-436-1.ROF file

Step 4 Opened SWFLUXIN.DAT file from the main RESRAD-OFFSITE directory

Step 5 Saved as SWFLUXIN-Test436-1.DAT

Step 6 Compared with SWFLUXIN-case1.DAT file in the V&V\Erosion release folder

Step 7 Opened EROSION RELEASE COMP CASE2.ROF

Step 8 Saved as Test-436-2.ROF

Step 9 Ran Test-436-2.ROF file

Step 10 Opened SWFLUXIN.DAT file from the main RESRAD-OFFSITE directory

Step 11 Saved as SWFLUXIN-Test436-2.DAT

Step 12 Compared with SWFLUXIN-case2.DAT file in the V&V\Erosion release folder

Step 13 Saved SWFLUXIN-Test436-1.DAT and SWFLUXIN-Test436-2.DAT in the results folder

Step 14 Saved Test436-1-FC and Test436-2-FC in the results folder

Result: Test Passes

Offsite release to erosion in V&V Report matched with Test-436 erosion release.

12.128 TEST CASE 437 TESTER'S REPORT

Documented in Results-Test-437.docx of 2/19/2020 8:23 AM

RESOFF-TEST-437

Objective: Test features of offsite's external radiation model

The following steps were taken for Test-437

Step 1 Opened External-1.ROF

Step 2 Saved as Test-437-1.ROF

Step 3 Ran Test-437-1.ROF file

Step 4 Opened Summary report from the main RESRAD-OFFSITE directory

Step 5 Noted external pathway dose for different radionuclides from page 44

Step 6 Compared with Yearly dose (code) column for source area 1000000 m2 results in Table 1 of the report Verification of External Model and External Exposure Pathway Dose.docx file in the V&V\External-Pathway folder

Step 7 Opened External-2.ROF

Step 8 Saved as Test-437-2.ROF

Step 9 Ran Test-437-2.ROF file

Step 10 Opened Summary report from the main RESRAD-OFFSITE directory

Step 11 Noted external pathway dose for different radionuclides from page 44

Step 12 Compared with Yearly dose (code) column for source area 100 m2 results in Table 1 of the report Verification of External Model and External Exposure Pathway Dose.docx file in the V&V\External-Pathway folder

Step 13 Saved Summary-Test437-1.rep and Summary-Test437-2.rep in the results folder

Result: Test Passes

External pathway dose in V&V Report for two test cases matched with Test-437 results as shown below.

Table 1 Comparison of External Exposure Pathway Dose for On-site Receptor									
				Source area = 1000000 m^2, thickness = 50 cm			Source radius = 100 m^2, thickness = 5 cm		
Radionuclide	Half-life, yr	decay constant (/yr)	Yearly average concentration, pCi/g	Yearly dose (Code), mrem/yr	Calculated, mrem/yr	ANL/EAD/TM-84, mrem/yr	Yearly dose (Code), mrem/yr	Calculated, mrem/yr	ANL/EAD/TM-84, mrem/yr
Al-26	7.16E+05	9.68E-07	1.00E+00	1.73E+01	1.73E+01	1.73E+01	5.82E+00	5.92E+00	5.92E+00
Co-57	7.42E-01	9.35E-01	6.50E-01	3.31E-01	3.26E-01	5.01E-01	1.87E-01	1.84E-01	2.83E-01
Co-60	5.27E+00	1.32E-01	9.37E-01	1.51E+01	1.52E+01	1.62E+01	5.20E+00	5.20E+00	5.55E+00
Cs-137	3.00E+01	2.31E-02	9.89E-01	3.37E+00	3.37E+00	3.41E+00	1.32E+00	1.31E+00	1.33E+00
Mn-54	8.56E-01	8.10E-01	6.85E-01	3.57E+00	3.54E+00	5.16E+00	1.34E+00	1.32E+00	1.93E+00
U-234	2.45E+05	2.83E-06	1.00E+00	4.01E-04	4.02E-04	4.02E-04	2.71E-04	2.86E-04	2.86E-04
U-235	7.04E+08	9.85E-10	1.00E+00	7.57E-01	7.57E-01	7.57E-01	3.90E-01	3.85E-01	3.85E-01

Note: Used high Kd in contaminated zone (atleast 1,000 cm3/g), very less erosion (support practice factor = 0.001)

The code results are taken from the summary report (page 44) at time zero after the run.

The dose results in ANL/EAD/TM-84 are at time zero for instantaneous dose (do not account for yearly average)

The calculated results correct ANL/EAD/TM-84 results for yearly average dose

Summary Report Results for Test437-1

```
RESRAD-OFFSITE, Version 4.0         T½ Limit = 30 days        02/19/2020  10:05  Page  44
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File  : Test437-1.ROF

                       Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                    in mrem/yr and as a Percentage of Total Dose at t = 0 years

                                           From releases to ground water and to surface water

              Ground          Fish           Radon          Plant          Meat           Milk           Soil           Water
Radio-     -------------  -------------  -------------  -------------  -------------  -------------  -------------  -------------
Nuclide      Dose     %     Dose     %     Dose     %     Dose     %     Dose     %     Dose     %     Dose     %     Dose     %
-------    --------- ---  --------- ---  --------- ---  --------- ---  --------- ---  --------- ---  --------- ---  --------- ---
Al-26      0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0
Co-57      0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0
Co-60      0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0
Cs-137     0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0
Mn-54      0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0
U-234      0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0
U-235      0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0
=======    ========= ===  ========= ===  ========= ===  ========= ===  ========= ===  ========= ===  ========= ===  ========= ===
Total      0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0


                       Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
                                    in mrem/yr and as a Percentage of Total Dose at t = 0 years

               Directly from primary contamination and from release to atmosphere (Inhalation excludes radon)

              Ground        Inhalation       Radon          Plant          Meat           Milk           Soil       All Pathways*
Radio-     -------------  -------------  -------------  -------------  -------------  -------------  -------------  -------------
Nuclide      Dose     %     Dose     %     Dose     %     Dose     %     Dose     %     Dose     %     Dose     %     Dose     %
-------    --------- ---  --------- ---  --------- ---  --------- ---  --------- ---  --------- ---  --------- ---  --------- ---
Al-26      1.73E+01  43   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   1.73E+01  43
Co-57      3.31E-01   1   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   3.31E-01   1
Co-60      1.51E+01  37   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   1.51E+01  37
Cs-137     3.37E+00   8   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   3.37E+00   8
Mn-54      3.57E+00   9   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   3.57E+00   9
U-234      4.01E-04   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   4.01E-04   0
U-235      7.57E-01   2   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   7.57E-01   2
=======    ========= ===  ========= ===  ========= ===  ========= ===  ========= ===  ========= ===  ========= ===  ========= ===
Total      4.05E+01 100   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   0.00E+00   0   4.05E+01 100

*Sum of dose from all releases and from primary contamination.
```

Results match with the Yearly dose (code) column for source area 1000000 m2 results in Table 1 of the report (highlighted in yellow)

RESRAD-OFFSITE, Version 4.0 T½ Limit = 30 days 02/19/2020 10:14 Page 44
Parent Dose Report
Title : RESRAD-OFFSITE Default Parameters
File : Test437-2.ROF

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
in mrem/yr and as a Percentage of Total Dose at t = 0 years

From releases to ground water and to surface water

Radio-Nuclide	Ground		Fish		Radon		Plant		Meat		Milk		Soil		Water	
	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%
Al-26	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Co-57	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Co-60	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Cs-137	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Mn-54	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
U-234	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
U-235	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0
Total	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
in mrem/yr and as a Percentage of Total Dose at t = 0 years

Directly from primary contamination and from release to atmosphere (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil		All Pathways*	
	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%	Dose	%
Al-26	5.82E+00	41	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	5.82E+00	41
Co-57	1.87E-01	1	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	1.87E-01	1
Co-60	5.20E+00	36	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	5.20E+00	36
Cs-137	1.32E+00	9	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	1.32E+00	9
Mn-54	1.34E+00	9	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	1.34E+00	9
U-234	2.71E-04	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	2.71E-04	0
U-235	3.90E-01	3	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	3.90E-01	3
Total	1.43E+01	100	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	0.00E+00	0	1.43E+01	100

*Sum of dose from all releases and from primary contamination.

Report Results for Test437-2

Results match with the Yearly dose (code) column for source area 100 m2 results in Table 1 of the report (highlighted in green)

12.129 TEST CASE 438 TESTER'S REPORT

Documented in Results-Test-438.docx of 2/19/2020 9:09 AM

RESOFF-TEST-438

Objective: Test features of OFFSITE's external radiation model

The following steps were taken for Test-438

Step 1 Opened EXTERNAL-3.ROF

Step 2 Saved as Test-438-1.ROF

Step 3 Ran Test-438-1.ROF file

Step 4 Noted only external exposure pathway is active and receptor is located 100% time in Pasture-Silage Field

Step 5 Viewed Deterministic Graphic

Step 6 Selected Individual Radionuclide Dose Plot Type

Step 7 Compared dose results with the values in Figure 1 and 2 in the V&V report (Verification of External Model and external pathway.docx)

Step 8 Opened EXTERNAL-4.ROF

Step 9 Saved as Test-438-2.ROF

Step 10 Ran Test-438-2.ROF file

Step 11 Noted only external exposure pathway is active and receptor is located 100% time in Non-leafy Vegetable Field

Step 12 Viewed Deterministic Graphic

Step 13 Selected Individual Radionuclide Dose Plot Type

Step 14 Compared dose results with the values in Figure 3 and 4 in the V&V report (Verification of External Model and external pathway.docx)

Result: Test Passes

External pathway doses in V&V Report matched with Test-438 external dose results as shown in the following figures.

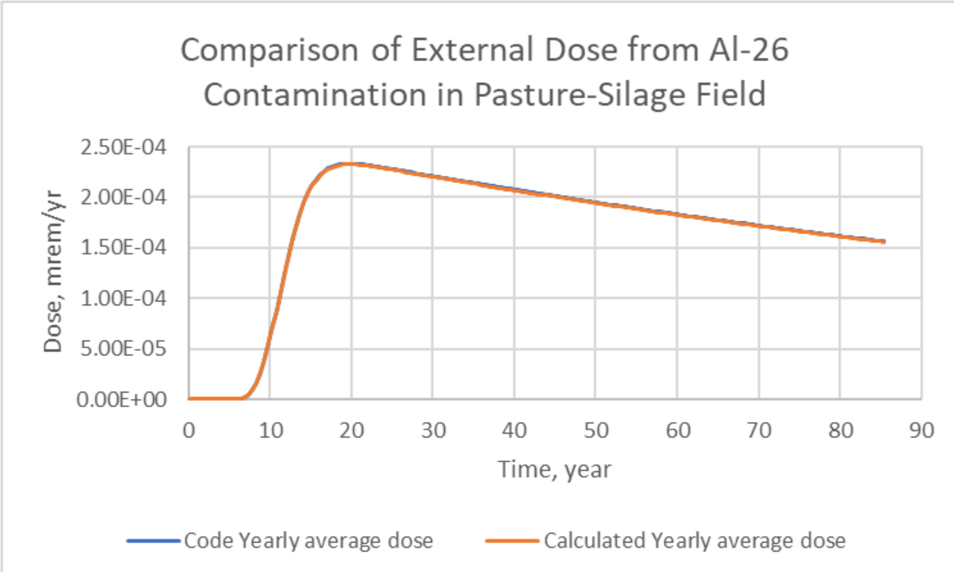

Figure External Dose from Al-26 Contamination in Pasture Silage Field from V&V Report

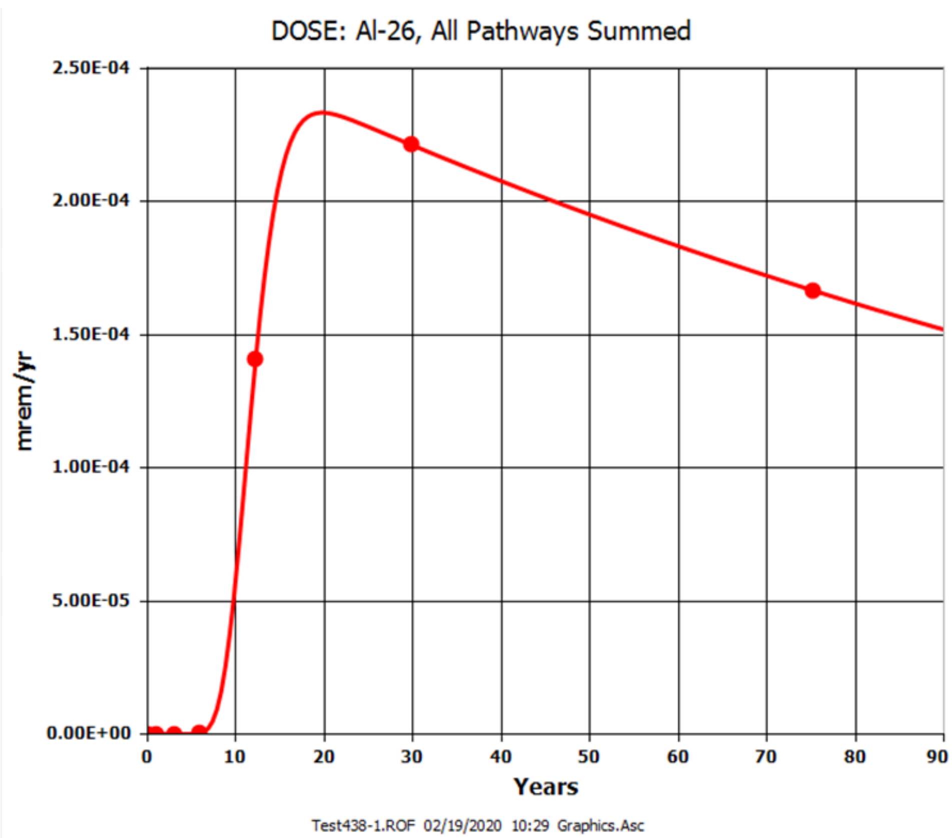

Figure External Dose from Al-26 Contamination in Pasture Silage Field from Test438-1

