Boundary and Initial Conditions for 2D Modeling

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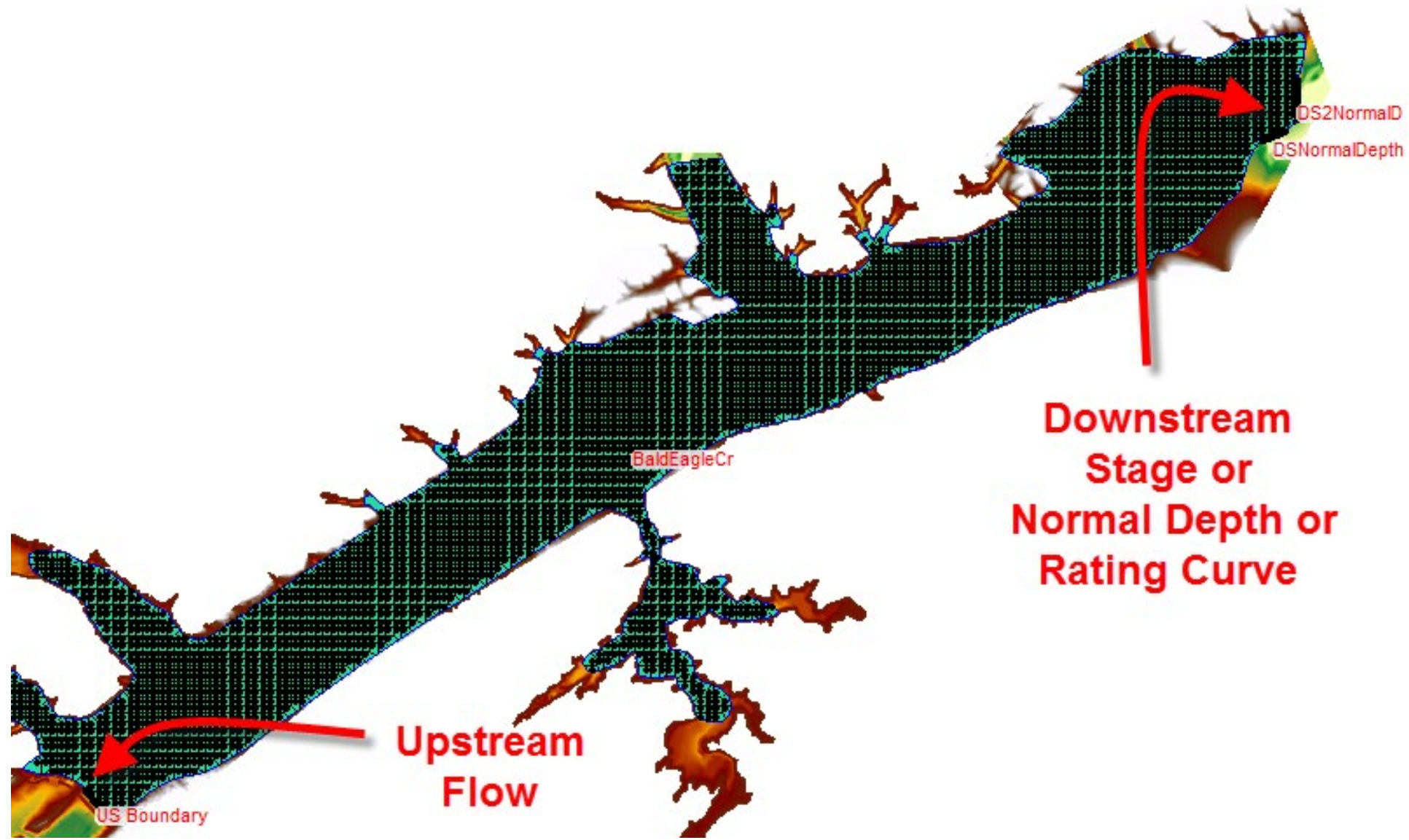
Overview

- External Boundary conditions

- Internal Boundary conditions

- Initial Conditions

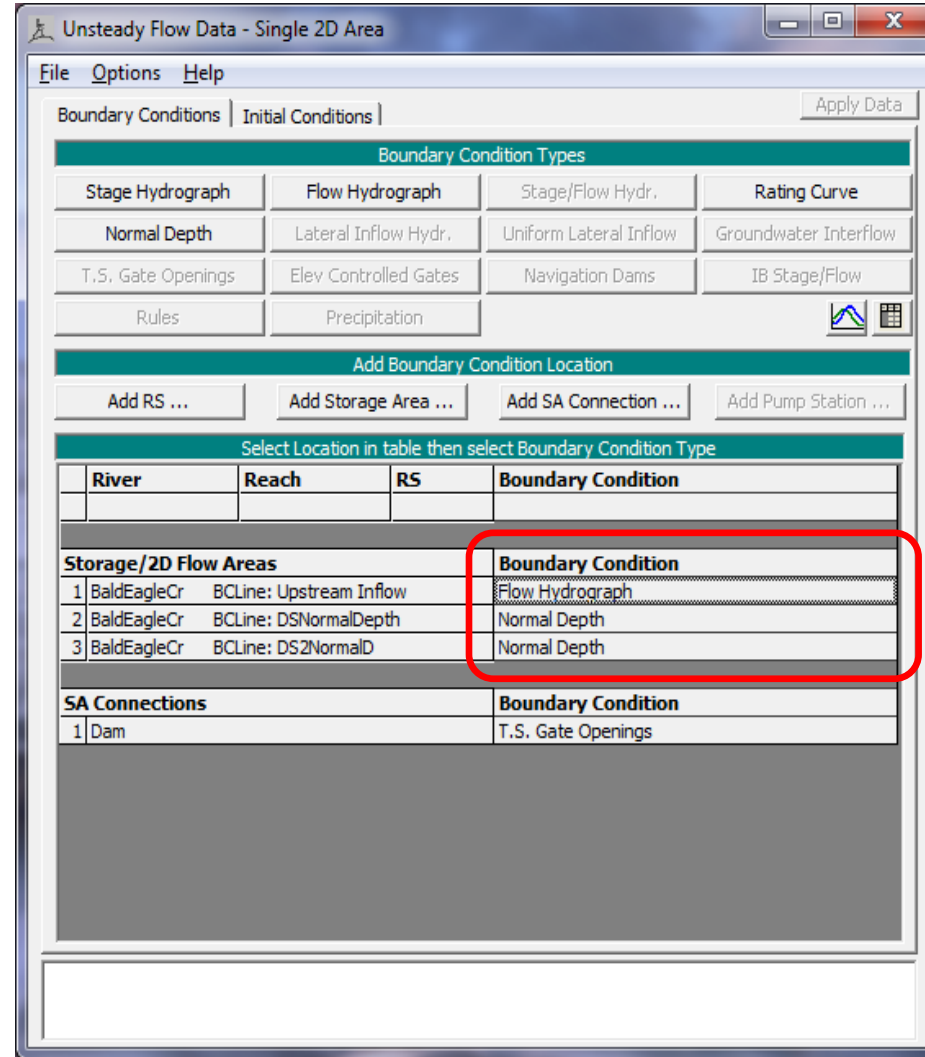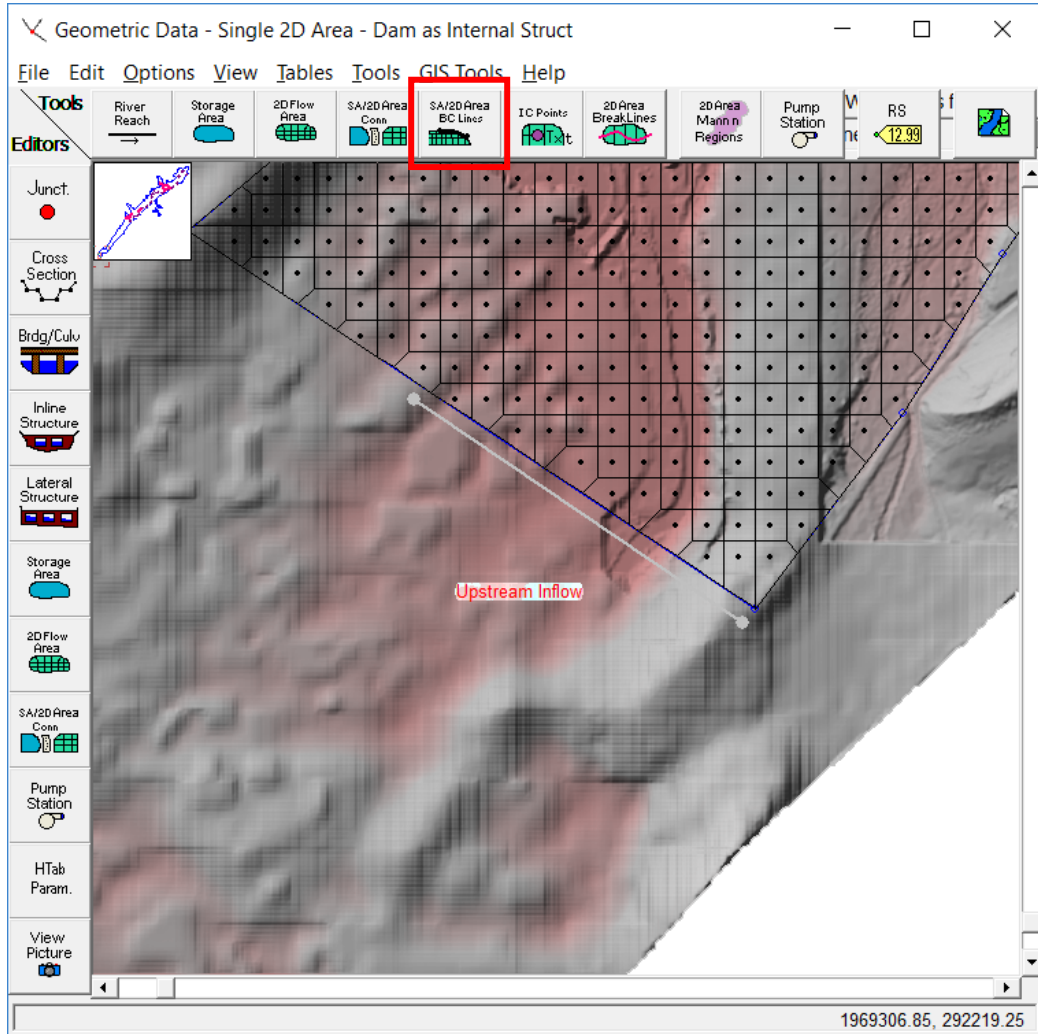# External Boundary Conditions Overview

