



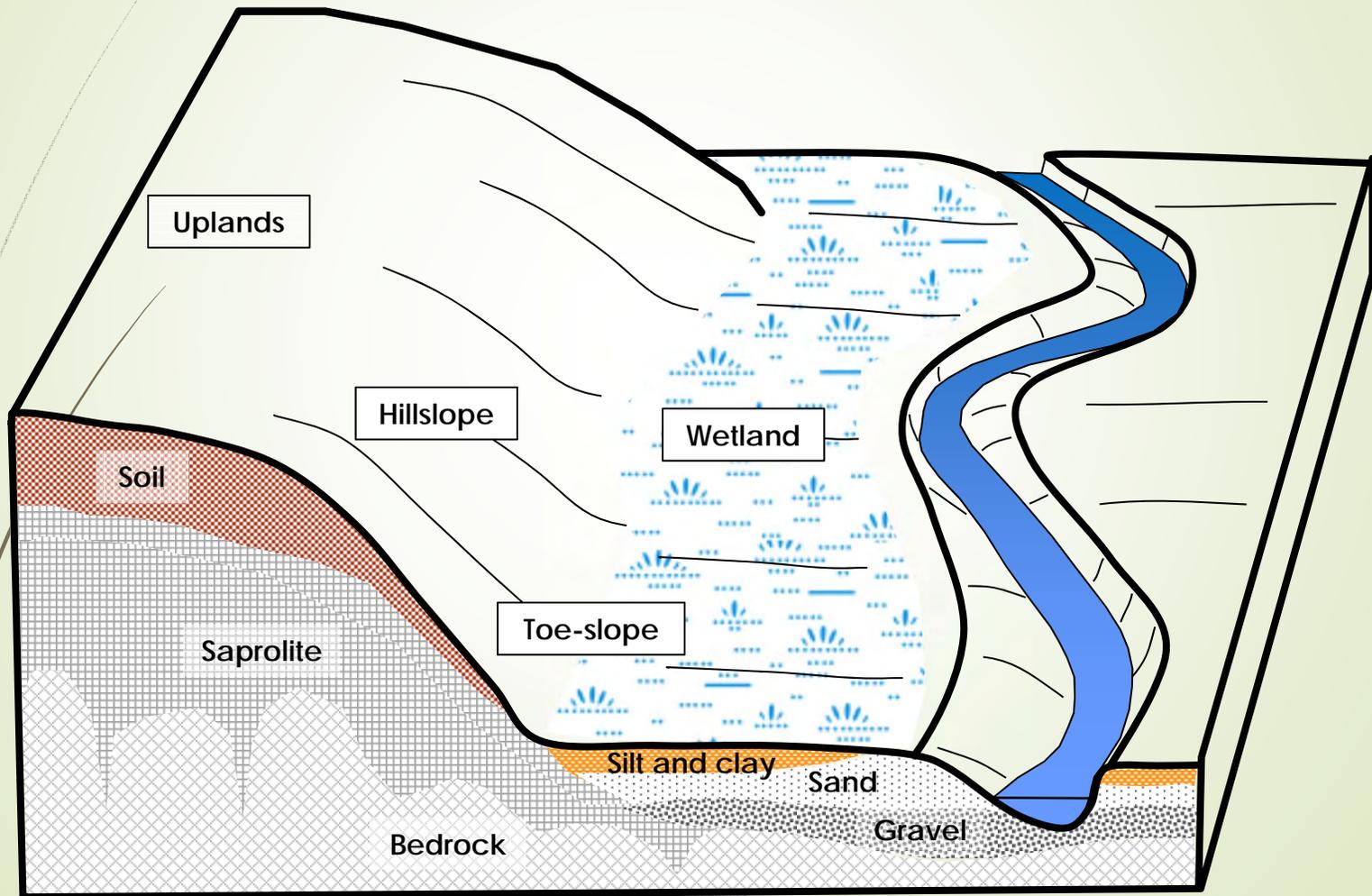
# **Building Basic and Advanced Model Scenarios in WetBud**

