



Hydraulic Structures

Embankments

Reservoirs





Hydraulic Structures in GSSHA

- Can be added to any model with a 1D stream network.
- Structures are special link types.
- Structures function as internal boundary conditions inside the stream network.
- Multiple structures can be combined at a single location.
- Structure types may vary in the stream network and at a single location.





Structure Types

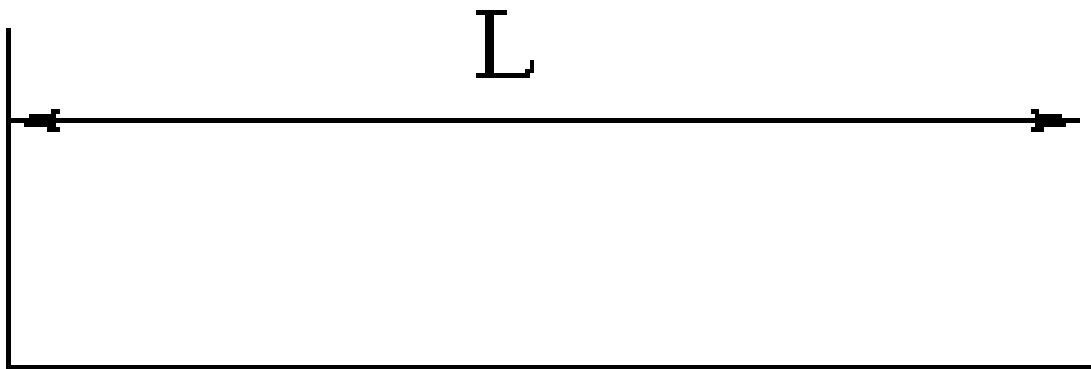
- Broad crested weirs
 - Horizontal
 - Parabolic
- Culverts
 - Circular
 - Rectangular
- Active control structures
 - Scheduled discharge
- Generic structure rating curve





Horizontal Weirs

- Common outlets for detention basins.



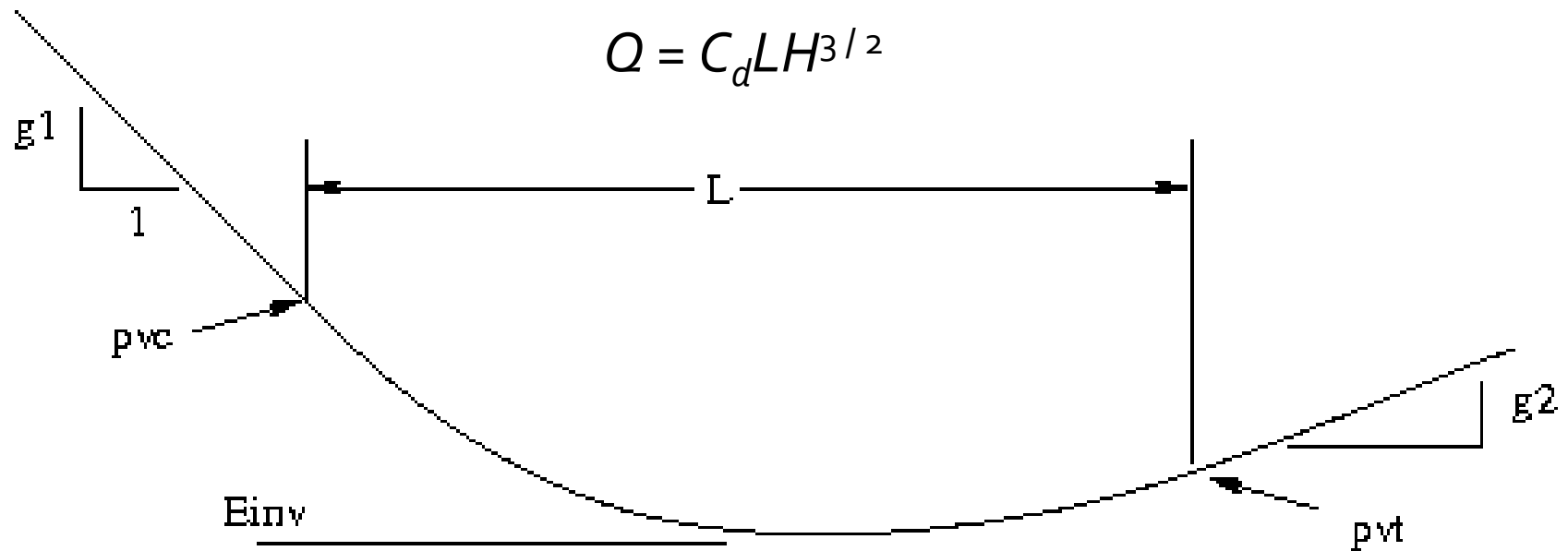
- $Q = C_d L H^{3/2}$

- STRUCTTYPE WEIR
 - CREST_LENGTH
 - CREST_LOW_ELEV
 - DISCHARGE_COEFF_FORWARD
 - DISCHARGE_COEFF_REVERSE





Sag Curve Weir



$g1$ = grade of steepest approach (negative) 0–1

pvc = point of vertical curve initiation

L = length of the vertical curve (horizontal dist.) meters

pvt = point of tangency (end of vertical curve)

