

Introduction to HEC-RAS

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US Army Corps
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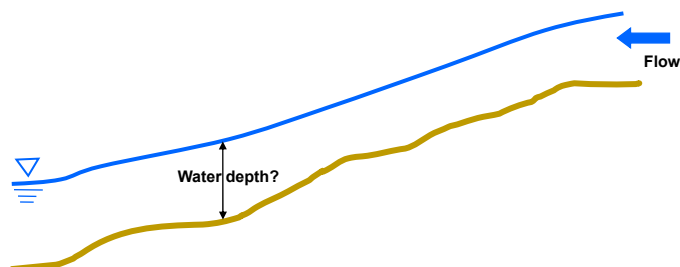
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HEC-RAS

- 1D/2D hydraulics program
- Compute water surface profiles from channel geometry and flow
- Steady and Unsteady Flow
- Sediment Transport
- Water Temperature
- Water Quality



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Type and Scale of Applications

- **Types of Studies**
 - Initial screening and reconnaissance studies
 - Detailed Investigations and alternative evaluations
 - Design Studies
 - Real-time forecasting
- **Spatial Scale of Application**
 - Very small urban areas with small drainage systems
 - Moderate-size river systems with natural and constructed channels
 - Large-scale river systems
- **Time Scale of Applications**
 - Peak flow profiles
 - Single event simulations
 - Long term simulations

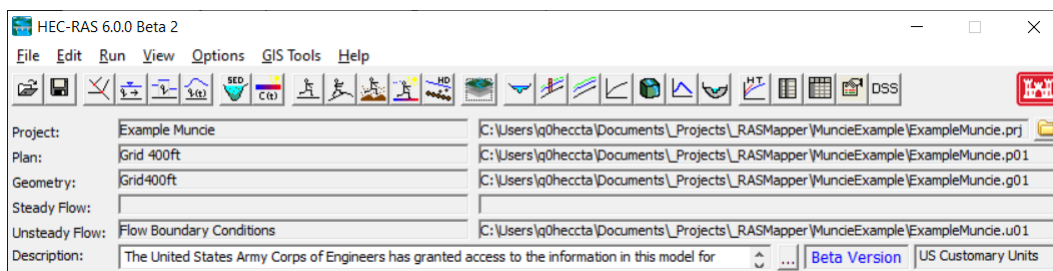
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HEC-RAS

- HEC-RAS interface helps orchestrate the model development, simulation, and analysis of results.

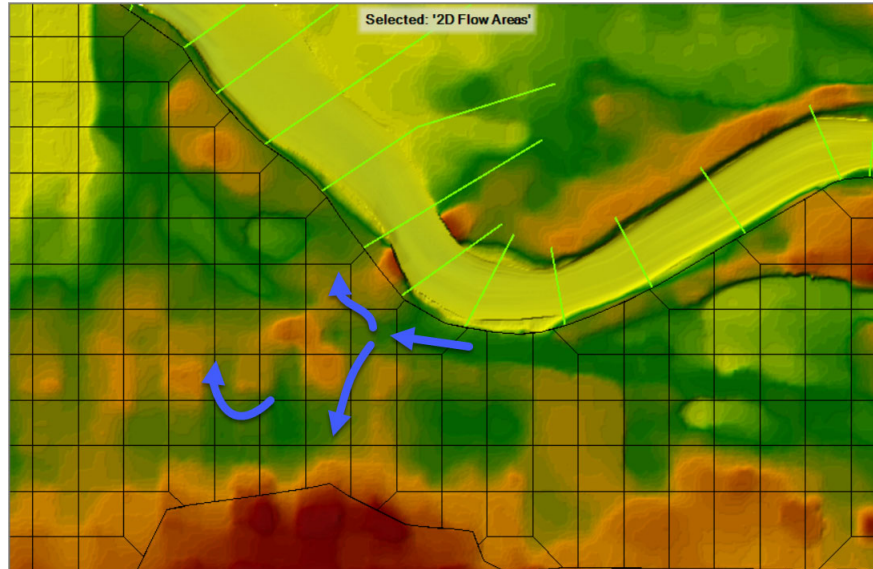


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Modeling in 1D or 2D?



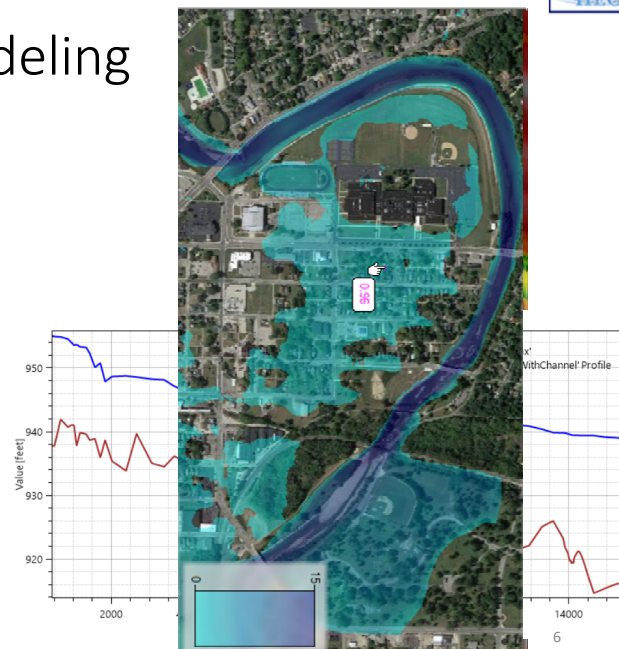
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Steps in Hydraulic Modeling

- Develop Geometric Data
 - Input survey information
 - Create data using GIS methods
 - Add hydraulic structures
- Enter flow data
 - Steady flow or Unsteady flow
- Perform the computations
- View Results
- Map Results for Analysis