Kerby Dobbs

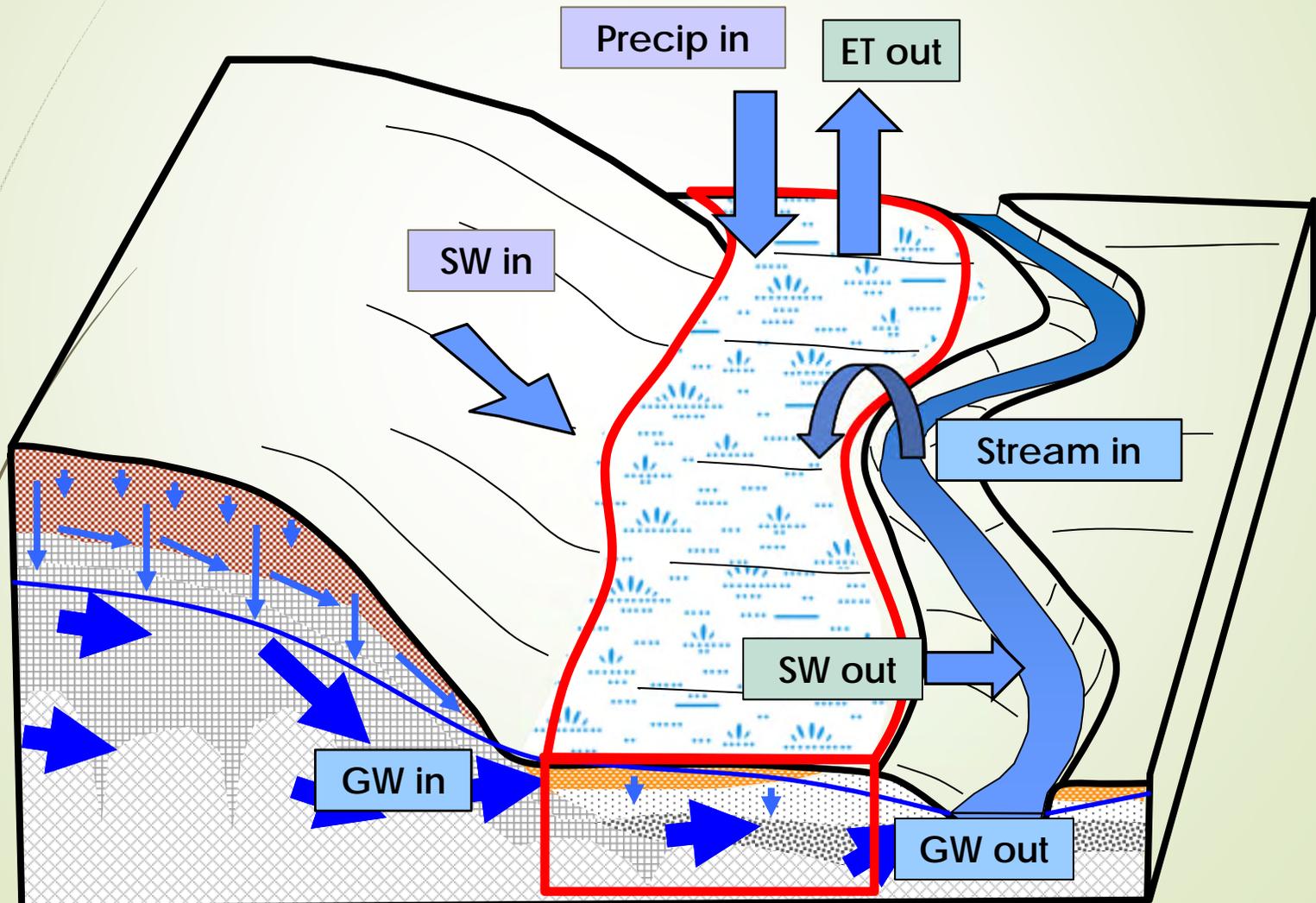
# Overview

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

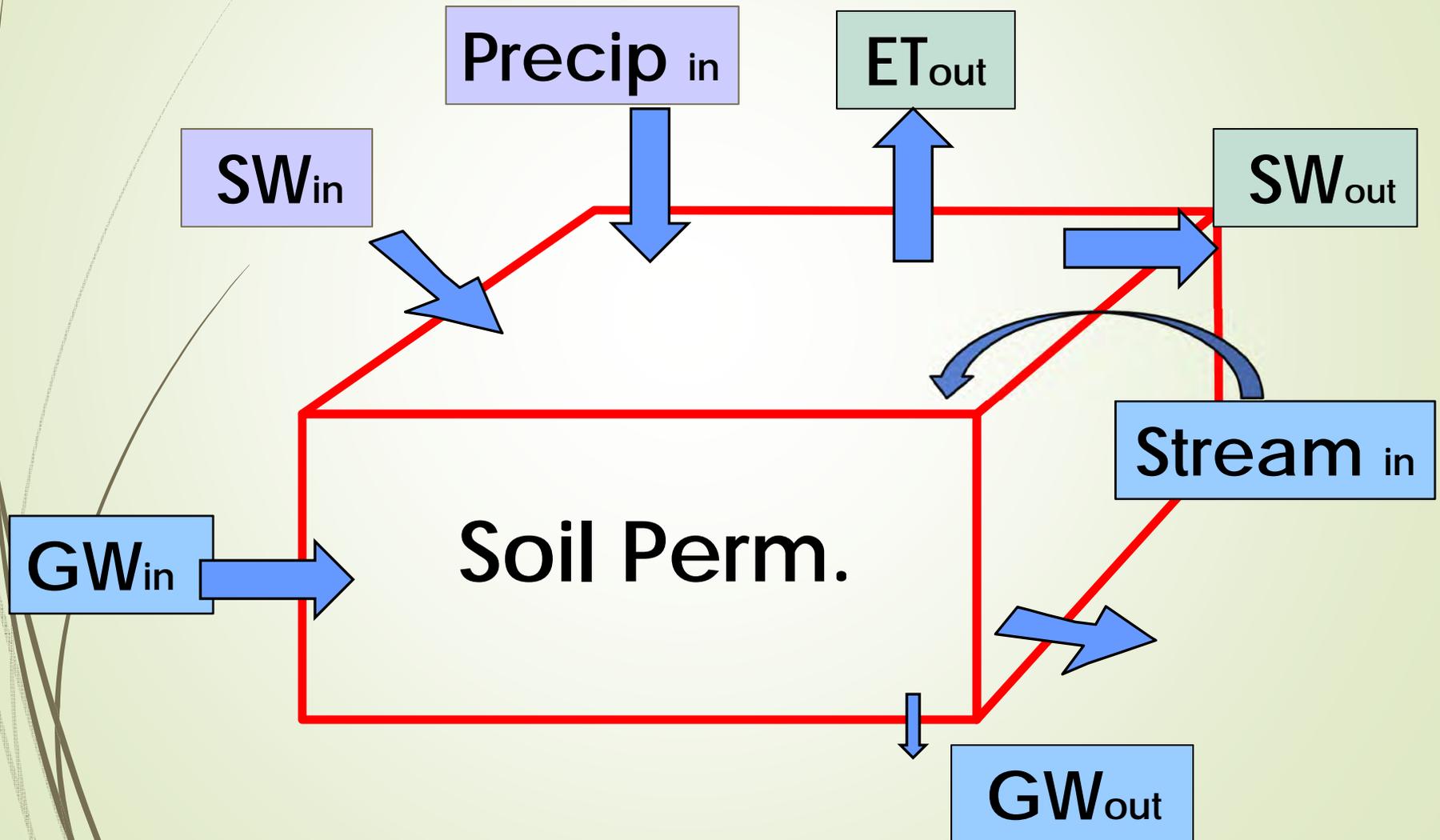
# Wetland/Project Site



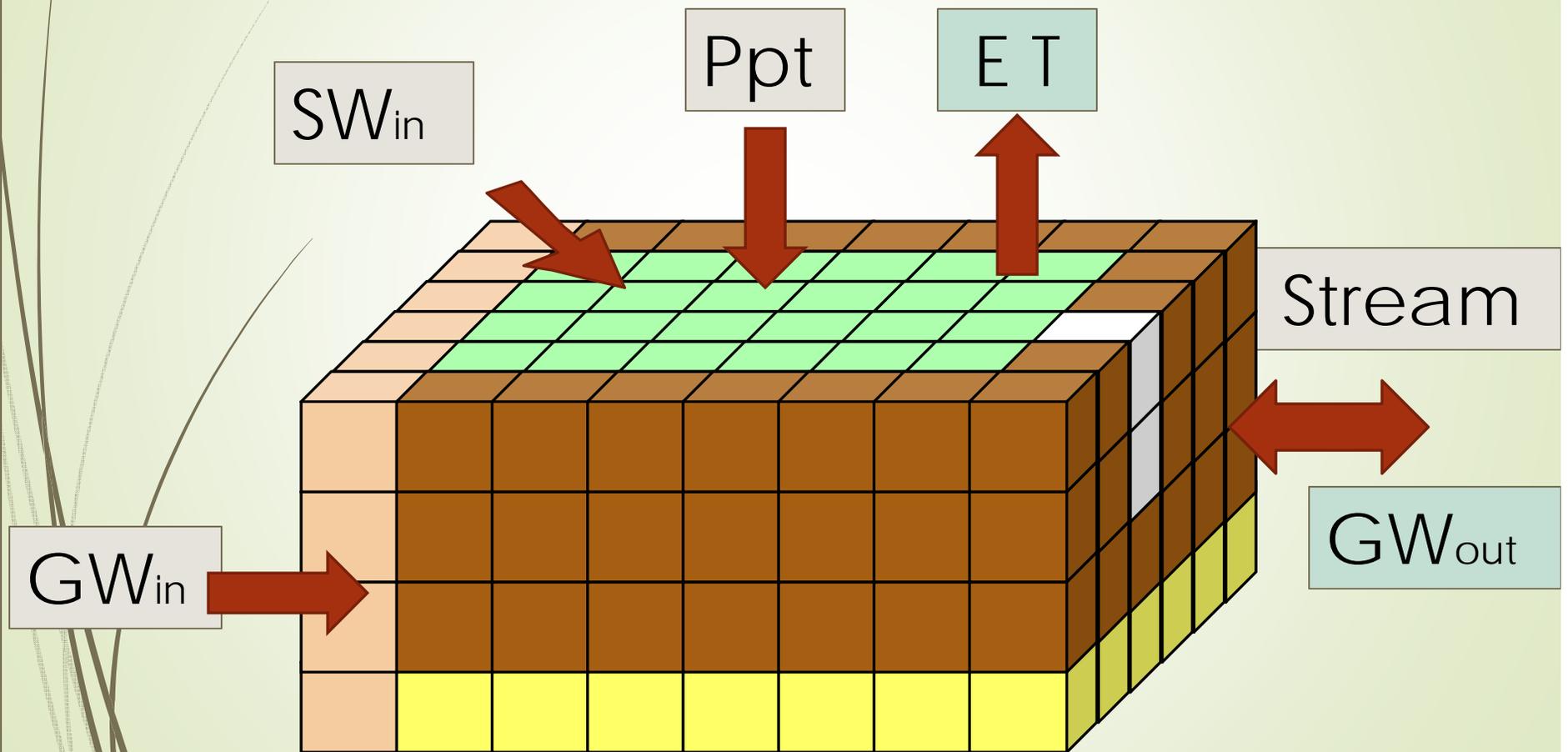
# Wetland/Project Site



# WetBud Basic Model – Mass Balance

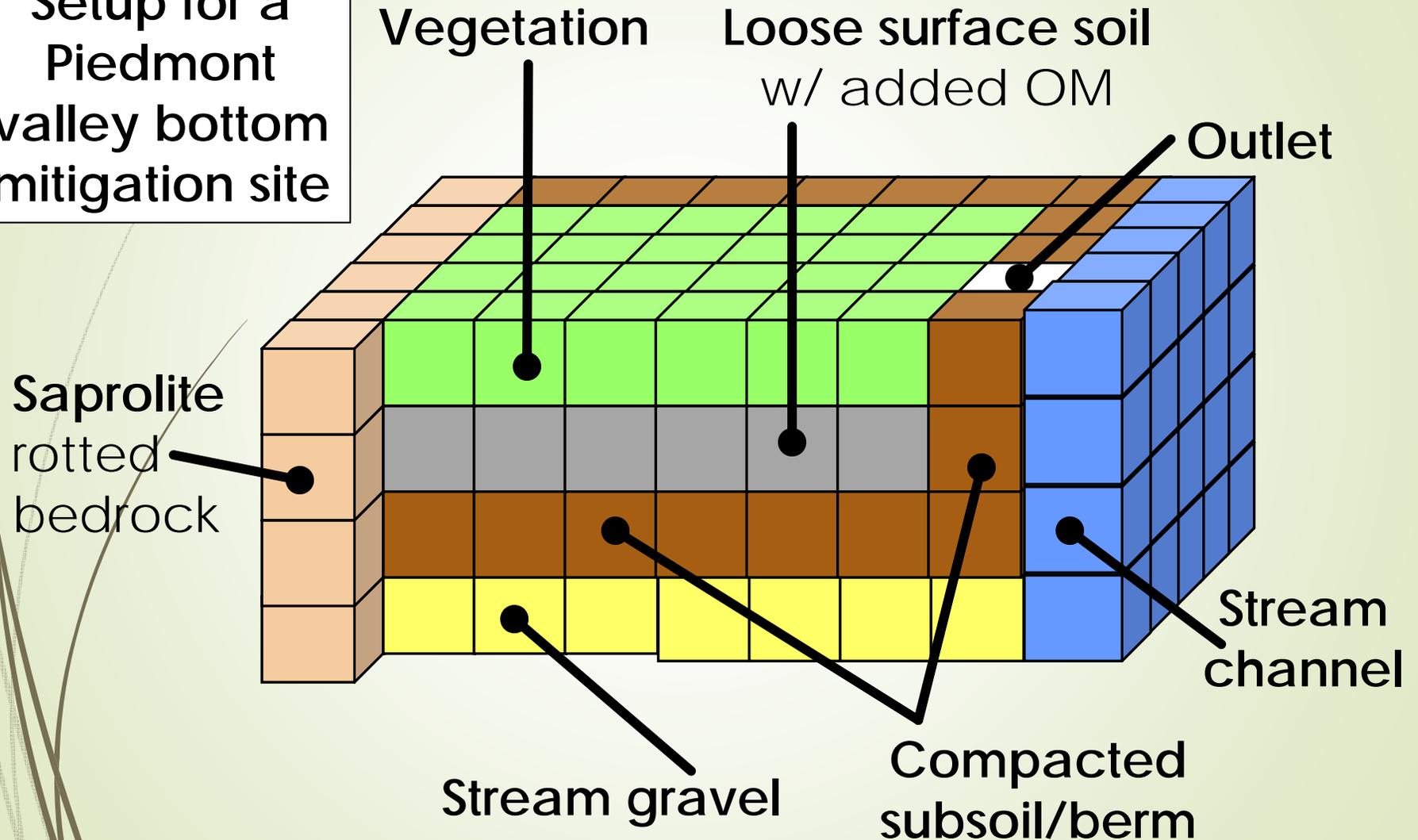


# WetBud Advanced Model – Finite-difference Grid



# WetBud – Advanced Version

Setup for a  
Piedmont  
valley bottom  
mitigation site



# 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

- ▶ Create weather station record

Weather Station Data - GSOD (NOAA)

Create New Station

Search by Code by Location

Code	WBAN	Location
		Great Dismal NWR
-Bedford		montvale project
00440385		Back Bay National W
00446906	-	Powhatan, VA
00448192	-	Suffolk Lake Kilby
00449213	-	Winterpock 4W, VA U
13740	13740	Richmond, VA
720498	99999	CHESTERFIELD AIR
722692	99999	Warrenton, VA
723075	13769	Oceana, VA
723075	13769	OCEANA NAS
723080	13737	Norfolk, VA
723085	13750	NORFOLK NS
723260	13891	Knoxville Municipal
724006	03701	CHESAPEAKE RGNL
724007	03719	Suffolk Executive
724007	99999	Suffolk Executive2
724010	13740	Richmond, VA
724020	93739	WALLOPS ISL STN
724030	93738	Sterling, VA - IAD
724036	03710	Manassas Regional /
724036	99999	2.Mannassas Region
724070	93730	ATLANTIC CITY INTL
724100	13733	Lynchburg, VA

General | Precipitation Info | Management | Help

Station Code - Site Code (WMO ID)  
724030 1

WBAN ID Number: 93738 COOP-ID: 448903 Call Sign: IAD / KIAD

Latitude: 38.00 Longitude: 77.00

State: VA

Location: Sterling, VA - IAD

Data Available From: Data Available To:

Comment: 38°56'N / 77°28'W, 88.4m (290') above s/l

# Precipitation data

- Download and import from web or manually import data:

The screenshot shows the 'Precipitation Data for GSOD Stations (NOAA)' application. The interface includes a menu bar with options like 'Available Data', 'Web Retrieval', 'Copy Station Data', 'Import from Excel', 'Import GHCN', and 'Help'. The main area is divided into three sections:

- Stations GSOD (NOAA):** A list of stations with columns for Code and Location. The list includes stations like 'Great Dismal NWR', 'Back Bay National', 'Powhatan, VA', etc.
- Precipitation Annual Log:** A table with columns for Year, Date, and precipitation values. The table shows data for the year 2013, with columns for 'Date', 'Mo', 'Sum', and 'Con'. The data rows range from 1973 to 1992.
- Control Panels:** On the right, there are panels for '1. Download Data' and '2. Import Data'. The 'Download Data' panel includes options for 'Year(s) to Download and Import' (set to 723075), 'Range of Years' (Single Year), 'From Year' (1973) and 'To Year' (2013), and 'Available Dates' (From Date: 1973-01-01, To Date: 2013-06-04). There are also buttons for 'Download Data', 'Delete Temp Files', and 'Terminate Download'. The 'Import Data' panel includes a 'File Directory' field (C:\Users\kdobbs\Documents\MyWebBud\Data\precip\), a 'File Name' field (C:\Users\kdobbs\Documents\MyWebBud\Data\precip\), and a 'Progress Log' area.

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

Weather Data

Stations GSOD (NOAA)

Code	Location
—	Great Dismal NWR
—Bedford	montvale project
00440385	Back Bay National
00446906	Powhatan, VA
00448192	Suffolk Lake Kilby
00449213	Winterpock 4W, VA
13740	Richmond, VA
720498	CHESTERFIELD AI
722692	Warrenton, VA
723075	Oceana, VA
723075	OCEANA NAS
723080	Norfolk, VA
723085	NORFOLK NS
723260	Knoxville Municipal
724006	CHESAPEAKE RGT
724007	Suffolk Executive
724007	Suffolk Executive2
724010	Richmond, VA
724020	WALLOPS ISL STN
724030	Sterling, VA - IAD
724036	Manassas Regione
724036	2.Mannassas Regic
724070	ATLANTIC CITY IN
724100	Lynchburg, VA

Weather Data Log

Year	Date Modified	Comments
1979	2013-01-08	
1980	2012-12-28	
1981	2012-12-28	
1982	2012-12-28	
1983	2012-12-28	
1984	2012-12-28	
1985	2012-12-28	
1986	2012-12-28	
1987	2012-12-28	
1988	2012-12-28	
1989	2012-12-28	
1990	2012-12-28	
1991	2012-12-28	
1992	2012-12-28	
1993	2012-12-28	
1994	2012-12-28	
1995	2012-12-28	
1996	2012-12-28	
1997	2012-12-28	
1998	2012-12-28	
1999	2012-12-28	

Available Data | Web Retrieval | Copy Station Data | Import from Excel | Help

Year(s) to Download and Import 00446906

Range of Years | Single Year

From Year: 1980 To Year: 2012

Select:  Available  User Default

Available Dates: From Date: 1980-01-01 To Date: 2012-12-28

File Directory: [Empty]

File Name: [Empty]

Progress Log: [Empty]

1. Download Data  
Delete Temp Files  
Terminate Download

2. Import Data  
Terminate Import

Exit Delete Year

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

Solar Data

Stations GSOD (NOAA)

Code	Location
—	Great Dismal NWR
-Bedford	montvale project
00440385	Back Bay National
00446906	Powhatan, VA
00448192	Suffolk Lake Kilby
00449213	Winterpock 4W, VA
13740	Richmond, VA
720498	CHESTERFIELD AI
722692	Warrenton, VA
723075	Oceana, VA
723075	OCEANA NAS
723080	Norfolk, VA
723085	NORFOLK NS
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724007	Suffolk Executive
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724030	Sterling, VA - IAD
724036	Manassas Region
724036	2.Manassas Regic
724070	ATLANTIC CITY IN
724100	Lynchburg, VA
724110	Roanoke, VA
724110	ROANOKE MUNICI
999999	NORFOLK REGION
999999	OCEANA NAS
999999	Washington Dulles I

Solar Data Log

Year	Date	Mc	Comme
1970	2013-08-26	copy fro	
1971	2013-08-26	copy fro	
1972	2013-08-26	copy fro	
1973	2013-08-26	copy fro	
1974	2013-08-26	copy fro	
1975	2013-08-26	copy fro	
1976	2013-08-26	copy fro	
1977	2013-08-26	copy fro	
1978	2013-08-26	copy fro	
1979	2013-08-26	copy fro	
1980	2013-08-26	copy fro	
1981	2013-08-26	copy fro	
1982	2013-08-26	copy fro	
1983	2013-08-26	copy fro	
1984	2013-08-26	copy fro	
1985	2013-08-26	copy fro	
1986	2013-08-26	copy fro	
1987	2013-08-26	copy fro	
1988	2013-08-26	copy fro	
1989	2013-08-26	copy fro	
1990	2013-08-26	copy fro	
1991	2013-08-26	auto do	
1992	2013-08-26	auto do	
1993	2013-08-26	auto do	
1994	2013-08-26	auto do	
1995	2013-08-26	auto do	
1996	2013-08-26	auto do	
1997	2013-08-26	auto do	

Available Data | Web Retrieval | Copy Station Data | Import from Excel | Help

Year(s) to Download and Import **723075**

Range of Years | Single Year |

From Year: 1973 To Year: 2013

Select:  Available  User Default

Available Dates: From Date: 1973-01-01 To Date: 2013-06-04

1. Download Data

Delete Temp Files

Terminate Download

2. Import Data

Ignore Missing Years

Import from:

National Oceanic and Atmospheric Administration (NOAA) (1961-2005) OLD

National Oceanic and Atmospheric Administration (NOAA) (1961-2010) OLD

National Oceanic and Atmospheric Administration (NOAA) (1991-2010) NEW

File Directory: C:\Users\kdobbs\Documents\MyWetBud\Data\solar\

File Name: C:\Users\kdobbs\Documents\MyWetBud\Data\solar\

Progress Log | Warnings

Exit Delete Year

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

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

The screenshot displays the NOAA Precipitation Data for GSOD Stations software. The interface includes a menu bar with options like 'Available Data', 'Web Retrieval', 'Copy Station Data', 'Import from Excel', 'Import GHCN', and 'Help'. The main area is divided into several sections:

- Stations GSOD (NOAA):** A list of stations with columns for Code and Location. The list includes stations like 'Great Dismal NWR', 'Back Bay National', 'Powhatan, VA', etc.
- Precipitation Annual Log:** A table with columns: Year, Date, Sum, Sum (t), and Con. The table shows data for years 1973 to 2004. Two rows are highlighted with red boxes: 1993 (Sum: 0.00, Sum (t): 0.00, Con: GSC) and 1999 (Sum: 1.10, Sum (t): 2.79, Con: GSC).
- Precipitation Monthly:** A table with columns: Mon, Value (t), and Value (t). It shows monthly precipitation values for the year 1973.
- Precipitation Daily:** A table with columns: Date, Value, Value, and Stat. It shows daily precipitation values for the year 1973.

Navigation and control elements include 'Exit' and 'Delete Year' buttons at the bottom, and various window management icons (minimize, maximize, close) throughout the interface.

# 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
  - Daylight length (Thornthwaite ET)

AY_LATIT	AY_MON	AY_VALUE
36.00	1	10.01
36.00	2	10.85
36.00	3	11.94
36.00	4	13.08
36.00	5	14.05
36.00	6	14.56
36.00	7	14.35
36.00	8	13.53
36.00	9	12.44
36.00	10	11.31
36.00	11	10.30
36.00	12	9.76
36.10	1	10.00
36.10	2	10.85
36.10	3	11.94
36.10	4	13.09
36.10	5	14.06
36.10	6	14.57
36.10	7	14.35
36.10	8	13.53
36.10	9	12.44

Daylight Range Specification

From Latitude (deg) 35

To Latitude (deg) 40

Step (deg) 0.5

Cancel Generate Records

# 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

The screenshot shows the 'Basic Scenarios' application window. The 'General' tab is active, displaying the following fields and options:

- Code:** WND (with a value of 41)
- Description:** PWMA WND
- Reference Weather Station:** 00446906
- Active
- Project Information:**
  - Project Latitude: 37.546
  - Project Longitude: -77.997
  - Ref Elevation (m): 0
- Standard Analysis Years:**
  - Dry Year Specification:**  User Specified (2007),  Automatically Calculated,  Partial Year
  - Normal Year Specification:**  User Specified (1983),  Automatically Calculated,  Partial Year
  - Wet Year Specification:**  User Specified (1993),  Automatically Calculated,  Partial Year
- Custom Analysis Range:**  Use Custom Range (yyyy-mm), From yyyy-mm, To yyyy-mm
- Comment:** (empty text box)

At the bottom left of the window, there is a small number '1'.

# Basic Scenario Setup – *Wetland and Watershed*

The screenshot shows the 'Basic Scenarios' software interface. The window title is 'Basic Scenarios'. At the top left, there is a 'New Basic Scenario' button. To the right are navigation buttons (back, forward, home, etc.) and 'Export' and 'Exit' buttons. Below the navigation is a search bar. The main area is divided into tabs: 'General', 'Wetland Watershed', 'Inputs and Outputs', and 'Management and Options'. The 'Wetland Watershed' tab is active. On the left, there is a table with columns 'Code' and 'Description'. The table contains one entry: 'WND' with description 'PWMA WND'. The main right area is titled 'Wetland and Watershed Data' and contains several input fields with their values and units.

