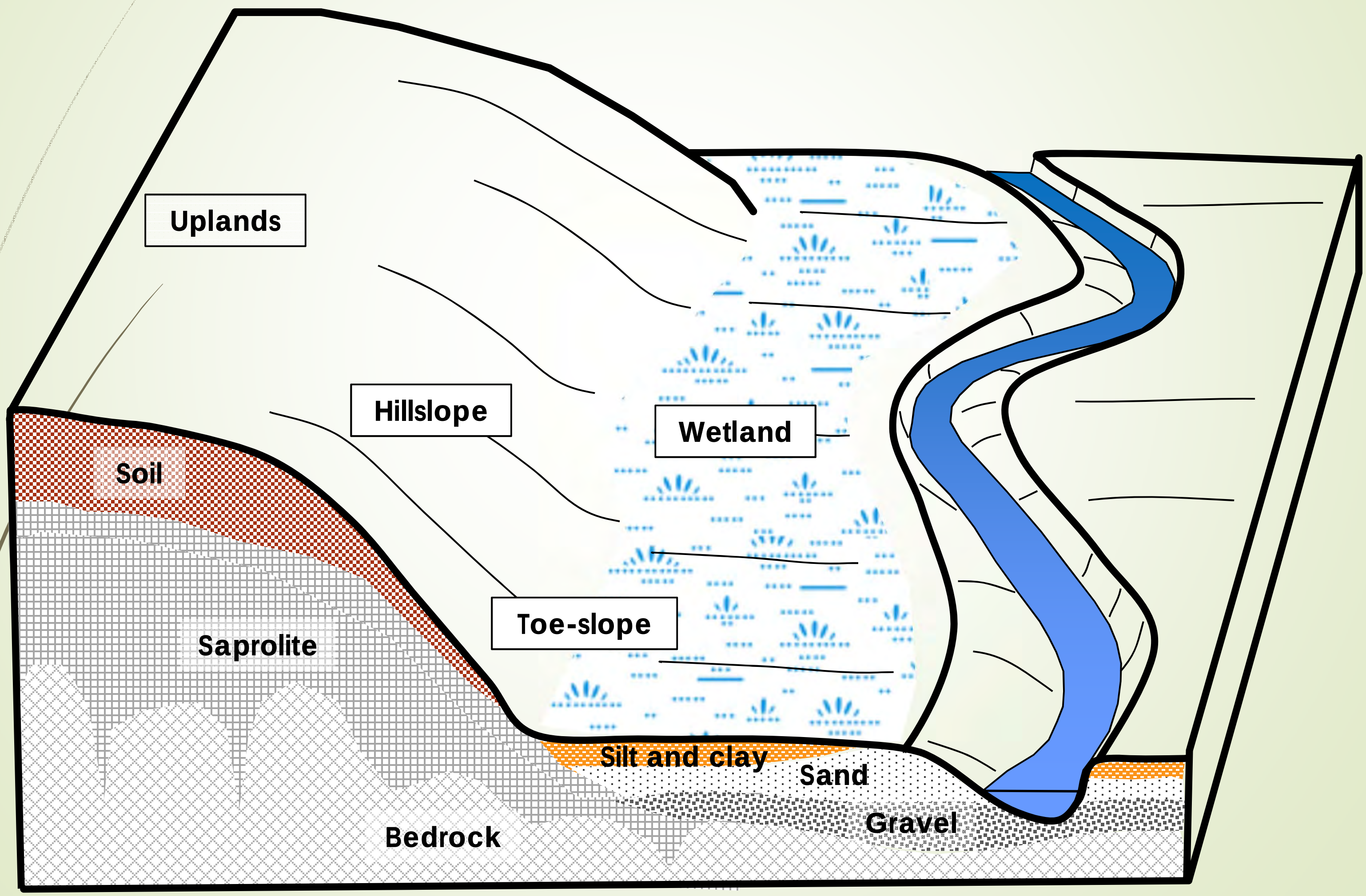
Building Basic and Advanced Model Scenarios in WetBud

Kerby Dobbs

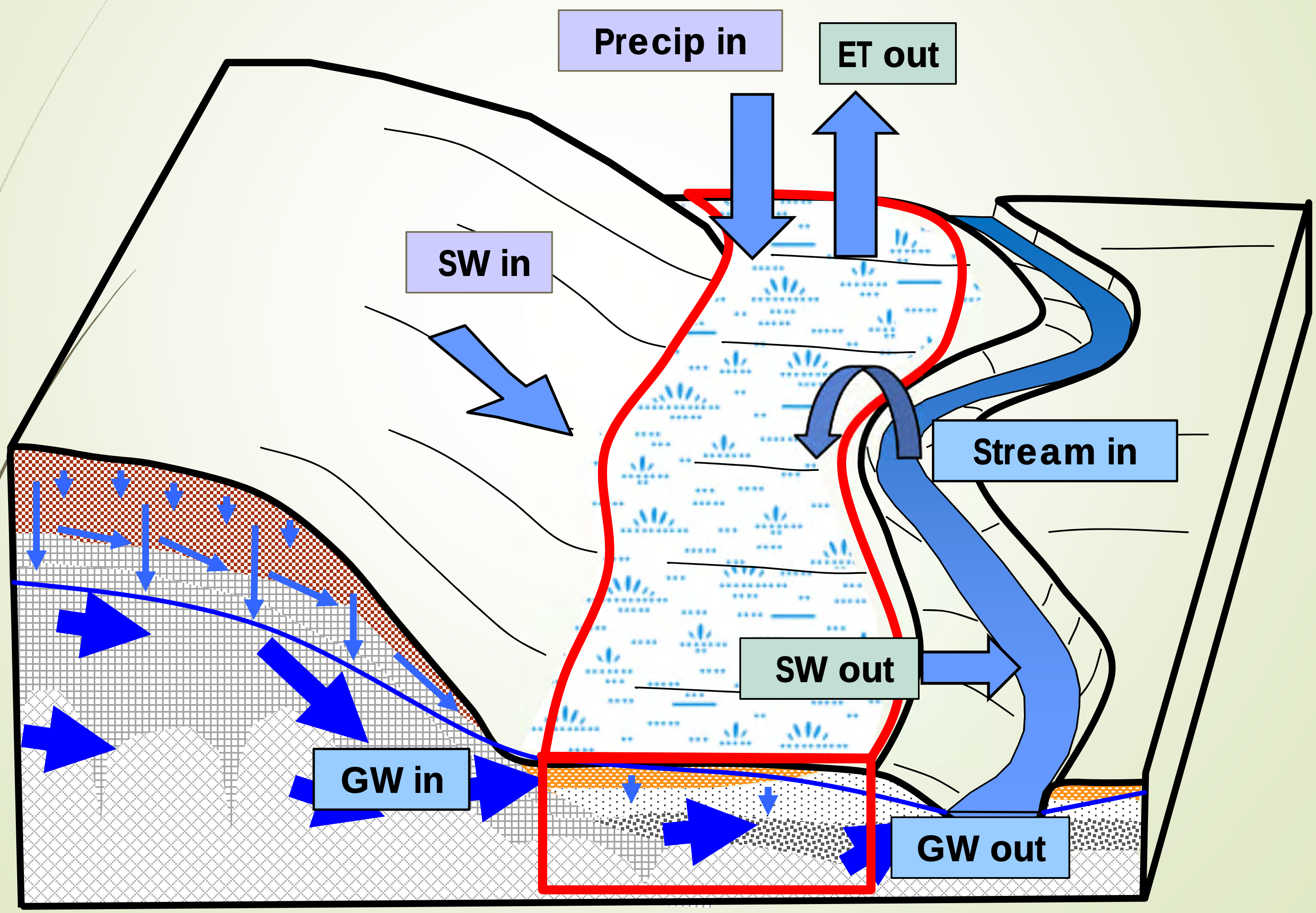
Overview

1. Intro
2. Building weather station data set
3. Basic Scenarios
4. Advanced Scenarios

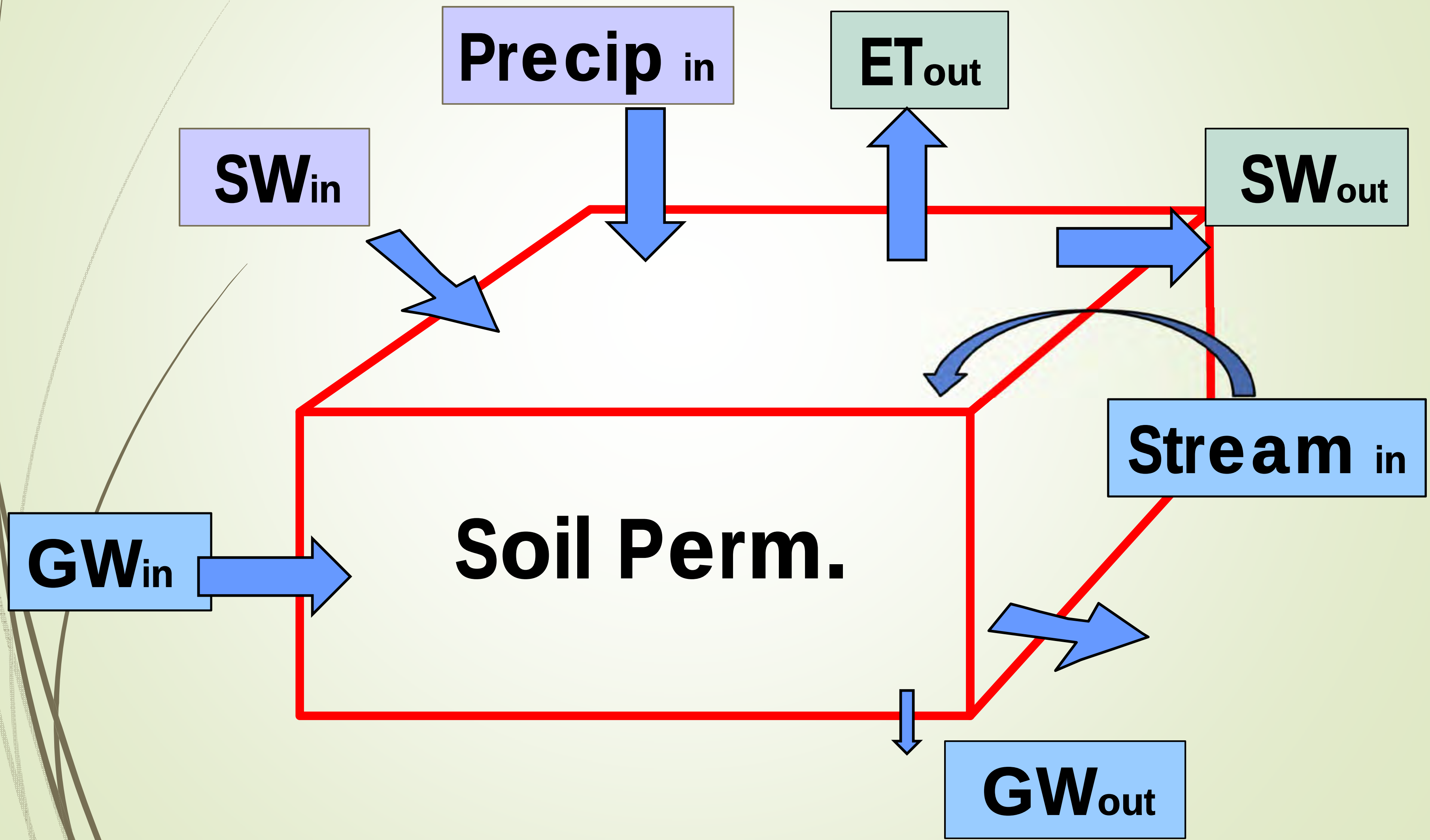
Wetland/Project Site



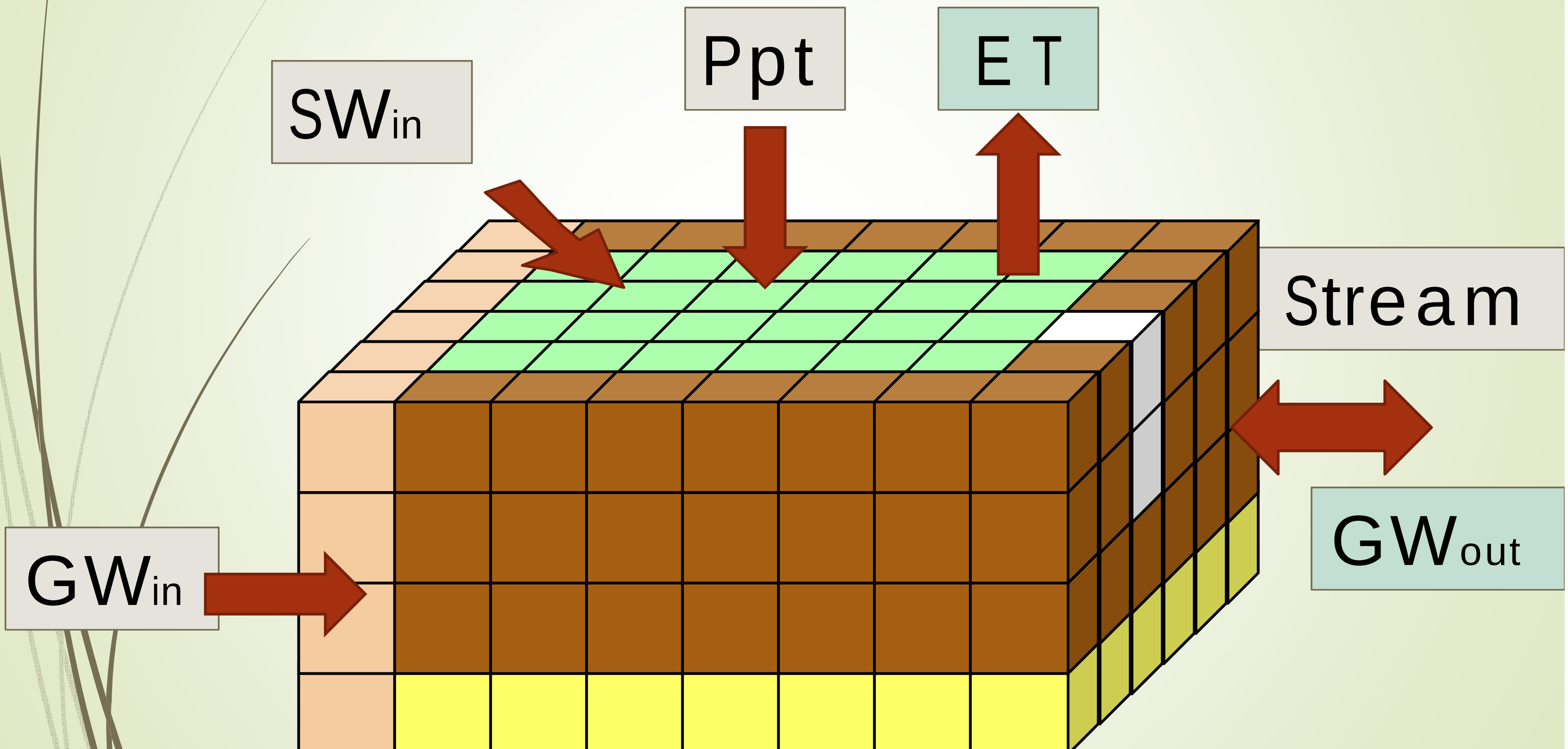
Wetland/Project Site



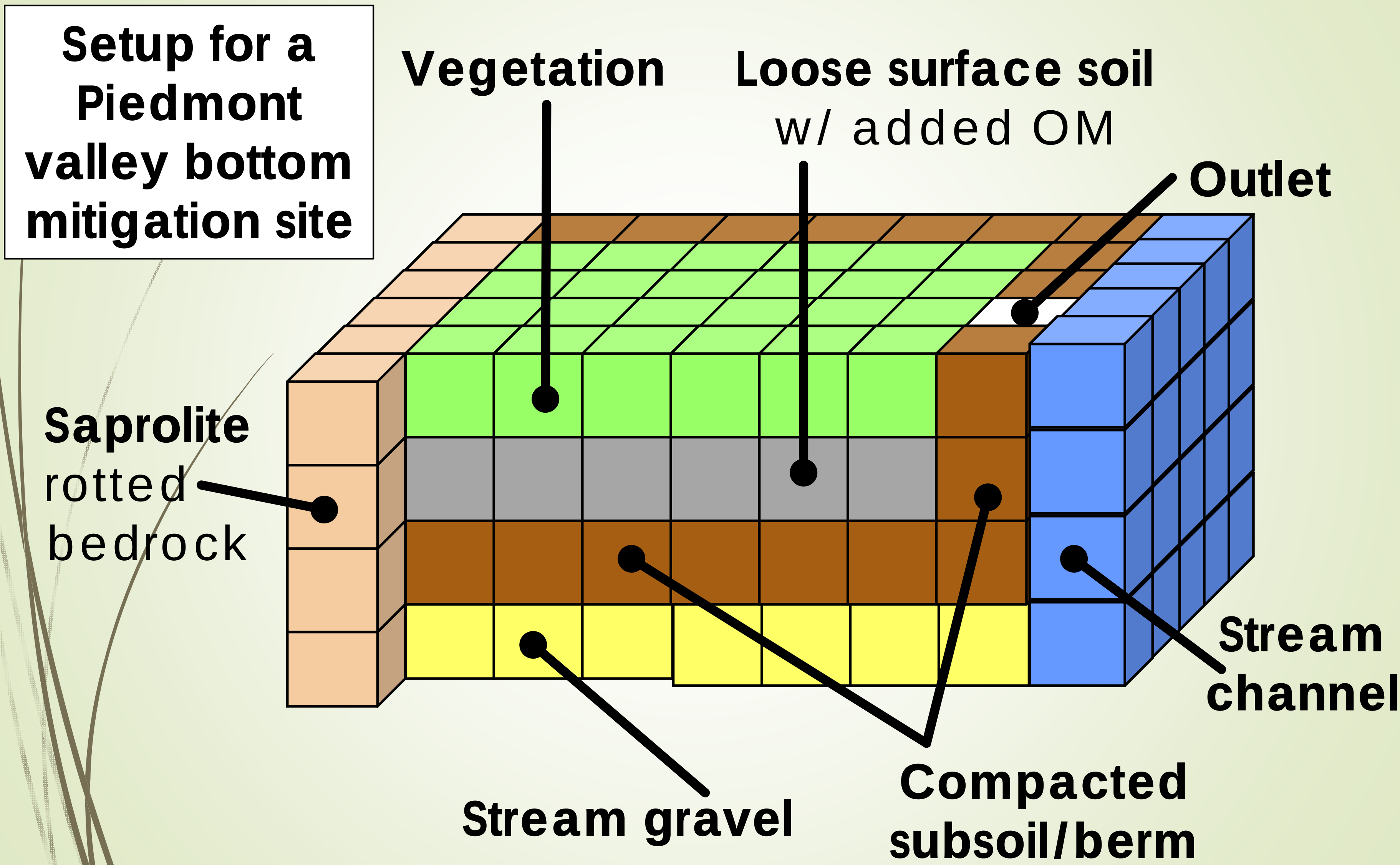
WetBud Basic Model – Mass Balance



WetBud Advanced Model – Finite-difference Grid



WetBud – Advanced Version

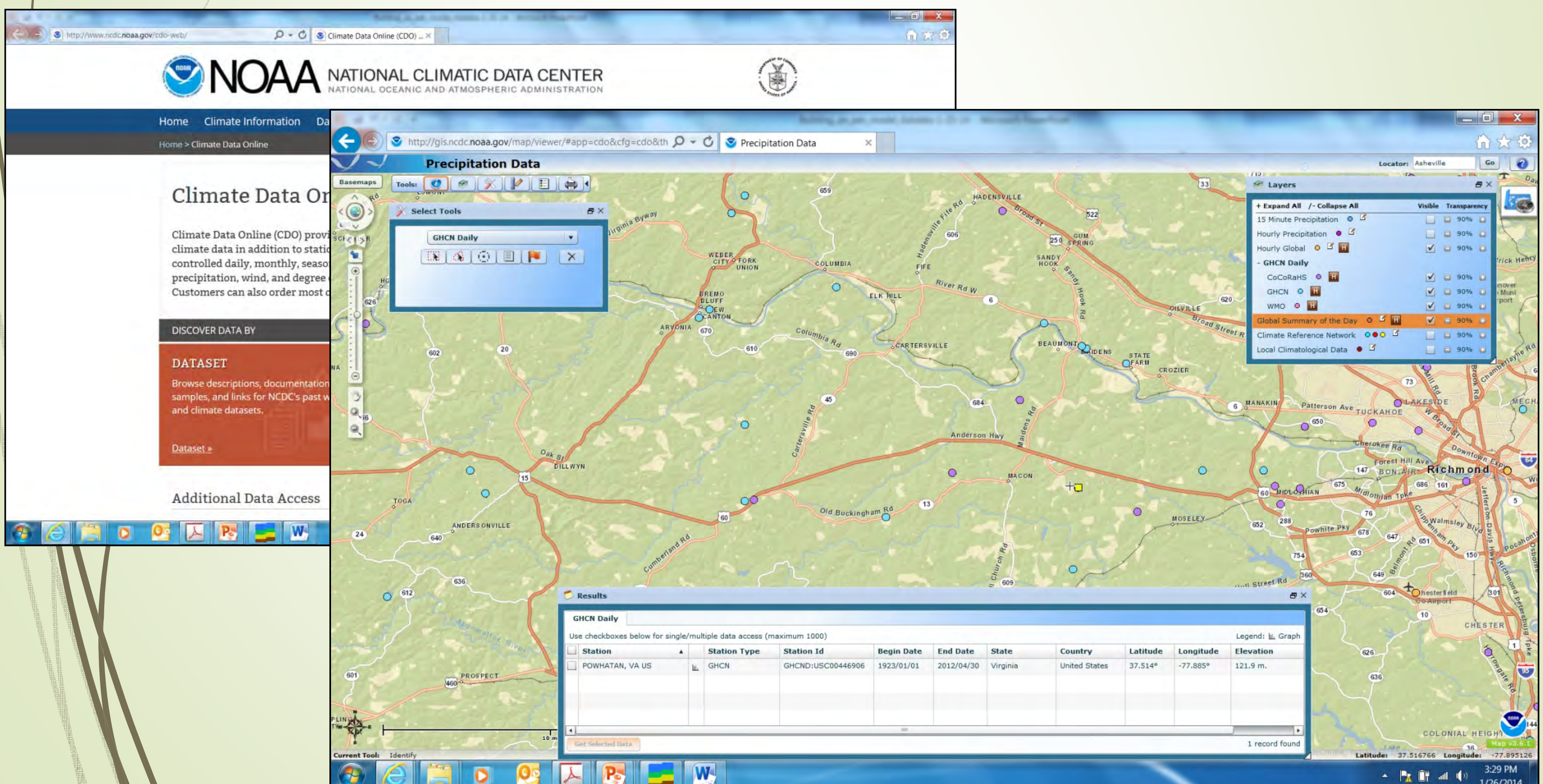


Building a weather station data set

- Weather station data includes:
  - Precipitation
  - Weather (for ET calculations)
  - Solar (for ET calculations)
- Additional data
  - Clear sky insolation index data (Penman ET)
  - Daylight length data (Thornthwaite ET)