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Geometric Data

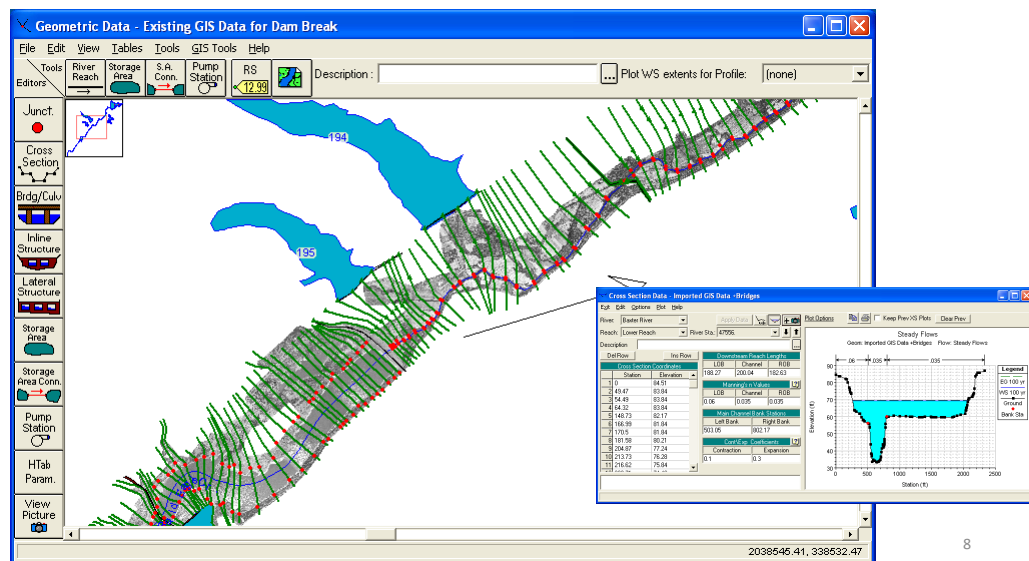
- Cross Sections
- Detailed Bridge Analysis
- Detailed Culvert Analysis (9 shapes)
- Inline Structures (Dams, weirs, drop structure, natural drops)
- Lateral Structures (Levees, diversion, natural lateral overflow)
- Storage Areas (Reservoirs, lakes, ponding areas, interior area inside a levee)
- 2D Flow Areas
- Hydraulic Connections
- Rating Curves
- Pump Stations
- Extensive data import and export

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Geometric Data Editor - Schematic



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HEC-RAS Mapper

Selected Layer: Cross Sections

Features

- Geometries
 - Muncie Base Geometry - 9 SAs
 - Muncie Geometry - 2D 100ft Grid
 - Muncie Geometry - 2D 50 ft grids
 - Muncie Geometry - 2D 200ft grids
- Rivers
 - Cross Sections
 - Bank Stations
 - Edge Lines
 - Interpolation Surface
- Storage Areas
 - 2D Flow Areas
 - Perimeters
 - Computation Points
 - Break Lines
 - Refinement Regions
- Structures
 - Manning's N
 - Boundary Conditions
 - Errors
- Muncie Geometry - 2D 25 ft grids
- Muncie Geometry - 2D mixed Cell size
- Rivers
- Cross Sections
- Storage Areas

Messages | Views | Profile Lines | Active Features

2DFlowArea: [No errors in Local Mesh.] [Full Mesh Out-of-Date]

Cross Sections Profile: 4626.553

Elevation (ft) vs Station (ft) plot showing ground elevation and cross-section elevations.

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Cross Section Data - Imported GIS Data +Bridges

River: Baxter River | Reach: Lower Reach | River Sta.: 47556

Del Row	Ins Row	Station	Elevation
1	0	84.51	
2	49.47	83.84	
3	54.49	83.84	
4	64.32	83.84	
5	148.73	82.17	
6	166.99	81.84	
7	170.5	81.84	
8	181.58	80.21	
9	204.87	77.24	
10	213.73	76.28	
11	216.62	75.84	

Downstream Reach Lengths		
LOB	Channel	ROB
188.27	200.04	182.63

Manning's n Values		
LOB	Channel	ROB
0.06	0.035	0.035

Main Channel Bank Stations		
Left Bank	Right Bank	
503.05	802.17	

Cont'Exp Coefficients	
Contraction	Expansion
0.1	0.3

Steady Flows

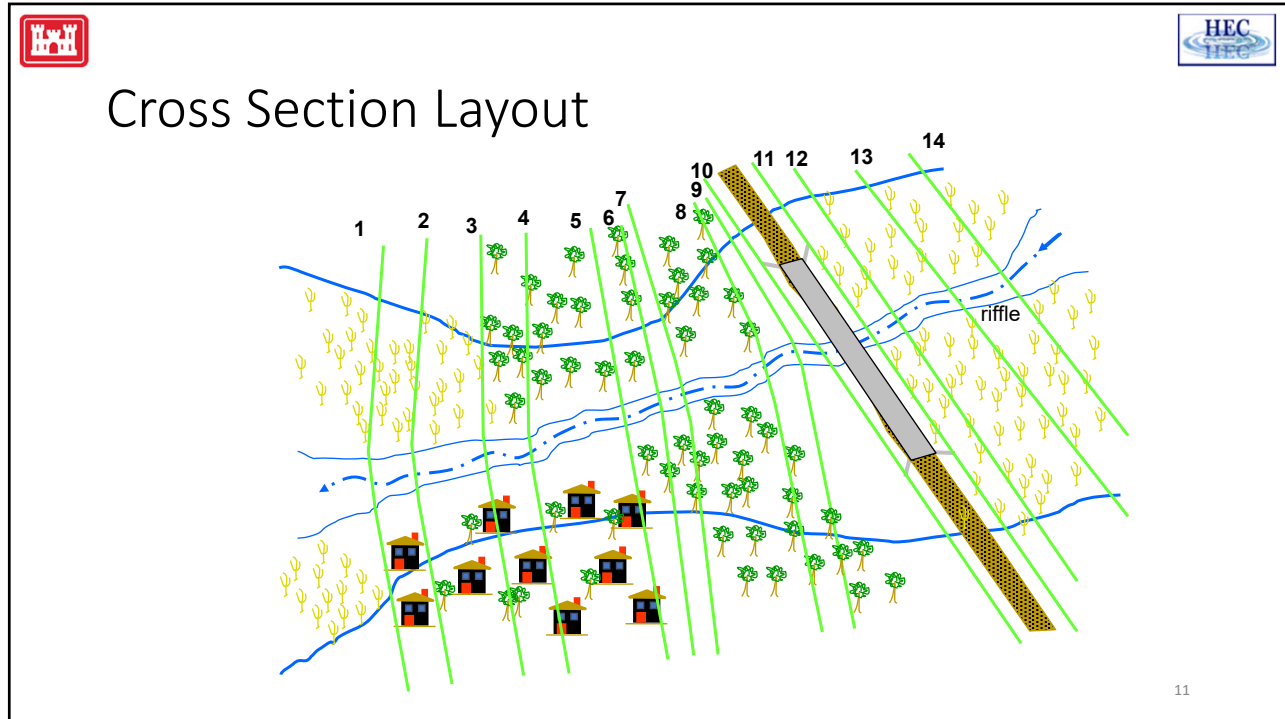
Geom: Imported GIS Data +Bridges | Flow: Steady Flows

