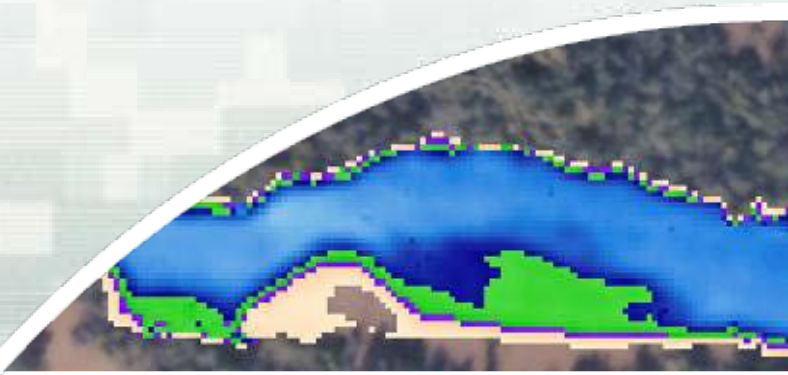
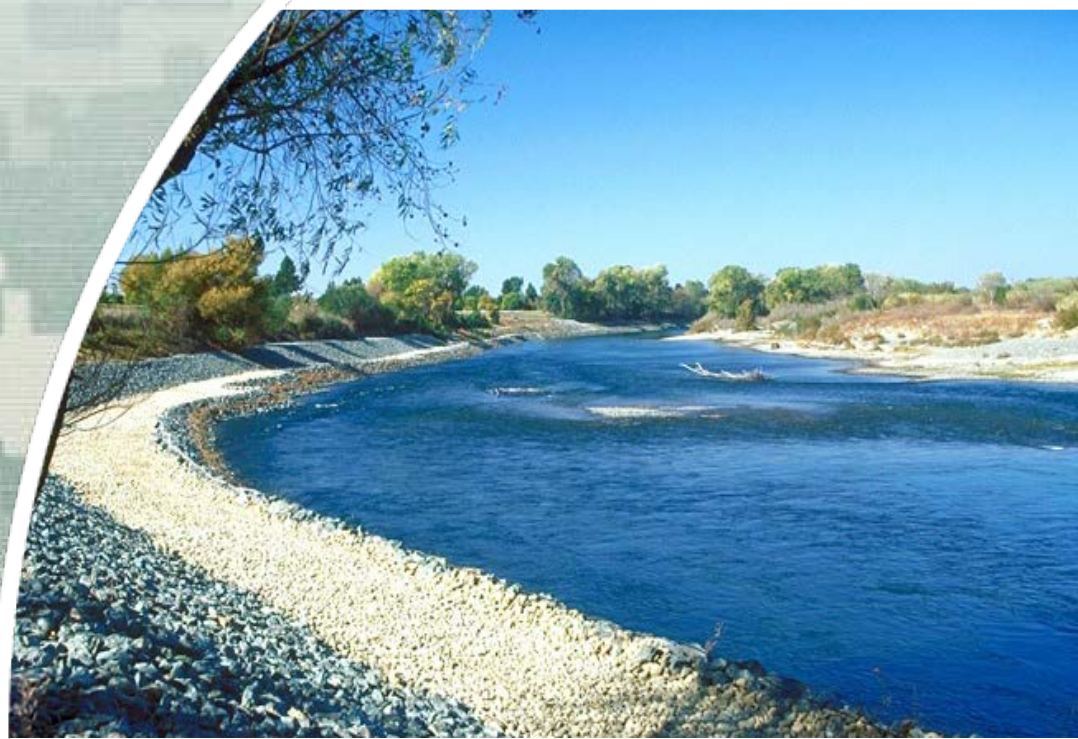
Overview of HEC-RAS and Steps to Develop an HEC-RAS Model





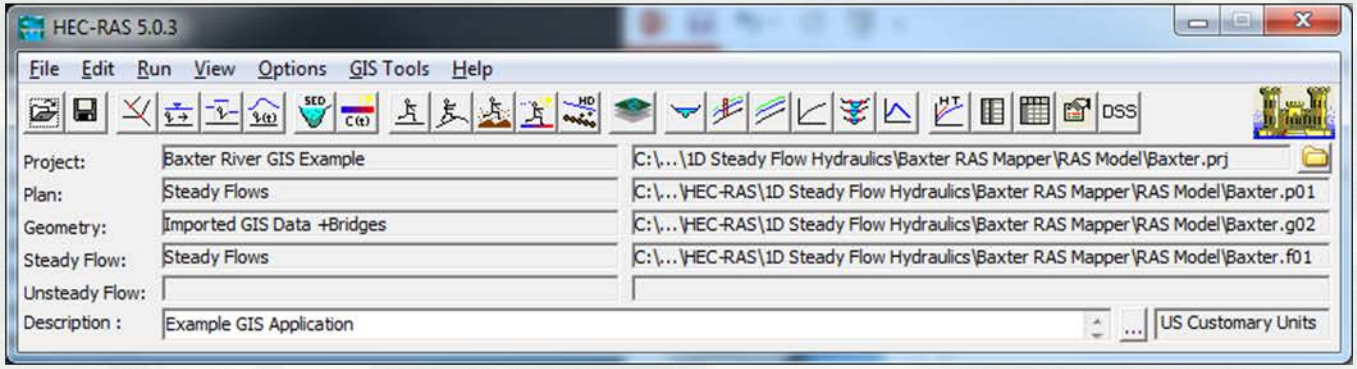
Stanford Gibson, PhD.