Downstream
Stage or
Normal Depth or
Rating Curve

Upstream
Flow

DS2NormalD
DSNormalDepth

BaldEagleCr

US Boundary

2D External Boundary Types

- Flow Time Series
  - **Usually for inflow (upstream/lateral)**
  - **Can also be used for outflow**
  - **Can be inside a 2D area**

- Stage Time Series
  - **Usually for outflow**
  - **Can also be used for inflow (i.e., tidal)**

- Normal Depth (outflow only)

- Rating Curve (outflow only)

- Precipitation (inflow to cells from above)

Creating External Boundary Condition Lines

Flow Hydrograph & EG Slope

- EG Slope required to compute normal depth
- TW Check higher of TW and normal depth
- Velocity transferred for full momentum equation

Flow Distribution along Boundary
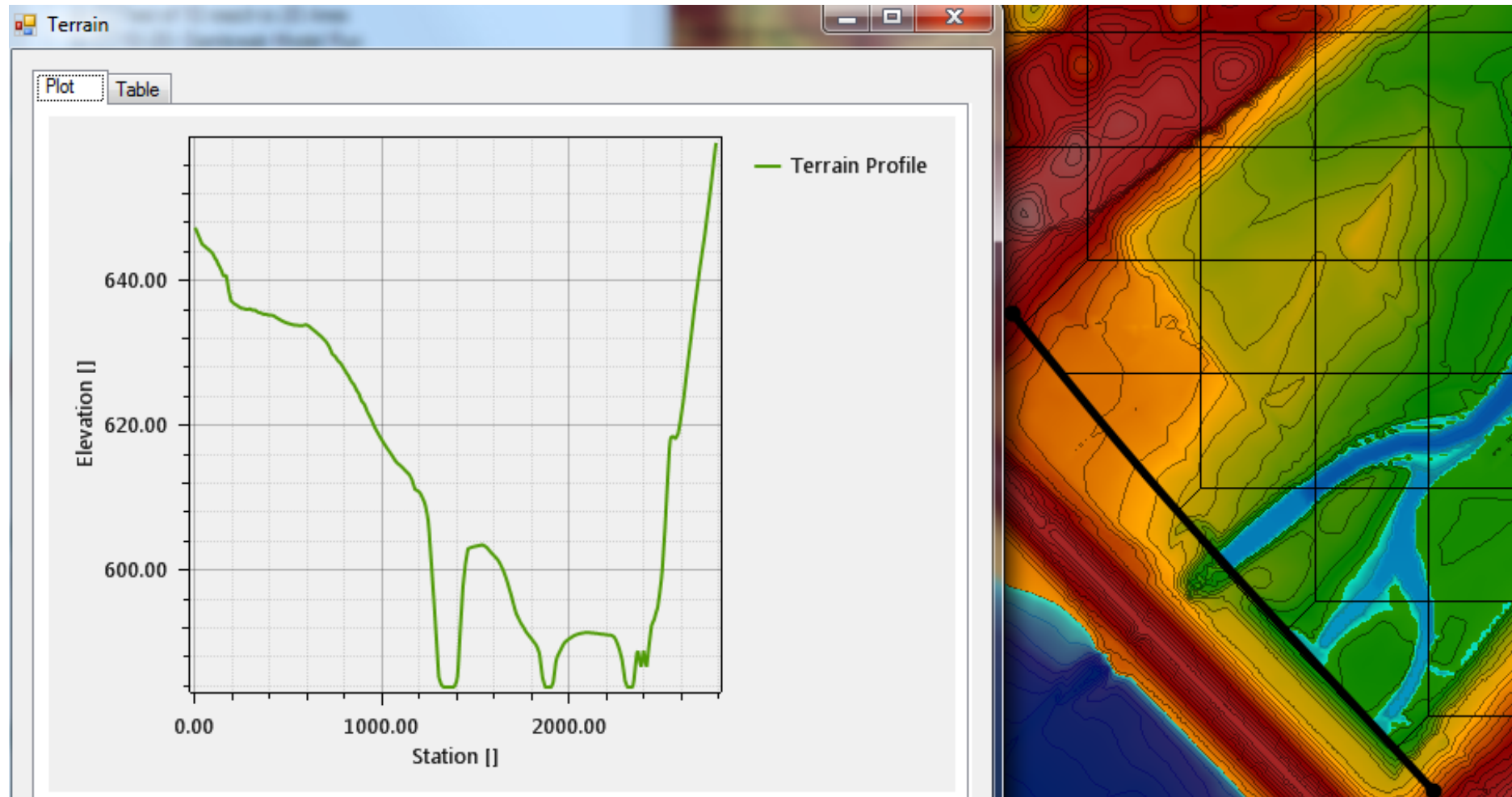
- Flow is distributed to the appropriate cells based on EG Slope Conveyance or actual water surface

Stage Hydrograph

Normal Depth

Flow/Stage/Normal Depth

- Flow Hydrograph
  - **Cell water surfaces can vary**

- Stage Hydrograph
  - **All of the boundary cells have the same water surface elevation**