Elevation (ft) vs Station (ft) plot showing channel geometry and flow area.

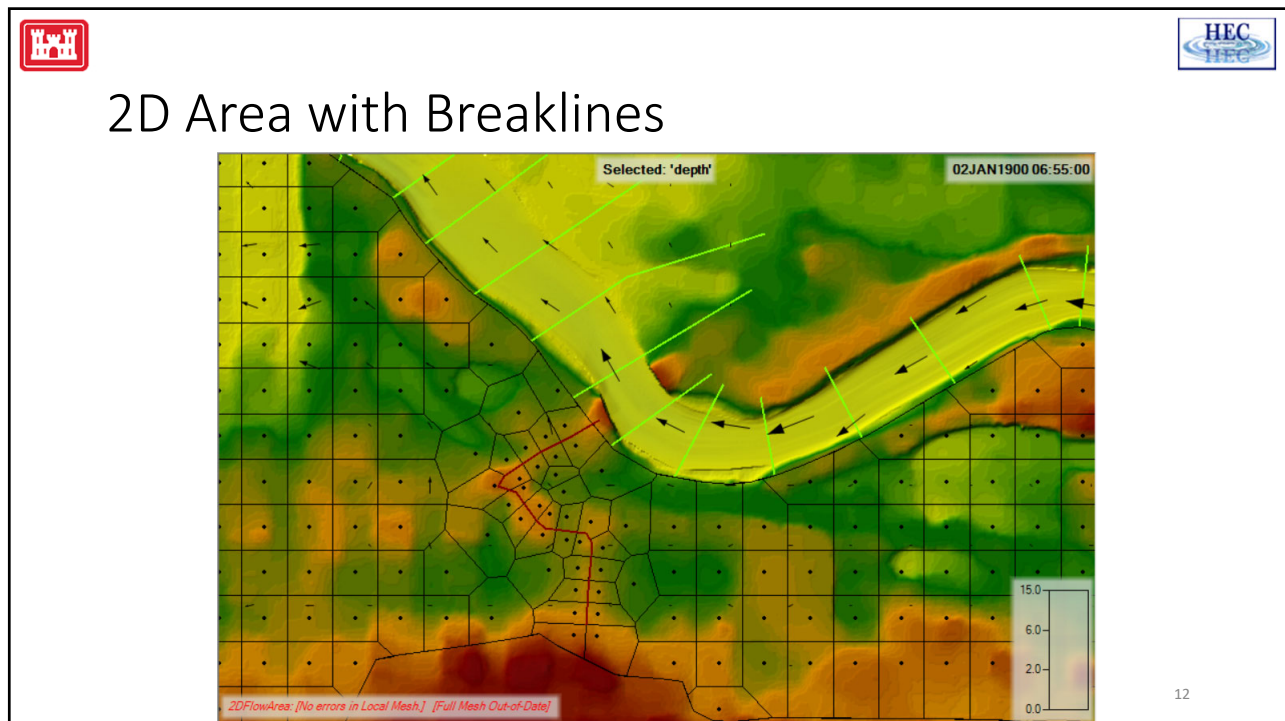
Cross Sections

- Perpendicular to flow
- Capture flow area
- Main Channel
- Overbanks
- Energy losses from friction and contraction and expansion losses

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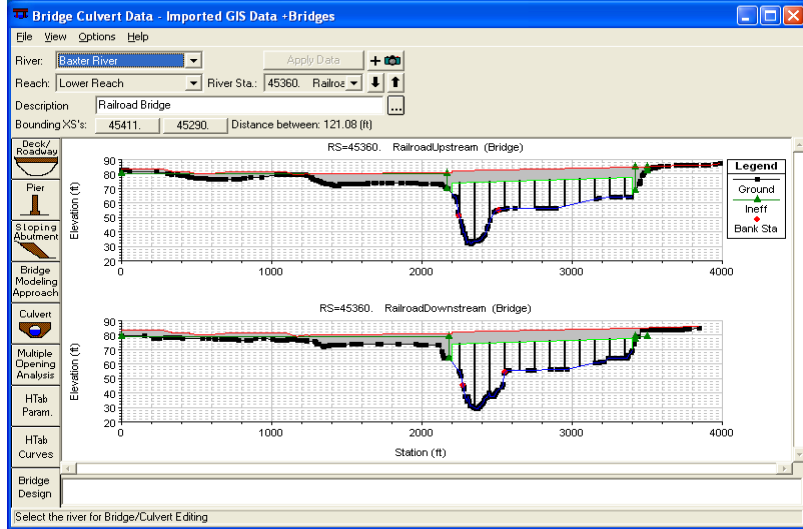


