National Center for Computational Hydroscience and Engineering (NCCHE)

The University of Mississippi

FEMA

DSS-WISE™ Lite Flood Simulation Report

PYTHON 3 test TOC

D4934 McGrady Dam PYTHON 3

NAXXXXX

February 08, 2024

Contact Information:

DSS-WISE™ Lite modeling questions: admin@dsswiseweb.ncche.olemiss.edu

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1.0 Overview

The Decision Support System for Water Infrastructure Security (DSS-WISE™) is an integrated software package combining 2D numerical flood modeling capabilities with a series of GIS-based decision support tools. It was developed by the National Center for Computational Hydroscience and Engineering (NCCHE) at the University of Mississippi and was initiated by the US Department of Homeland Security (DHS) Science and Technology Directorate through the Southeast Region Research Initiative (SERRI) Program.

A simplified, and fully automated, version of the DSS-WISE™ software suite (DSS-WISE™ Lite Ver 1.0) was developed on behalf of the US Army Corps of Engineers (USACE) Critical Infrastructure Protection and Resilience (CIPR) Program and the DHS Office of Infrastructure Protection. This simplified dam break flood modeling capability was available to interested parties through the Dams Sector Analysis Tool (DSAT) secure web portal until November 2014. An updated version with more features was developed on behalf of Federal Emergency Management (FEMA) and is available at dsswiseweb.ncche.olemiss.edu.

The DSS-WISE™ Lite software suite, running on NCCHE servers, automatically processes input files for dam-break modeling scenarios submitted by an user. DSS-WISE™ Lite further simplifies simulations by making several general overarching assumptions in an effort to streamline data preparation and computations.

The results produced by this simplified dam-break flood simulation tool represent a rough approximation. They are not intended to replace more detailed flood inundation modeling and mapping products or capabilities developed by hydraulic and hydrologic engineers and GIS professionals.

The user is, therefore, warned that professional engineering judgment should be used in the interpolation of the results generated by this simplified and automated dam-break flood analysis.

To learn more about DSS-WISE™ and DSS-WISE™ Lite visit us at:
`https://dsswiseweb.ncche.olemiss.edu`

Disclaimer

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Elevation Datum

All reported elevations use the North American Vertical Datum of 1988 (NAVD 88).

2.0 Modeling Parameters and Conditions

2.1 Project Information

Project Name:	D4934 McGrady Dam PYTHON 3
Scenario Name:	PYTHON 3 test TOC
NIDID:	NAXXXXX
Scenario Description:	PYTHON 3 test TOC
User e-mail:	nuttita@ncche.olemiss.edu
Group:	UNITED STATES

2.2 Simulation Parameters

Domain buffer distance (miles):	5
Simulation cell size requested (ft):	20.0
Simulation duration requested (days):	3

2.3 Impounding Structure(s) Characteristics

Number of Structures: 1

Structure Name:	Dam
Structure Type:	Embankment
Hydraulic Height (ft):	10.0
Crest Elevation (ft):	62.8
Length (ft):	1413.8712692867657

2.4 Bridge(s) to be Removed

Number of Bridges: 3

Bridge Name:	S-15-114 over Black Creek
Length(ft):	50.0
Coordinates (Latitude/Longitude):	32.84462175486479/-80.77282279729843

Bridge Name:	Black Creek Road
Length(ft):	70.0
Coordinates (Latitude/Longitude):	32.805000768016086/-80.79505562782286

Bridge Name:	Cavanaugh Road
Length(ft):	45.0
Coordinates (Latitude/Longitude):	32.8429508111024/-80.77197253704071

2.5 User-Drawn Levees

Number of User-Drawn Levees: 0

2.6 Reservoir Characteristics

Number of Reservoirs: 1

Reservoir Name:	Reservoir 1
Selected Reservoir Point (Latitude/Longitude):	32.850569518526314/-80.77232122421263
Pool Elevation @ Max Storage (ft):	62.8
Maximum Storage Volume (ac-ft):	740.0
Pool Elevation @ Normal Storage (ft):	58.39999999999999
Normal Storage Volume (ac-ft):	209.0
Pool Elevation @ Failure (ft):	62.8
Failure Storage Volume (ac-ft):	740.0

2.7 Failure Conditions

Structure Name:	Dam
Structure Type:	Embankment
Failure Mode:	Total Dam Breach
Breach Type:	Embankment
Pool Elevation @ Failure (ft):	62.8
Storage Volume @ Failure (ac-ft):	740.0
Breach Location (Latitude/Longitude):	32.84705864193242/-80.77171498632309

3.0 Automated Data Preparation and Job Flow Summary

3.1 Job Flow Summary

1. Prepare Digital Elevation Model (DEM) and Land Use/Land Cover (LULC) tiles for the Area of Interest (AOI) based on requested cellsize and maximum downstream distance.
2. Burn U.S. Army Corps of Engineers (USACE) levee lines and group-specific levee lines (if any) within the AOI, as well as any user-drawn levees into the DEM.
3. Assign Manning's coefficients based on LULC classifications.
4. Validate user provided simulation input parameters.
5. Remove user identified bridges from the DEM.
6. Estimate reservoir bathymetry.
7. Extend impounding structures if the specified reservoir level cannot be contained.
8. Fill reservoir to specified failure elevation.
9. Prepare boundary condition and all input data for simulation.

