Example of Human Health Impacts Assessment Using Imported Soil Concentration Spreadsheet Data (Example No. 2)

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Introduction

The U.S. Army Engineer Research and Development Center (ERDC) is developing the Army Risk Assessment Modeling System (ARAMS) to provide the Army with the capability to perform human and ecologically based risk/hazard assessments associated with past practice and current activities at military installations. The intent of the system is to provide a platform from which a variety of assessments can be performed. The system is envisioned to help a risk analyst visualize an assessment from source, through multiple environmental media (e.g., groundwater, surface water, air, and land), to sensitive receptors of concern (e.g., humans and ecological endpoints).

ARAMS uses the Framework for Risk Analysis in Multimedia Environmental Systems (FRAMES) developed by the Pacific Northwest National Laboratory (PNNL) for linking disparate objects, such as environmental fate/transport models, databases, spreadsheets, etc. FRAMES is a Windows-based software platform that provides an interactive user interface and, more importantly, specifications to allow a variety of DOS and Windows-based environmental codes to be integrated within a single framework.

This document is intended to serve as a tutorial for helping new users with the application of ARAMS/FRAMES and the components within this system. This example does not include the steps for project planning and the use of associated tools under the "File" menu. These tools help the user plan the risk assessment, including development of the conceptual site model and the Risk Assessment Guidelines for Superfund (RAGS) Part D Table 1 for human health risk assessment. Several Help files within ARAMS explain these tools.

Example Description

This case will use measured soil concentrations to calculate the human health effects of a receptor directly exposed to the soil. The measured values will be entered into the FRAMES system using the Soil Concentration File (SCF) Spreadsheet Imports module. FRAMES accesses and reads the spreadsheet and creates a Soil Concentration File (SCF). These soil concentrations will be used to estimate health impacts to humans on or near the site for pathways such as air inhalation, soil ingestion, and soil dermal contact. This case demonstrates the capability to enter SCF file values through a spreadsheet interface. The completed FRAMES working space for this example will look like Figure 1 when completed.

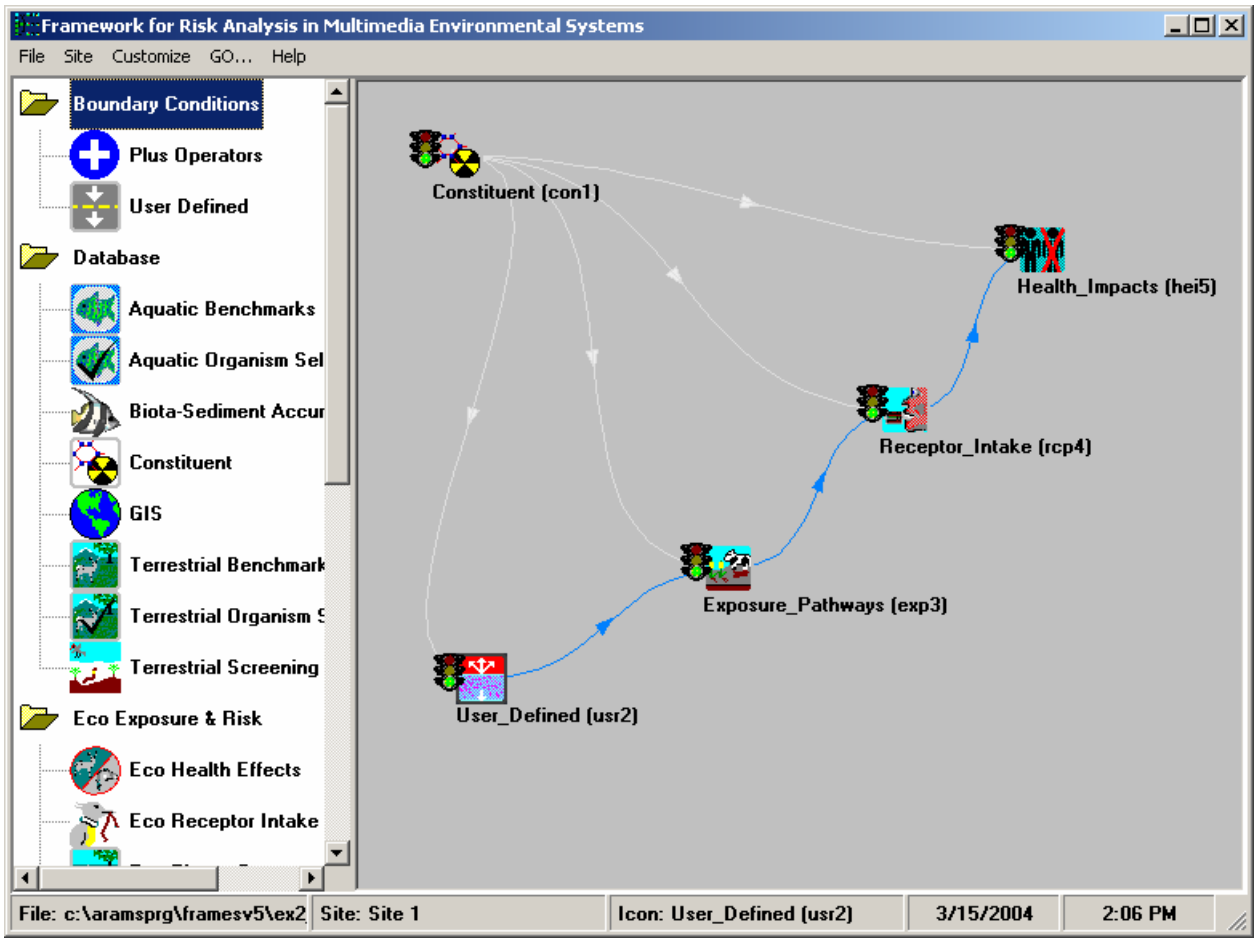

Figure 1. Object workspace for example application

Input Data

- Double-click on "ARAMS" icon to open "ARAMS info and Disclaimer" window and then select "Accept" to continue.

- Choose FRAMES in the ARAMS toolbar to launch FRAMES. (Note: If this is the first time you have used ARAMS, you will need to configure it for FRAMES by selecting "**File,**" then "*****Must Configure Path to FRAMES*****" and supplying the path to the "**fui.exe**" file).

- While ARAMS/FRAMES is running, click "File" from the FRAMES menu and choose "New." A window titled "Global Input Data Open New" will appear (see Figure 2). In the "File Name" box enter the project name (type: "Sample*2*," maximum of eight characters) and click "Open" (see Figure 3). **Do not name the "new file" "Example2" because it will write over the existing**

"Example2" file that was distributed with the tutorial. A window titled "Create New Site" will appear. Next, type the project site name (type: Site 1) and click "OK" (see Figure 4).

Double-Click on the **Constituent** icon so that the icon appears on the upper left corner of the main screen. Repeat this operation to place the following additional icons into the workspace:

"User Defined"
"Exposure Pathways"
"Receptor Intake"
"Health Impacts"

Click on and drag each icon to its respective position on the workspace. Connect the Constituent icon with the Source icons by holding down SHIFT, left-clicking on the Constituent Icon, dragging the cursor to the Source icon, and releasing the mouse button (Note: To remove this line, repeat the steps used to connect it. To remove an icon from the screen, right-click and a menu will appear with different options. Click "Delete" and the icon will be taken out.).

In the same fashion, connect the following pairs of icons:

Constituent	→	*User Defined (already done)*
Constituent	→	*Exposure Pathways*
Constituent	→	*Receptor Intake*
Constituent	→	*Health Impacts*
User Defined	→	*Exposure Pathways*
Exposure Pathways	→	*Receptor Intake*
Receptor Intake	→	*Health Impacts*

FRAMES should now look something like Figure 1.

CONSTITUENT DATABASE MODULE

Right-click the Constituent icon and choose General Info (see Figure 5). When the General Info screen opens, enter "Constituent" in the "User Label" text box and select "FRAMES Constituent Database Selection" in the "Select from applicable models" text box (see Figure 6). Click OK at the bottom of the screen to return to the work area. The status light attached to the constituent icon will change from black to red. Right-click on the constituent icon in the main screen and choose User Input. The Constituent Selection screen will open (see Figure 7). The constituents used in this case are Chromium III and STRONTIUM-90. Scroll to select the constituent from the constituents list or use the Find option to search for it. Click the "Add >>>" button to add the constituent to the selected constituents list. Click "File" and choose "Save and Exit" to return to the workspace screen. The Constituent icon's status light will change from red to green.