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Bridges

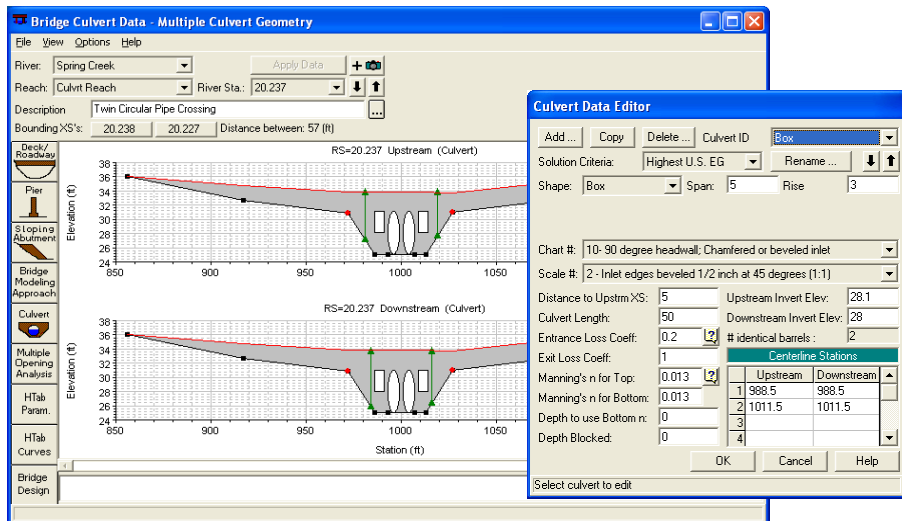
- More complicated way to account for floodplain changes
- Conveyance change
- Energy losses



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Culverts

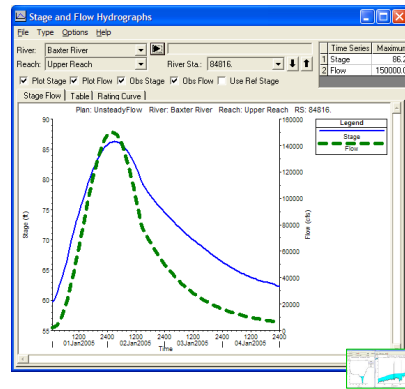
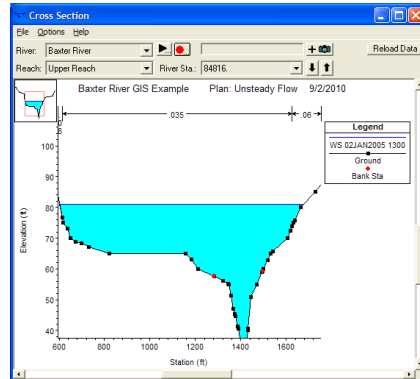


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Steady vs Unsteady Flow

- Steady = Constant flow
- Unsteady = Flow variation in time

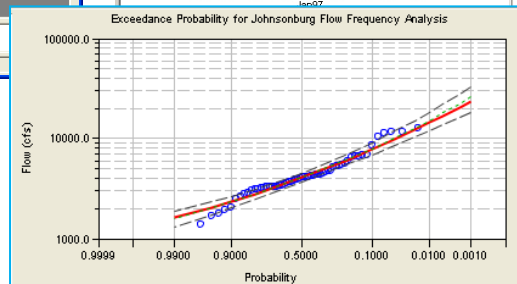
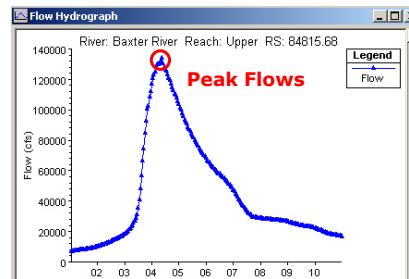
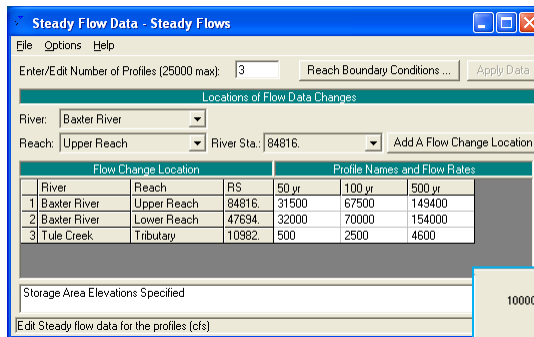


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Steady Flow Data Editor



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Unsteady Flow Data Editor Boundary Conditions

Unsteady Flow Data - PMF Event from HMS

File Options Help

Boundary Conditions | Initial Conditions | Apply Data

Select Location for Boundary Condition

River: Bald Eagle Cr.
Reach: Lock Haven | River Sta.: 137520 | Add a Boundary Condition Location

Boundary Condition Types

Stage Hydrograph	Flow Hydrograph	Stage/Flow Hydr.	Rating Curve
Normal Depth	Lateral Inflow Hydr.	Uniform Lateral Inflow	Groundwater Interflow
T.S. Gate Openings	Elev Controlled Gates	Navigation Dams	IB Stage/Flow

Rules

River	Reach	RS	Boundary Condition Type
1	Bald Eagle Cr.	Lock Haven	137520 Flow Hydrograph
2	Bald Eagle Cr.	Lock Haven	81454 IS T.S. Gate Openings
3	Bald Eagle Cr.	Lock Haven	28519 Lateral Inflow Hydr.
4	Bald Eagle Cr.	Lock Haven	1 Lateral Inflow Hydr.
5	Bald Eagle Cr.	Lock Haven	138948 Uniform Lateral Inflow
6	Bald Eagle Cr.	Lock Haven	80720 Uniform Lateral Inflow
7	Bald Eagle Cr.	Lock Haven	76865 Lateral Inflow Hydr.
8	Bald Eagle Cr.	Lock Haven	67130 Lateral Inflow Hydr.
9	Bald Eagle Cr.	Lock Haven	68041 Uniform Lateral Inflow

Storage Area and SA Connections: Storage Area: 190 | Add a Boundary Condition Location

Storage Area or SA Connection	Boundary Condition Type
1	

Initial internal water surface elevations set

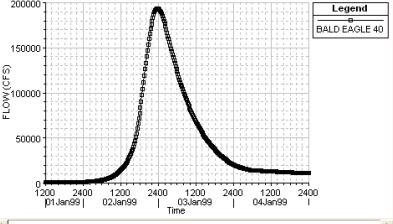
DSS Plot

File Options Help

Path: [All Paths]

Plot | Table



BALD EAGLE 40 FLOW
PMF Inflow Hydrograph



Legend
BALD EAGLE 40

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Steady Flow Hydraulic Computations