3.2 Reservoir Bathymetry and Filling

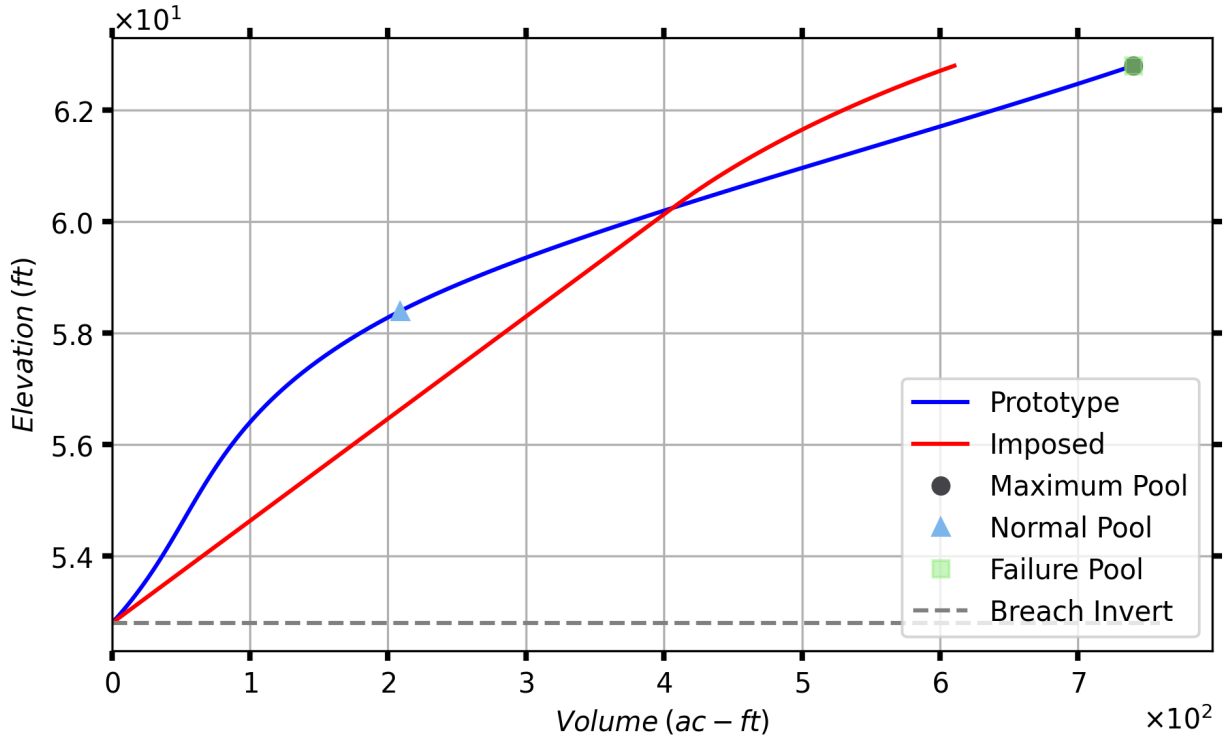

Figure 1. Stage-Volume Curve for Reservoir: Reservoir 1.

Prototype: Theoretical cubic Hermite spline curve generated from user-provided reservoir elevation and volume information.
Imposed: Measured from reservoir bathymetry after filling to the failure elevation.

The reservoir water surface was detected to be in the DEM, so bathymetry estimation was performed using the prototype stage-volume curve shown above.
User-given Storage Volume at Failure (ac-ft): 740.0
Imposed Storage Volume at Failure (ac-ft): 610.4
After filling to the failure elevation, the imposed reservoir volume matched 82.5% of the prototype volume.

Extended Structures:
Dam has been extended to contain the reservoir.

3.3 Data Sources

1. Digital Elevation Models

   Sources: USGS 3D Elevation Program (3DEP) 2019 datasets, NOAA, and any group-specific DEM data if provided

   Resolutions: 2, 1, 1/3, and 1/9th arc-second, 1 meter, and varying resolutions of group-specific DEM data (if any), based upon availability

   Vertical Datum: NAVD88

   Horizontal Datum: NAD83

2. National Land Use/Land Cover Data

   Sources: USGS 2016 (CONUS), 2011 (Alaska), and 2001 (Hawaii and Puerto Rico)

   Resolution: 30 m

3. National Levee Database

   Source: USACE

4. Group-specific levee data

   Source: Provided by individual groups

3.4 Digital Elevation Model

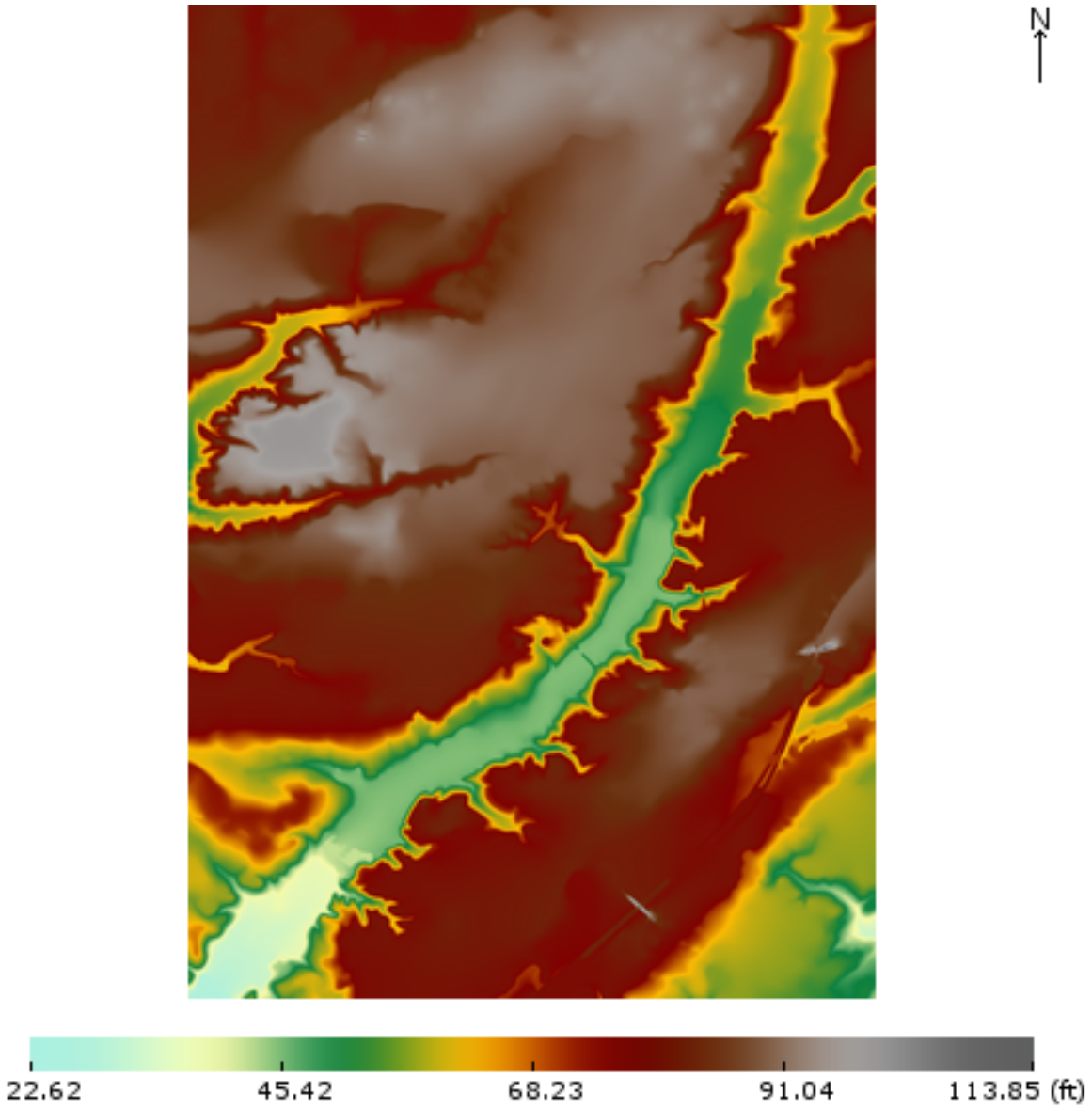

Figure 2. Map of Digital Elevation Model with Levees for AOI.