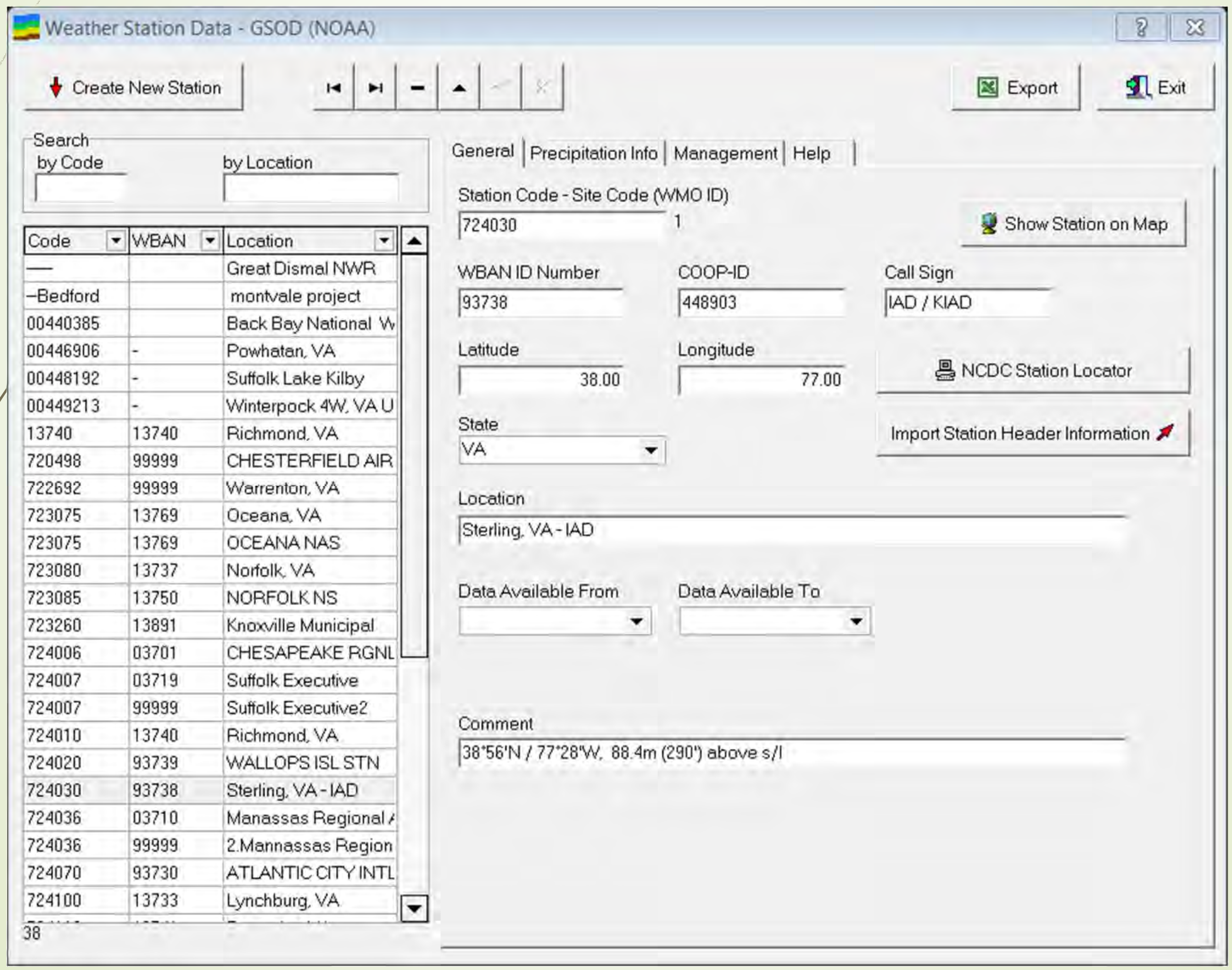
Building a weather station data set

- Locate nearest weather station - http://www.ncdc.noaa.gov/cdo-web/



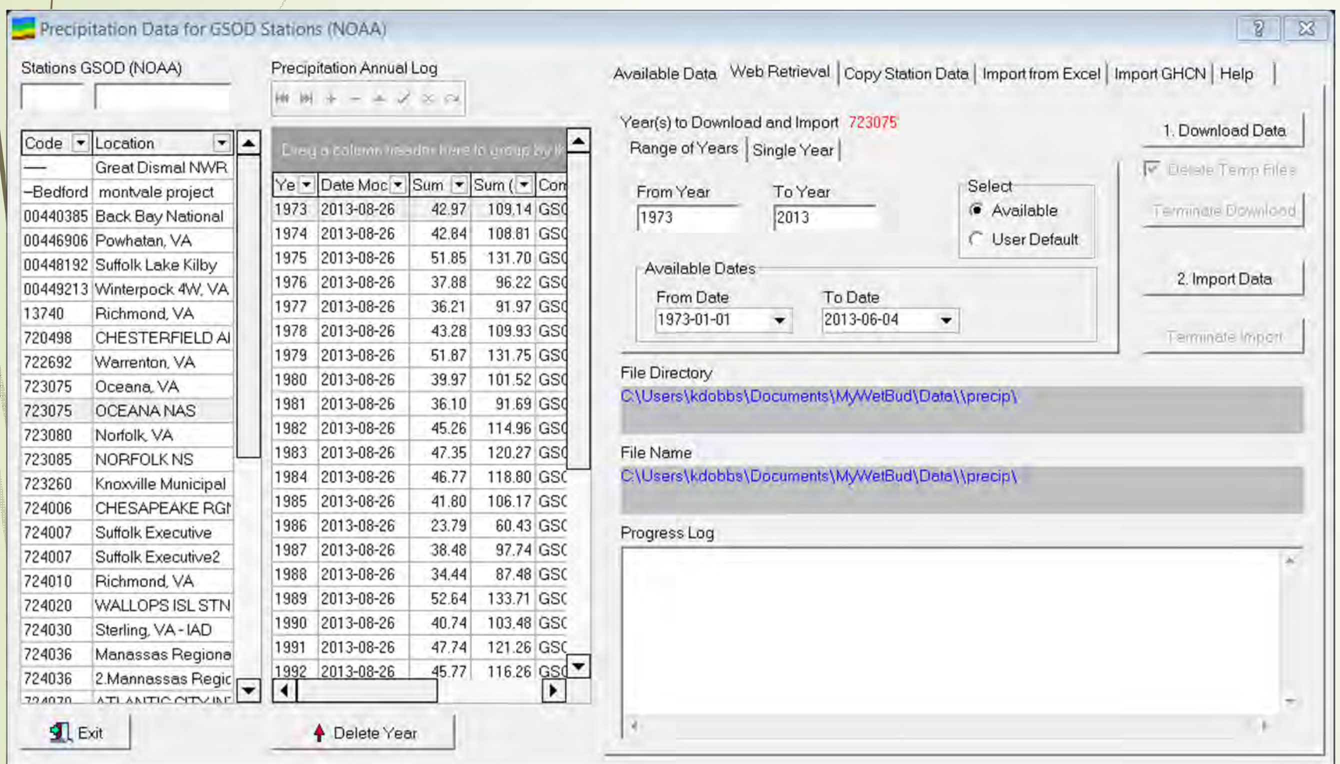
Building a weather station data set

- Create weather station record



Precipitation data

- Download and import from web or manually import data:

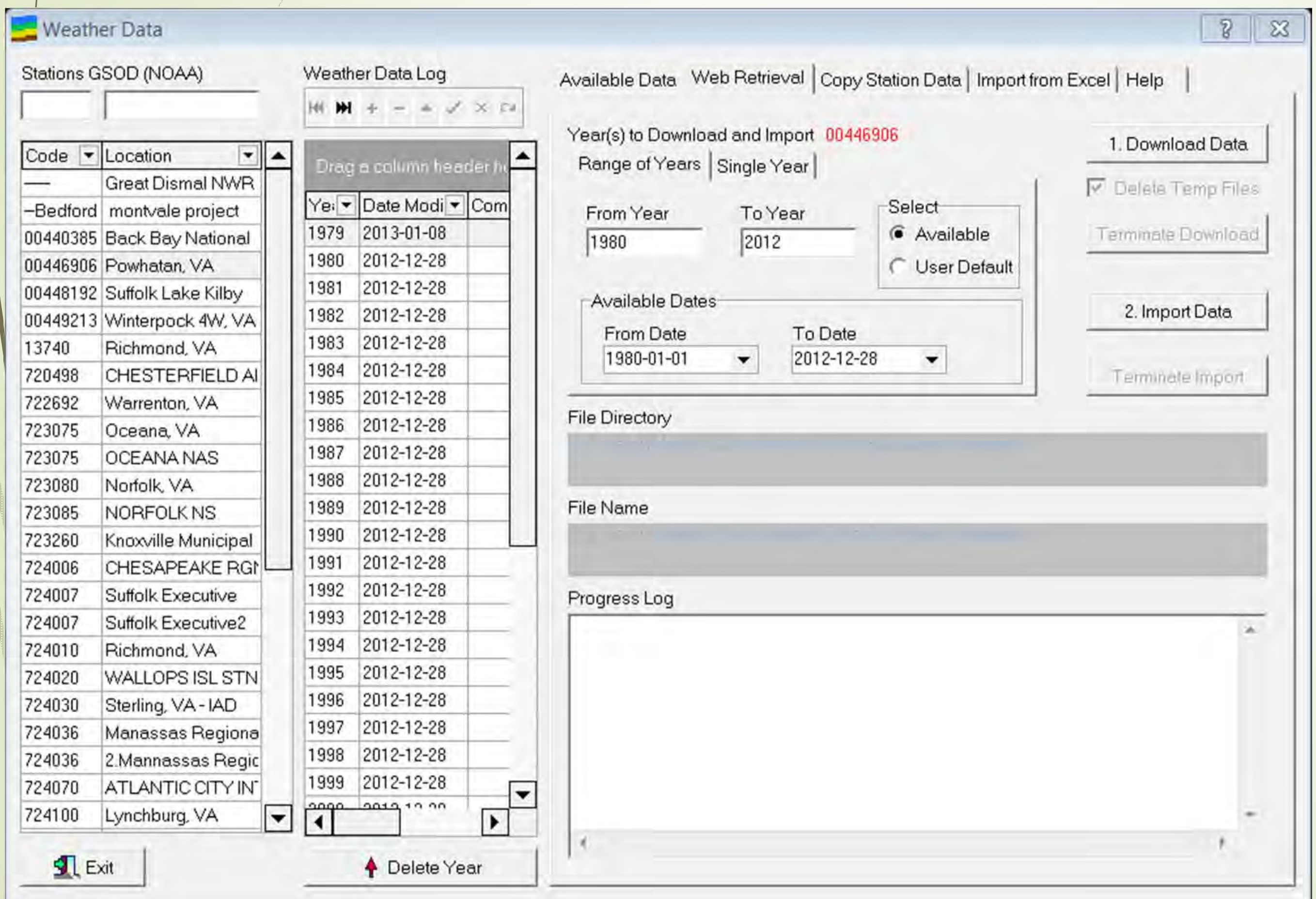


If your station does not have complete data set:

- Create record for next nearest station
- Download data for that station
- Copy data to your station record

Weather data

- Used in ET calculations

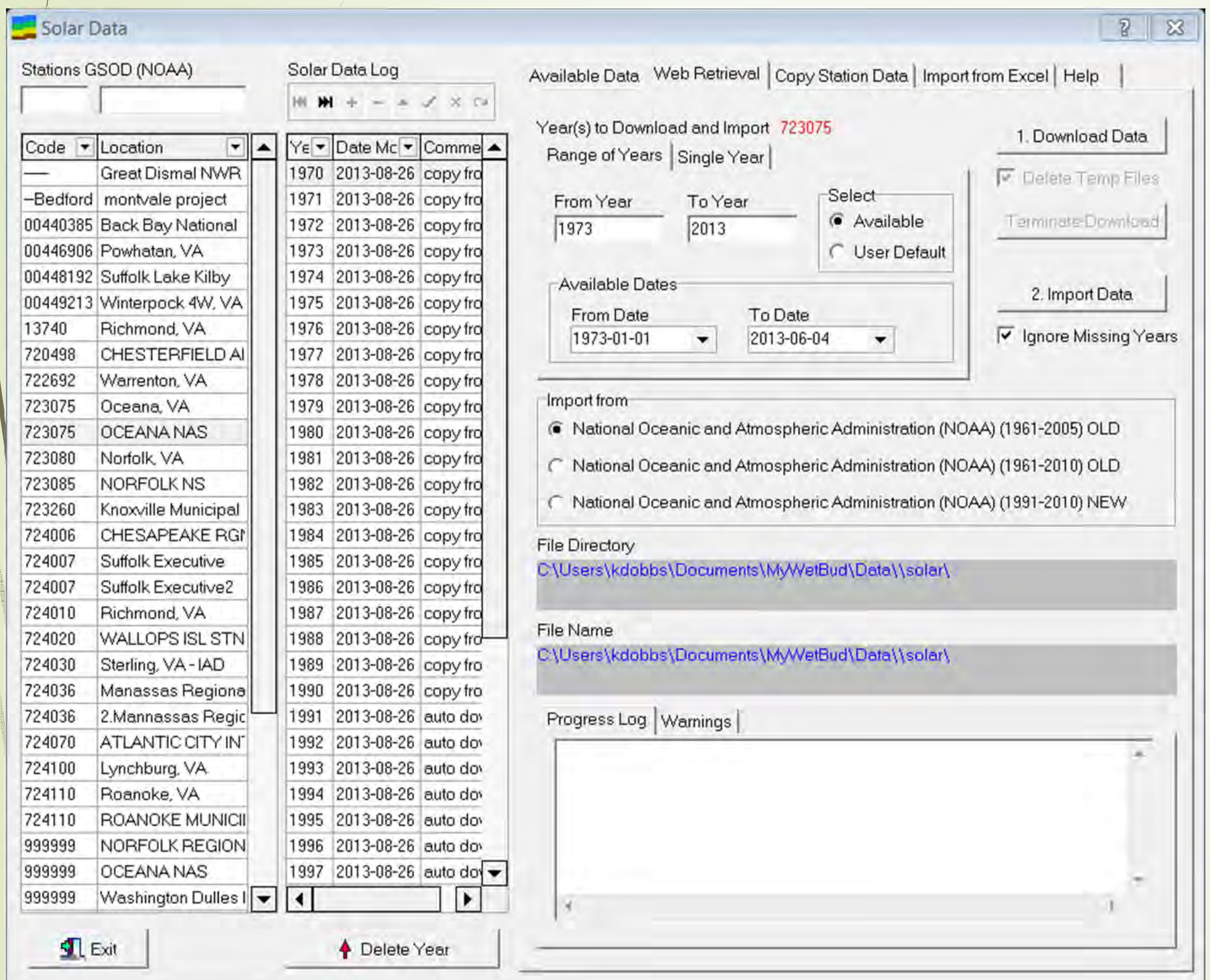


If your station does not have complete data set:

- Create record for next nearest station
- Download data for that station
- Copy data to your station record

Solar data

- Used in ET calculations

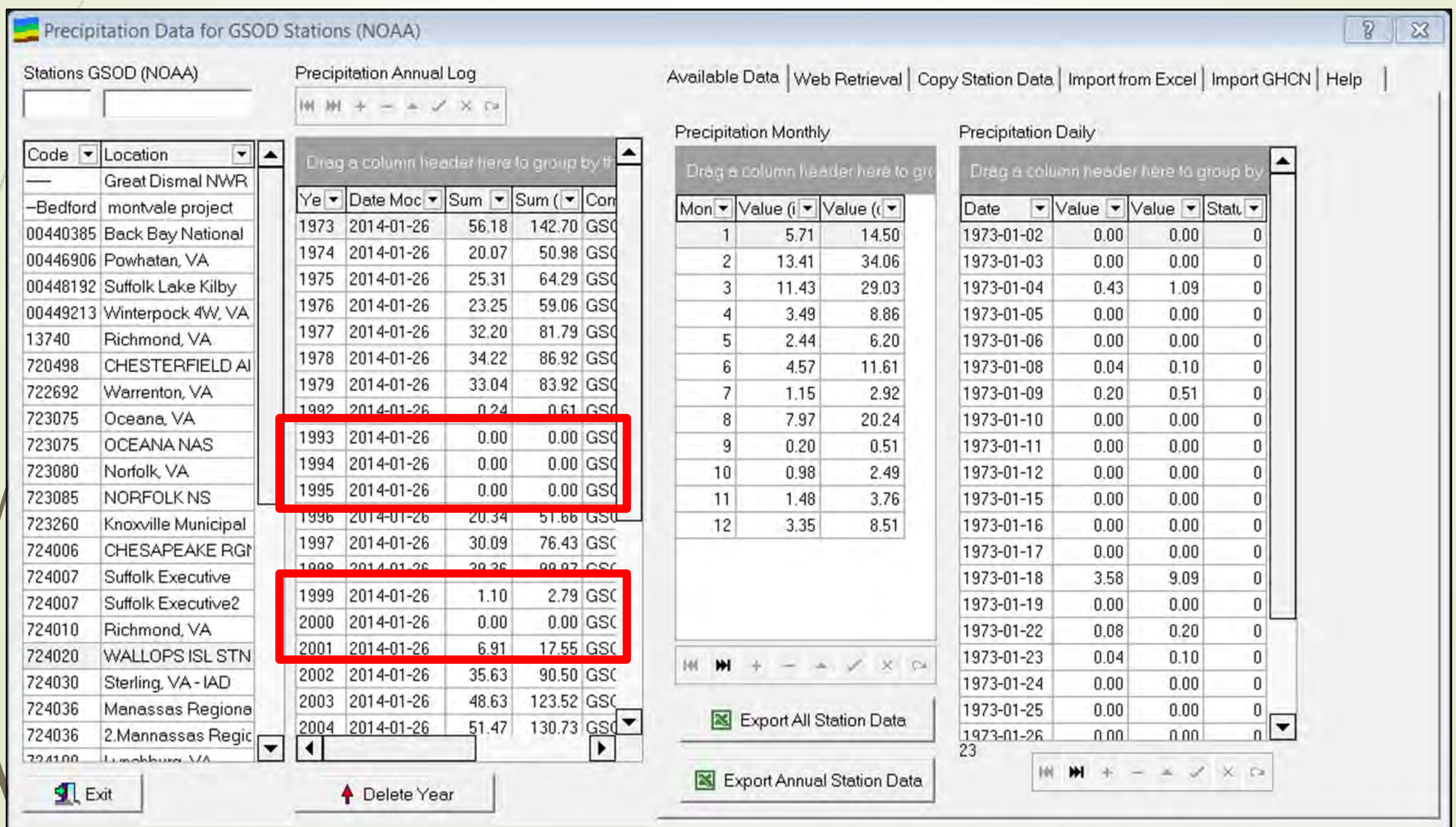


If your station does not have solar data:

- Create record for nearest station that does have solar data
- Download solar data for that station
- Copy solar data to your station record

Building a weather station data set

<u>IMPORTANT:</u> QAQC of climatological data is WetBud user's responsibility. Make sure to review the data before including in water budget analysis.

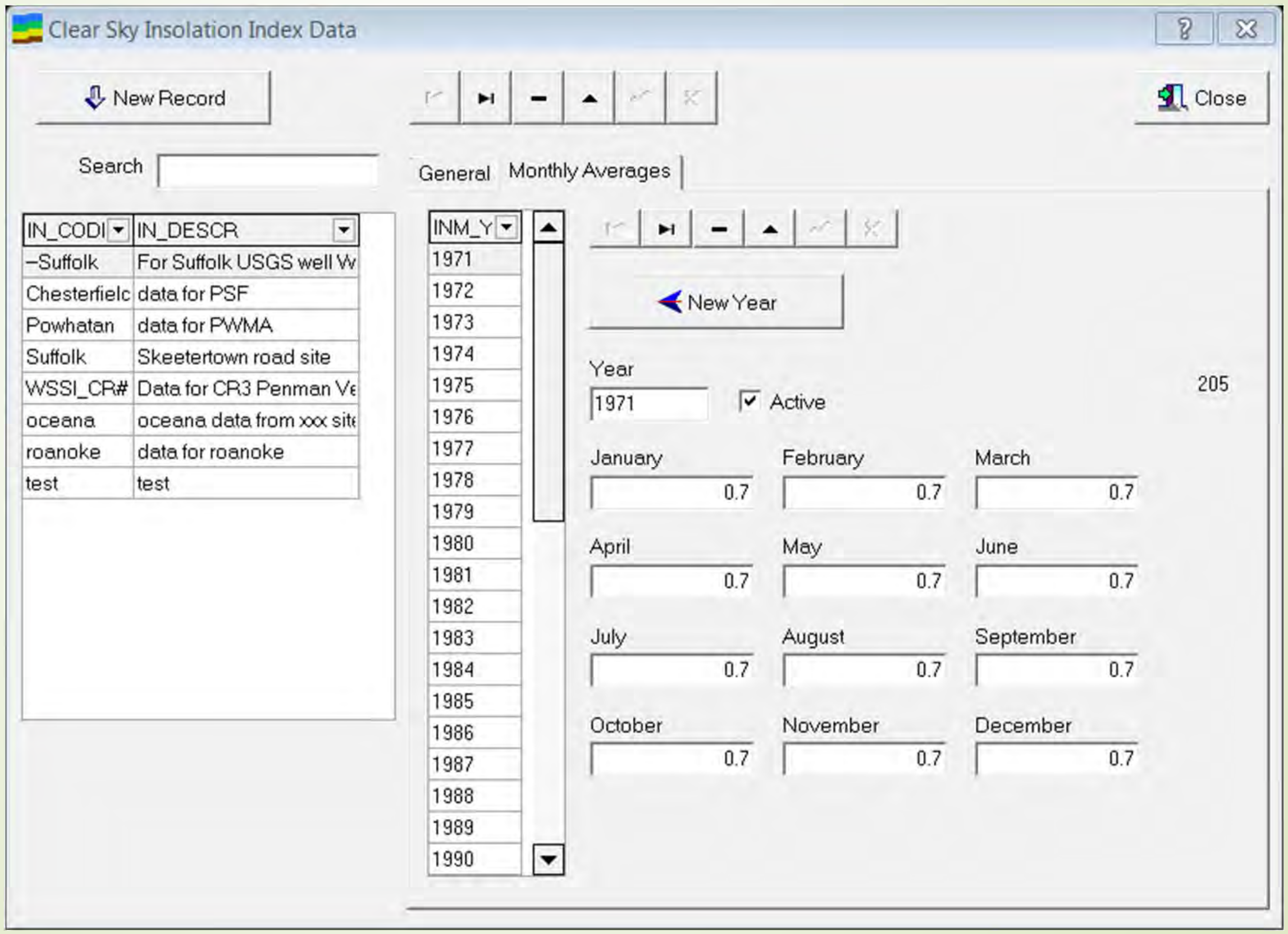


Additional data for ET calculations

- In addition to weather and solar data:
  - Clear sky insolation index (Penman ET)
  - Daylight length (Thornthwaite ET)

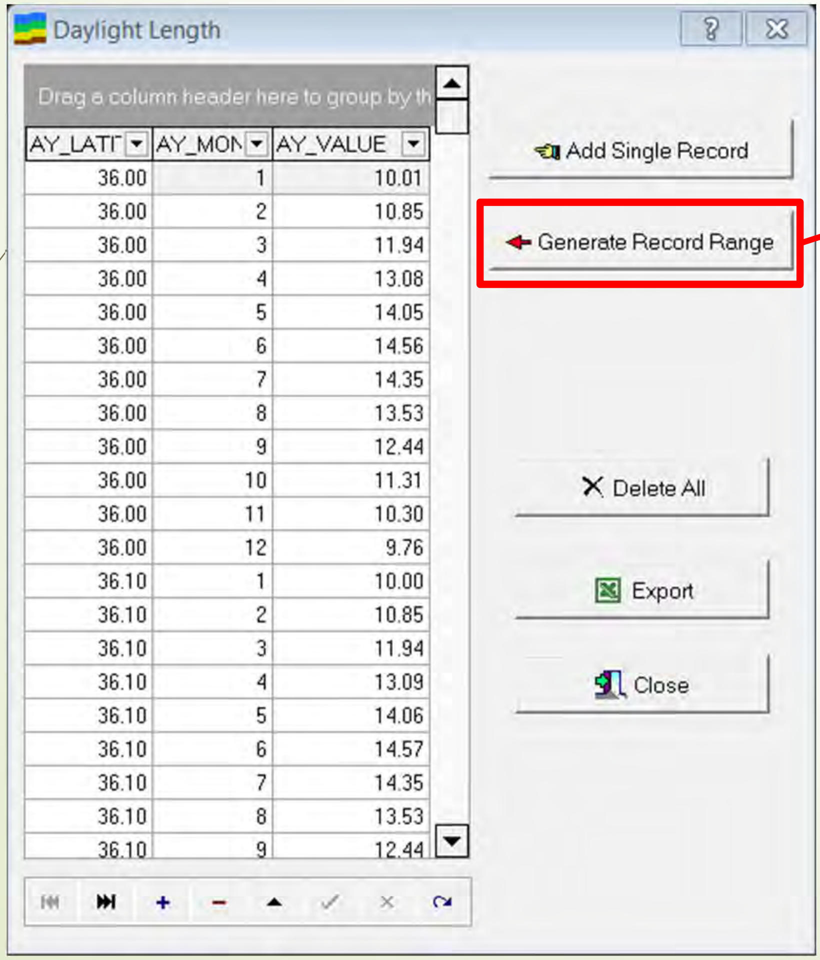
Building a weather station data set

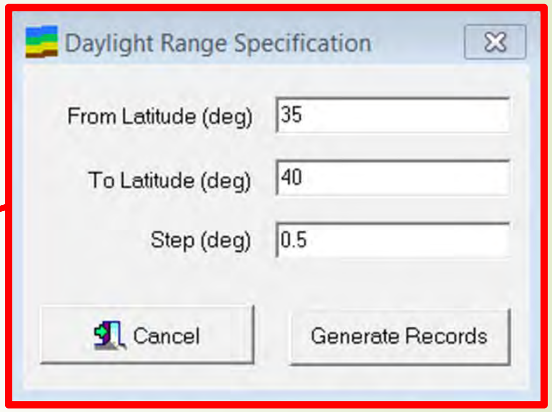
- Parameters for ET
  - Clear sky insolation index (Penman ET)



Building a weather station data set

- Parameters for ET
  - Daylight length (Thornthwaite ET)