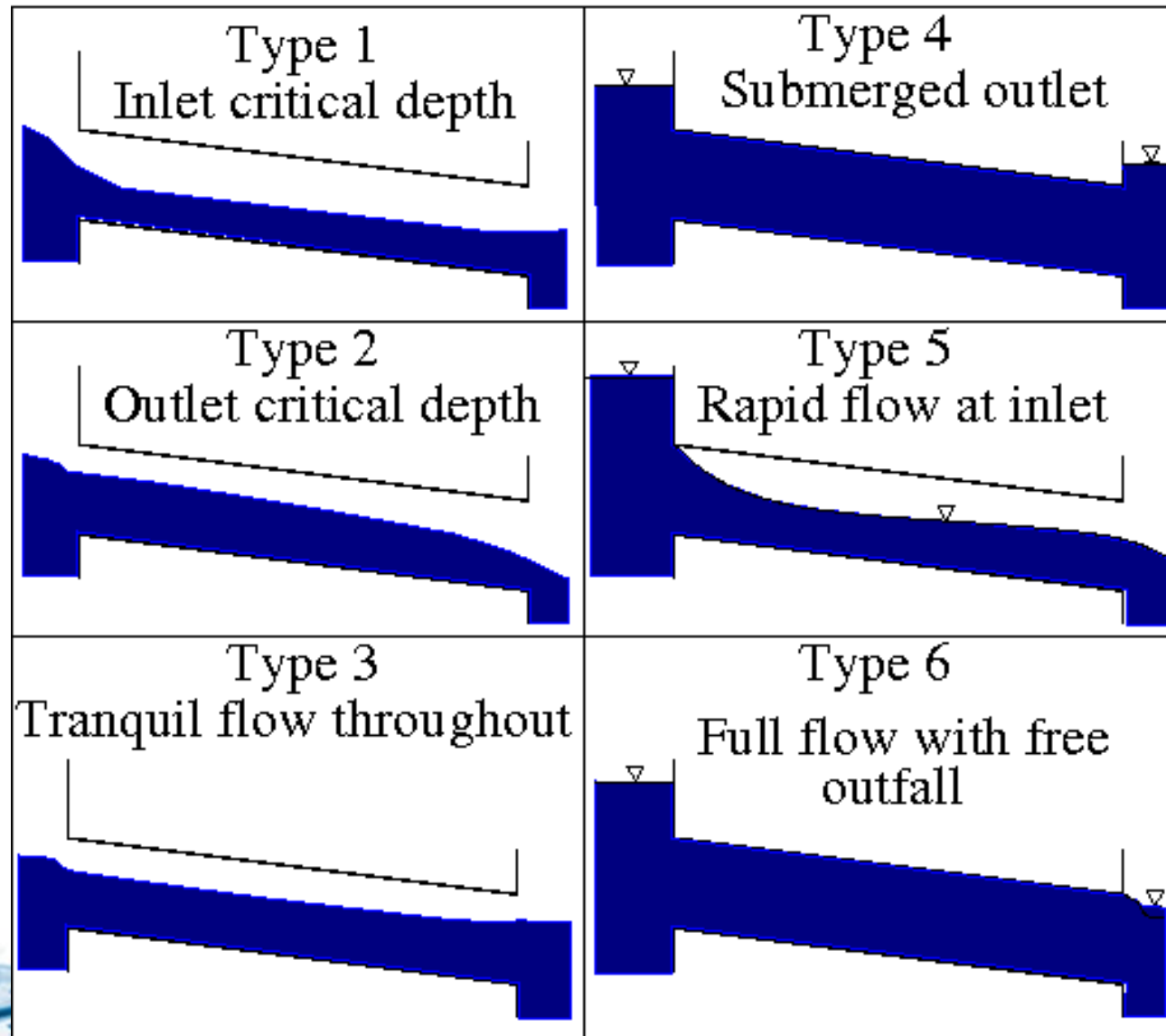
$g2$ = grade of shallowest approach (positive) 0–1

E_{inv} = Elevation of the invert





Culvert Flow Types





Scheduled Releases

- Specified discharges as a function of time.
- History matching with known releases.

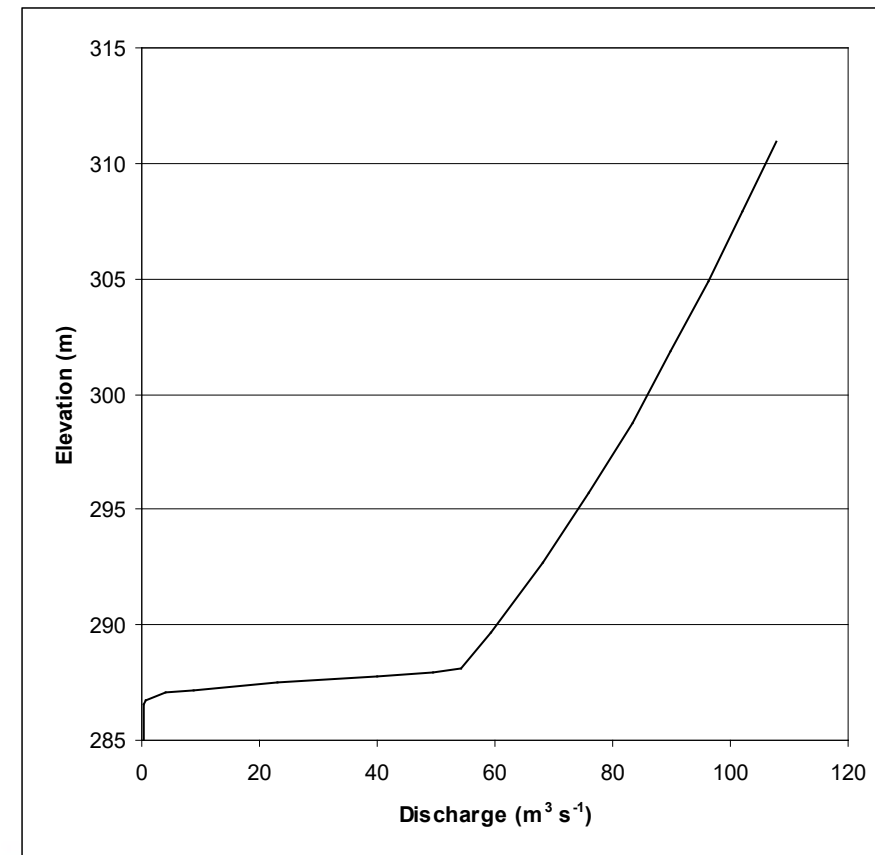




Rating Curve

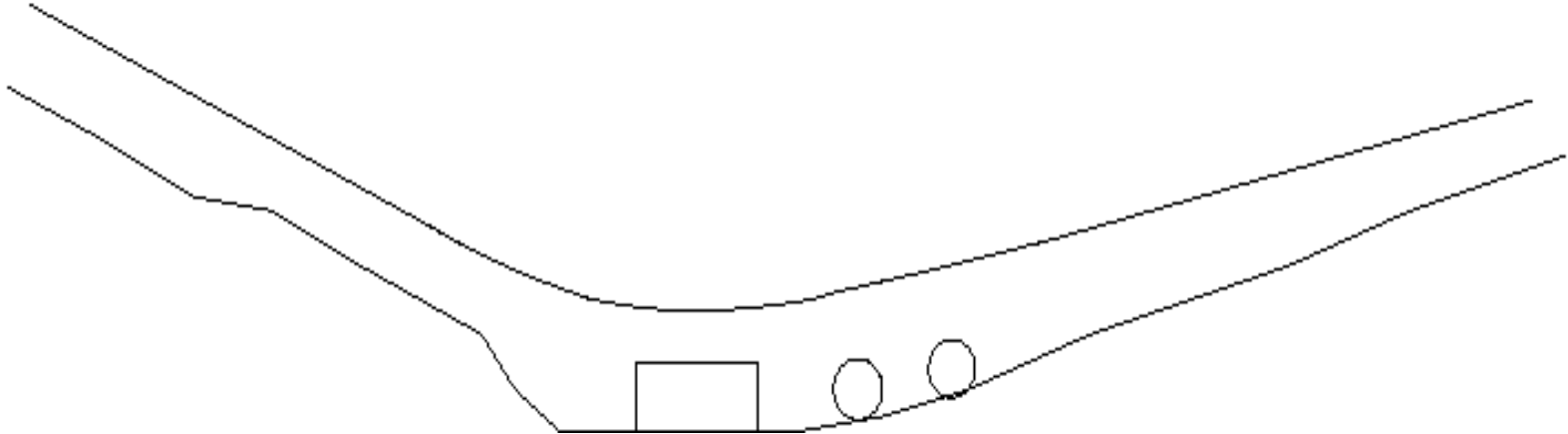
- Series of discharge vs. water surface elevation points.
- Simulate any hydraulic structure or flow control device.