- Normal Depth
  - **Normal Depth computation is applied separately to each cell**
  - **Cell water surface elevations can vary**
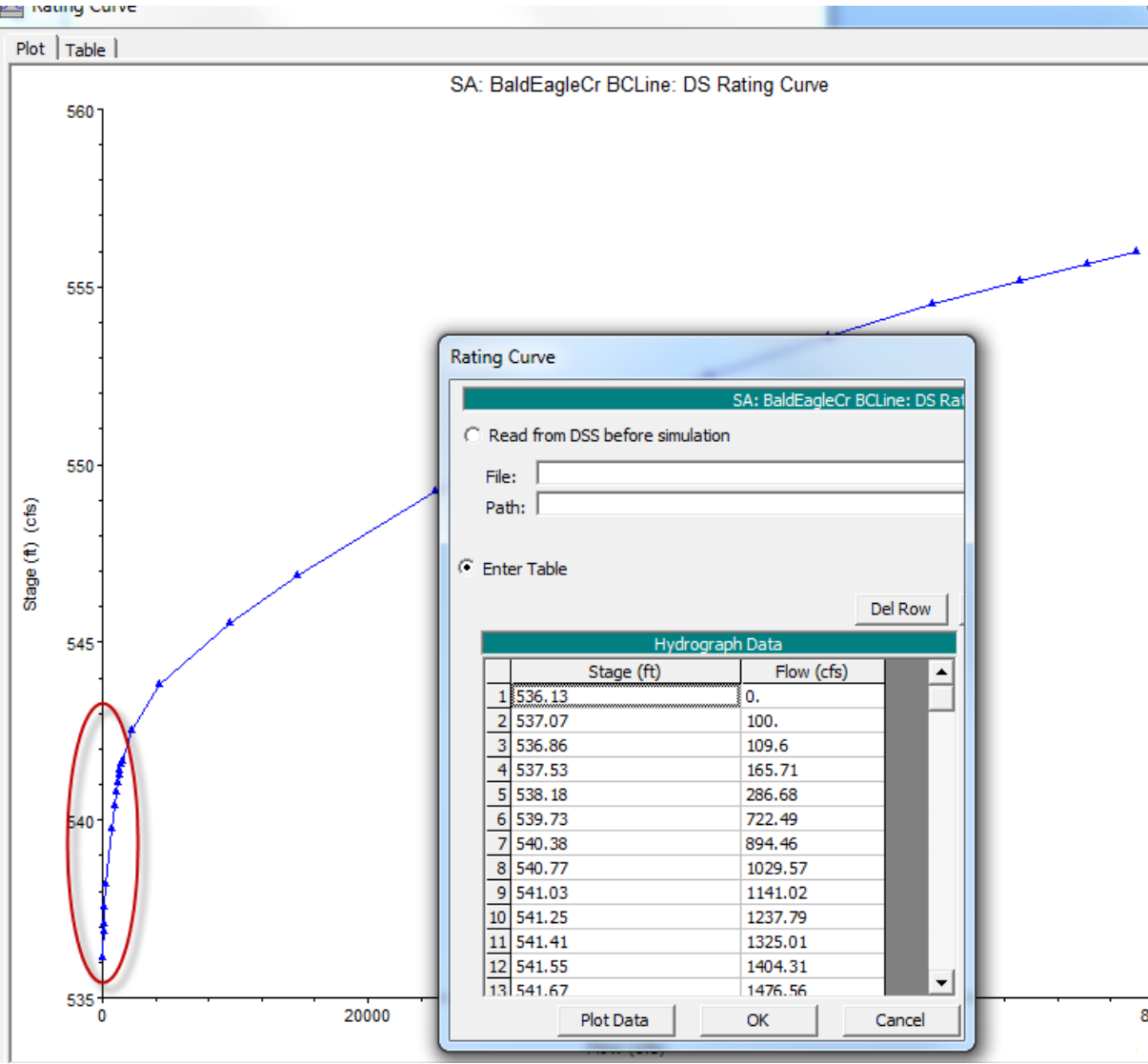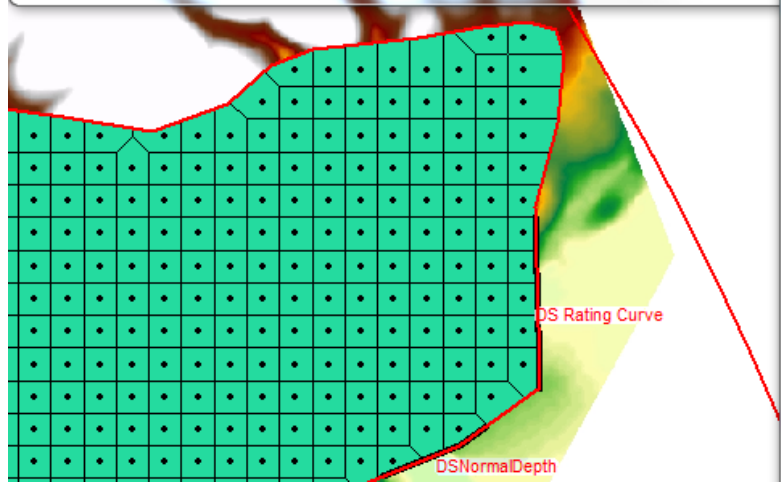
Rating Curve

Rating Curve Considerations

- Flow based on conveyance-averaged WSE

- Flow distribution based on conveyance

- Watch out for a steeply sloped curve and/or sharp transitions in the curve

- Watch out for "bad" low flow curve

- Zero flow point on Rating Curve does **NOT** have to be at invert (could be higher)

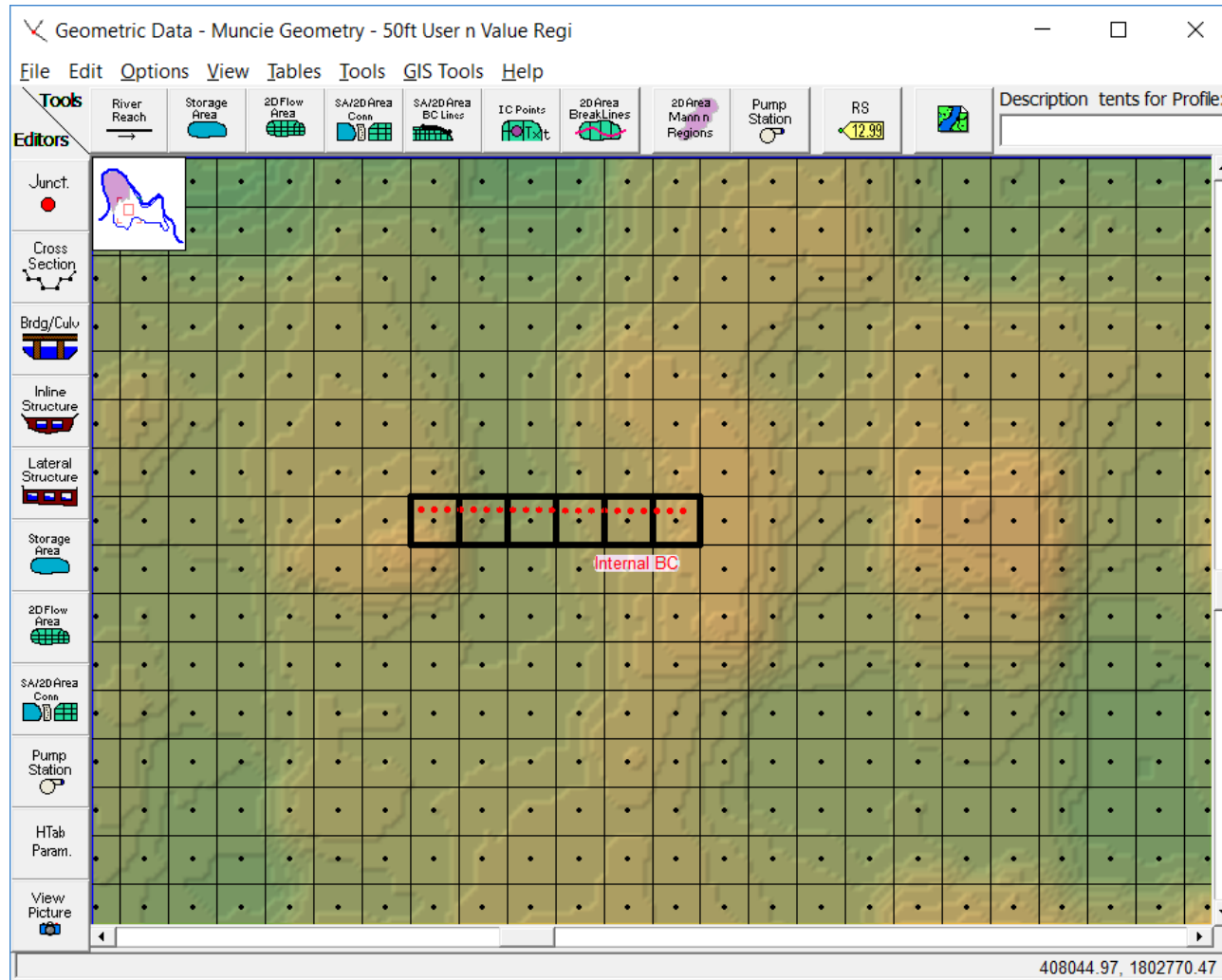- Can have initialization problems (not consistent with cold-start conditions)

