



# **RASCAL 4.0**

Radiological Assessment System for Consequence Analysis

National Radiological Emergency Preparedness Conference

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# RASCAL 4

- Released beta version March 1<sup>st</sup>
- Presentation goals:
  - Highlight the big changes
  - Demonstrate new capabilities
  - Discuss the future

## **A presentation in 4 parts:**

1. Data and user interface changes
2. Transport & diffusion, decay, and mixture methods
3. Dose differences & future plans
4. New interface for utilities

# Data and User Interface Changes

- What has changed?
- Why was it changed?
- How does the change impact results?

# Updated Core Inventory

- Old core inventory – RASCAL 3
  - Taken from NUREG-1228 / WASH-1400
  - Selected for early health effects + likely noble gases
- New core inventory – RASCAL 4
  - Based on normalizes SCALE/ORIGEN run
  - Increased number of nuclides from 33 to 58
  - No longer select for early health effects
- Impact – small changes to source term

# Updated Coolant Inventory

- From ANSI/ANS 18.1-1999
- Old inventory (RASCAL 3) excluded:
  - nuclides with half-life < 50 minutes, and
  - noble gases for BWRs
- New inventory (RASCAL 4) includes all
- A more complete set; nuclide number increased from 36 to 63
- Impact – small changes to source term



# Improvements to Source Term and Release Path methods

- BWR release pathways
- PWR Steam Generator Tube Ruptures
- Spent Fuel Pool drained

# BWR release options

**Available release pathways**

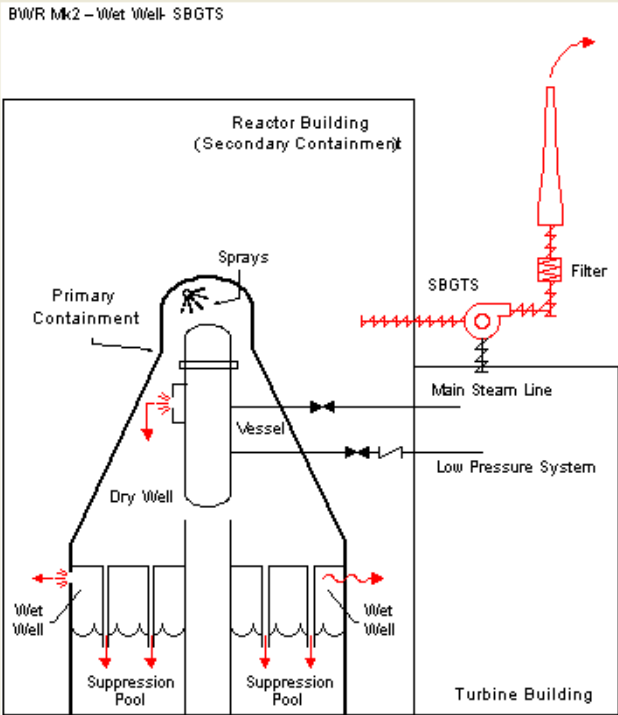
Pathway from dry well to reactor building (secondary containment)

- Through the suppression pool
- Through the dry well wall
- Bypass reactor building

Pathway to atmosphere

- Via Standby Gas Treatment System (SBGTS)
- Direct from reactor building or other rapid, unfiltered release

BWR Mk2 - Wet Well- SBGTS



Reactor Building (Secondary Containment)

Primary Containment

Sprays

Dry Well

Wet Well

Suppression Pool

Vessel

Main Steam Line

Low Pressure System

Turbine Building

SBGTS

Filter

OK

Cancel

Help

Print

**SBGTS - filtered and released at stack height**

**Direct - unfiltered and released at user entered height**



# SGTR Changes

Steam Generator Tube Rupture
✕

Pathway description:  (optional; 60 character max)

Release height:   (Stack height: 185 ft)

Release timings: Core uncovered: 2010/02/22 00:00

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Leak rate to atmosphere described by:

Leak controlled  
by 2 flows

Simpler location  
description

Date	Time	Event	Event setting
2010/02/22	00:00	Leak rate into SG	500 gal/min
2010/02/22	00:00	Rupture location	Above water level
2010/02/22	00:00	Steaming rate	7.5E+04 lb/h
2010/02/22	00:00	Release point	Safety relief valve

Release point can  
vary with time

# Spent Fuel Pool Uncovered

**Pool Storage - Uncovered Fuel** ✕

Date reactor was shutdown for newest batch of fuel: 2010/02/22 ▾

Total number of spent fuel batches in the pool: 10 ▾ (3 batches/core)

Fuel uncovered and not cooled: 2010/02/22 ▾ 00:00

Fuel is recovered or cooled by sprays or steam cooling?  
 No  
 Yes, at 2010/02/22 ▾ 01:00

OK  
Cancel  
Help

**Simpler interface  
Fewer questions**

## Changes in SF Pool

- New version requires only age of newest batch, total batch count, and times for cooling lost and regained
- Assumes a 18 month refuel interval and cladding fire if not cooled for 2 hours
- Release over 24 hours unless recooled
- Impact – generally smaller source terms