•286.5	0.31
•286.585	0.36
•286.737	0.714
•287.042	4.08
•287.195	8.873
•287.50	23.05
•287.80	40.06
•288.11	54.21
•292.683	68.027
•298.78	83.262
•304.878	96.372
•310.975	107.70





Compound Structure Example



- Hydraulic structure consisting of four elements:
 - sag vertical-curve weir
 - box culvert
 - two circular culverts
- Each structure element allowed to have a different invert elevation.





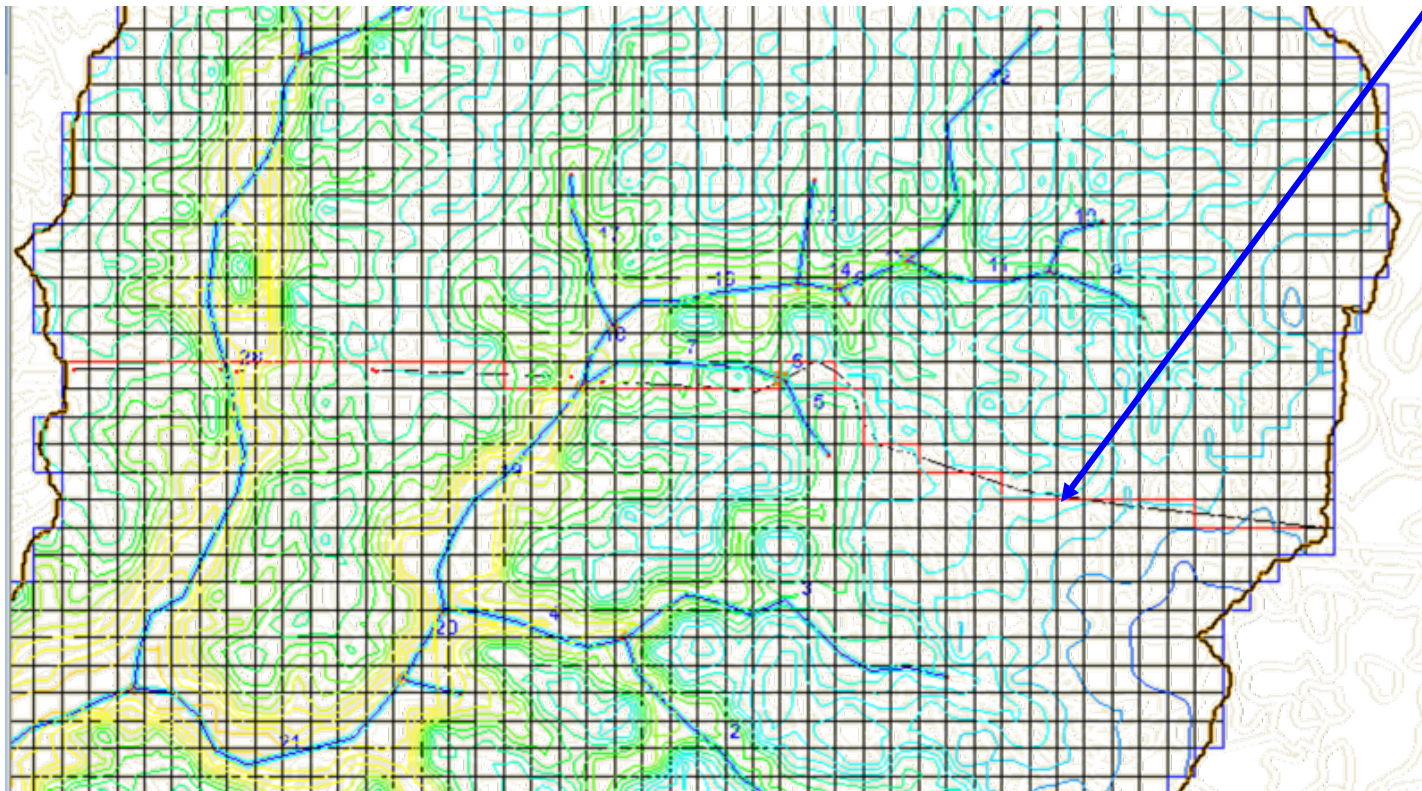
Embankment Conceptualization





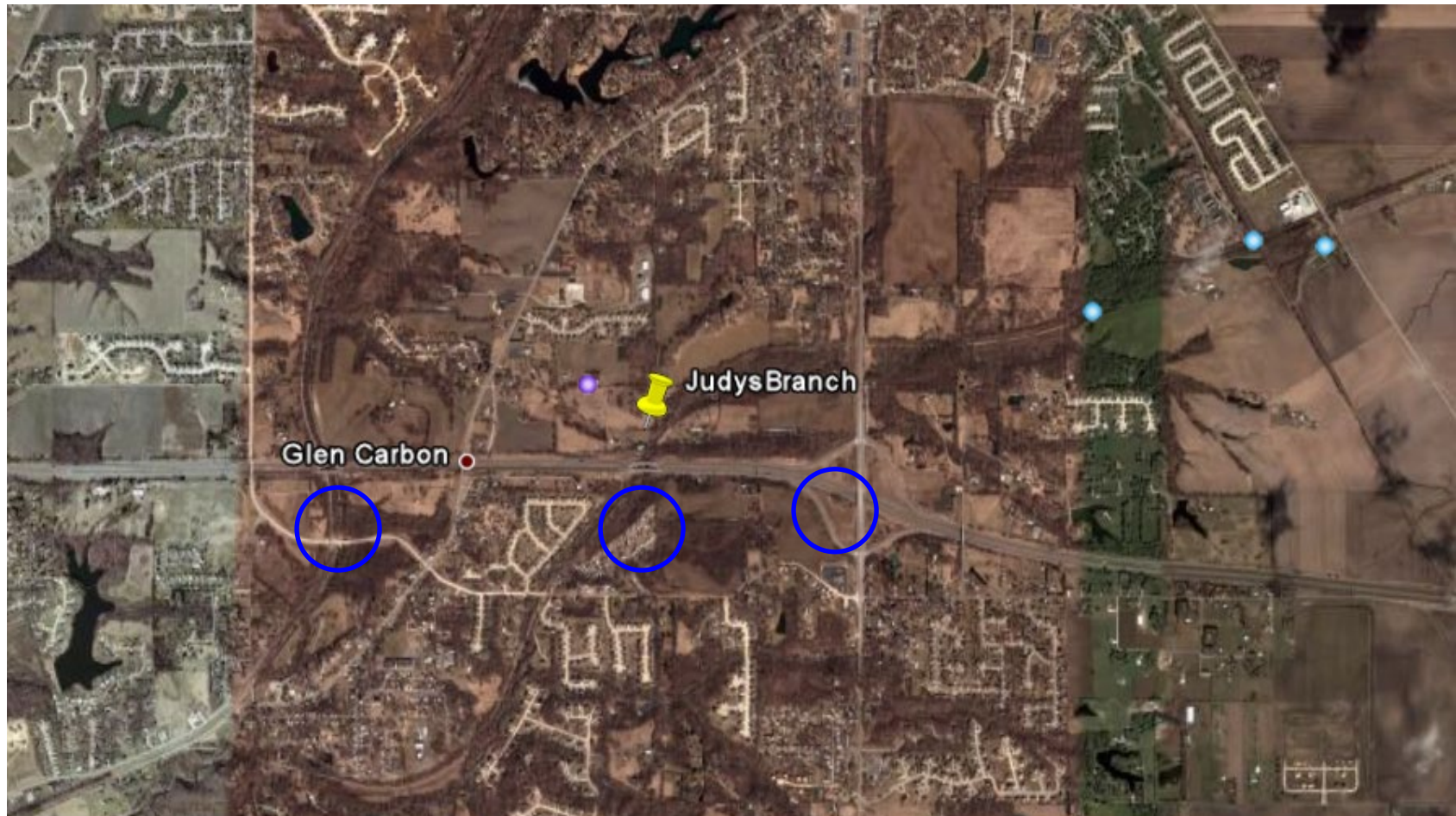
GSSHA Embankment

Red line representing
embankment in WMS





Culvert Locations





Culvert Conceptualization

The image displays the GSSHA Hydraulic Structures dialog box overlaid on a map. The dialog box is titled "GSSHA Hydraulic Structures" and contains the following fields and buttons:

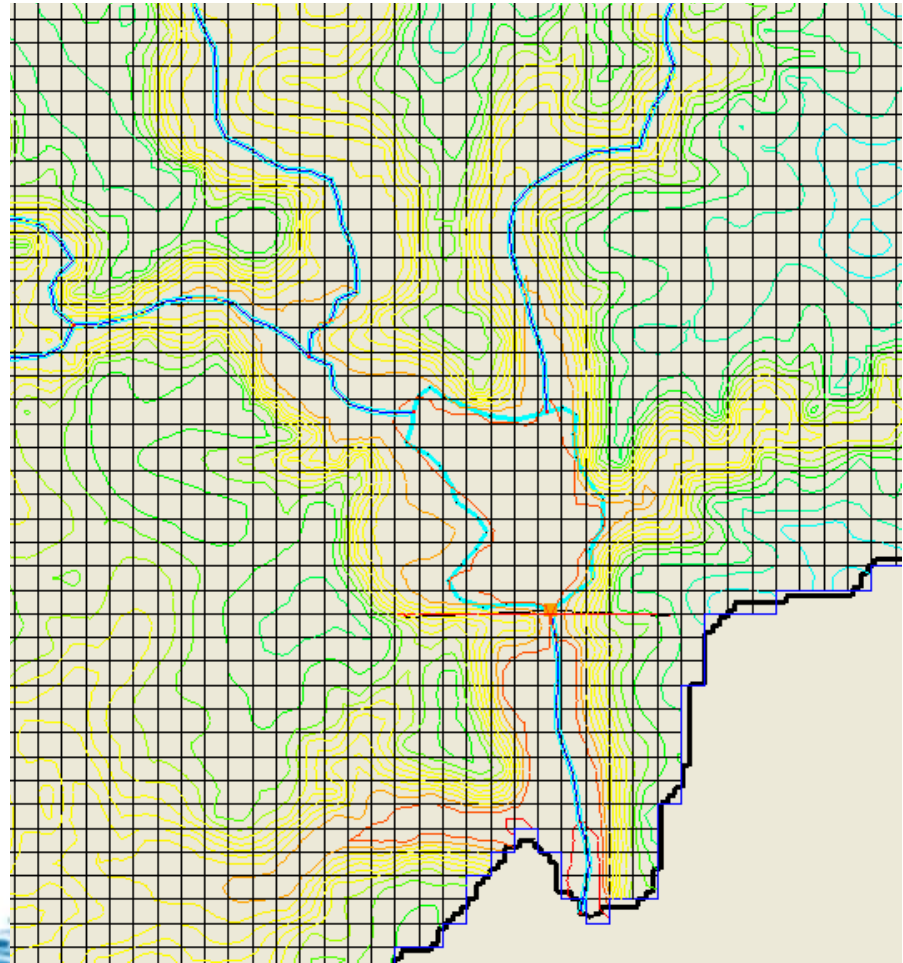
- Hydraulic Structures and Curves**
 - Culvert 1** (selected in the list)
 - Add:** Detention Basin, Weir, Culvert, Rating Curve, Rule Curve, Sched. Discharge
 - Delete**
 - Curve undefined.**
 - Plot Storage Capacity...**
- Name:** Culvert 1
- Culvert type:** Rectangular
- Box Width (m):** 2.4
- Box Height (m):** 2.4
- Upstream invert (m):** 154.0
- Downstream invert (m):** 153.8
- Inlet loss coeff:** 0.5
- Loss coeff (rev. flow):** 0.5
- Length (m):** 10.0
- Manning's roughness:** 0.025
- Help**, **OK**, **Cancel**

The map in the background shows a grid with a red rectangle highlighting a specific area. A black arrow points to a location within this rectangle, labeled "Culvert location and WMS representation of the culvert". The map also shows a blue line representing a stream or river, with a blue arrow indicating flow direction. The number "6" is visible on the map near the highlighted area.



Lakes/Reservoirs/ Detention Basins

- Lakes/reservoirs and detention basins are dynamic features that exist both in the stream network and on the overland flow plane.