3.5 Reservoir Boundary and Breaching Structure

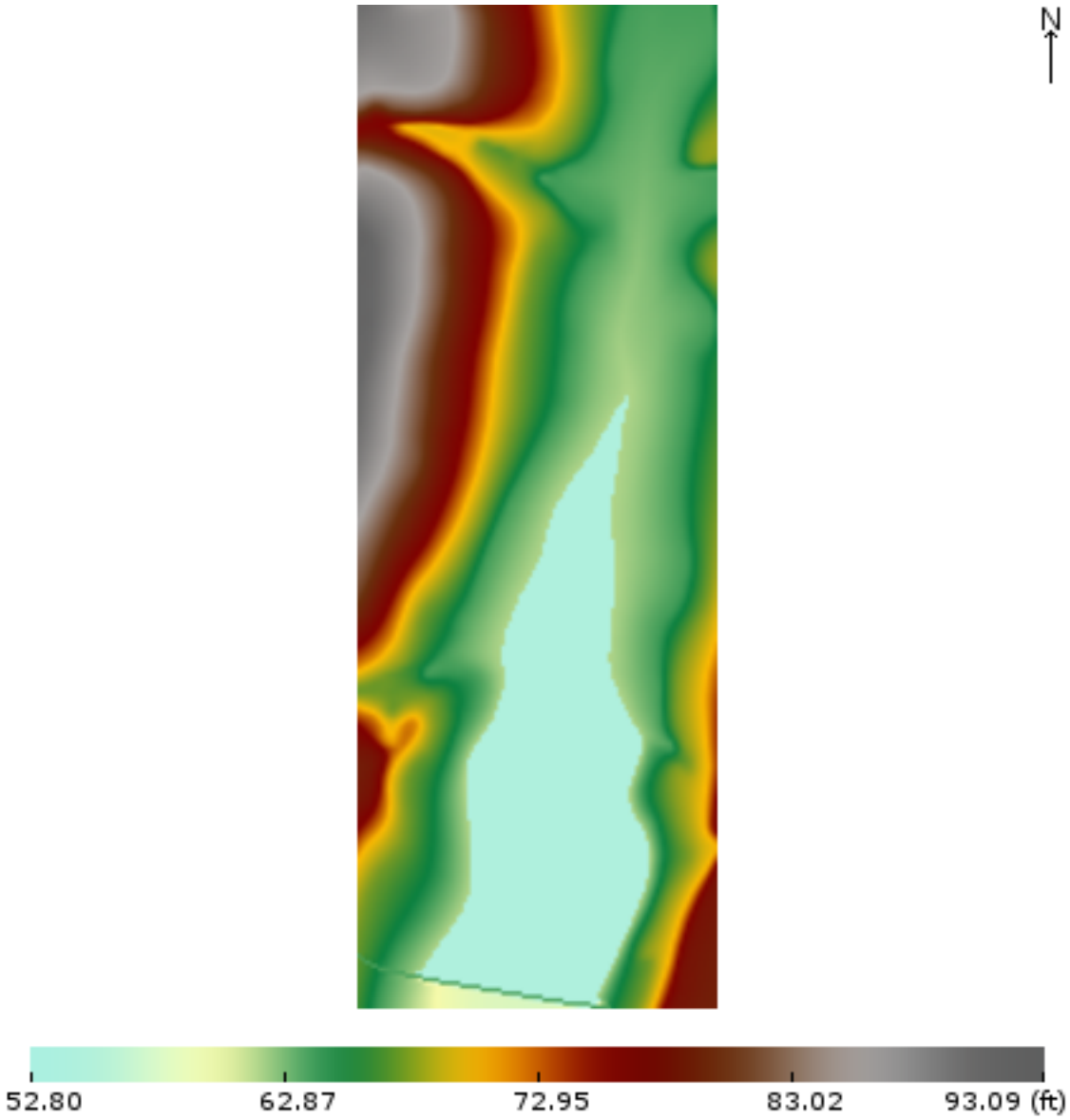

Figure 3. Map of Reservoir Boundary and Breached Structure.

3.6 Reservoir Initial Depth Profile

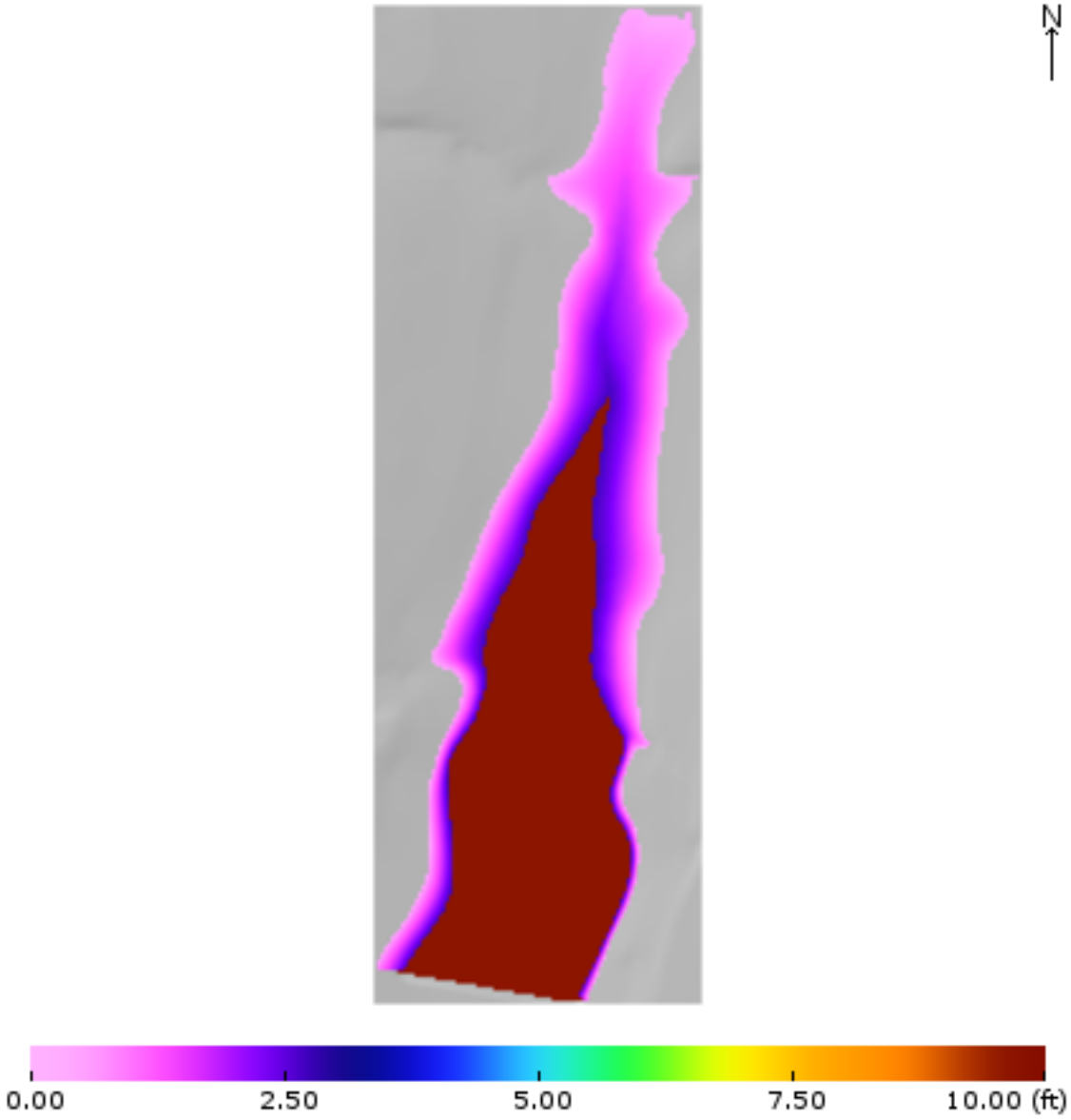

Figure 4. Map of Initial Depths in Reservoir at Failure Conditions.