H7

**Slide 11**

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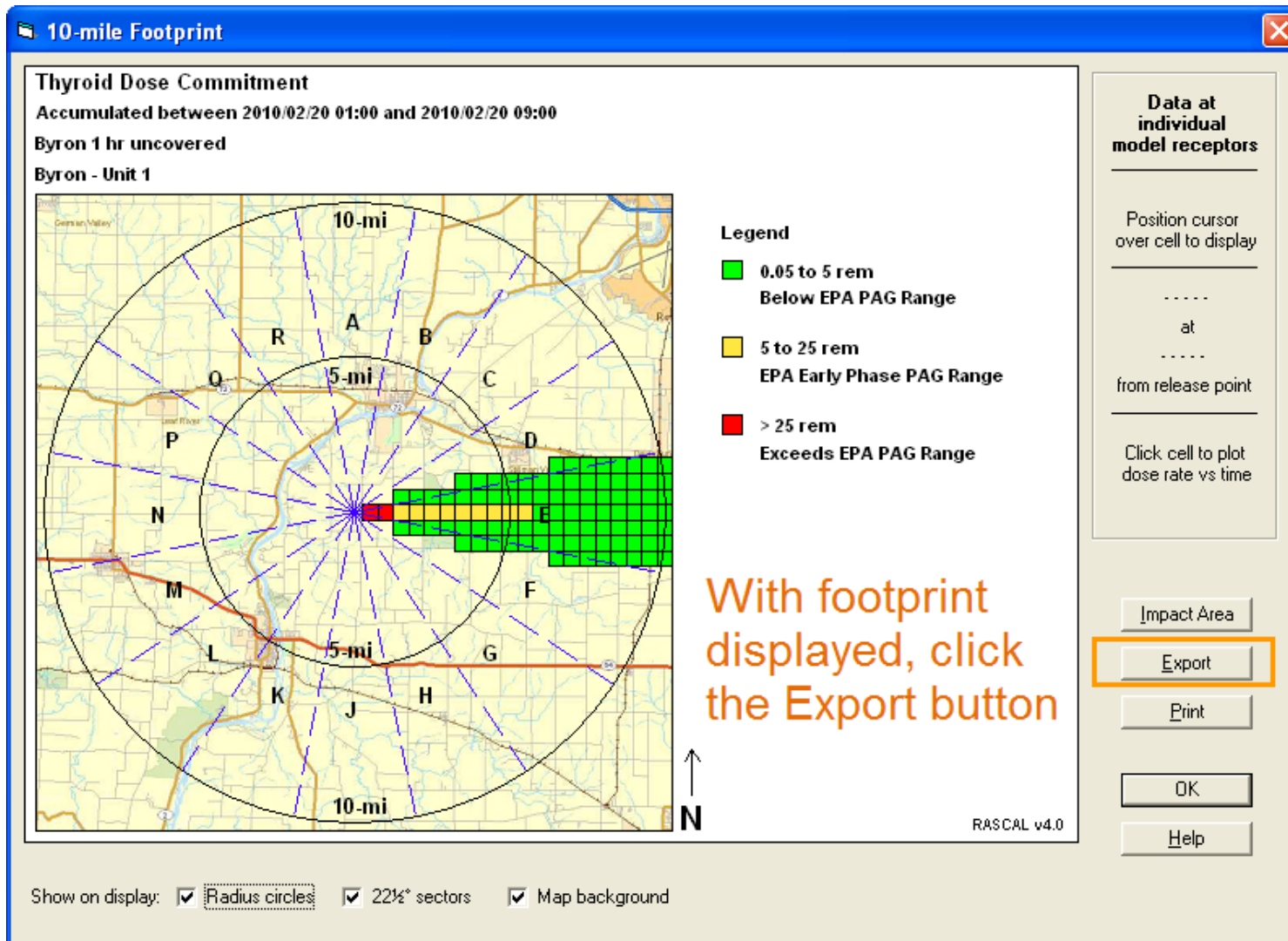
**H7**

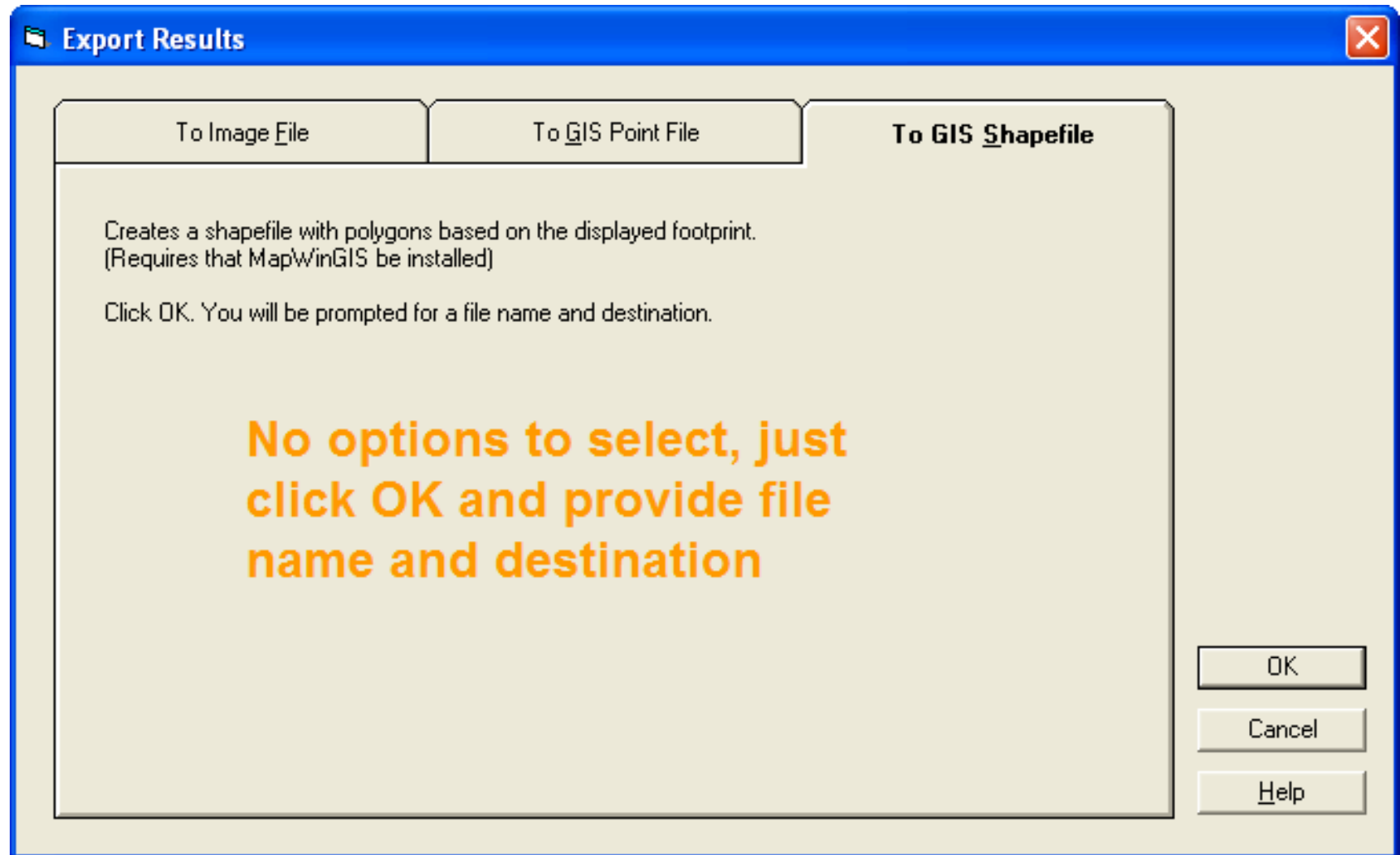
Original text said "mon"...I expanded to month. Please change if that was not the correct expansion