US Army Corps of Engineers
BUILDING STRONG®

Starting HEC-RAS

- Double-click icon

- Main HEC-RAS Window
  - Project
  - Plan
  - Geometry
  - Flow



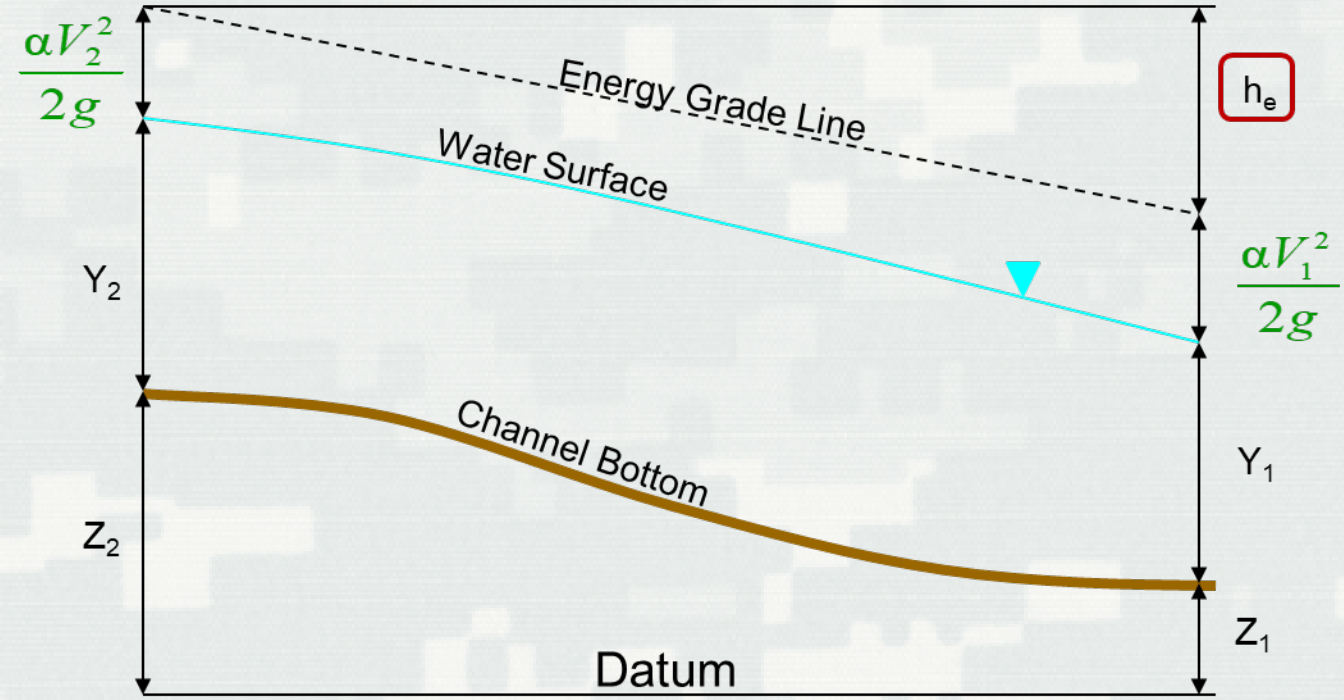
Classifications of Open Channel Flow

- Steady vs. Unsteady

Steady Flow

Unsteady Flow

Energy Principles



$$Z_2 + Y_2 + \frac{\alpha_2 V_2^2}{2g} = Z_1 + Y_1 + \frac{\alpha_1 V_1^2}{2g} + h_e$$

Energy Losses

- Energy Losses:

$$h_e = L\overline{S}_f + C\left|\frac{\alpha_2 V_2^2}{2g} - \frac{\alpha_1 V_1^2}{2g}\right|$$

Friction losses + Contraction and Expansion

Friction Loss Calculations in HEC-RAS

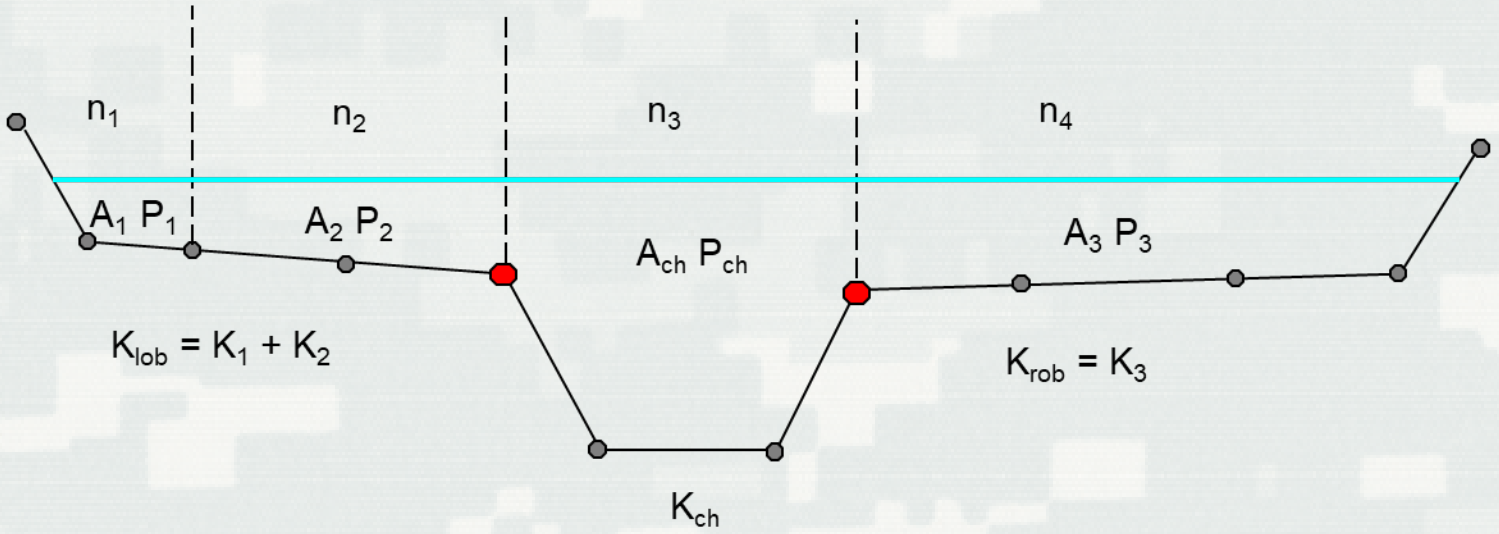
- Friction loss is evaluated by the following equation in HEC-RAS:

$$h_f = \overline{S}_f L$$

- The energy slope is from Manning's equation:

$$S_f = \left(\frac{Q}{K} \right)^2 \text{ where: } K = \frac{1.486}{n} A R^{2/3}$$