3.7 Land Use/Land Cover

Image Dimensions: N-S: 6.148 miles E-W: 4.258 miles

Figure 5. Map of Land Use for AOI.

4.0 Simulation Results

4.1 Simulation Summary

Simulation Request Received:	03:34 PM CST (02/08/2024)
Simulation Start Time:	03:40 PM CST (02/08/2024)
Simulation End Time:	03:57 PM CST (02/08/2024)
DEM resolution used for simulation (ft):	20.0
DEM resolution requested (ft):	20.0
Final distance reached downstream (miles):	6.2
Domain buffer distance (miles):	5
Elapsed simulation time after breach initiation (hrs):	42.4
Remaining reservoir volume at termination (%):	41.746
Termination condition:	Maximum downstream distance plus additional time reached.

4.2 Land Use and Manning's Roughness Coefficient for Inundated Area

Land Use Description	% of Inundated Area	n-Value($m^{-1/3}s$)	Code	Color
Woody Wetlands	95.04	0.1500	90	
Developed, Open Space	1.53	0.0404	21	
Open Water	1.24	0.0330	11	
Evergreen Forest *	1.08	0.1000	42	
Grassland/Herbaceuous	0.74	0.0400	71	
Emergent Herbaceuous Wetlands	0.27	0.1825	95	
Shrub/Scrub	0.03	0.0400	52	
Developed, Low Intensity	0.02	0.0678	22	
unclassified	0.00	0.0350	0	
Perennial Snow/Ice	0.00	0.0100	12	
Developed, Medium Intensity	0.00	0.0678	23	
Developed, High Intensity	0.00	0.0404	24	
Barren Land	0.00	0.0113	31	
Deciduous Forest *	0.00	0.1000	41	
Mixed Forest *	0.00	0.1200	43	
Dwarf Scrub *	0.00	0.0350	51	
Sedge/Herbaceous *	0.00	0.0350	72	
Lichens *	0.00	0.0350	73	
Moss *	0.00	0.0350	74	
Hay/Pasture	0.00	0.0350	81	
Cultivated Crops	0.00	0.0700	82	

Note: * indicates an n-value estimated by NCCHE. ** indicates an n-value given by the user. Other values are taken from literature.

4.3 Coverage and Sources of DEM Raster Datasets

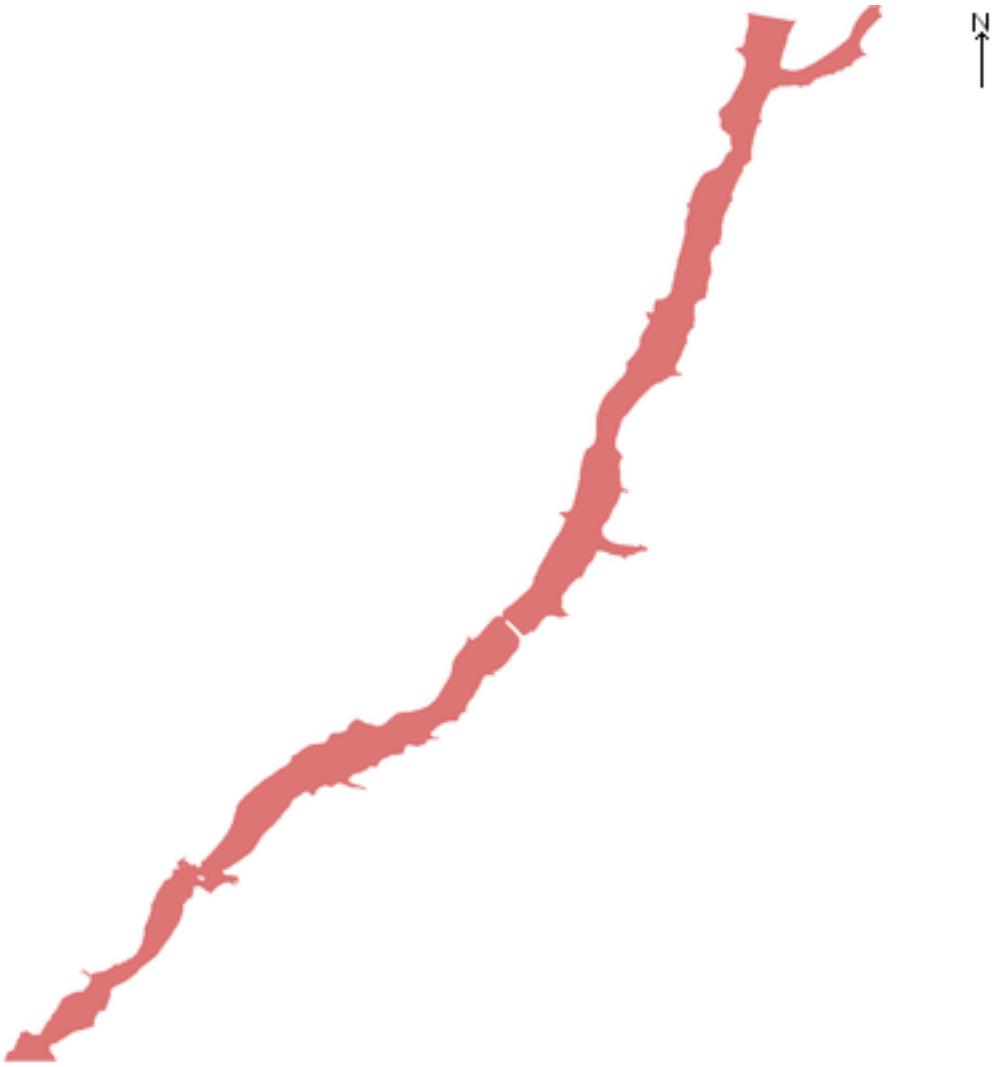

Figure 6. Coverage of DEM Raster Datasets in the Inundation Area.

DEM Source	Source Resolution	Source Dataset	Color
USGS	1 arc-second	usgs_1as	
USGS	1/3 arc-seconds	usgs_13as	

Note: The DEM for this job was created from the source DEM raster datasets listed above. These DEM raster datasets were resampled and reprojected to the user defined cell size and UTM zone, respectively. Resampled and projected DEM raster datasets were then stacked in the order specific to the group under which this simulation was submitted.