- Compute **Plan** comprised of a **Geometry** and **Flow**

Steady Flow Analysis

File Options Help

Plan: Press/Weir Method | Short ID: Press/Weir M

Geometry File: Beaver Cr. + Bridge - P/W

Steady Flow File: Beaver Cr. - 3 Flows

Flow Regime:
 Subcritical
 Supercritical
 Mixed



Plan Description:

COMPUTE










Enter to compute water surface profiles

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Viewing Results


- Graphics
 - Cross sections
 - Water surface profiles
 - Generic plots – Any variable in profile
 - Rating Curves
 - XYZ Plot
 - Stage and flow hydrographs
 - Animation – (cross section, profile, 3D plots)
- Tabular Output
 - Pre-defined detailed tables
 - Pre-defined summary tables
 - User-define output tables

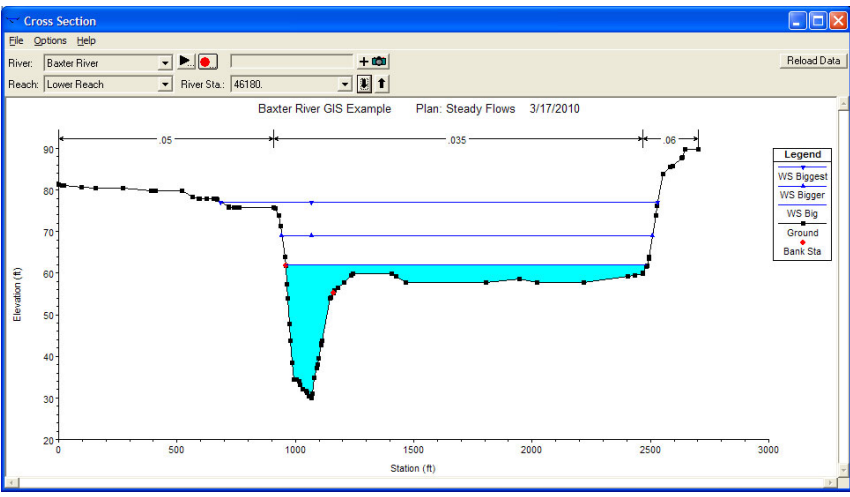
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Cross Section Plot