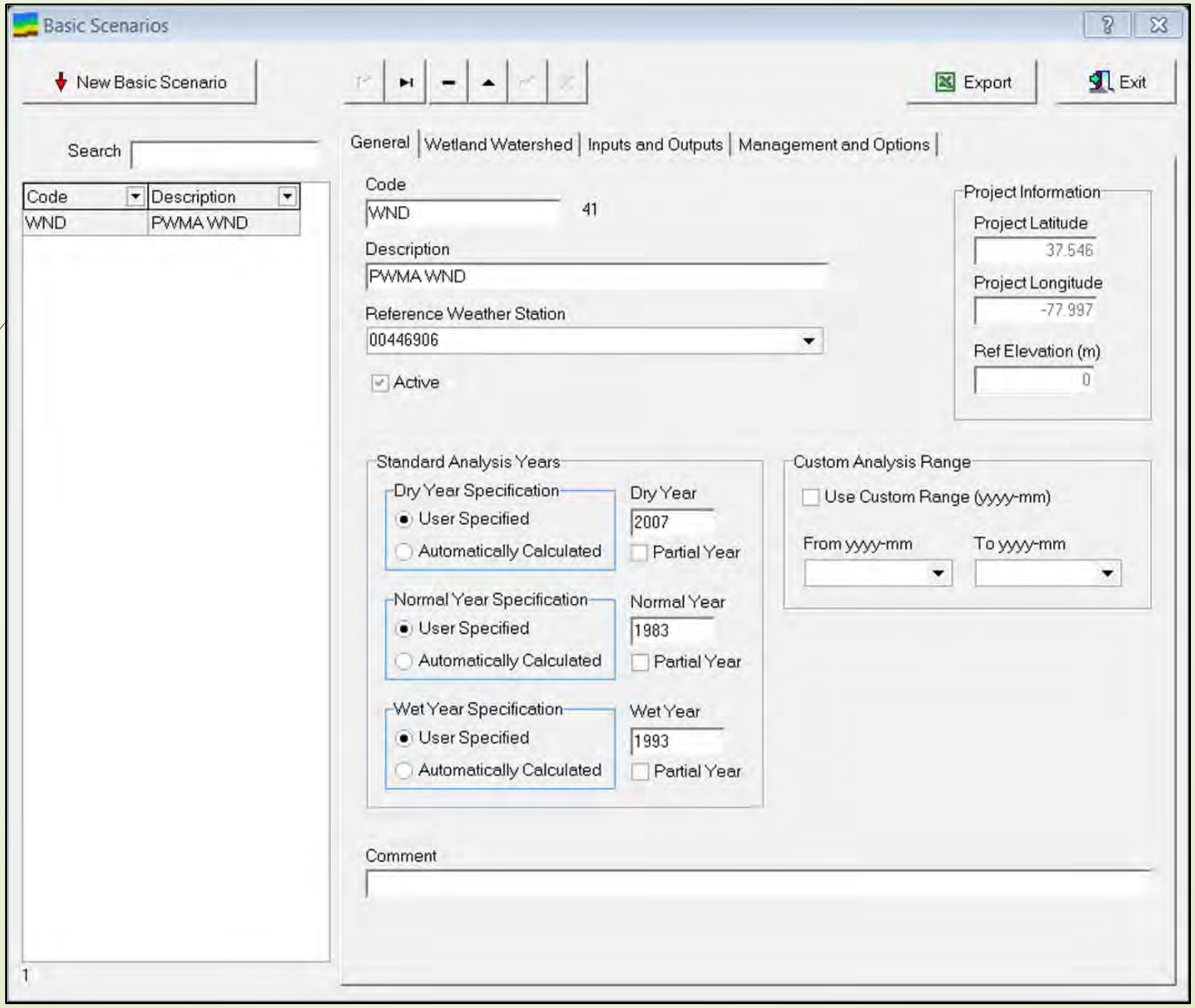


Additional inputs and outputs

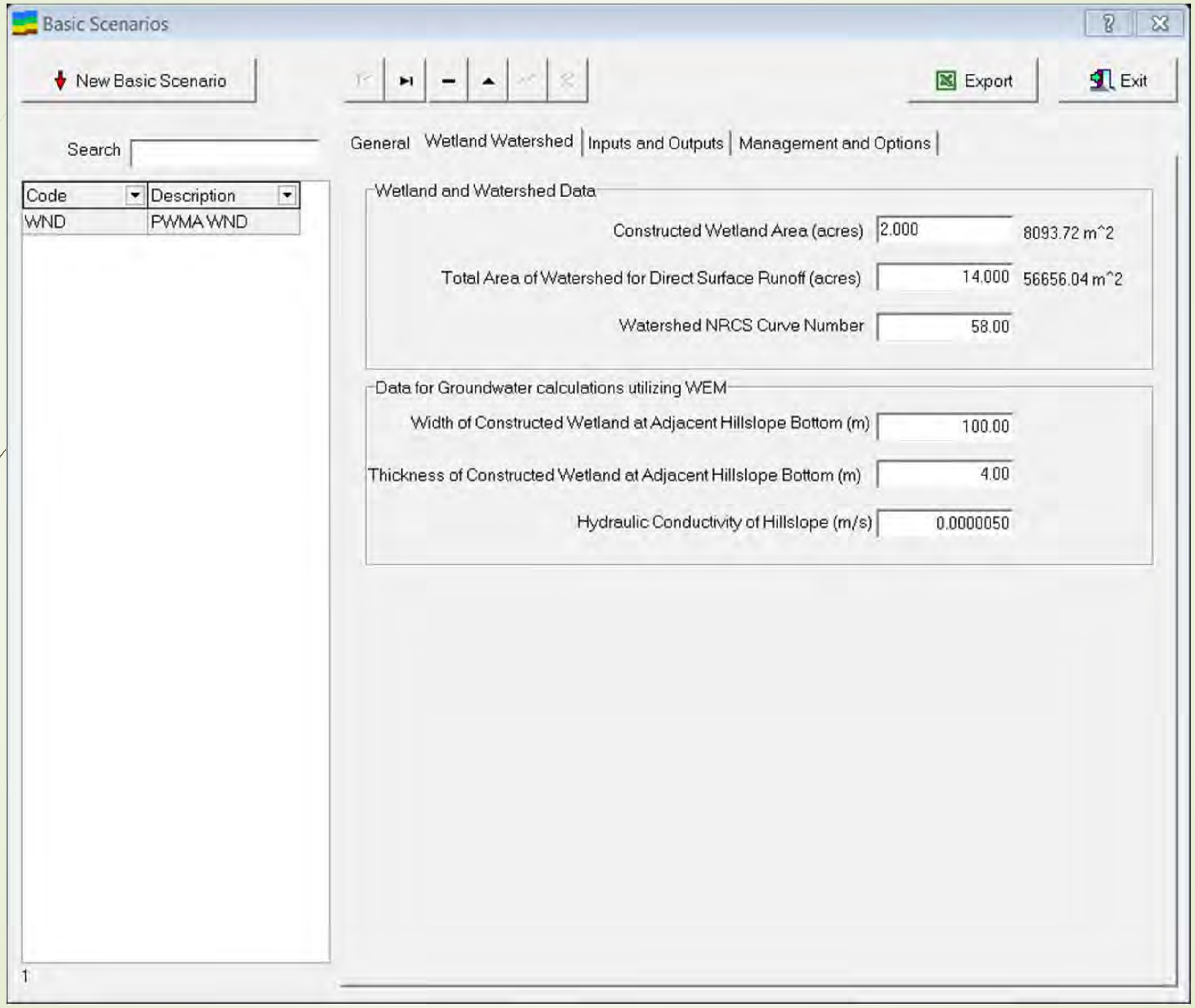
- Water budget inputs:
  - Groundwater in (quantified by user/manual import or calculated by Wem)
  - Surface runoff (calculated by WetBud)
  - Channelized flow (manual import)
  - Stream overbank (quantified by user/manual import or calculated by WetBud)
- Water budget outputs:
  - Groundwater out (quantified by user/manual import)
  - Surface flow (leaves site by overtopping ‘weir’ height assigned by user)
  - Channelized flow (quantified by user/manual import)

Basic Scenario Setup – *General*

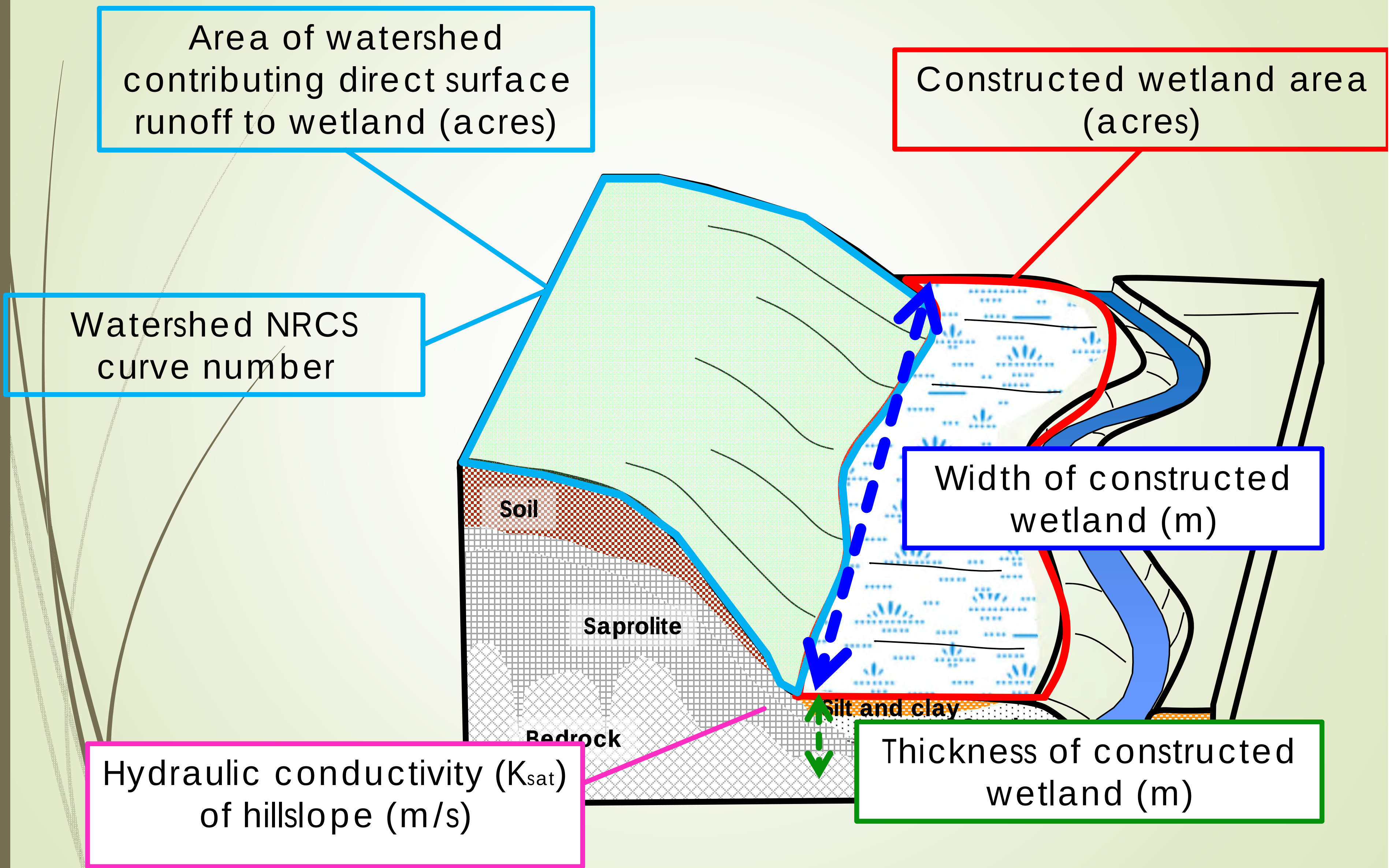
- Create new Basic Scenario and assign WND years for analysis



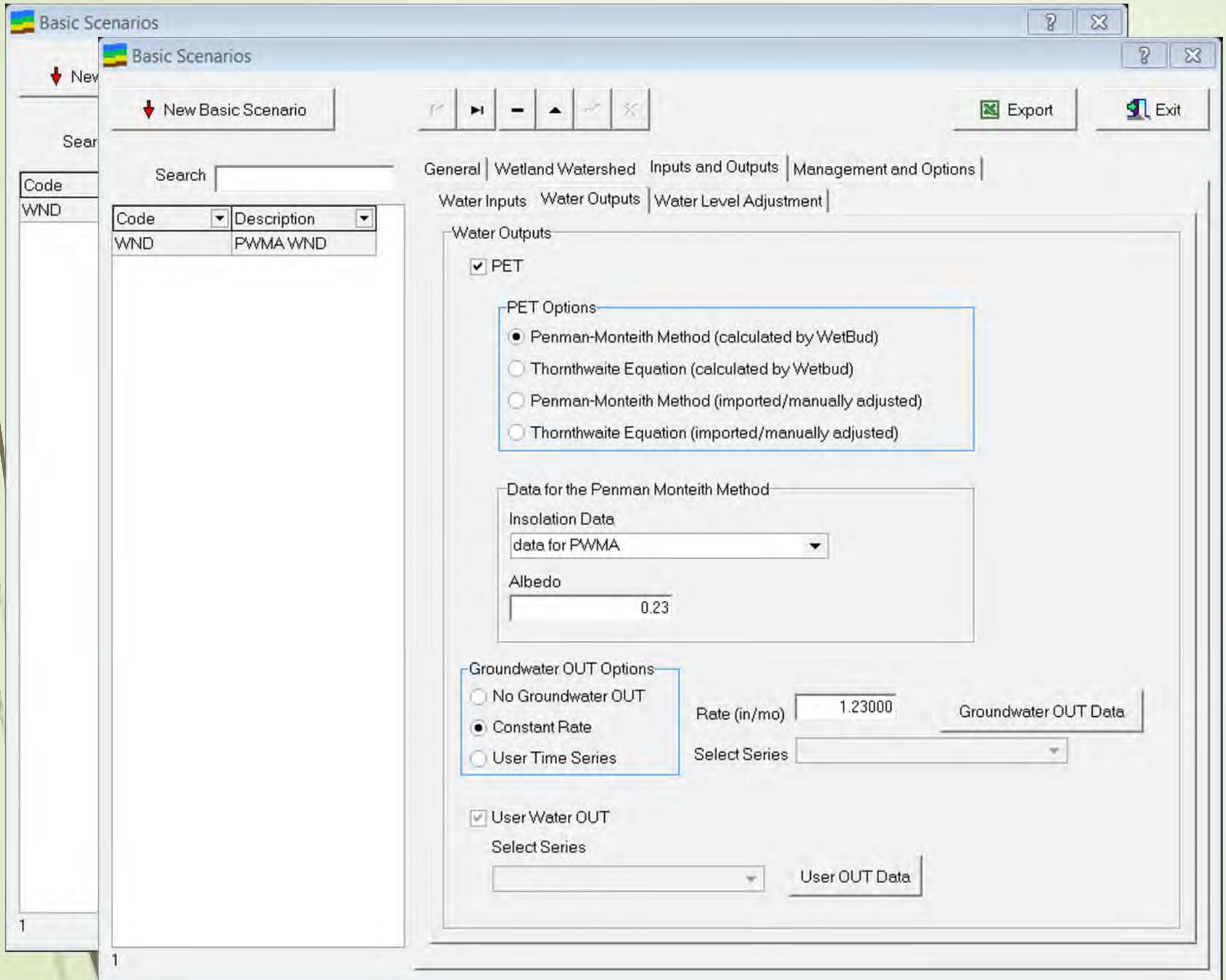
Basic Scenario Setup – *Wetland and Watershed*



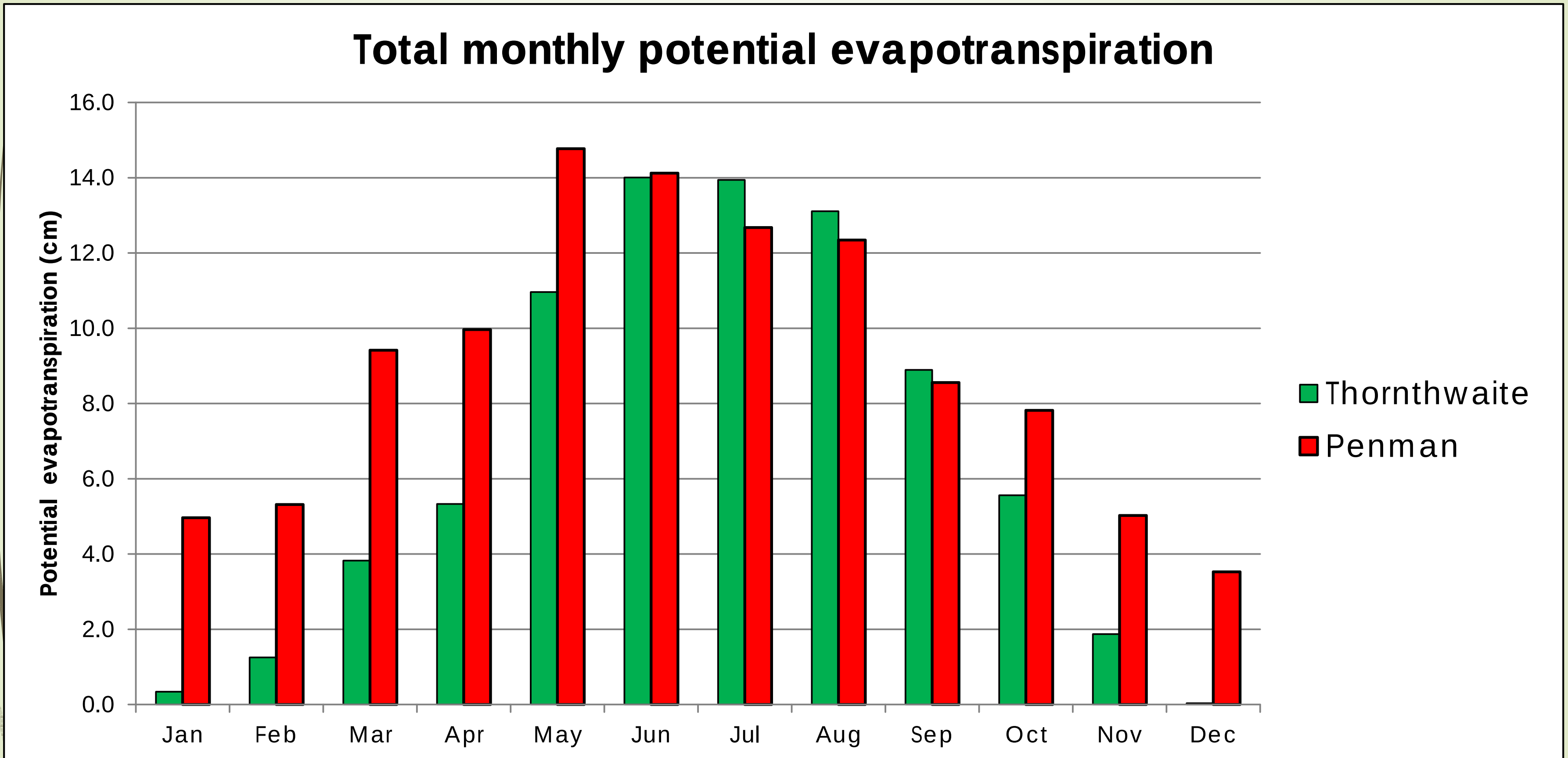
Basic Scenario Setup – *Wetland and Watershed*



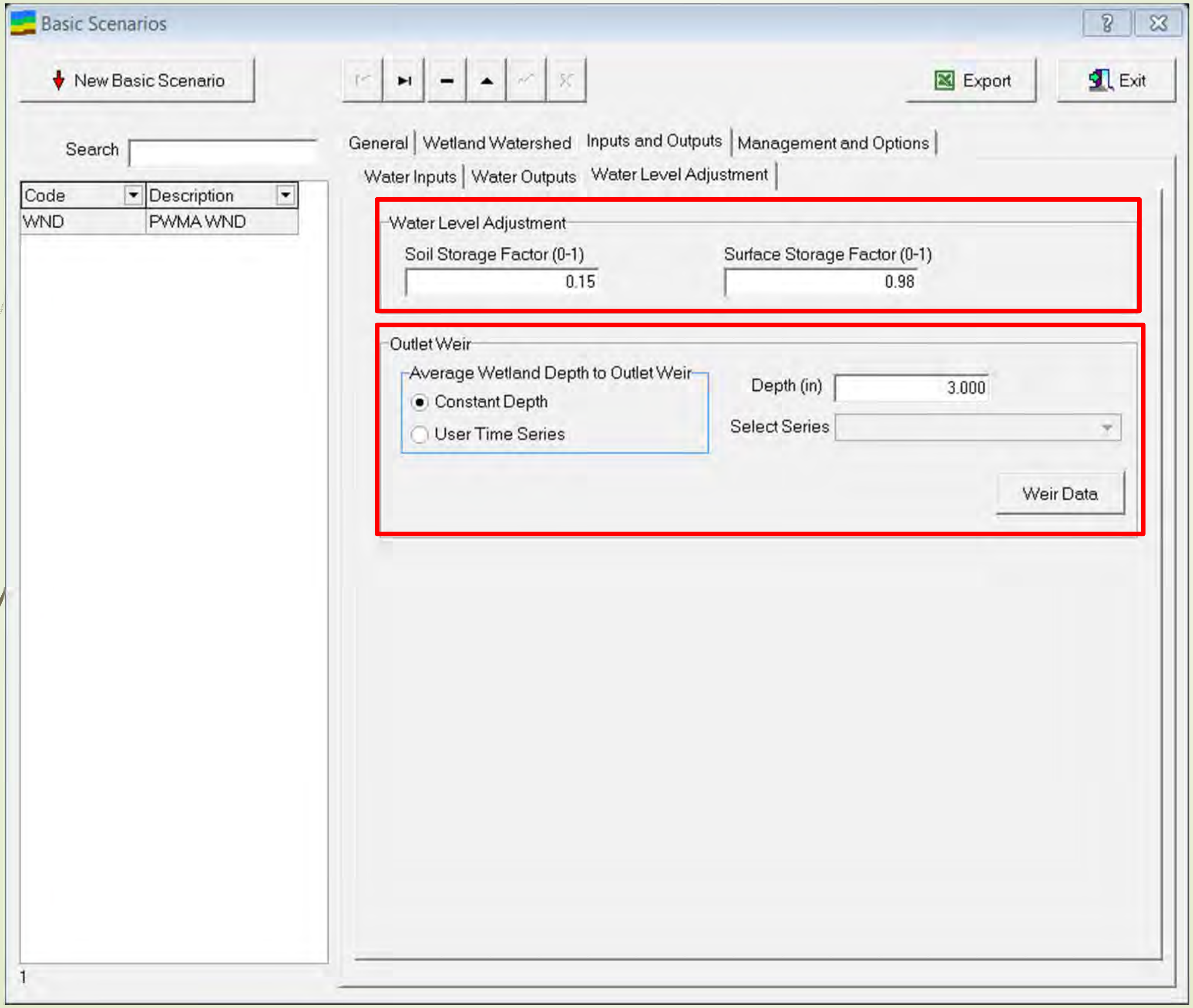
Basic Scenario Setup – *Inputs and Outputs*



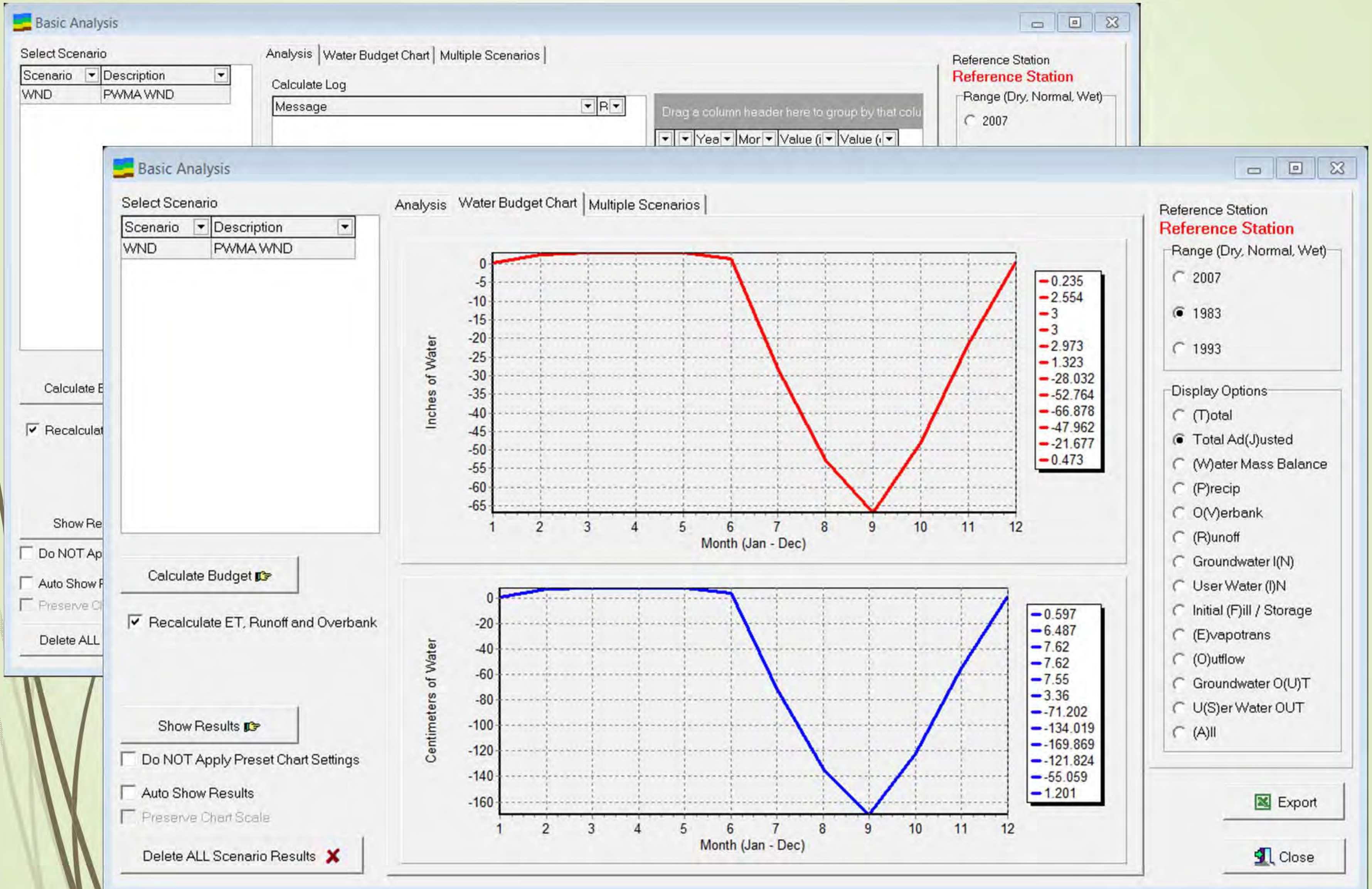
Basic Scenario Setup – *Inputs and Outputs*



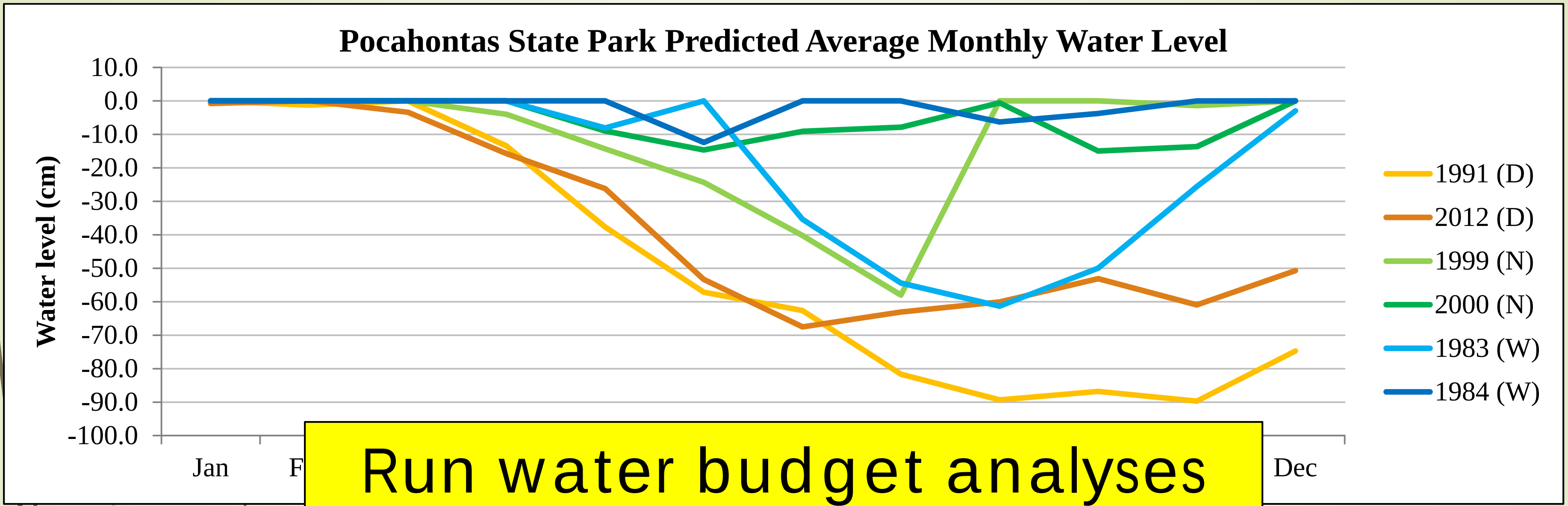
Basic Scenario Setup – *Inputs and Outputs*