Code	Description
WND	PWMA WND

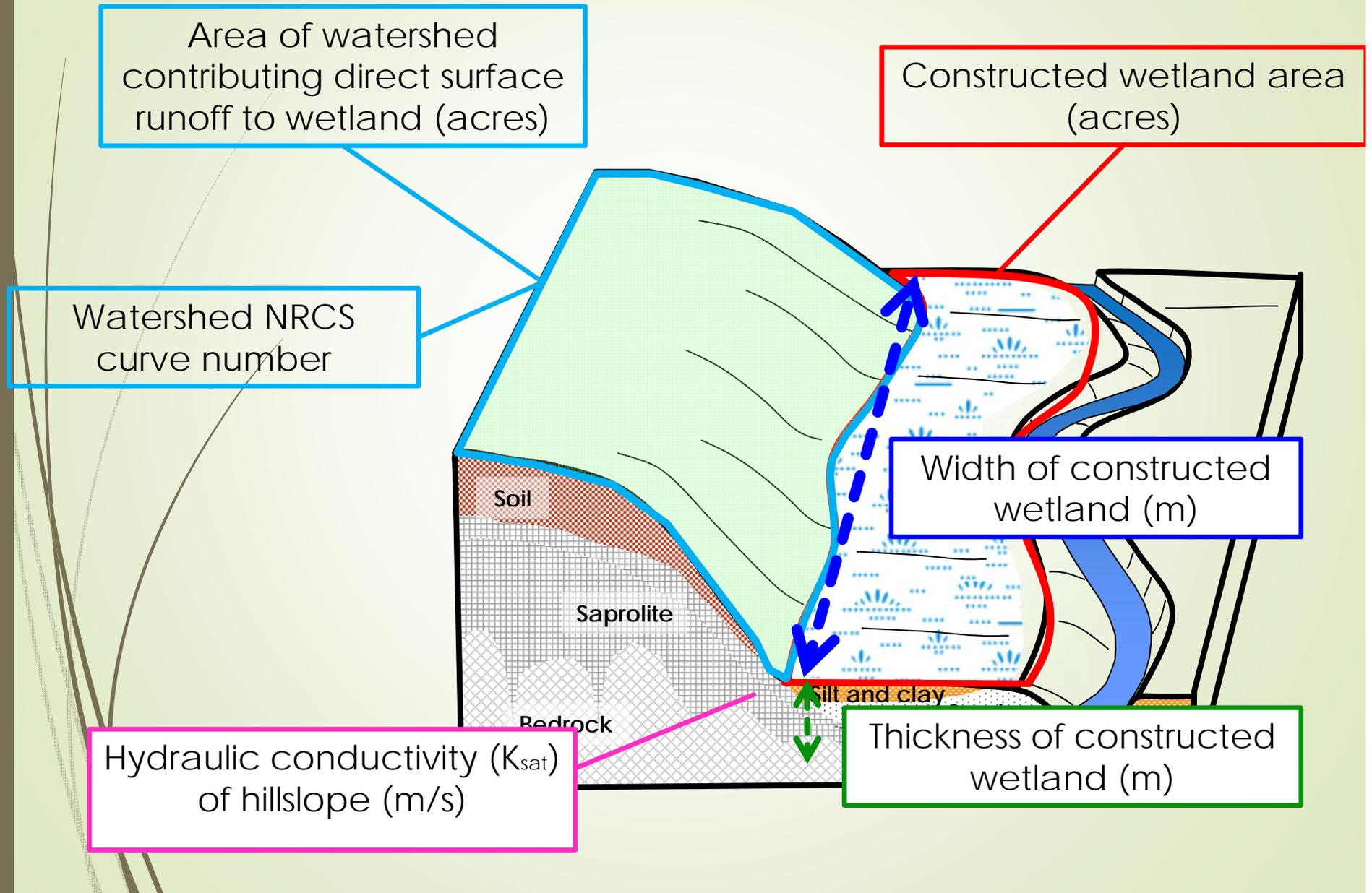
**Wetland and Watershed Data**

Constructed Wetland Area (acres)	2.000	8093.72 m <sup>2</sup>
Total Area of Watershed for Direct Surface Runoff (acres)	14.000	56656.04 m <sup>2</sup>
Watershed NRCS Curve Number	58.00	

**Data for Groundwater calculations utilizing WEM**

Width of Constructed Wetland at Adjacent Hillslope Bottom (m)	100.00
Thickness of Constructed Wetland at Adjacent Hillslope Bottom (m)	4.00
Hydraulic Conductivity of Hillslope (m/s)	0.0000050

# Basic Scenario Setup – *Wetland and Watershed*

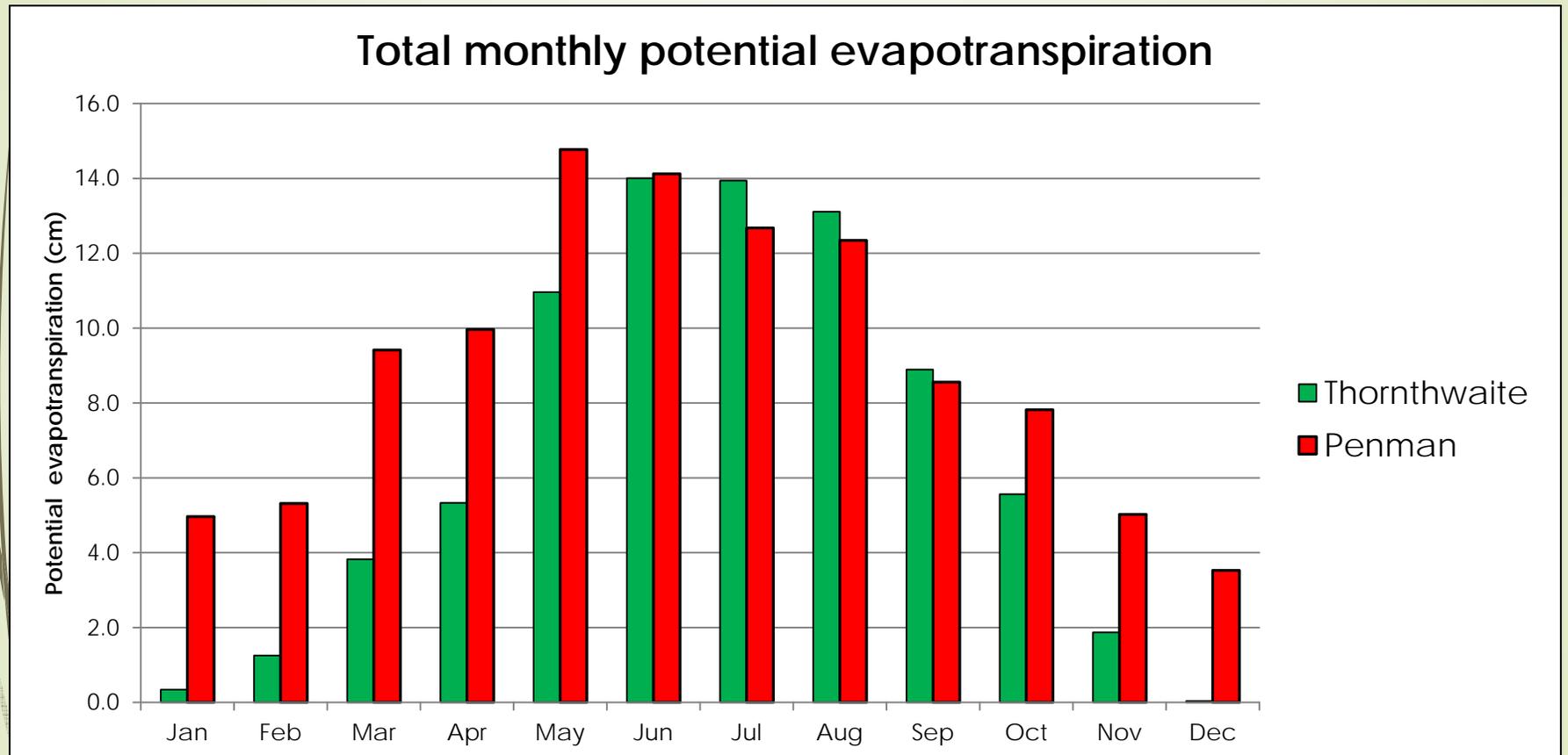


# Basic Scenario Setup – *Inputs and Outputs*

The screenshot displays the 'Basic Scenarios' application window. The main window has a title bar with a question mark and a close button. Below the title bar is a toolbar with a 'New Basic Scenario' button, navigation arrows, an 'Export' button, and an 'Exit' button. The interface is divided into several panes:

- Left Pane:** A search area with a 'Search' field and a table listing scenarios. The table has columns for 'Code' and 'Description'. One entry is visible: 'WND' with description 'PWMA WND'.
- Top Tab Bar:** Contains tabs for 'General', 'Wetland Watershed', 'Inputs and Outputs' (which is selected), and 'Management and Options'.
- Sub-Tab Bar:** Contains sub-tabs for 'Water Inputs', 'Water Outputs' (selected), and 'Water Level Adjustment'.
- Main Content Area:** Titled 'Water Outputs', it contains several configuration options:
  - PET:** A checked checkbox. Below it, 'PET Options' are listed with radio buttons:
    - Penman-Monteith Method (calculated by WetBud)
    - Thornthwaite Equation (calculated by Wetbud)
    - Penman-Monteith Method (imported/manually adjusted)
    - Thornthwaite Equation (imported/manually adjusted)
  - Data for the Penman Monteith Method:** A section with a dropdown for 'Insolation Data' set to 'data for PWMA' and a text field for 'Albedo' set to '0.23'.
  - Groundwater OUT Options:** A section with radio buttons:
    - No Groundwater OUT
    - Constant Rate
    - User Time SeriesNext to it is a 'Rate (in/mo)' field set to '1.23000' and a 'Groundwater OUT Data' dropdown.
  - User Water OUT:** A checked checkbox. Below it is a 'Select Series' dropdown and a 'User OUT Data' button.