Reservoir Fluxes

- Rainfall
- Overland flow
- Stream flow
- ET
- Outlet discharge
- Seepage/groundwater recharge





Interaction with Overland

- Reservoirs occupy overland flow cells.
- Water flows from the overland cells to the reservoirs and from the reservoirs to the overland cells.
- As reservoirs expand they overtake overland cells.
- As reservoirs recede they release overland cells.





Overland Cells Within a Reservoir

No cell processes occur while overland cells are occupied

- Cell to cell flow
- Infiltration
- Soil ET





Reservoir Stream Interaction

- A reservoir is a boundary condition in stream network.
- Flow from streams to reservoirs and from reservoirs to streams
- Reservoirs overtake stream cells when the overland flow cells containing them are taken.
- Reservoir releases stream cells as overland cells are released.





Creating Reservoirs

- Defined in stream network with polygon
- Embankment that represents the dam
- Specify outlet hydraulic structure
- Specify minimum, maximum and initial water level

A screenshot of the "GSSHA Polygon Attributes" dialog box. The dialog has a blue title bar with the text "GSSHA Polygon Attributes" and a red close button. The main area is light beige. At the top, "Polygon type:" is followed by a dropdown menu showing "Perennial Lake (Minimum)". Below this is a section titled "Lake Attributes" in blue. Inside this section, "Polygon Lake ID: ???" is displayed. There are three input fields: the first contains "285.0" and is labeled "Minimum water surface elevation"; the second contains "285.5" and is labeled "Initial water surface elevation"; the third contains "305.0" and is labeled "Maximum water surface elevation". To the right of these fields is a button labeled "Plot Storage Capacity...". At the bottom of the dialog is a section titled "Wetland Attributes" in blue, which is currently empty.