Conveyance Calculations
HEC-RAS Default Method

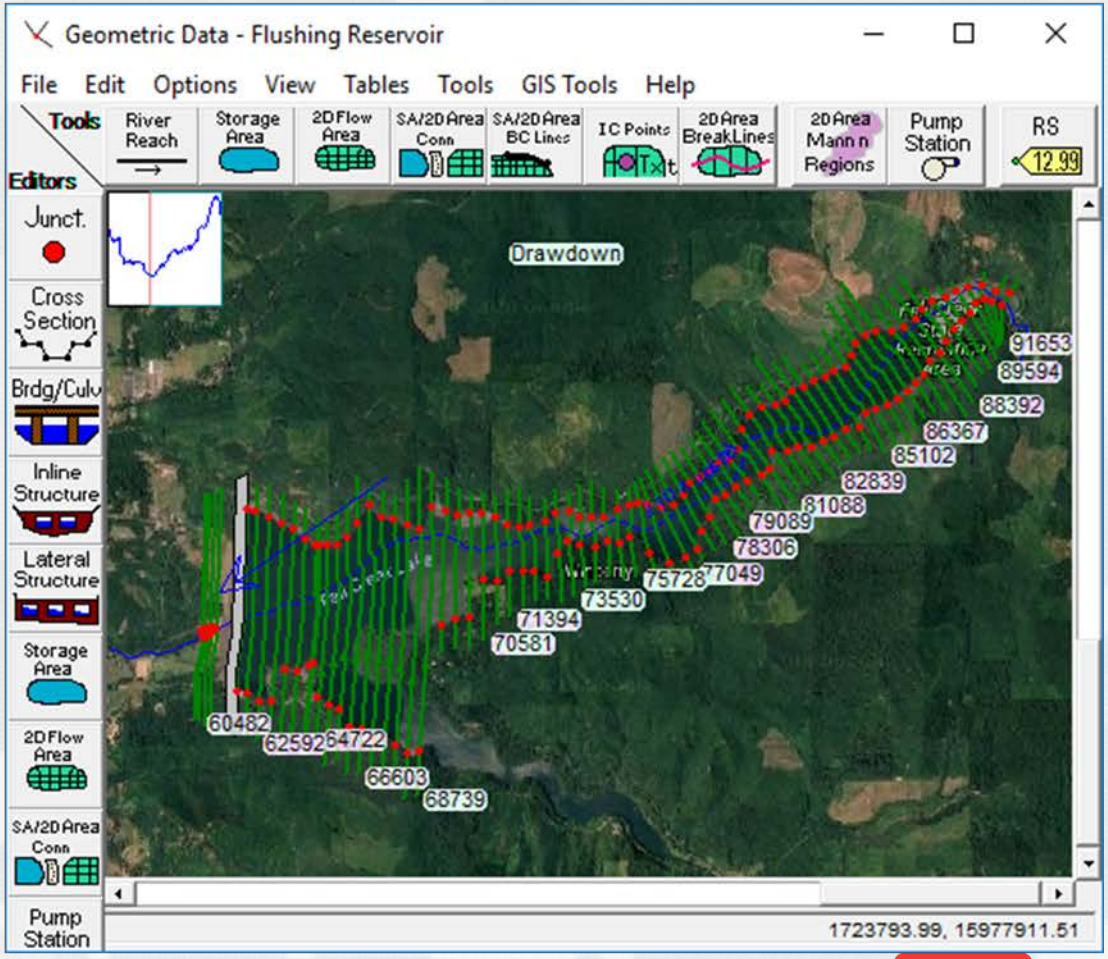


Steps to Develop a Hydraulic Model with HEC-RAS

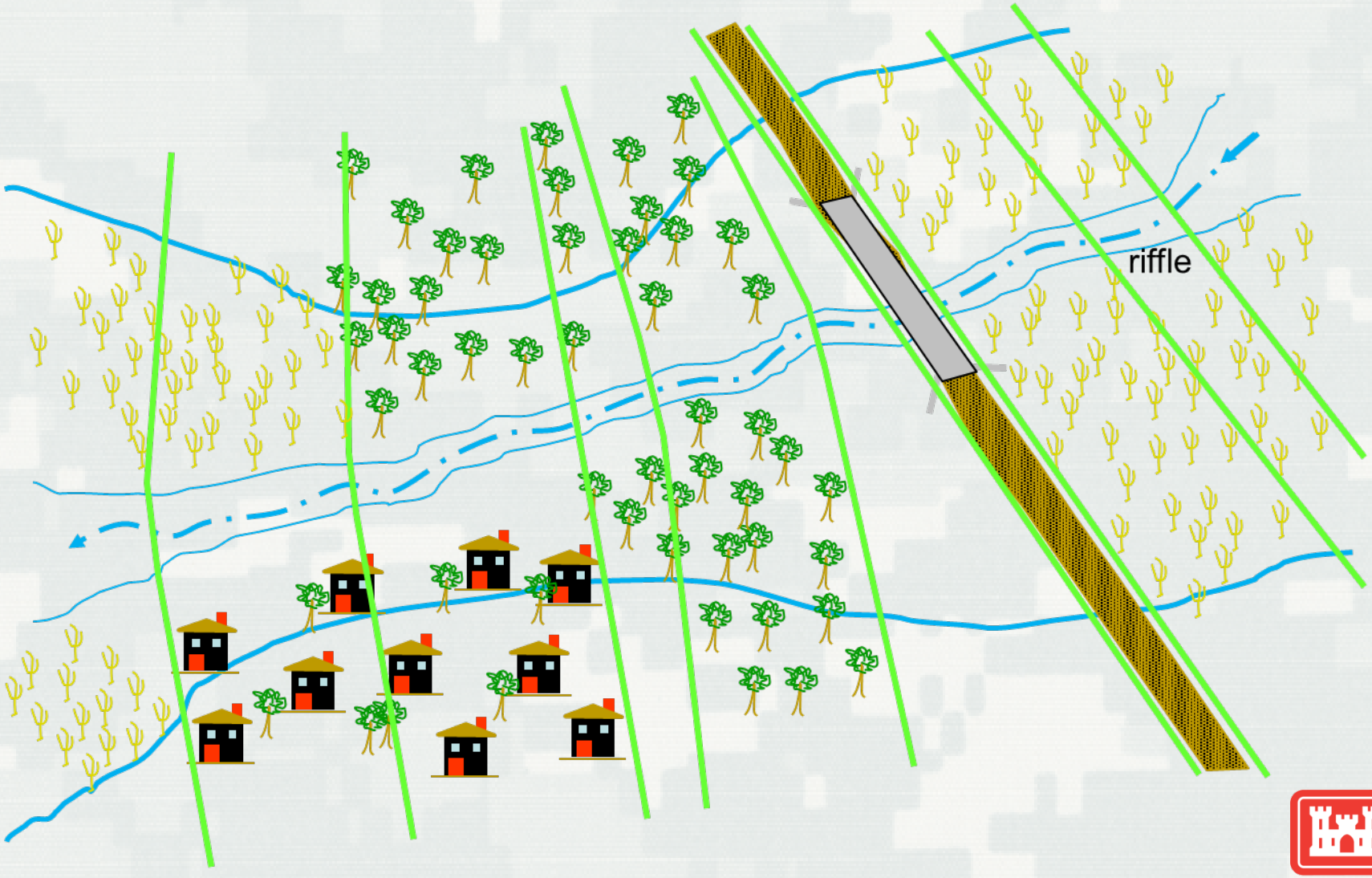
- Start a New Project
- Enter Geometric Data
  - ► Create or import geometry data and add structures
- Enter Flow and Boundary Data
- Establish a Plan and Perform the Computations
- Evaluate Model Results
- Adjust Model, as Necessary