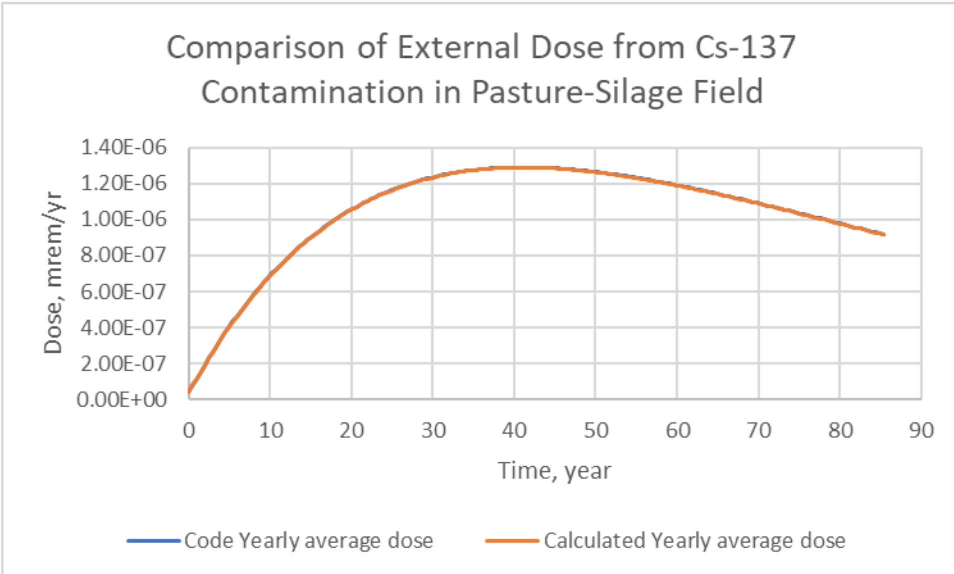

Figure External Dose from Cs-137 Contamination in Pasture Silage Field from V&V Report

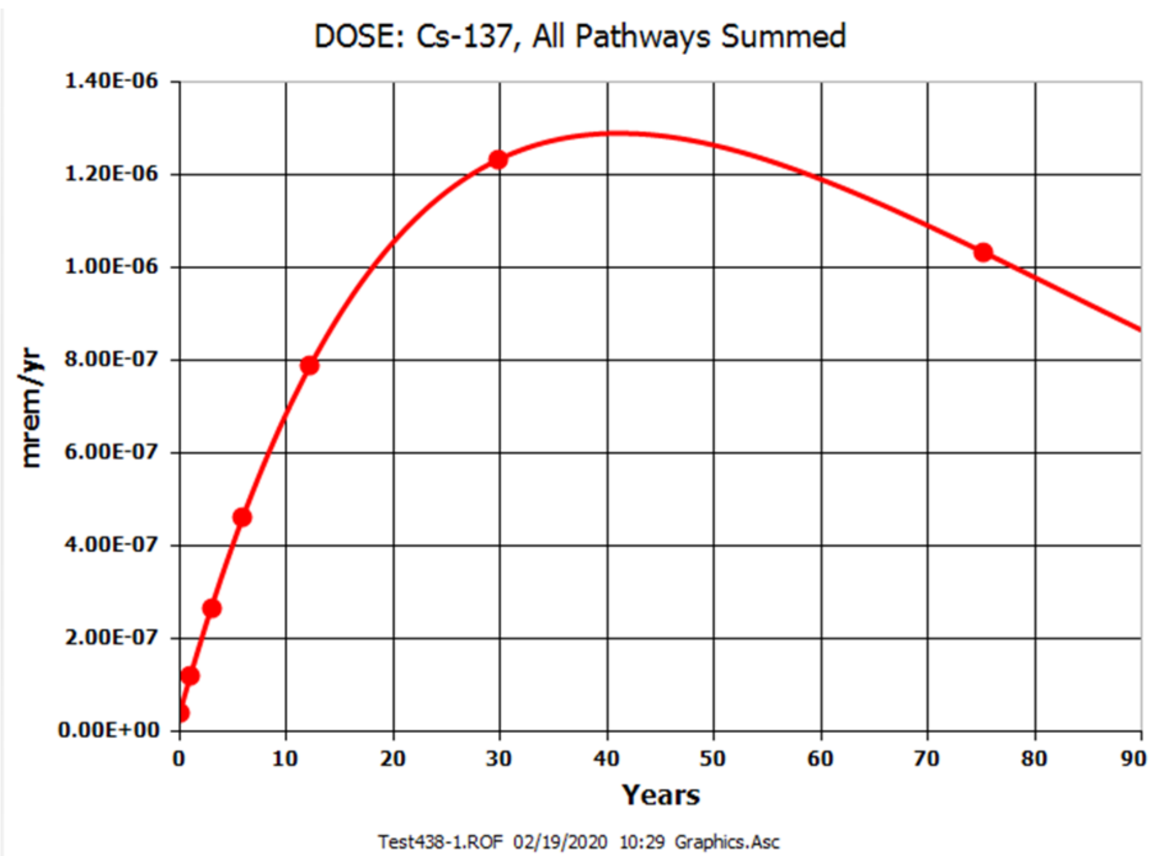

Figure External Dose from Cs-137 Contamination in Pasture Silage Field from Test438-1

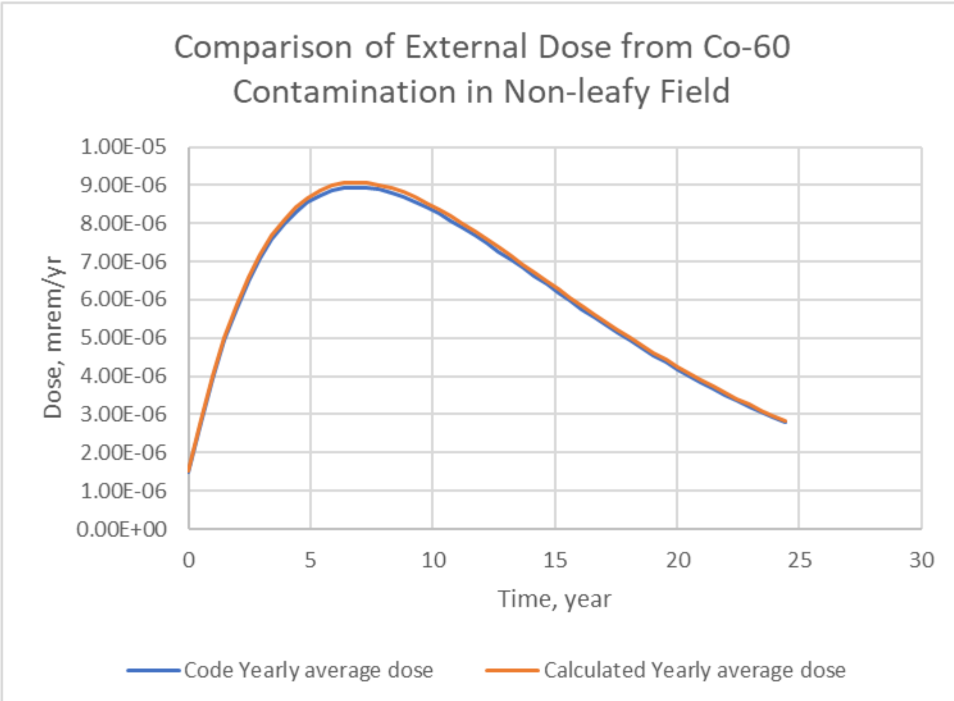

Figure External Dose from Co-60 Contamination in Non-leafy Vegetable Field from V&V Report

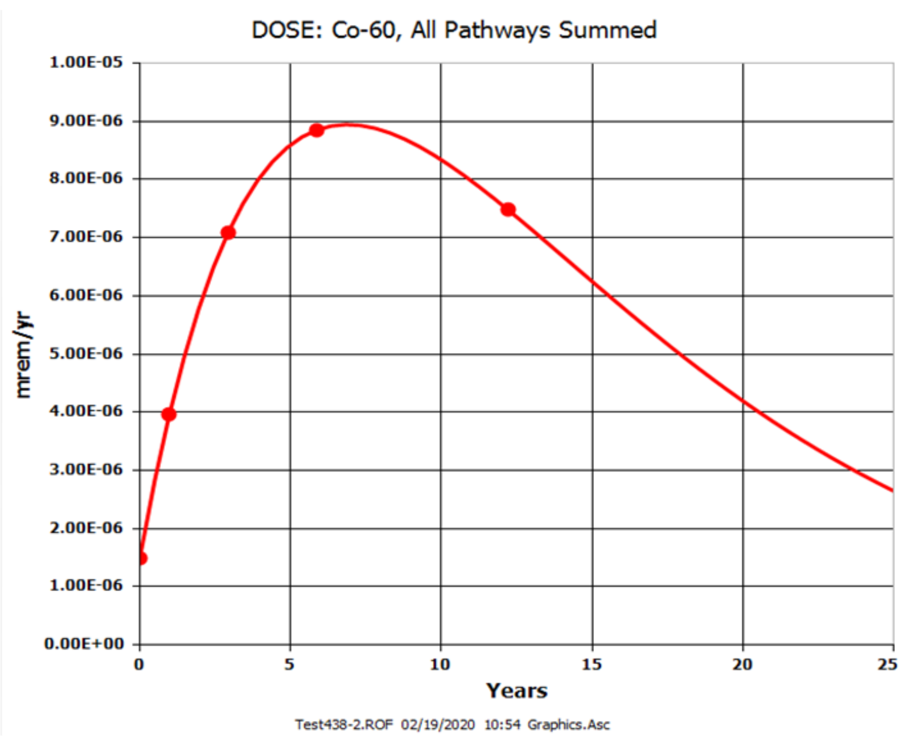

Figure External Dose from Co-60 Contamination in Non-leafy Vegetable Field from Test438-2

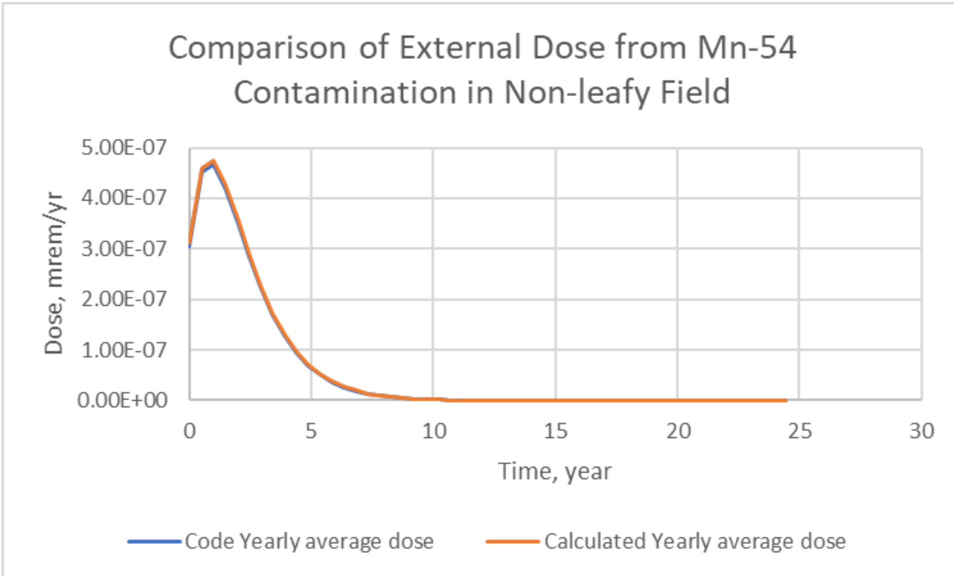

Figure External Dose from Mn-54 Contamination in Non-leafy Vegetable Field from V&V Report

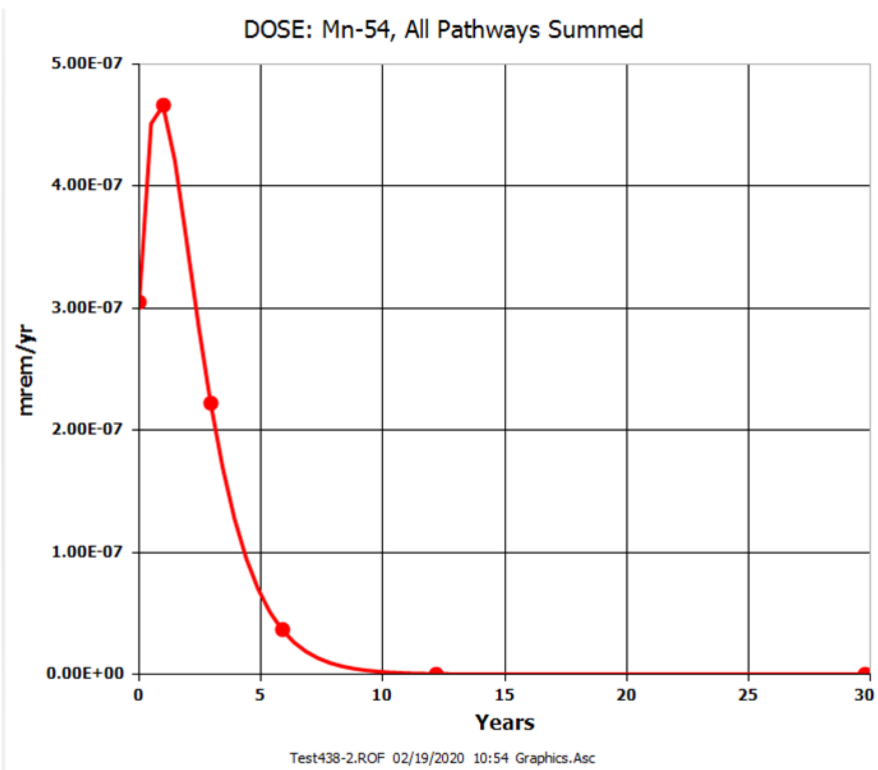

Figure External Dose from Mn-54 Contamination in Non-leafy Vegetable Field from Test438-2