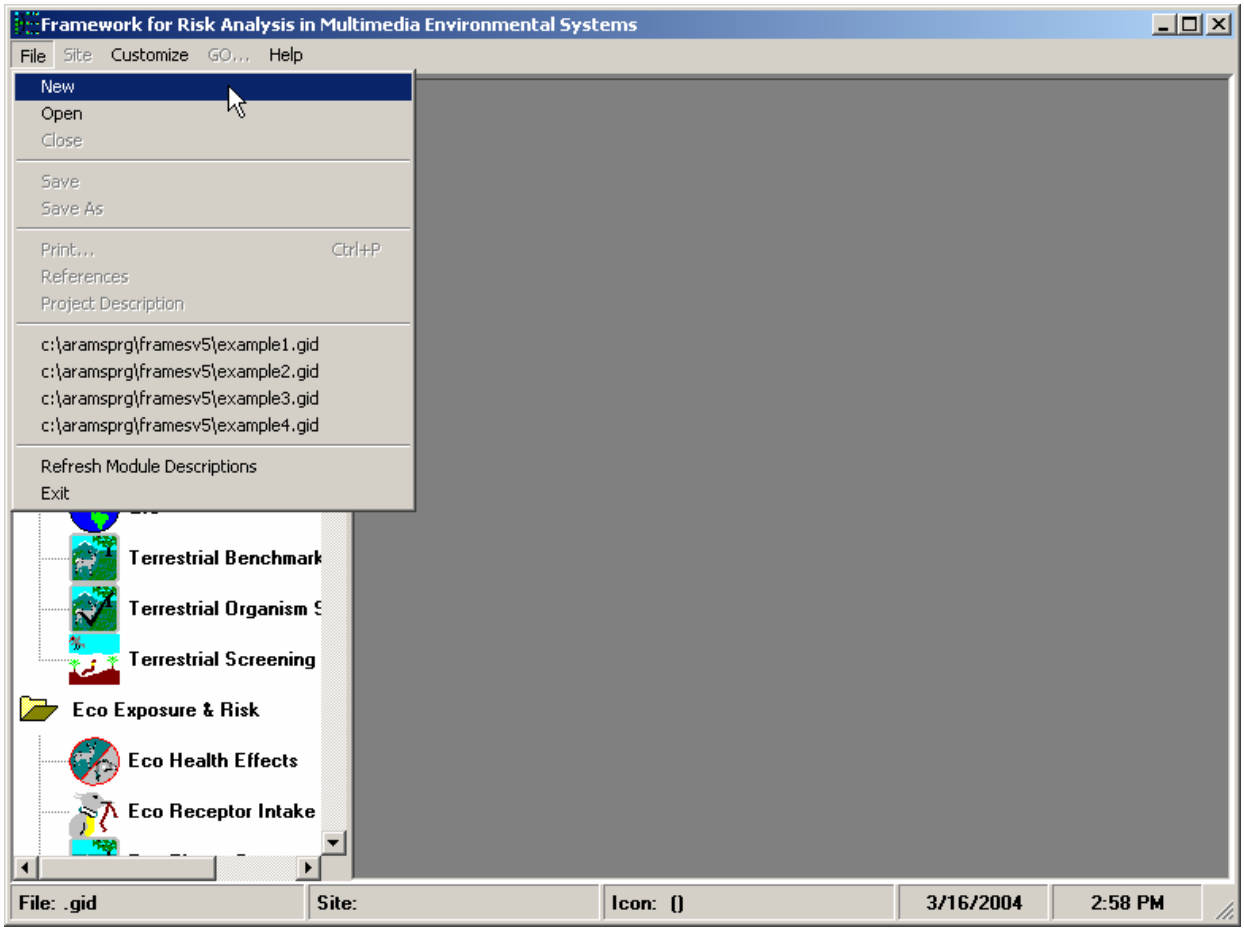

Figure 2. Opening a new file

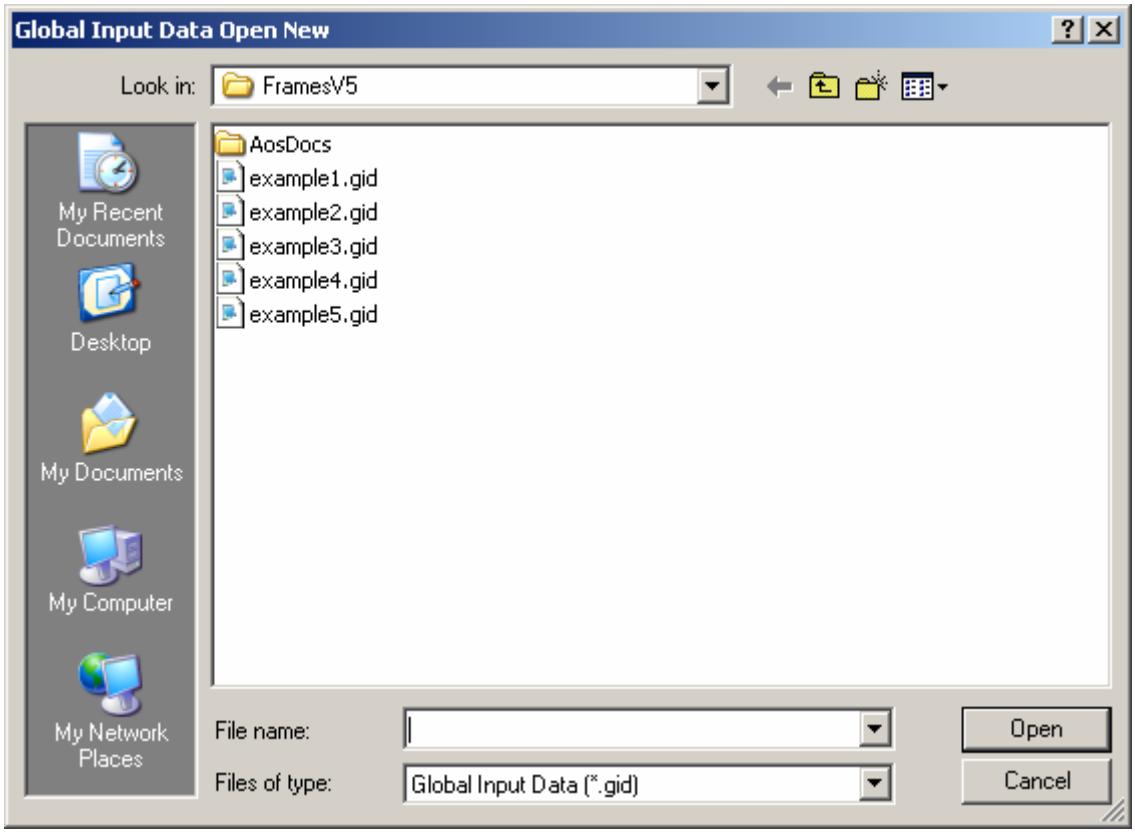

Figure 3. Global Input Data Open New screen (New File Window)

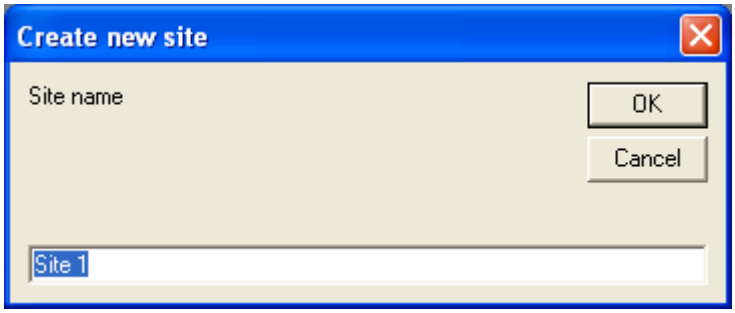

Figure 4. Create New Site screen (Input “Site name” box)

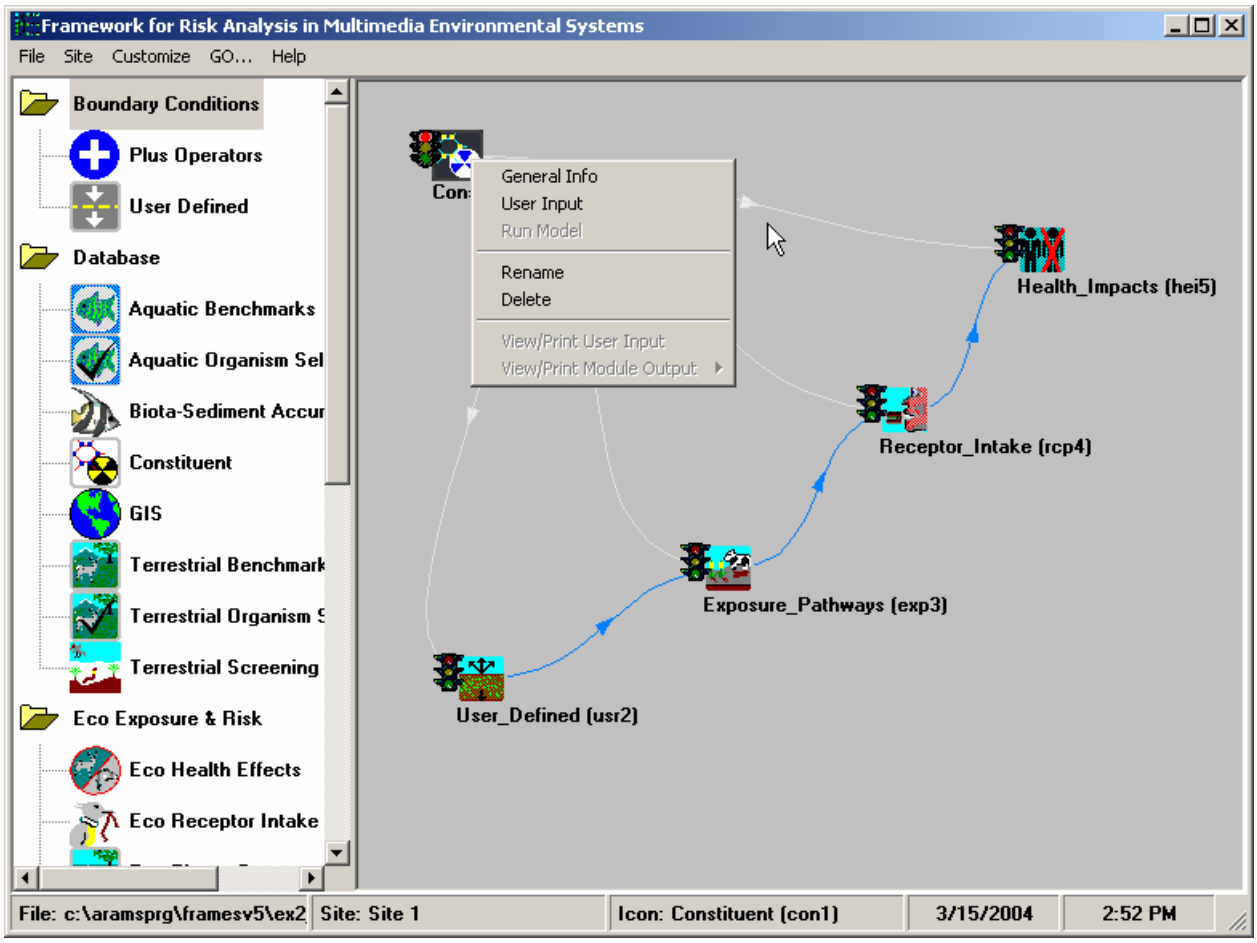

Figure 5. Workspace screen (Right-click on the Constituent icon)