# Basic Scenario Setup – *Inputs and Outputs*



# Basic Scenario Setup – *Inputs and Outputs*

Basic Scenarios

New Basic Scenario

Search

Code Description

WND	PWMA WND
-----	----------

General | Wetland Watershed | **Inputs and Outputs** | Management and Options

Water Inputs | Water Outputs | Water Level Adjustment

Water Level Adjustment

Soil Storage Factor (0-1) 0.15

Surface Storage Factor (0-1) 0.98

Outlet Weir

Average Wetland Depth to Outlet Weir

Constant Depth

User Time Series

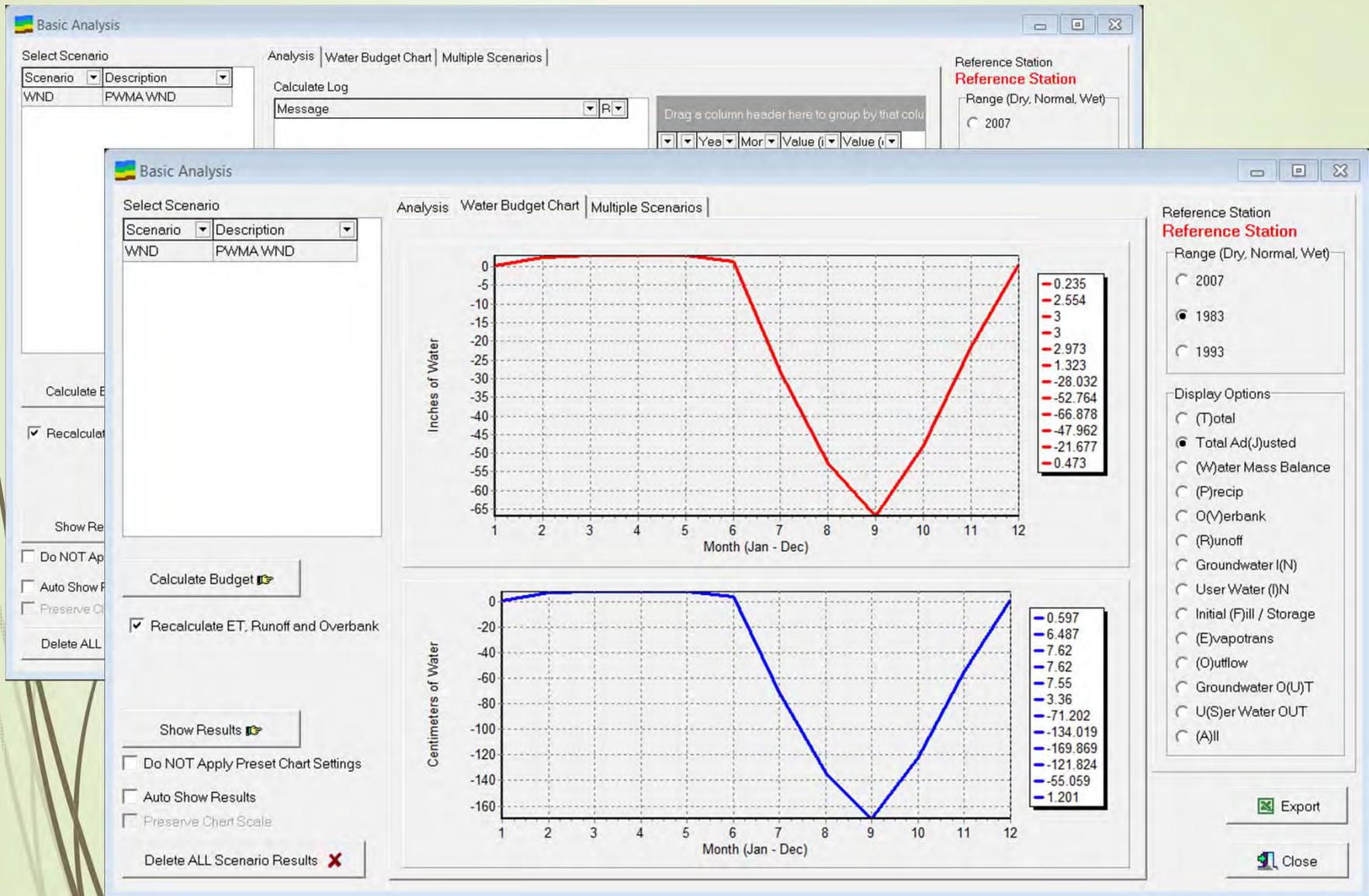
Depth (in) 3.000

Select Series

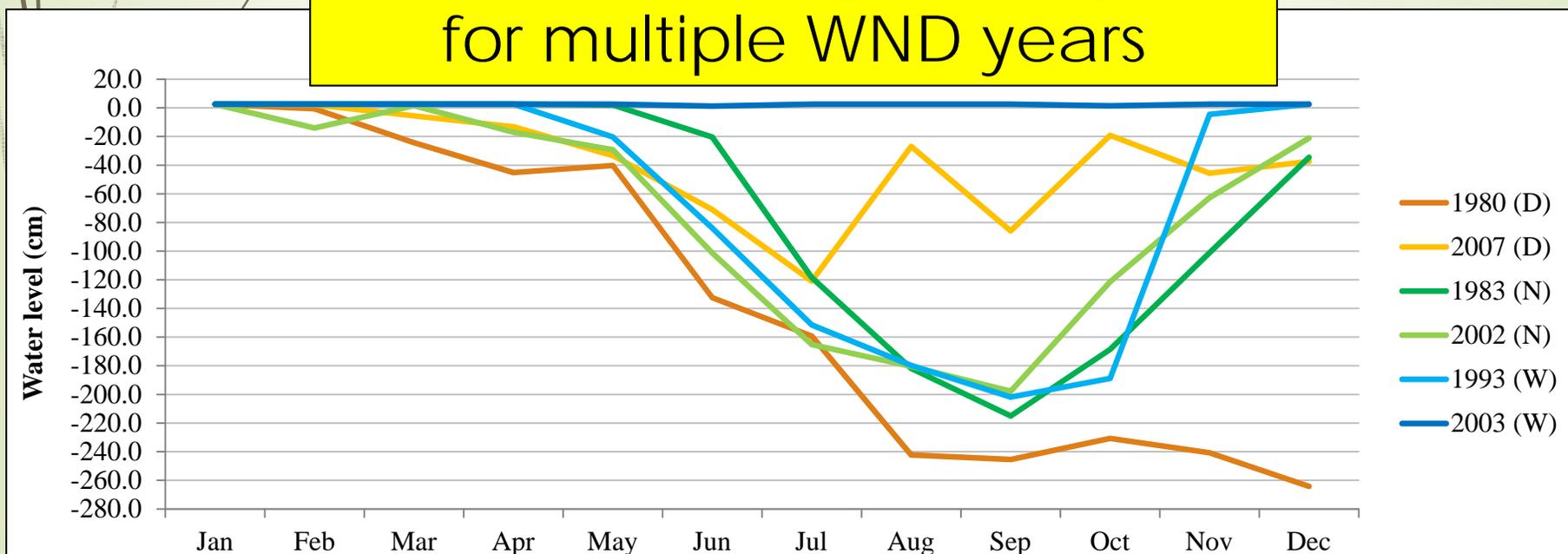
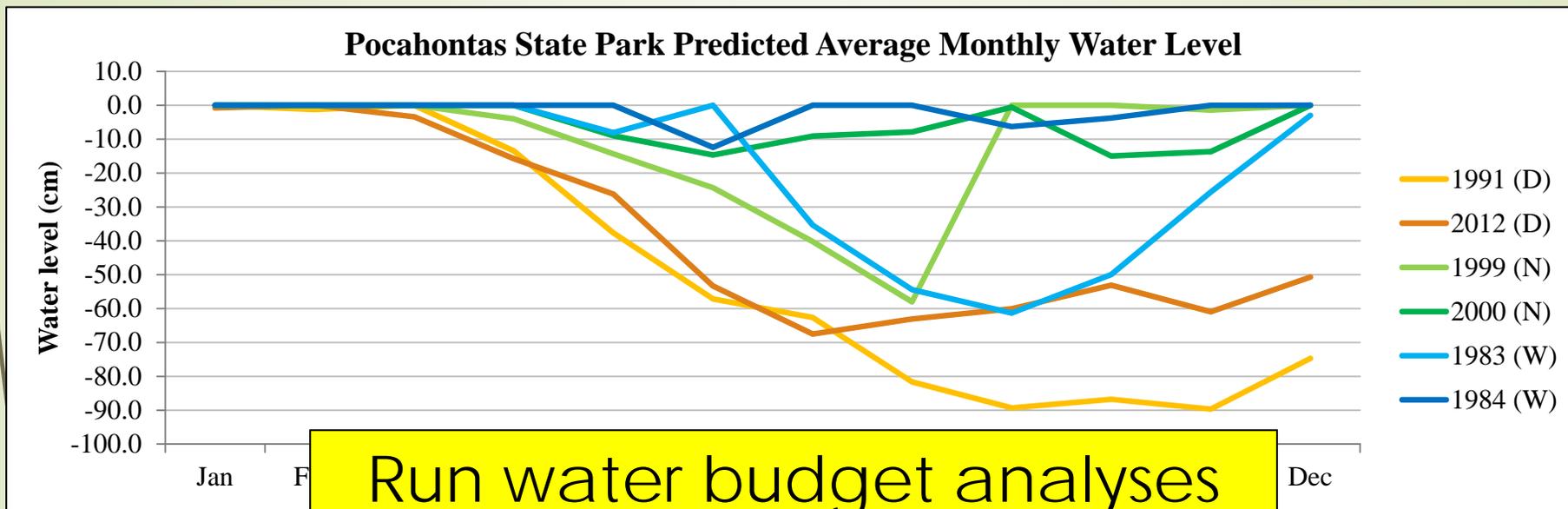
Weir Data

1

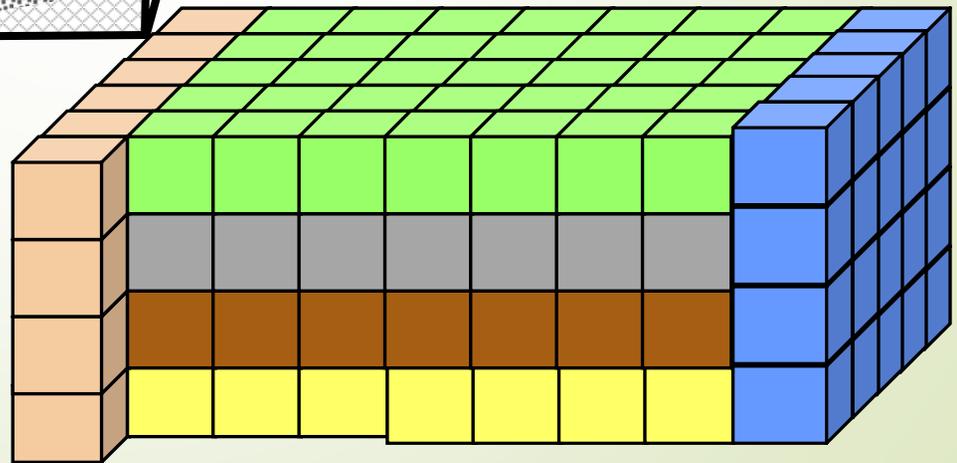
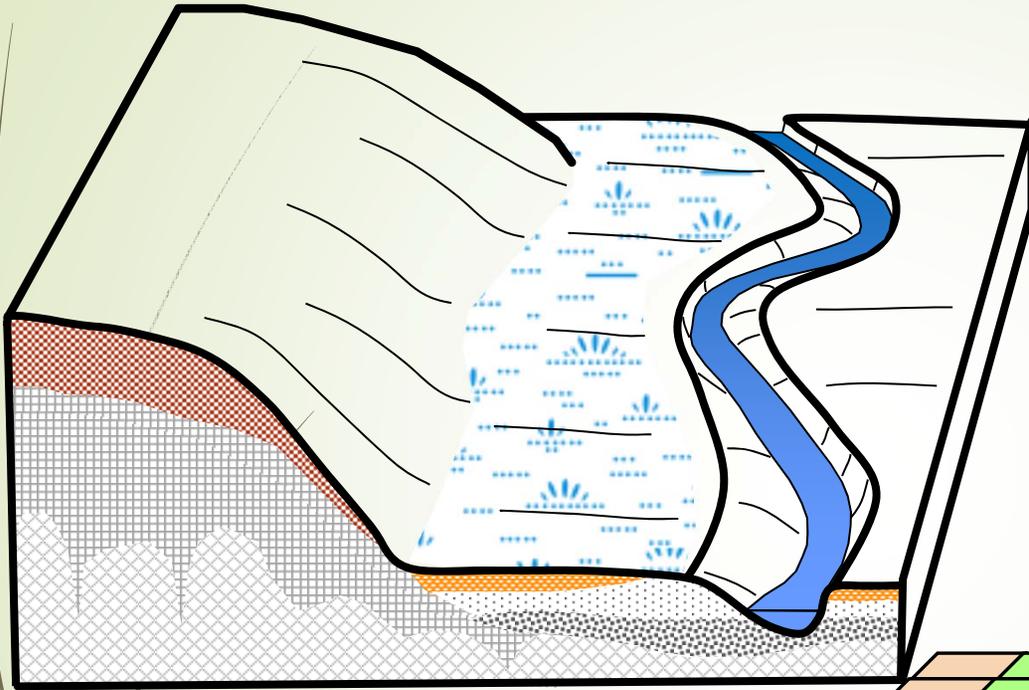
# Basic Scenario Analysis and Output