Practically no difference in V&V dose results for external exposure and Test 438 results

12.130 TEST CASE 439 TESTER'S REPORT

Documented in Results-Test-439.docx of 2/19/2020 2:47 PM

RESOFF-TEST-439

Objective: Test features of OFFSITE's particulate inhalation

The following steps were taken for Test-439

Step 1 Opened INHALATION-1.ROF

Step 2 Saved as Test-439-1.ROF

Step 3 Ran Test-439-1.ROF file

Step 4 Noted only inhalation exposure pathway is active and receptor is located 100% time outside on primary contamination

Step 5 Viewed Deterministic Graphic

Step 6 Selected Individual Radionuclide Dose Plot Type

Step 7 Compared dose results with the values in Figure 1 and 2 in the V&V report (Verification of particulate inhalation pathway dose.docx)

Step 8 Opened INHALATION-2.ROF

Step 9 Saved as Test-439-2.ROF

Step 10 Ran Test-439-2.ROF file

Step 11 Noted only inhalation exposure pathway is active and receptor is located 100% time inside on primary contamination

Step 12 Viewed Deterministic Graphic

Step 13 Selected Individual Radionuclide Dose Plot Type

Step 14 Compared dose results with the values in Figure 3 and 4 in the V&V report (Verification of particulate inhalation pathway dose.docx)

Step 15 Opened INHALATION-3.ROF

Step 16 Saved as Test-439-3.ROF

Step 17 Ran Test-439-3.ROF file

Step 18 Noted only inhalation exposure pathway is active and receptor is located 100% time outside on the Dwelling

Step 19 Viewed Deterministic Graphic

Step 20 Selected Individual Radionuclide Dose Plot Type

Step 21 Compared dose results with the values in Figure 5 and 6 in the V&V report (Verification of particulate inhalation pathway dose.docx)

Step 22 Opened INHALATION-4.ROF

Step 23 Saved as Test-439-4.ROF

Step 24 Ran Test-439-4.ROF file

Step 25 Noted only inhalation exposure pathway is active and receptor is located 100% time inside on the Dwelling

Step 26 Viewed Deterministic Graphic

Step 27 Selected Individual Radionuclide Dose Plot Type

Step 28 Compared dose results with the values in Figure 7 and 8 in the V&V report (Verification of particulate inhalation pathway dose.docx)

Result: Test Passes

Inhalation pathway doses in V&V Report matched with Test-439 inhalation dose results as shown in the following figures.

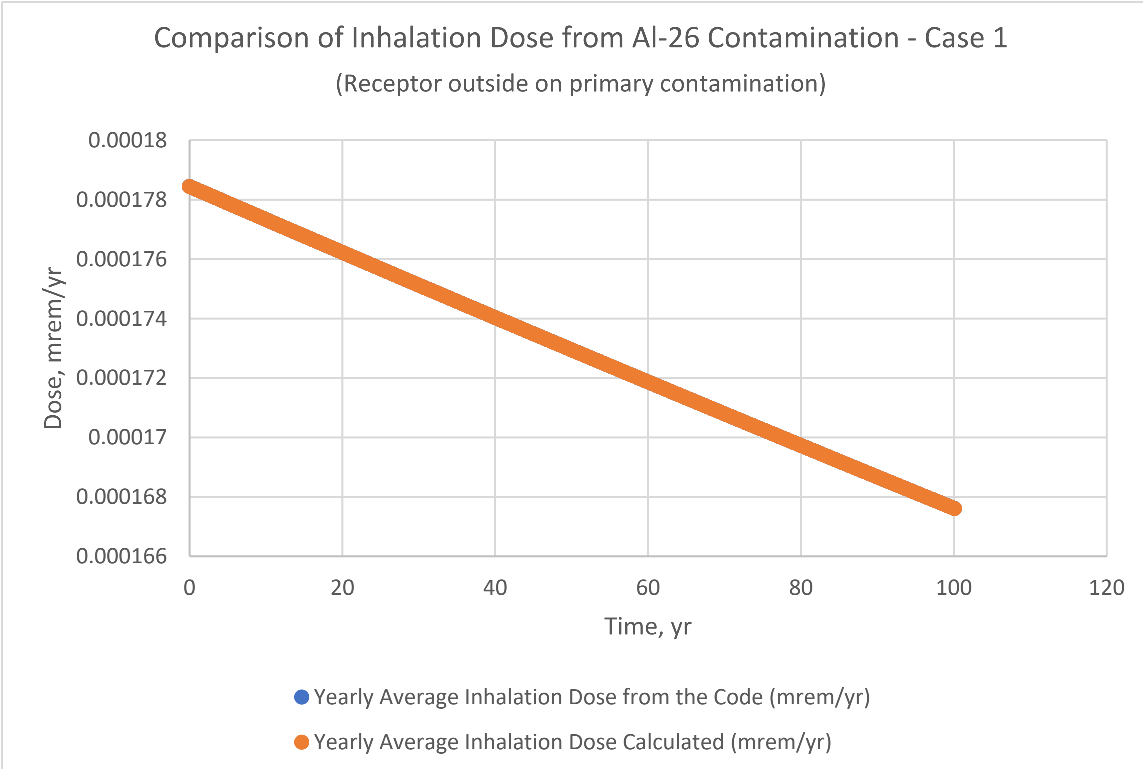

Figure Inhalation Dose from Al-26 Contamination outside on Primary Contamination from V&V Report

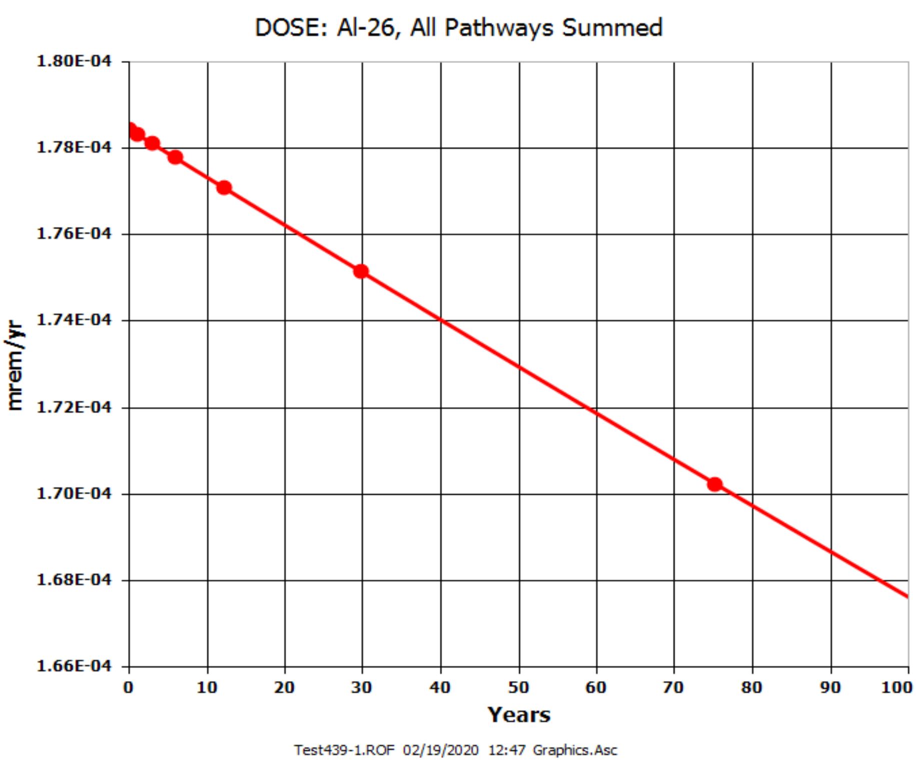

Figure Inhalation Dose from Al-26 Contamination outside on Primary Contamination from Test439-1

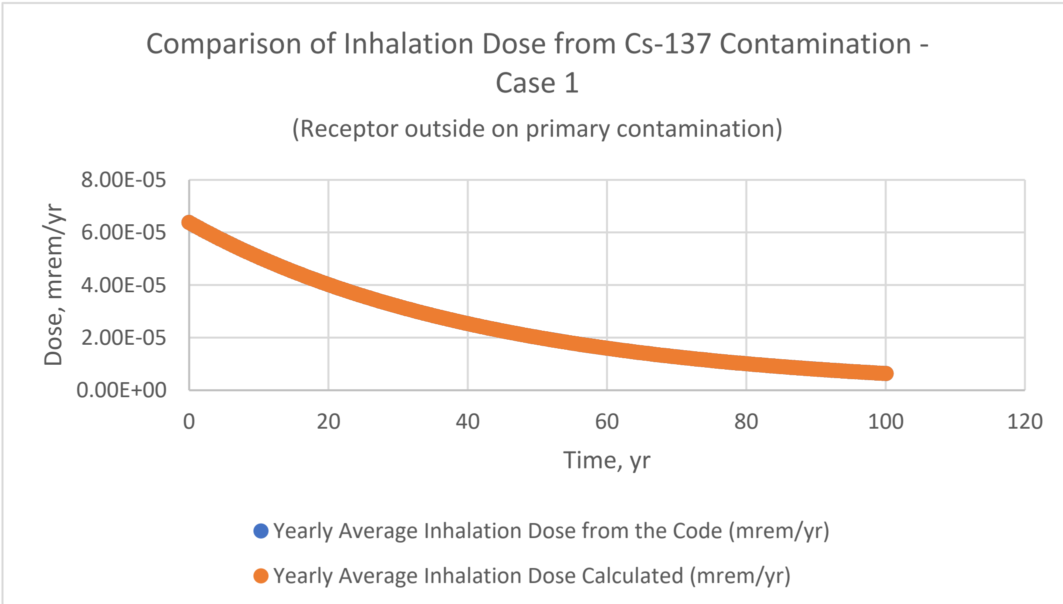

Figure Inhalation Dose from Cs-137 Contamination Outside on Primary Contamination from V&V Report

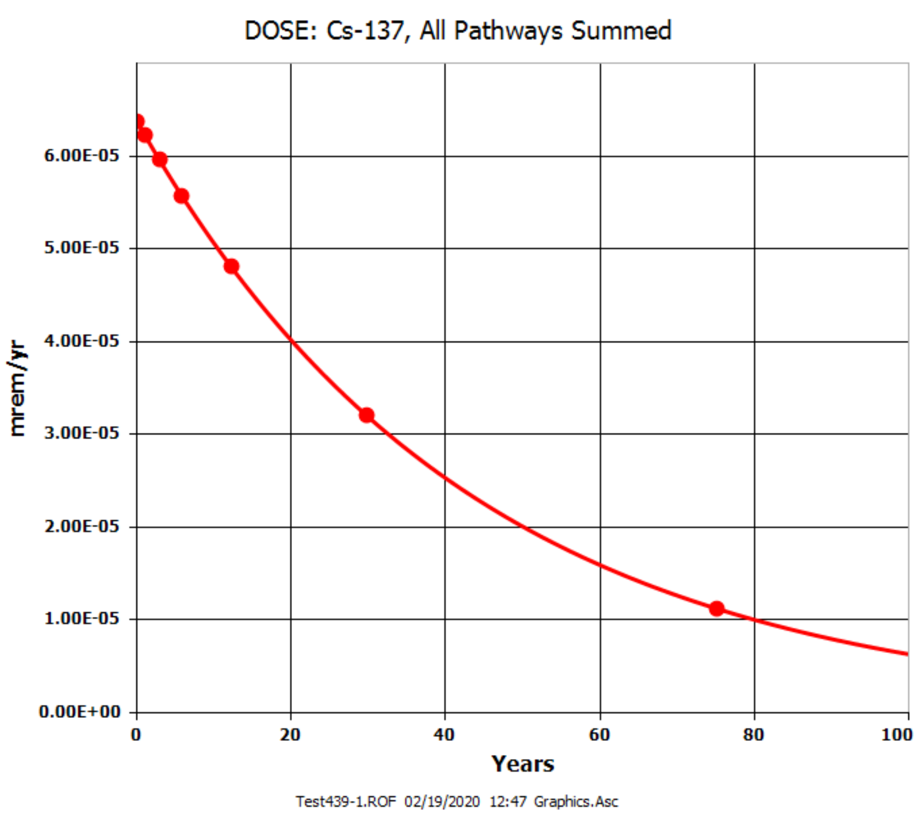

Figure Inhalation Dose from Cs-137 Contamination Outside on Primary Contamination from Test439-1