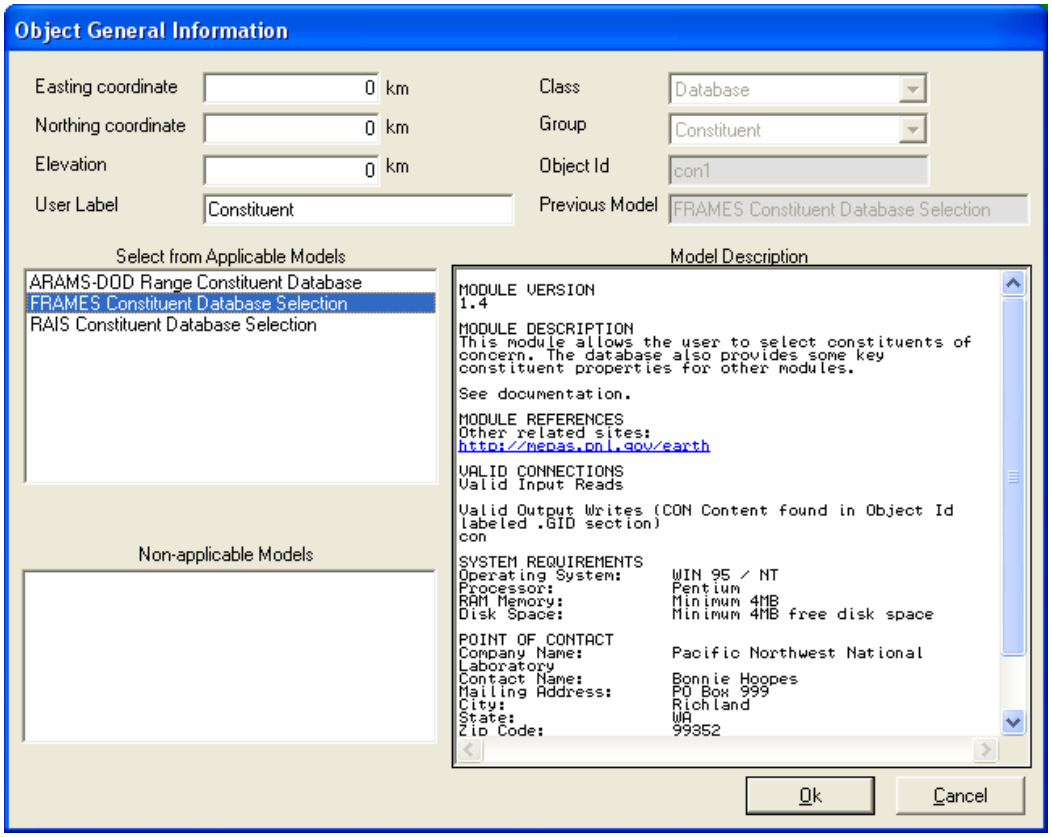

Figure 6. Object General Information screen

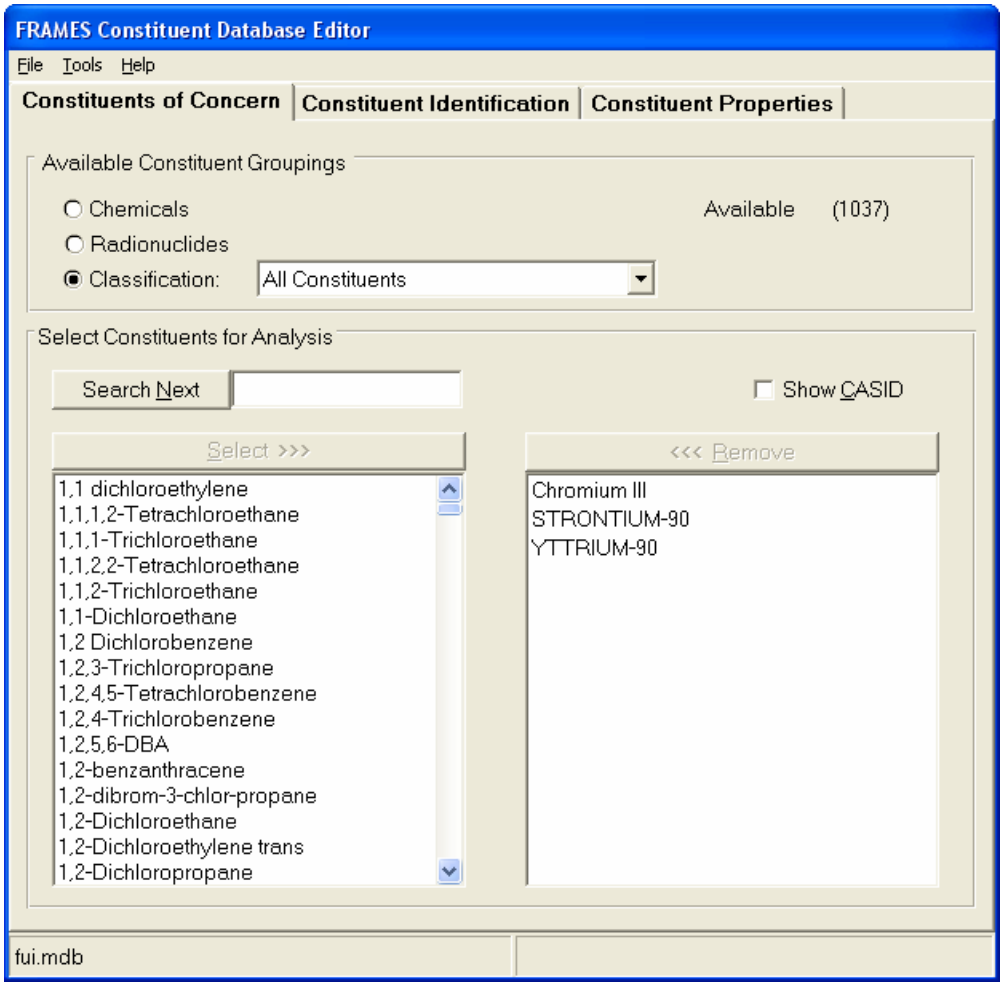

Figure 7. FRAMES Constituent Selection screen (Constituents of Concern Tab)

The following is a listing of all data input required by the remaining modules used in this example. *Names of object icons* are in bold, italics, and underlined headings. *Menu items* (displayed by right-clicking on the icon) are shown below the module in bold and indented to the right of the icon names. *Explanations* of data required by each menu item are indented further to the right. To save information for your scenario, select "File" and then "Save" from the main FRAMES menu.

USER DEFINED

General Info

A window titled "Object General Information" will appear. In the Label text box, put in "User Defined." In "Select from Applicable Models," choose "SCF Spreadsheet Imports" and click "Ok." The status light next to the icon should turn red.

The user should first choose each module for each object before entering any data, thus, enter the "General Info" on each remaining module and make a selection before selecting the "User Input." After selecting modules, User Input should be performed, and the mod-

ules run, starting with the modules at the upper end of the chain and working down the chain.

User Input

A window titled "SCF Spreadsheet Import" will appear (see Figure 8). Click "Browse…" and select "SCFImportTemplate.xls" from its location on the disk. From the drop-down menus, select "Chemicals," "Site C Surface Contamination at Fort Campbell and "Mean Concentration" for Use. Note that there are data for two sites in this example spreadsheet, and there are several concentration measures in the spreadsheet that could have been used in the analysis besides the mean. Click "File," and choose "Save and Exit" to return to the workspace screen. The status light next to the Source Term icon should turn yellow.

Run Model

The model runs in the background. The status light next to the Source Term icon should turn green.

View/Print Module output

A second menu will appear (see Figure 9). Select the "SCF Text View" to view a screen output like Figure 10. Choose "SCF Graphical View" to view a screen output in Excel format (see Figure 11).