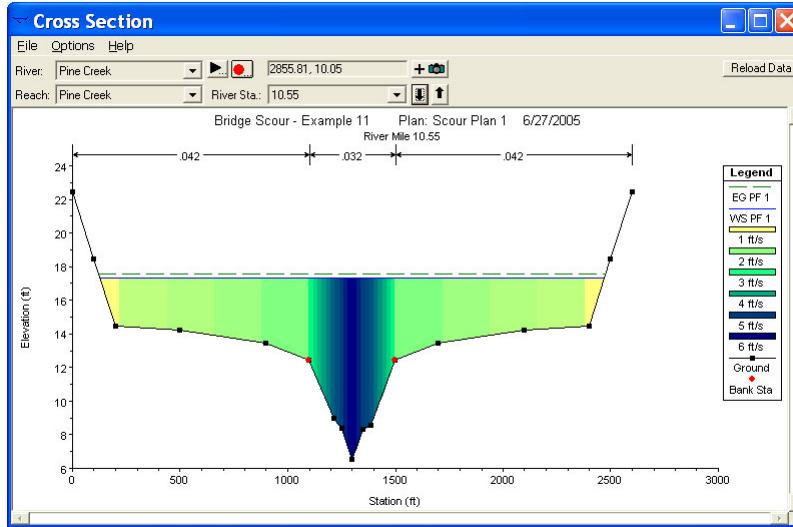


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Velocity Distribution

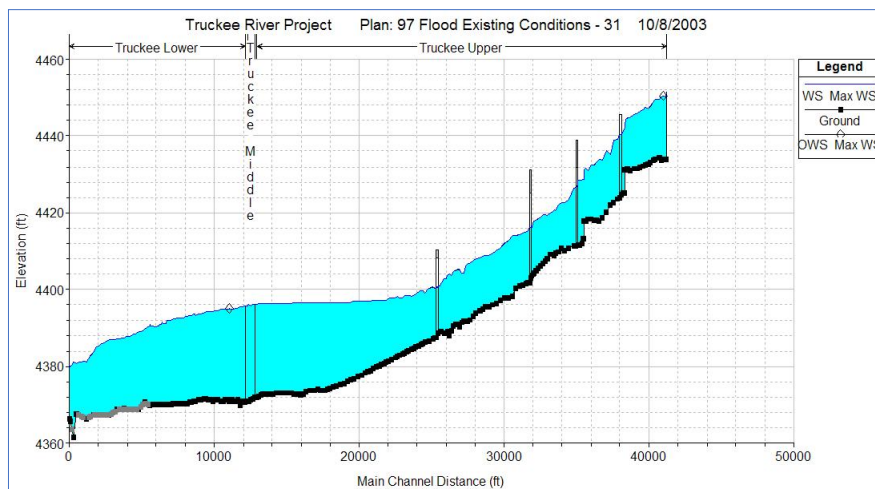


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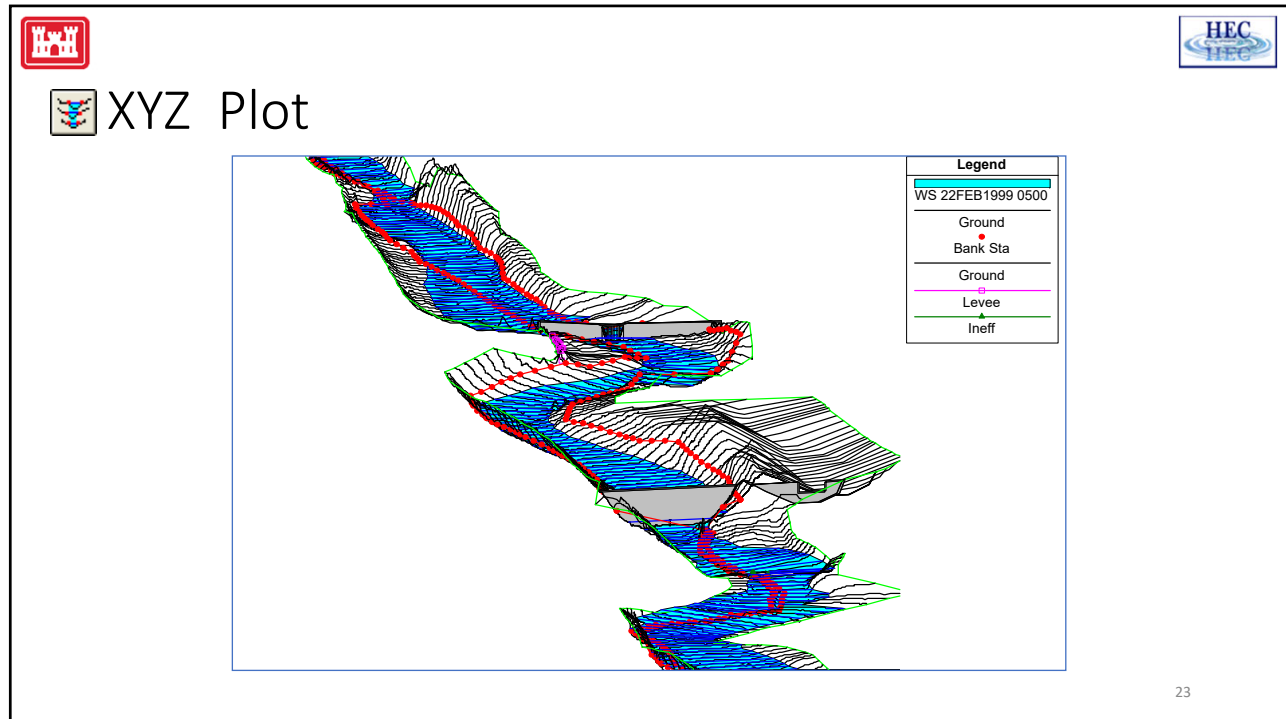