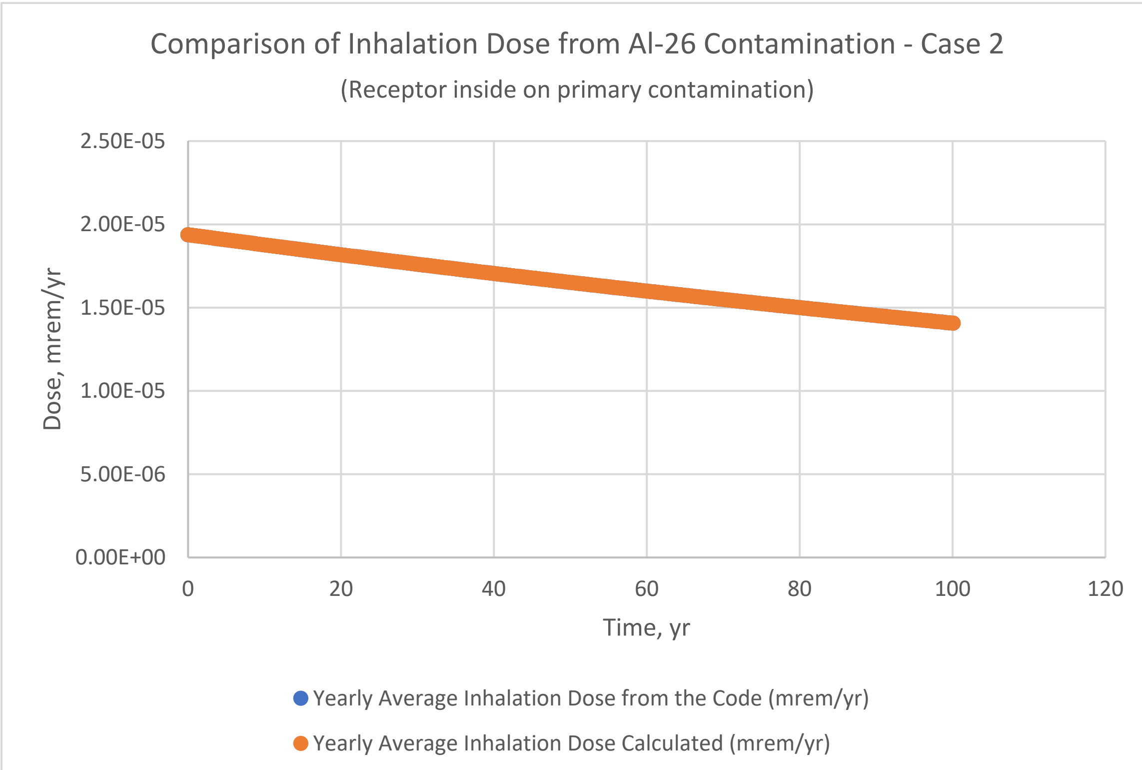

Figure Inhalation Dose from Al-26 Contamination inside on Primary Contamination from V&V Report

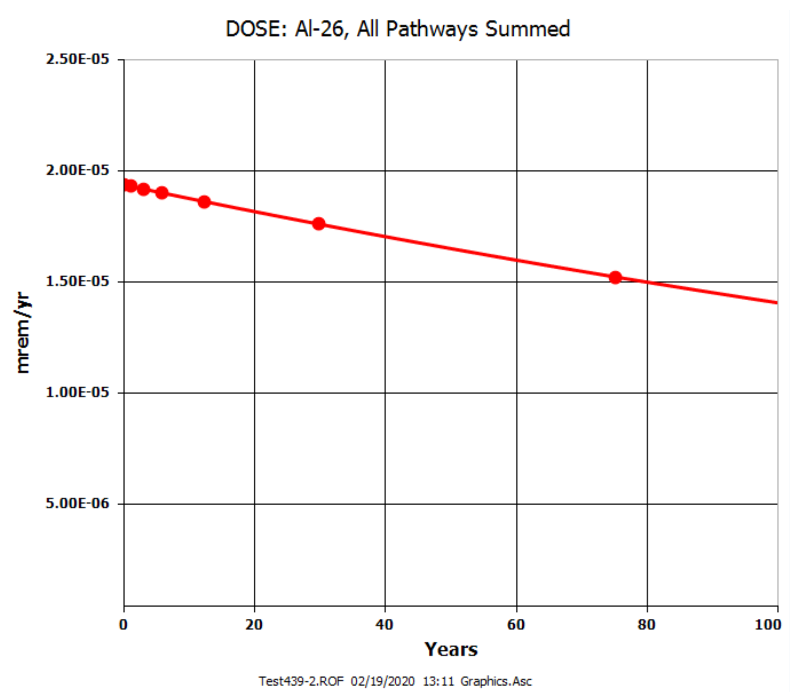

Figure Inhalation Dose from Al-26 Contamination inside on Primary Contamination from Test439-2

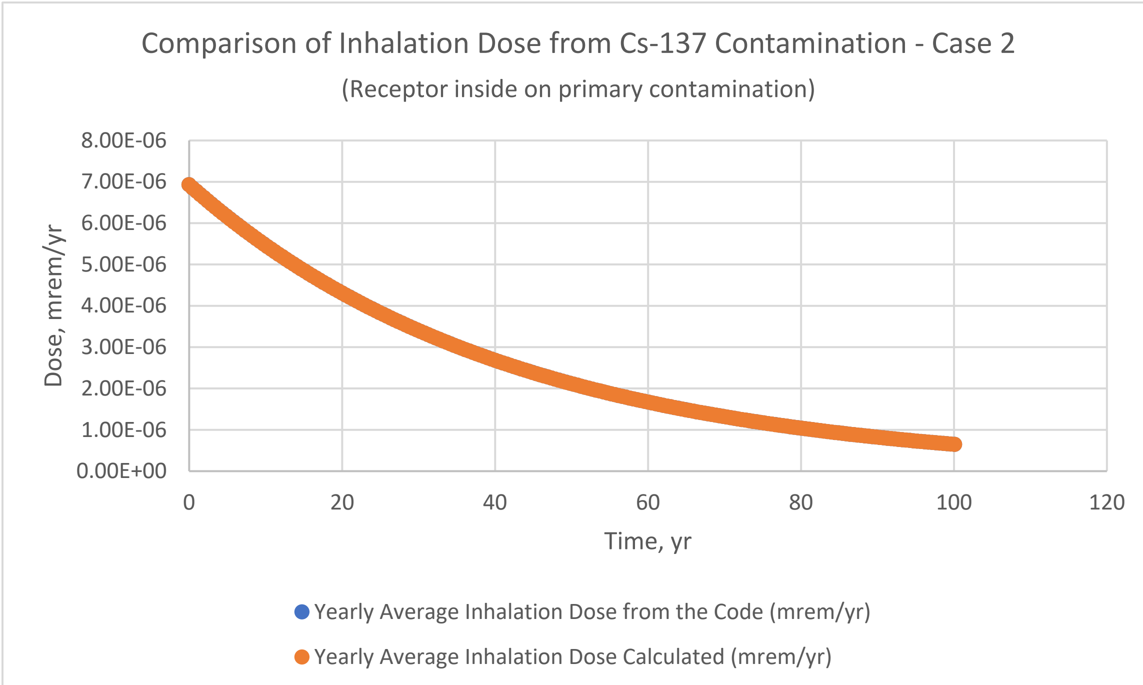

Figure Inhalation Dose from Cs-137 Contamination inside on Primary Contamination from V&V Report

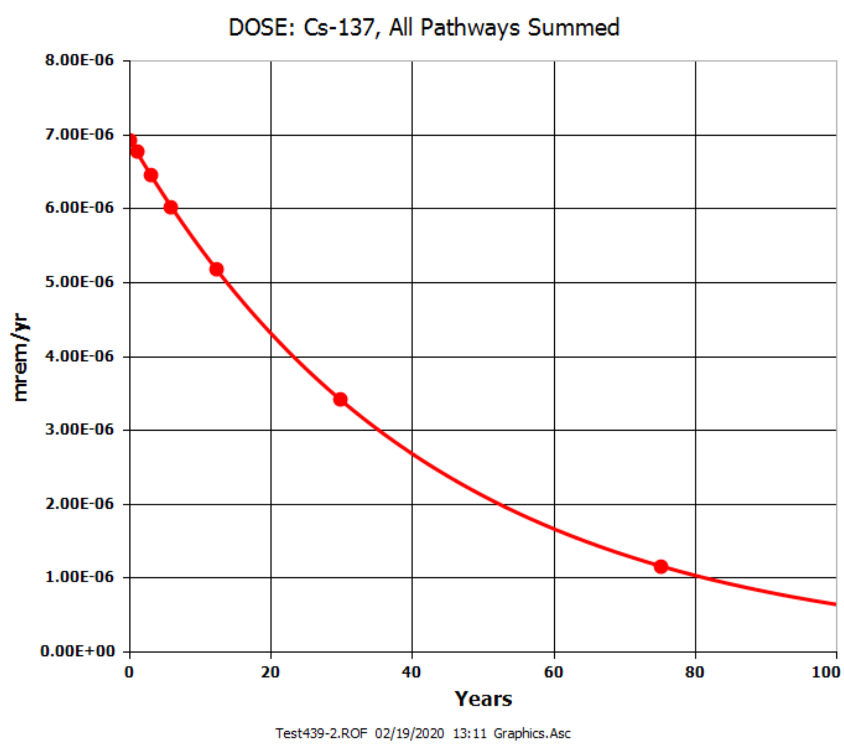

Figure Inhalation Dose from Cs-137 Contamination inside on Primary Contamination from Test439-2

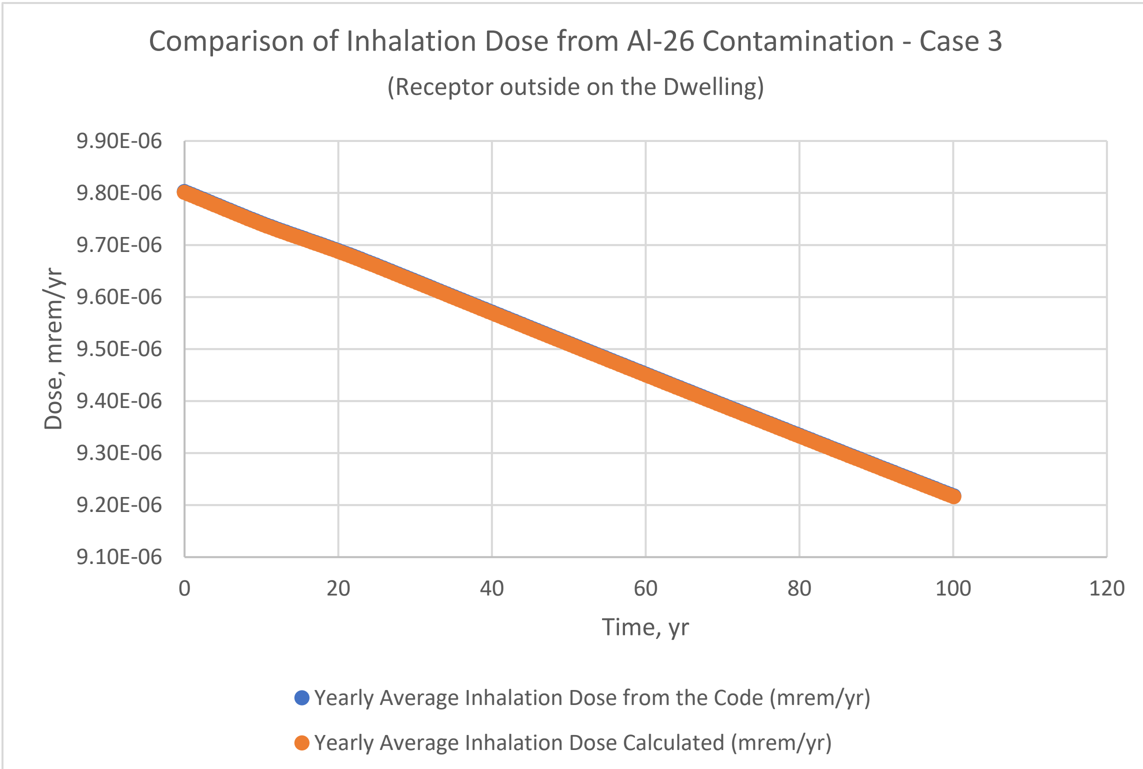

Figure Inhalation Dose from Al-26 Contamination outside on Dwelling from V&V Report

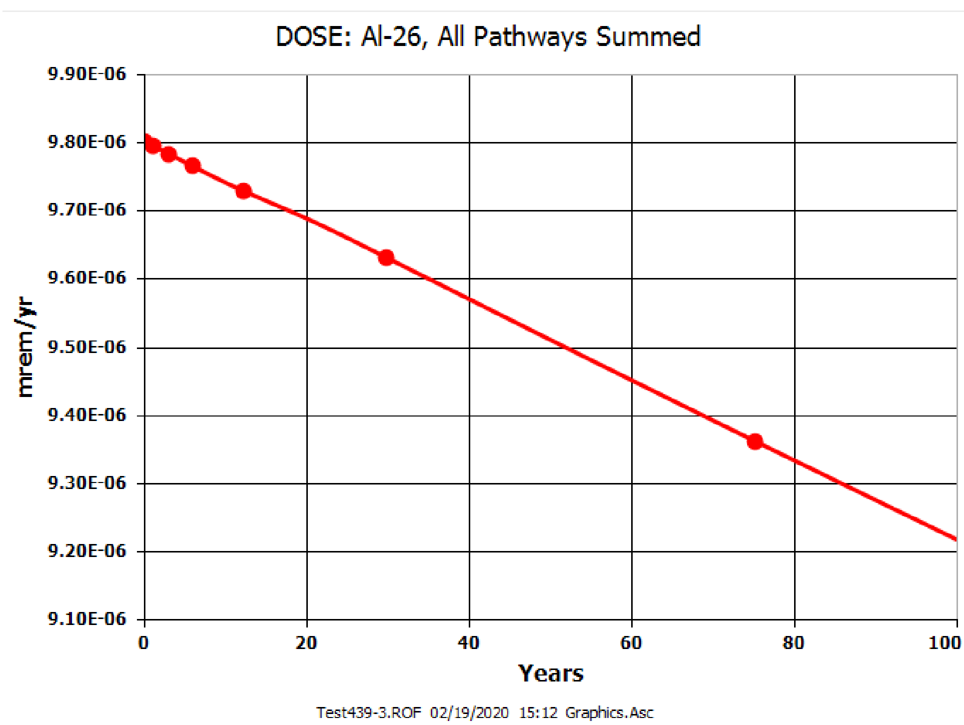

Figure Inhalation Dose from Al-26 Contamination outside on Dwelling from Test439-3