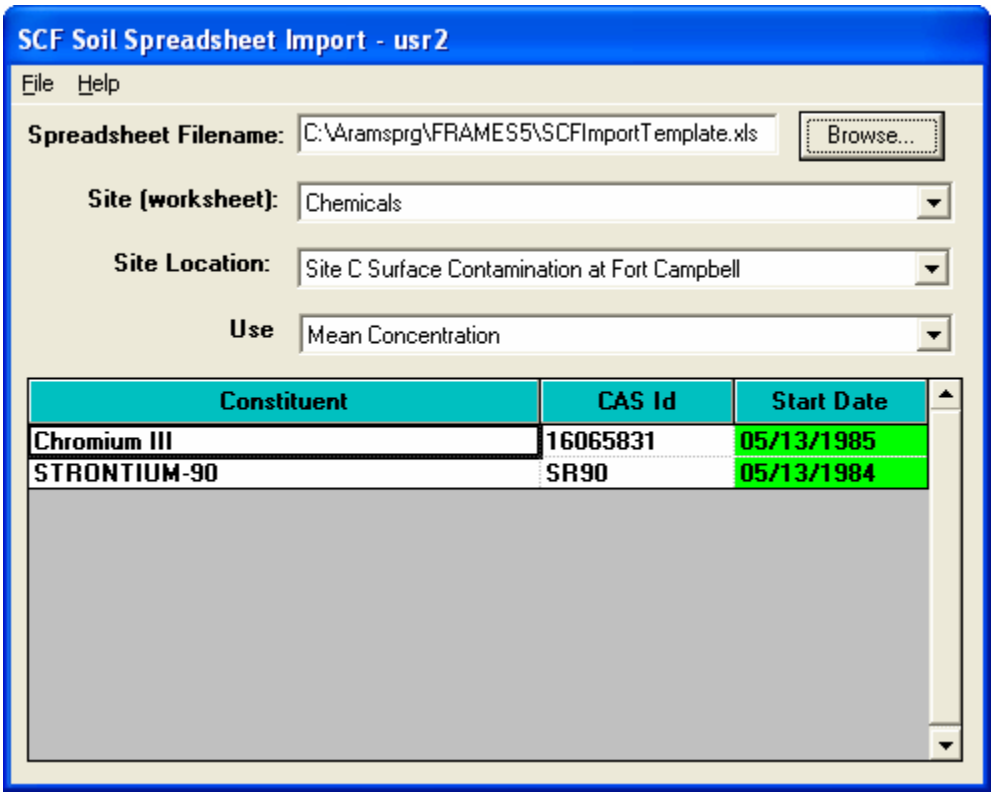

Figure 8. SCF Spreadsheet Import screen

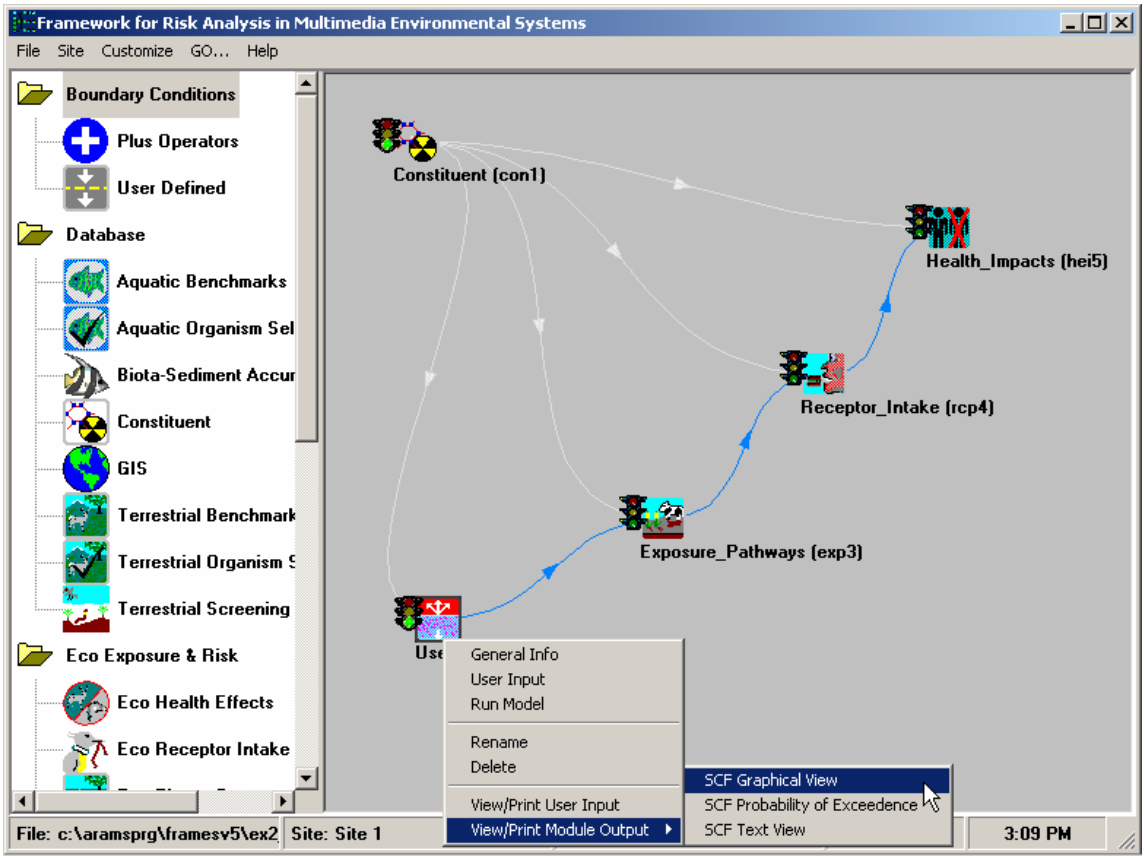

Figure 9. Selecting the Output display format

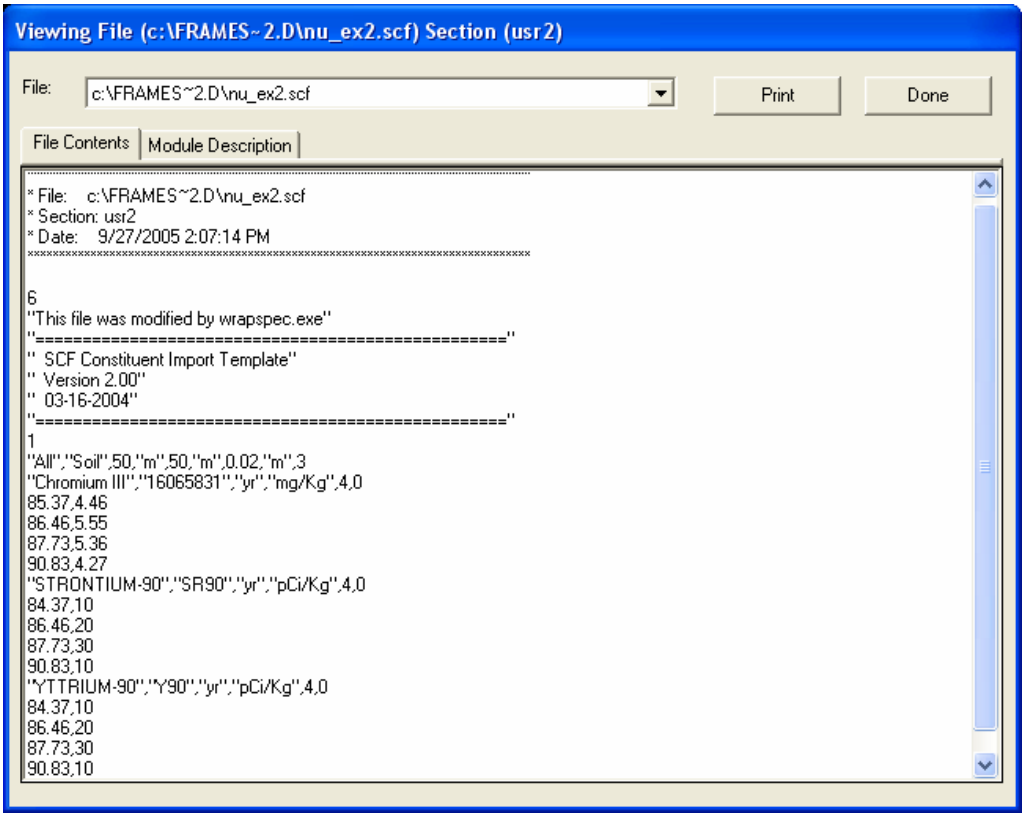

Figure 10. SCF Text View – Soil Concentrations screen

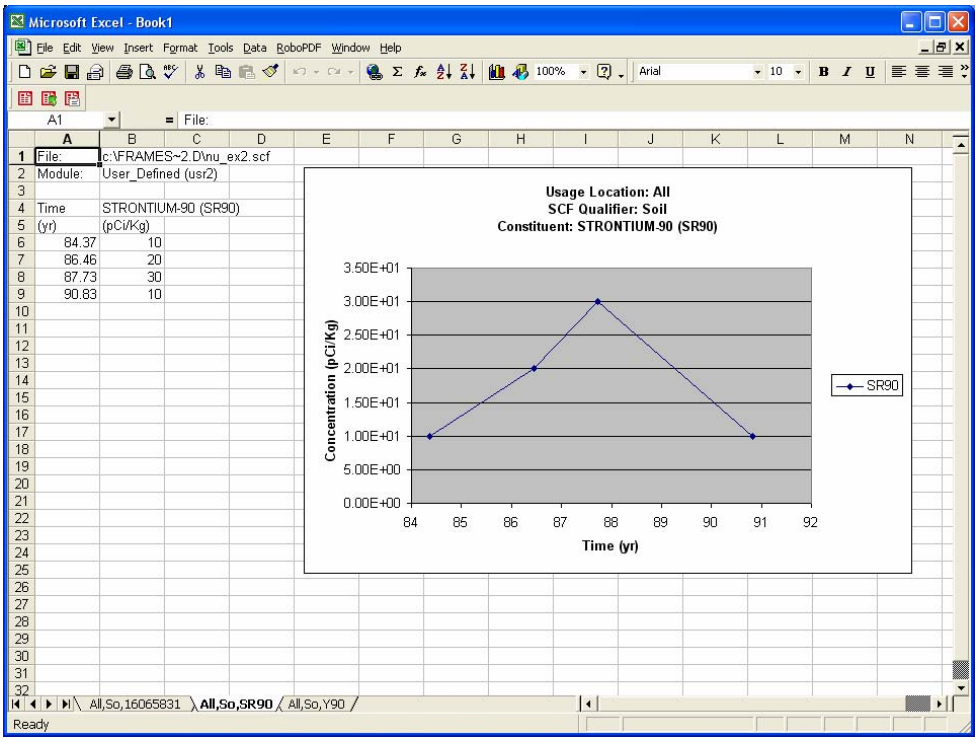

Figure 11. Source Term Icon Output (Excel Format View)

EXPOSURE PATHWAYS

General Info

A window titled "Object General Information" will appear. In the Label text box, put in "Exposure Pathways." In "Select from Applicable Models," choose "MEPAS 5.0 Exposure Pathways Module" and click "Ok." The status light next to the Exposure Pathway icon should turn red.

User Input

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A window titled "MEPAS Chronic Exposure Module" will appear. Click on the "Soil" tab (see Figure 12) and ensure the following:

Exposure duration – EM-SMED = 35 yr

In the "Pathways" tab (under the "Soil" tab), check the following:

Leafy vegetables, Other vegetables, Meat, Milk, Soil-Ingestion, Soil – Inhalation, Soil – Dermal, Soil – External.

Select *use only the initial soil concentration from the SCF* under Soil Concentration Usage. This results in taking the observed soil concentration at the first time point and considering the fate of that concentration over time thence due to leaching and decay. Had

all soil concentration been used, the observed values would have been used without any consideration of soil fate processes. The latter is a perfectly valid approach when observations are available over time, so could have been selected in this example since measured values are available over time.

Click the "Exposure Controls" tab and fill it out according to the data in Figure 13, or the information below.

Time to start exposure computation –EC-TEXPOS = 0.0 yr
Maximum time for reporting – EC-MAXTIM = 10.0 yr
Number of time points for evaluation – EC-NTIMES = 10

Note that if the option of *Use all time varying soil concentrations from the SCF* had been selected, then the start time and maximum time for reporting should be selected to capture the years in the spread sheet, i.e., 84 to 91.

Click the "Leach Rates" tab and fill it out according to the data in Figures 14 and 15, or the information below.

Leach rate selection option = EC-LEACHOPTION = "User provided leach rate constants"
Surface soil leach rate constant = "Chromium III" in top dropdown box and 1.0 1/yr in bottom boxes.
Surface soil leach rate constant = "STRONTIUM-90" and "YTTRIUM-90" in top dropdown boxes and 1.0 1/yr in bottom boxes.

Click the "Constituent Parameters" tab and fill it out according to the data in Figures 16 and 17, or the information below. Note that some values are passed from the constituent database whereas others, such as the value for chromium, must be entered.

Constituent = "Chromium III" and Parameters = "Half-Life in Surface Soil" in top box and 100000 days in bottom boxes. Parameter = "Half-Life in Groundwater" (for food holdup, after harvesting before consumption but in a closed system) set to 1.0E20 days to represent little or no decay.
Constituent = "STRONTIUM-90" and Parameters = "Half-Life in Surface Soil" in top box and 10600 days in bottom boxes.
Progeny = "YTTRIUM-90" and Parameters = "Half-Life in Surface Soil" in top box and 2.7 days in bottom boxes. The same values are set for half life in groundwater for both strontium and yttrium.

The half-life values for the two radionuclides are pulled from the constituent database. The half-life for chromium is user-specified to a relatively high value to represent the expected limited or no degradation.

All default values are being used for the other parameters that can be viewed under the "Customize" menu. Then click "File," and choose "Save and Exit" to return to the workspace screen. The Exposure Pathways icon's status light will change from red to yellow.

Run Model

The model runs in the background in a command prompt window. The status light next to the Exposure icon should turn green.

View/Print Module Output

A second menu will appear. Select the "EPF Text View" to view a screen output like Figure 18. Choose "EPF Graphical View" to view a screen output like Figure 19. Note that the values change over time due to leaching and decay.