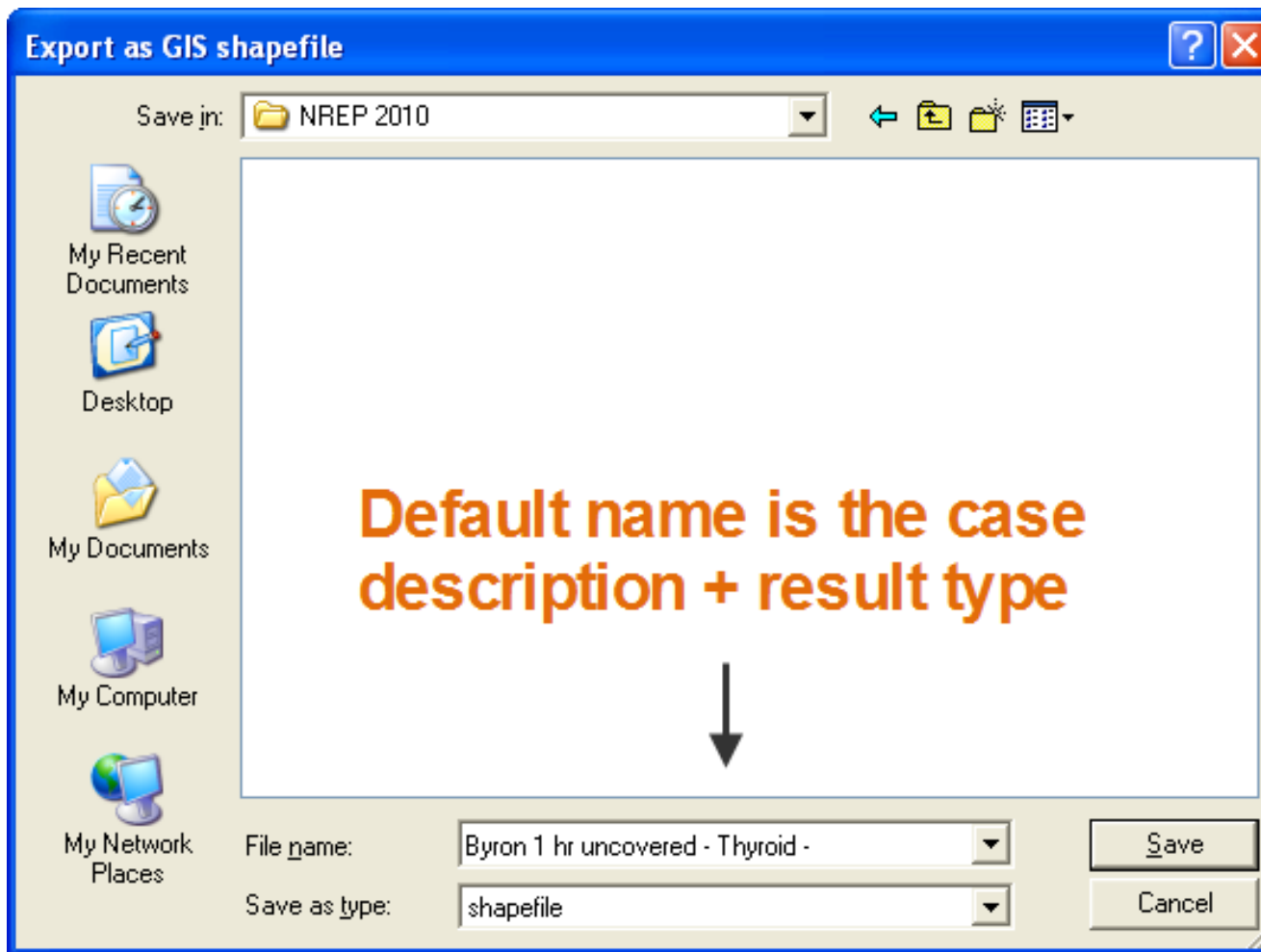
HXP3, 2/24/2010

# Export Footprint to Shapefile

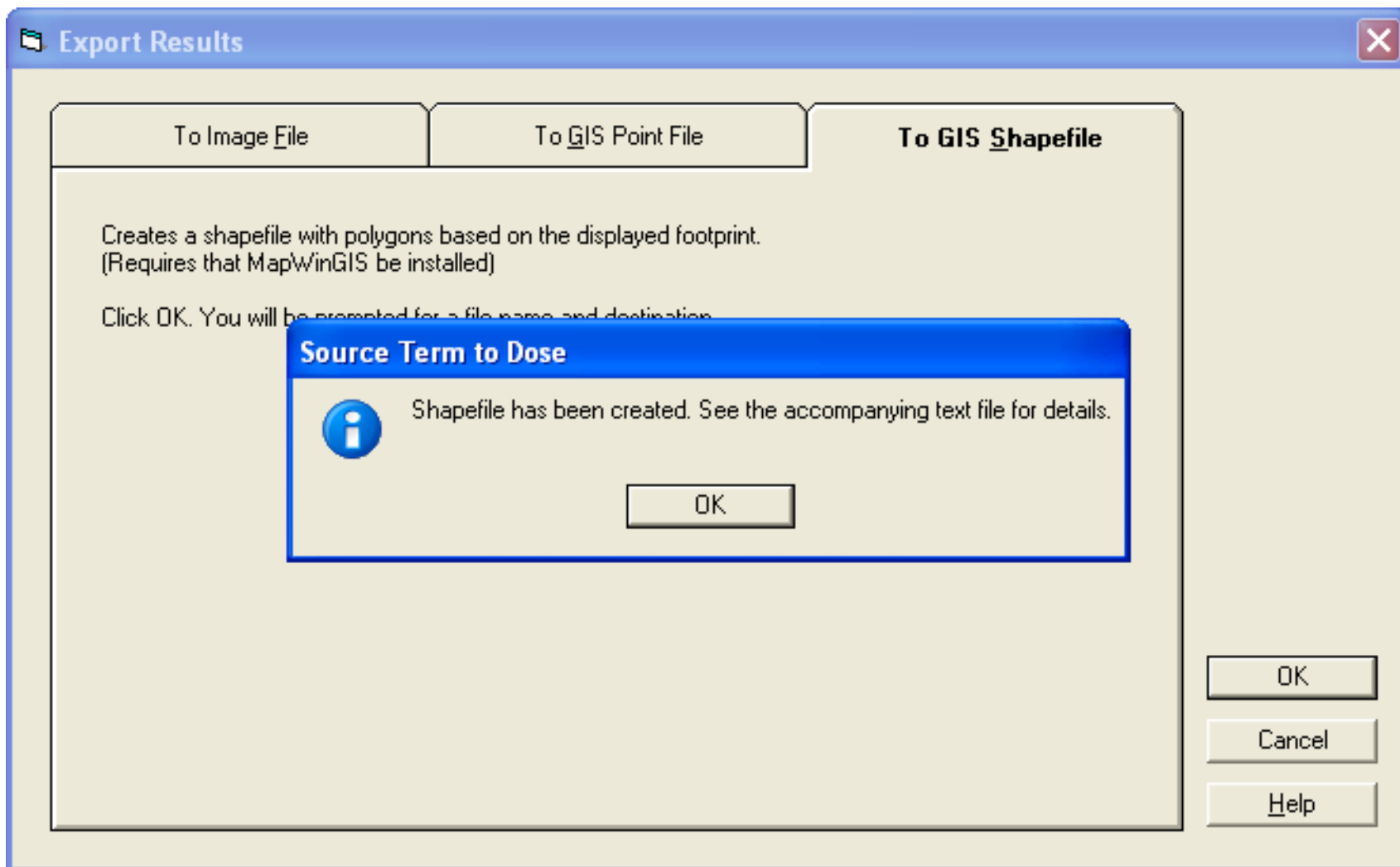
- Requires the MapWindow GIS open source software
- [www.mapwindow.org](http://www.mapwindow.org)
- Separate installation required for this feature to work
- Latest installation available with RASCAL installation