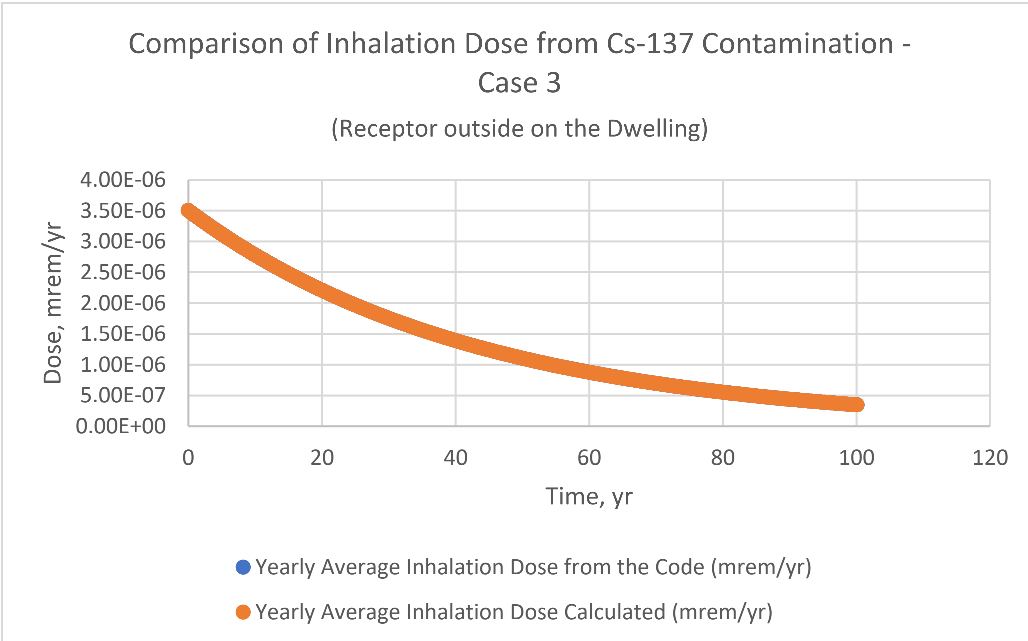

Figure Inhalation Dose from Cs-137 Contamination outside on Dwelling from V&V Report

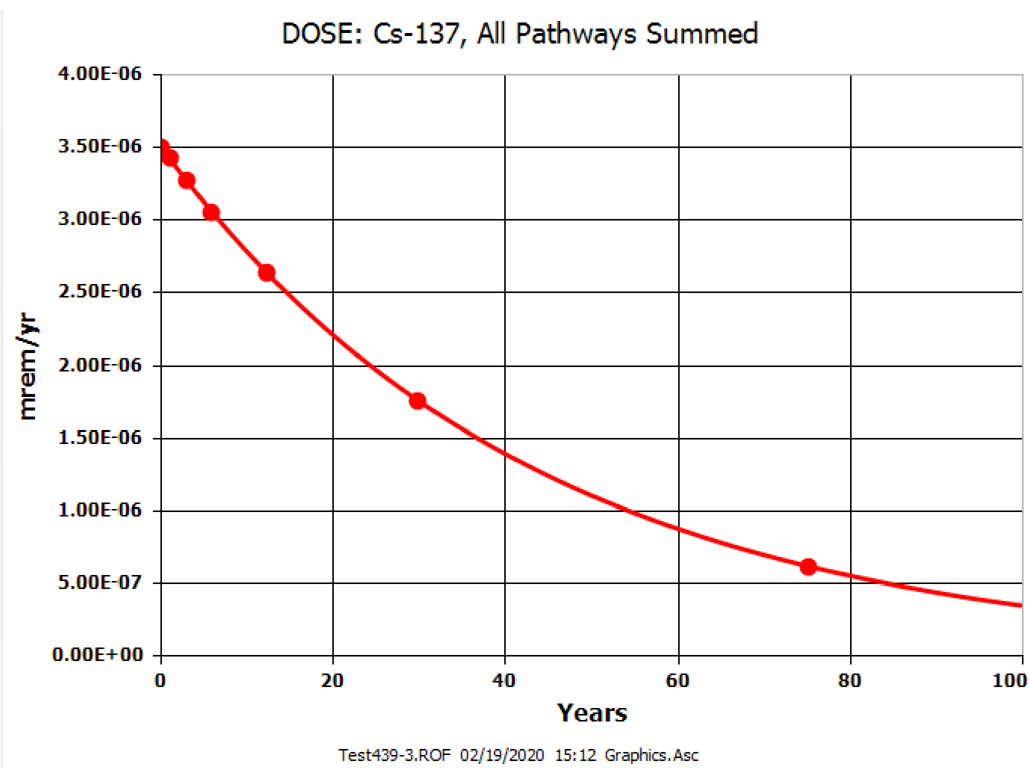

Figure Inhalation Dose from Cs-137 Contamination outside on Dwelling from Test439-3

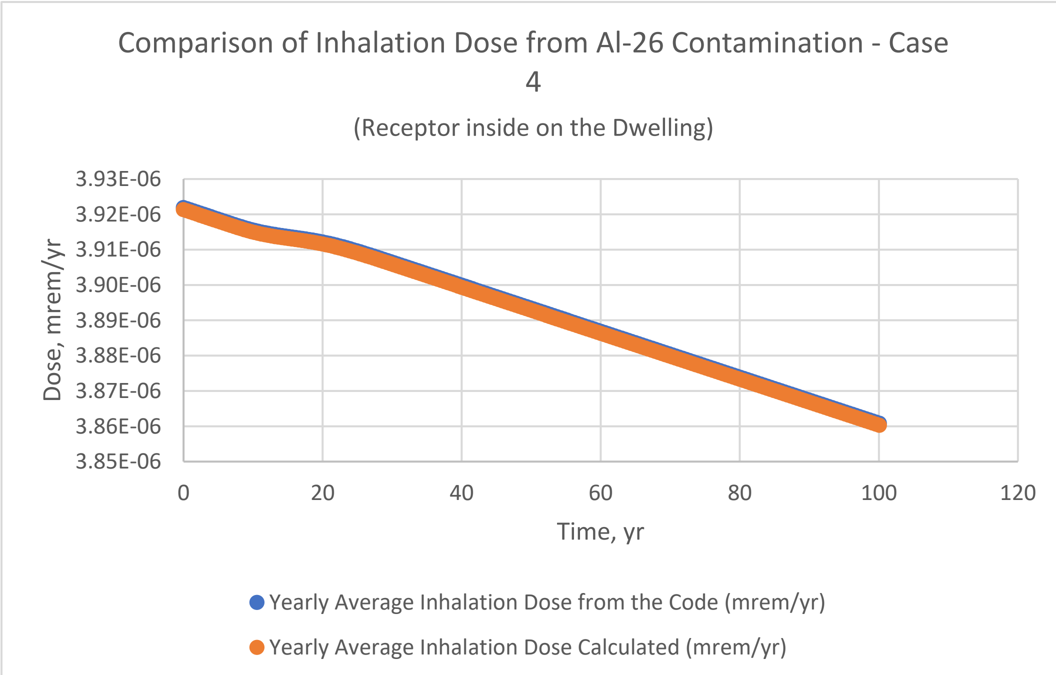

Figure Inhalation Dose from Al-26 Contamination inside on Dwelling from V&V Report

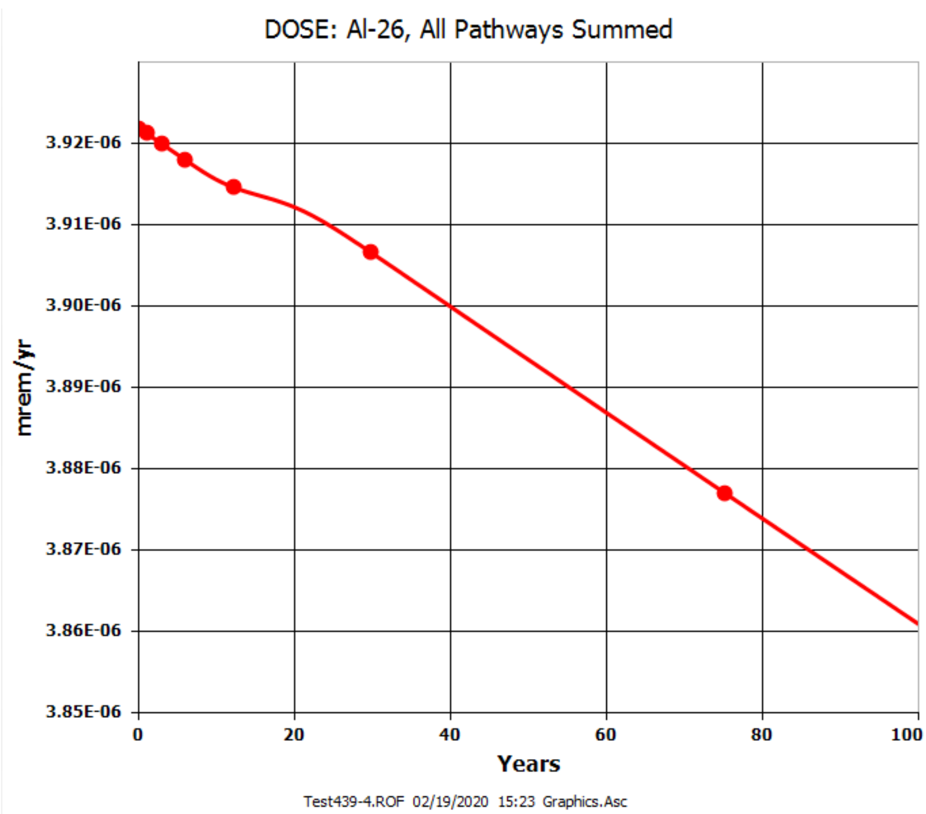

Figure Inhalation Dose from Al-26 Contamination inside on Dwelling from Test439-4

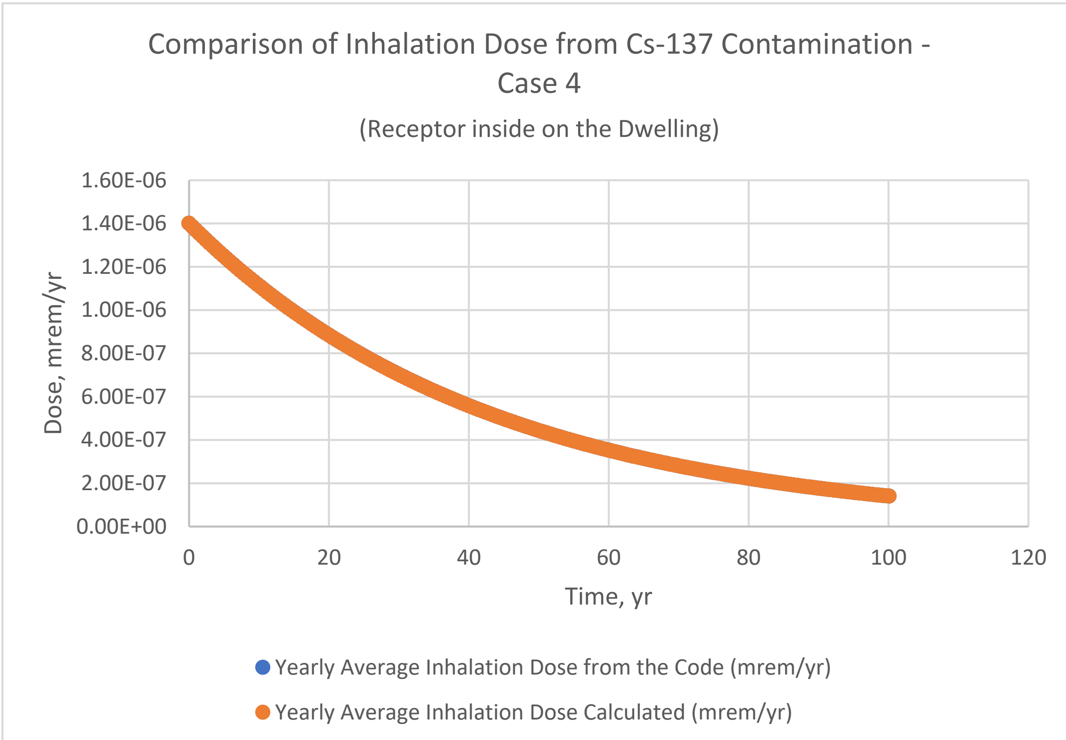

Figure Inhalation Dose from Cs-137 Contamination inside on Dwelling from V&V Report

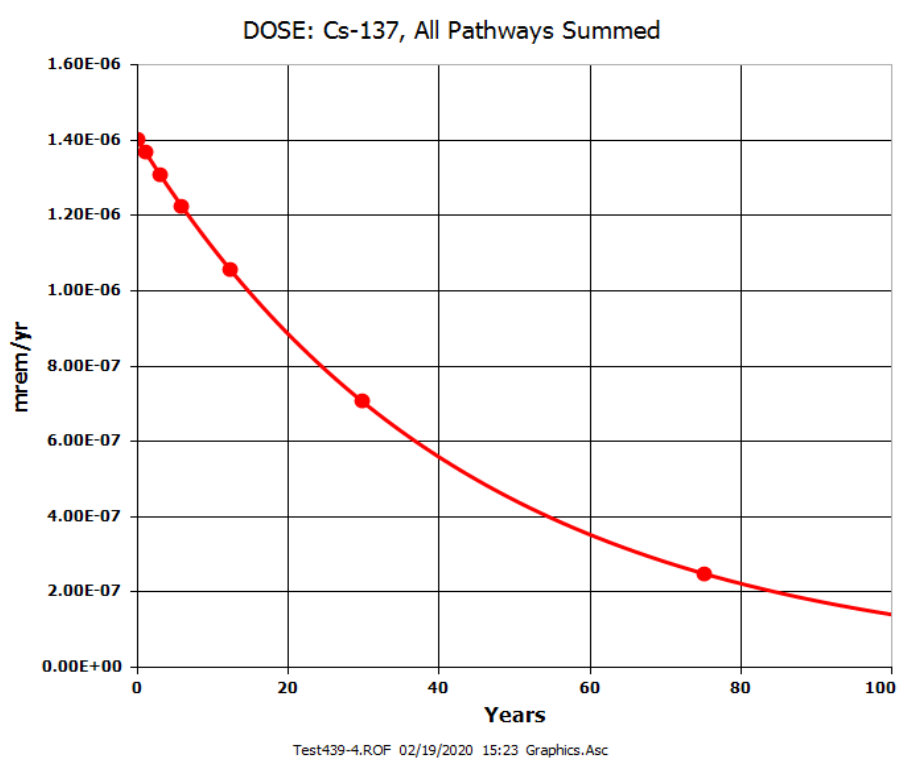

Figure Inhalation Dose from Cs-137 Contamination inside on Dwelling from Test439-4