AS Geometric Data Editor

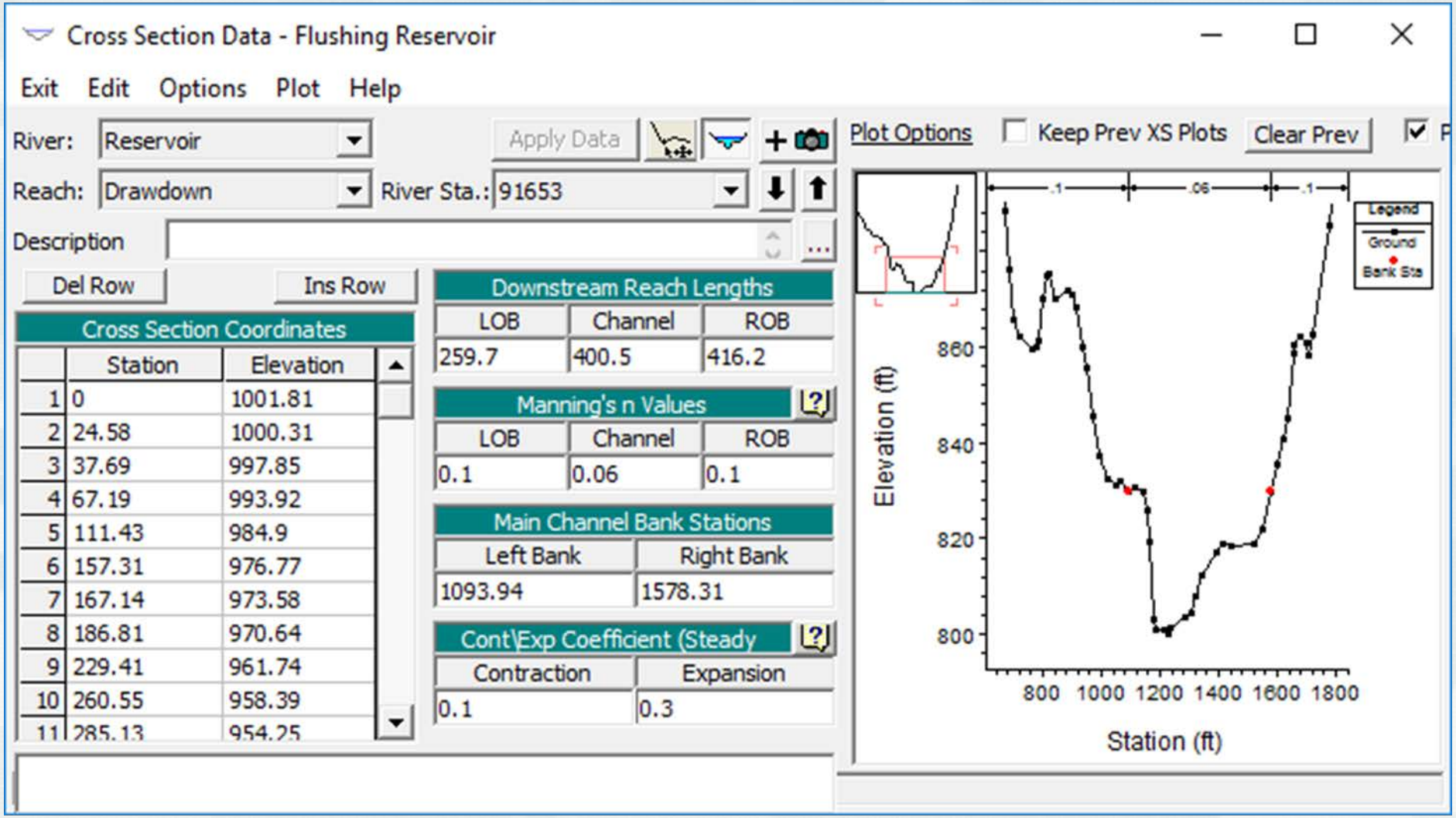
- Rivers/reaches
- Junctions
- River Stations
  - Cross section data
  - Hydraulic Structures



Cross Sections



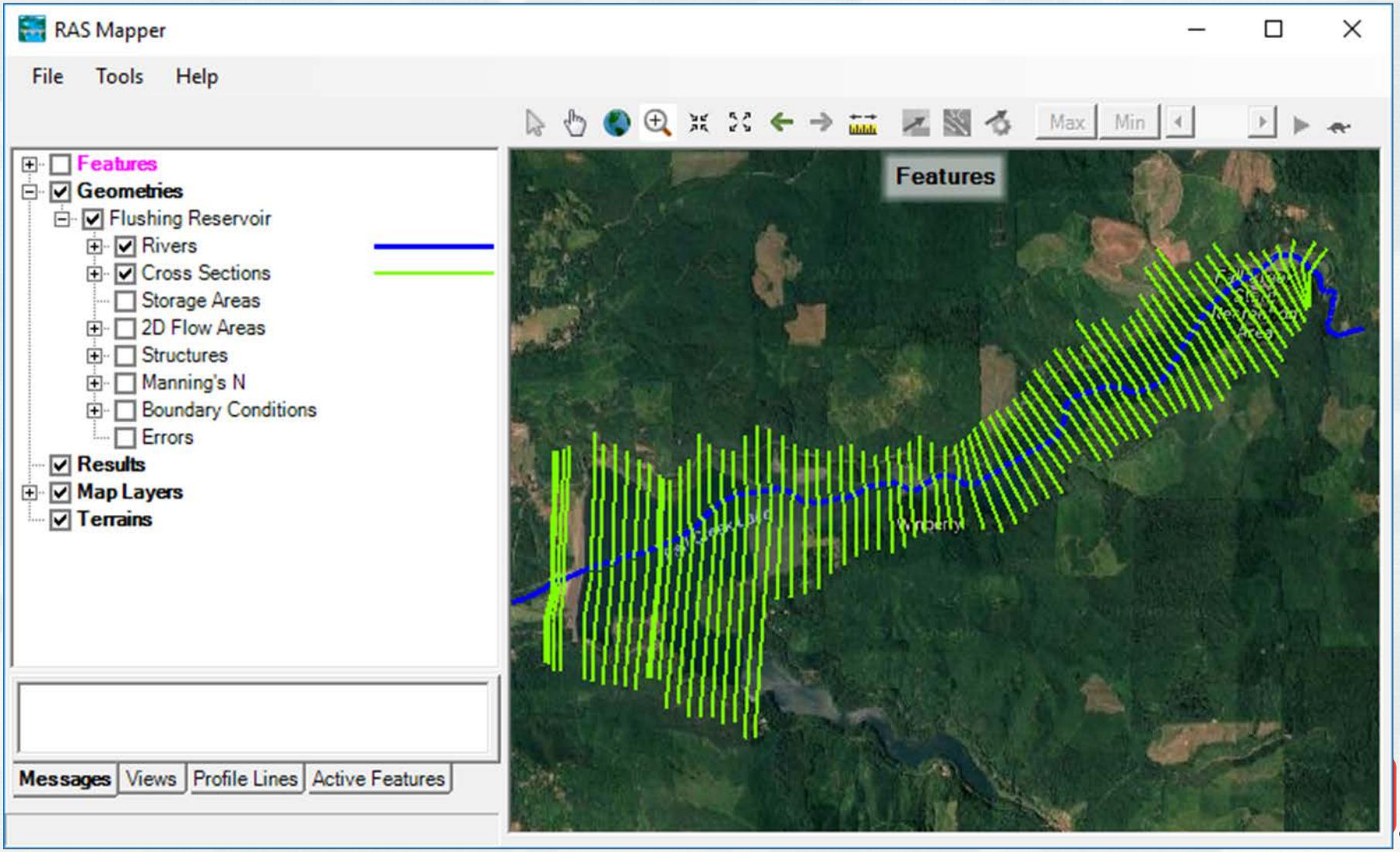
Cross Section Data Editor



RAS Mapper

- Add a Terrain Model
- Create River network
- Create Bank Lines
- Create Flow Path Lines
- Locate Cross Sections
- Use Editors and Tables in RAS to complete additional data
  - ► Manning's n values, Ineffective flow areas, …
  - ► Bridges, Culverts, …