External Boundary Locations

- Extend boundary condition locations away from study area of interest
  - **Normal Depth is an approximate boundary**
  - **Stage creates a horizontal WSE along the boundary cells**

Internal Boundary Conditions

- Flow Hydrographs Only

- Must be completely inside of the 2D Flow Area

- Can have positive and/or negative flows

Boundary Output

2D Starting Options Overview

- User Specified Initial Conditions
  - 2D starts dry
  - Horizontal WSE
  - 2D **Initial Condition Time** (Optional)
    - **Allows each 2D area to compute an initial profile**
    - **Somewhat similar to 1D initial backwater**
  - Optional entire model **Warm Up** period to settle simulation
- Use **Restart File**
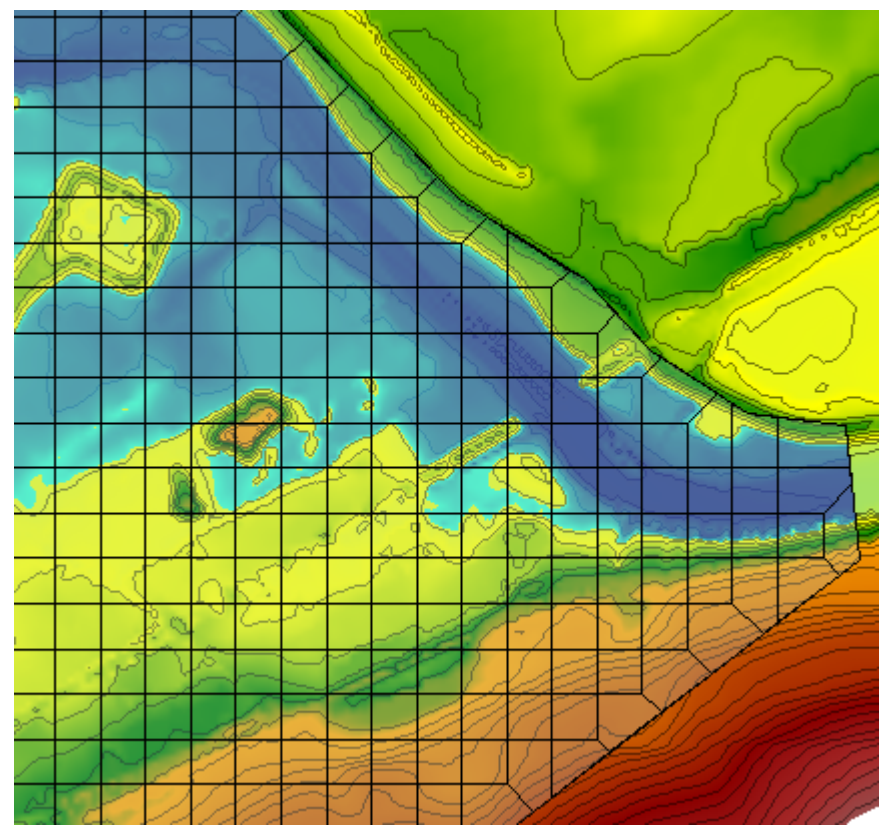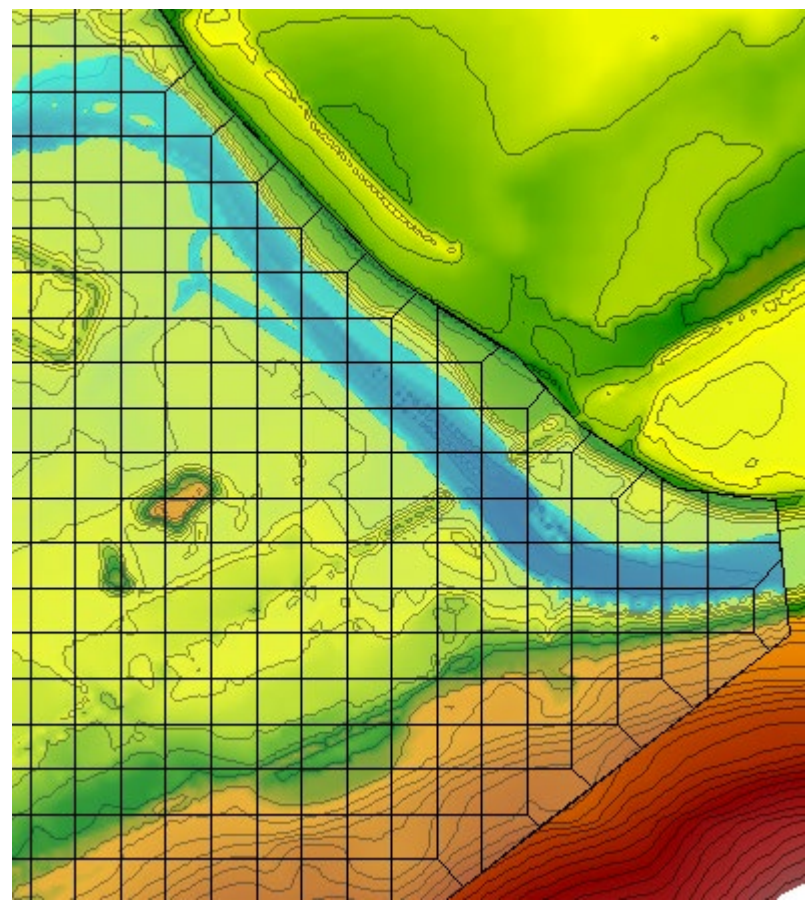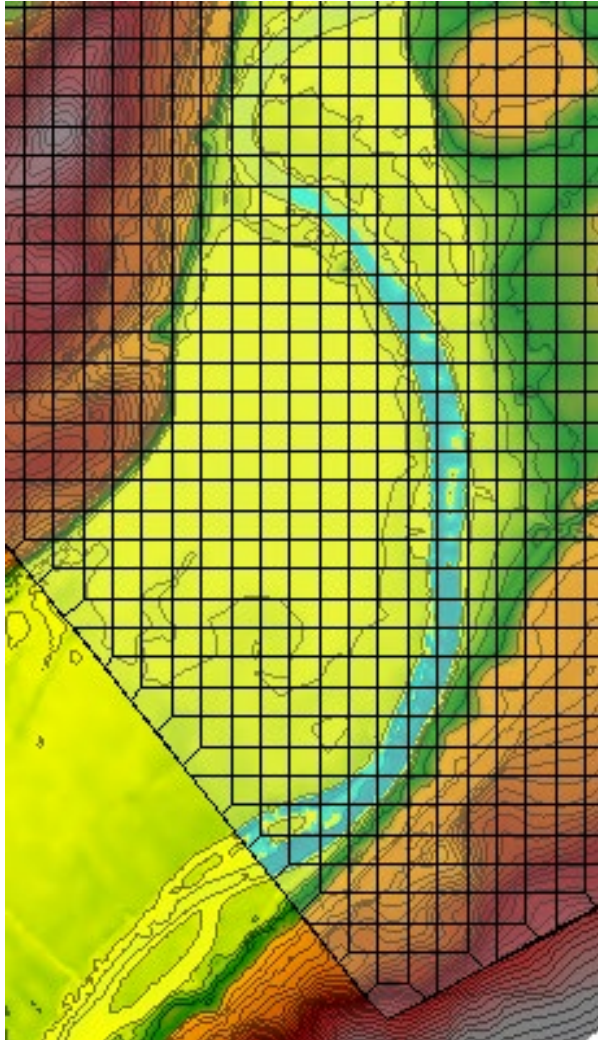 - Restart File created by previous run