Practically no difference in V&V dose results for inhalation pathway and Test 439 results

12.131 TEST CASE 440 TESTER'S REPORT

Documented in Results-Test-440.docx of 2/19/2020 2:44 PM

RESOFF-TEST-440

Objective: Test features of OFFSITE's soil ingestion

The following steps were taken for Test-440

Step 1 Opened SOIL-INGESTION-1.ROF

Step 2 Saved as Test-440-1.ROF

Step 3 Ran Test-440-1.ROF file

Step 4 Noted only SOIL INGESTION pathway is active and receptor is located 100% time outside on primary contamination

Step 5 Viewed Deterministic Graphic

Step 6 Selected Individual Radionuclide Dose Plot Type

Step 7 Compared dose results with the values in Figure 1 and 2 in the V&V report (Verification of SOIL-INGESTION pathway dose.docx)

Step 8 Opened SOIL-INGESTION-2.ROF

Step 9 Saved as Test-440-2.ROF

Step 10 Ran Test-440-2.ROF file

Step 11 Noted only SOIL-INGESTION exposure pathway is active and receptor is located 100% time outside on primary contamination

Step 12 Viewed Deterministic Graphic

Step 13 Selected Individual Radionuclide Dose Plot Type

Step 14 Compared dose results with the values in Figure 3 and 4 in the V&V report (Verification of particulate SOIL-INGESTION pathway dose.docx)

Step 15 Opened SOIL-INGESTION-3.ROF

Step 16 Saved as Test-440-3.ROF

Step 17 Ran Test-440-3.ROF file

Step 18 Noted only SOIL-INGESTION exposure pathway is active and receptor is located 100% time outside on the Pasture and Silage field

Step 19 Viewed Deterministic Graphic

Step 20 Selected Individual Radionuclide Dose Plot Type

Step 21 Compared dose results with the values in Figure 5 and 6 in the V&V report (Verification of particulate SOIL-INGESTION pathway dose.docx)

Step 22 Opened SOIL-INGESTION-4.ROF

Step 23 Saved as Test-440-4.ROF

Step 24 Ran Test-440-4.ROF file

Step 25 Noted only SOIL-INGESTION exposure pathway is active and receptor is located 100% time outside on the Non-Leafy Vegetable field

Step 26 Viewed Deterministic Graphic

Step 27 Selected Individual Radionuclide Dose Plot Type

Step 28 Compared dose results with the values in Figure 7 and 8 in the V&V report (Verification of particulate SOIL-INGESTION pathway dose.docx)

Result: Test Passes

Soil ingestion pathway doses in V&V Report matched with Test-440 ingestion dose results as shown in the following figures.

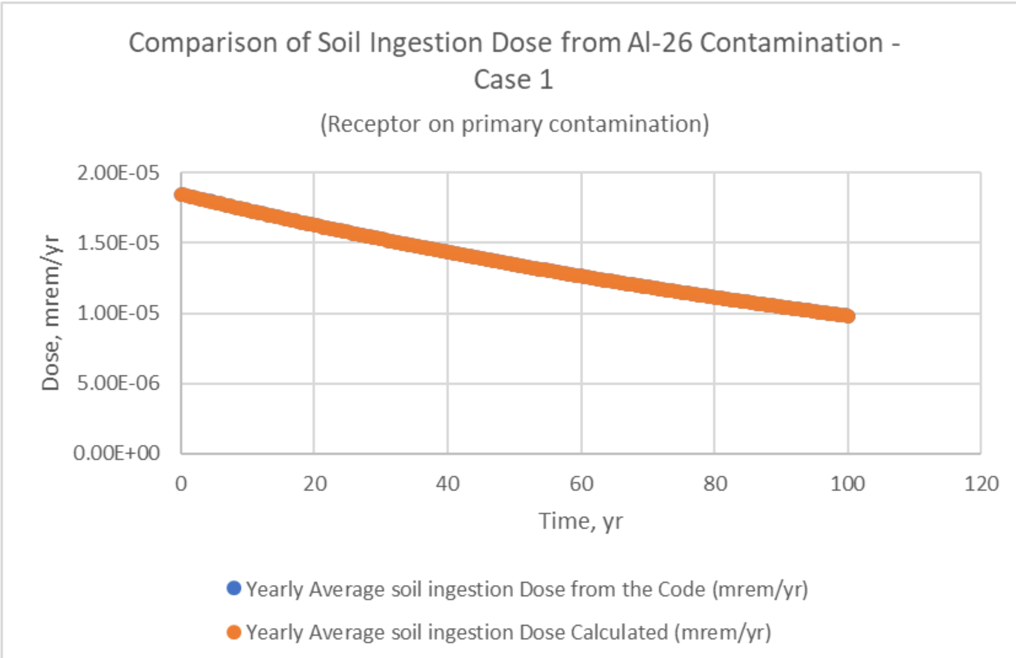

Figure Soil Ingestion Dose from Al-26 Contamination outside on Primary Contamination from V&V Report

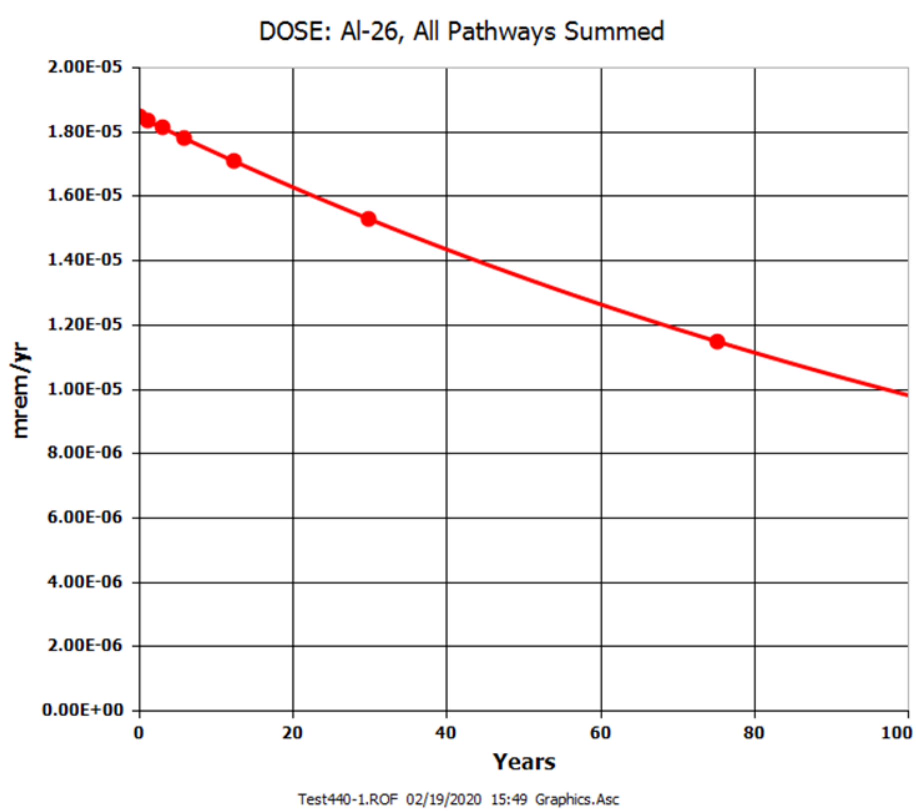

Figure Soil Ingestion Dose from Al-26 Contamination outside on Primary Contamination from Test440-1

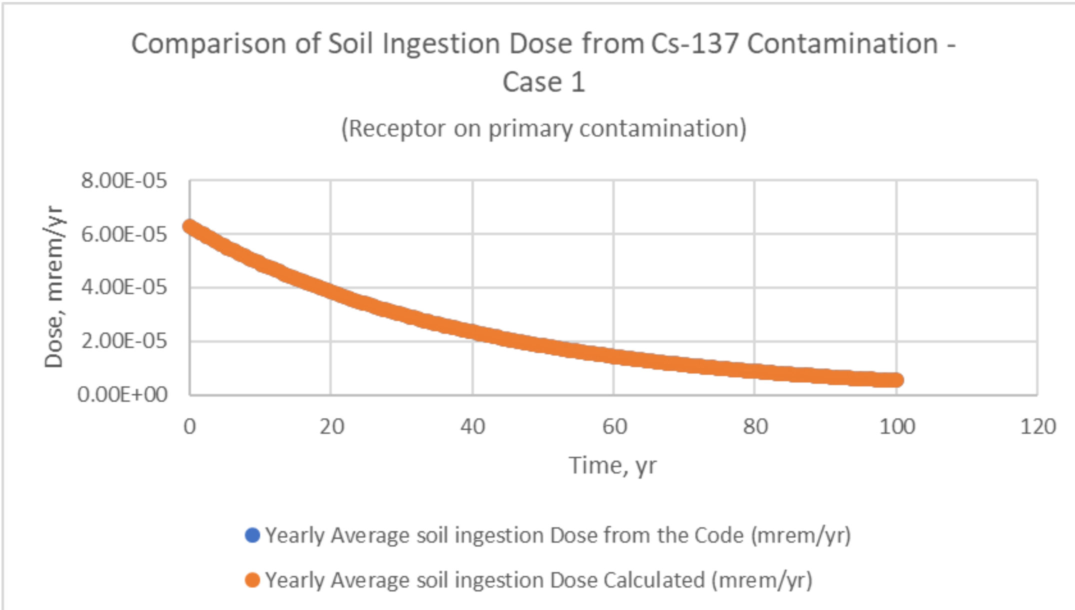

Figure Soil Ingestion Dose from Cs-137 Contamination Outside on Primary Contamination from V&V Report

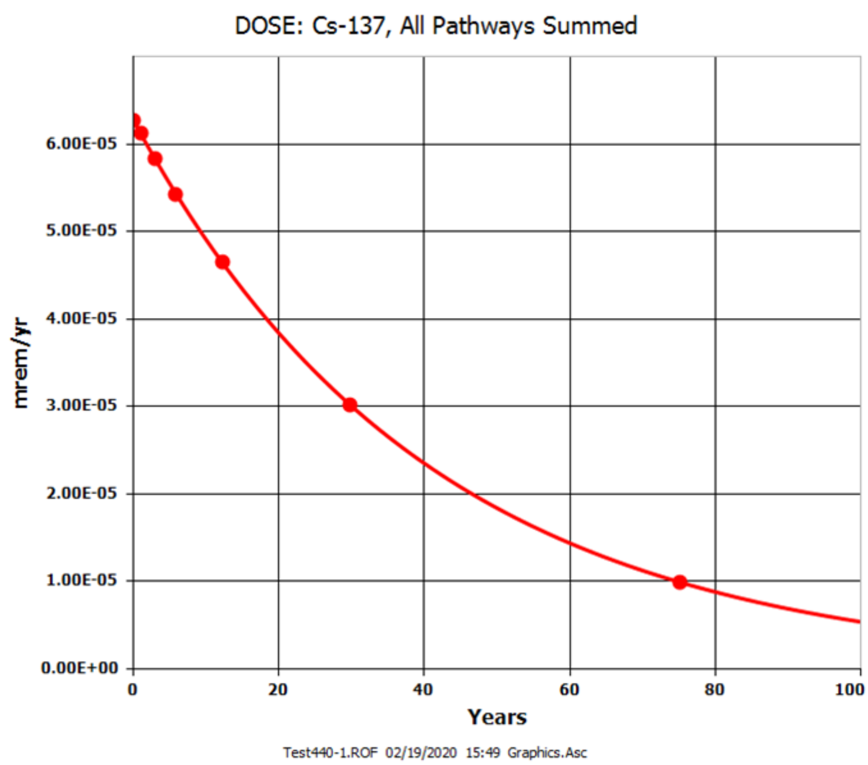

Figure Soil Ingestion Dose from Cs-137 Contamination Outside on Primary Contamination from Test440-1

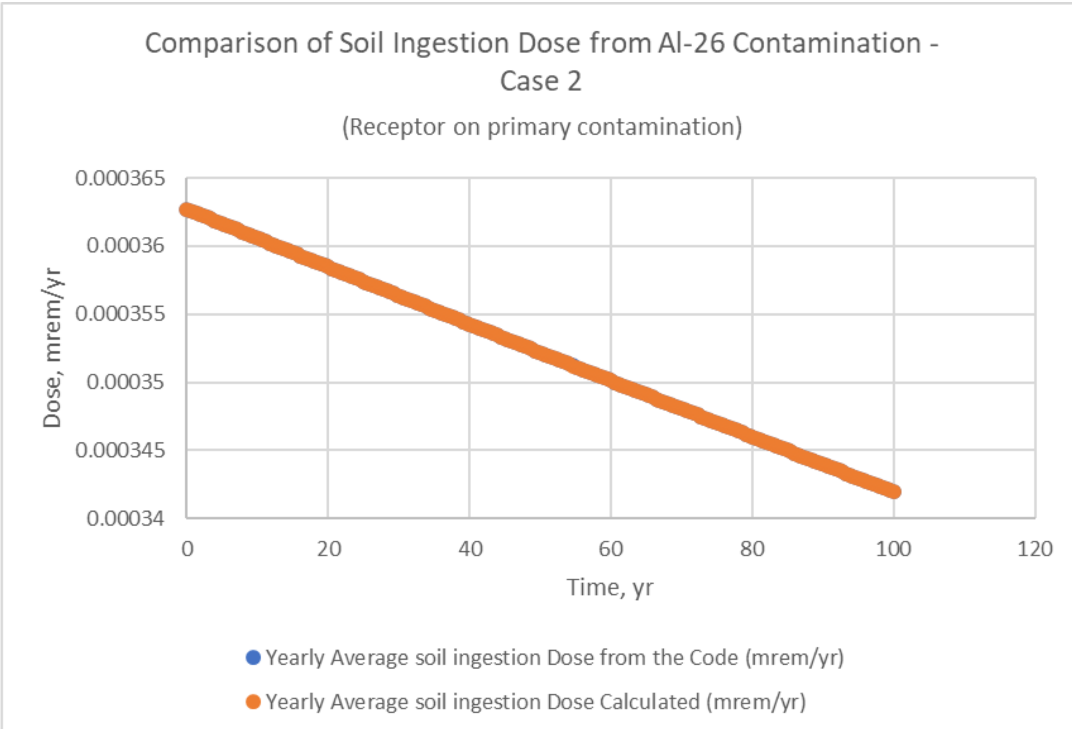

Figure Soil Ingestion Dose from Al-26 Contamination outside on Primary Contamination from V&V Report