4.4 Maximum Flood Depth

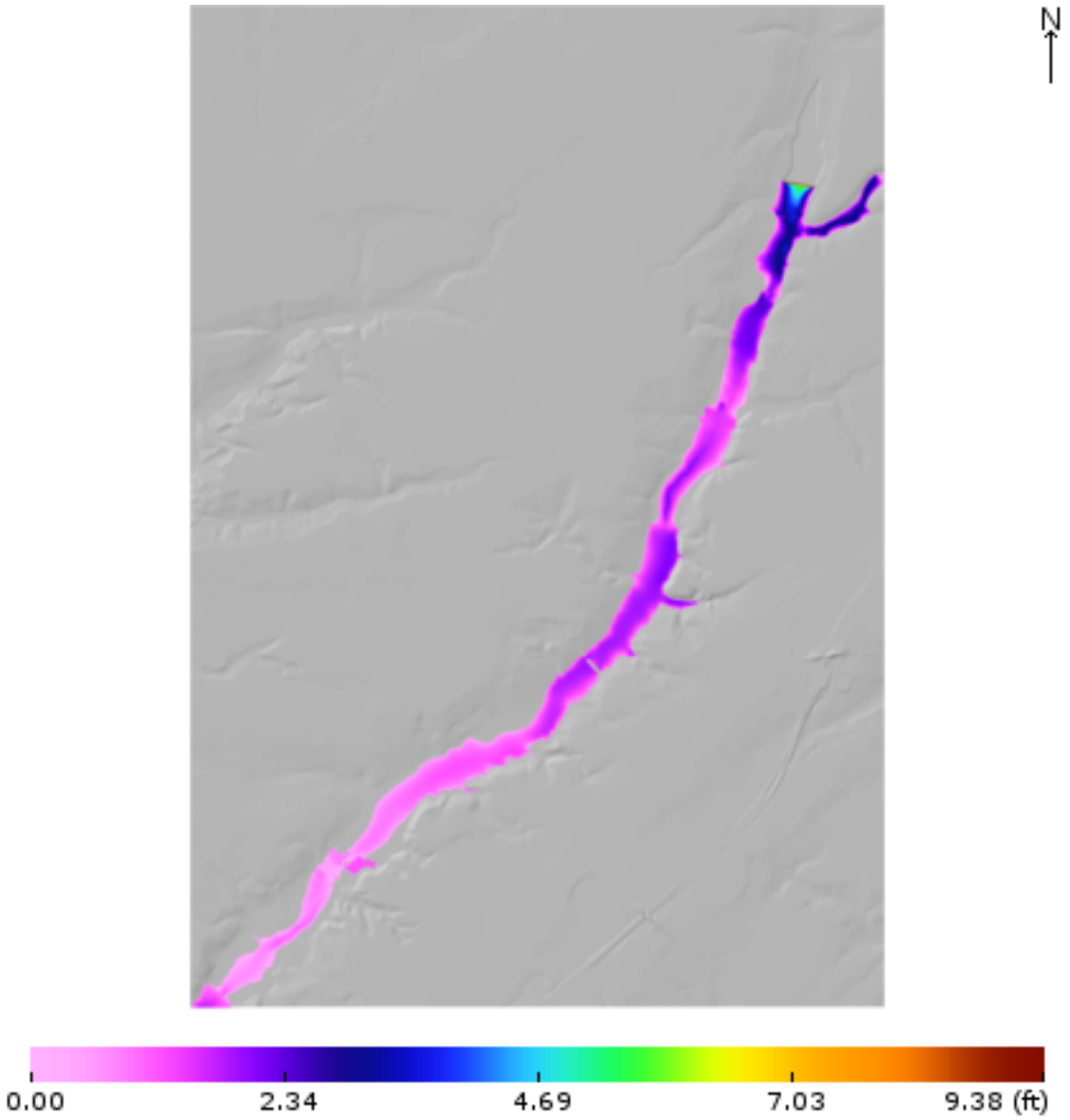

Figure 7. Maximum Flood Depth Map.

4.5 Flood Arrival Time

Flood arrival time is measured from the beginning of the simulation.