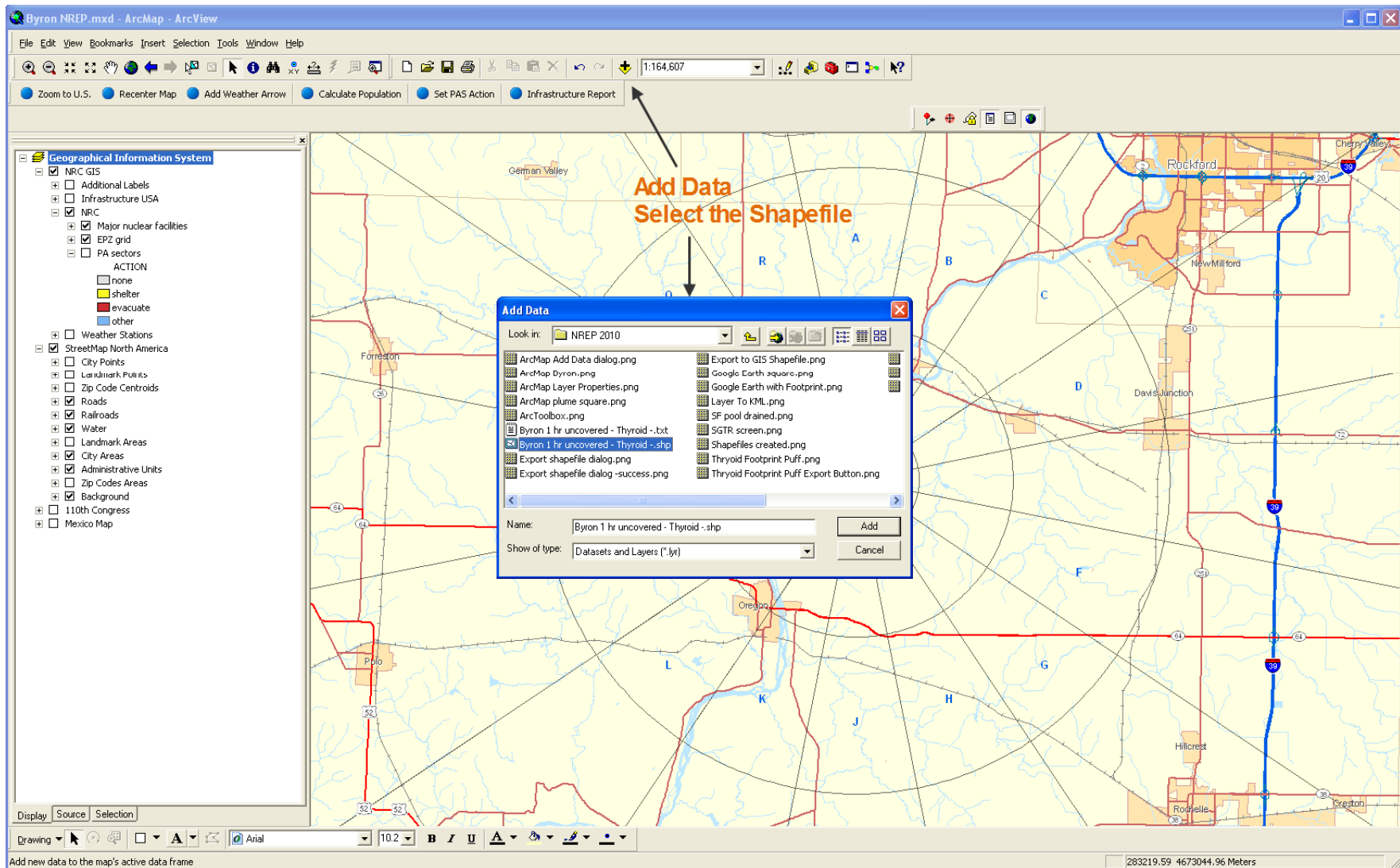






The screenshot shows a software dialog box titled "Export Results" with a close button in the top right corner. It features three tabs: "To Image File", "To GIS Point File", and "To GIS Shapefile". The "To GIS Shapefile" tab is selected and active. The text in this tab reads: "Creates a shapefile with polygons based on the displayed footprint. (Requires that MapWinGIS be installed)" and "Click OK. You will be prompted for a file name and destination." A blue-bordered information dialog box is overlaid on top of the main dialog, with the title "Source Term to Dose" and the message "Shapefile has been created. See the accompanying text file for details." and an "OK" button. In the bottom right corner of the main dialog, there are three buttons: "OK", "Cancel", and "Help".

# Add Shapefile to GIS



The screenshot shows the ArcMap interface with the 'Add Data' dialog box open. The dialog box is titled 'Add Data' and shows a list of files in the 'NREP 2010' folder. The file 'Byron 1 hr uncovered - Thyroid - .shp' is selected. The 'Name' field contains 'Byron 1 hr uncovered - Thyroid - .shp' and the 'Show of type' dropdown is set to 'Datasets and Layers (\*.lyr)'. The 'Add' button is highlighted. An arrow points to the 'Add Data' button in the toolbar. The map background shows a geographical information system with various layers and features.