# Wet, Normal, and Dry Years



# Advanced Scenarios

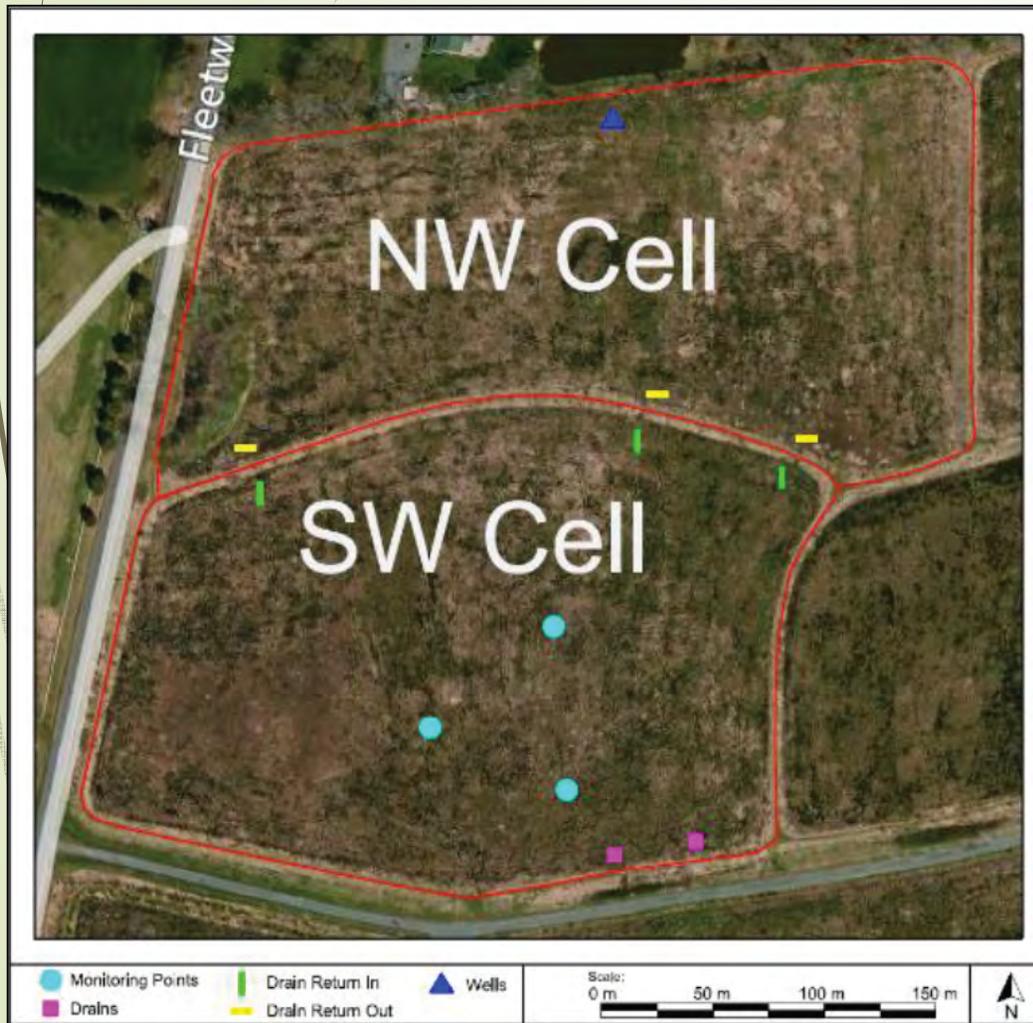


# Advanced Scenario Preparation

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

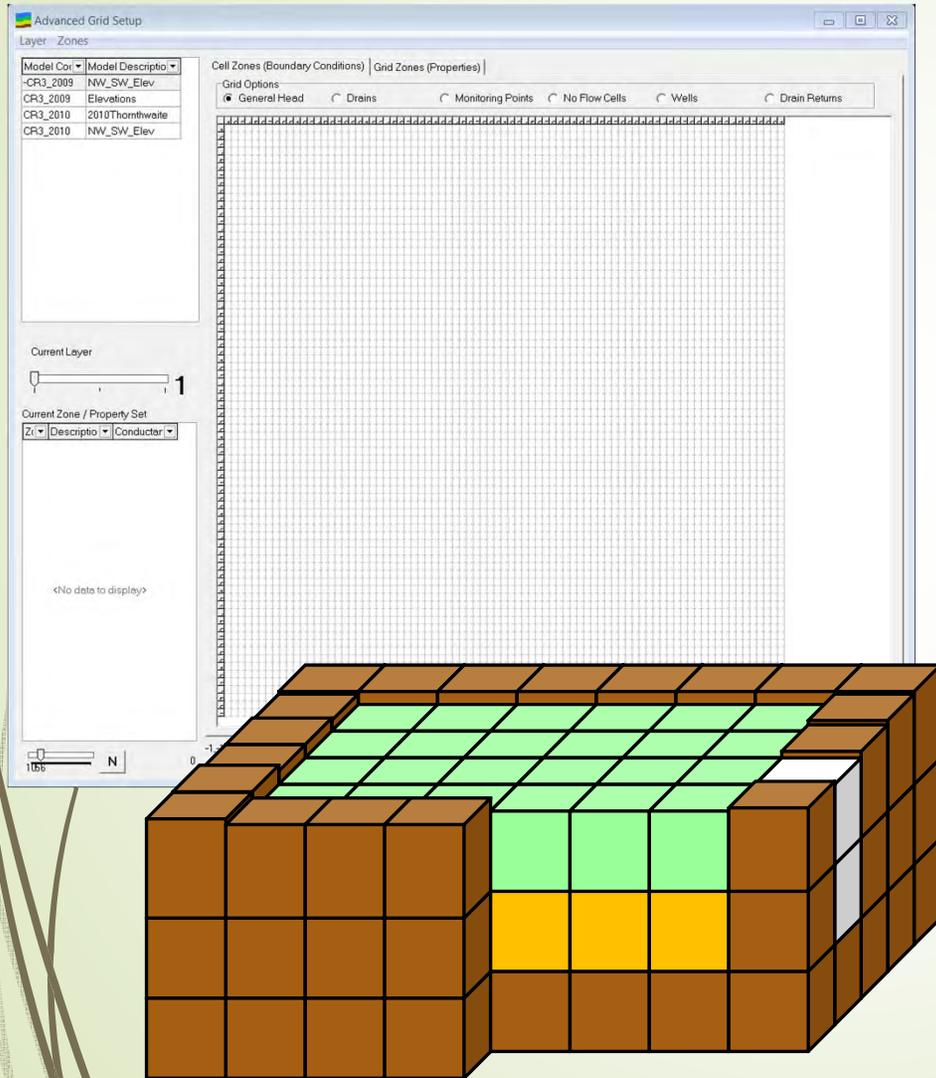
### Stratigraphy and Lithology

- 3 layers
  - Surface veg
  - Topsoil
  - Compacted clay

### Areal Extent and Topography

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

# 1. Conceptual Model



## Hydrologic boundaries

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

## Stratigraphy and Lithology

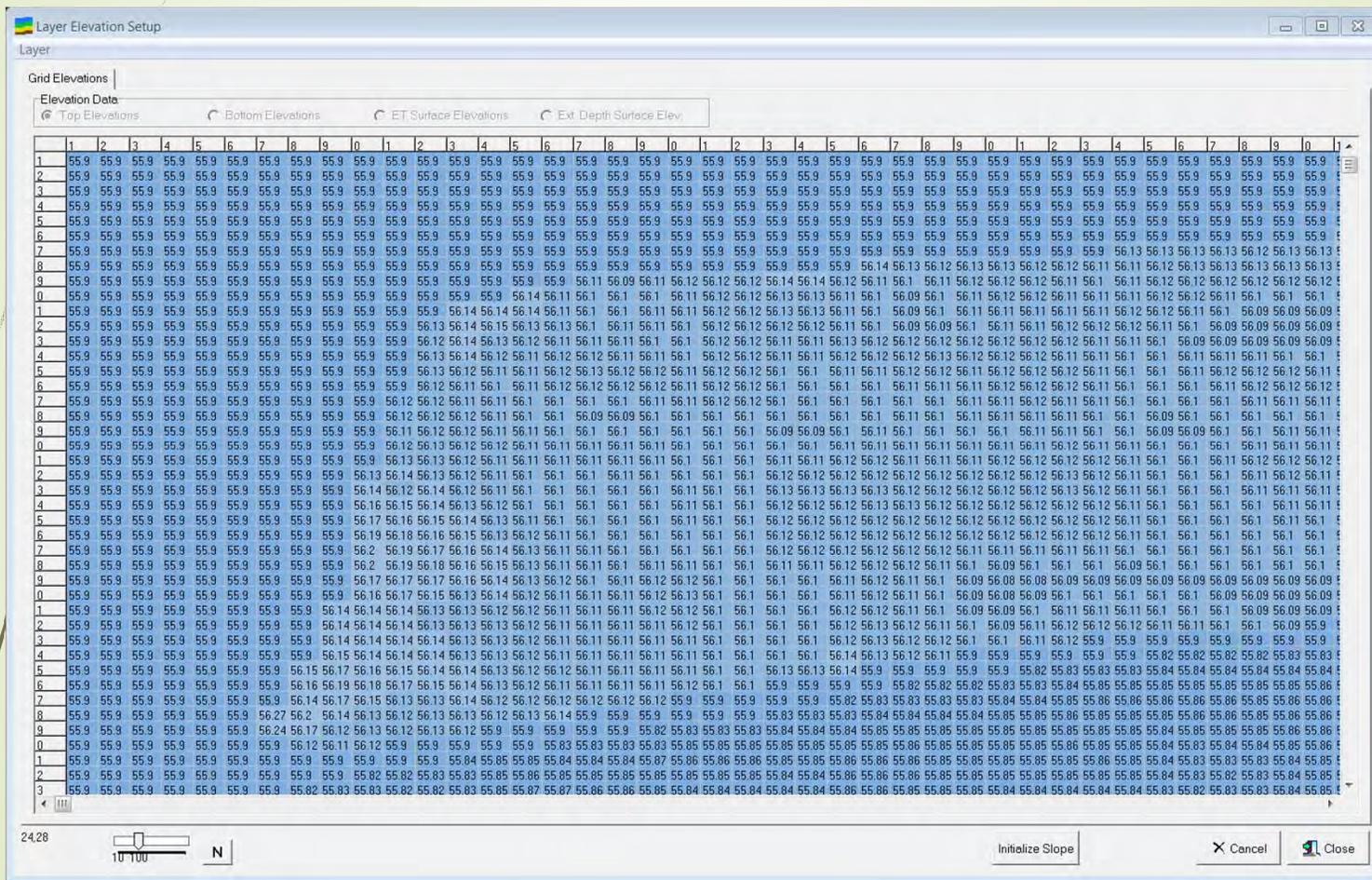
- 3 layers
  - Surface veg
  - Topsoil
  - Compacted clay

## Areal Extent and Topography

- What size model grid?
- 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)

# Creating a Time Step Array

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

Advanced Parameter Setup 3 - Time Steps and Solvers

Time Steps | SIP Solver | PCG Solver | NWT Solver

New Time Step Array

Description	Num
CR-3_2009_Thorn	365
CR-3_2010_Thorn	365
CR3w_Thorn	731

Description: CR-3\_2009\_Thorn 7

Number of Time Steps: 365

Time Step Unit: (day)

Buttons: Copy Time Step Array, Delete Time Steps, Import Precip/ET/Runoff Rate, Chart Time Step Data, Create All Time Steps, Export Time Step Array, New Time Step, Import Time Step Array, Duplicate Last Entry

Time Steps in Array

Tim	Time	Numbe	Time St	Transi	Precip Rate 1	Precip Rate 2	ET Rate	ET Surf. I	ET Surf. I	ET Extinc	Ru
1	86400	3	1.2	<input checked="" type="checkbox"/>	0.0000E+00	0.0000E+00	0.0000E+00				
2	86400	3	1.2	<input checked="" type="checkbox"/>	0.0000E+00	0.0000E+00	0.0000E+00				
3	86400	3	1.2	<input checked="" type="checkbox"/>	0.0000E+00	0.0000E+00	0.0000E+00				
4	86400	3	1.2	<input checked="" type="checkbox"/>	0.0000E+00	0.0000E+00	0.0000E+00				
5	86400	3	1.2	<input checked="" type="checkbox"/>	0.0000E+00	0.0000E+00	0.0000E+00				
6	86400	3	1.2	<input checked="" type="checkbox"/>	1.7639E-08	1.7639E-08	0.0000E+00				
7	86400	3	1.2	<input checked="" type="checkbox"/>	3.2338E-07	3.2338E-07	0.0000E+00				
8	86400	3	1.2	<input checked="" type="checkbox"/>	1.9991E-07	1.9991E-07	0.0000E+00				
9	86400	3	1.2	<input checked="" type="checkbox"/>	0.0000E+00	0.0000E+00	0.0000E+00				

Close

# Importing Precip, ET, and Runoff into Time Step Array

Stations GSOD (NOAA)

Code	Location
—	Great Dismal NWR
—Bedford	montvale project
00440385	Back Bay National
00446906	Powhatan, VA
00448192	Suffolk Lake Kilby
00449213	Winterpock 4W, VA
13740	Richmond, VA
720498	CHESTERFIELD A
722692	Warrenton, VA
723075	Oceana, VA
723075	OCEANA NAS
723080	Norfolk, VA
723085	NORFOLK NS
723260	Knoxville Municipal
724006	CHESAPEAKE RG
724007	Suffolk Executive
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724036	2.Mannassas Regi
724100	Lynchburg, VA
724110	Roanoke, VA
724110	ROANOKE MUNIC
999999	NORFOLK REGION
999999	OCEANA NAS

Import Range | Available Precipitation Data | Available ET Data

Select Range Dates

From Date: 1/1/2007  
To Date: 12/31/2007

Convert Head to

millimeters (mm)  
 centimeters (cm)  
 meters (m)  
 inches (in)

Calculate Rate Based on

seconds (s)  
 minutes (min)  
 hours (h)  
 days (d)  
 months (mo)

Precipitation Rate Calculations

Do not Calculate Precip Rate  
 Precip Rate 1  
 Precip Rate 2

ET Calculations

Do not Calculate ET Rate  
 ET Rate based on Penman  
 ET Rate based on Thornthwaite

Surface Runoff Calculations

Calculate Runoff Values

Curve Number: 40 | Runoff Area (ac): 0

Period for Each Time Step

Day  
 Month

Calculate and Preview Time Step Array Data

Import Options

Import Precipitation Rate  
 Import ET Rate  
 Import Runoff Rate

Starting Time Step: 1

Preview

Col	Rate 1	ET Rate
1	6.4088E-07	1.2523E-08
2	0.0000E+00	2.5177E-08
3	0.0000E+00	1.4149E-08
4	0.0000E+00	1.7704E-08
5	2.0579E-08	1.0531E-08
6	2.9104E-07	2.6837E-08
7	0.0000E+00	2.5460E-08
8	2.7634E-07	1.9800E-08
9	0.0000E+00	3.4590E-08
10	0.0000E+00	2.7592E-08
11	0.0000E+00	1.2732E-08
12	2.9398E-08	1.8971E-08
13	0.0000E+00	2.3655E-08
14	0.0000E+00	2.6857E-08
15	0.0000E+00	3.2248E-08
16	0.0000E+00	3.5644E-08
17	0.0000E+00	2.4648E-08
18	0.0000E+00	8.5800E-09
19	0.0000E+00	1.6643E-08
20	0.0000E+00	3.5788E-08

Export

Close

**Note:** Precipitation data must exist in station record and ET rates must be calculated in Basic Scenario prior to import into time step array. (US Fish and Wildlife)

# Importing Precip, ET, and Runoff into Time Step Array

The screenshot displays a software application window titled "Import Precipitation, ET and Runoff Rate Data to Time Step Array". The interface is divided into several sections:

- Stations GSOD (NOAA):** A list of stations with columns for Code and Location. The list includes stations like "Great Dismal NWR", "Back Bay National", "Powhatan, VA", etc.
- Import Range:** A section with tabs for "Available Precipitation Data" and "Available ET Data".
- Precipitation Annual Log:** A table with columns: Year, Date, Mod, Sum (in), Sum (cm), and Source. It shows data for years 1979 and 1980.
- Precipitation Monthly:** A table with columns: Month, Value (in), and Value (cm). It shows data for months 1 and 2.
- Precipitation Daily:** A table with columns: Date, Value (in), and Value (cm). It shows data for dates 2007-01-01 and 2007-01-02.

A second window of the same application is overlaid, showing the "Penman" data selected. It features the same station list and import range tabs. The data tables are:

- Penman Annual Log:** A table with columns: Year, Date, Mod, Sum (in), Sum (cm), and Source. It shows data for years 1979 through 2012.
- Penman Monthly:** A table with columns: Month, Value (cm), and Value (in). It shows data for months 1 through 12.
- Penman Daily:** A table with columns: Date, Value (cm), and Value (in). It shows data for dates from 1979-01-01 to 1979-01-21.

# Importing Precip, ET, and Runoff into Time Step Array

Import Range | Available Precipitation Data | Available ET Data

Stations GSOD (NOAA)

Code	Location
—	Great Dismal NWR
—	Bedford montvale project
00440385	Back Bay National
00446906	Powhatan, VA
00448192	Suffolk Lake Kilby
00449213	Winterpock 4W, VA
13740	Richmond, VA
720498	CHESTERFIELD A
722692	Warrenton, VA
723075	Oceana, VA
723075	OCEANA NAS
723080	Norfolk, VA
723085	NORFOLK NS
723260	Knoxville Municipal
724006	CHESAPEAKE RG
724007	Suffolk Executive
724007	Suffolk Executive2
724010	Richmond, VA
724020	WALLOPS ISL STM
724030	Sterling, VA- IAD
724036	Manassas Region
724036	2.Mannassas Regi
724100	Lynchburg, VA
724110	Roanoke, VA
724110	ROANOKE MUNIC
999999	NORFOLK REGION
000000	OCEANA NAS

Select Range Dates

From Date: 1/1/2007

To Date: 12/31/2007

Precipitation Rate Calculations

- Do not Calculate Precip Rate
- Precip Rate 1
- Precip Rate 2

ET Calculations

- Do not Calculate ET Rate
- ET Rate based on Penman
- ET Rate based on Thornthwaite

Surface Runoff Calculations

Calculate Runoff Values

Curve Number: 40 | Runoff Area (ac): 0

Period for Each Time Step

- Day
- Month

Convert Head to

- millimeters (mm)
- centimeters (cm)
- meters (m)
- inches (in)

Calculate Rate Based on

- seconds (s)
- minutes (min)
- hours (h)
- days (d)
- months (mo)

Preview

Col	Rate 1	ET Rate
1	6.4088E-07	1.2523E-08
2	0.0000E+00	2.5177E-08
3	0.0000E+00	1.4149E-08
4	0.0000E+00	1.7704E-08
5	2.0579E-08	1.0531E-08
6	2.9104E-07	2.6837E-08
7	0.0000E+00	2.5460E-08
8	2.7634E-07	1.9800E-08
9	0.0000E+00	3.4590E-08
10	0.0000E+00	2.7592E-08
11	0.0000E+00	1.2732E-08
12	2.9398E-08	1.8971E-08
13	0.0000E+00	2.3655E-08
14	0.0000E+00	2.6857E-08
15	0.0000E+00	3.2248E-08
16	0.0000E+00	3.5644E-08
17	0.0000E+00	2.4648E-08
18	0.0000E+00	8.5800E-09
19	0.0000E+00	1.6643E-08
20	0.0000E+00	3.5788E-08

Calculate and Preview Time Step Array Data

Import Options

- Import Precipitation Rate
- Import ET Rate
- Import Runoff Rate

Starting Time Step: 1

**Import**

Export

Close

# 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 be defined by compacted cells
- **Drain(s)** and **Drain Returns**

Advanced Grid Setup

Model Cor	Model Descriptio
-CR3_2009	NW_SW_Elev
CR3_2009	Elevations
CR3_2010	2010Thornthwaite
CR3_2010	NW_SW_Elev

Cell Zones (Boundary Conditions) | Grid Zones (Properties)

Grid Options

Drains  Monitoring Points  No Flow Cells  Wells  Drain Returns

Advanced Parameter Setup 1 - Cell Zones

Drains | General Heads | Monitoring Points | No Flow Areas | Wells | Drain Returns

Description: Outside\_Bndry\_CF

New No Flow Definition

Description: Outside\_Bndry\_C 1

Zone Number: 1

No flow options:

- Inactive Cell (no flow cell, IBOUND = 0)
- Cell is constant head (IBOUND < 0)
- Active Cell (regular flow, IBOUND > 0)

Current Layer: 1

Current Zone / Property Set

Zone Num	Description
1	Outside_Bndry_CR

1056 N 1 -1,-1

Test No Flow X Cancel Close Close

# 5. Create Grid Zones (Properties)

Types of Grid Zones: 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.

The image displays two side-by-side screenshots of the 'Advanced Parameter Setup 2 - Grid Zones' software interface. The left window is set to 'Hydraulic Conductivity' and shows a table with the following data:

Zone	Description
1	Veg/Surface Water
2	CR3 Topsoil
3	Perm Sub Soil
14	TestCR3

The 'New Conductivity Zone' dialog box is open, showing fields for Description (Veg/Surface Water), Zone Number (1), KX (2.1), KY (2.1), and KZ (2.1). The right window is set to 'Specific Storage' and shows a table with the following data:

Zone	Description
1	Water/Veg Layer
7	CR 3 Top Soil
8	Impermeable

The 'New Spec Storage Zone' dialog box is open, showing fields for Description (Water/Veg Layer), Zone Number (1), Specific Storage (0.98), and Specific Yield (0.98). Below the windows is a 3D grid model of a rectangular block, with a central 5x5 area highlighted in green and yellow, representing the grid zones being created.