GSSHA Polygon Attributes

Polygon type: Perennial Lake (Minimum)

Lake Attributes

Polygon Lake ID: ???

285.0 Minimum water surface elevation

285.5 Initial water surface elevation

305.0 Maximum water surface elevation

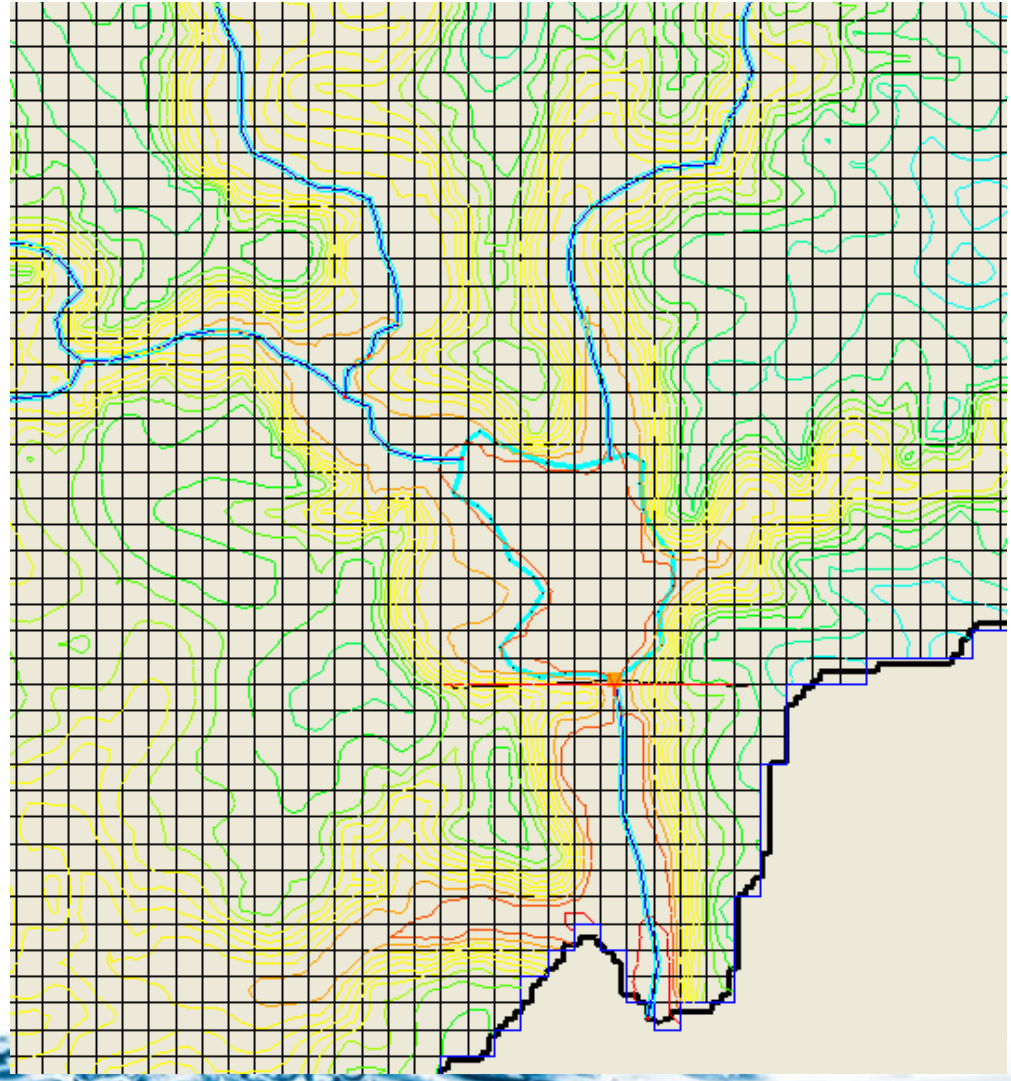
Plot Storage Capacity...