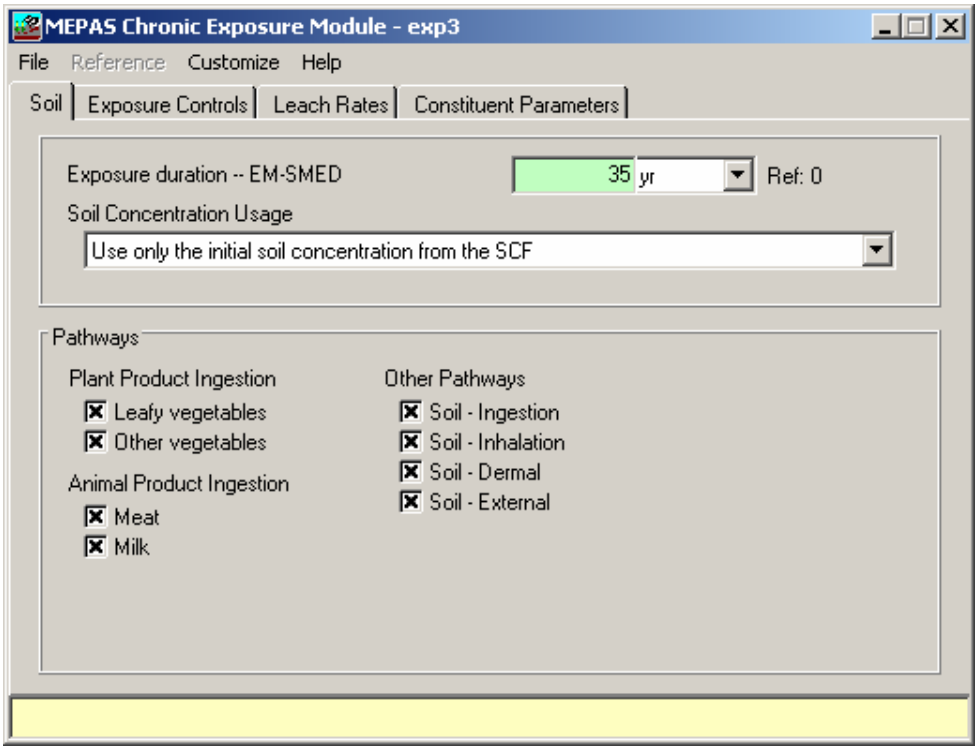


Figure 12. MEPAS Chronic Exposure Module - Soil

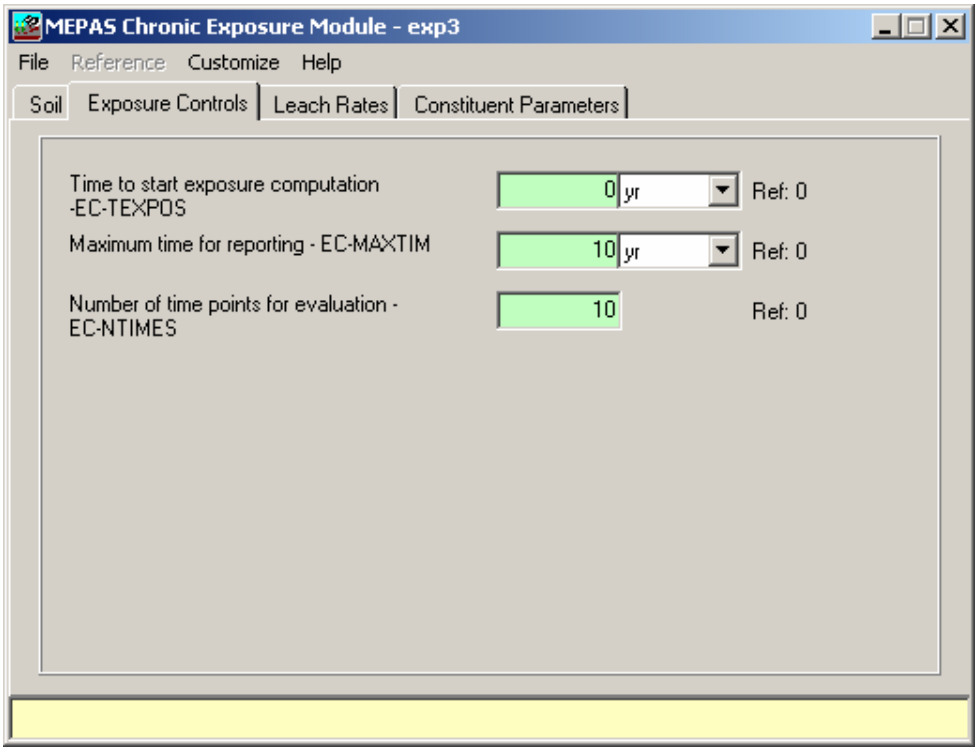


Figure 13. MEPAS Chronic Exposure Module – Exposure Controls

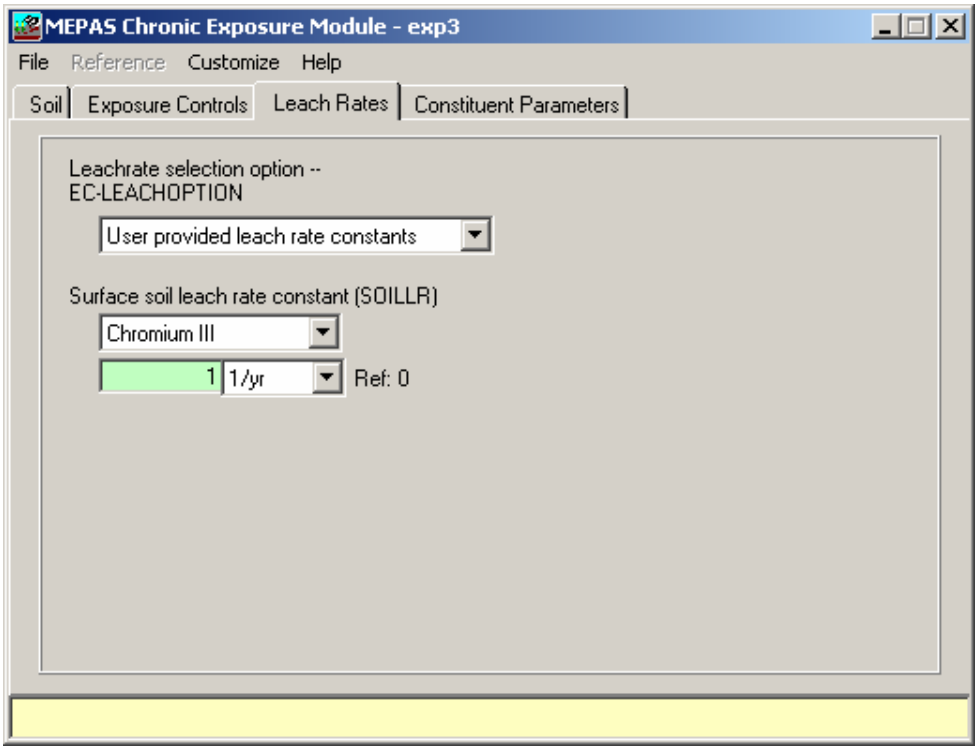


Figure 14. MEPAS Chronic Exposure Module – Leach Rates (Chromium III)

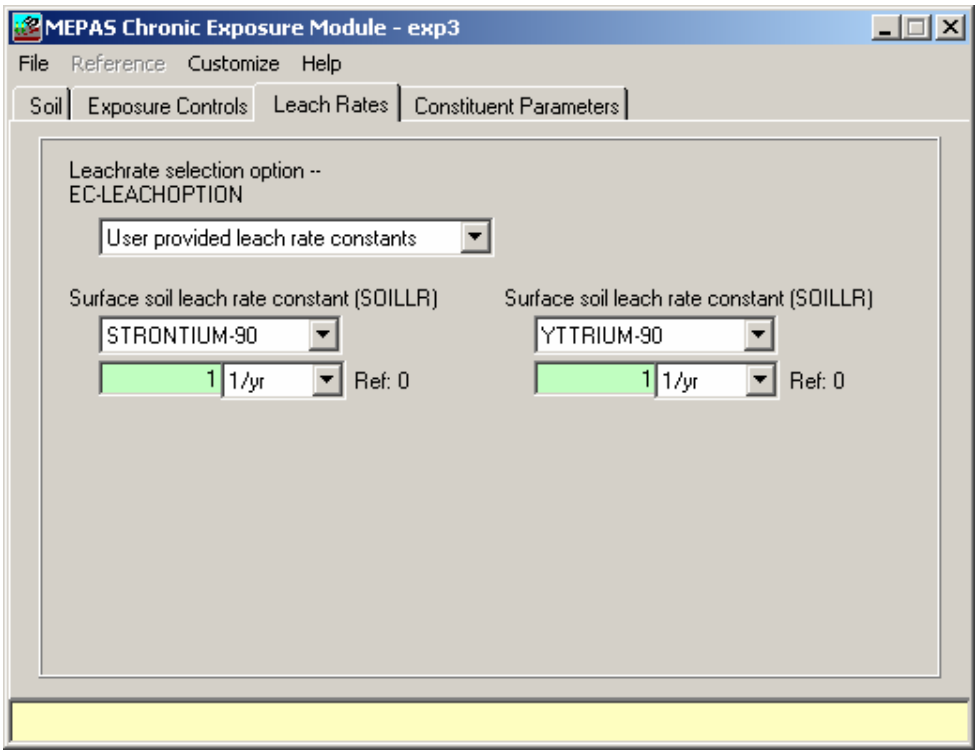


Figure 15. MEPAS Chronic Exposure Module – Leach Rates (STRONTIUM-90)

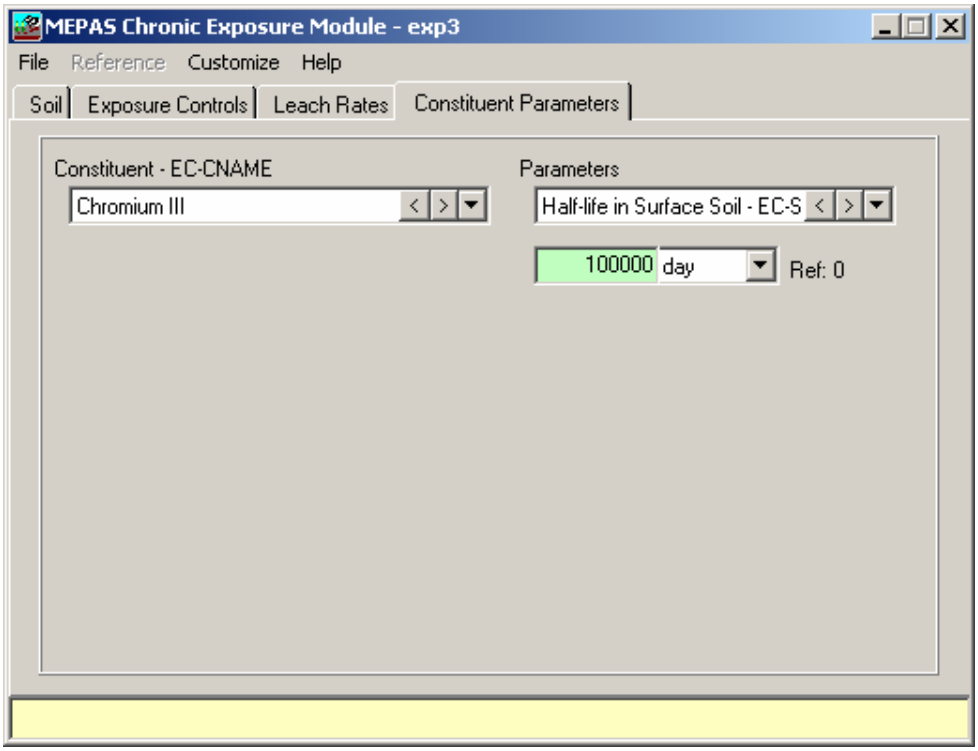


Figure 16. MEPAS Chronic Exposure Module – Constituent Parameters (Chromium III)

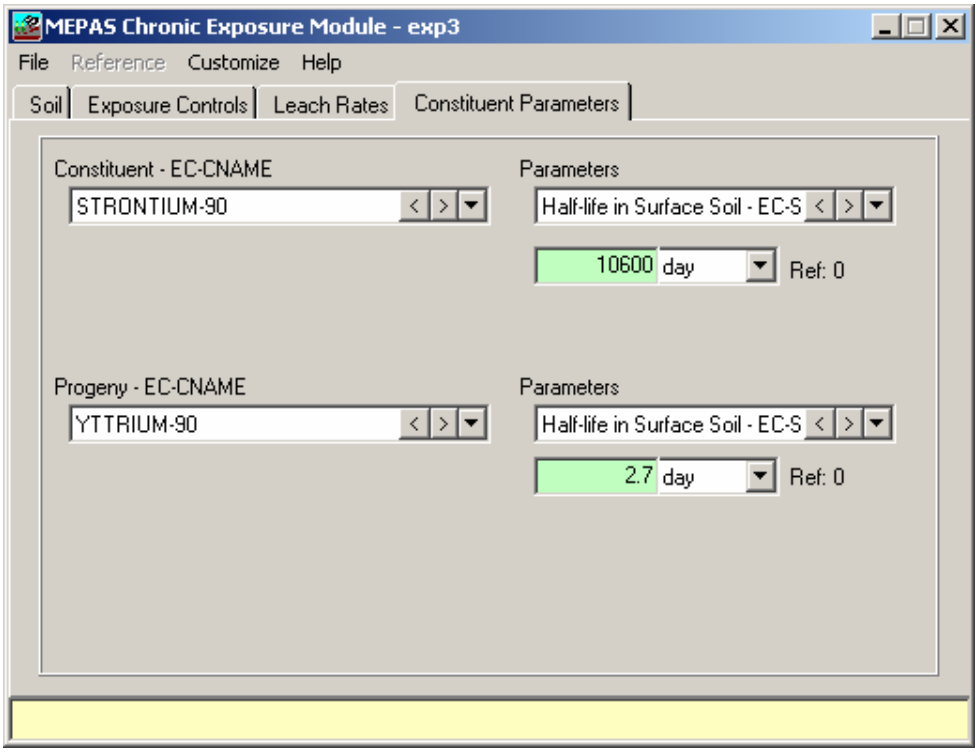


Figure 17. MEPAS Chronic Exposure Module – Constituent Parameters (STRONTIUM-90)