1D Stays Wet
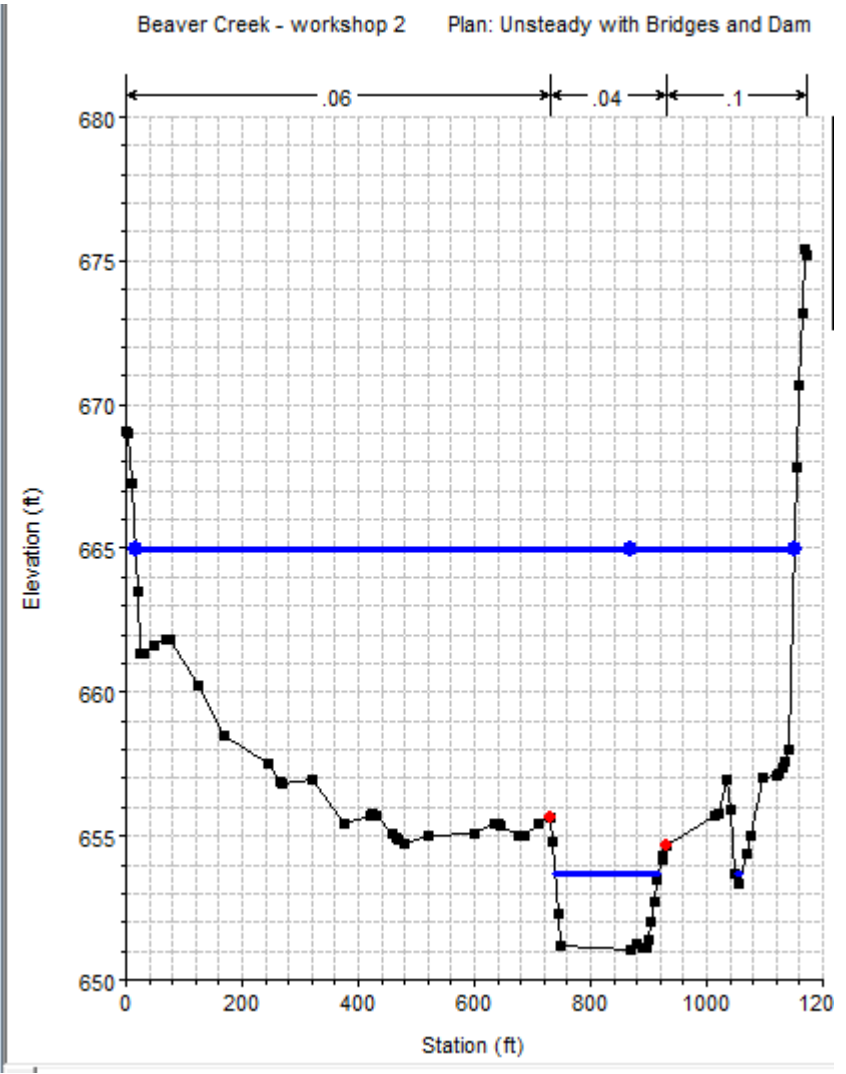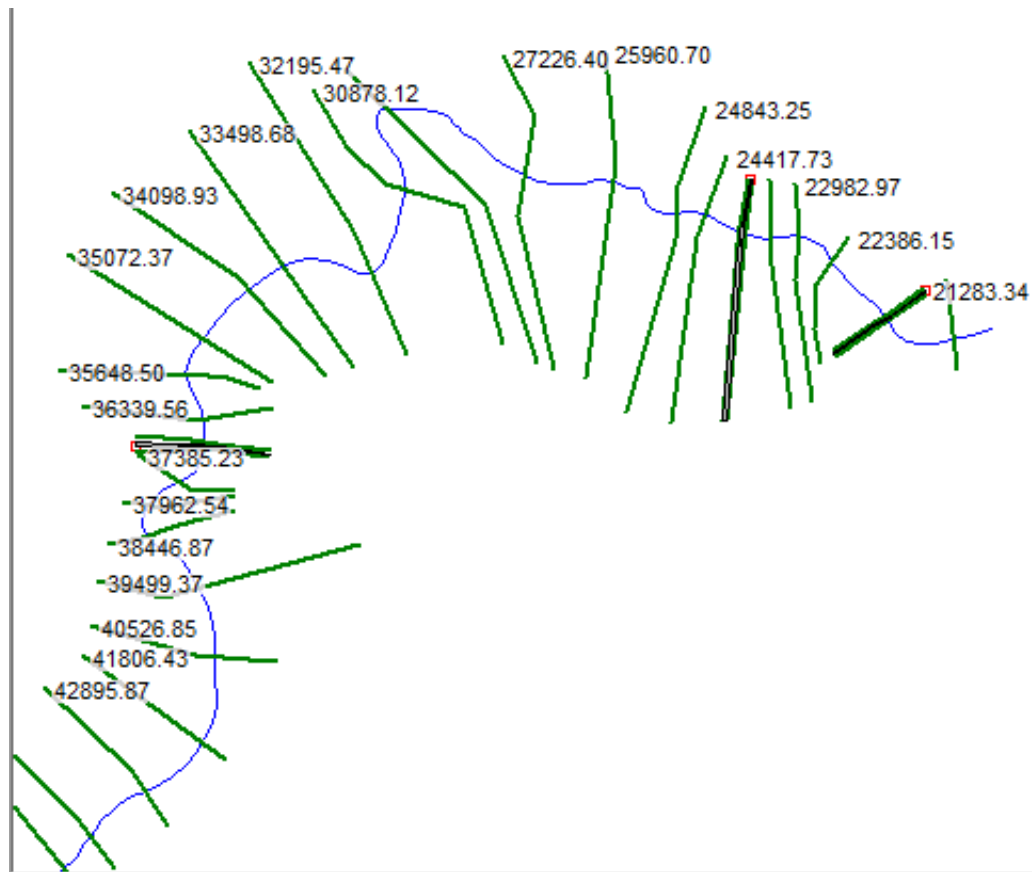
2D Wetting/Drying