**Add Data**  
Look in: NREP 2010

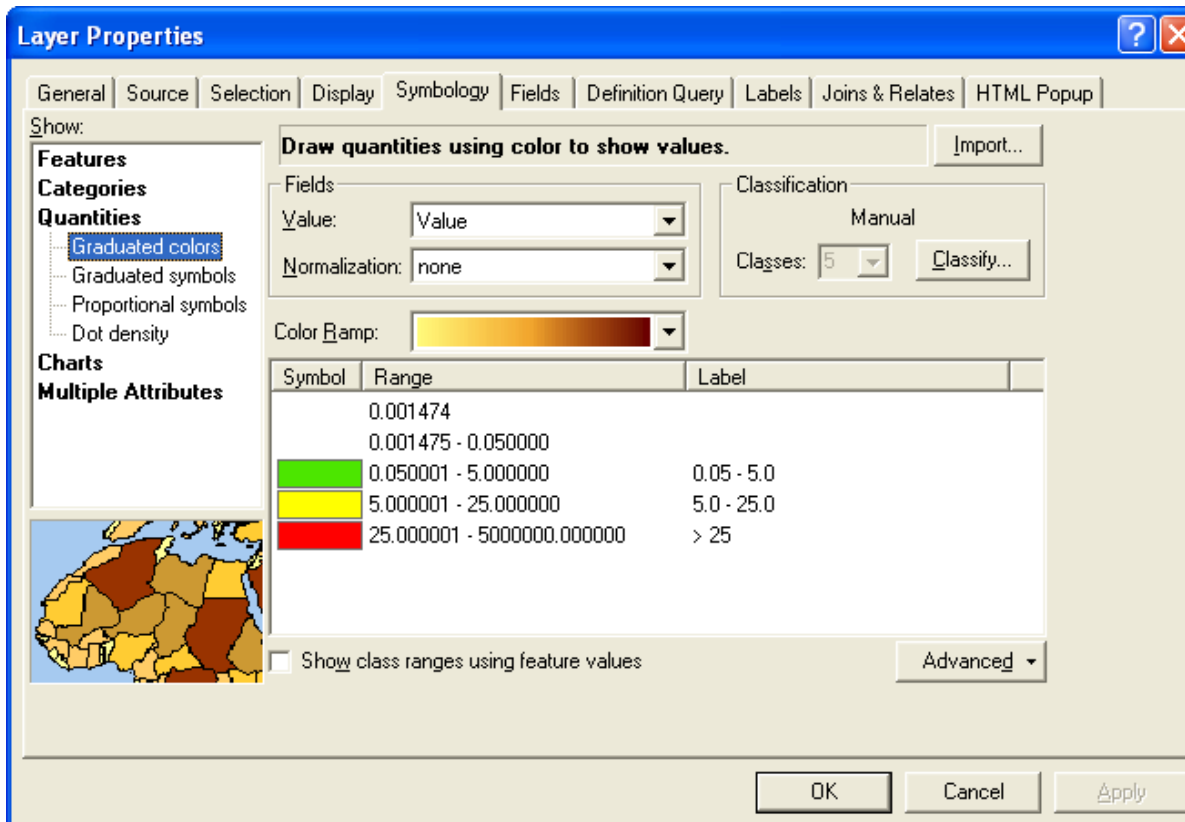
ArcMap Add Data dialog.png	Export to GIS Shapefile.png
ArcMap Byron.png	Google Earth square.png
ArcMap Layer Properties.png	Google Earth with Footprint.png
ArcMap plume square.png	Layer To KML.png
ArcToolbox.png	SF pool drained.png
Byron 1 hr uncovered - Thyroid - .txt	SGTR screen.png
Byron 1 hr uncovered - Thyroid - .shp	Shapefiles created.png
Export shapefile dialog.png	Thyroid Footprint Puff.png
Export shapefile dialog -success.png	Thyroid Footprint Puff Export Button.png

Name: Byron 1 hr uncovered - Thyroid - .shp Add  
Show of type: Datasets and Layers (\*.lyr) Cancel

Geographical Information System

- [-] NRC GIS
  - [ ] Additional Labels
  - [ ] Infrastructure USA
  - [x] NRC
    - [x] Major nuclear facilities
    - [x] EPZ grid
    - [ ] PA sectors
    - ACTION
      - [ ] none
      - [ ] shelter
      - [ ] evacuate
      - [ ] other
  - [ ] Weather Stations
  - [x] StreetMap North America