RAS Mapper

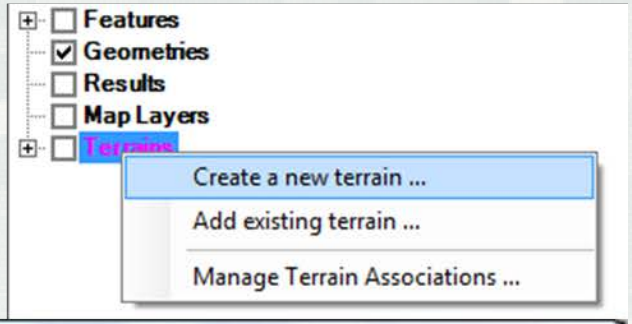

RAS Mapper
File
Tools
Help
Max
Min
Features
Geometries
Flushing Reservoir
Rivers
Cross Sections
Storage Areas
2D Flow Areas
Structures
Manning's N
Boundary Conditions
Errors
Results
Map Layers
Terrains
Features
Messages
Views
Profile Lines
Active Features

RAS Mapper Terrain

- Various formats are supported
  - Binary Floating Point Raster (FLT)
  - Esri Arc/Info Grid format
  - GeoTIFF (still rounds and compresses)
  - Others (e.g. USGS DEM, etc)
- Imported data is rounded to based on precision selected
  - Default is 1/32 (~0.03 ft) (1/128 for metric)
- Define Projection by importing a shapefile prj

RAS Mapper

- Add a New Terrain Layer



New Terrain Layer

Set SRS ...

Input Terrain Files

Filename	Projection	Cell Size	Rounding	Info
Terrain.tile1.tif	PROJCS["NAD_1983_StatePlane_California_III_...	20	(na)	i
Terrain.tile2.tif	PROJCS["NAD_1983_StatePlane_California_III_...	20	(na)	i
Terrain.tile3.tif	PROJCS["NAD_1983_StatePlane_California_III_...	20	(na)	i
Terrain.tile4.tif	PROJCS["NAD_1983_StatePlane_California_III_...	20	(na)	i
Terrain.tile5.tif	PROJCS["NAD_1983_StatePlane_California_III_...	20	(na)	i

Output Terrain File

Rounding (Precision): 1/32 ☑ Create Stitches ☐ Merge Inputs to Single Raster

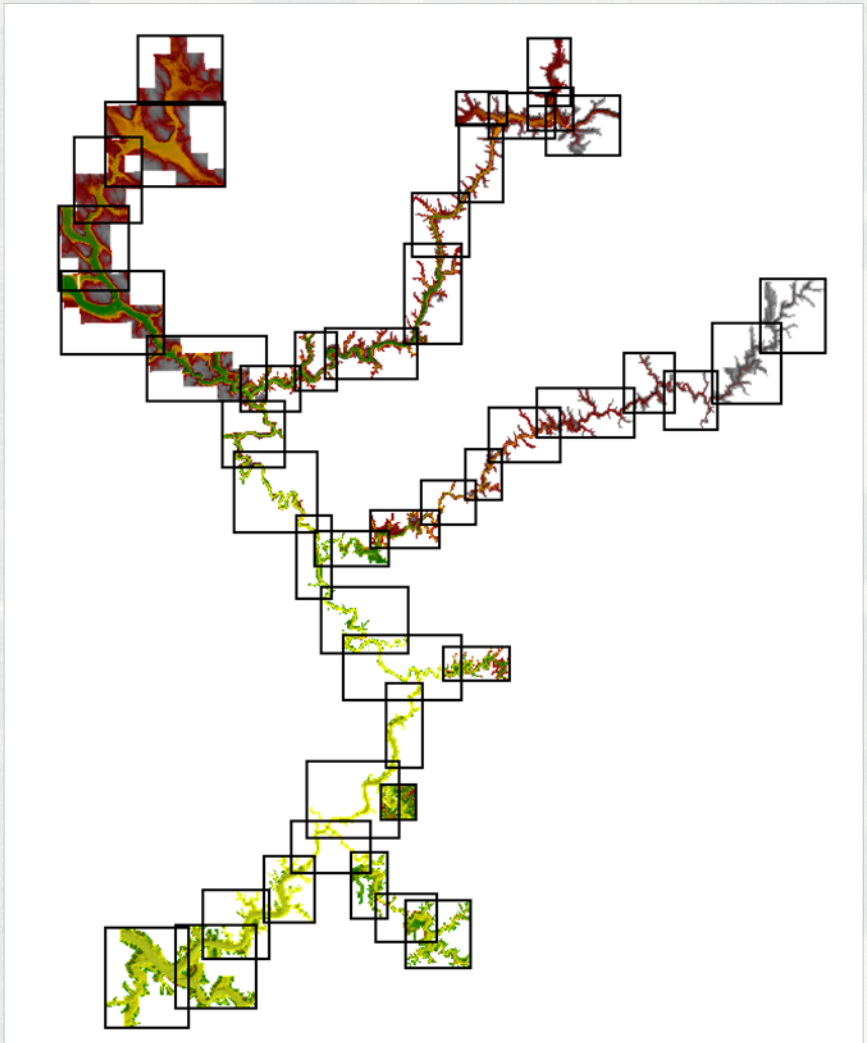
Vertical Conversion: None

Filename: C:\Temp___Examples\EditingTest\Terrain\Terrain.hdf

Create Cancel

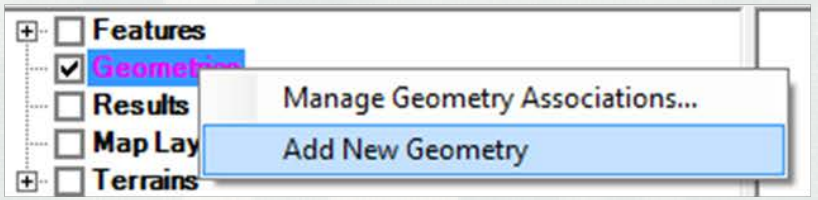
RAS Mapper - Terrain

- Uses GeoTIFF format
  - Tiles data for more efficient storage
  - Compresses data for efficient storage
  - Pyramids data for fast visualization
    - Allows for on-the-fly inundation mapping
- Multiple Terrain Models as 1 Layer
- No file size limitations – BigTiFF supported