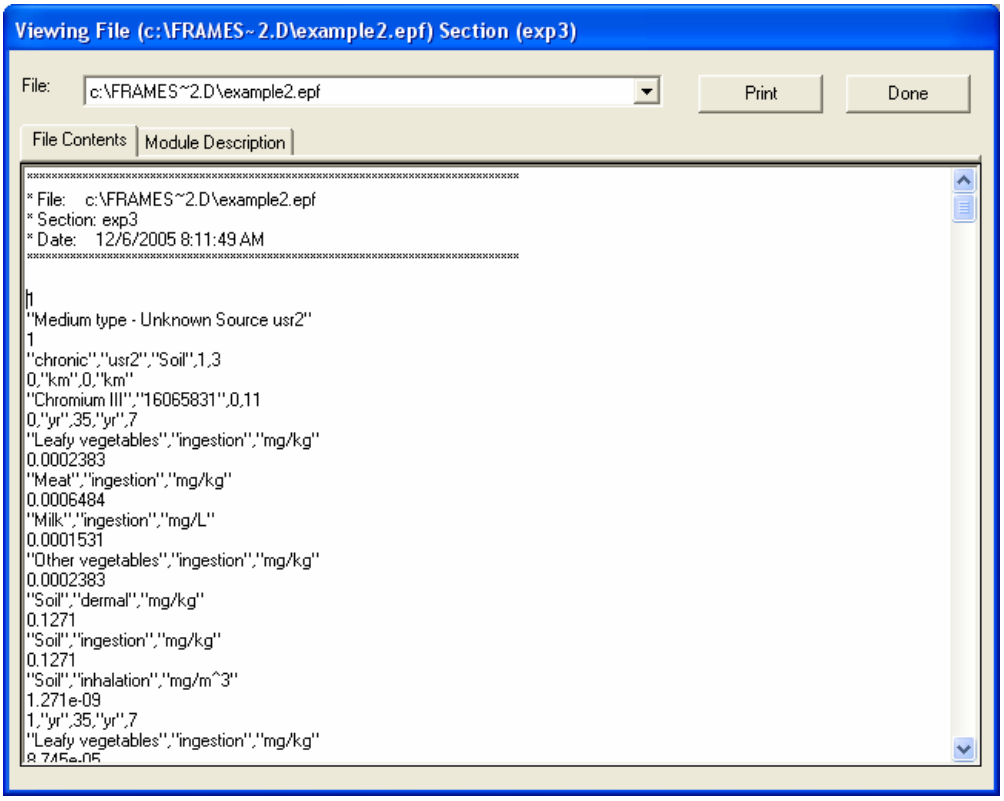
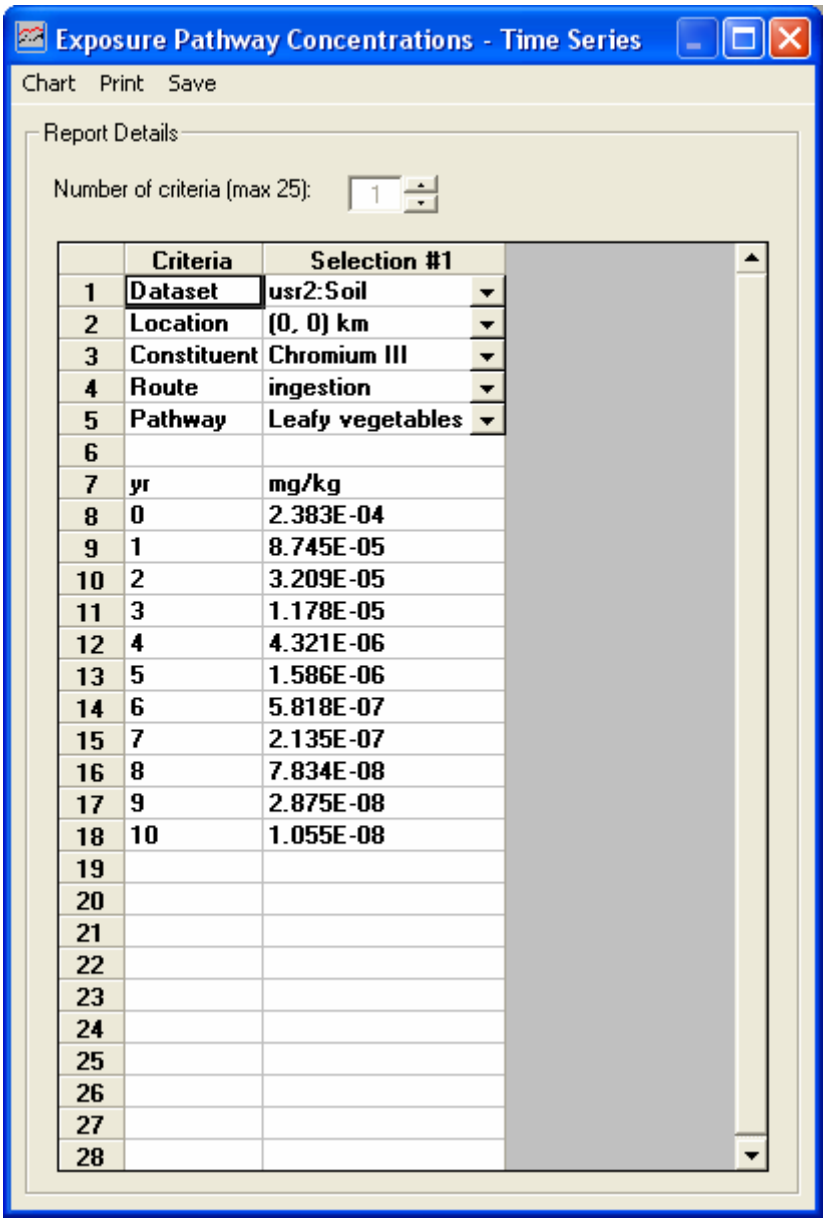


Figure 18. Exposure Pathways Output (Text View)



	Criteria	Selection #1
1	Dataset	usr2:Soil
2	Location	(0, 0) km
3	Constituent	Chromium III
4	Route	ingestion
5	Pathway	Leafy vegetables
6		
7	yr	mg/kg
8	0	2.383E-04
9	1	8.745E-05
10	2	3.209E-05
11	3	1.178E-05
12	4	4.321E-06
13	5	1.586E-06
14	6	5.818E-07
15	7	2.135E-07
16	8	7.834E-08
17	9	2.875E-08
18	10	1.055E-08
19		
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Figure 19. Exposure Pathways Output Screen (Graphical View)

RECEPTOR INTAKE

General Info

A window titled "Object General Information" will appear. In the Label text box, put in "Receptor Intake." In "Select from Applicable Models," choose "MEPAS 5.0 Receptor Intakes Module" and click "Ok." The status light next to the Receptor Intake icon should turn red.

User Input

A window titled “MEPAS Receptor Intake Module" will appear. Fill it out according to Figure 20. The parameters under the “Customize” menu are left at the default values.

Then click “File” and choose “Save and Exit” and again click “File” and choose “Save and Exit” to return to the work screen. The Receptor Intake icon’s status light will change from red to yellow.

Run Model

The model runs in the background in a command prompt window. The status light next to the Receptor icon should turn green.

View/Print Module Output

A second menu will appear. Select the “RIF Text View” to view a screen output like Figure 21. Choose “RIF Graphical View” to view a screen output like Figure 22.