    - [ ] City Points
    - [ ] Landmark Points
    - [ ] Zip Code Centroids
    - [x] Roads
    - [x] Railroads
    - [x] Water
    - [ ] Landmark Areas
    - [x] City Areas
    - [x] Administrative Units
    - [ ] Zip Codes Areas
    - [x] Background
    - [ ] 110th Congress
    - [ ] Mexico Map

# Adjust symbology to match the RASCAL legend



**Layer Properties**

General | Source | Selection | Display | Symbology | Fields | Definition Query | Labels | Joins & Relates | HTML Popup

Show:

**Features**

**Categories**

**Quantities**

- Graduated colors
- Graduated symbols
- Proportional symbols
- Dot density

**Charts**

**Multiple Attributes**

**Draw quantities using color to show values.** Import...




Fields: Value

Classification: Manual

Normalization: none

Classes: 5 Classify...

Color Ramp:

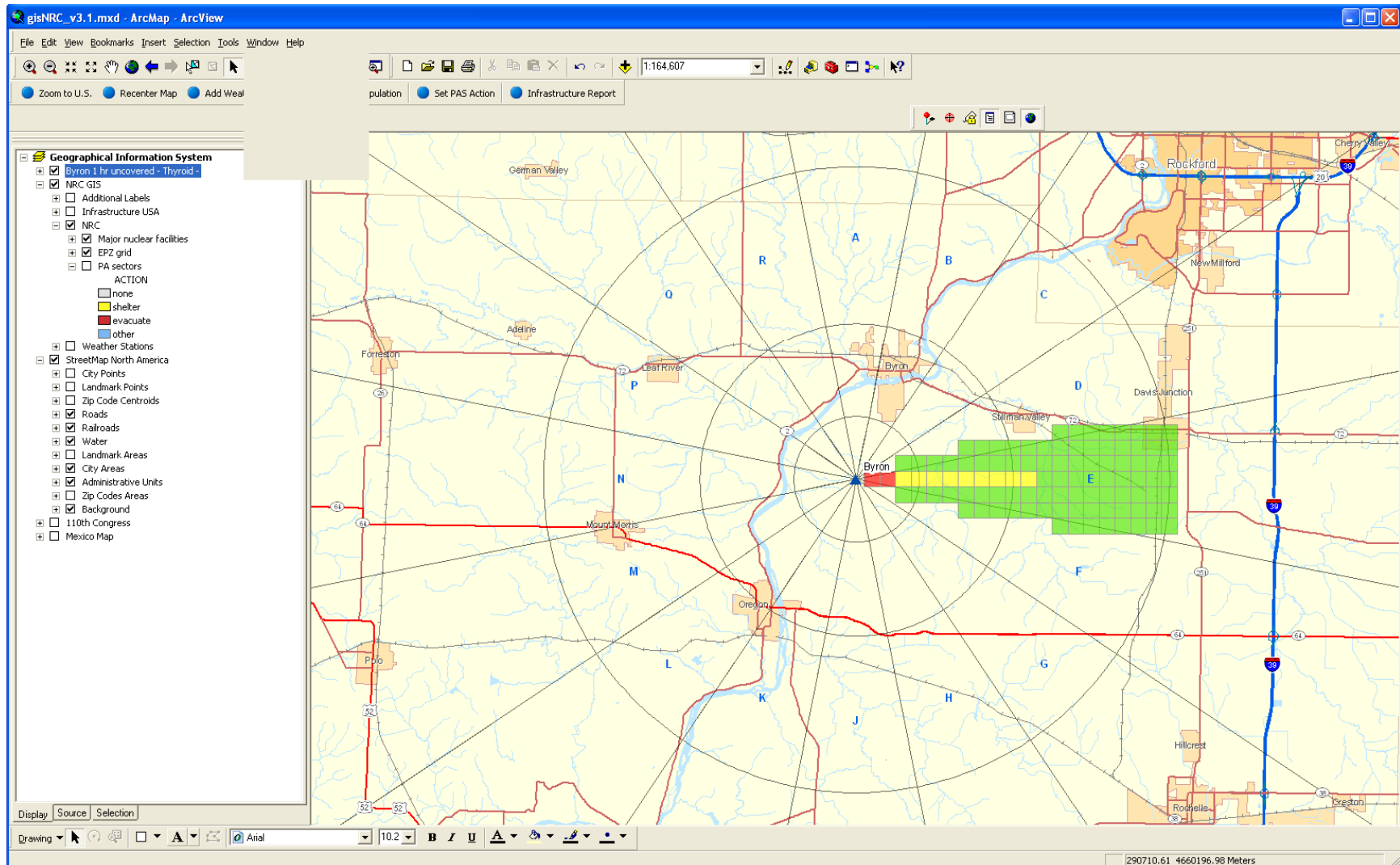
Symbol	Range	Label
	0.001474	
	0.001475 - 0.050000	
	0.050001 - 5.000000	0.05 - 5.0
	5.000001 - 25.000000	5.0 - 25.0
	25.000001 - 5000000.000000	> 25