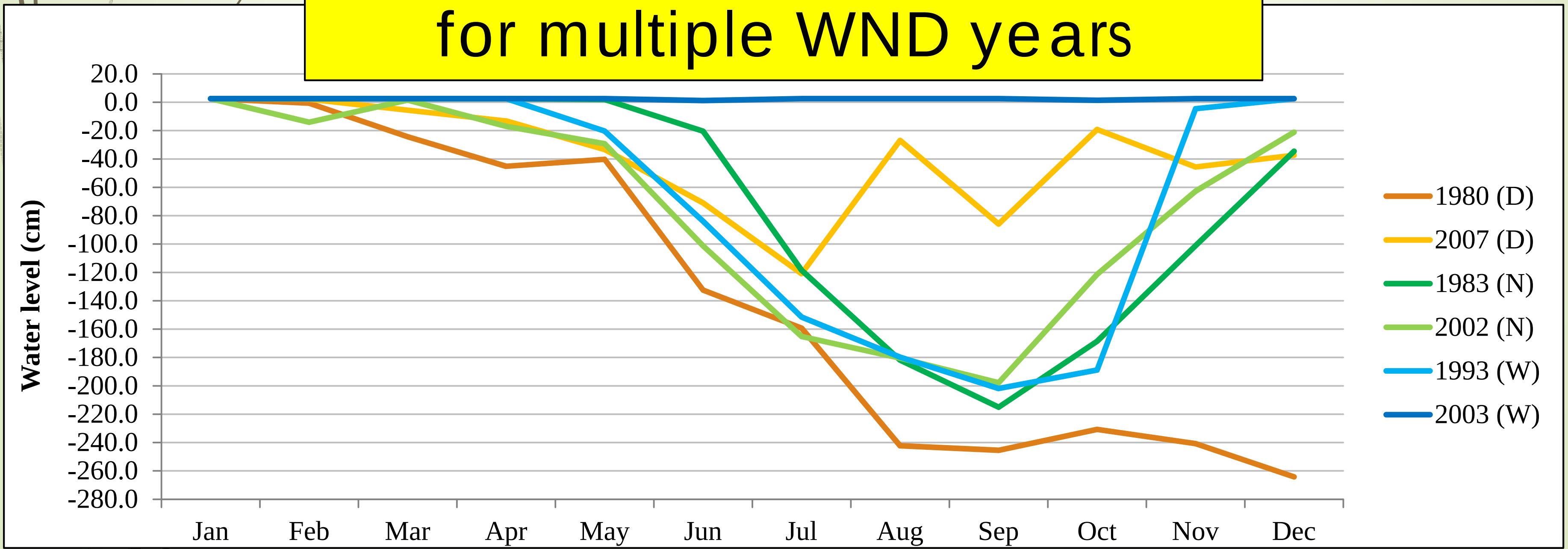
Basic Scenario Analysis and Output



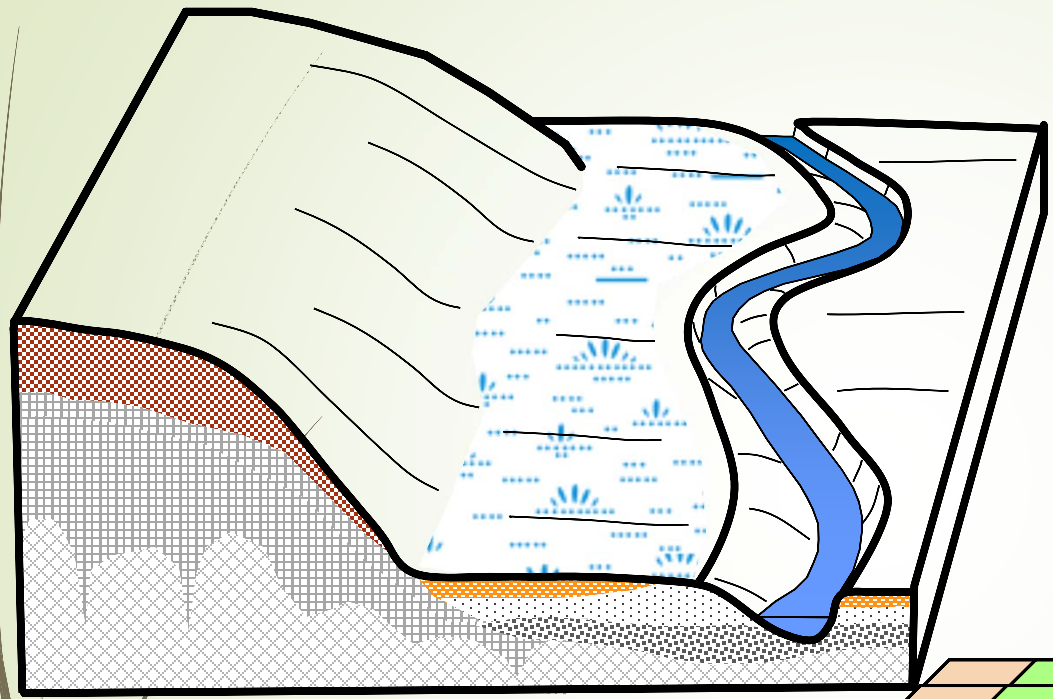
Wet, Normal, and Dry Years

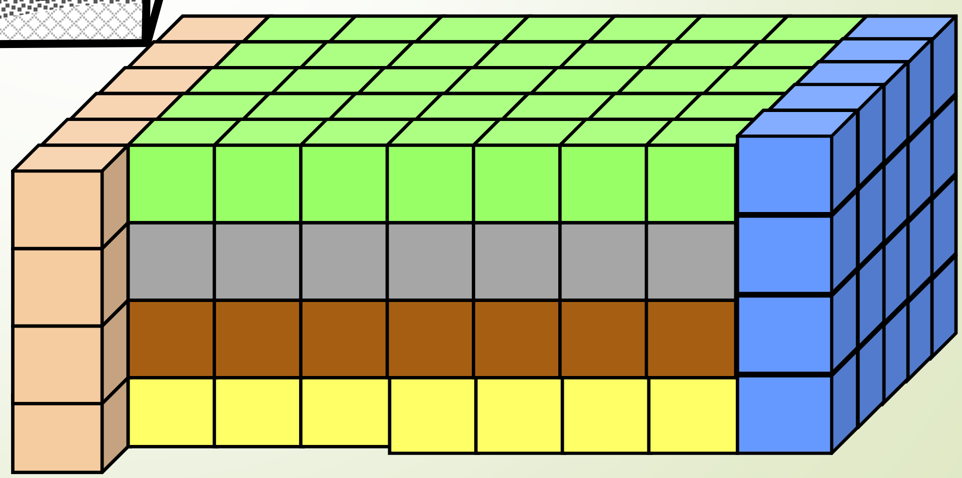


Run water budget analyses for multiple WND years



Advanced Scenarios



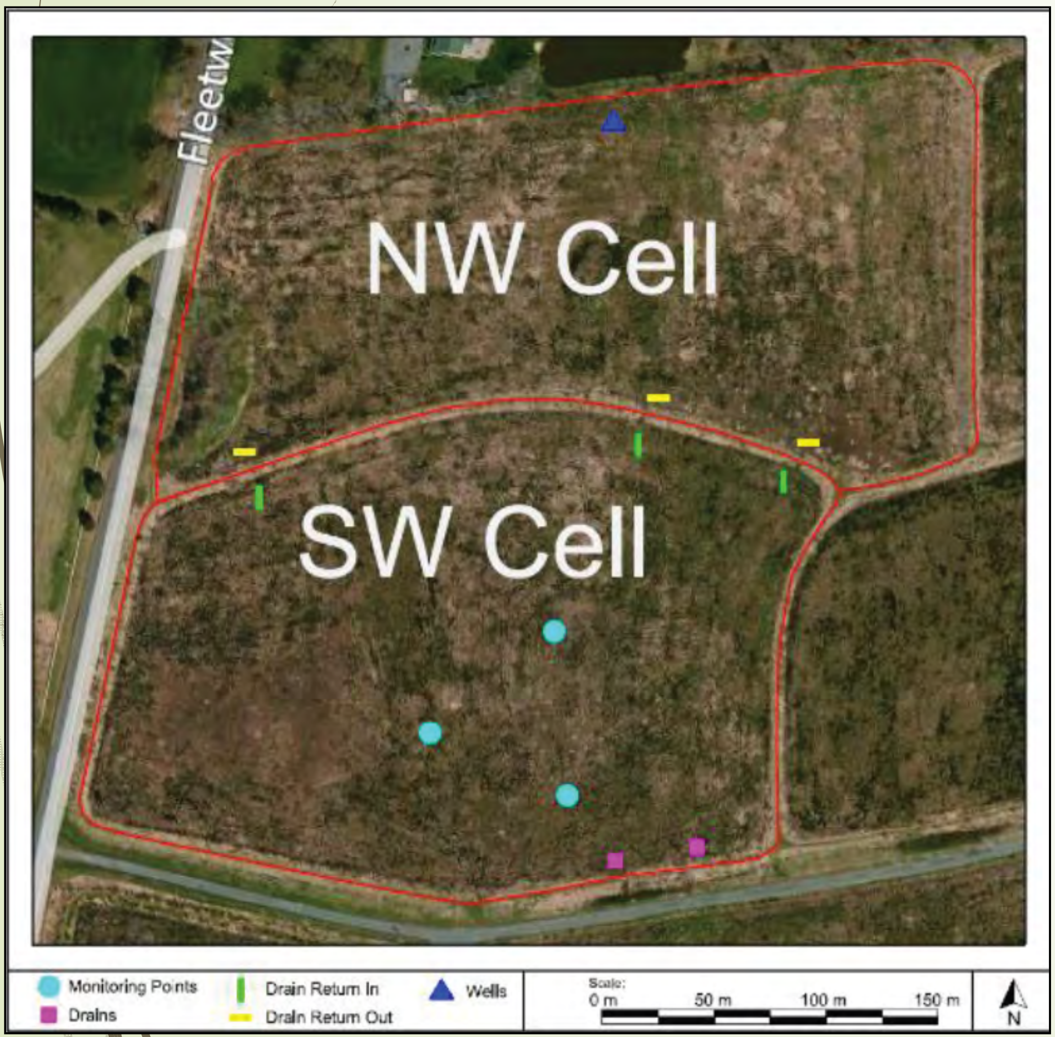


Advanced Scenario Preparation

1. Develop full scale conceptual model
   a. Topography
   b. Hydrologic boundary conditions
   c. Stratigraphy/Lithology
2. Create layer elevation files for model grid
3. Create **time step array**
4. Create **cell zones** for hydrologic boundary conditions (e.g. head boundaries, no flow areas drains, etc.)
5. Create **grid zones** for cell properties (e.g. K_{sat}, ET, etc.)
6. Create chart formatting dataset for Advance Model output

1. Conceptual Model

Cedar Run Wetland Mitigation Bank



Hydrologic boundaries

- Mainly surface water driven system with compacted clay berm and subsoil
- Inlet and outlet weirs

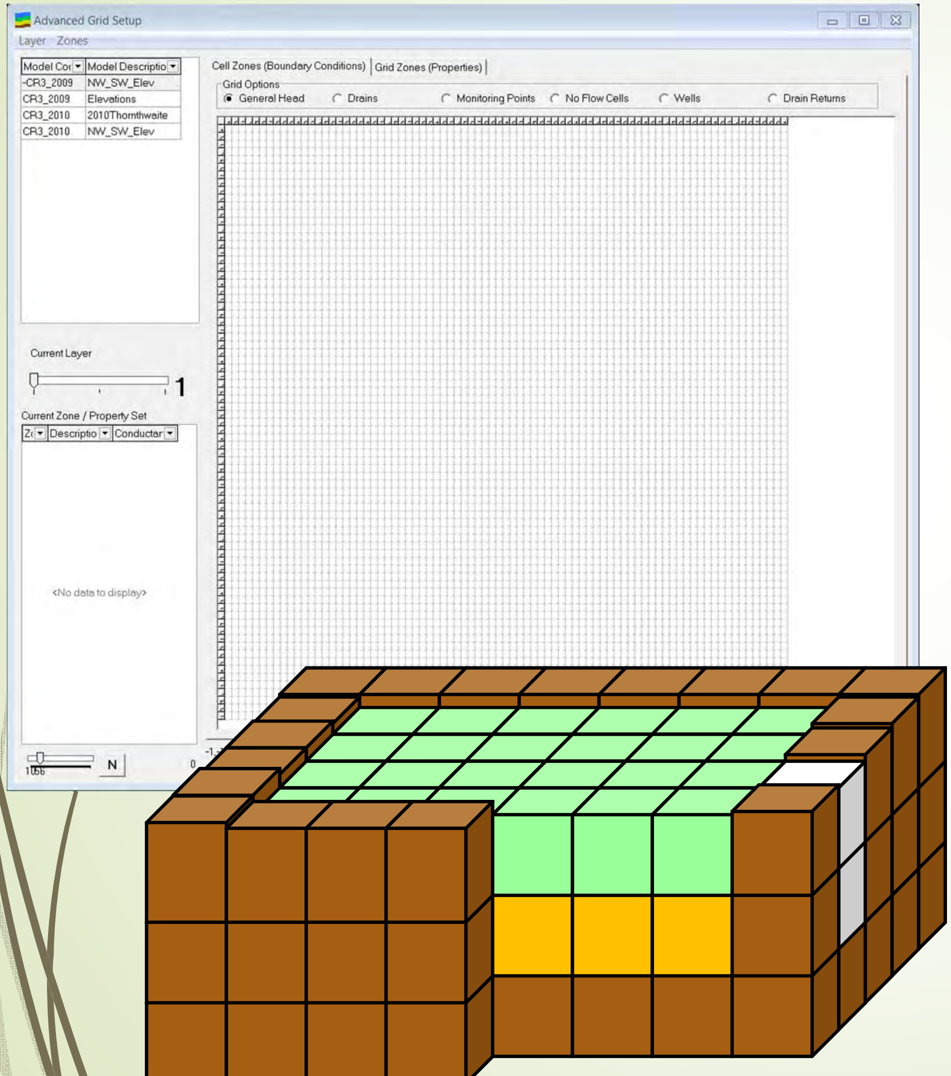
Stratigraphy and Lithology

- 3 layers
  - Surface veg
  - Topsoil
  - Compacted clay

Areal Extent and Topography

- What size model grid?
- Flat layers?
- Topography?

1. Conceptual Model



<u>Hydrologic boundaries</u>

- Mainly surface water driven system with compacted clay berm and subsoil
- Inlet and outlet weirs

<u>Stratigraphy and Lithology</u>

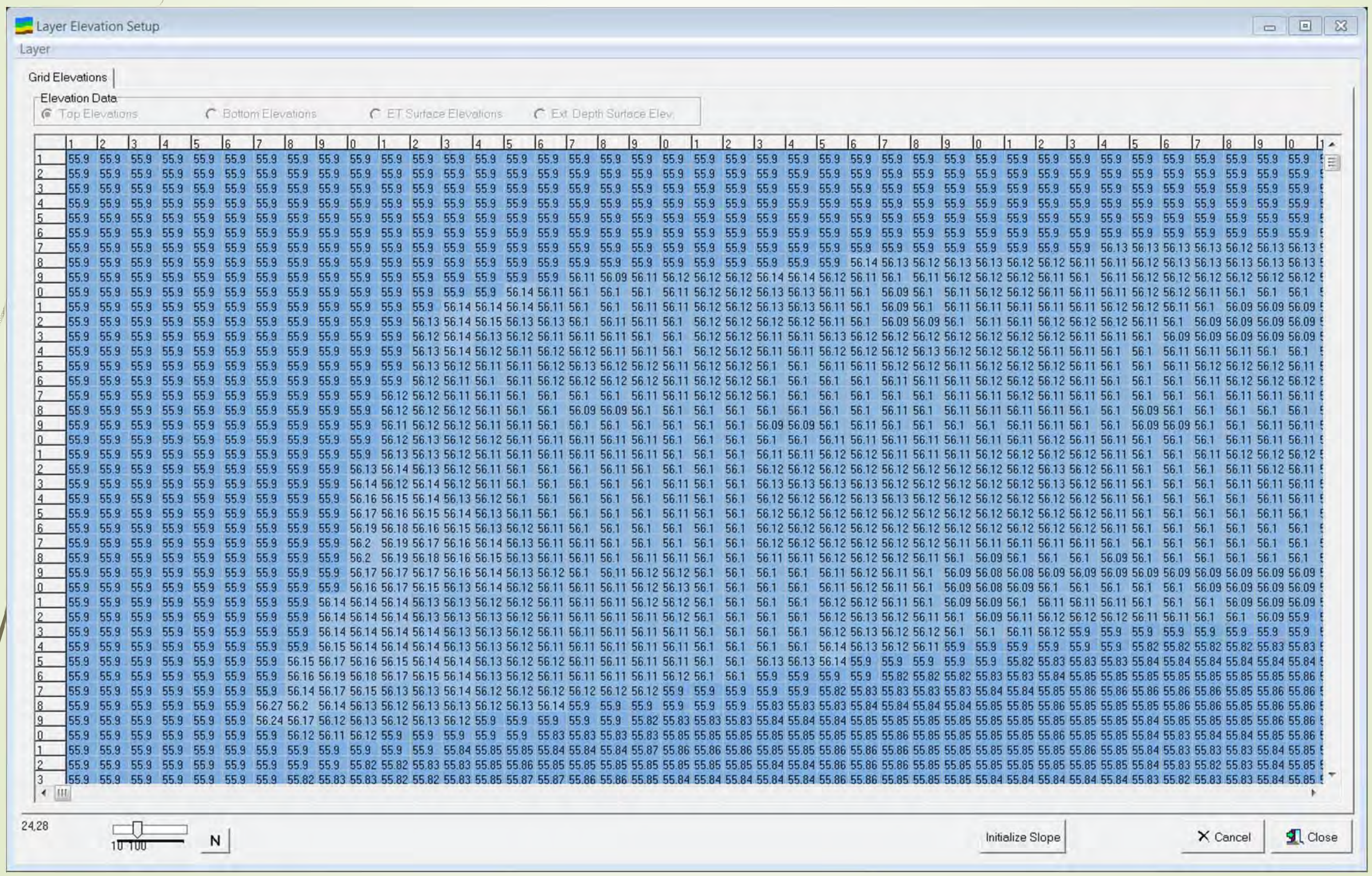
- 3 layers
  - Surface veg
  - Topsoil
  - Compacted clay

<u>Areal Extent and Topography</u>

- What size model grid?
- Model units?
- Flat layers?
- Topography?

2. Create Layer Elevation Files

- Excel spreadsheet same size as model grid
  - Each cell must contain a value for elevation



from Dahl, 2000 (US Fish and Wildlife)

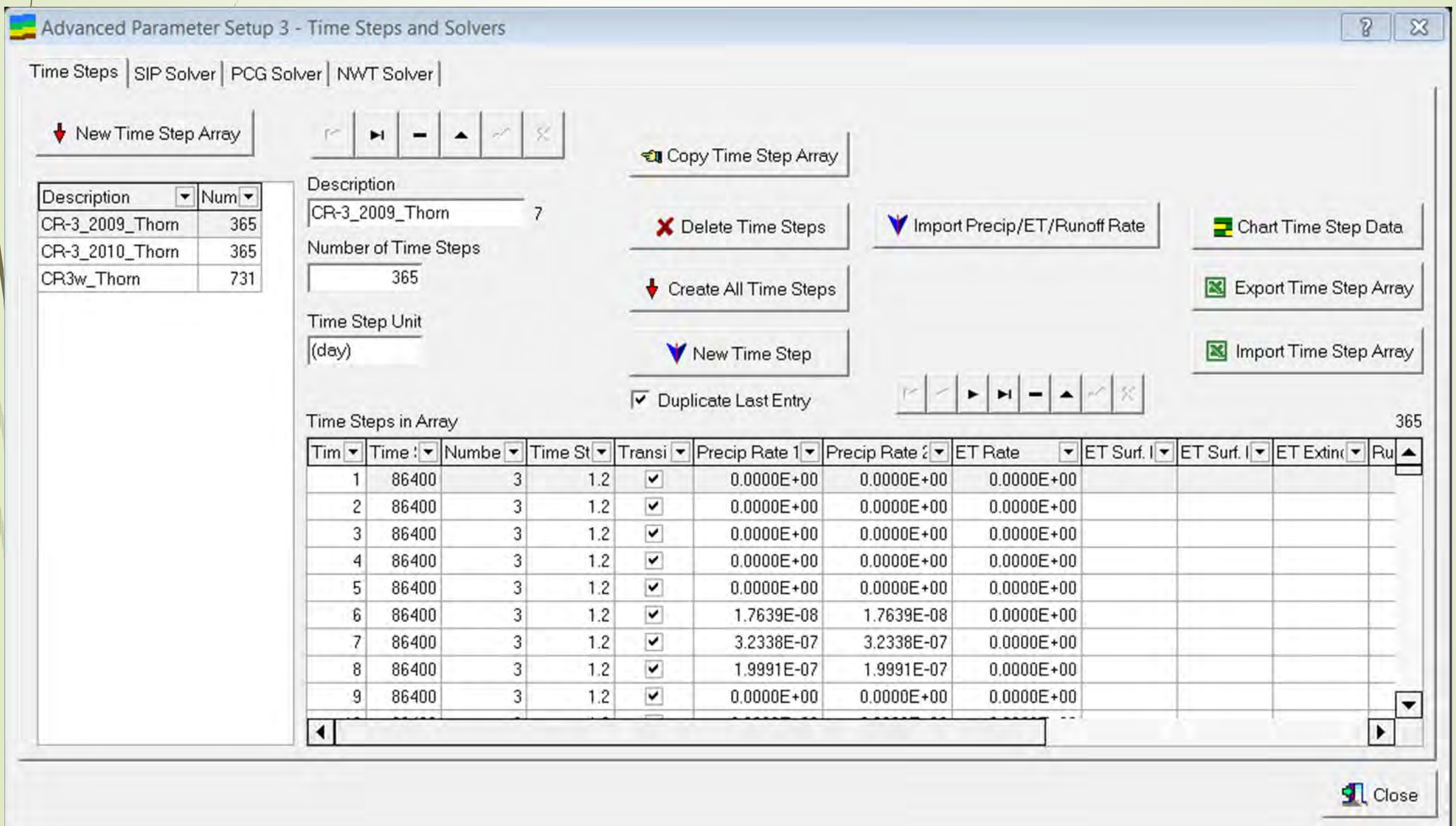
3. Create Time Step Array

- Time step array is used to set up simulation period
- Simulation period consists of one (steady-state) and/or multiple (transient) time steps
- Contains hydrologic input (e.g. precipitation) and output (e.g. ET) data for each time step
  - Time step data are applied to the model through cell zones (boundary conditions) and grid zones (properties)

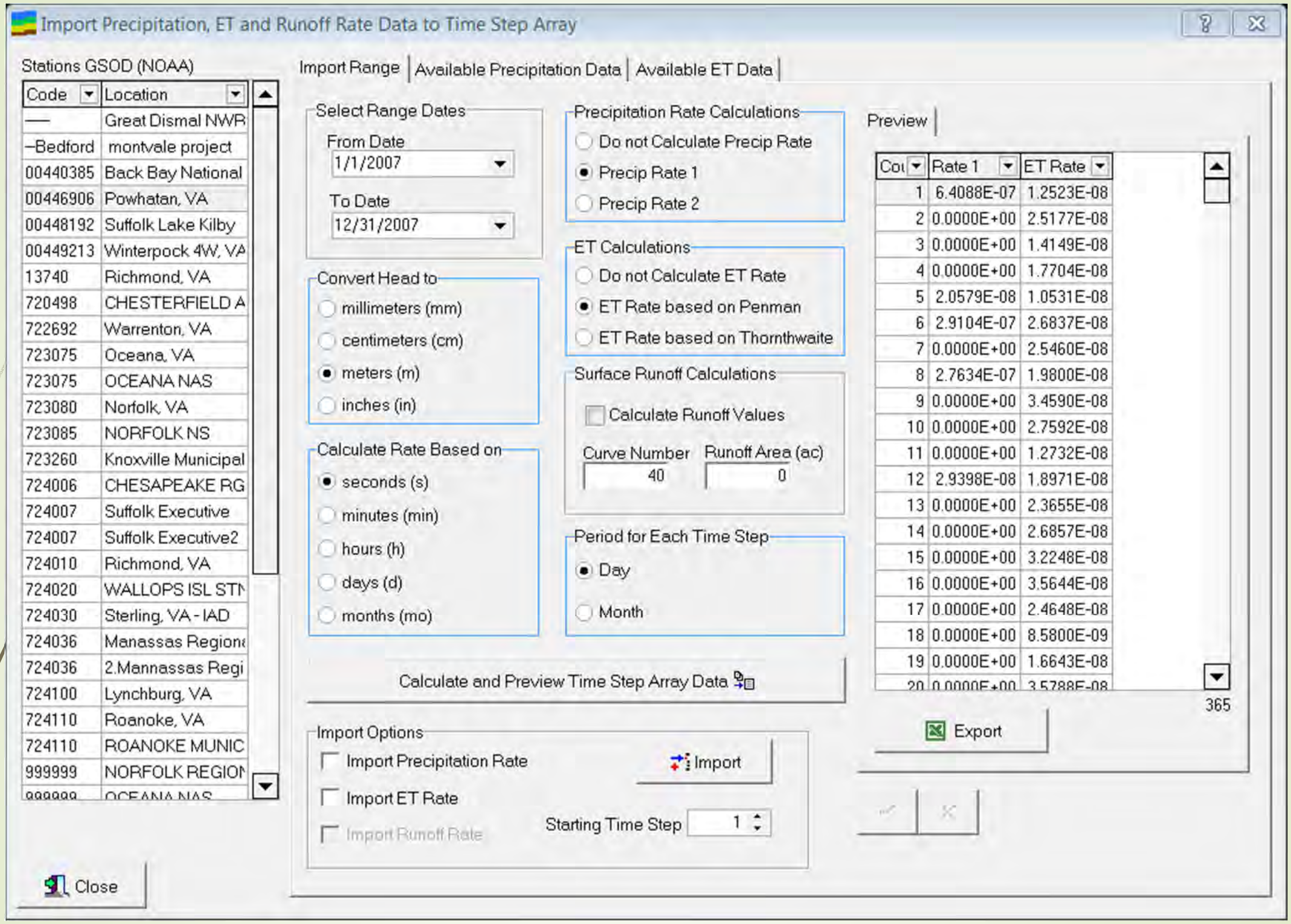
from Dahl, 2000 (US Fish and Wildlife)

Creating a Time Step Array

- 1-year simulation period with daily time steps
- All rates/values entered in model units (e.g. m/s)