Profile Plot

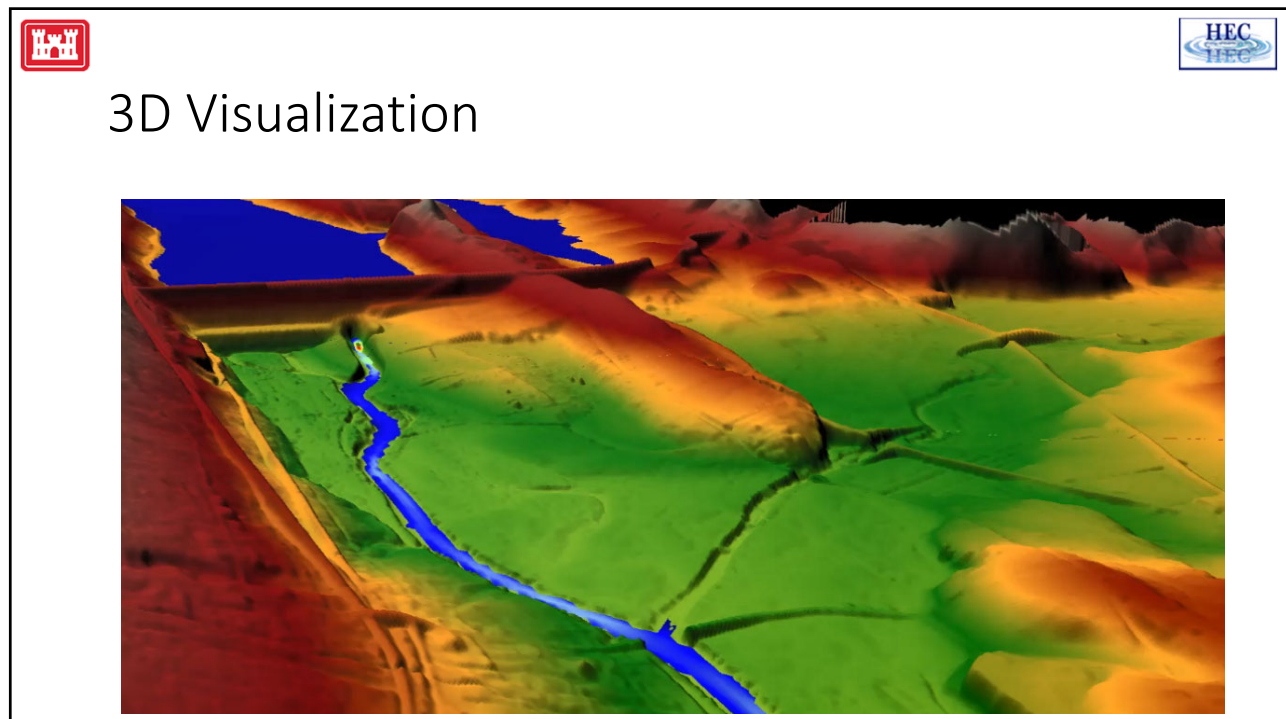


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Summary Tabular Output

Profile Output Table - Standard Table 1

HEC-RAS Plan: Unsteady River: Beaver Creek Reach: Kentwood Profile: Max WS

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Kentwood	5.99	Max WS	13996.17	209.90	219.85		220.18	0.002570	7.42	6331.47	1895.91	0.46
Kentwood	5.9325°	Max WS	13992.26	208.67	219.28		219.63	0.002459	7.03	6362.24	1819.58	0.45
Kentwood	5.875°	Max WS	13986.51	207.45	218.79		219.10	0.002096	6.37	6703.48	1784.99	0.42
Kentwood	5.8175°	Max WS	13983.76	206.23	218.40		218.64	0.001567	5.50	7421.29	1795.34	0.36
Kentwood	5.76	Max WS	13981.22	205.00	218.14		218.30	0.001058	4.58	8524.62	1732.38	0.30
Kentwood	5.71°	Max WS	13979.01	204.80	217.97		218.11	0.000883	4.57	8996.28	1800.36	0.27
Kentwood	5.66°	Max WS	13978.72	204.60	217.84		217.95	0.000790	4.65	8680.50	1868.11	0.26
Kentwood	5.61	Max WS	13977.01	204.40	217.73		217.79	0.000681	4.39	8786.53	1932.07	0.23
Kentwood	5.55333°	Max WS	13976.91	204.23	217.63		217.70	0.000591	4.30	8780.18	1952.55	0.23
Kentwood	5.49666°	Max WS	13976.74	204.07	217.53		217.62	0.000549	4.26	8733.22	1907.18	0.22
Kentwood	5.44	Max WS	13976.49	203.90	217.44		217.54	0.000494	4.14	8615.68	1844.11	0.22
Kentwood	5.41	Max WS	13975.87	202.70	216.79	212.23	217.40	0.001534	6.57	7795.38	1841.45	0.37
Kentwood 5.4 Highway 149 Bridge												
Kentwood	5.39	Max WS	13970.40	202.70	215.53		216.33	0.002445	7.56	6481.47	1695.13	0.46
Kentwood	5.34°	Max WS	13970.08	202.75	215.41		215.56	0.001007	4.67	6329.81	1665.20	0.29
Kentwood	5.29	Max WS	13968.39	202.80	215.20		215.31	0.000960	4.11	5797.61	1619.80	0.27
Kentwood	5.23666°	Max WS	13966.93	201.83	214.90		215.03	0.001191	5.12	6093.02	1652.62	0.31
Kentwood	5.18333°	Max WS	13965.64	200.87	214.46		214.69	0.001706	6.65	5800.47	1675.41	0.37
Kentwood	5.13	Max WS	13963.72	199.90	213.83		214.14	0.001883	7.41	5809.88	1683.71	0.40
Kentwood	5.08666°	Max WS	13963.59	199.90	213.40		213.71	0.001923	7.02	6110.63	1781.07	0.40
Kentwood	5.04333°	Max WS	13962.91	199.90	213.02		213.28	0.001781	6.30	6669.60	1883.69	0.38
Kentwood	5.0	Max WS	13962.81	199.90	212.67	210.51	212.81	0.001203	4.88	8236.80	1973.56	0.31

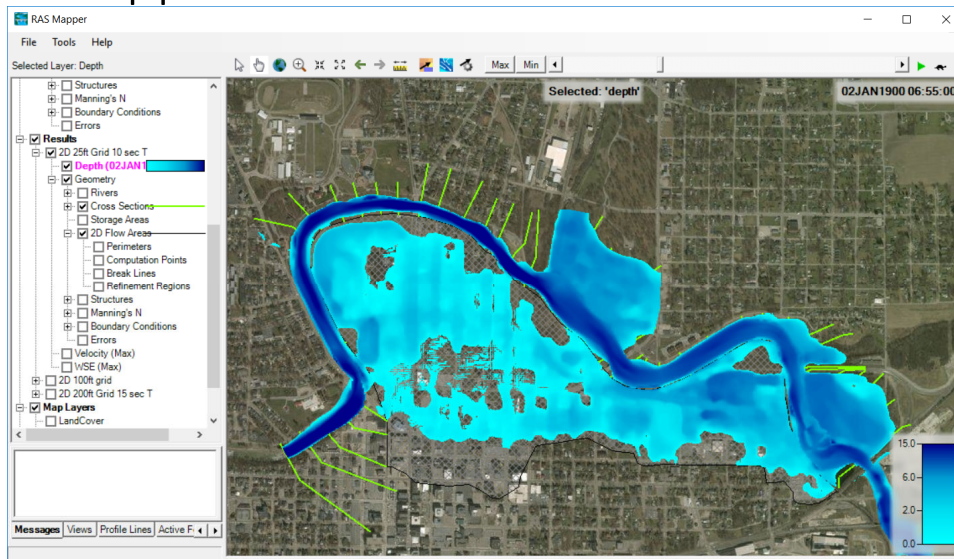
Total flow in cross section.