Show class ranges using feature values

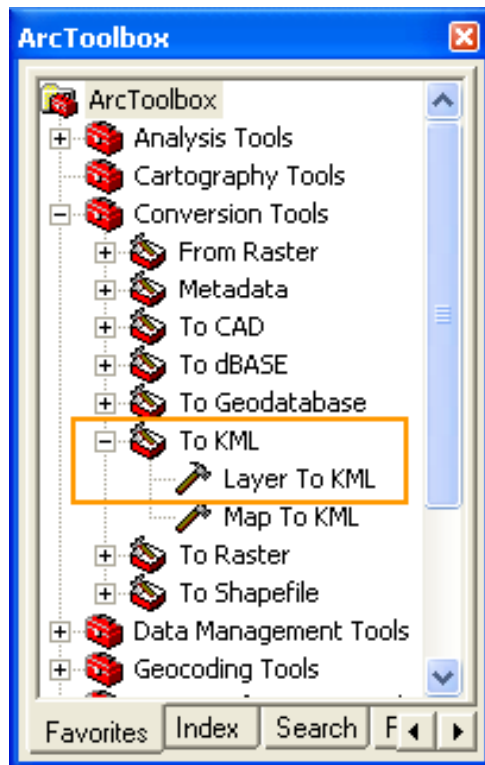
Advanced

OK Cancel Apply

# Adjust Transparency

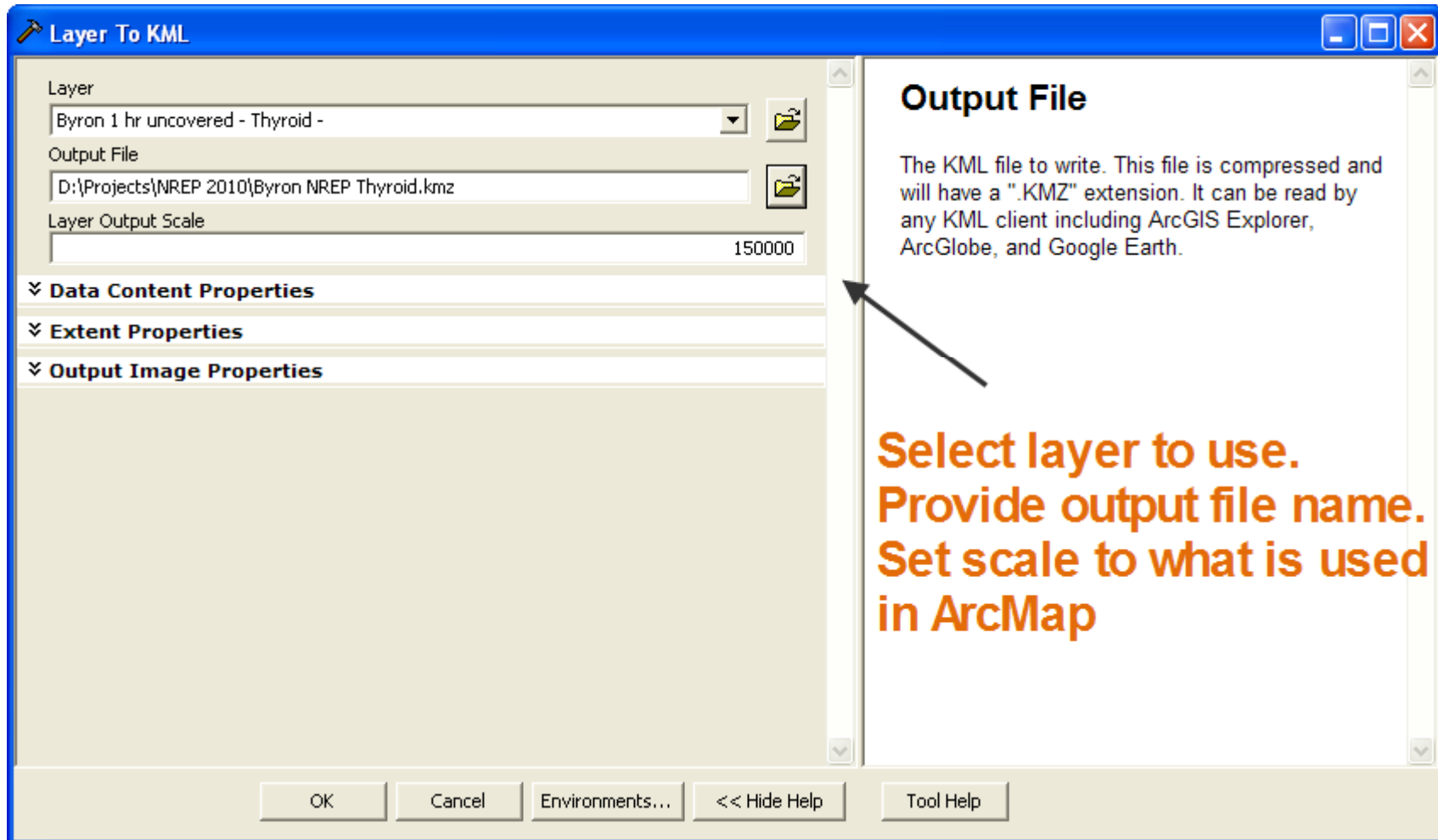