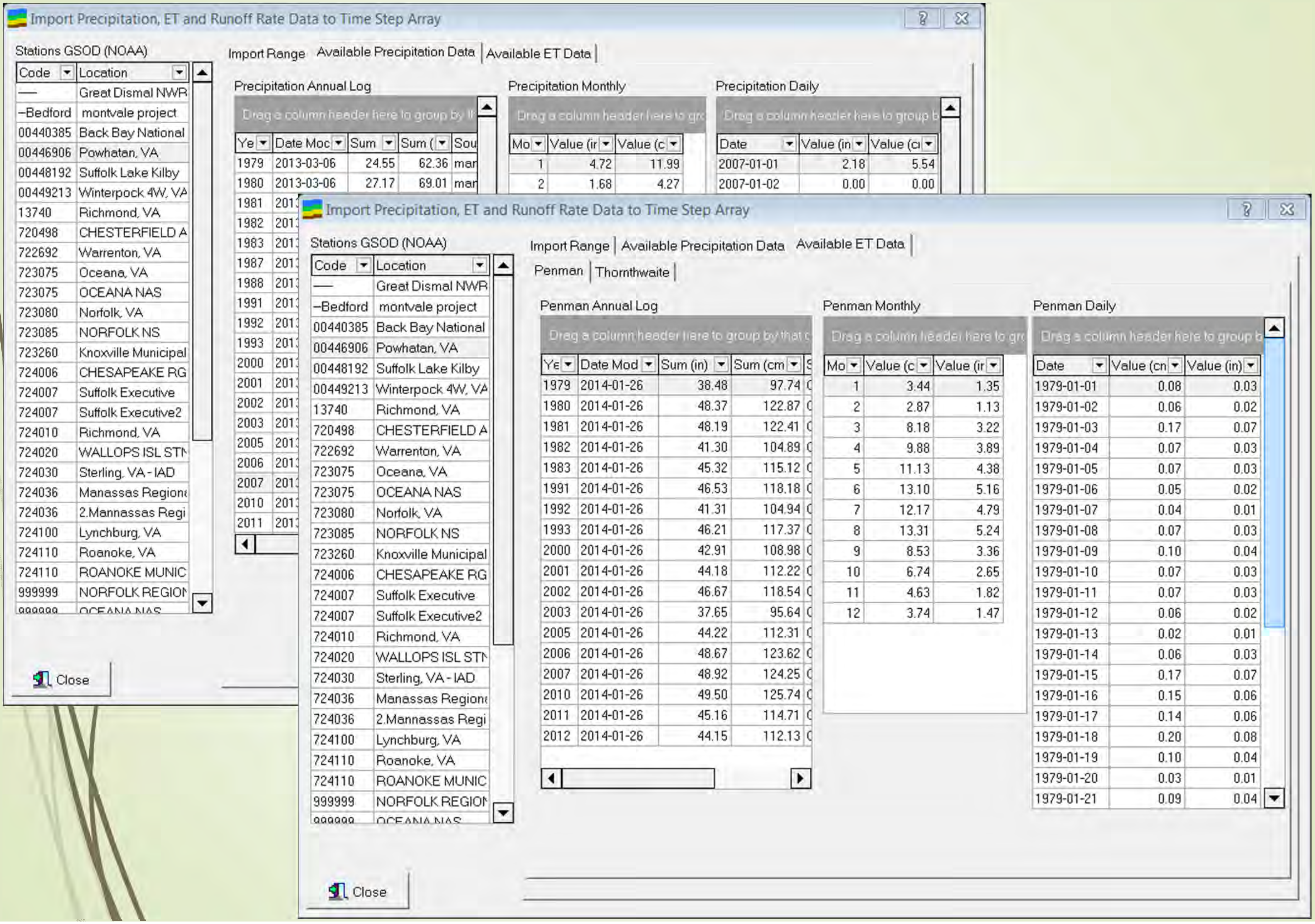
Importing Precip, ET, and Runoff into Time Step Array



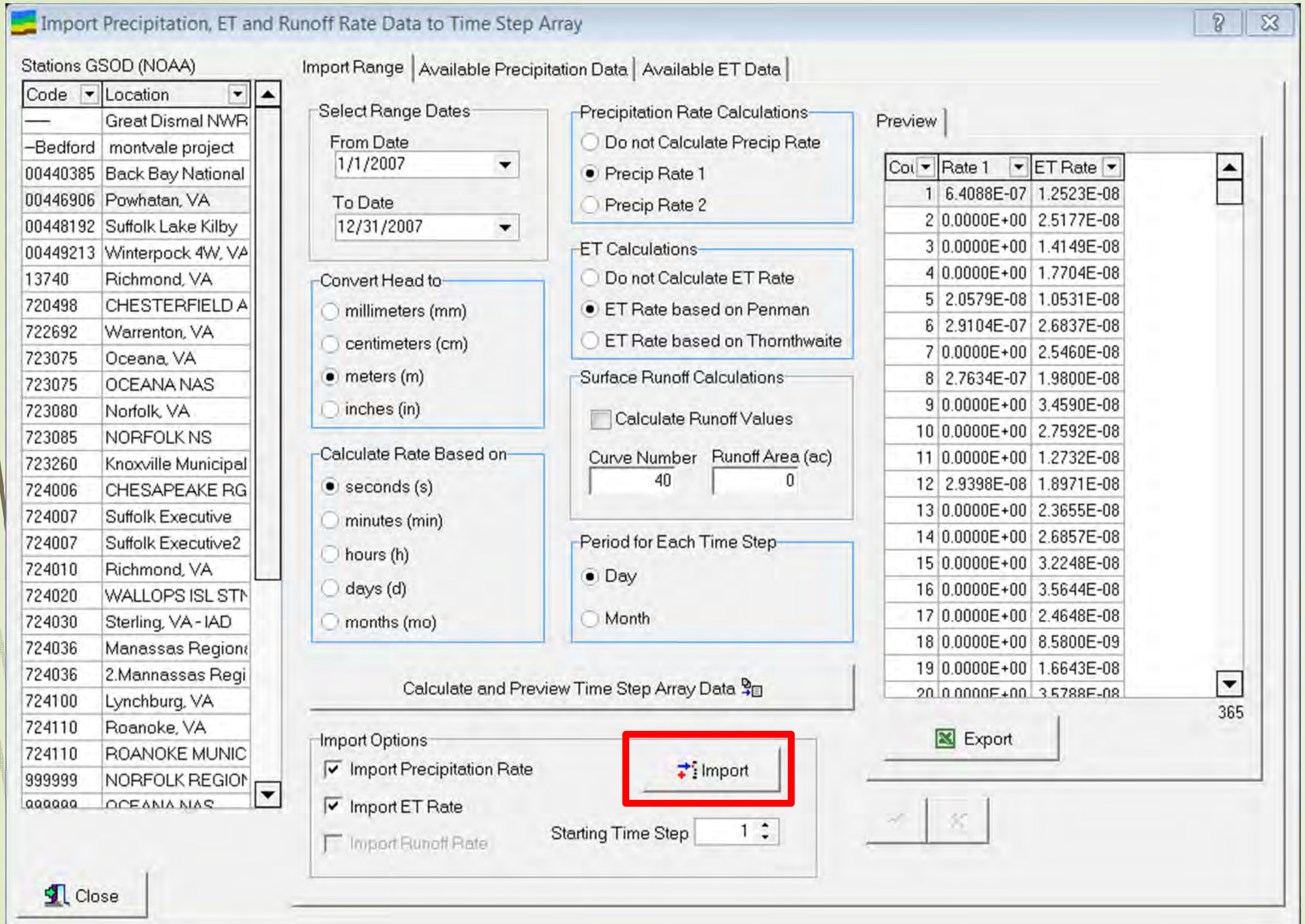
<u>Note:</u> Precipitation data must exist in station record and ET rates must be calculated in Basic Scenario prior to import into time step array.

from [illegible]hl, 2000 (US Fish and Wildlife)

Importing Precip, ET, and Runoff into Time Step Array



Importing Precip, ET, and Runoff into Time Step Array

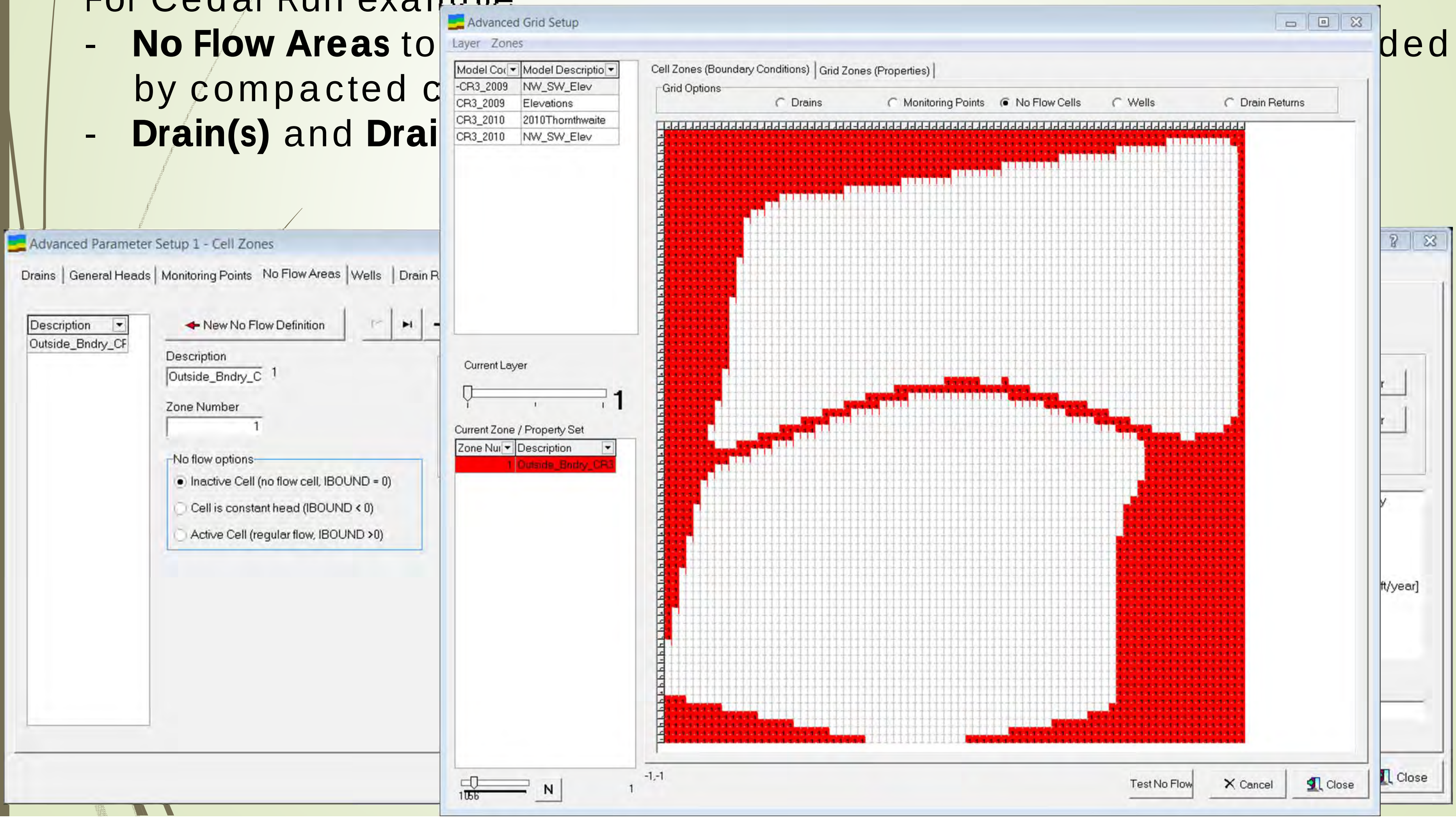


4. Create Cell Zones (Boundary Conditions)

Types of Cell Zones: Drains, General Head Boundaries, Monitoring Pts., No Flow Areas, Wells, and Drain Returns

For Cedar Run example:

- **No Flow Areas** to ... ded by compacted c...
- **Drain(s)** and **Drai**...

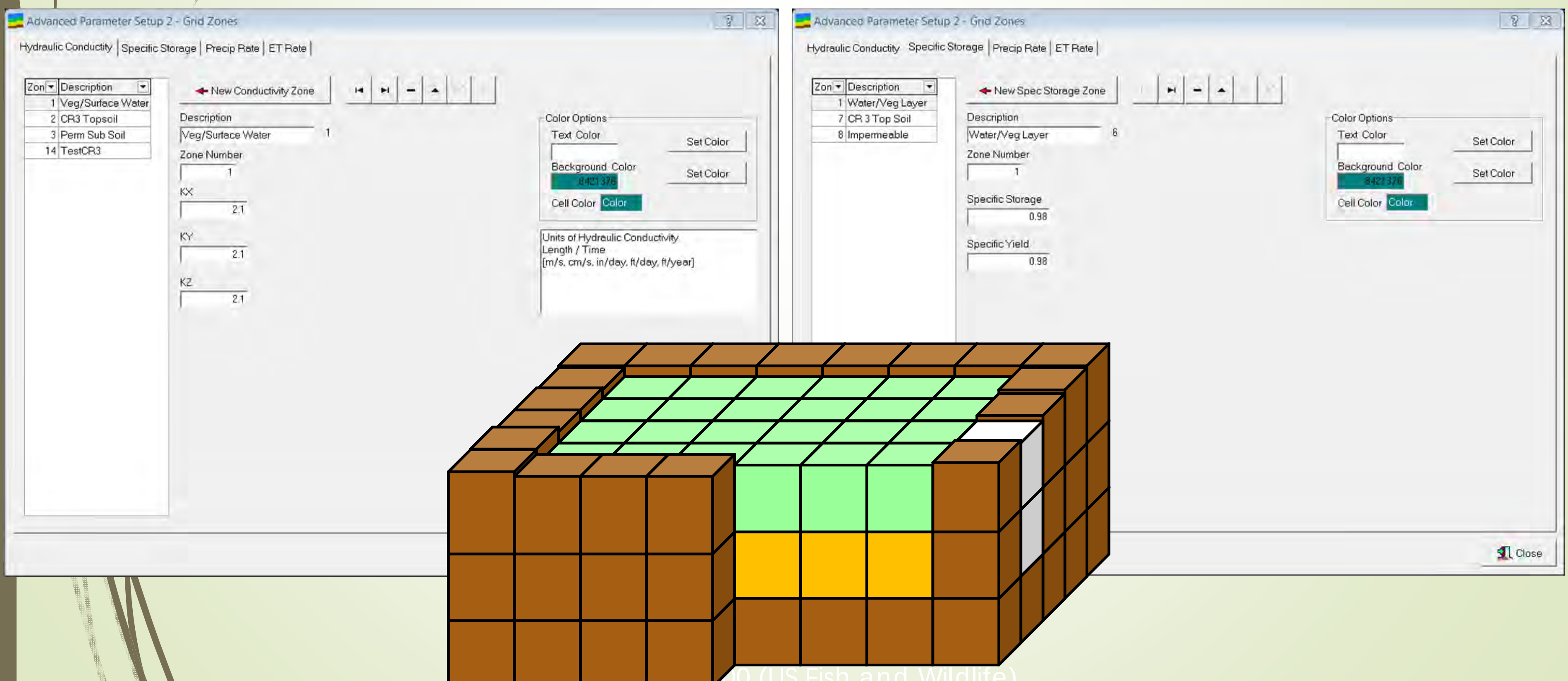


5. Create Grid Zones (Properties)

<u>Types of Grid Zones:</u> Hydraulic Conductivity, Specific Storage, Precip Rate, and ET Rate

For Cedar Run example:

- Create **Hydraulic Conductivity** and **Specific Storage Zones** for surface veg., topsoil, and compacted clay.

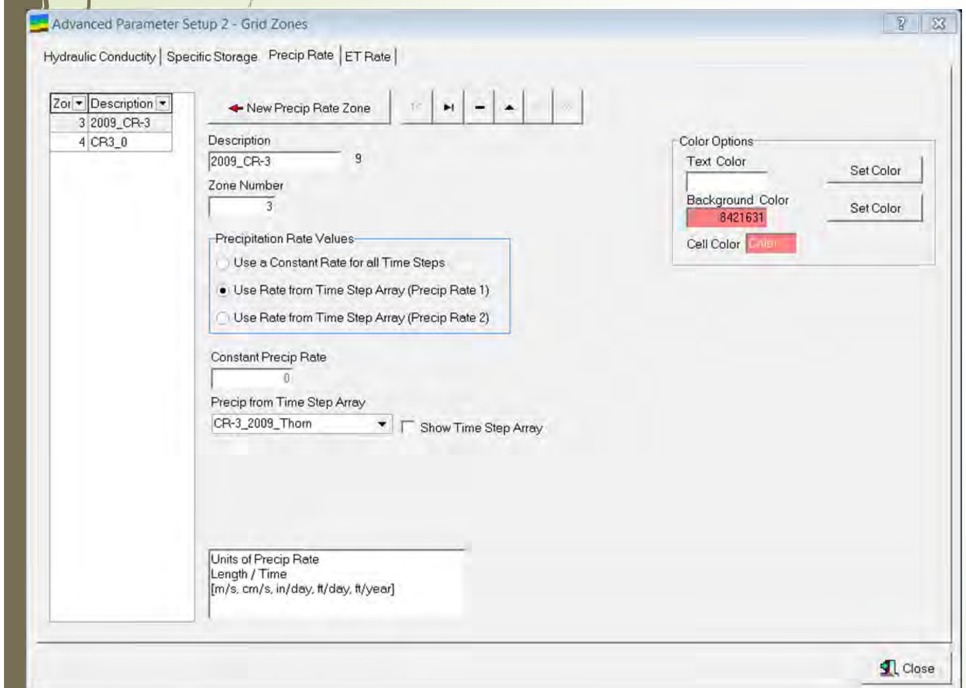


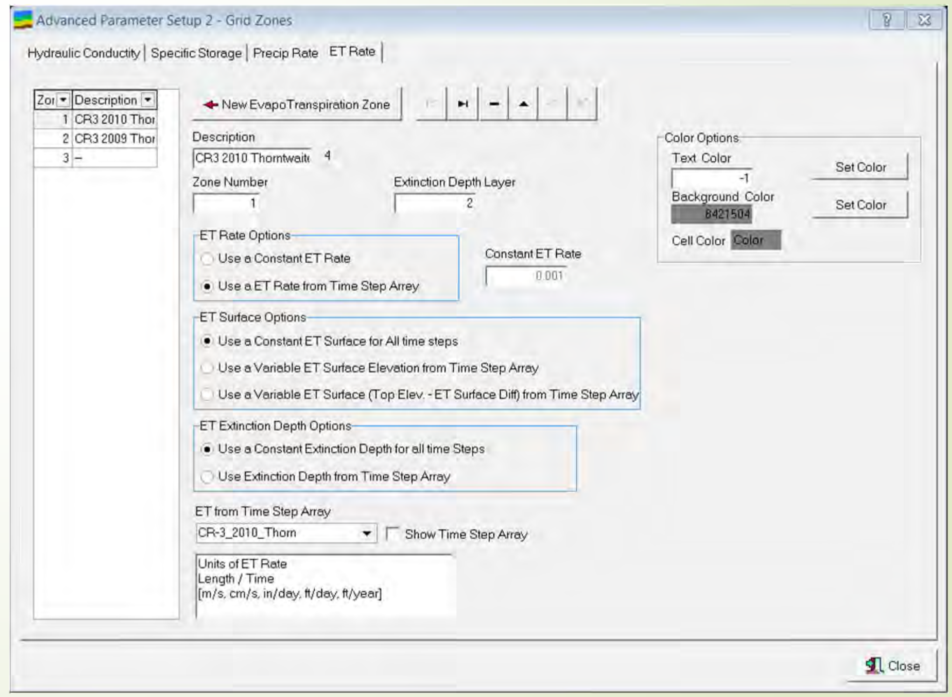
5. Create Grid Zones (Properties)

<u>Types of Grid Zones:</u> Hydraulic Conductivity, Specific Storage, Precip Rate, and ET Rate

For all models:

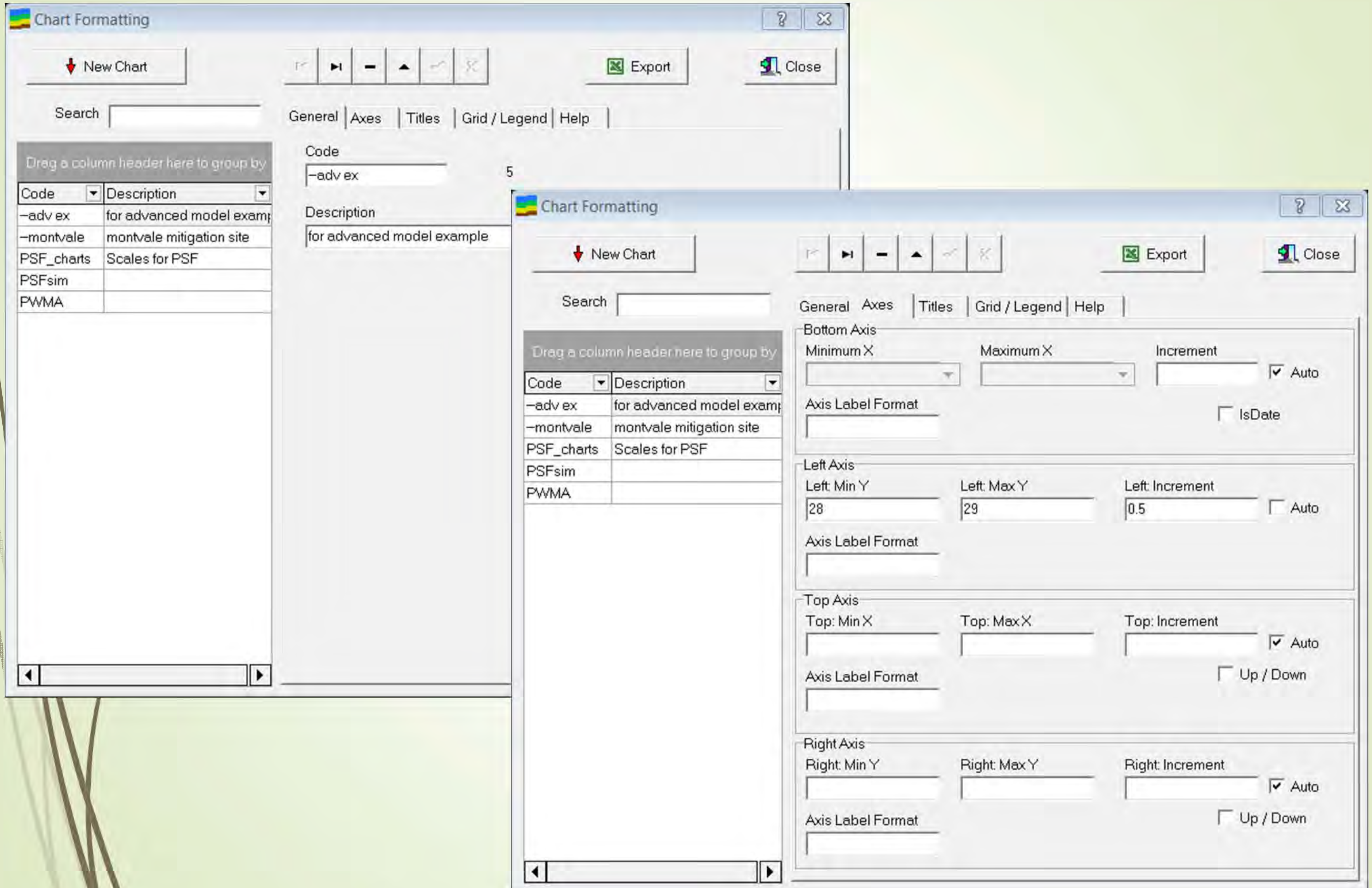
- Create **Precip Rate** and **ET Zone** and assign time step array or constant rate





from Dahl, 2000 (US Fish and Wildlife)

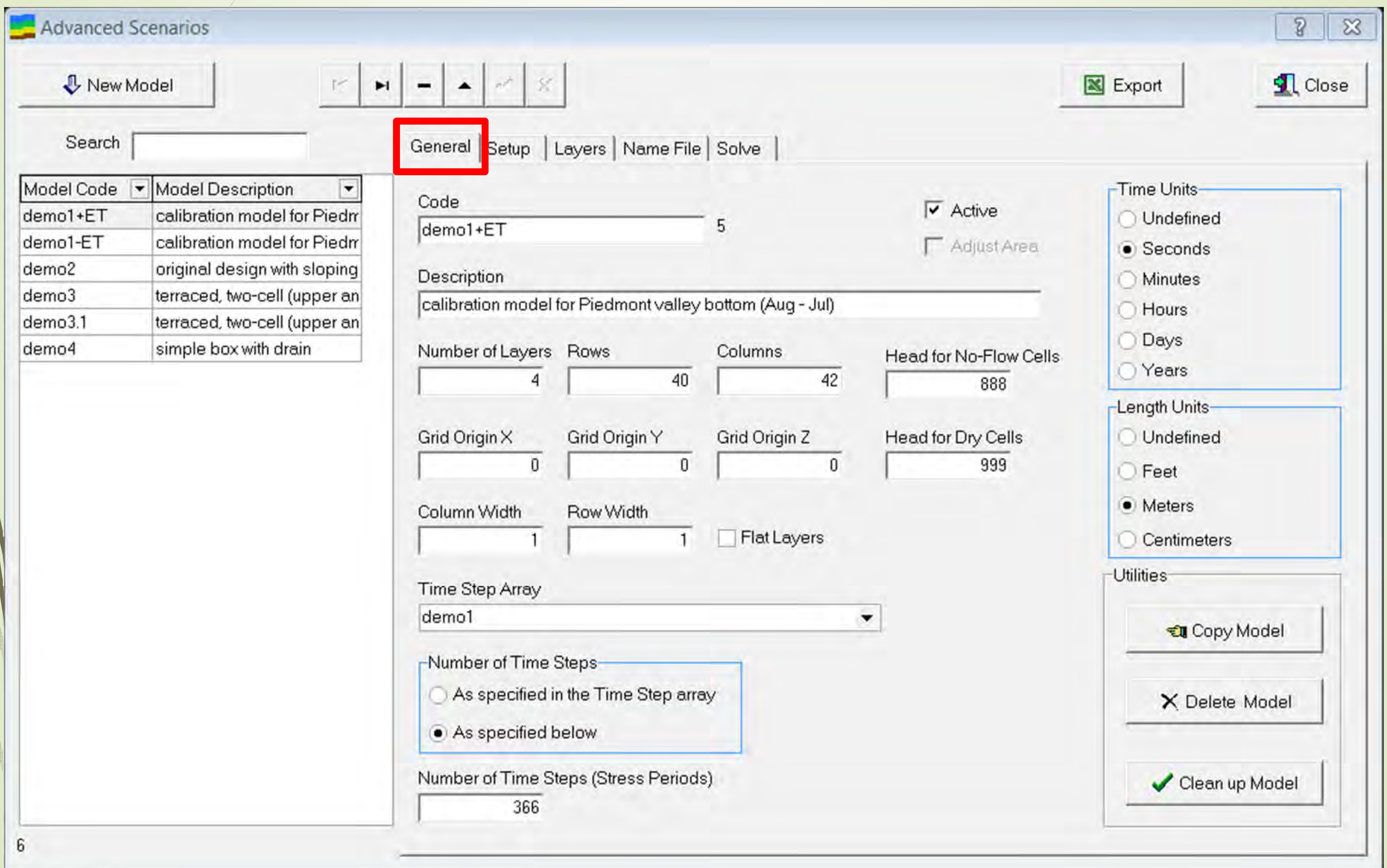
6. Create Chart Formatting Dataset



from Dahl, 2000 (US Fish and Wildlife)

Advanced Model Setup – *General* tab

- Create new Advanced Scenario, specify units of time and length, size of the model grid, and select a Time Step Array.