Filling 2D Channel

- Use Initial Conditions Time to fill channel

- Upstream flow will eventually fill channel

- May take a long time to fill, especially reservoirs

- Initial [horizontal] WSE can be used to speed things up

- A Restart File can save time

Initial Conditions Ramp Up

2D Initial Conditions

- Separate Initial Conditions computed for each 2D area, one at a time
- All external flows go from zero to starting value during Ramp Up and are then held constant
- Initial WSE (from Unsteady flow data file) applies to all cells
- Starting WSE at a Stage boundary condition uses smart projection
- Model Warm Up period (General tab from computational settings and options) is for entire model
  - **For a single 2D area Initial Conditions and Warm Up do mostly the same thing**
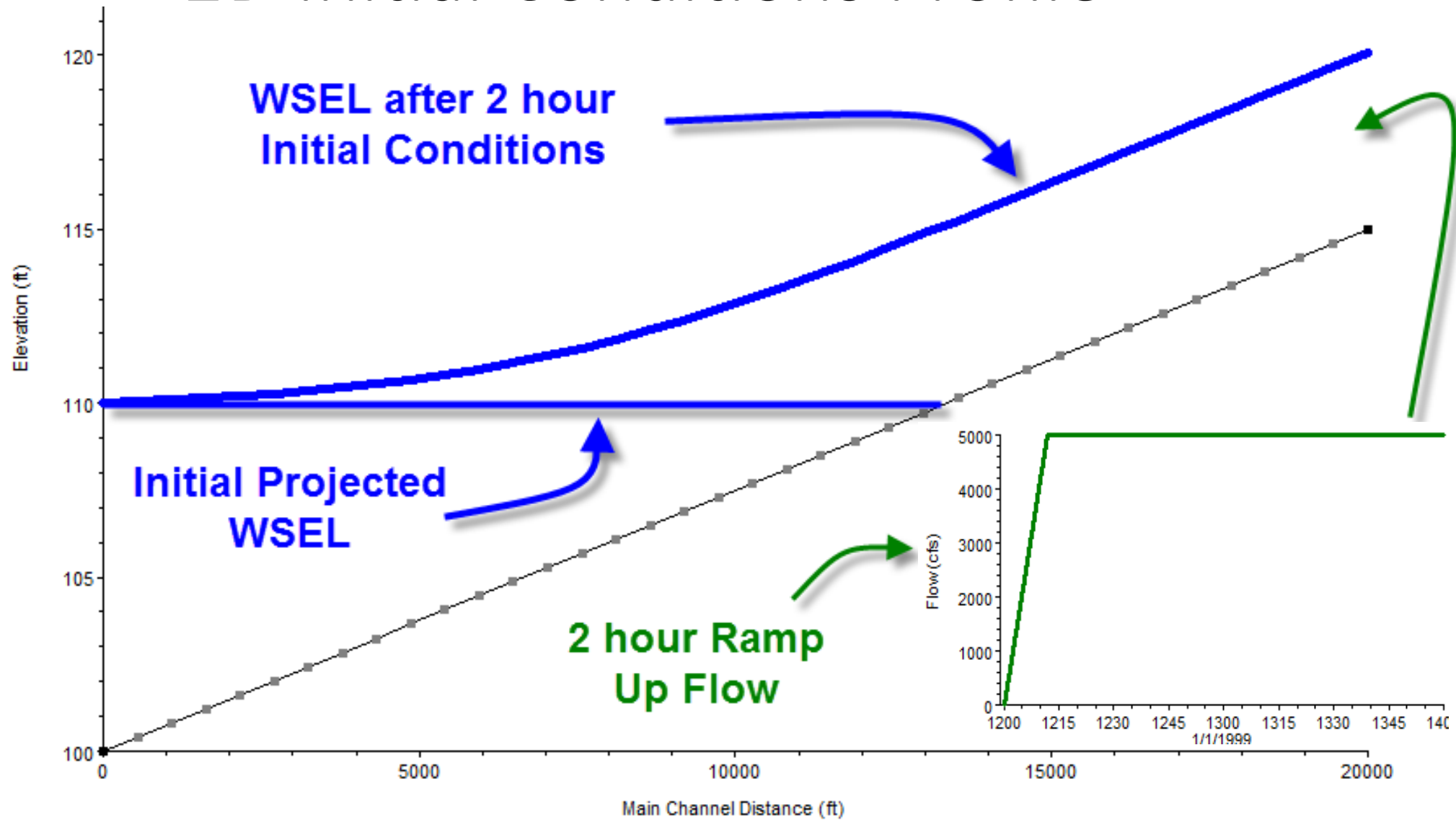
2D Initial Conditions in Progress
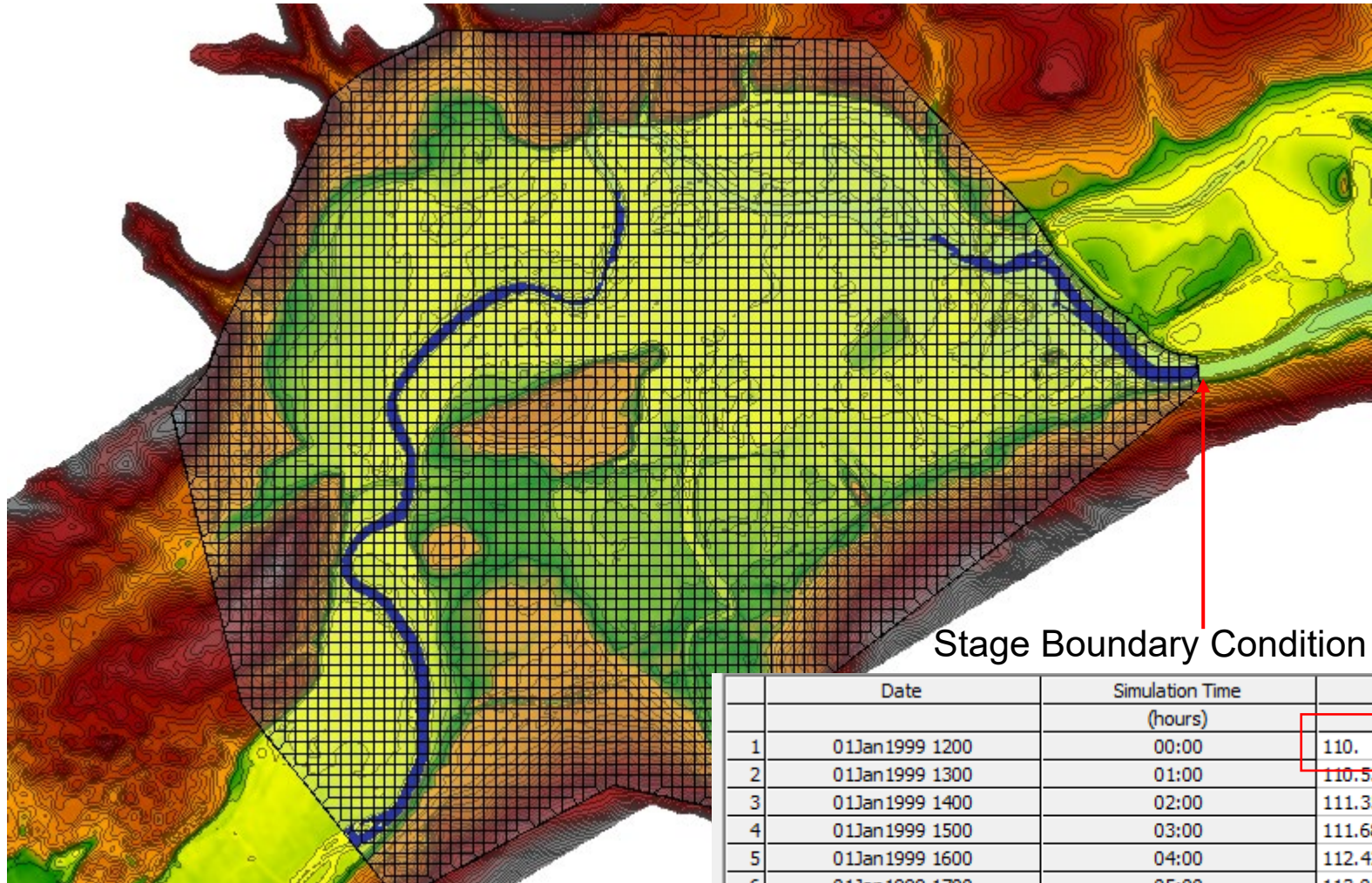
Stage Boundary Condition