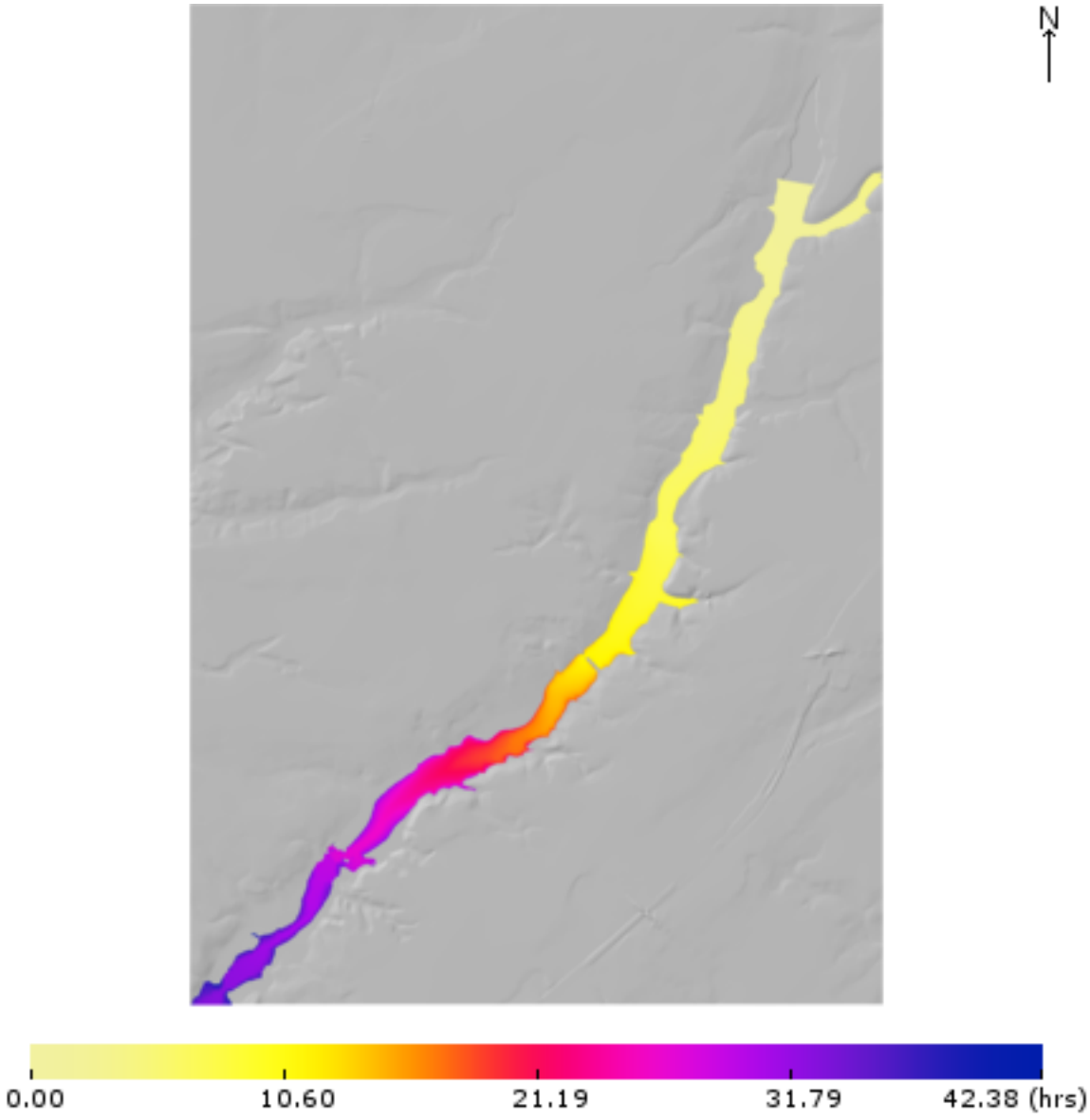

Figure 8. Flood Arrival Time Map.

4.6 Computed Breach Hydrograph through the Breaching Structure

The positive discharges (Q^+) are measured in the positive direction with respect to each observation line.

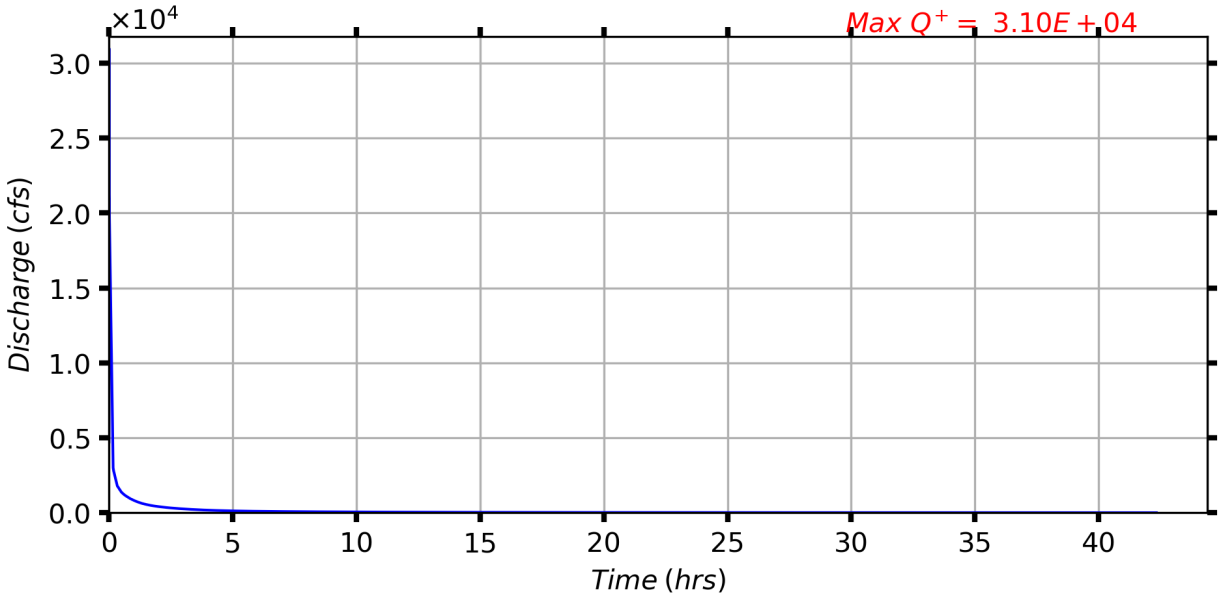

Figure 9. Breach Discharge Measured at: Dam.

4.7 Observation Line Hydrograph(s)

The positive discharges (Q^+) are measured in the positive direction with respect to each observation line.

S-15-114

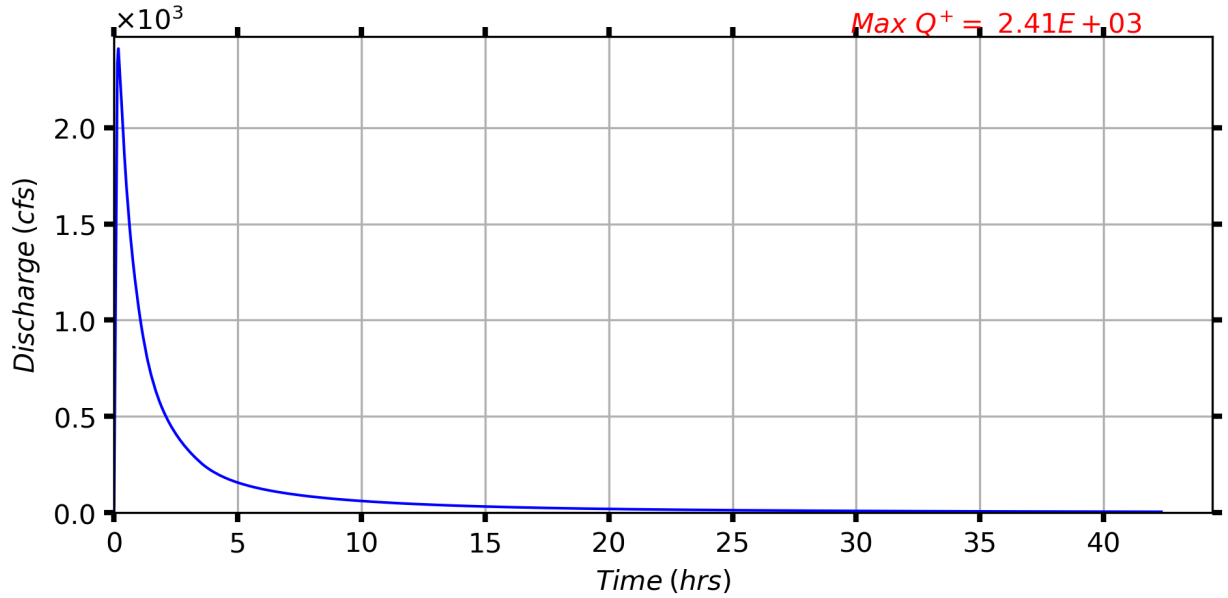

Figure 10. Discharge Measured at: S-15-114.