# 5. Create Grid Zones (Properties)

Types of Grid Zones: 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

Advanced Parameter Setup 2 - Grid Zones

Hydraulic Conductivity | Specific Storage | Precip Rate | ET Rate

Zoi	Description
3	2009_CR-3
4	CR3_0

← New Precip Rate Zone

Description: 2009\_CR-3 9

Zone Number: 3

Color Options:  
Text Color: [ ] Set Color  
Background Color: 8421631 Set Color  
Cell Color: Color

Precipitation Rate Values:  
 Use a Constant Rate for all Time Steps  
 Use Rate from Time Step Array (Precip Rate 1)  
 Use Rate from Time Step Array (Precip Rate 2)

Constant Precip Rate: 0

Precip from Time Step Array: CR-3\_2009\_Thorn  Show Time Step Array

Units of Precip Rate Length / Time: [m/s, cm/s, in/day, ft/day, ft/year]

Close

Advanced Parameter Setup 2 - Grid Zones

Hydraulic Conductivity | Specific Storage | Precip Rate | ET Rate

Zoi	Description
1	CR3 2010 Thorn
2	CR3 2009 Thorn
3	-

← New EvapoTranspiration Zone

Description: CR3 2010 Thornwaik 4

Zone Number: 1 Extinction Depth Layer: 2

Color Options:  
Text Color: -1 Set Color  
Background Color: 8421504 Set Color  
Cell Color: Color

ET Rate Options:  
 Use a Constant ET Rate Constant ET Rate: 0.001  
 Use a ET Rate from Time Step Array

ET Surface Options:  
 Use a Constant ET Surface for All time steps  
 Use a Variable ET Surface Elevation from Time Step Array  
 Use a Variable ET Surface (Top Elev. - ET Surface Diff) from Time Step Array

ET Extinction Depth Options:  
 Use a Constant Extinction Depth for all time Steps  
 Use Extinction Depth from Time Step Array

ET from Time Step Array: CR-3\_2010\_Thorn  Show Time Step Array

Units of ET Rate Length / Time: [m/s, cm/s, in/day, ft/day, ft/year]

Close

from Dahl, 2000 (US Fish and Wildlife)

# 6. Create Chart Formatting Dataset

The image displays two overlapping windows of the 'Chart Formatting' application. The left window is in the 'General' tab, showing a search bar and a table with columns 'Code' and 'Description'. The right window is in the 'Axes' tab, showing settings for four axes: Bottom, Left, Top, and Right. Each axis has fields for Minimum, Maximum, and Increment, along with an 'Axis Label Format' field and a checkbox for 'Auto' or 'IsDate'/'Up / Down'.

Code	Description
-adv ex	for advanced model exampl
-montvale	montvale mitigation site
PSF_charts	Scales for PSF
PSFsim	
PWMA	

**Bottom Axis**

Minimum X: [ ] Maximum X: [ ] Increment: [ ]  Auto

Axis Label Format: [ ]  IsDate

**Left Axis**

Left: Min Y: [28] Left: Max Y: [29] Left: Increment: [0.5]  Auto

Axis Label Format: [ ]

**Top Axis**

Top: Min X: [ ] Top: Max X: [ ] Top: Increment: [ ]  Auto

Axis Label Format: [ ]  Up / Down

**Right Axis**

Right: Min Y: [ ] Right: Max Y: [ ] Right: Increment: [ ]  Auto

Axis Label Format: [ ]  Up / Down

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.

The screenshot shows the 'Advanced Scenarios' software interface. The 'General' tab is selected and highlighted with a red box. The interface includes a search bar, a table of model codes, and various configuration fields for model parameters.

Model Code	Model Description
demo1+ET	calibration model for Piedr
demo1-ET	calibration model for Piedr
demo2	original design with sloping
demo3	terraced, two-cell (upper an
demo3.1	terraced, two-cell (upper an
demo4	simple box with drain

**General Tab Configuration:**

- Code:** demo1+ET, 5
- Description:** calibration model for Piedmont valley bottom (Aug - Jul)
- Number of Layers:** 4
- Rows:** 40
- Columns:** 42
- Head for No-Flow Cells:** 888
- Grid Origin X:** 0
- Grid Origin Y:** 0
- Grid Origin Z:** 0
- Head for Dry Cells:** 999
- Column Width:** 1
- Row Width:** 1
- Flat Layers
- Time Step Array:** demo1
- Time Units:** Seconds (selected)
- Length Units:** Meters (selected)
- Number of Time Steps (Stress Periods):** 366
- Utilities:** Copy Model, Delete Model, Clean up Model

# 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.

The screenshot displays the 'Advanced Scenarios' software interface, specifically the 'General' tab. The interface is divided into several sections:

- Model List:** A table with two columns: 'Model Code' and 'Model Description'. The entries are:

Model Code	Model Description
demo1+ET	calibration model for Piedrr
demo1-ET	calibration model for Piedrr
demo2	original design with sloping
demo3	terraced, two-cell (upper an
demo3.1	terraced, two-cell (upper an
demo4	simple box with drain
- Code:** A text input field containing 'demo1+ET' and a numeric field containing '5'. A red box highlights this area.
- Description:** A text input field containing 'calibration model for Piedmont valley bottom (Aug - Jul)'. A red box highlights this area.
- Time Units:** A group box containing radio buttons for 'Undefined', 'Seconds', 'Minutes', 'Hours', 'Days', and 'Years'. 'Seconds' is selected.
- Length Units:** A group box containing radio buttons for 'Undefined', 'Feet', 'Meters', and 'Centimeters'. 'Meters' is selected.
- Time Step Array:** A dropdown menu currently showing 'demo1'. A red box highlights this area.
- Number of Time Steps:** Radio buttons for 'As specified in the Time Step array' and 'As specified below'. 'As specified below' is selected.
- Number of Time Steps (Stress Periods):** A numeric input field containing '366'.
- Grid Parameters:** Fields for 'Number of Layers' (4), 'Rows' (40), 'Columns' (42), 'Head for No-Flow Cells' (888), 'Grid Origin X' (0), 'Grid Origin Y' (0), 'Grid Origin Z' (0), 'Head for Dry Cells' (999), 'Column Width' (1), and 'Row Width' (1). There is also a 'Flat Layers' checkbox.
- Utilities:** Three buttons: 'Copy Model', 'Delete Model', and 'Clean up Model'.

# 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.

Advanced Scenarios

New Model

Search

General | Setup | Layers | Name File | Solve

Model Code	Model Description
demo1+ET	calibration model for Piedr
demo1-ET	calibration model for Piedr
demo2	original design with sloping
demo3	terraced, two-cell (upper an
demo3.1	terraced, two-cell (upper an
demo4	simple box with drain

Code: demo1+ET 5  Active  Adjust Area

Description: calibration model for Piedmont valley bottom (Aug - Jul)

Number of Layers: 4 Rows: 40 Columns: 42 Head for No-Flow Cells: 888

Grid Origin X: 0 Grid Origin Y: 0 Grid Origin Z: 0 Head for Dry Cells: 999

Column Width: 1 Row Width: 1  Flat Layers

Time Step Array: demo1

Number of Time Steps:  As specified in the Time Step array  As specified below

Number of Time Steps (Stress Periods): 366

Time Units:  Undefined  Seconds  Minutes  Hours  Days  Years

Length Units:  Undefined  Feet  Meters  Centimeters

Utilities:

# Advanced Model Setup

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

The screenshot displays the 'Advanced Scenarios' software interface. The main window has a 'General' tab selected. On the left, a table lists model codes and descriptions. The 'Code' field is set to 'demo1+ET' and the 'Description' is 'calibration model for Piedmont valley'. The 'Time Units' are set to 'Seconds'. The 'Advanced Grid Setup' dialog is open, showing a grid with 4 layers and 40 rows. The 'Number of Layers' is 4, 'Rows' is 40, 'Grid Origin X' is 0, 'Grid Origin Y' is 0, 'Column Width' is 1, and 'Row Width' is 1. The 'Time Step Array' is set to 'demo1', and the 'Number of Time Steps (Stress Periods)' is 366. The 'Advanced Grid Setup' dialog also shows a list of layers and a grid visualization.

Model Code	Model Description
demo1+ET	calibration model for Piedr
demo1-ET	calibration model for Piedr
demo2	original design with sloping
demo3	terraced, two-cell (upper an
demo3.1	terraced, two-cell (upper an
demo4	simple box with drain

Code: demo1+ET 5

Description: calibration model for Piedmont valley

Time Units:  Undefined  Seconds

Number of Layers: 4 Rows: 40

Grid Origin X: 0 Grid Origin Y: 0

Column Width: 1 Row Width: 1

Time Step Array: demo1

Number of Time Steps:  As specified in the Time Step array  As specified below

Number of Time Steps (Stress Periods): 366

# 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**.

The screenshot shows the 'Advanced Scenarios' software interface. The 'General' tab is selected. The 'Time Step Array' section is highlighted with a red box. The 'Number of Time Steps (Stress Periods)' is set to 366.

Model Code	Model Description
demo1+ET	calibration model for Piedr
demo1-ET	calibration model for Piedr
demo2	original design with sloping
demo3	terraced, two-cell (upper an
demo3.1	terraced, two-cell (upper an
demo4	simple box with drain

Code: demo1+ET 5  Active  Adjust Area

Description: calibration model for Piedmont valley bottom (Aug - Jul)

Number of Layers: 4 Rows: 40 Columns: 42 Head for No-Flow Cells: 888

Grid Origin X: 0 Grid Origin Y: 0 Grid Origin Z: 0 Head for Dry Cells: 999

Column Width: 1 Row Width: 1  Flat Layers

Time Step Array: demo1

Number of Time Steps:  As specified in the Time Step array  As specified below

Number of Time Steps (Stress Periods): 366

Time Units:  Undefined  Seconds  Minutes  Hours  Days  Years

Length Units:  Undefined  Feet  Meters  Centimeters

Utilities:

# Advanced Model Setup – *General* tab

► Save

Advanced Scenarios

New Model

Search

General | Setup | Layers | Name File | Solve

Model Code	Model Description
demo1+ET	calibration model for Piedr
demo1-ET	calibration model for Piedr
demo2	original design with sloping
demo3	terraced, two-cell (upper an
demo3.1	terraced, two-cell (upper an
demo4	simple box with drain

Code: demo1+ET 5  Active  Adjust Area

Description: calibration model for Piedmont valley bottom (Aug - Jul)

Number of Layers: 4 Rows: 40 Columns: 42 Head for No-Flow Cells: 888

Grid Origin X: 0 Grid Origin Y: 0 Grid Origin Z: 0 Head for Dry Cells: 999

Column Width: 1 Row Width: 1  Flat Layers

Time Step Array: demo1

Number of Time Steps:  As specified in the Time Step array  As specified below

Number of Time Steps (Stress Periods): 366

Time Units:  Undefined  Seconds  Minutes  Hours  Days  Years

Length Units:  Undefined  Feet  Meters  Centimeters

Utilities:

6

# 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.

The screenshot shows the 'Advanced Scenarios' software interface, specifically the 'Setup' tab. The window title is 'Advanced Scenarios'. The interface includes a toolbar with a 'New Advanced Scenario' button and navigation icons. A search bar is located above a table of scenarios. The table has two columns: 'Scenario Cod' and 'Description'. The 'Setup' tab is active, showing various configuration options. The 'Flow Package' section has 'UPW' selected. The 'Solver' section has 'NWT Solver' selected. The 'Precipitation Rate Options' section has '3-Precipitation Rate is Applied to the Highest Active Cell in each Vertical Column' selected. The 'ET Options' section has '3-Evapotranspiration is Applied to the Highest Active Cell in each Vertical Column' selected. The 'Chart Settings for Heads' section has '-adv ex' selected. The 'Path for storing Modflow Input and Output files' is set to 'C:\Wetbud\MODFLOW output' with a 'Browse' button next to it. A small number '4' is visible in the bottom left corner of the window.

Scenario Cod	Description
-CR3_2009	NW_SW_Elev
CR3_2009	Elevations
CR3_2010	2010Thornthwaite
CR3_2010	NW_SW_Elev

Flow Package

LPF

UPW

Solver

SIP Solver

PCG Solver

NWT Solver

Precipitation Rate Options

1-Precipitation Rate is only Applied to Cells in the Top Layer

3-Precipitation Rate is Applied to the Highest Active Cell in each Vertical Column

ET Options

1-Evapotranspiration is only Applied to Cells in the Top Layer

2-The Cell for each Vertical Column is Specified by the User

3-Evapotranspiration is Applied to the Highest Active Cell in each Vertical Column

Chart Settings for Heads

-adv ex

Path for storing Modflow Input and Output files

C:\Wetbud\MODFLOW output

Browse

4

# Advanced Model Setup – *Layers* tab

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

The screenshot displays the 'Advanced Scenarios' software interface, specifically the 'Layers' tab. The window title is 'Advanced Scenarios'. The interface includes a search bar, a 'New Advanced Scenario' button, and navigation controls. The 'Layers' tab is active, showing a table of layer properties and various parameter settings.

Scenario Cod	Description
-CR3_2009	NW_SW_Elev
CR3_2009	Elevations
CR3_2010	2010Thornthwaite
CR3_2010	NW_SW_Elev

Layer Descrip	Top	Bottc	ET Surf	ET Ext
1 Veg/Surface Wa	58.000	55.710	58.000	0.300
2 Top Soil	56.170	55.480		
3 Low Perm Subso	55.940	55.170		

Parameters for Layer 1:

- Description: Veg/Surface Water
- Layer Number: 1
- Top Elevation: 58.000
- Bot Elevation: 55.710
- Initial Head: 55.800
- ET Surf Elev.: 58.000
- ET Ext. Depth: 0.300
- Color Contours:
- Flat Layers:

Layer Wetting:  Inactive,  Active

Wetting Threshold Length: 0.0010

Vertical Conductivity:  Value,  Ratio

Horizontal Anisotropy:  Isotropic condition,  Specified Anisotropy per Cell,  Uniform Anisotropy Value

Anisotropy: 1.00e+00

Layer Type:  Confined,  Unconfined (Layer 1),  Unconfined (S Varies),  Unconfined (T Varies)

Layer Condition (IBOUND):  Variable Head,  Constant Head,  No Flow

Interblock Transmissivity (under LPP):  Harmonic Mean,  Logarithmic Mean,  AM Thickn LM Hydraulic Conductivity

# Advanced Model Setup – *Layers* tab

➤ Importing elevation data

The screenshot displays the 'Advanced Scenarios' software interface. The 'Layer Elevation Setup' dialog box is open, showing a table of 'Grid Elevations' with columns 1, 2, 3, and 4, and rows 1 through 33. The 'Import Layer Elevations' dialog box is also open, featuring a grid for data entry and a 'Select Excel File' button. The 'Import Layer Elevations' dialog box has tabs for 'Import Grid from Excel', 'Import XYZ from Excel', and 'Help'. The 'Import Layer Elevations' dialog box also includes a 'Select Excel File' button, a slider for 'IblRows1', a 'IblCols1' field, and checkboxes for 'Exclude Title Row' and 'Exclude First Column'. The 'Import Layer Elevations' dialog box has an 'Import' button and an 'Exit' button. The 'Layer Elevation Setup' dialog box has a 'Search' field and a table of 'Scenario Cod' and 'Descri'.