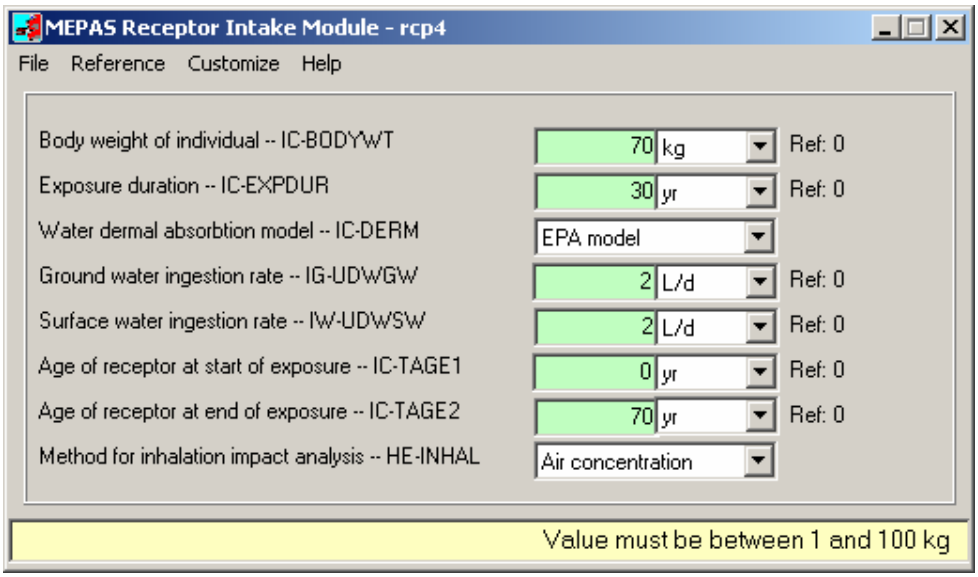


Figure 20. MEPAS Receptor Intake Module Screen

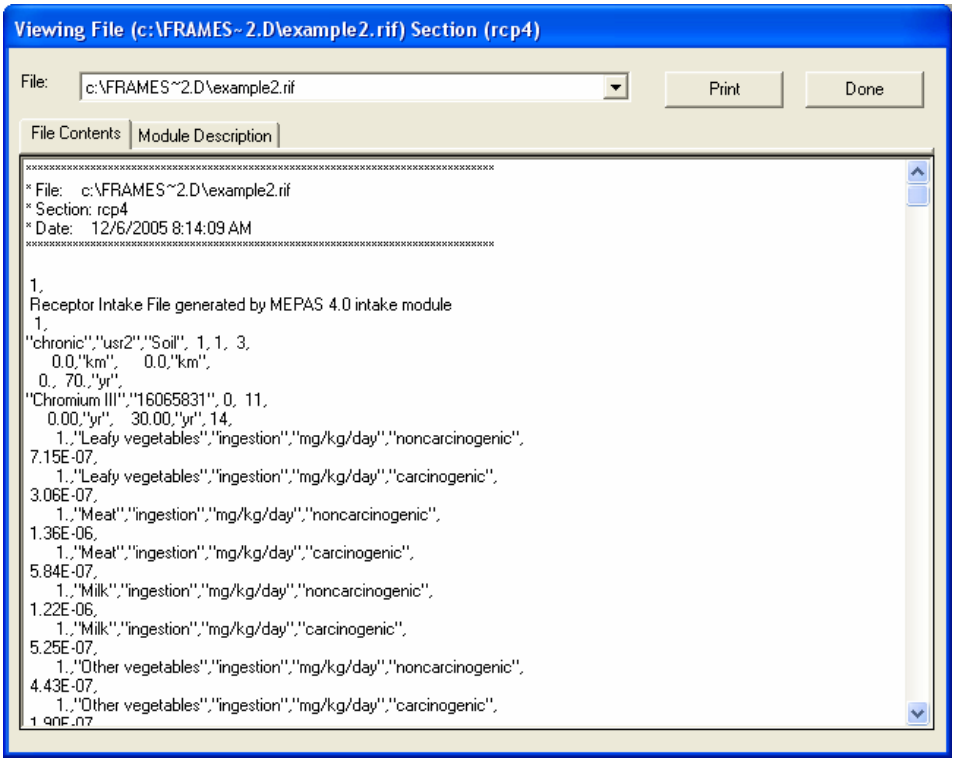
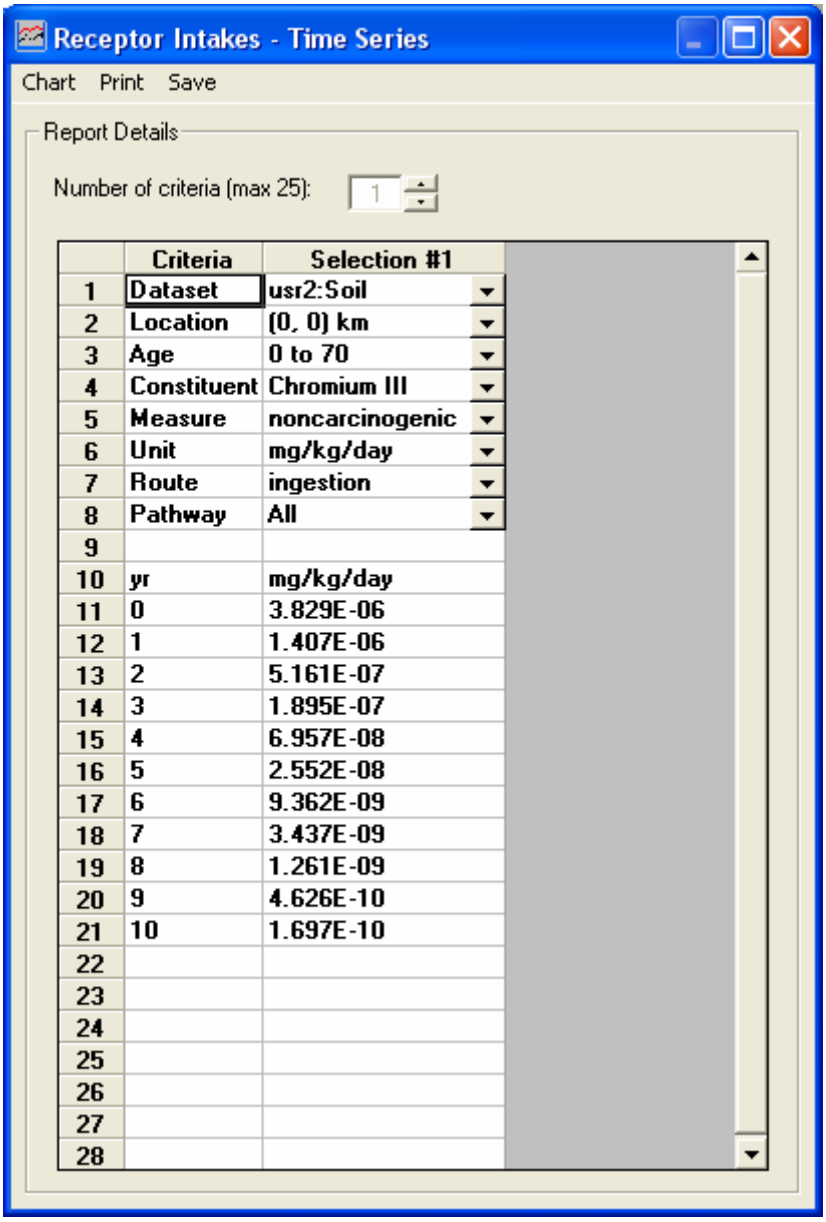


Figure 21. Receptor Intake Output (Text View)



	Criteria	Selection #1
1	Dataset	usr2:Soil
2	Location	(0, 0) km
3	Age	0 to 70
4	Constituent	Chromium III
5	Measure	noncarcinogenic
6	Unit	mg/kg/day
7	Route	ingestion
8	Pathway	All
9		
10	yr	mg/kg/day
11	0	3.829E-06
12	1	1.407E-06
13	2	5.161E-07
14	3	1.895E-07
15	4	6.957E-08
16	5	2.552E-08
17	6	9.362E-09
18	7	3.437E-09
19	8	1.261E-09
20	9	4.626E-10
21	10	1.697E-10
22		
23		
24		
25		
26		
27		
28		

Figure 22. Receptor Intake Output (Graphical View)

HEALTH IMPACTS

General Info

A window titled "Object General Information" will appear. In the Label text box, type "Health Impacts." In "Select from Applicable Models," choose "MEPAS 5.0 Health Impacts Module" and click "Ok." The status light next to the Health Impacts icon should turn red.

User Input

A window titled “MEPAS Human Health Impacts Module " will appear. Click on the “Chemical” tab and ensure that the following is true in Figure 23.

Click on “Radionuclide” tab and ensure that the following default selections and values are true in Figure 24.

Go to “File” and choose “Save and Exit” to return to the workspace screen. The Health Impacts icon’s status light will change from red to yellow.

Run Model

The model runs in the background in a command prompt window. The status light next to the Health Impacts icon should turn green.

View/Print Module Output

A second menu will appear (see Figure 25). Select “*HIF Text View*” to view a screen output like Figure 26. Choose “*HIF Graphical View*” to view a screen output like Figure 27.

Selecting the “*Summary Views of Risk, Hazard and Dose*” output command will result in an output screen like Figure 28.