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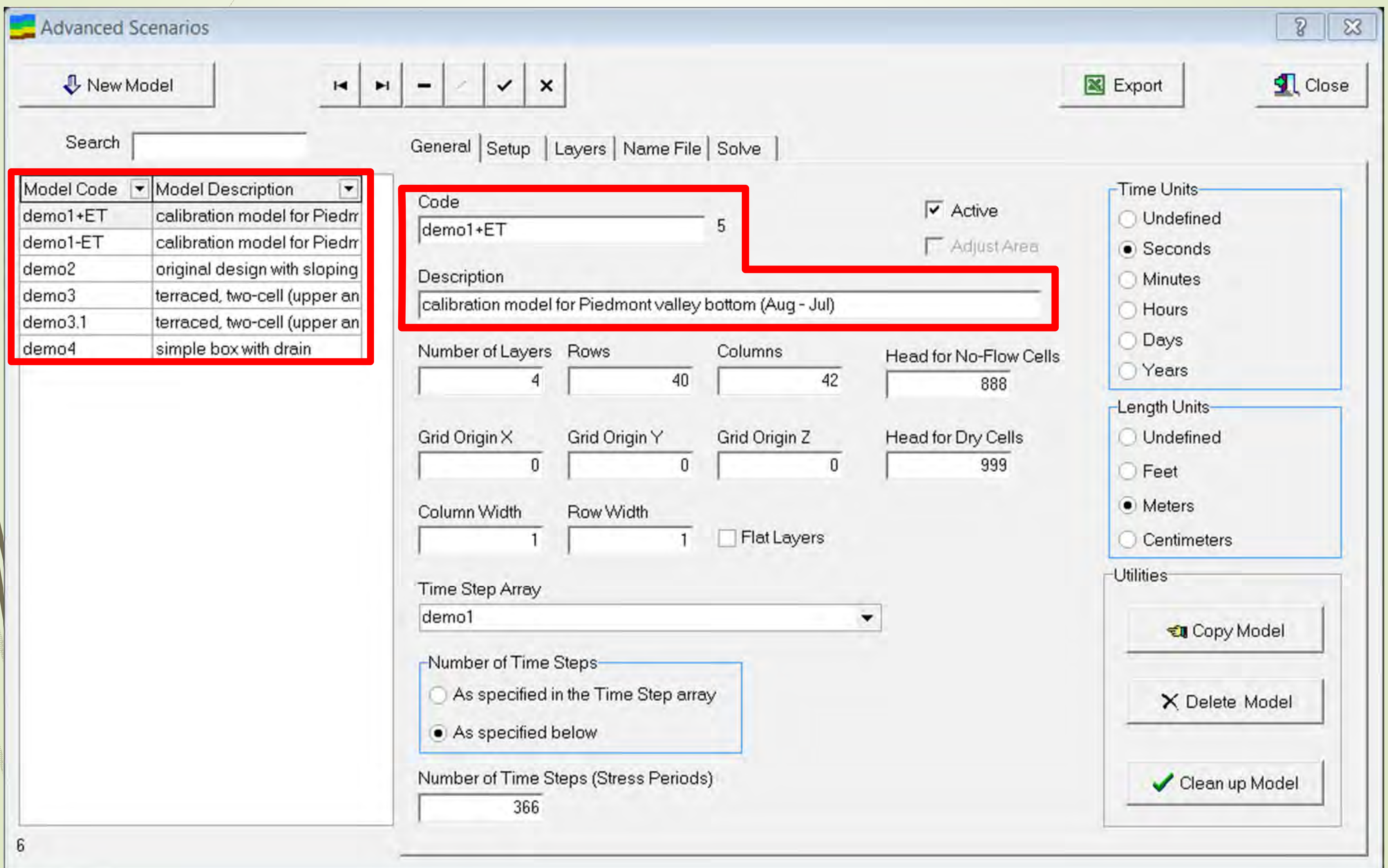

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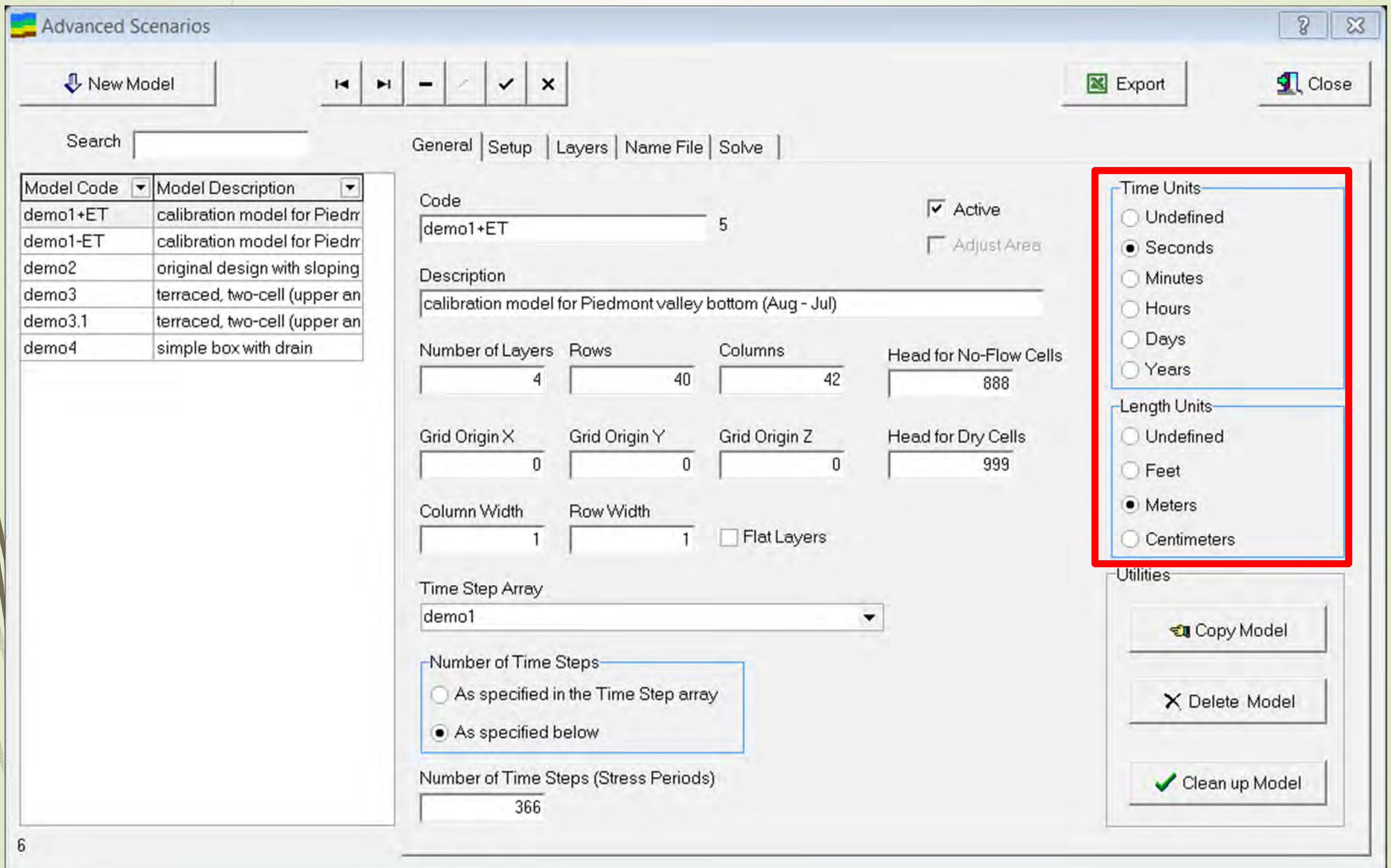

Advanced Model Setup

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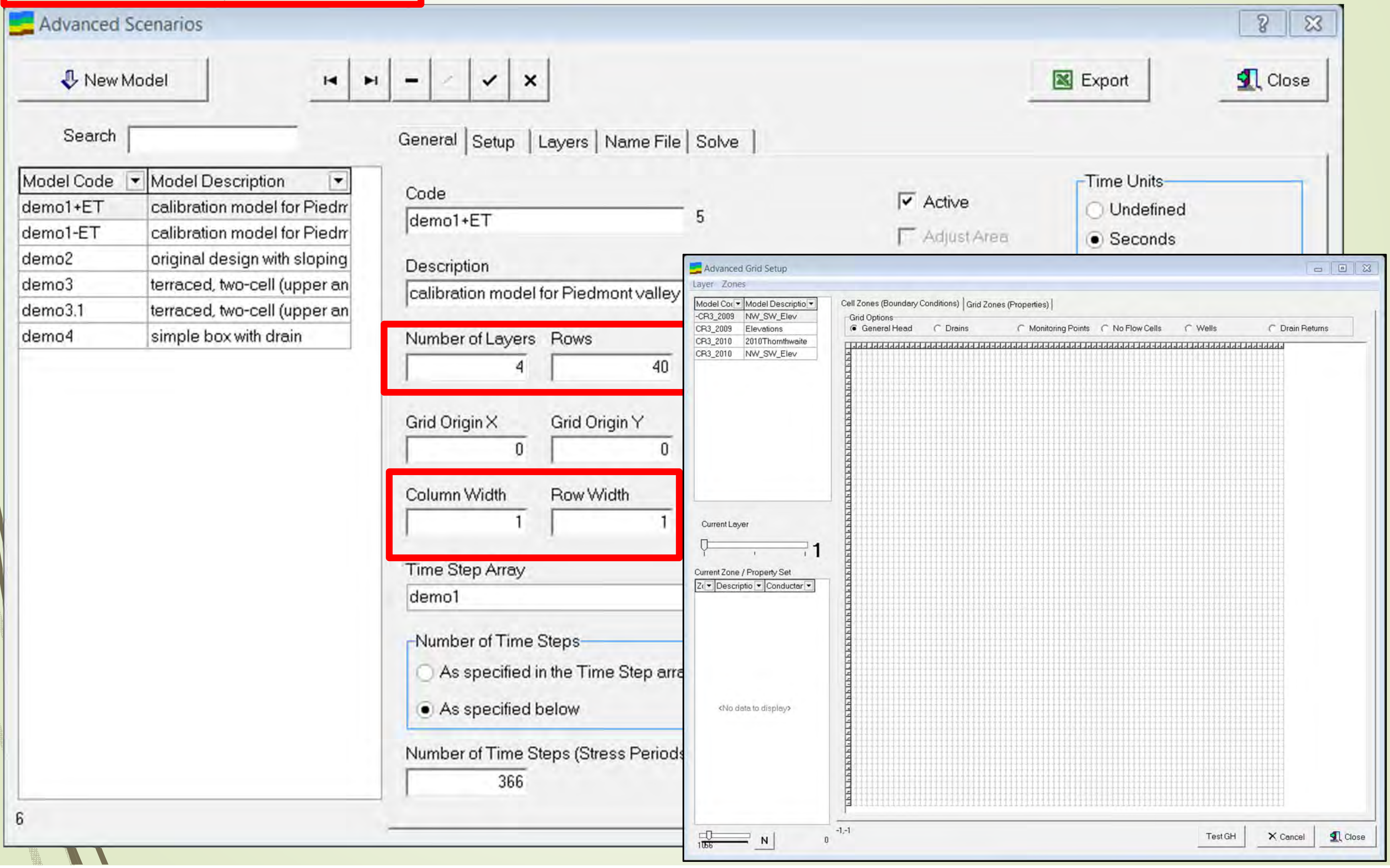

Advanced Model Setup – *General* tab

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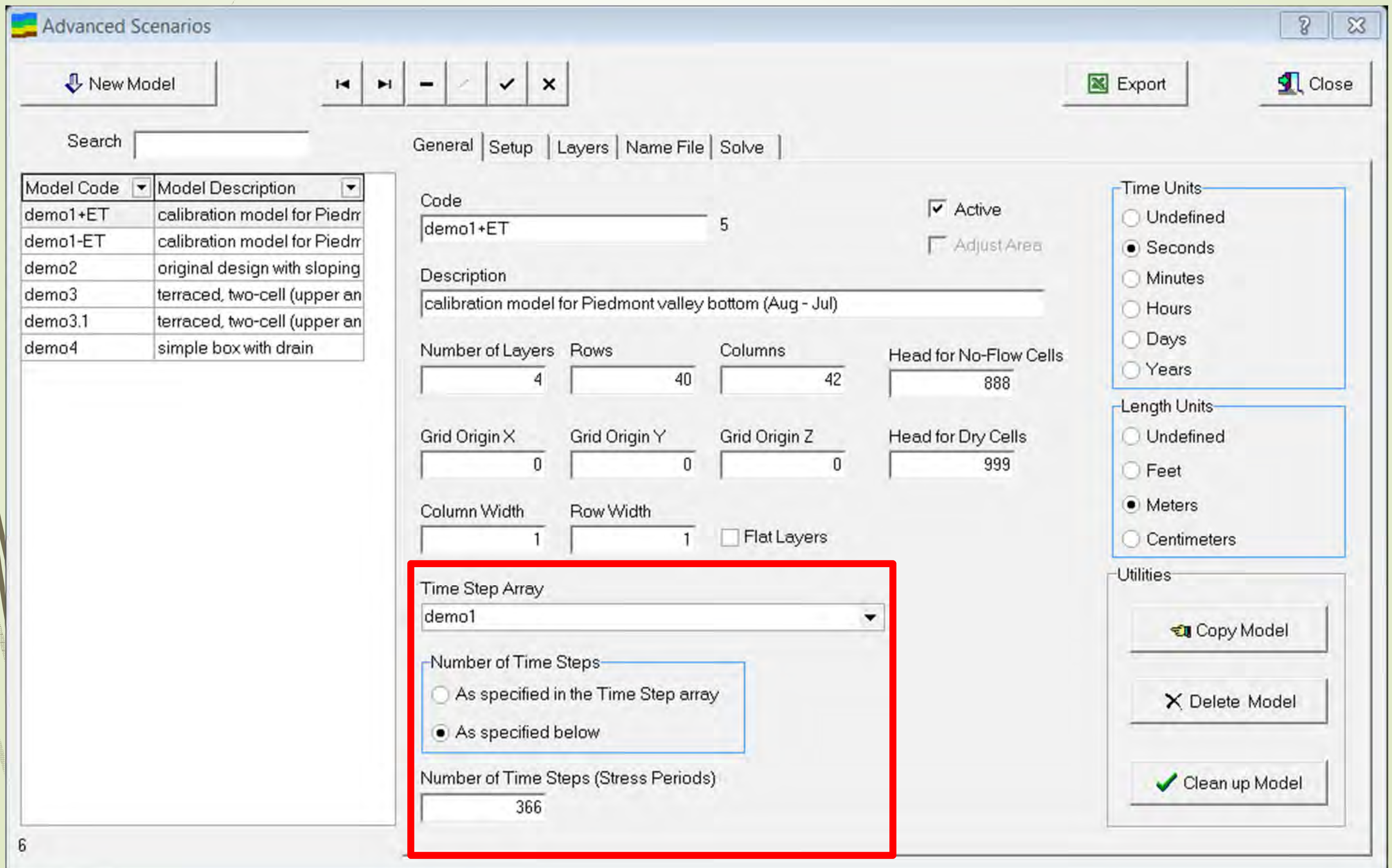
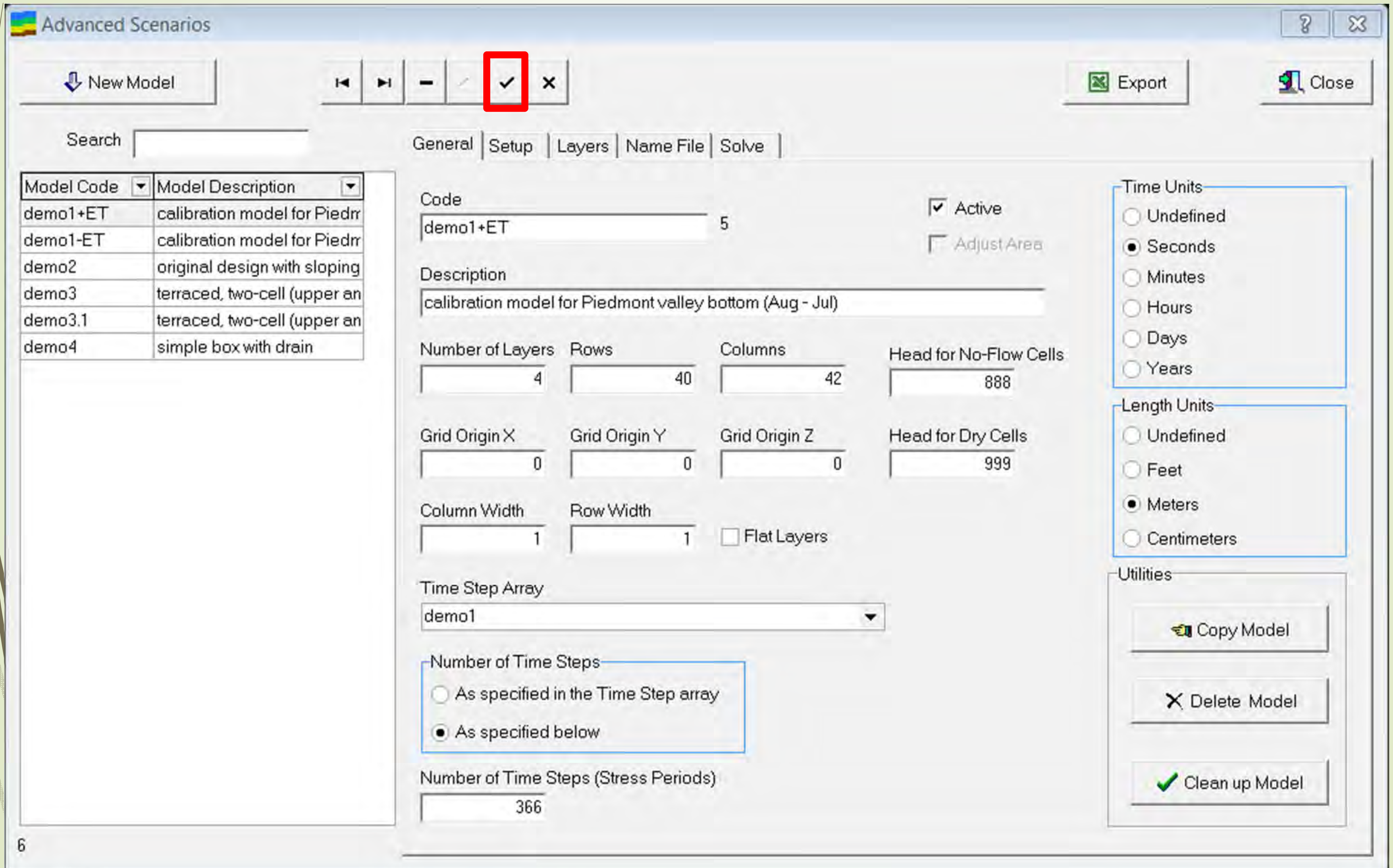


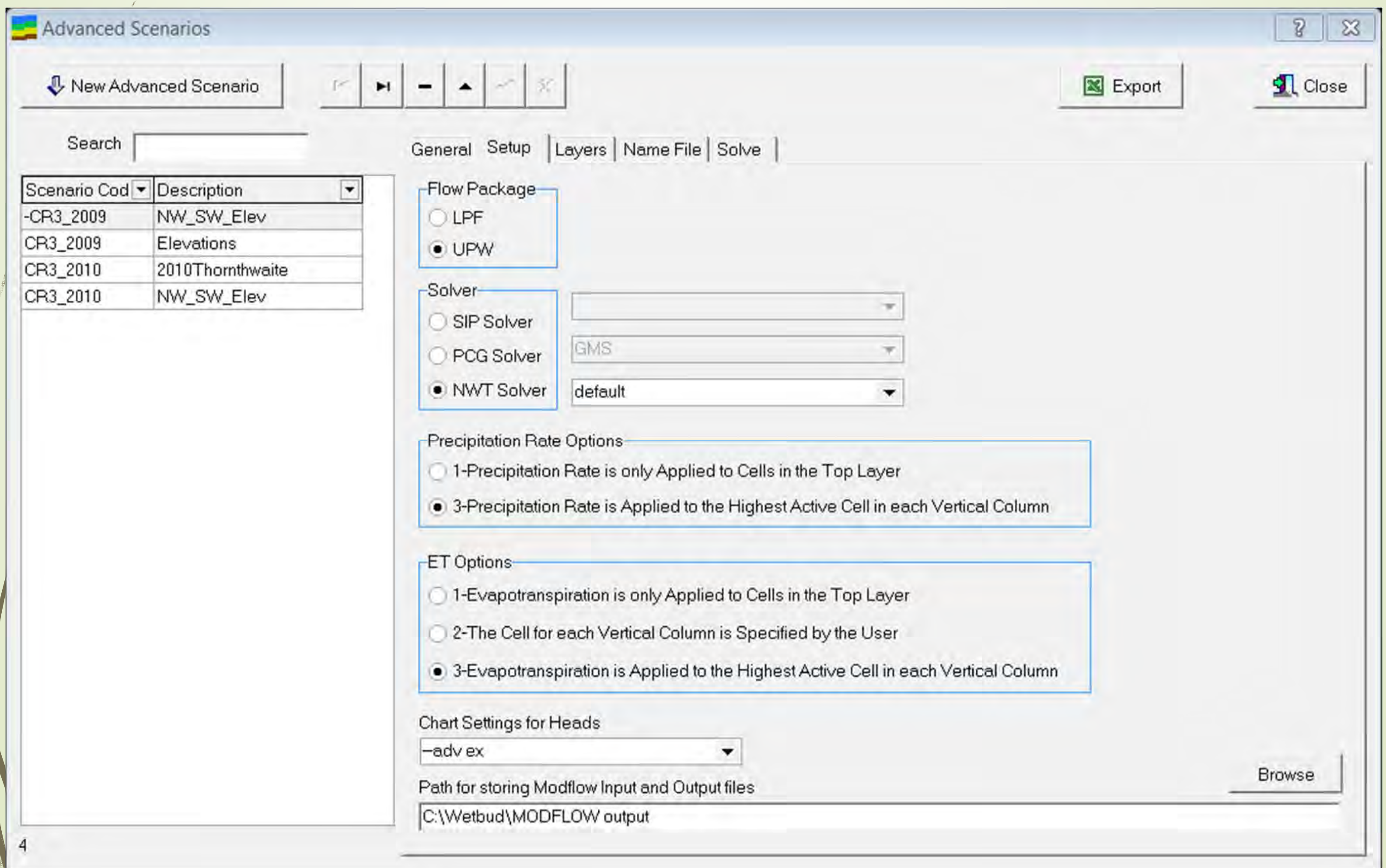
Advanced Model Setup – *General* tab

- Save



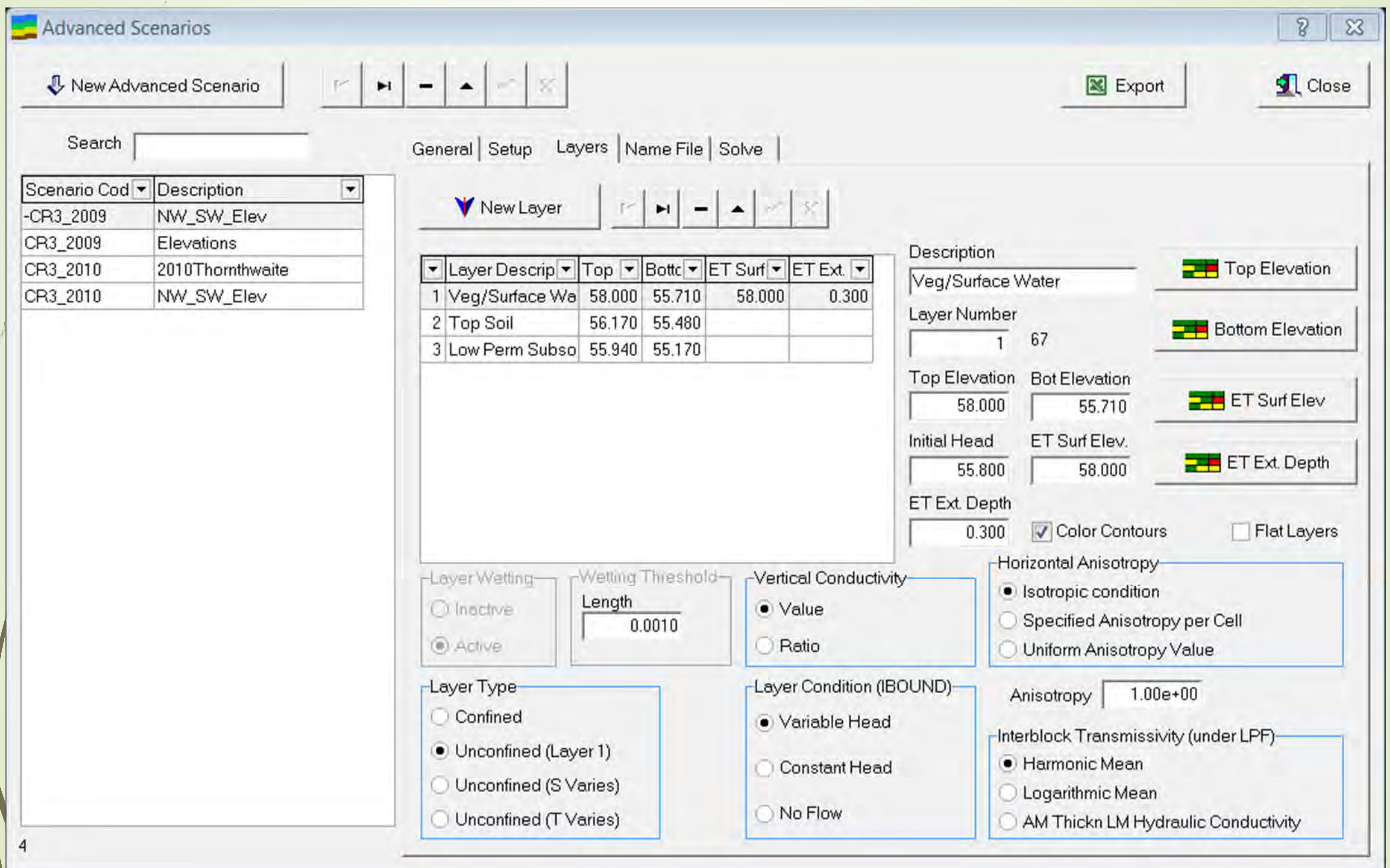
Advanced Model Setup – *Setup* tab

- Select a precipitation option, ET option, chart settings file, and assign the path for storing MODFLOW Input and Output files.