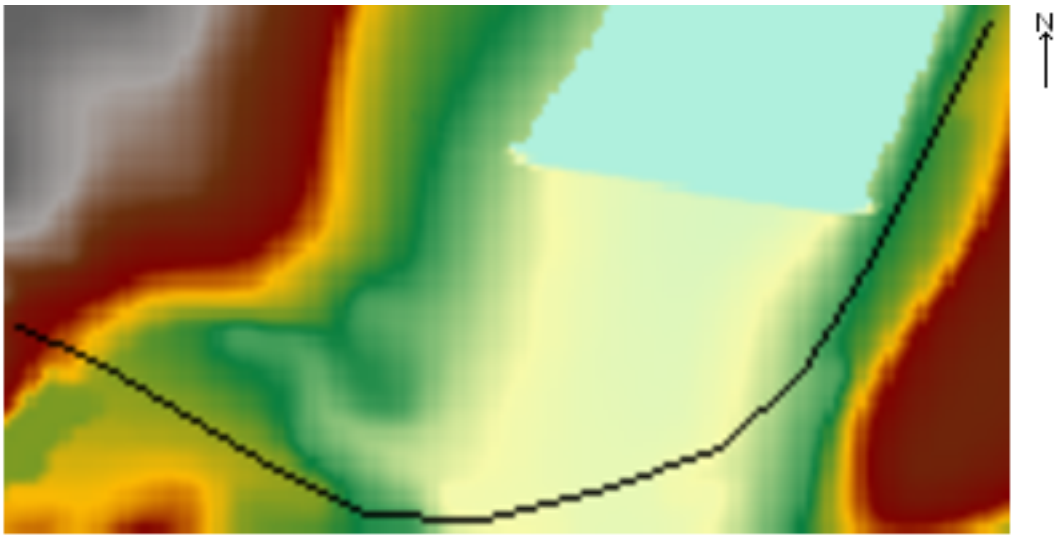

Image Dimensions: N-S: 0.298 miles E-W: 0.568 miles

Figure 11. Observation Line: S-15-114.

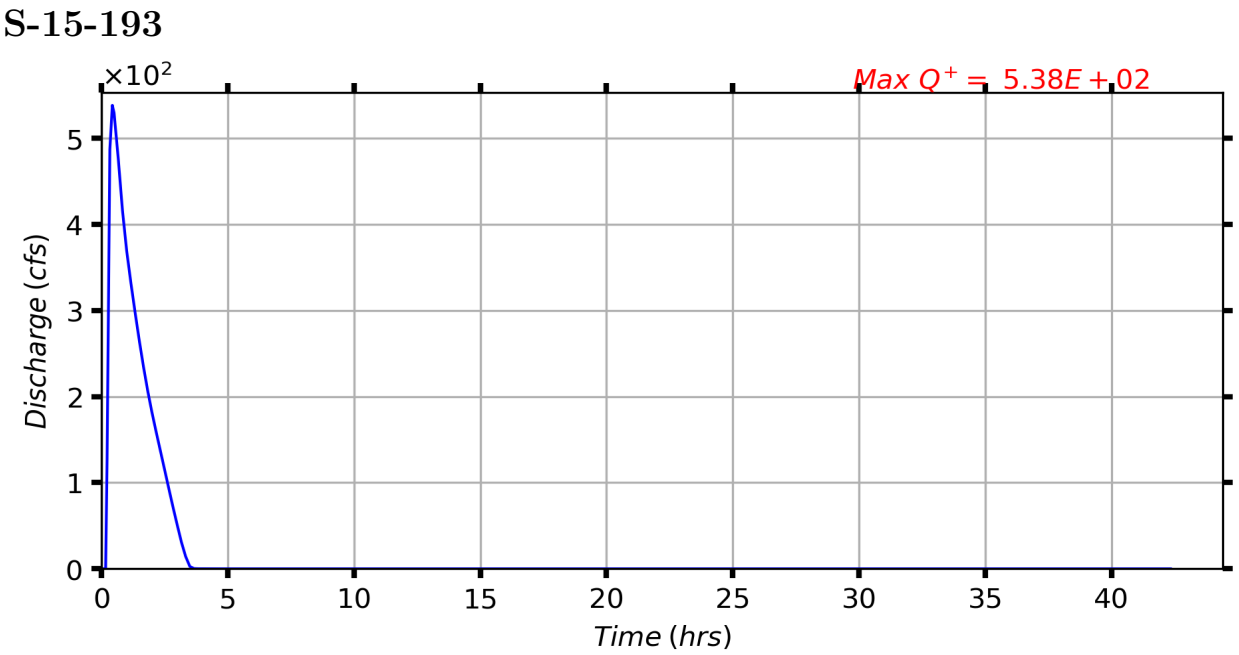

Figure 12. Discharge Measured at: S-15-193.

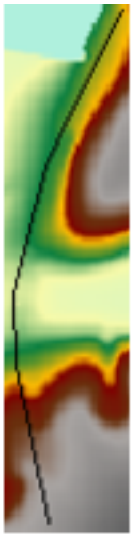

Image Dimensions: N-S: 0.599 miles E-W: 0.143 miles

Figure 13. Observation Line: S-15-193.

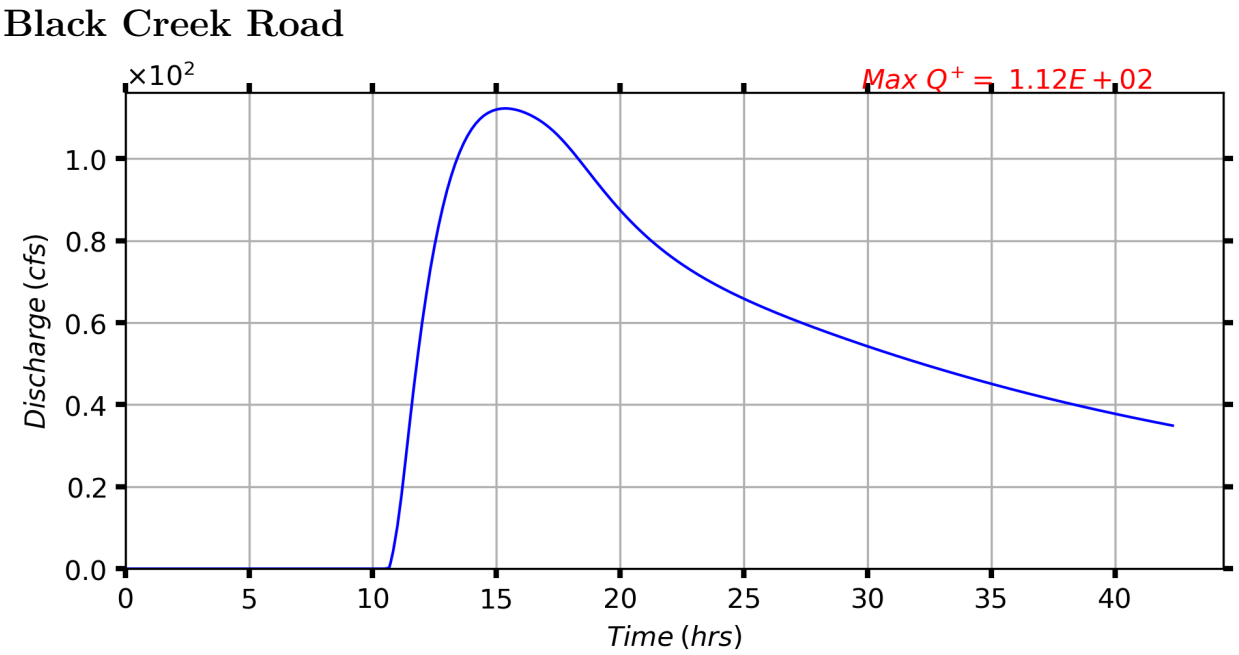

Figure 14. Discharge Measured at: Black Creek Road.