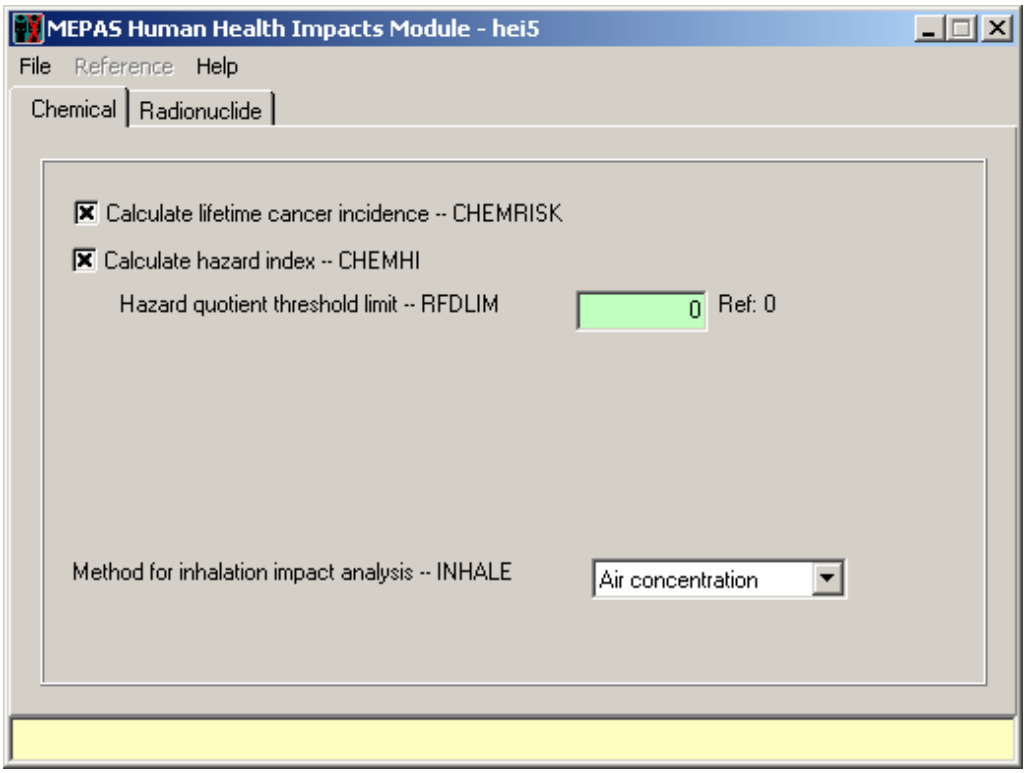


Figure 23. MEPAS Human Health Impacts Module – Chemical

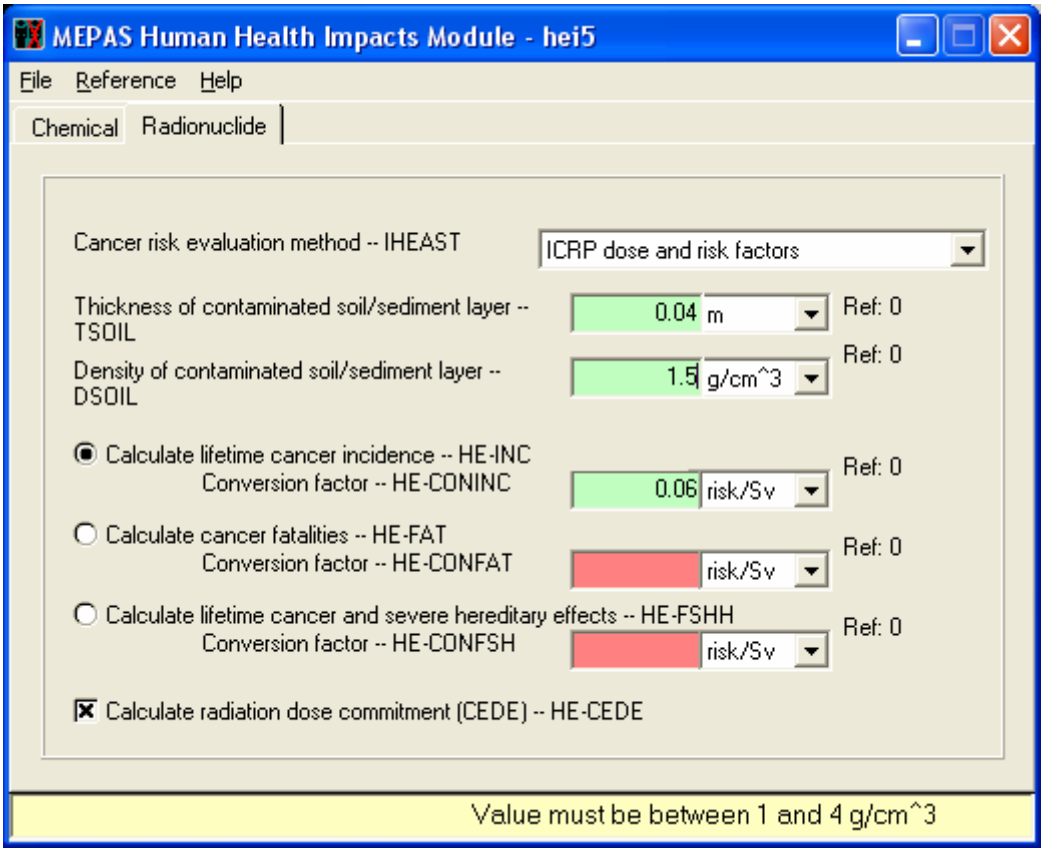


Figure 24. MEPAS Human Health Impacts Module – Radionuclide

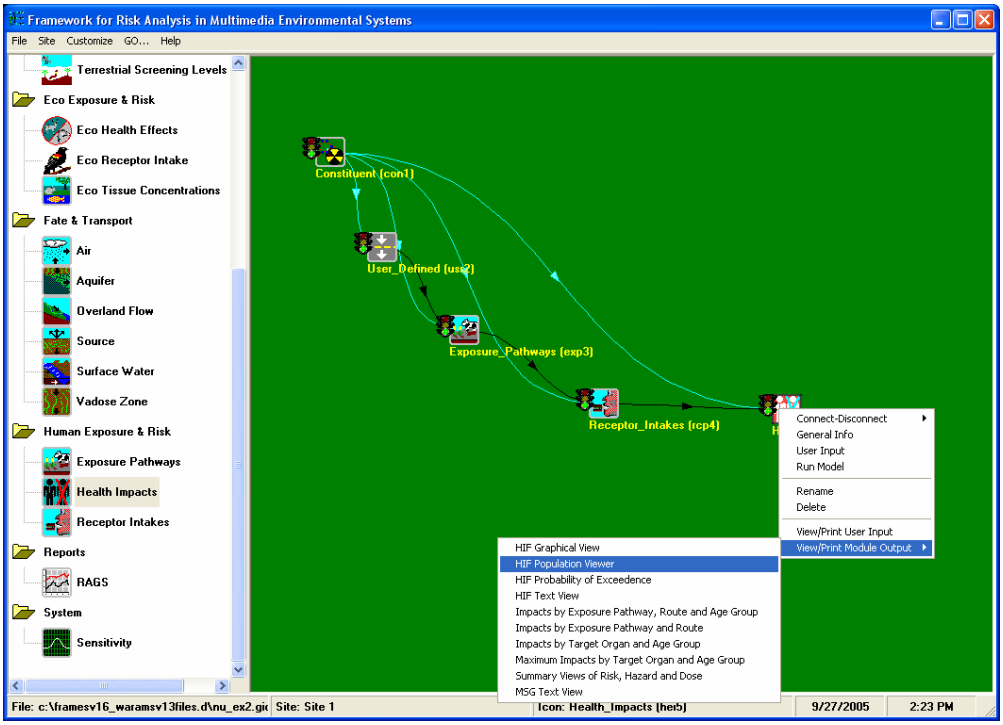


Figure 25. Health Impacts Output Menu

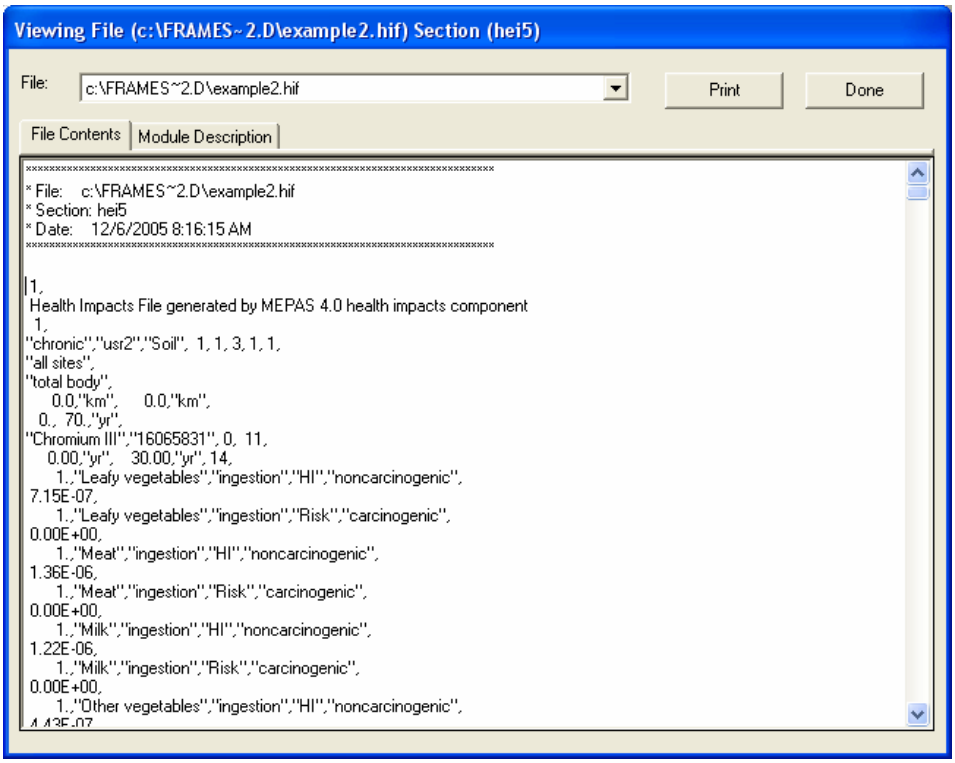
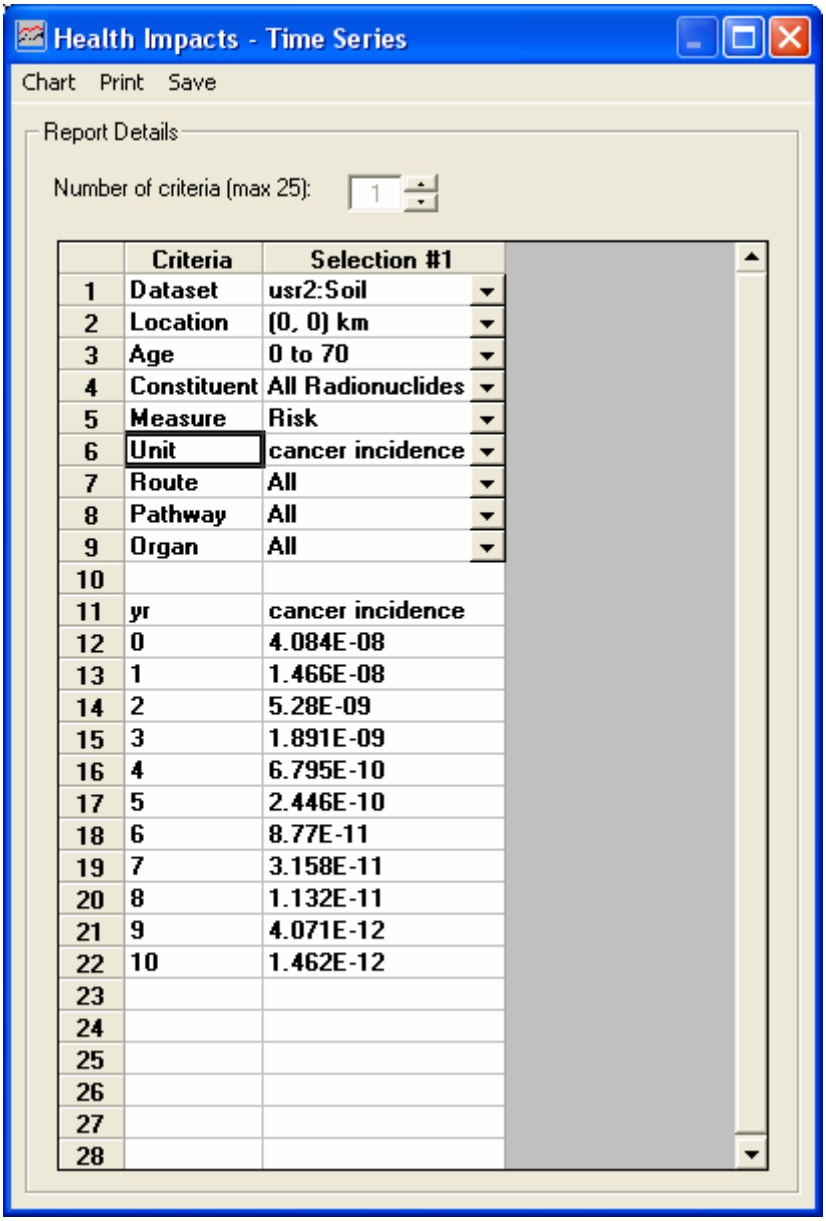
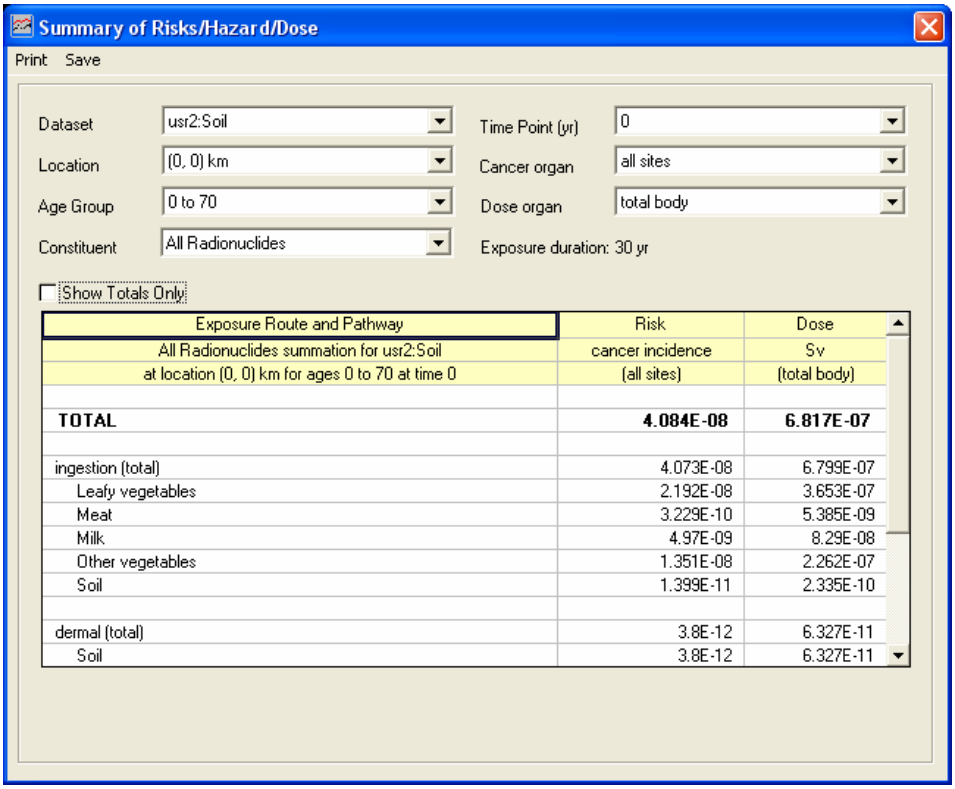


Figure 26. Health Impacts Output (text view)



	Criteria	Selection #1
1	Dataset	usr2:Soil
2	Location	(0, 0) km
3	Age	0 to 70
4	Constituent	All Radionuclides
5	Measure	Risk
6	Unit	cancer incidence
7	Route	All
8	Pathway	All
9	Organ	All
10		
11	yr	cancer incidence
12	0	4.084E-08
13	1	1.466E-08
14	2	5.28E-09
15	3	1.891E-09
16	4	6.795E-10
17	5	2.446E-10
18	6	8.77E-11
19	7	3.158E-11
20	8	1.132E-11
21	9	4.071E-12
22	10	1.462E-12
23		
24		
25		
26		
27		
28		

Figure 27. Health impacts output (graphical view)



Exposure Route and Pathway	Risk	Dose
All Radionuclides summation for usr2:Soil	cancer incidence	Sv
at location (0, 0) km for ages 0 to 70 at time 0	(all sites)	(total body)
TOTAL	**4.084E-08**	**6.817E-07**
ingestion (total)	4.073E-08	6.799E-07
Leafy vegetables	2.192E-08	3.653E-07
Meat	3.229E-10	5.385E-09
Milk	4.97E-09	8.29E-08
Other vegetables	1.351E-08	2.262E-07
Soil	1.399E-11	2.335E-10
dermal (total)	3.8E-12	6.327E-11
Soil	3.8E-12	6.327E-11

Figure 28. Summary of Risks/Hazard/Dose screen