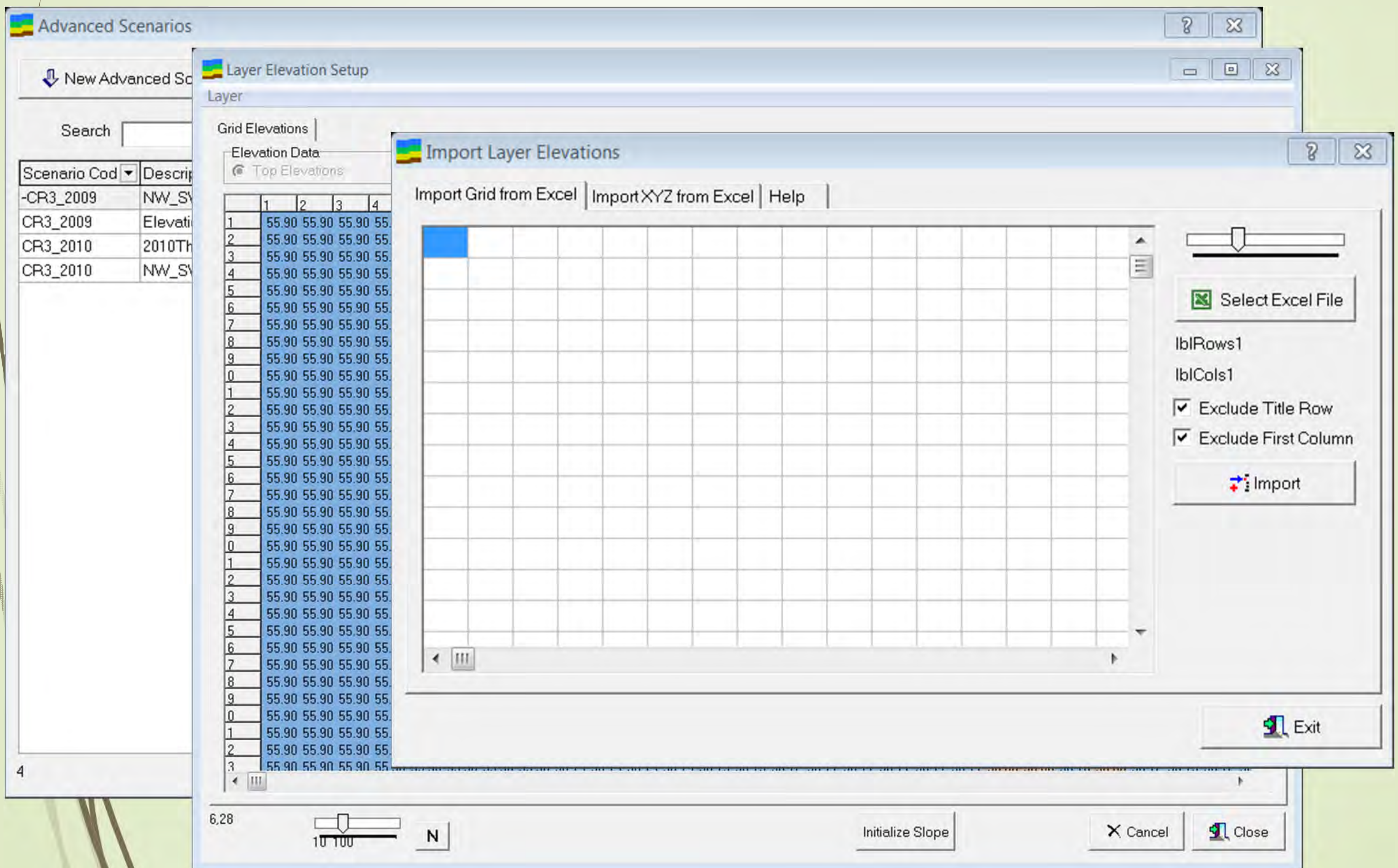
Advanced Model Setup – *Layers* tab

- Create all layers, import elevation data, and select layer parameters.



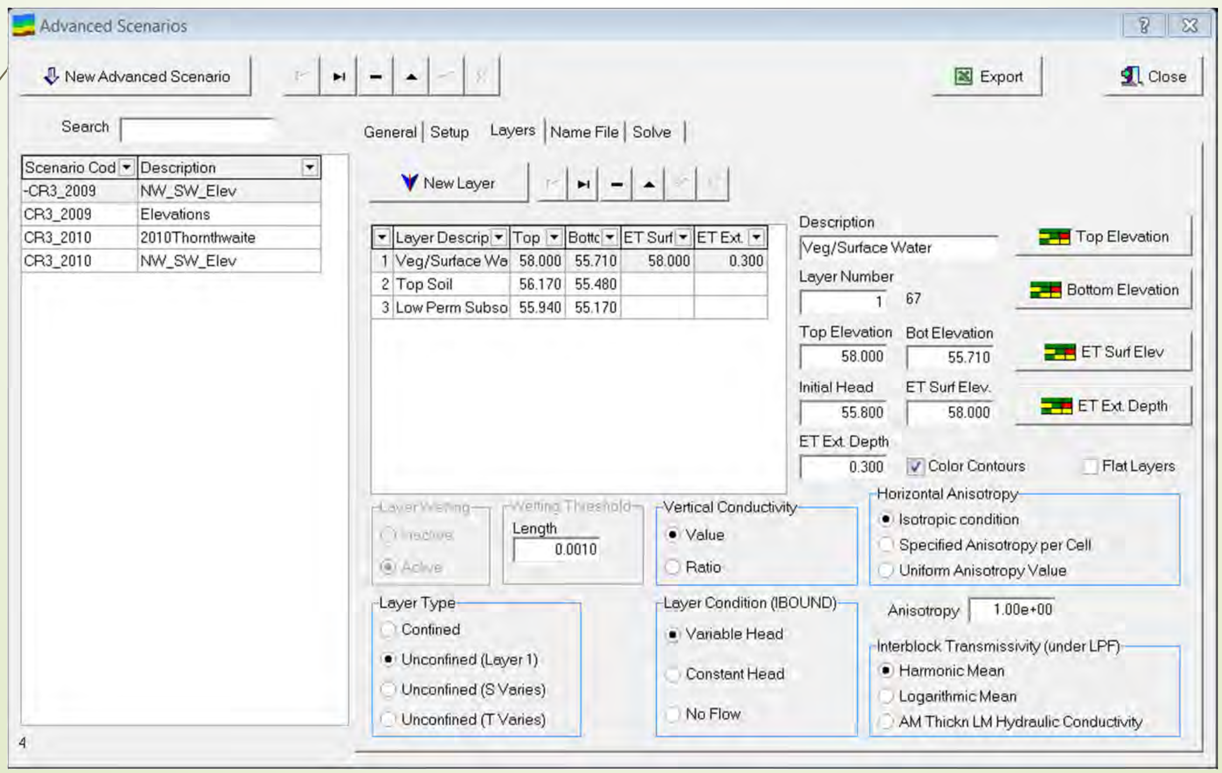
Advanced Model Setup – *Layers* tab

- Importing elevation data



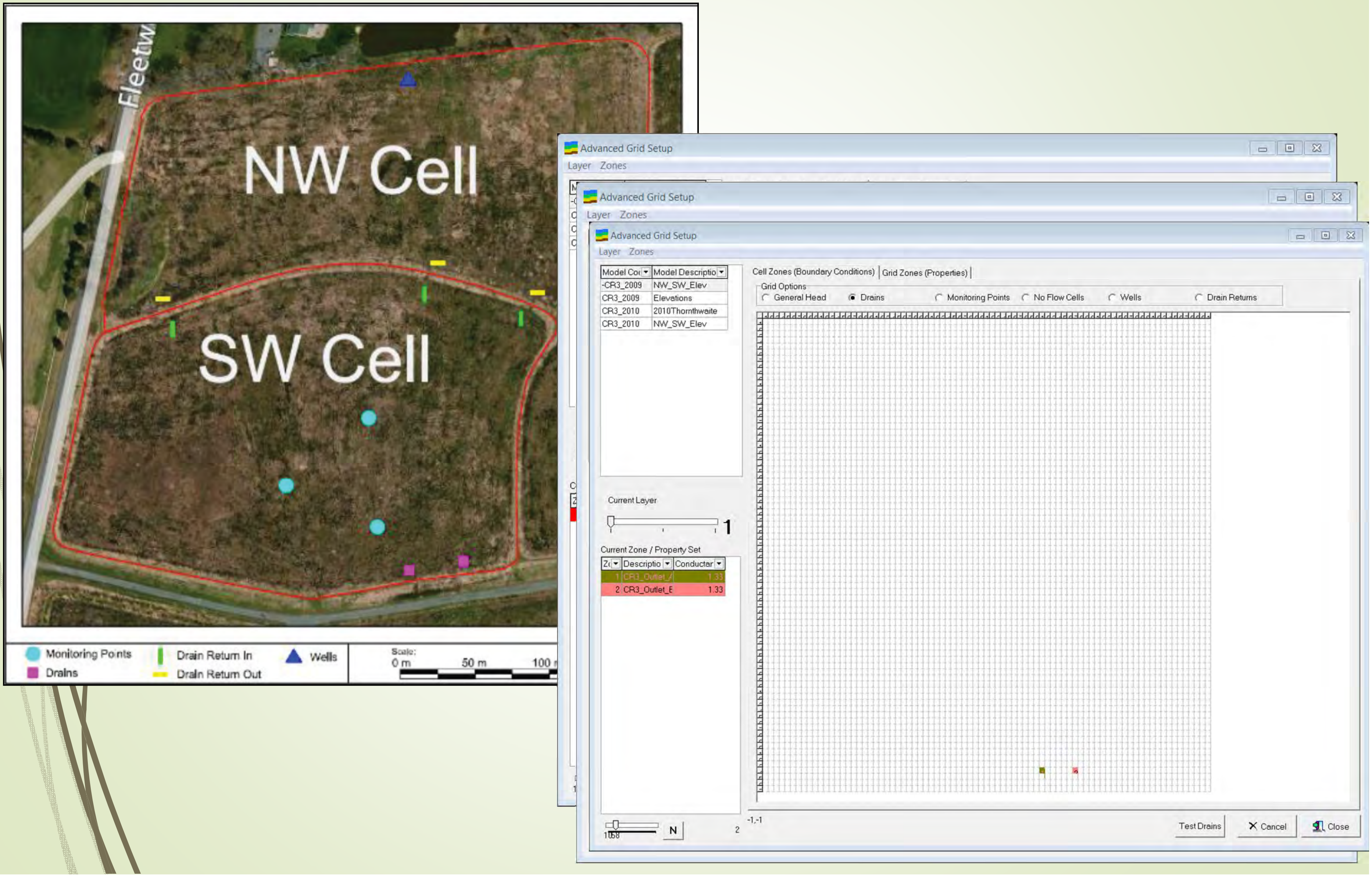
Advanced Model Setup – *Layers* tab

- Initial head
- ET surface elevation
- ET extinction depth



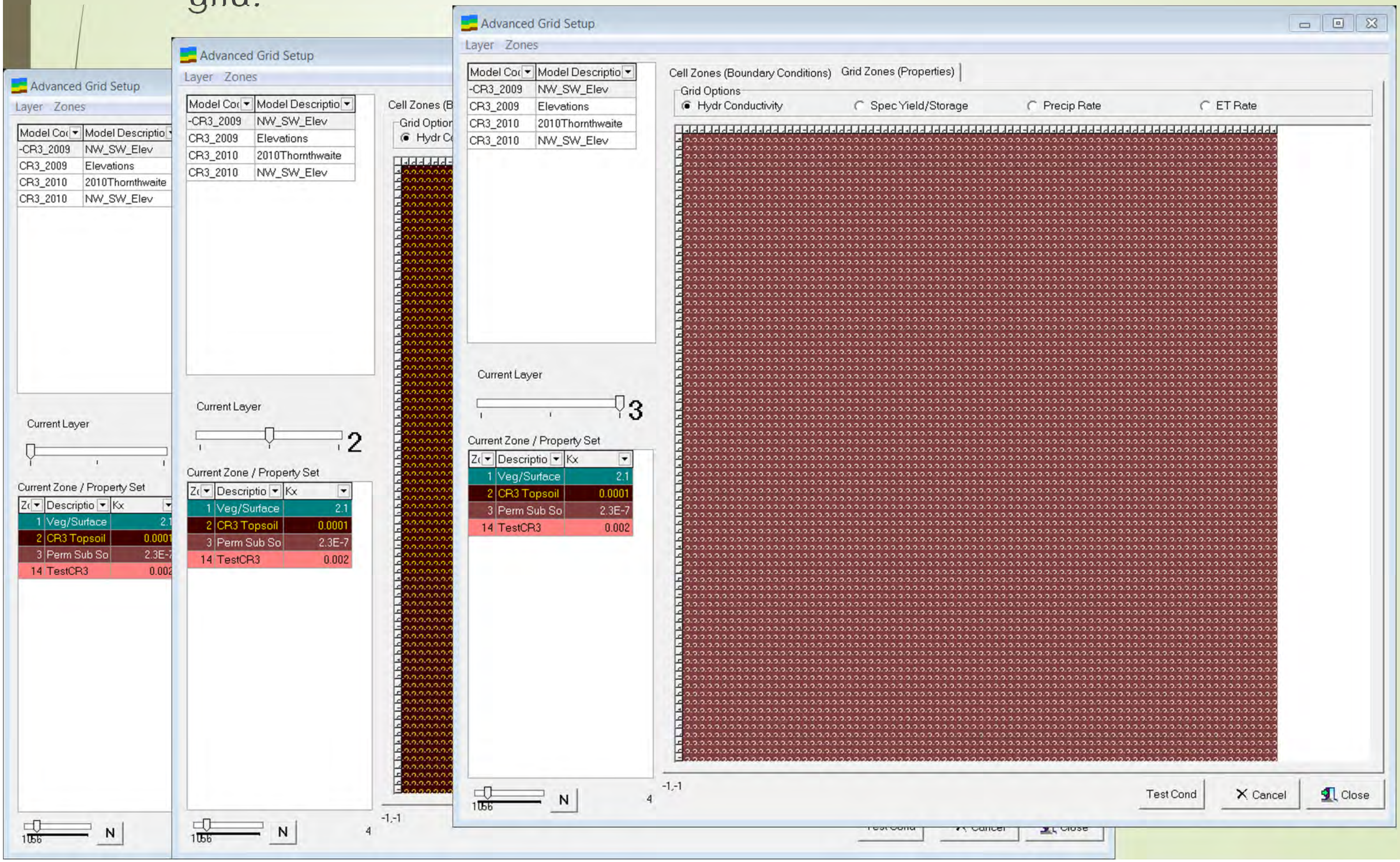
Advanced Model Grid Setup – Cell Zones

- Assign Cell Zones(Boundary Conditions) to cells in the model grid.



Advanced Model Grid Setup – Grid Zones

- Assign Grid Zones(Properties)to every cell in each layer of the model grid.



Advanced Model Grid Setup – Grid Zones

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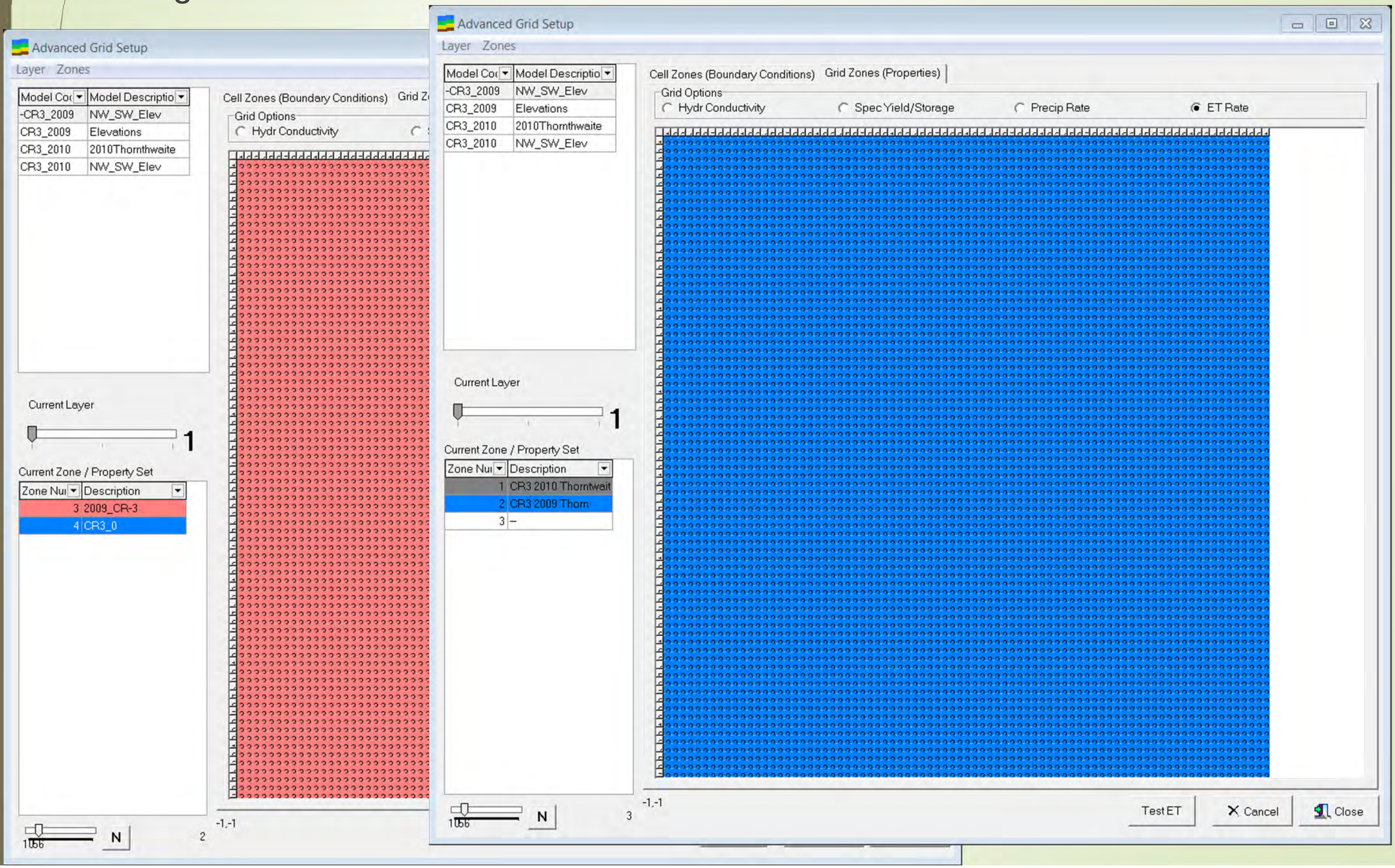
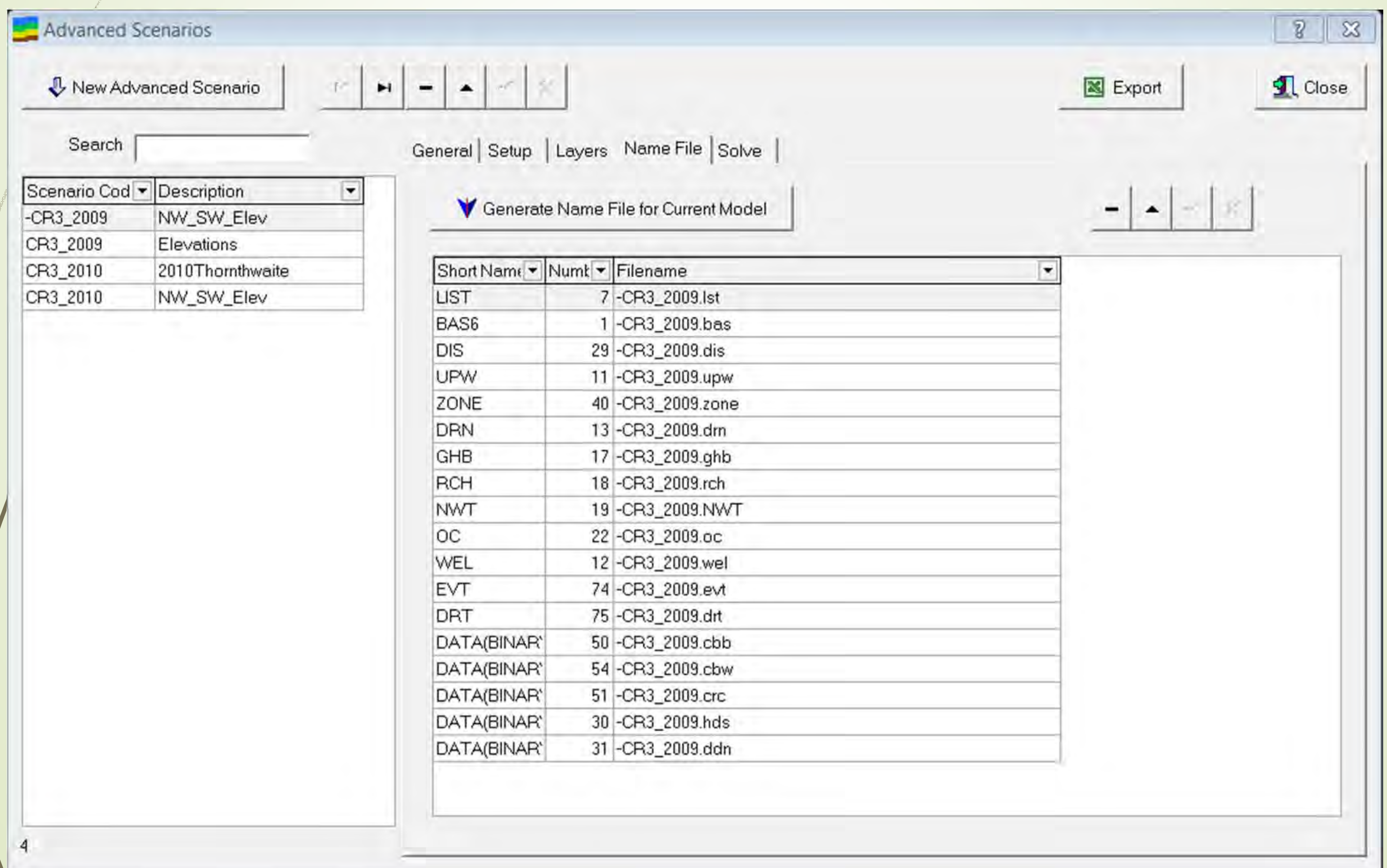


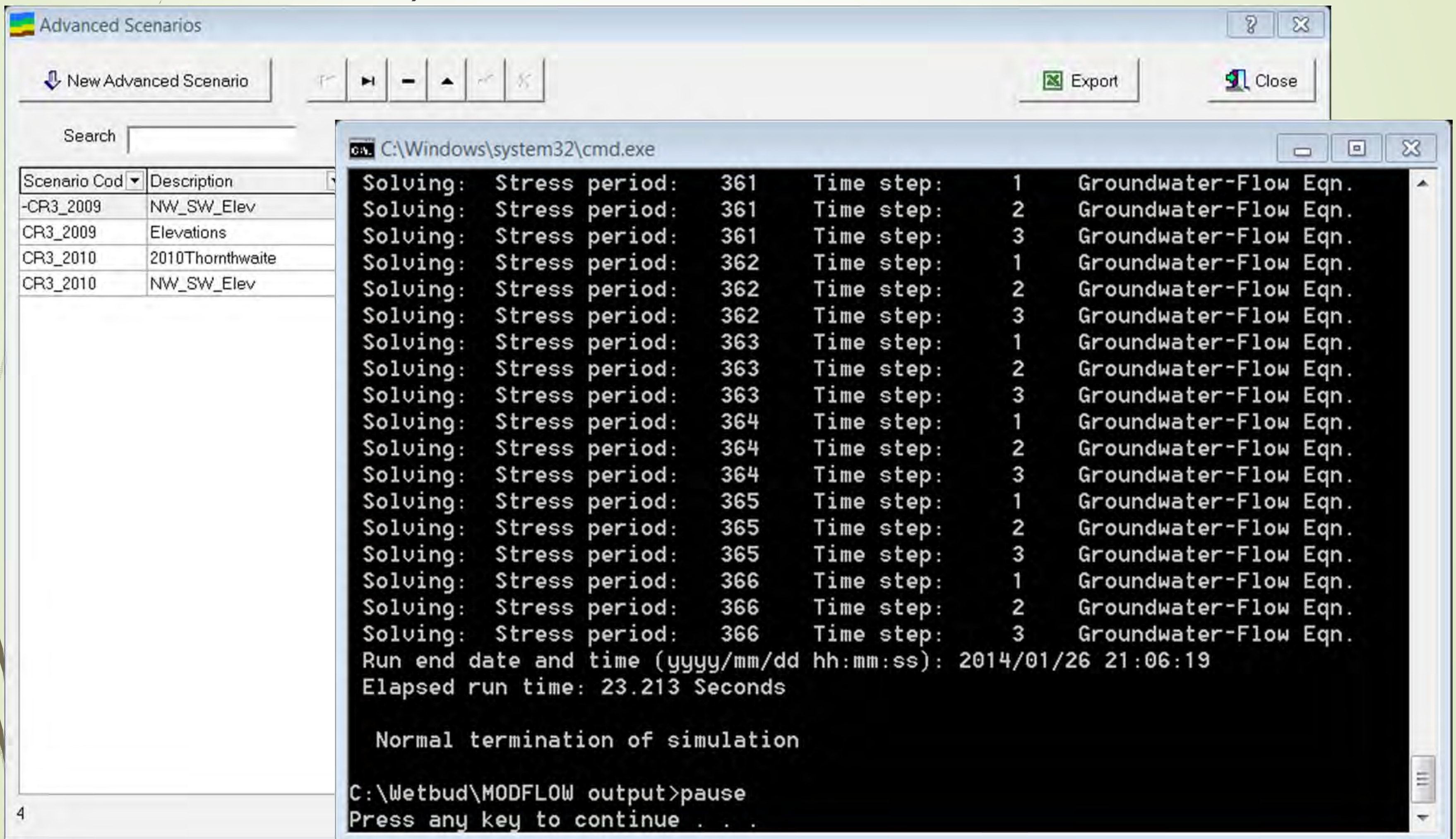
Advanced Model Output

- Once grid setup is complete, return to Advanced Scenarios window.
- In the *Name File* tab, generate name files for the current scenario. Save and proceed to the *Solve* tab.



Advanced Model Output

- In the Solve tab, create MODFLOW input files, execute MODFLOW, and show Model results (see ***Section 4.7. Advanced Model Output*** for more information).