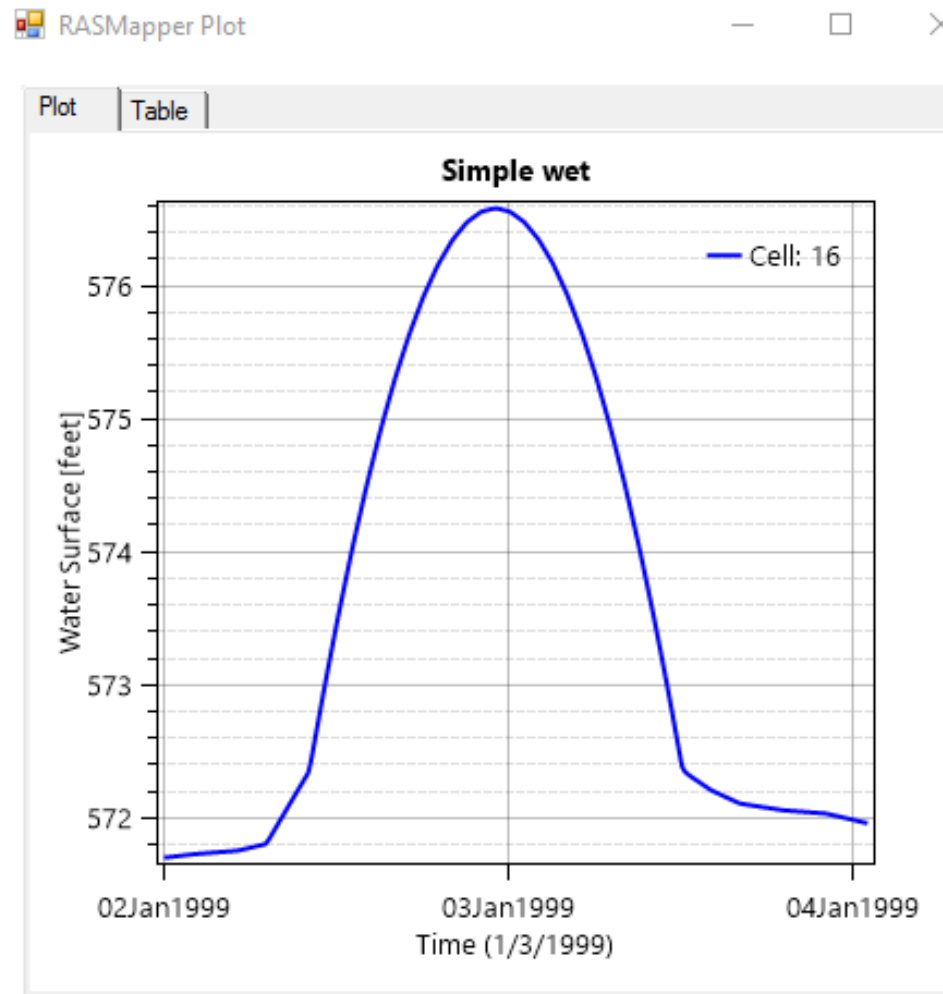|	Date	Simulation Time (hours)	
1	01Jan1999 1200	00:00	110.
2	01Jan1999 1300	01:00	110.53
3	01Jan1999 1400	02:00	111.35
4	01Jan1999 1500	03:00	111.68
5	01Jan1999 1600	04:00	112.42
6	01Jan1999 1700	05:00	113.05

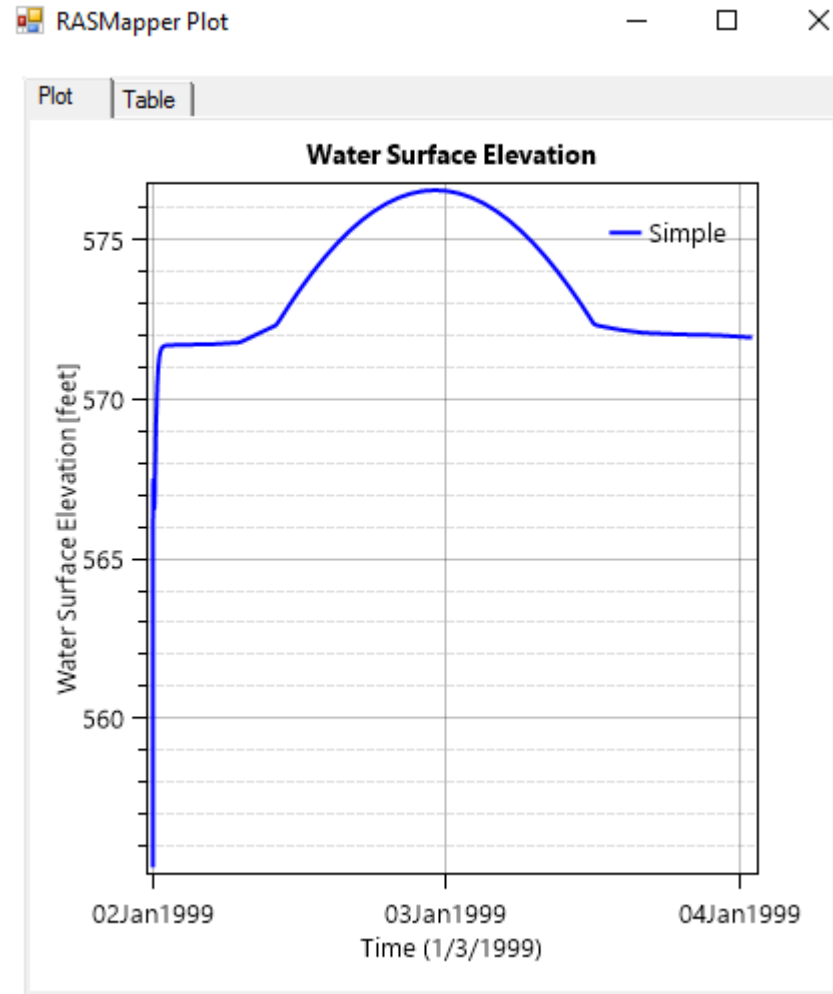☑ Use Initial Stage (recommended)   ? t Data   OK

2D Initial Conditions Profile
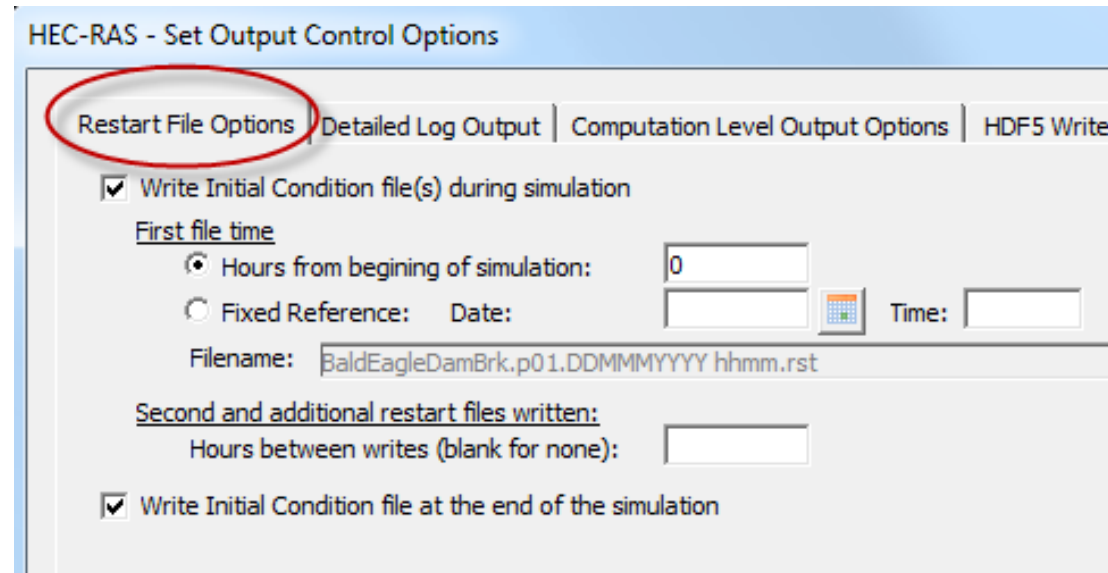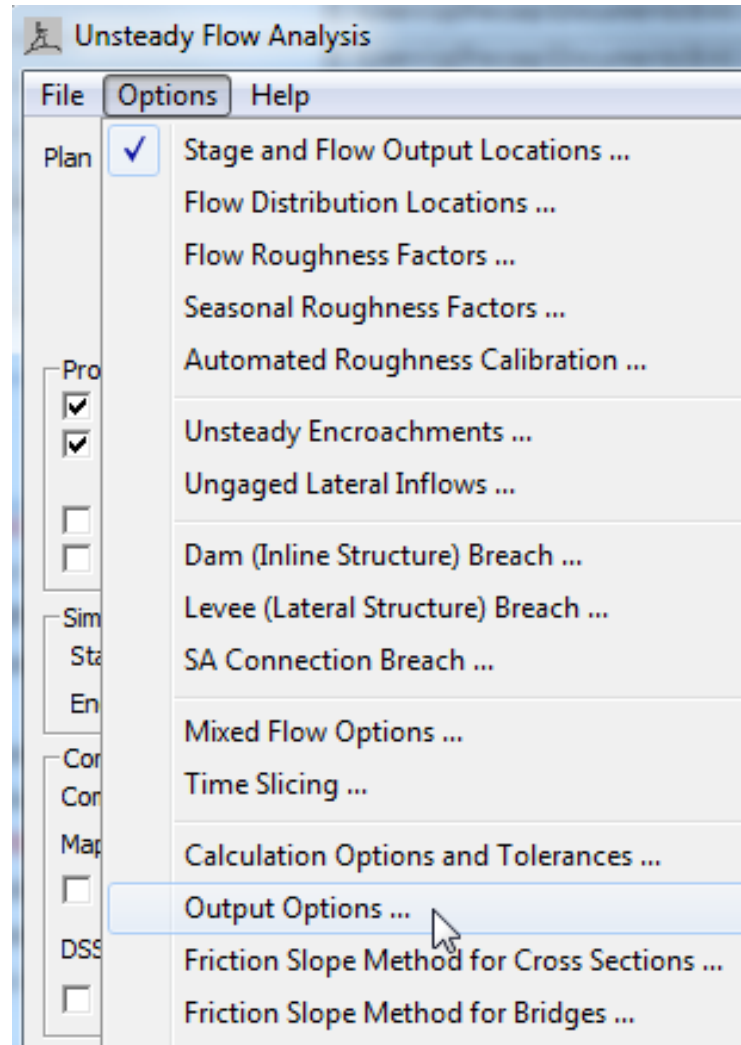
Dry vs Wet Start