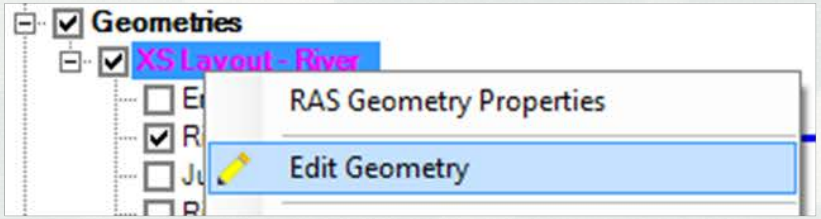


RAS Mapper

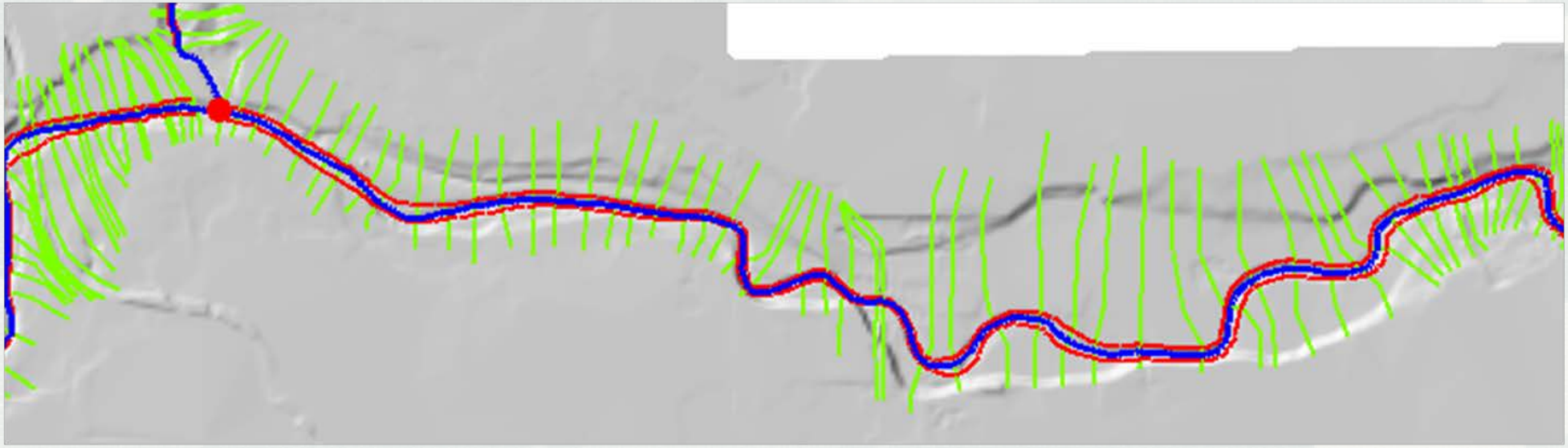
- Create a New Geometry



- Start Editing Geometry

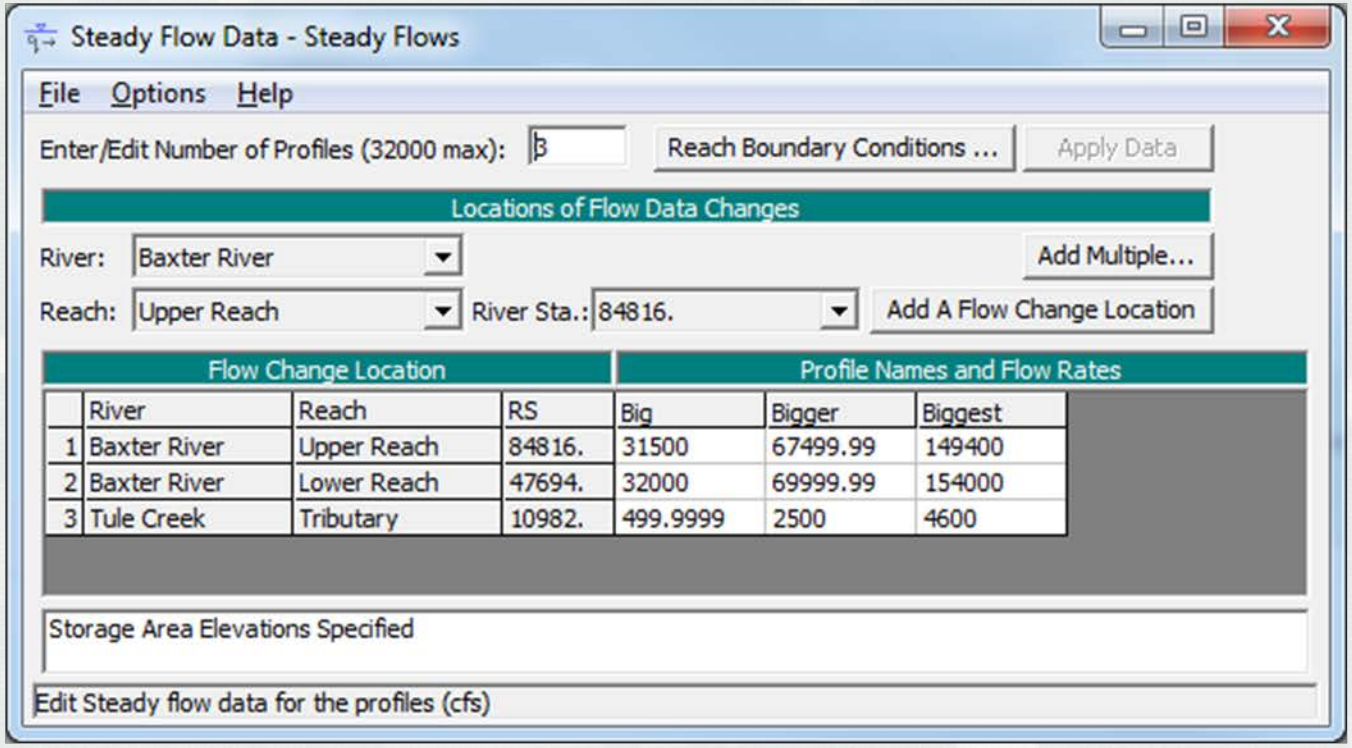


- Create River, XS and other RAS Layers



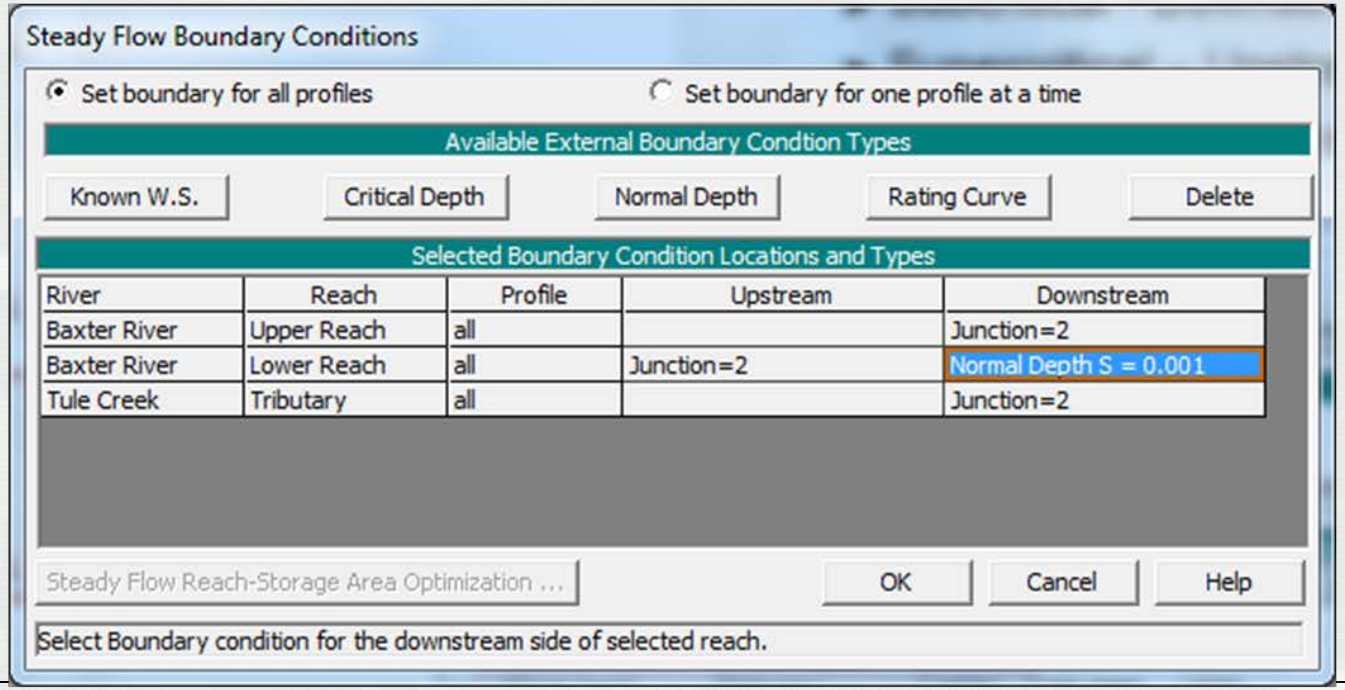
Steady Flow Data Editor