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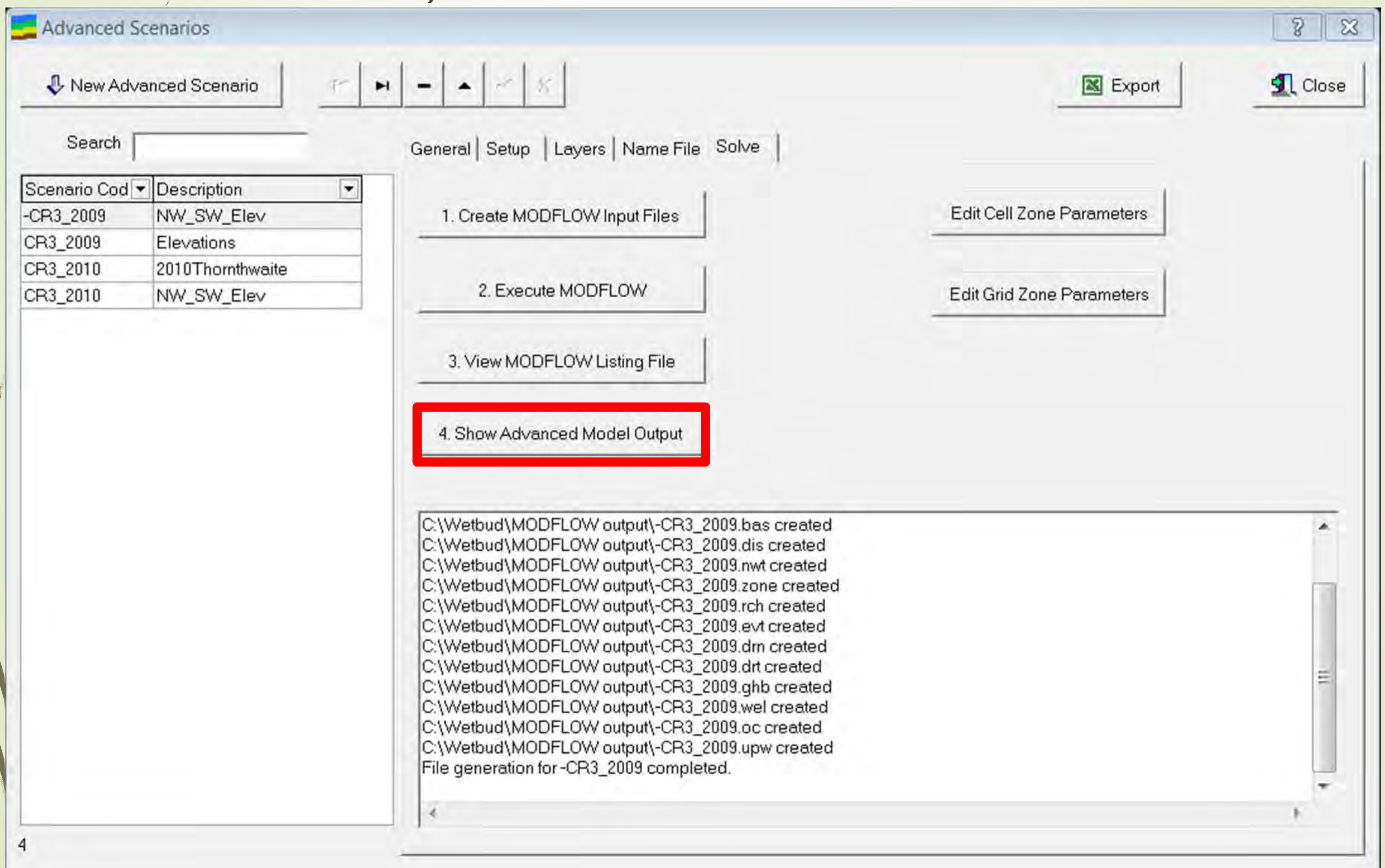
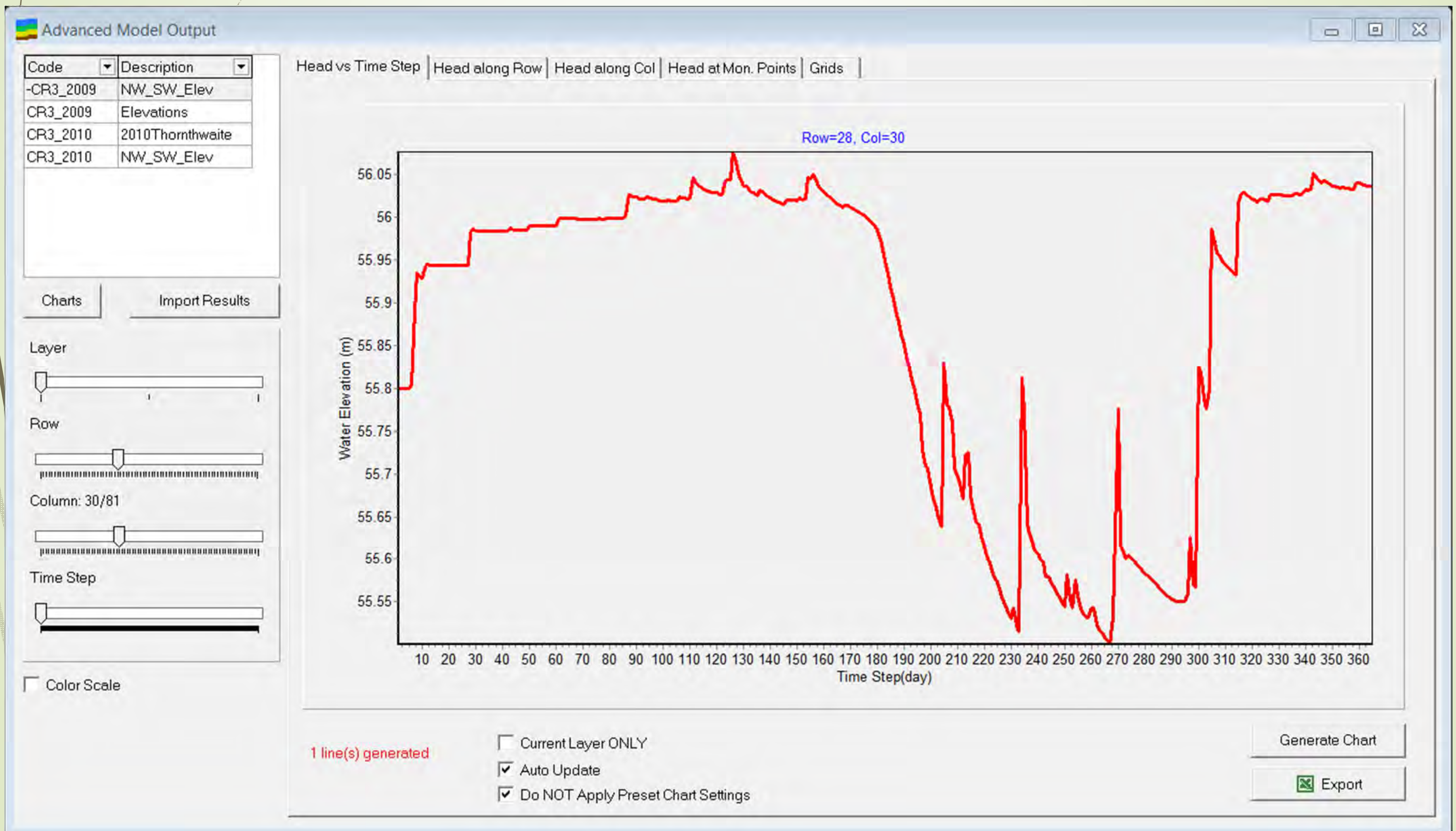


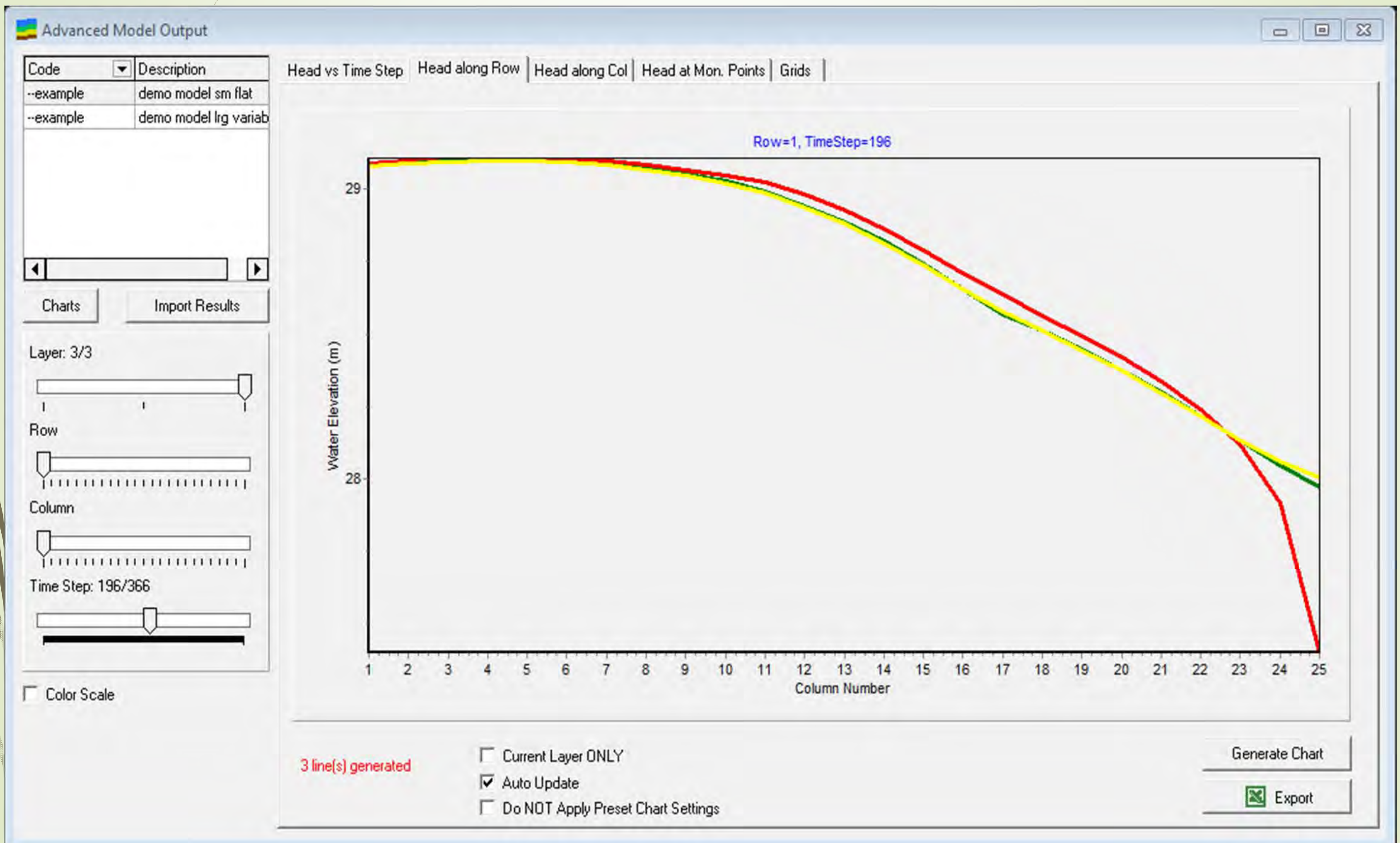
Advanced Model Output – **Head vs. Time Step**

- In the Advanced Model Output window, import results and generate charts in the output display tabs.



Advanced Model Output – **Head along row**

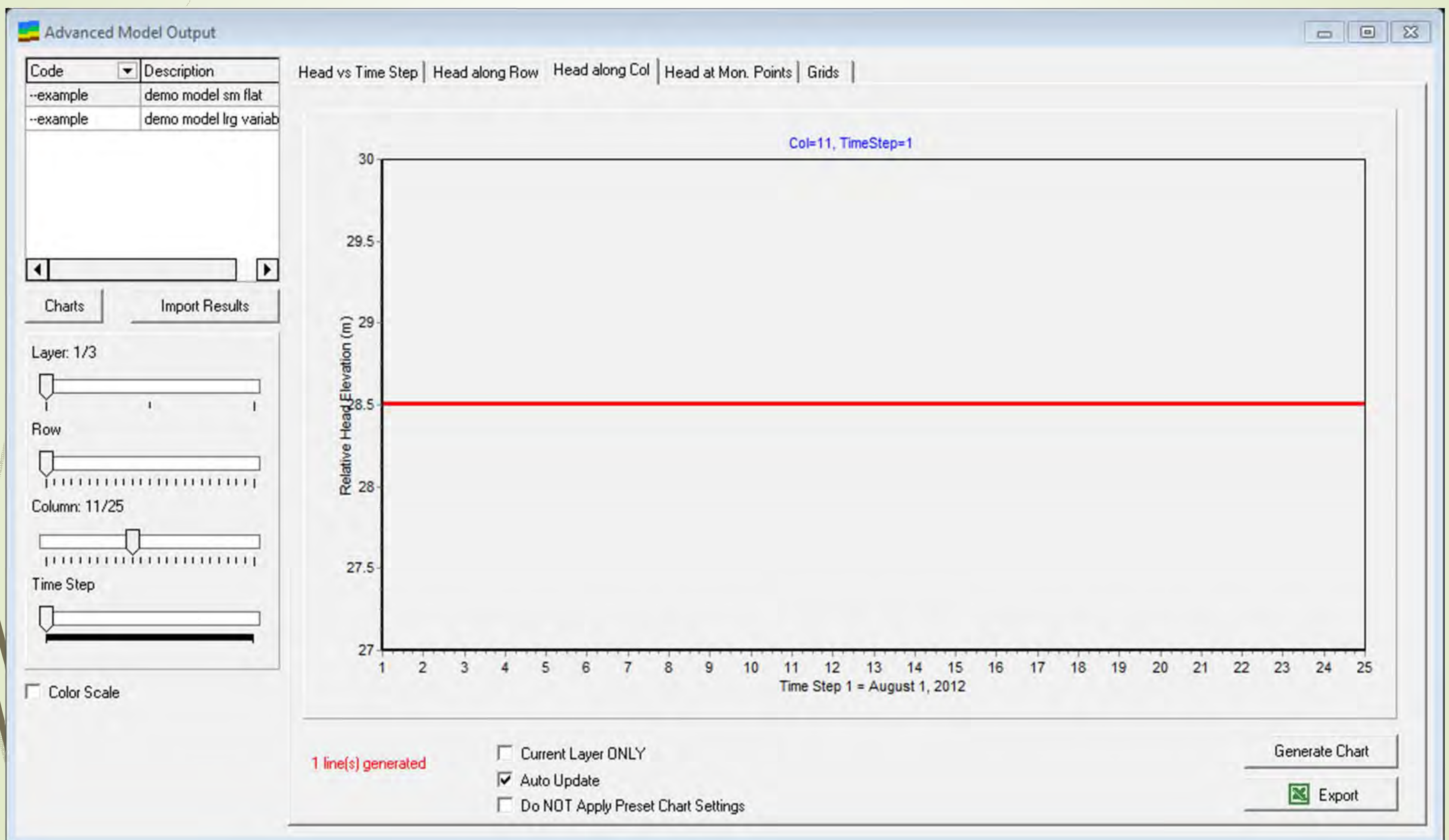
- In the Advanced Model Output window, import results and generate charts in the output display tabs.



Output shown here not from CR3

Advanced Model Output – **Head along col**

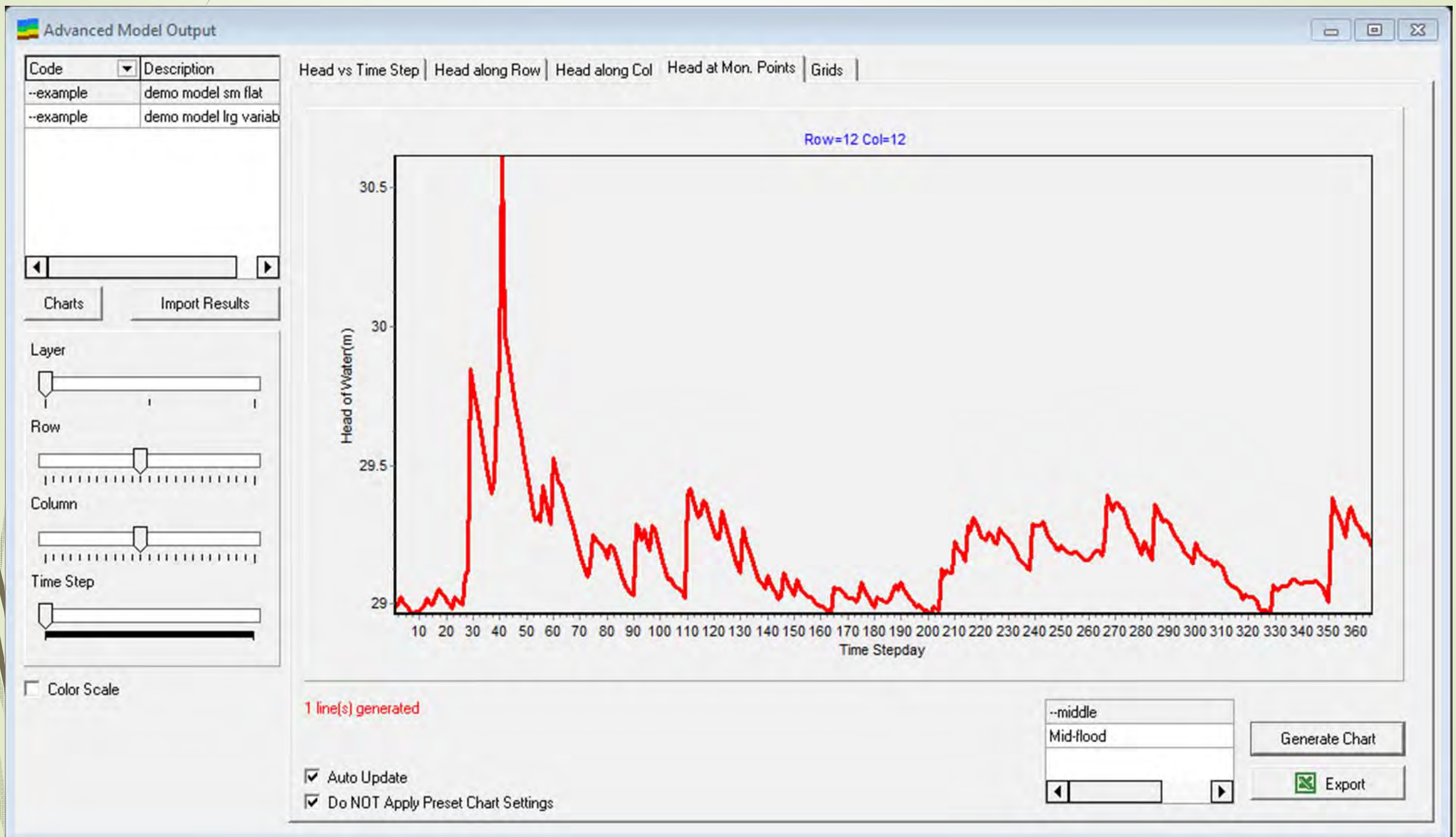
- In the Advanced Model Output window, import results and generate charts in the output display tabs.



Output shown here not from CR3

Advanced Model Output – **Mon. points**

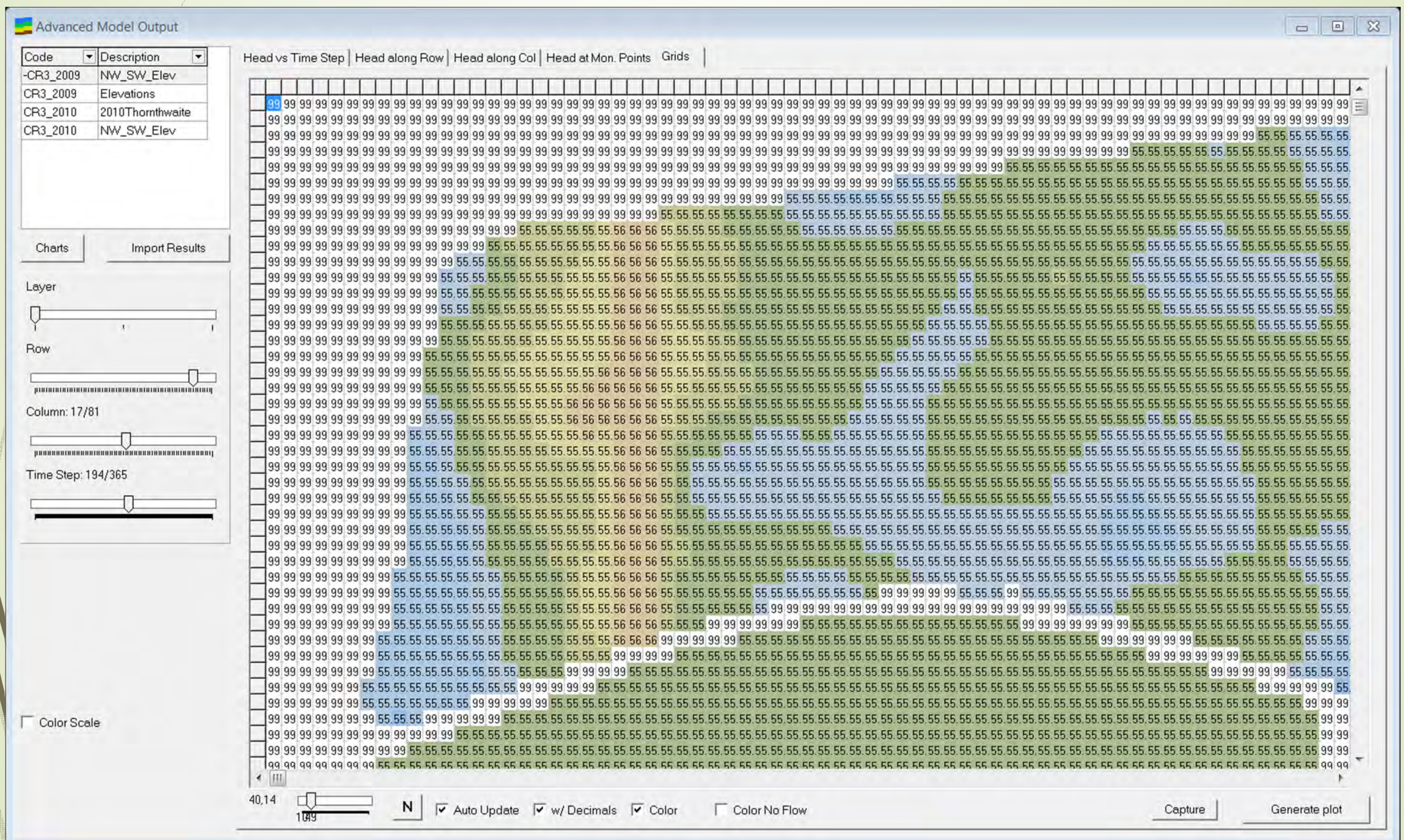
- In the Advanced Model Output window, import results and generate charts in the output display tabs.



Output shown here not from CR3

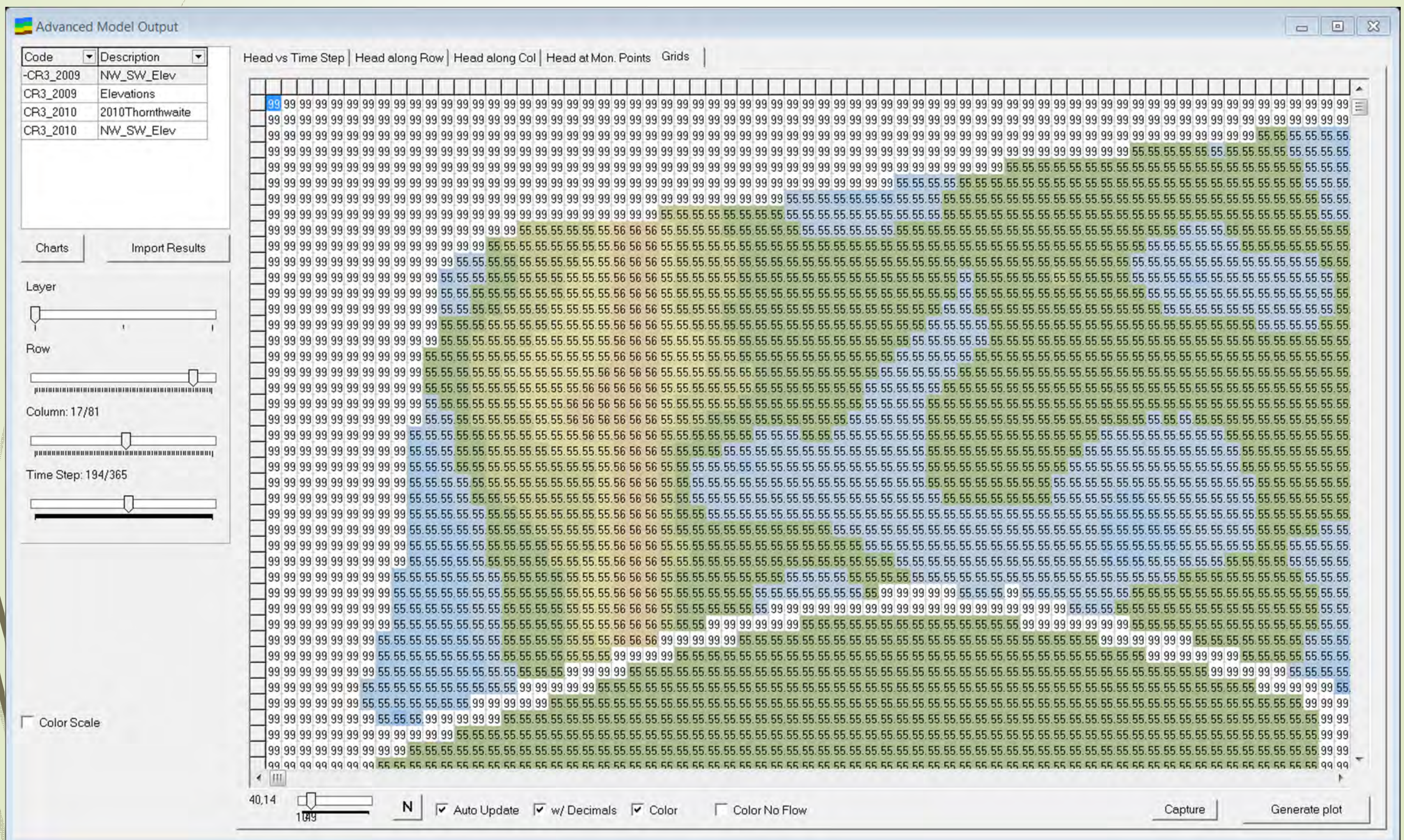
Advanced Model Output - **Grids**

- In the Advanced Model Output window, import results and generate charts in the output display tabs.



Advanced Model Output - **Grids**

- In the Advanced Model Output window, import results and generate charts in the output display tabs.



Advanced Model Output - **Grids**

More to come after lunch...

...questions?