Using a Restart File

- Write Initial Condition file out at time zero [or at the desired time(s)] from a previous run.

- Create a new Unsteady Flow file and Plan ("Save As…")

- Select Use a Restart File option in Unsteady Flow Initial Conditions Tab

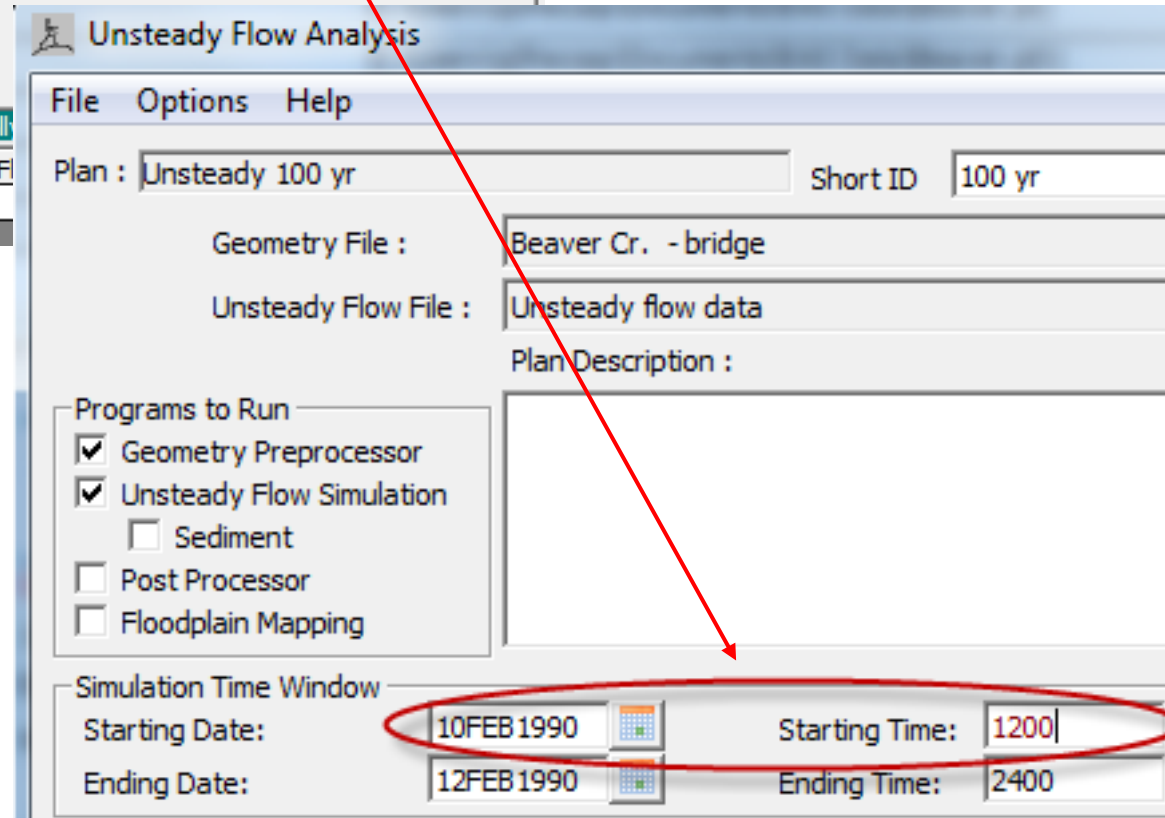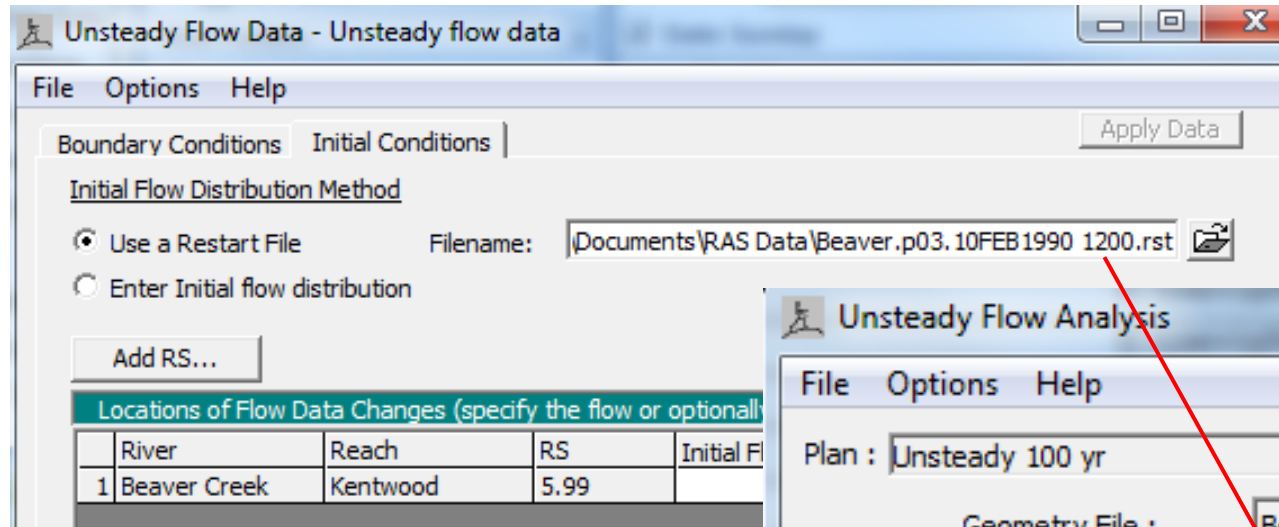- Adjust starting date, and any hydrographs, if needed (if you start model later than previous run).

Write Initial Condition File

Select Restart

Hydrograph Starting Time

Restart File

- Geometry must be the same
- Switch equation Momentum/Diffusion if desired
  - **Can use Diffusion Wave run as restart for Full Eqns**
- Can change the time step
- Can change the output interval
- Can (generally) change flow and plan data

Interpolate From Previous Results

- New for Version 6.0

- User selects a previous plan results file
  (ProjectName.p##.hdf)

- Geometry does not have to be the same

- Interpolates water levels, velocities,
  and flows

- Works for 1D and 2D

Flat WSEL vs Momentum

Questions?