- Number of Profiles
- Flow for each reach and each profile
- Flow Change at any cross section



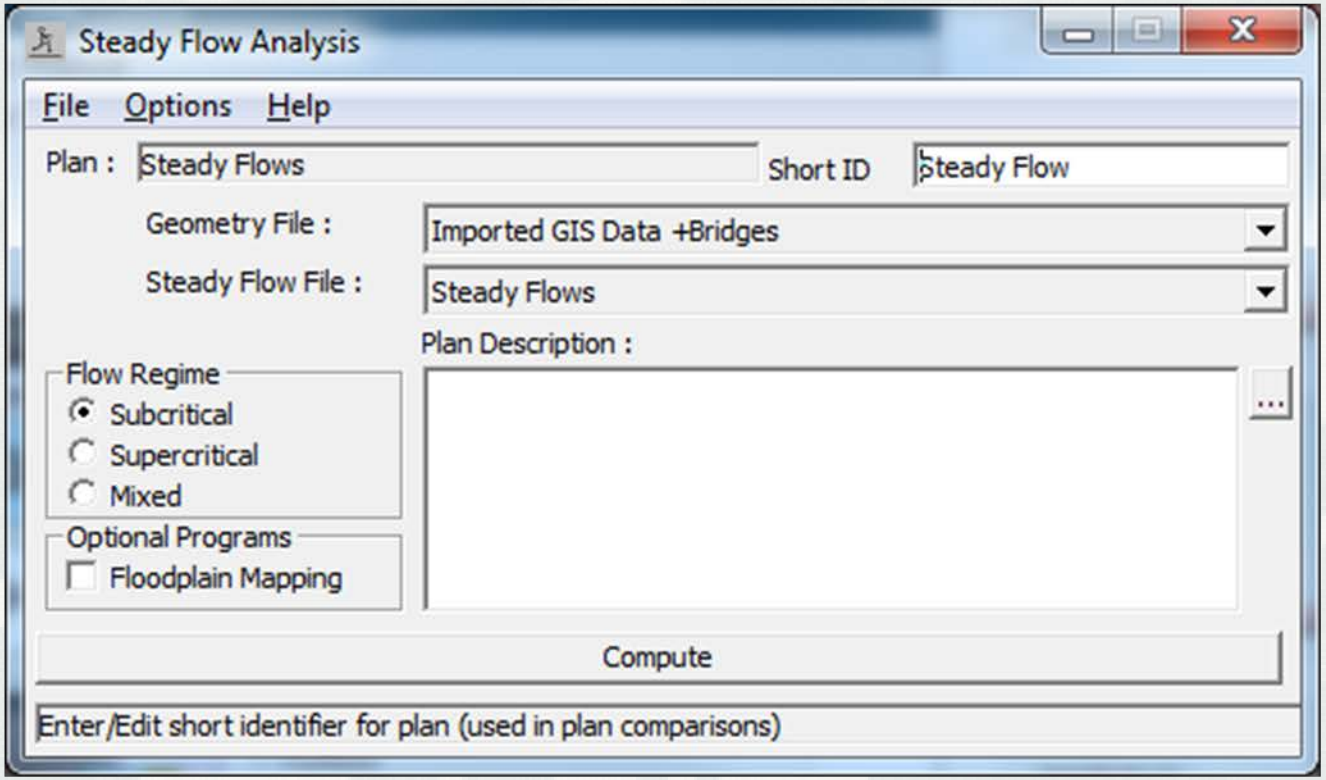
Reach Boundary Conditions

- External Boundary Input
  - Subcritical - Downstream
  - Supercritical – Upstream
  - Mixed Flow – Upstream and Downstream
- Internal from Junctions