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RAS Mapper

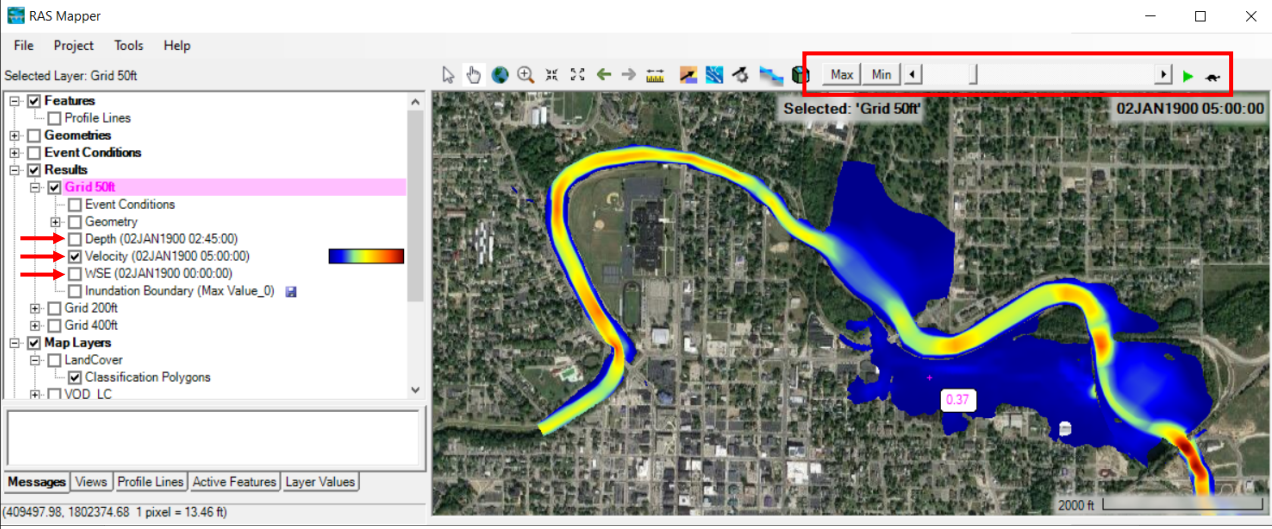


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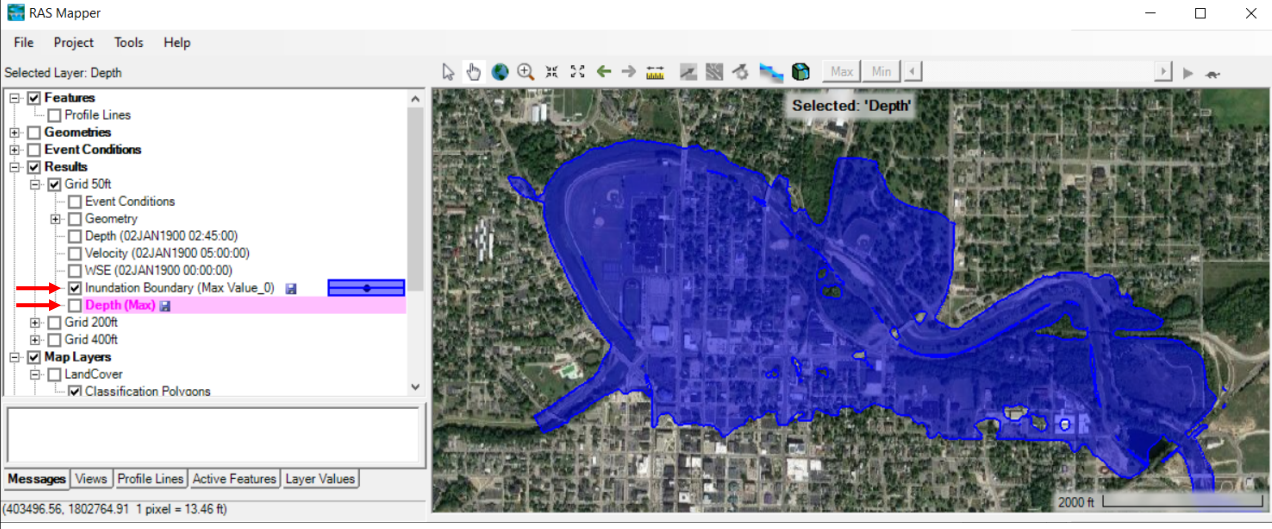
Results Maps: Dynamic Maps



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Results Maps: Stored Maps

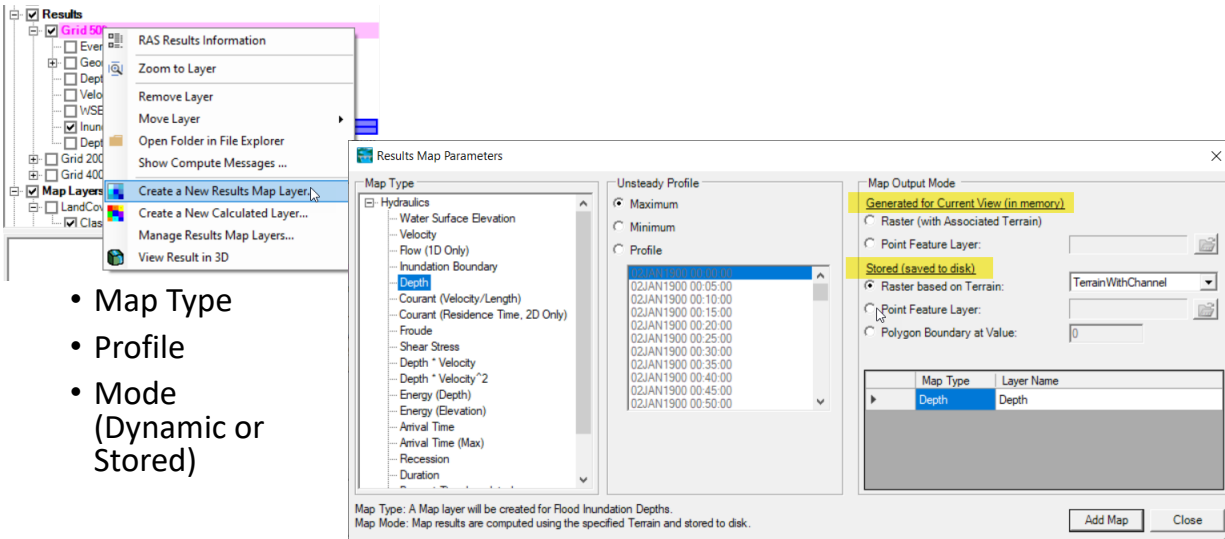


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Results Maps



- Map Type
- Profile
- Mode (Dynamic or Stored)



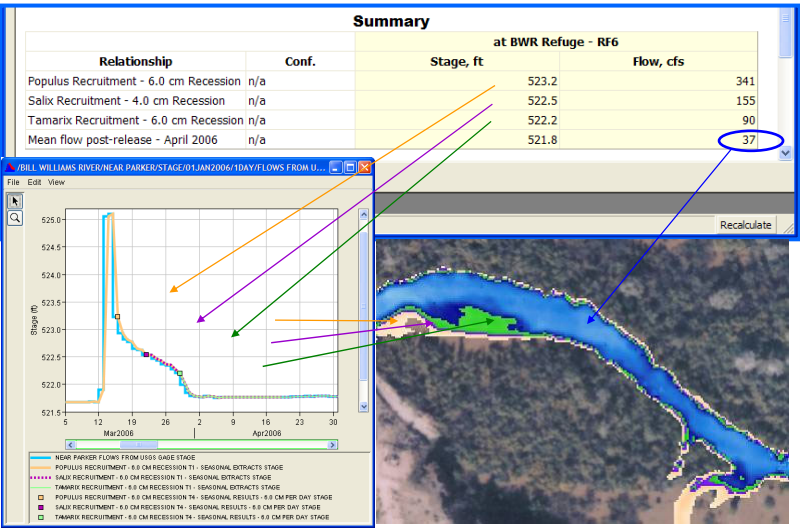
Map Type: A Map layer will be created for Flood Inundation Depths.
Map Mode: Map results are computed using the specified Terrain and stored to disk.

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Mapping for Habitat Suitability

Summary				
at BWR Refuge - RF6				
Relationship	Conf.	Stage, ft	Flow, cfs	
Populus Recruitment - 6.0 cm Recession	n/a	523.2	341	
Salix Recruitment - 4.0 cm Recession	n/a	522.5	155	
Tamarix Recruitment - 6.0 cm Recession	n/a	522.2	90	
Mean flow post-release - April 2006	n/a	521.8		37



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Questions?



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