Scenario Cod	Descri
-CR3_2009	NW_SY
CR3_2009	Elevati
CR3_2010	2010Th
CR3_2010	NW_SY

Grid Elevations	1	2	3	4
1	55.90	55.90	55.90	55.90
2	55.90	55.90	55.90	55.90
3	55.90	55.90	55.90	55.90
4	55.90	55.90	55.90	55.90
5	55.90	55.90	55.90	55.90
6	55.90	55.90	55.90	55.90
7	55.90	55.90	55.90	55.90
8	55.90	55.90	55.90	55.90
9	55.90	55.90	55.90	55.90
0	55.90	55.90	55.90	55.90
1	55.90	55.90	55.90	55.90
2	55.90	55.90	55.90	55.90
3	55.90	55.90	55.90	55.90
4	55.90	55.90	55.90	55.90
5	55.90	55.90	55.90	55.90
6	55.90	55.90	55.90	55.90
7	55.90	55.90	55.90	55.90
8	55.90	55.90	55.90	55.90
9	55.90	55.90	55.90	55.90
0	55.90	55.90	55.90	55.90
1	55.90	55.90	55.90	55.90
2	55.90	55.90	55.90	55.90
3	55.90	55.90	55.90	55.90
4	55.90	55.90	55.90	55.90
5	55.90	55.90	55.90	55.90
6	55.90	55.90	55.90	55.90
7	55.90	55.90	55.90	55.90
8	55.90	55.90	55.90	55.90
9	55.90	55.90	55.90	55.90
0	55.90	55.90	55.90	55.90
1	55.90	55.90	55.90	55.90
2	55.90	55.90	55.90	55.90
3	55.90	55.90	55.90	55.90

# Advanced Model Setup – *Layers* tab

- Initial head
- ET surface elevation
- ET extinction depth

Advanced Scenarios

New Advanced Scenario

Search

General | Setup | Layers | Name File | Solve

Scenario Cod	Description
-CR3_2009	NW_SW_Elev
CR3_2009	Elevations
CR3_2010	2010Thornthwaite
CR3_2010	NW_SW_Elev

New Layer

Layer Descrip	Top	Bot	ET Surf	ET Ext.
1 Veg/Surface We	58.000	55.710	58.000	0.300
2 Top Soil	56.170	55.480		
3 Low Perm Subso	55.940	55.170		

Description: Veg/Surface Water

Layer Number: 1 67

Top Elevation: 58.000 Bot Elevation: 55.710

Initial Head: 55.800 ET Surf Elev.: 58.000

ET Ext. Depth: 0.300

Color Contours:  Flat Layers:

Layer Writing:  Inactive  Active

Writing Threshold Length: 0.0010

Vertical Conductivity:  Value  Ratio

Horizontal Anisotropy:  Isotropic condition  Specified Anisotropy per Cell  Uniform Anisotropy Value

Layer Type:  Confined  Unconfined (Layer 1)  Unconfined (S Varies)  Unconfined (T Varies)

Layer Condition (BOUND):  Variable Head  Constant Head  No Flow

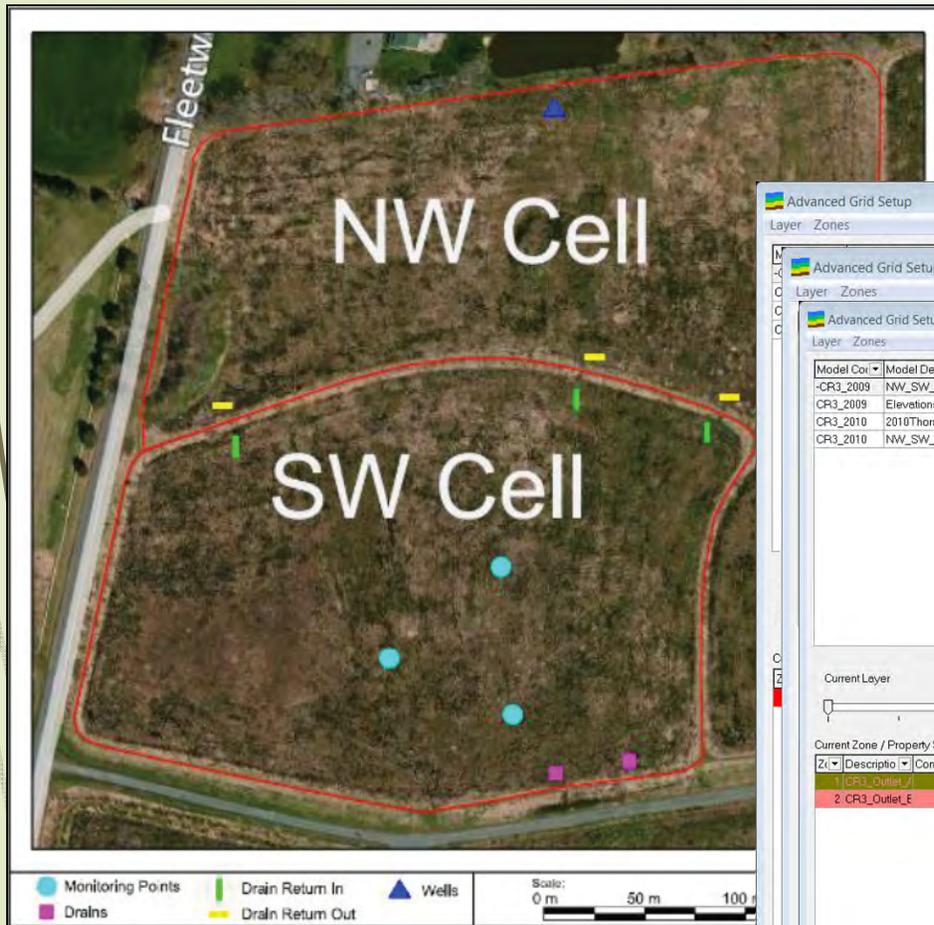
Anisotropy: 1.00e+00

Interblock Transmissivity (under LPP):  Harmonic Mean  Logarithmic Mean  AM Thickn LM Hydraulic Conductivity

4

# Advanced Model Grid Setup – Cell Zones

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



Advanced Grid Setup

Layer: Zones

Model Col: Model Descriptio

Model Col	Model Descriptio
-CR3_2009	NW_SW_Elev
CR3_2009	Elevations
CR3_2010	2010Thornthwaite
CR3_2010	NW_SW_Elev

Cell Zones (Boundary Conditions) | Grid Zones (Properties)

Grid Options:

- General Head
- Drains
- Monitoring Points
- No Flow Cells
- Wells
- Drain Returns

Current Layer: 1

Current Zone / Property Set

Zi	Descriptio	Conductor
1	CR3_Outlet_I	1.33
2	CR3_Outlet_E	1.33

Test Drains | X Cancel | Close

# Advanced Model Grid Setup – Grid Zones

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

The screenshot displays the 'Advanced Grid Setup' software interface with several overlapping windows. The primary window in the foreground is titled 'Advanced Grid Setup' and shows the 'Layer Zones' configuration. It includes a table for 'Layer Zones' and a 'Cell Zones (Boundary Conditions) Grid Zones (Properties)' section with radio buttons for 'Hydr Conductivity', 'Spec Yield/Storage', 'Precip Rate', and 'ET Rate'. A large grid of cells is visible, with a 'Current Layer' slider set to 3. Below the grid, a 'Current Zone / Property Set' table is shown.

Model Cor	Model Descriptio
-CR3_2009	NW_SW_Elev
CR3_2009	Elevations
CR3_2010	2010Thornthwaite
CR3_2010	NW_SW_Elev

Model Cor	Model Descriptio
-CR3_2009	NW_SW_Elev
CR3_2009	Elevations
CR3_2010	2010Thornthwaite
CR3_2010	NW_SW_Elev

Z	Descriptio	Kx
1	Veg/Surface	2.1
2	CR3 Topsoil	0.0001
3	Perm Sub So	2.3E-7
14	TestCR3	0.002

# Advanced Model Grid Setup – Grid Zones

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

The screenshot displays the 'Advanced Grid Setup' software interface. The main window is titled 'Advanced Grid Setup' and contains several panels:

- Layer Zones Table:** A table listing model configurations for different layers.
- Cell Zones (Boundary Conditions) Grid Zones (Properties):** A large grid area where individual cells are being assigned zone numbers. The grid is currently showing a pattern of red and blue cells.
- Grid Options:** Radio buttons for 'Hydr Conductivity', 'Spec Yield/Storage', 'Precip Rate', and 'ET Rate'. 'ET Rate' is selected.
- Current Layer:** A slider set to 1.
- Current Zone / Property Set:** A dropdown menu showing a list of zones: 1 CR3 2010 Thornwait, 2 CR3 2009 Thorn, and 3 -.
- Bottom Left:** A scale bar and a north arrow.
- Bottom Right:** Buttons for 'Test ET', 'Cancel', and 'Close'.

Model Cor	Model Descriptio
-CR3_2009	NW_SW_Elev
CR3_2009	Elevations
CR3_2010	2010Thornthwaite
CR3_2010	NW_SW_Elev

Zone Num	Description
1	CR3 2010 Thornwait
2	CR3 2009 Thorn
3	-

# 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.

The screenshot displays the 'Advanced Scenarios' software window. The 'Name File' tab is active, showing a list of files to be generated for the current model. The window includes a search bar, a 'New Advanced Scenario' button, and navigation controls. The 'Generate Name File for Current Model' button is highlighted.

Scenario Cod	Description
-CR3_2009	NW_SW_Elev
CR3_2009	Elevations
CR3_2010	2010Thornthwaite
CR3_2010	NW_SW_Elev

Short Name	Numt	Filename
LIST	7	-CR3_2009.lst
BAS6	1	-CR3_2009.bas
DIS	29	-CR3_2009.dis
UPW	11	-CR3_2009.upw
ZONE	40	-CR3_2009.zone
DRN	13	-CR3_2009.drn
GHB	17	-CR3_2009.ghb
RCH	18	-CR3_2009.rch
NWT	19	-CR3_2009.NWT
OC	22	-CR3_2009.oc
WEL	12	-CR3_2009.wel
EVT	74	-CR3_2009.evt
DRT	75	-CR3_2009.drt
DATA(BINAR'	50	-CR3_2009.cbb
DATA(BINAR'	54	-CR3_2009.cbw
DATA(BINAR'	51	-CR3_2009.crc
DATA(BINAR'	30	-CR3_2009.hds
DATA(BINAR'	31	-CR3_2009.ddn

# 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).

The screenshot shows the 'Advanced Scenarios' software interface. On the left, there is a table of scenarios:

Scenario Cod	Description
-CR3_2009	NW_SW_Elev
CR3_2009	Elevations
CR3_2010	2010Thornthwaite
CR3_2010	NW_SW_Elev

On the right, a command prompt window titled 'C:\Windows\system32\cmd.exe' displays the following output:

```
Solving: Stress period: 361 Time step: 1 Groundwater-Flow Eqn.
Solving: Stress period: 361 Time step: 2 Groundwater-Flow Eqn.
Solving: Stress period: 361 Time step: 3 Groundwater-Flow Eqn.
Solving: Stress period: 362 Time step: 1 Groundwater-Flow Eqn.
Solving: Stress period: 362 Time step: 2 Groundwater-Flow Eqn.
Solving: Stress period: 362 Time step: 3 Groundwater-Flow Eqn.
Solving: Stress period: 363 Time step: 1 Groundwater-Flow Eqn.
Solving: Stress period: 363 Time step: 2 Groundwater-Flow Eqn.
Solving: Stress period: 363 Time step: 3 Groundwater-Flow Eqn.
Solving: Stress period: 364 Time step: 1 Groundwater-Flow Eqn.
Solving: Stress period: 364 Time step: 2 Groundwater-Flow Eqn.
Solving: Stress period: 364 Time step: 3 Groundwater-Flow Eqn.
Solving: Stress period: 365 Time step: 1 Groundwater-Flow Eqn.
Solving: Stress period: 365 Time step: 2 Groundwater-Flow Eqn.
Solving: Stress period: 365 Time step: 3 Groundwater-Flow Eqn.
Solving: Stress period: 366 Time step: 1 Groundwater-Flow Eqn.
Solving: Stress period: 366 Time step: 2 Groundwater-Flow Eqn.
Solving: Stress period: 366 Time step: 3 Groundwater-Flow Eqn.
Run end date and time (yyyy/mm/dd hh:mm:ss): 2014/01/26 21:06:19
Elapsed run time: 23.213 Seconds

Normal termination of simulation

C:\Wetbud\MODFLOW output>pause
Press any key to continue . . .
```

# 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).

The screenshot shows the 'Advanced Scenarios' software interface. The 'Solve' tab is active, displaying a list of scenarios on the left and a list of MODFLOW output files on the right. The 'Show Advanced Model Output' button is highlighted with a red box.

Scenario Cod	Description
-CR3_2009	NW_SW_Elev
CR3_2009	Elevations
CR3_2010	2010Thornthwaite
CR3_2010	NW_SW_Elev

1. Create MODFLOW Input Files

2. Execute MODFLOW

3. View MODFLOW Listing File

4. Show Advanced Model Output

Edit Cell Zone Parameters

Edit Grid Zone Parameters

```
C:\Wetbud\MODFLOW output\ -CR3_2009.bas created
C:\Wetbud\MODFLOW output\ -CR3_2009.dis created
C:\Wetbud\MODFLOW output\ -CR3_2009.nwt created
C:\Wetbud\MODFLOW output\ -CR3_2009.zone created
C:\Wetbud\MODFLOW output\ -CR3_2009.rch created
C:\Wetbud\MODFLOW output\ -CR3_2009.evt created
C:\Wetbud\MODFLOW output\ -CR3_2009.drn created
C:\Wetbud\MODFLOW output\ -CR3_2009.drt created
C:\Wetbud\MODFLOW output\ -CR3_2009.ghb created
C:\Wetbud\MODFLOW output\ -CR3_2009.wel created
C:\Wetbud\MODFLOW output\ -CR3_2009.oc created
C:\Wetbud\MODFLOW output\ -CR3_2009.upw created
File generation for -CR3_2009 completed.
```