# ArcMap to Google Earth

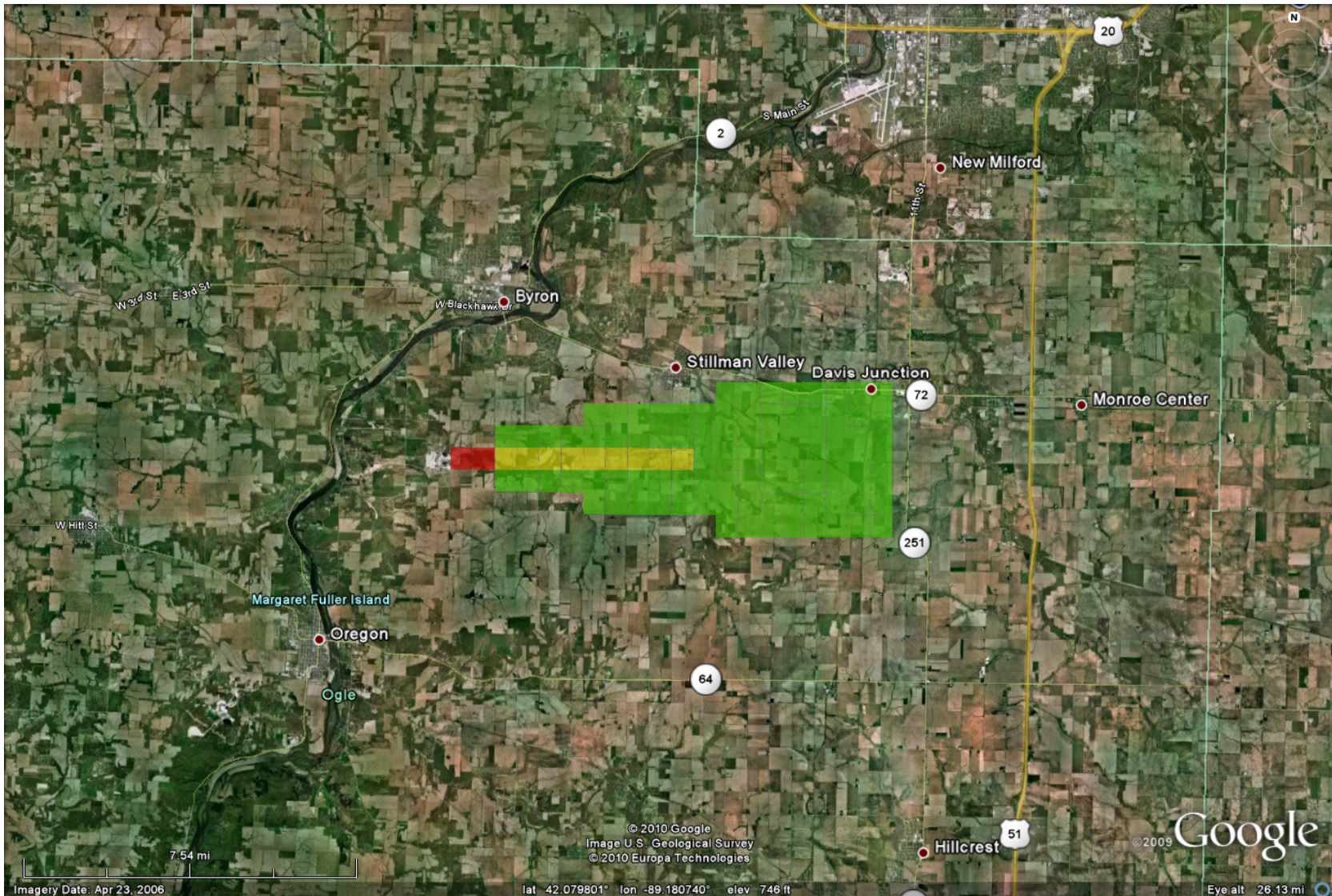


Use the conversion tool  
“Layer to KML” in the  
ArcToolbox

# Layer to KML



# Drag KML into Google Earth



# Display Plume in:

RASCAL

ArcMap

Google Earth