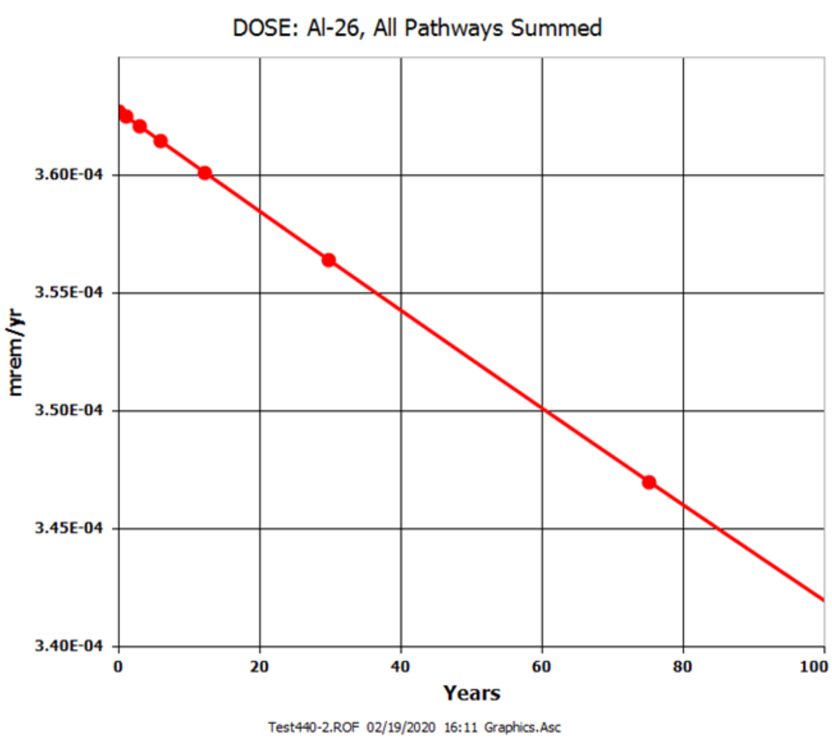

Figure Soil Ingestion Dose from Al-26 Contamination outside on Primary Contamination from Test440-2

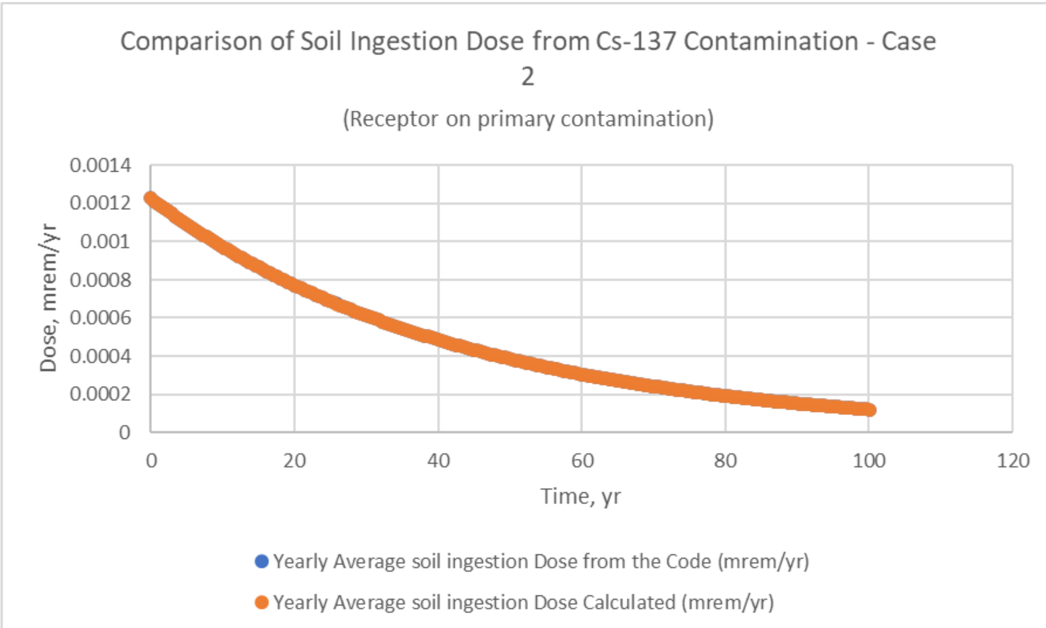

Figure Soil Ingestion Dose from Cs-137 Contamination outside on Primary Contamination from V&V Report

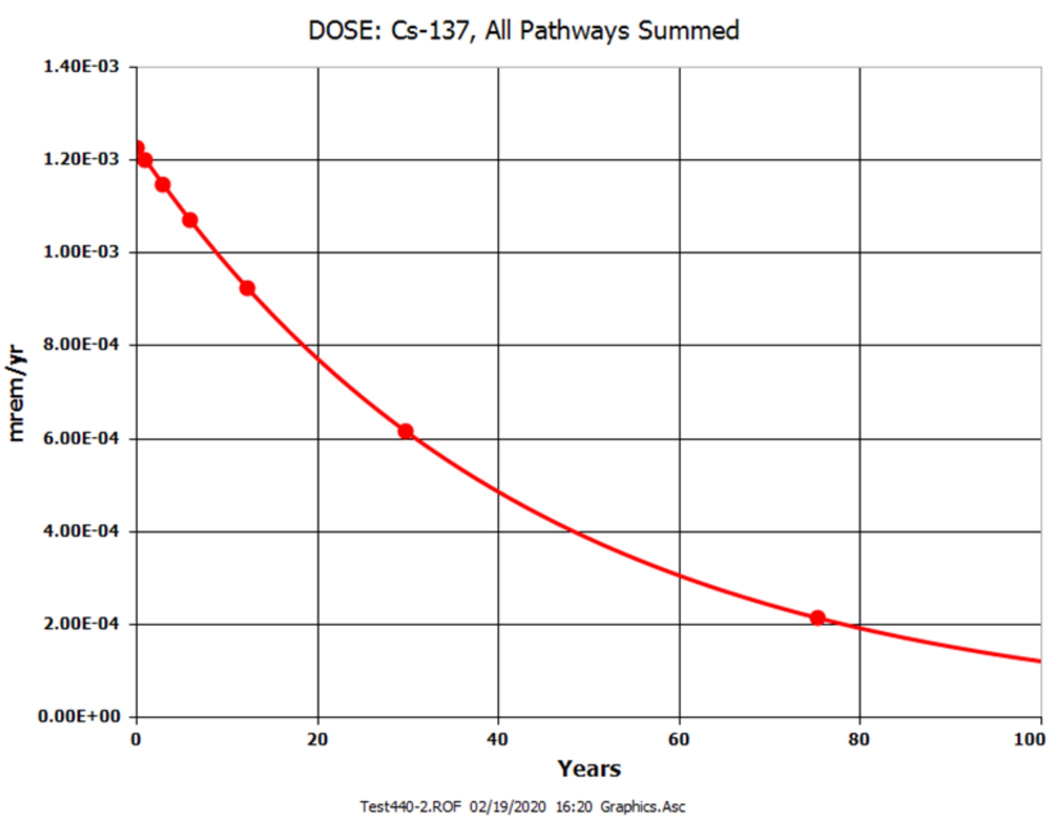

Figure Soil Ingestion Dose from Cs-137 Contamination outside on Primary Contamination from Test440-2

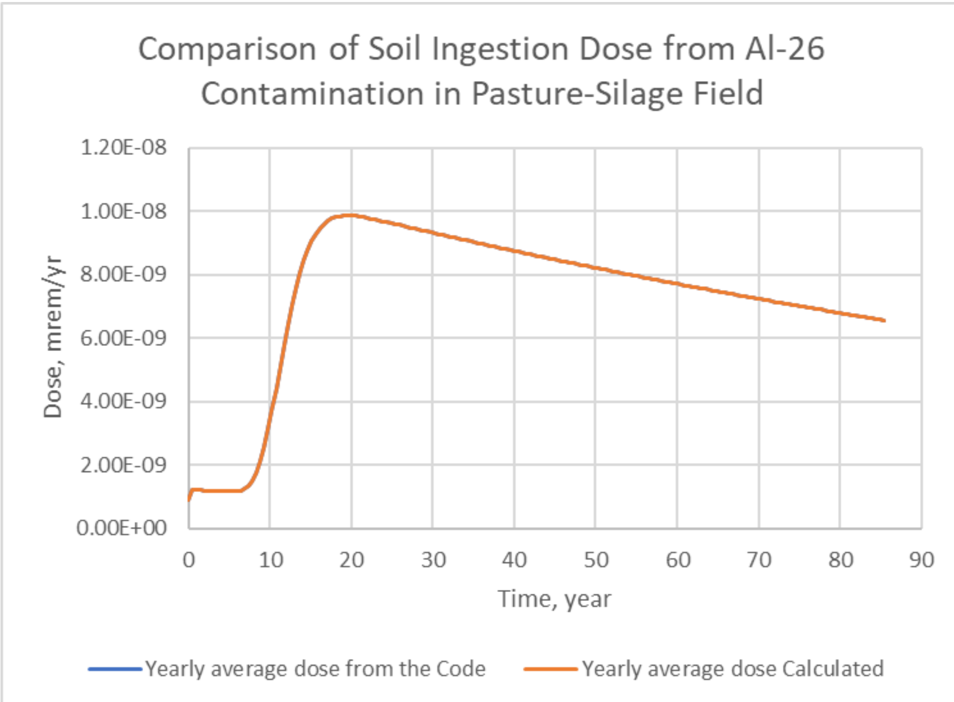

Figure Soil Ingestion Dose from Al-26 Contamination outside on Pasture and Silage Field from V&V Report

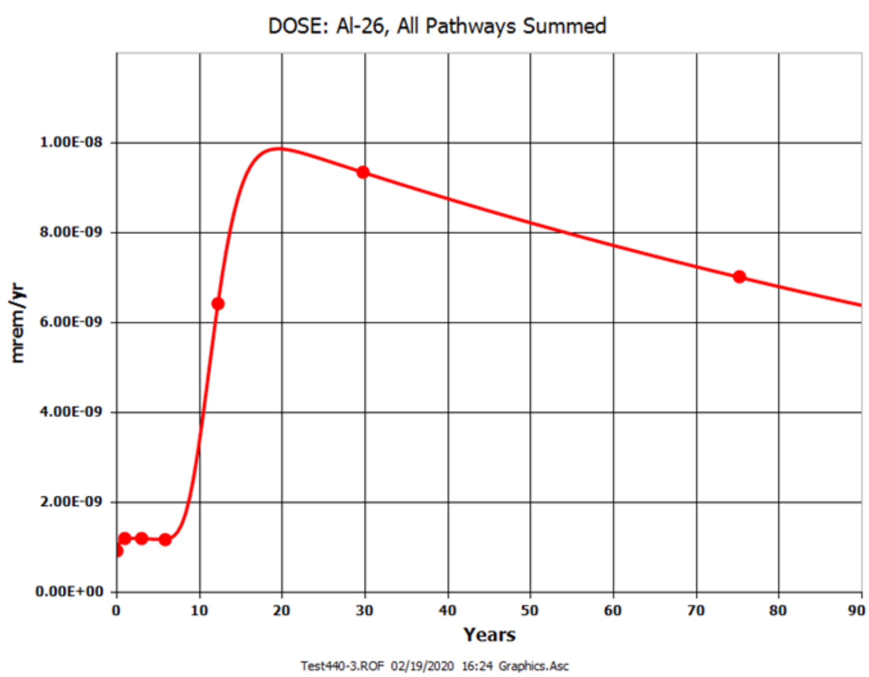

Figure Soil Ingestion Dose from Al-26 Contamination outside on Pasture and Silage Field from Test440-3

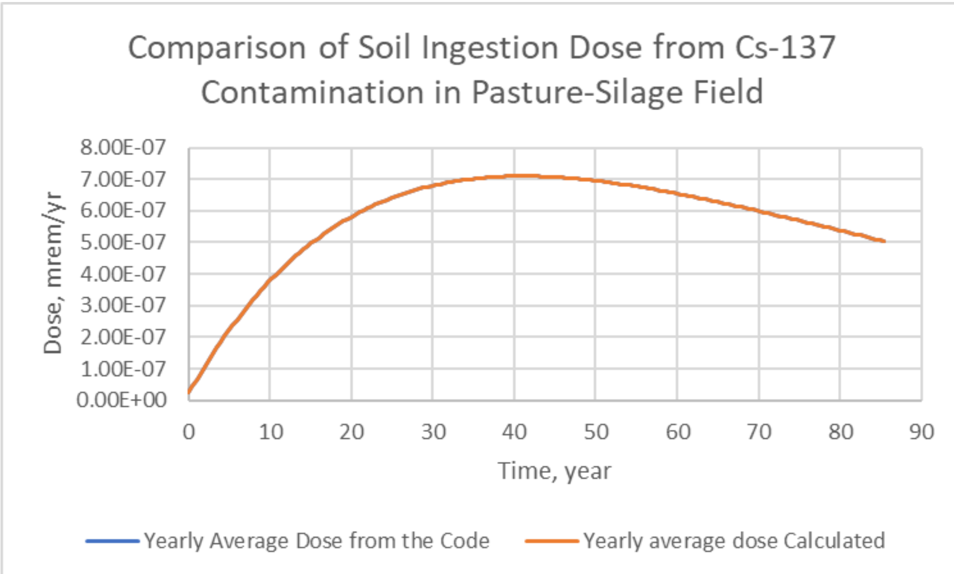

Figure Soil Ingestion Dose from Cs-137 Contamination outside on Pasture and Silage Field from V&V Report