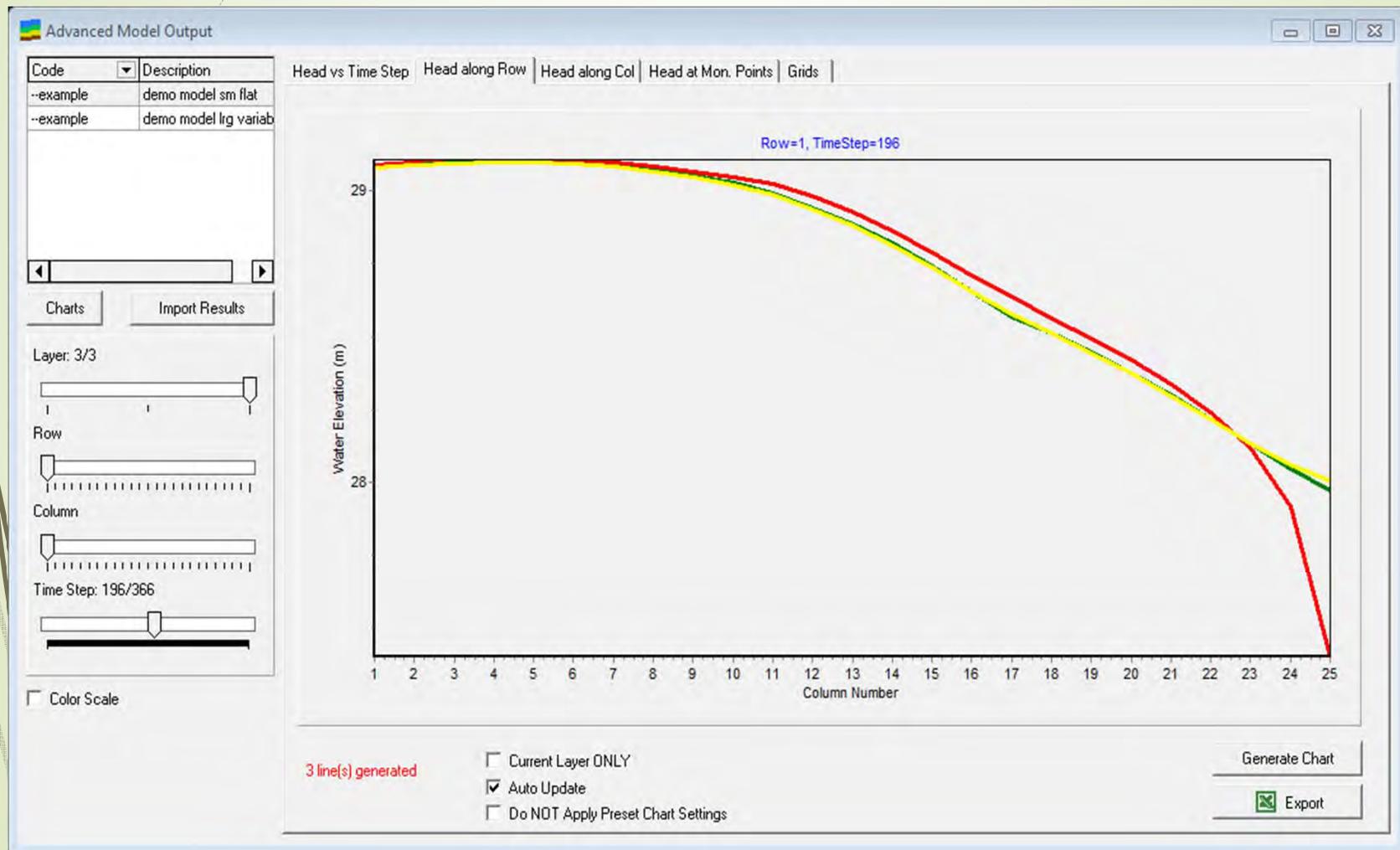
# Advanced Model Output – Head vs. Time Step

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



# Advanced Model Output – Head along row

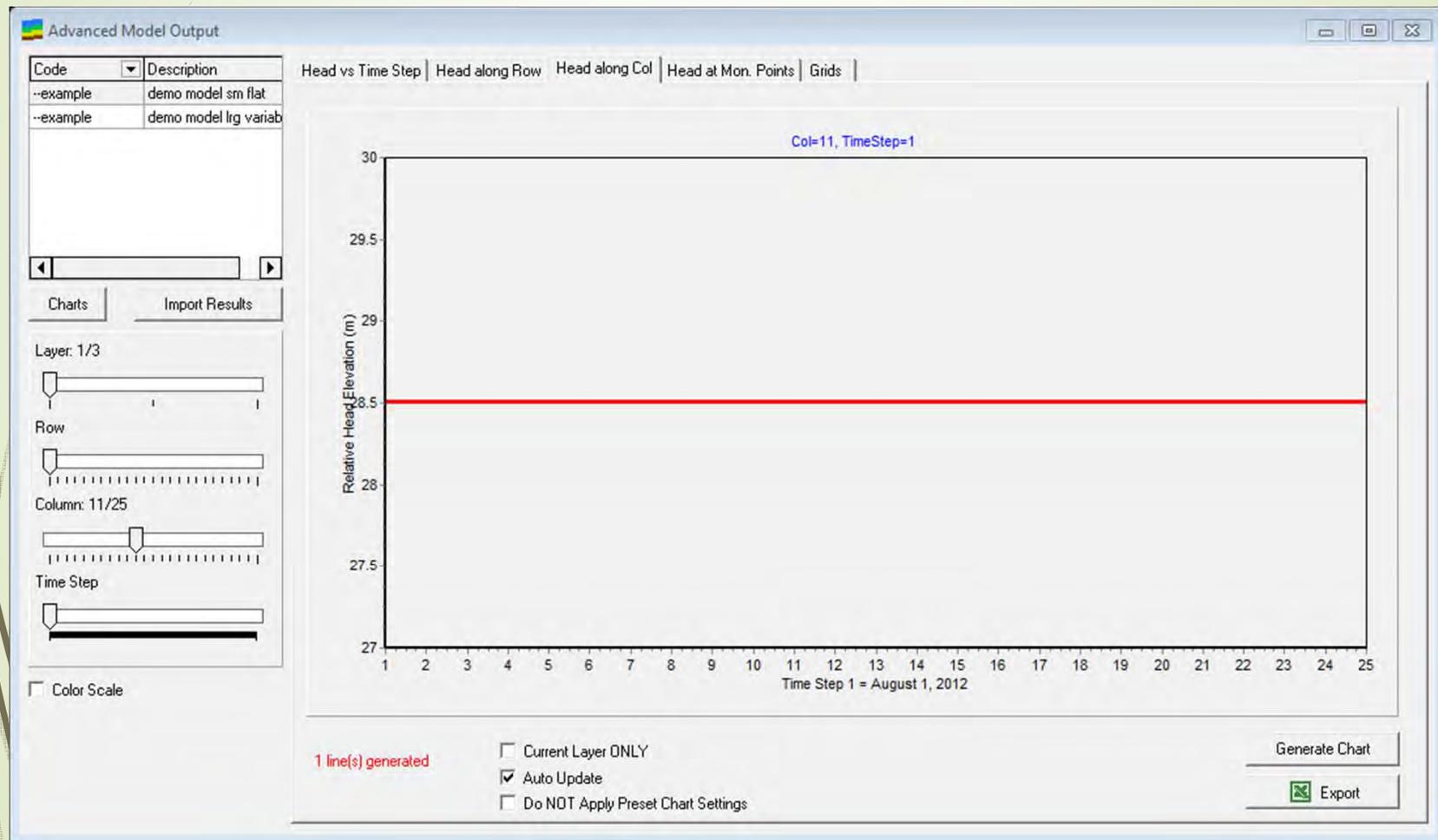
- In the Advanced Model Output window, import results and generate charts in the output display tabs.



Output shown here not from CR3

# Advanced Model Output – Head along col

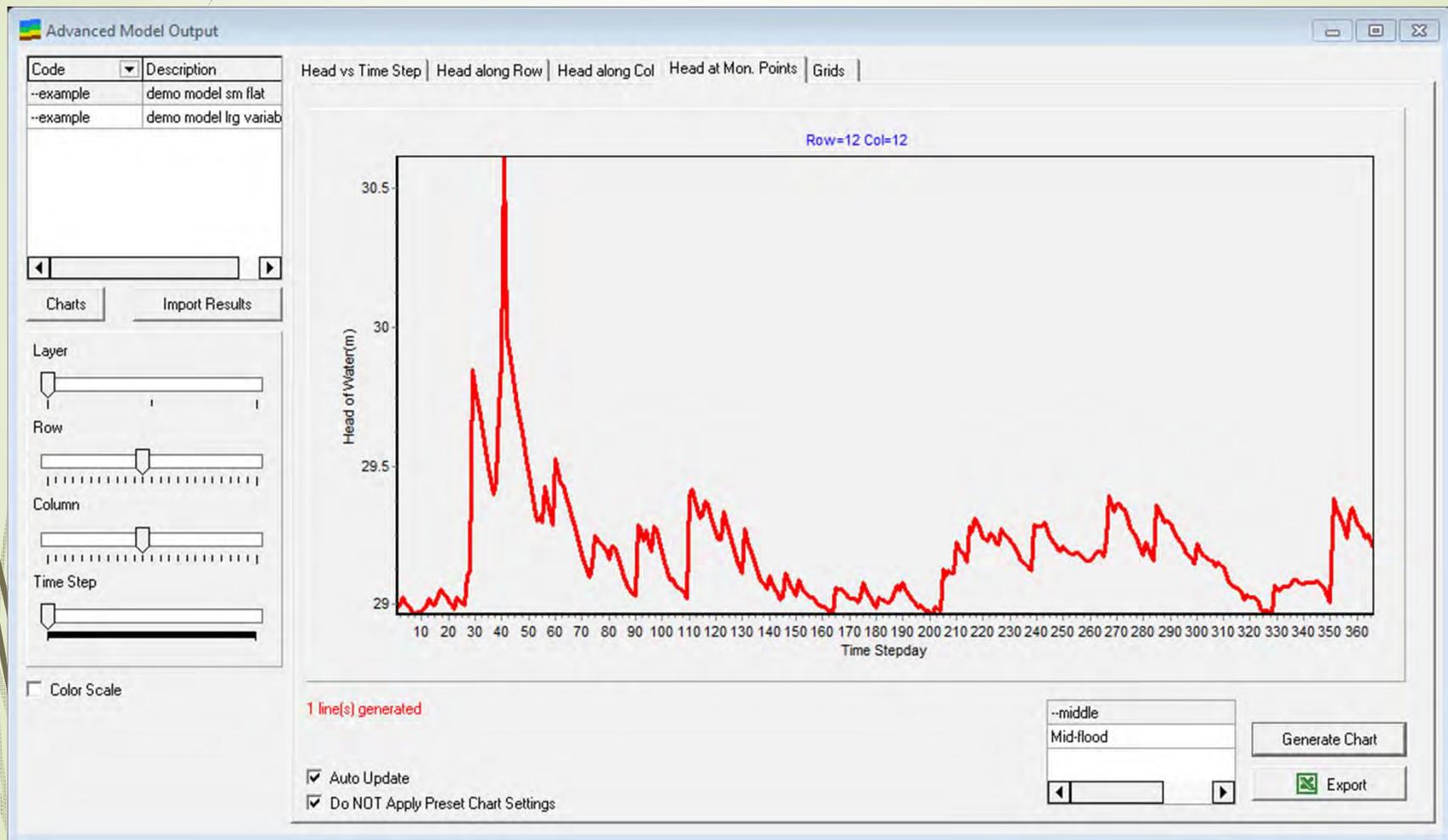
- In the Advanced Model Output window, import results and generate charts in the output display tabs.



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.

The screenshot displays the 'Advanced Model Output' window. On the left, there is a table with columns 'Code' and 'Description'. Below this table are control panels for 'Charts', 'Import Results', 'Layer', 'Row', 'Column: 17/81', and 'Time Step: 194/365'. The main area is a large grid with columns labeled 'Head vs Time Step', 'Head along Row', 'Head along Col', 'Head at Mon. Points', and 'Grids'. The grid contains numerical data, with the first cell highlighted in blue. At the bottom, there are status indicators (40.14, 100), a 'Color Scale' checkbox, and buttons for 'Auto Update', 'w/ Decimals', 'Color', 'Color No Flow', 'Capture', and 'Generate plot'.

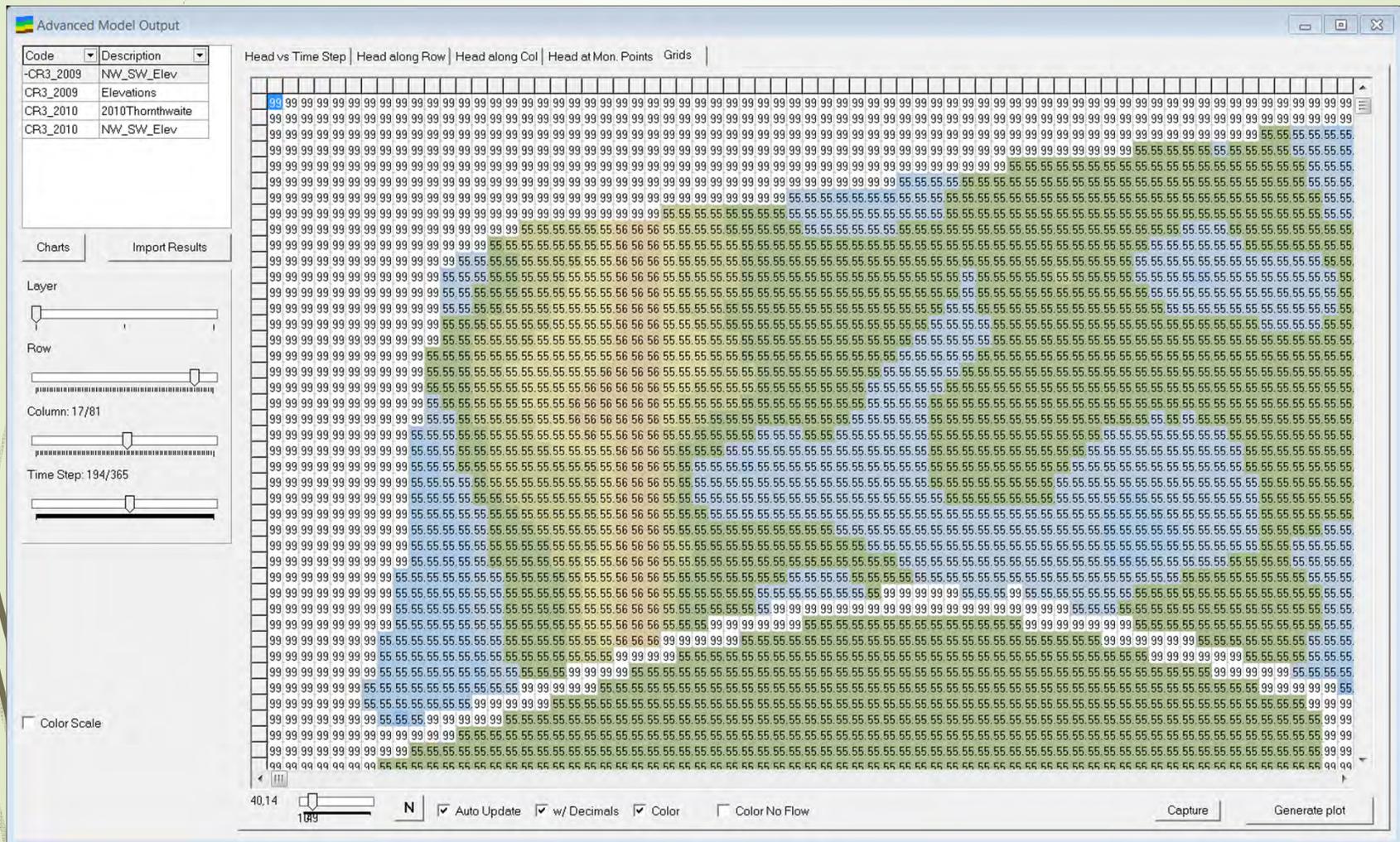
Code	Description
-CR3_2009	NW_SW_Elev
CR3_2009	Elevations
CR3_2010	2010Thornthwaite
CR3_2010	NW_SW_Elev

Head vs Time Step | Head along Row | Head along Col | Head at Mon. Points | Grids

40.14 | 100 |  Auto Update |  w/ Decimals |  Color |  Color No Flow | Capture | Generate plot

# 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?