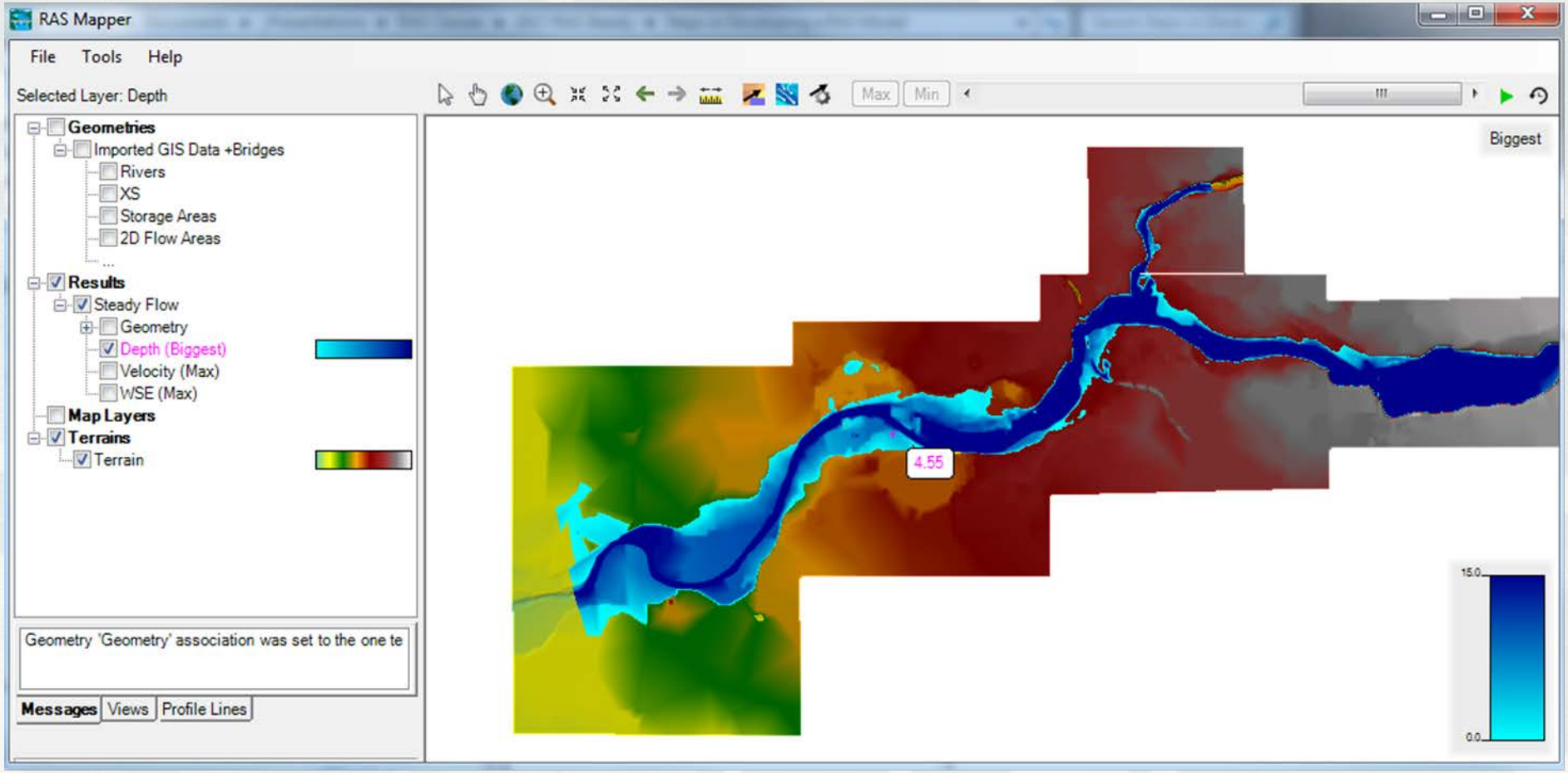


Steady Flow Analysis Window

- Define Plan:
  - Plan Title
  - Short ID
  - Geometry file
  - Flow file
  - Flow Regime
- Compute



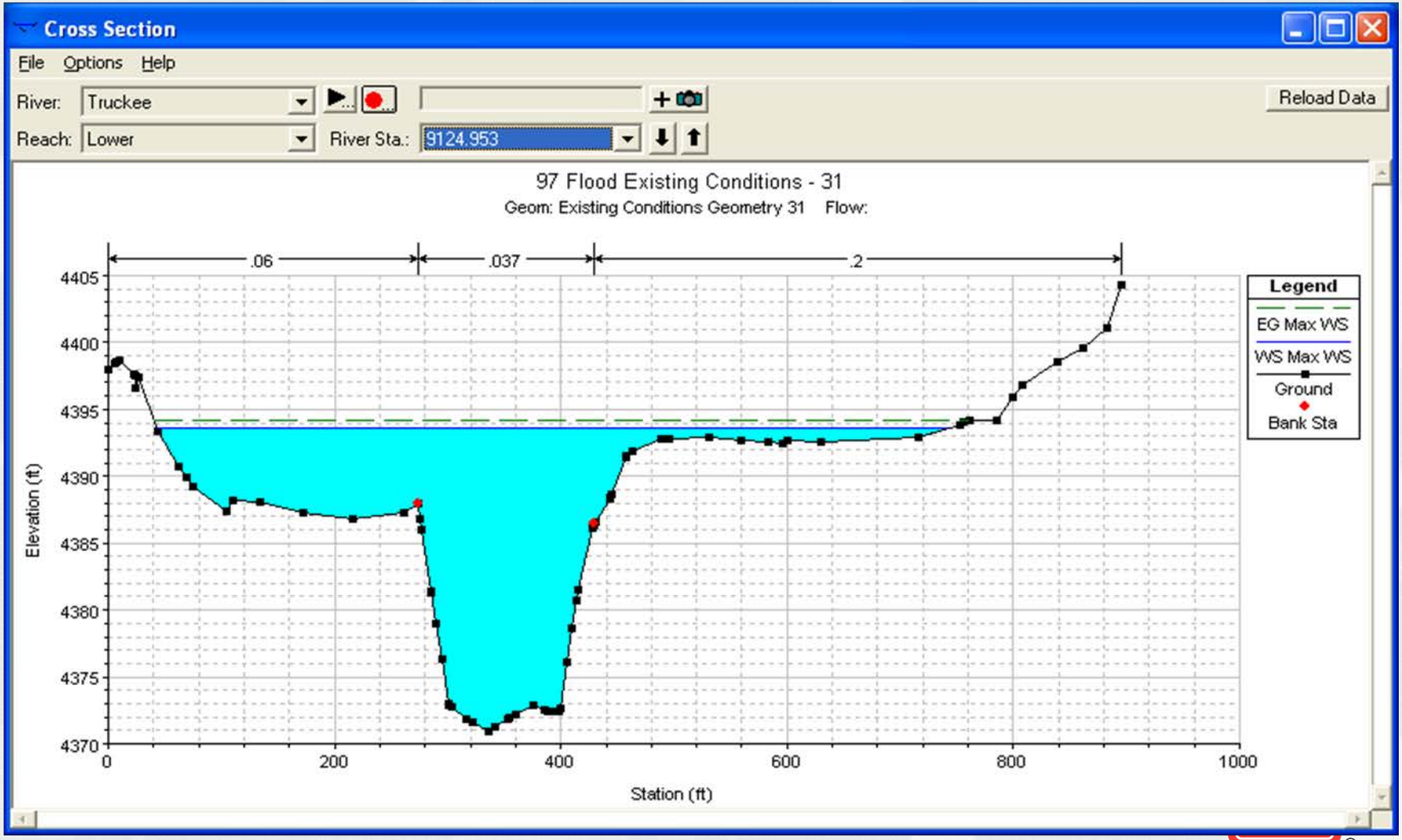
Viewing Results – RAS Mapper



Viewing Results

- Graphics
  - Cross sections 
  - Water surface profiles 
  - Generic plots – Any variable in profile 
  - Rating Curves 
  - XYZ Plot 
  - Stage and flow hydrographs – Unsteady Flow Only 
- Tabular Output
  - Pre-defined detailed tables 
  - Pre-defined summary tables 
  - User-define output tables

Cross Section Plot



Profile Plot