Wetland Attributes



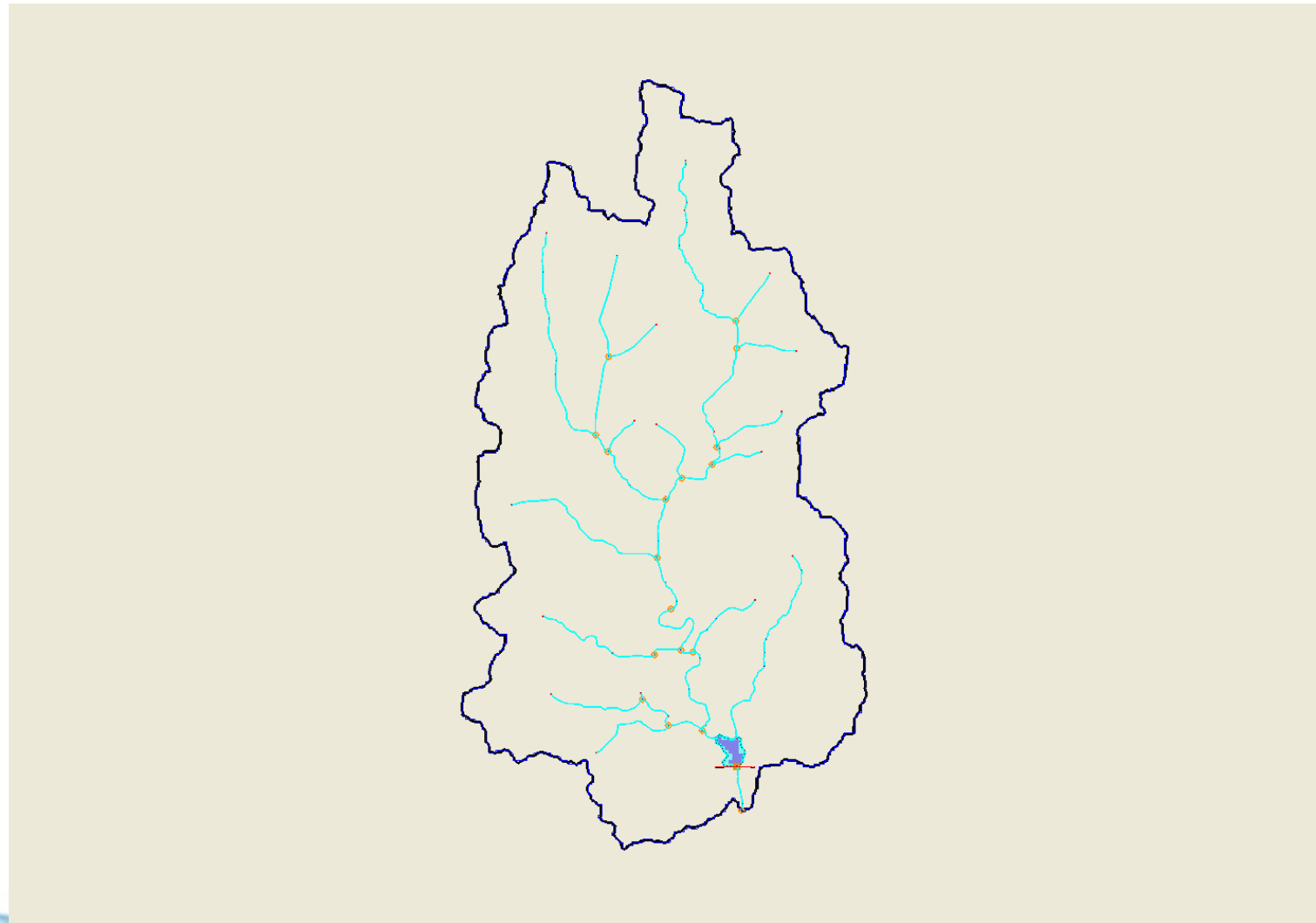
Stage/Area/Volume Relationship

- Stage/Area/Volume relationship is calculated directly from the grid elevations.
- WMS shows plots of relationships.