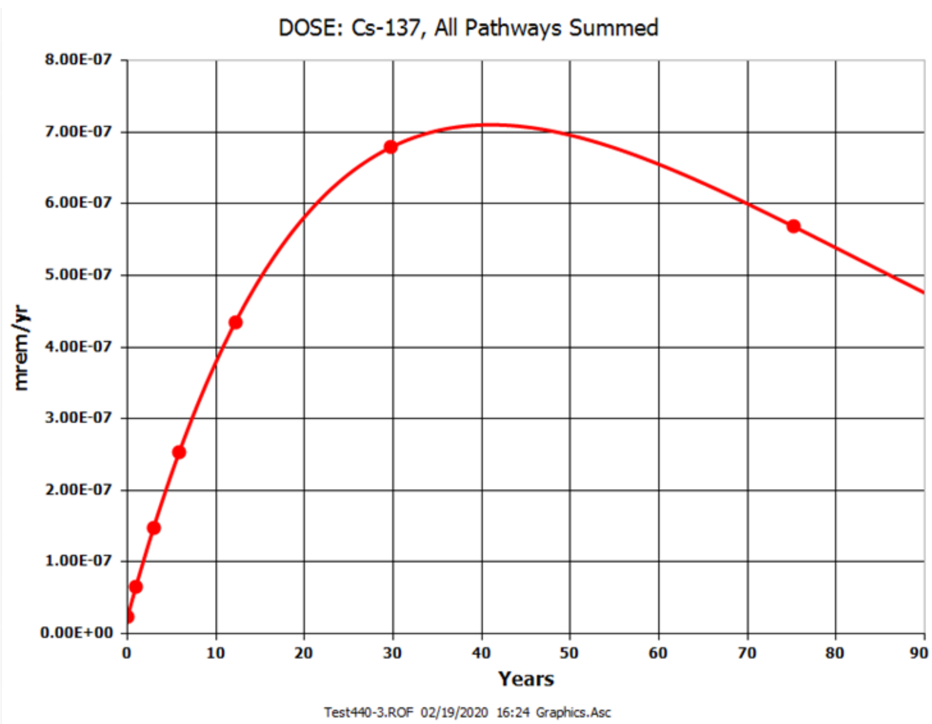

Figure Soil Ingestion Dose from Cs-137 Contamination outside on Pasture and Silage Field from Test440-3

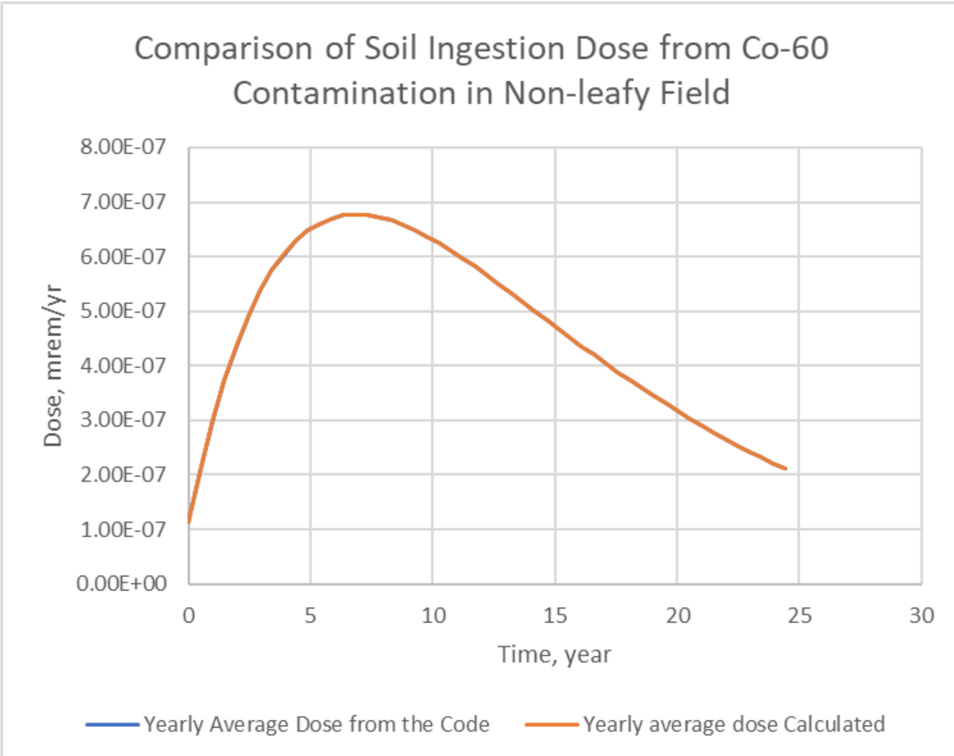

Figure Soil Ingestion Dose from Co-60 Contamination outside on Non-leafy Vegetable Field from V&V Report

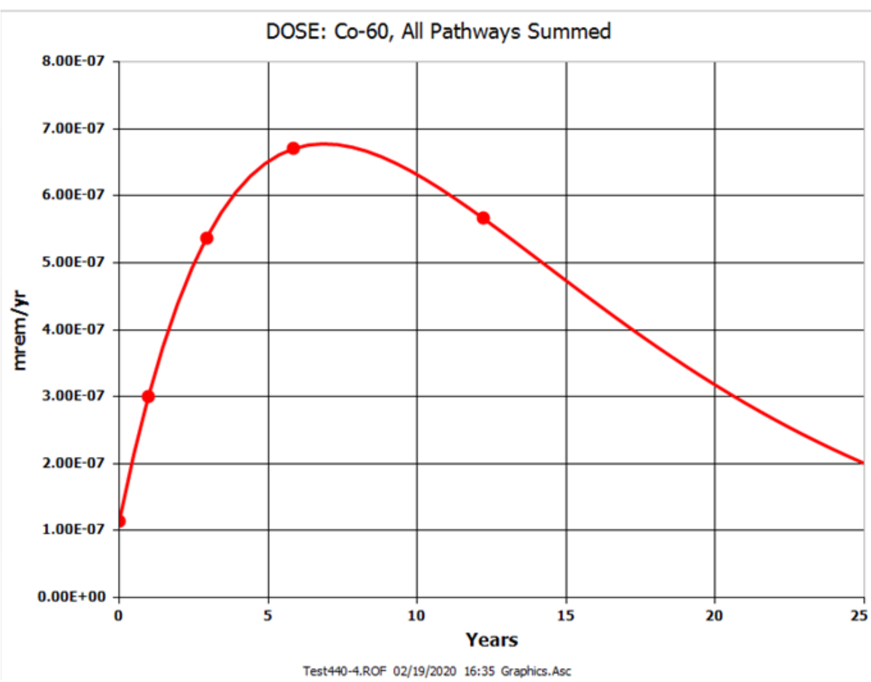

Figure Soil Ingestion Dose from Co-60 Contamination outside on Non-leafy Vegetable Field from Test440-4

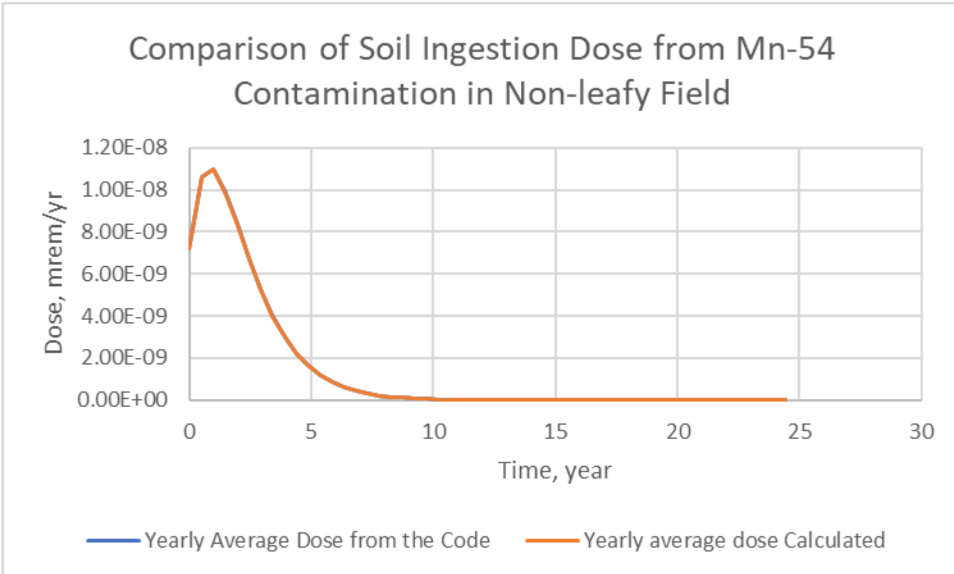

Figure Soil Ingestion Dose from Mn-54 Contamination outside on Non-Leafy Vegetable Field from V&V Report

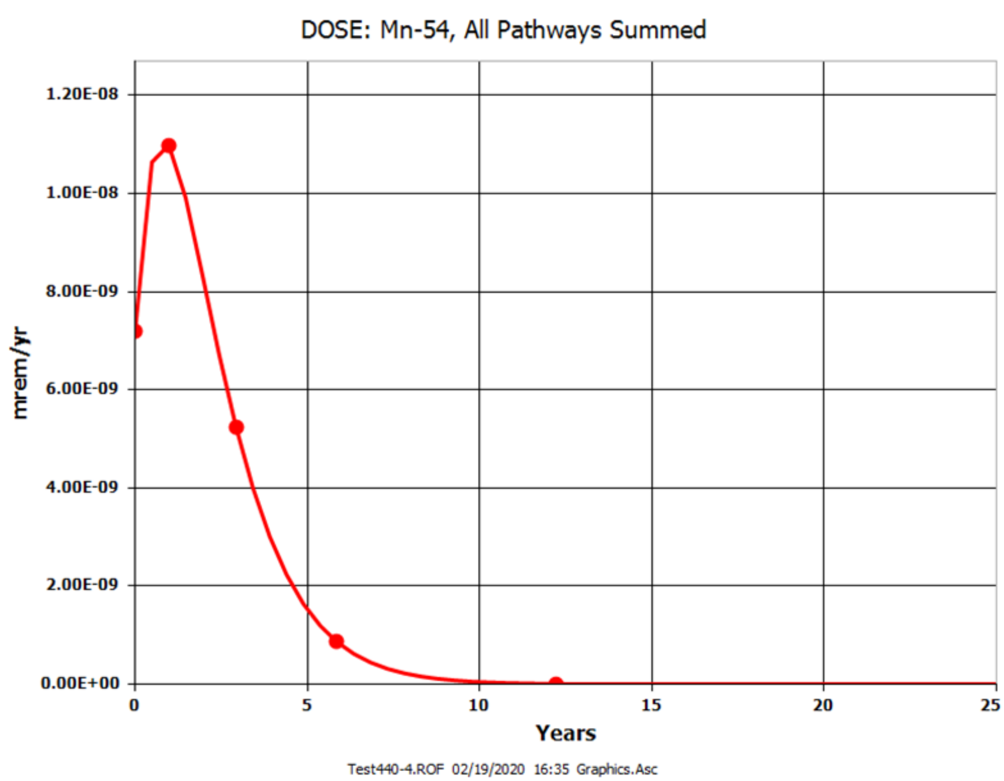

Figure Soil Ingestion Dose from Mn-54 Contamination outside on Non-Leafy Vegetable Field from Test440-4

Practically no difference in V&V dose results for inhalation pathway and Test 440 results

12.132 TEST CASES 441 THROUGH 447

The test reports for each of these 7 tests are spreadsheets comparing the candidate RESRAD-OFFSITE Version 4.0 output of the test run against the development RESRAD-OFFSITE Version 4.0 output for one of the verification runs described in Section 3. Each of these spreadsheets has three tabs, the one tab has the output of the test (129 row and 17 columns of output), another has the output of the verification run with column headers added (131 rows and 17 columns), the third compares the data in the other two tabs, cell by cell, and shows that there is no difference between those two tabs. They are not in a format that can be easily incorporated into this report. They are a sub-set of the verification documented and illustrated in Section 3.

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Gnanapragasam, E, S. Kamboj, Yu, C., D. LePoire, J.-J. Cheng, and C. Wang, K. Beckman, 2020, *User's Manual for RESRAD-OFFSITE Code Version 4 Vol 2*, NUREG/CR-7268, ANL/EVS/TM-19/2, Argonne National Laboratory, Lemont, Illinois, February.

Kamboj, S., C. Yu, and D.J. LePoire, 1998, *External Exposure Model Used in the RESRAD Code for Various Geometries of Contaminated Soil,* ANL/EAD/TM-84, prepared by Argonne National Laboratory, Lemont, Ill., for U.S. Department of Energy, Washington, D.C.

ICRP, 1983, *Radionuclide Transformations: Energy and Intensity of Emissions*, Publication 38, Annals of the ICRP, Vols. 11−13, Pergamon Press, New York, N.Y.

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Yu, C., E.K. Gnanapragasam, J.-J. Cheng, S. Kamboj, B.M. Biwer, and D. J. LePoire, 2011, *Verification of RESRAD-OFFSITE*, NUREG/CR-7038, ANL-10/27, Argonne National Laboratory, Lemont, IL, Feb.

Yu, C., E. Gnanapragasam, J.-J. Cheng, D. LePoire, S. Kamboj, and C. Wang, 2020, *User's Manual for RESRAD-OFFSITE Code Version 4 Vol 1*, NUREG/CR-7268, ANL/EVS/TM-19/2, Argonne National Laboratory, Lemont, Illinois, February.

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