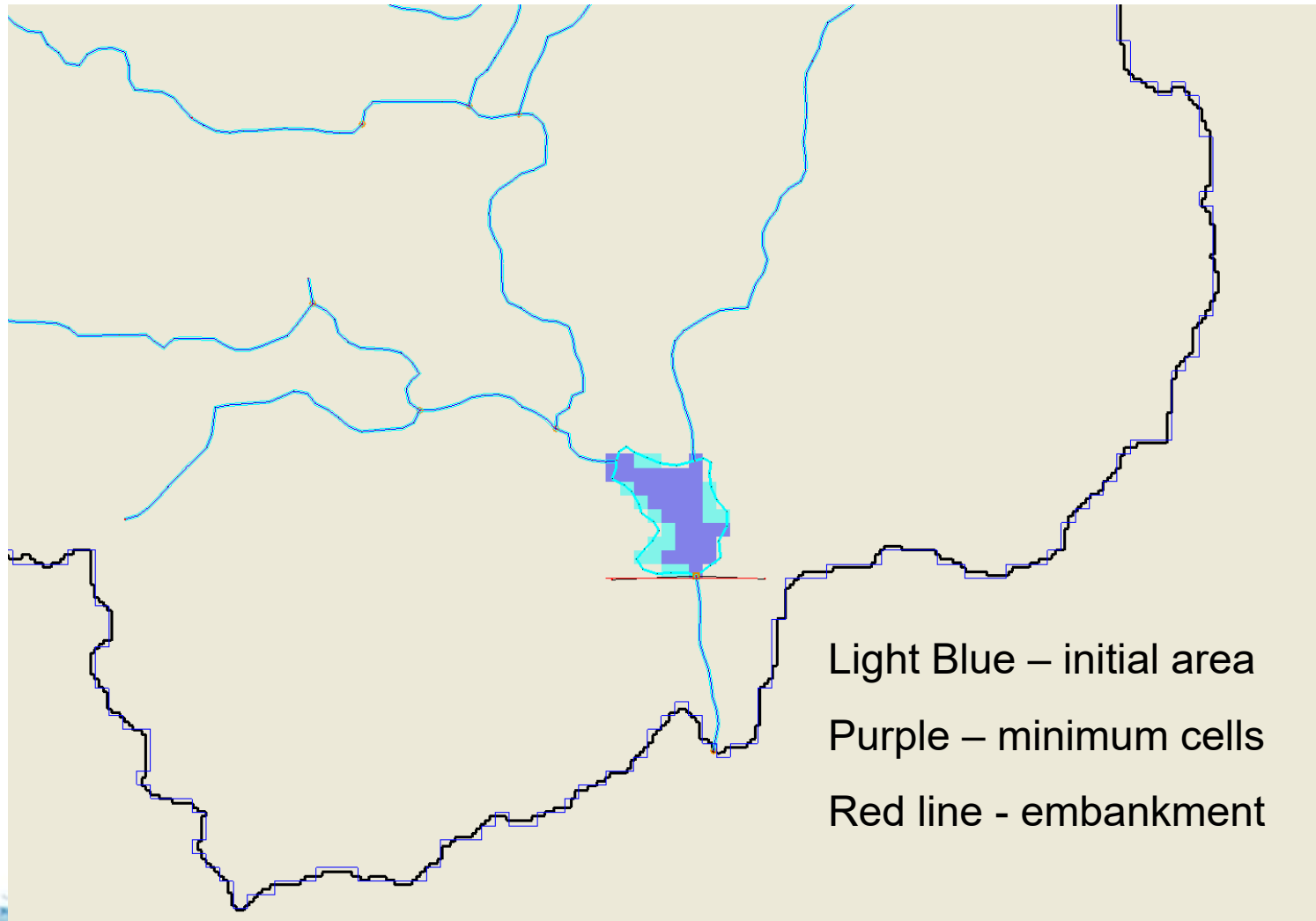


Eau Galle Reservoir Watershed with Stream Network



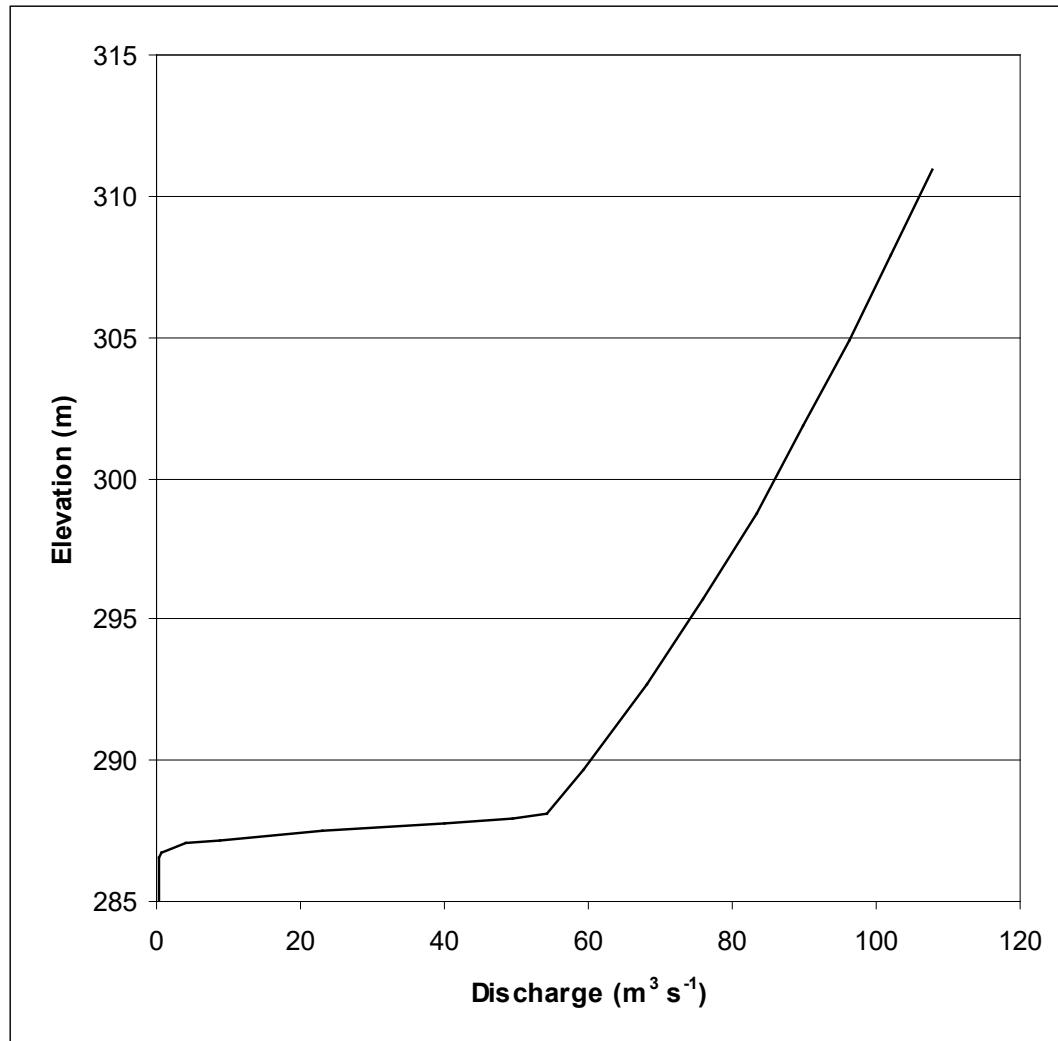


Eau Galle Reservoir





Eau Galle Reservoir Outlet Works



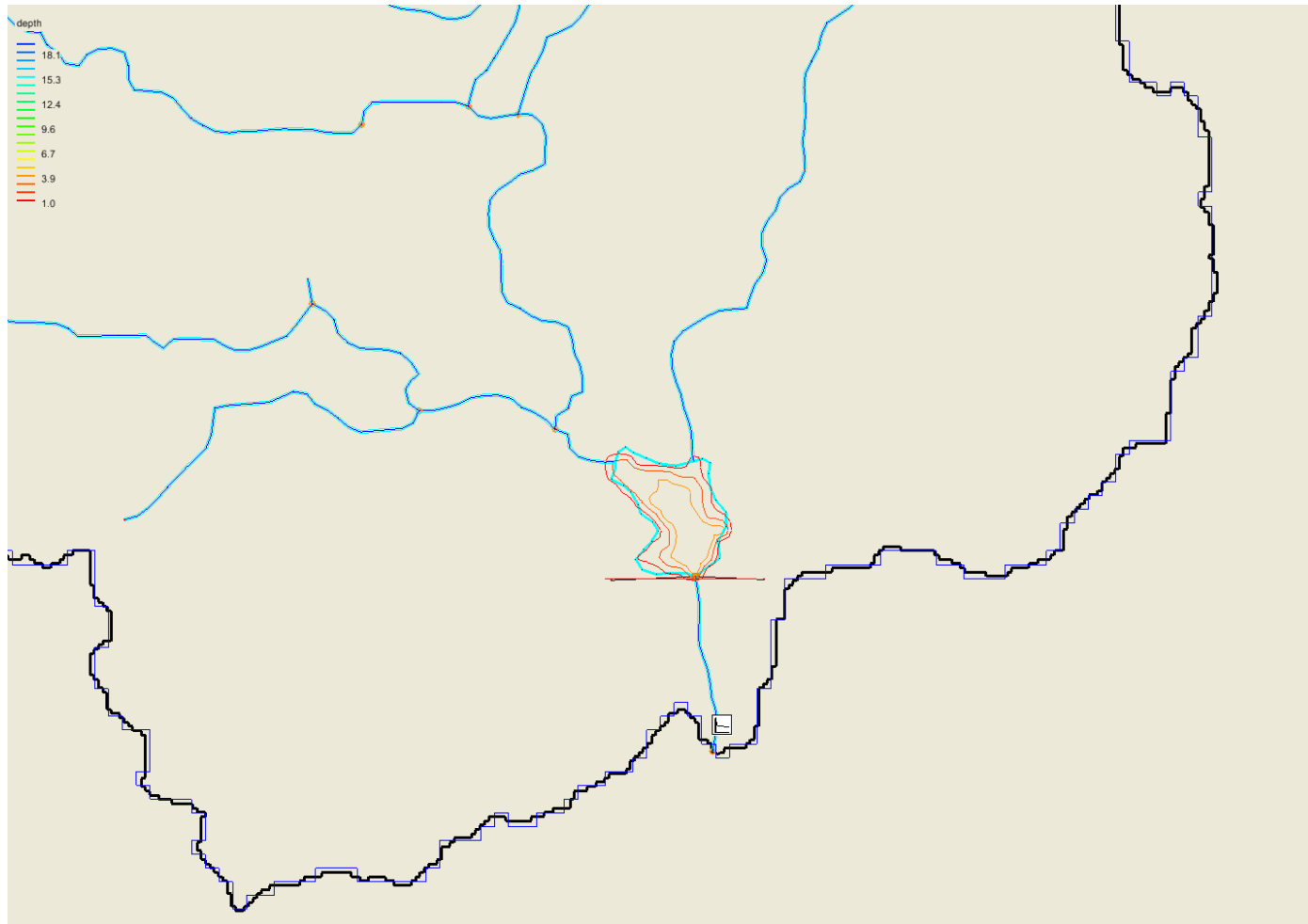


Reservoir Animation





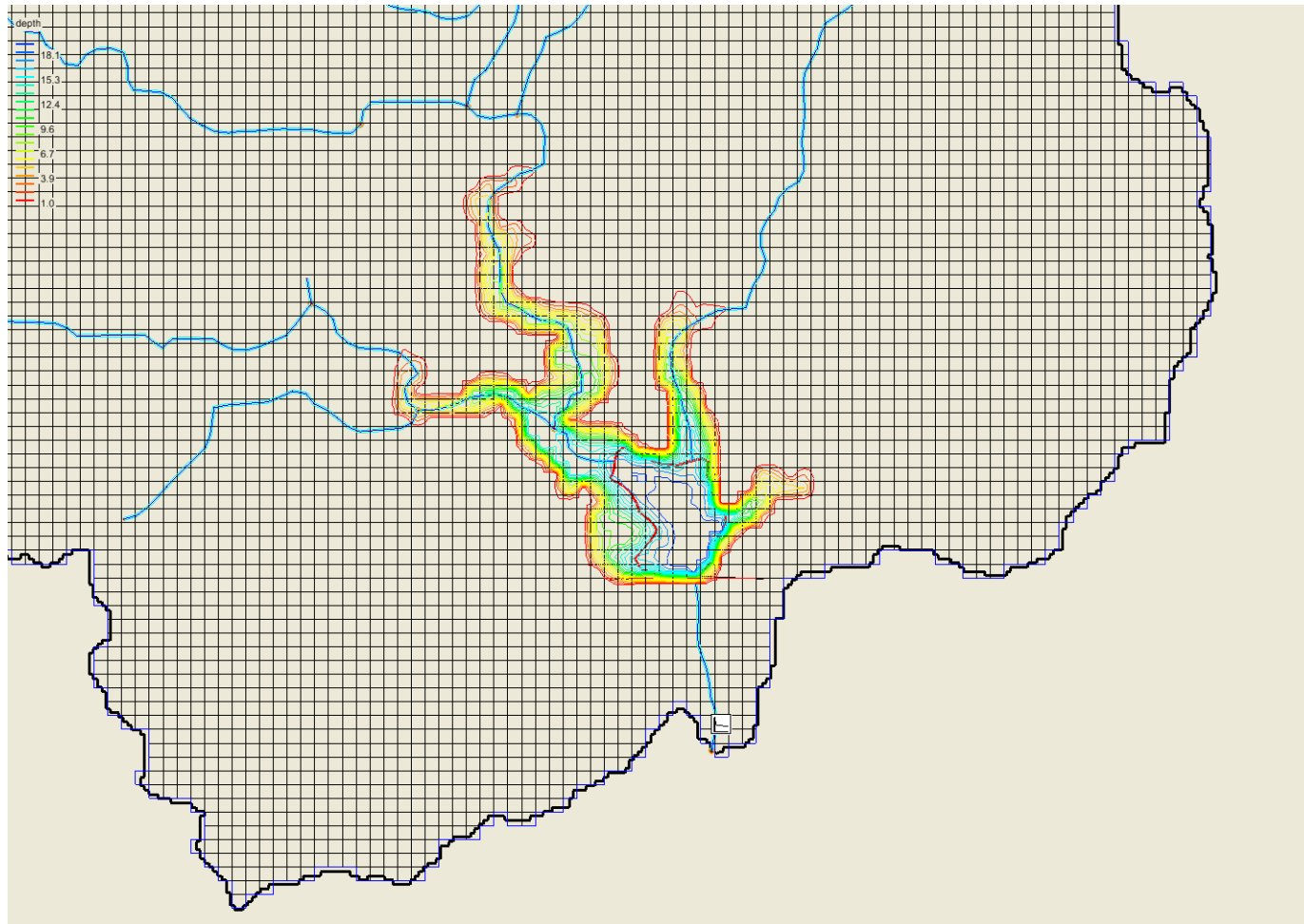
Eau Galle Reservoir Initial Condition





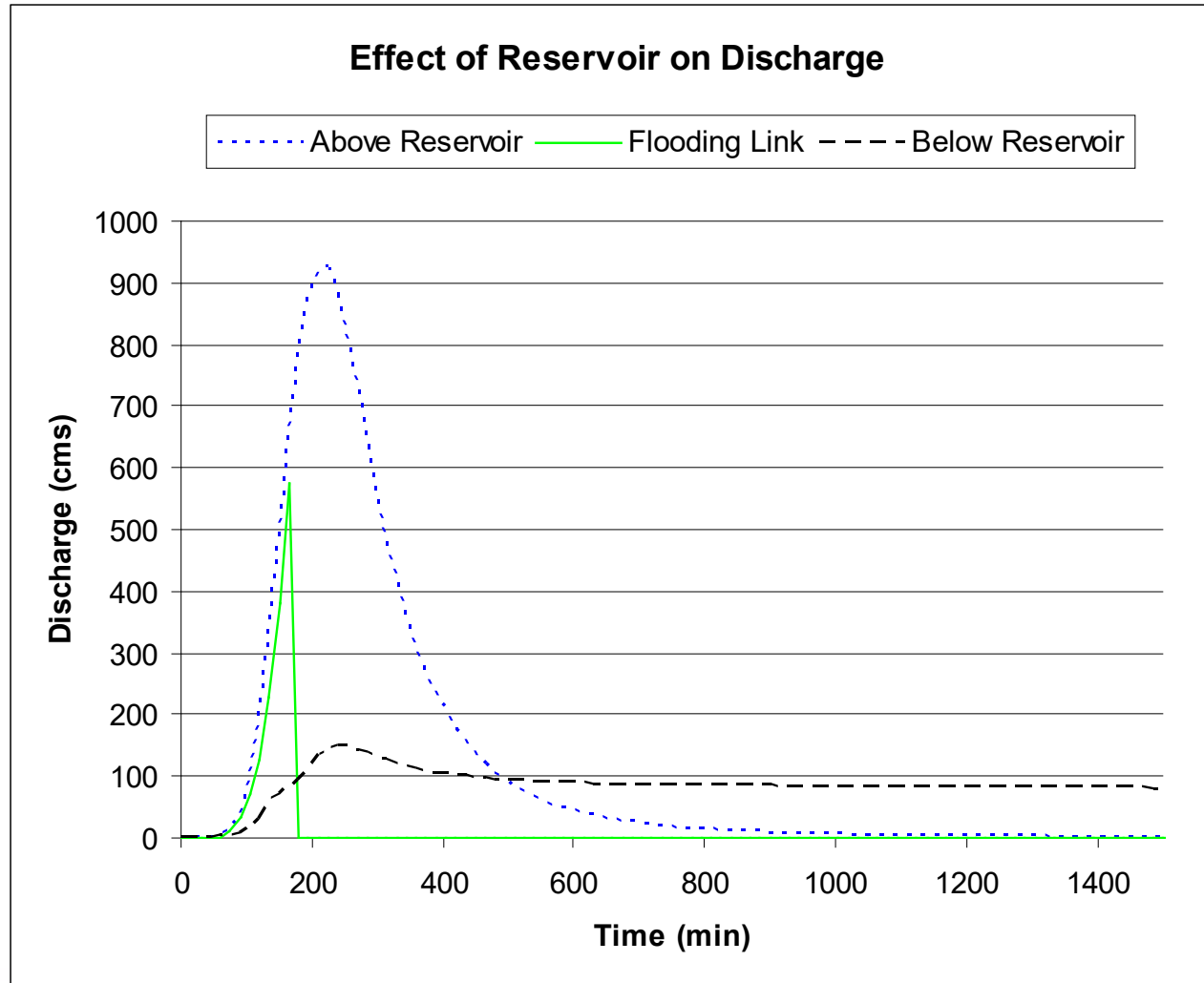
Eau Galle Reservoir

Maximum Flood





Stream Discharge Associated with Reservoir





Reservoir Level and Volume