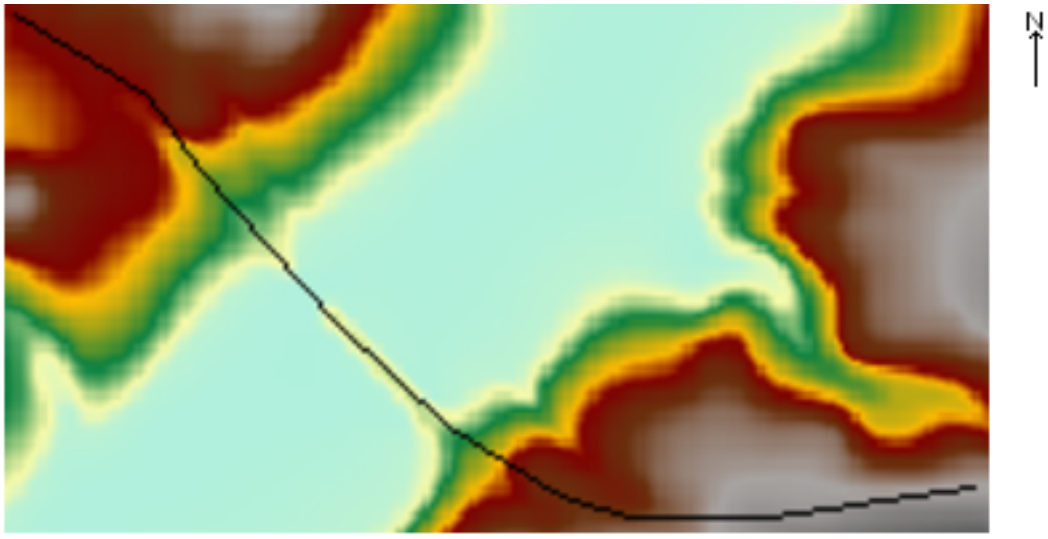

Image Dimensions: N-S: 0.382 miles E-W: 0.711 miles

Figure 15. Observation Line: Black Creek Road.

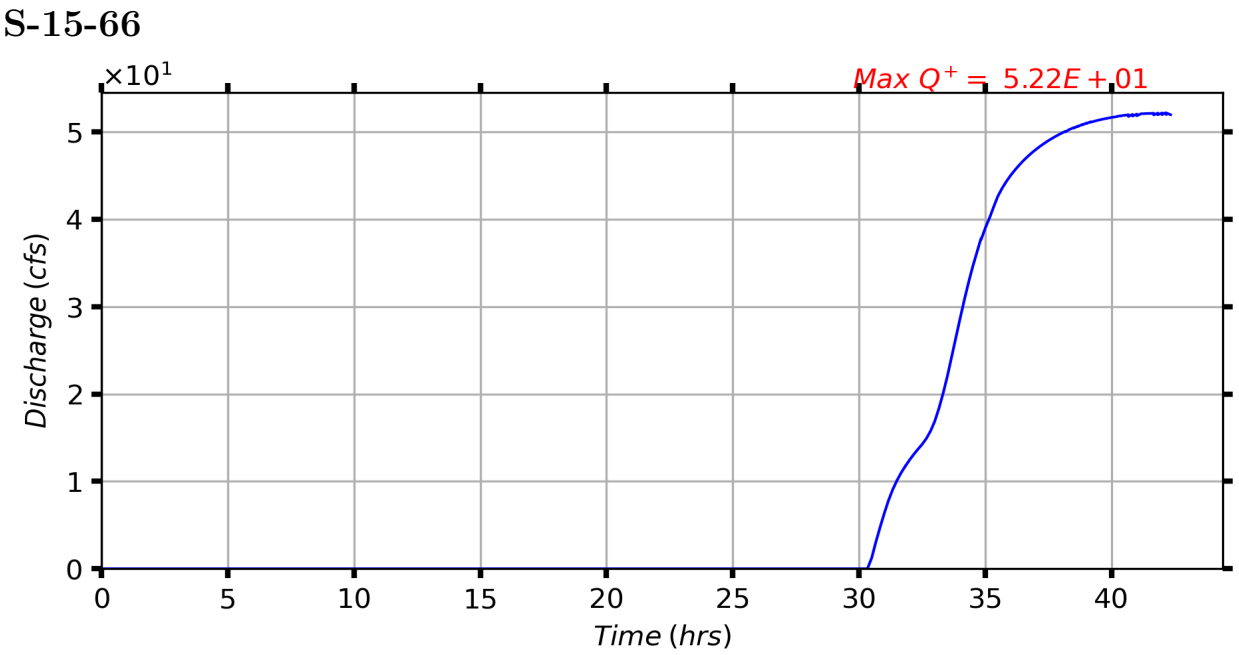

Figure 16. Discharge Measured at: S-15-66.

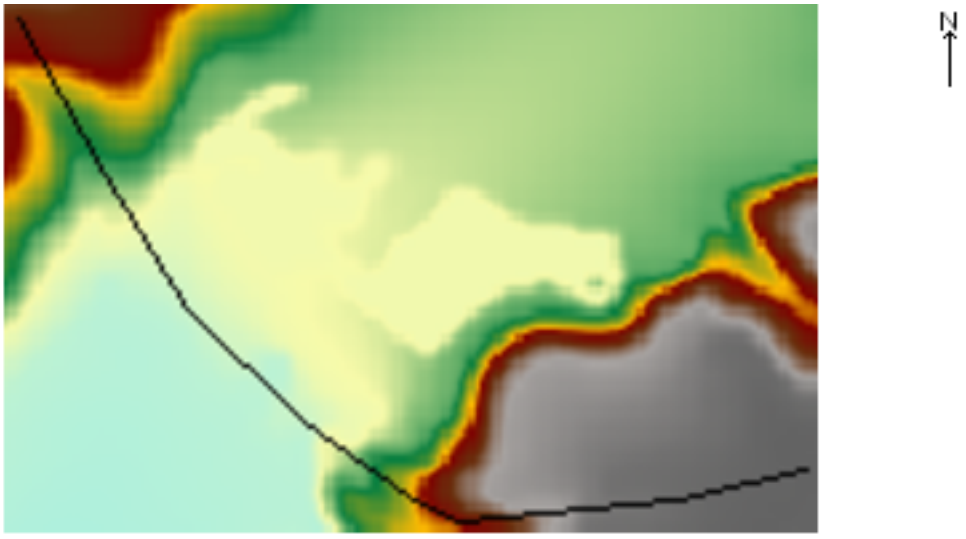

Image Dimensions: N-S: 0.379 miles E-W: 0.584 miles

Figure 17. Observation Line: S-15-66.

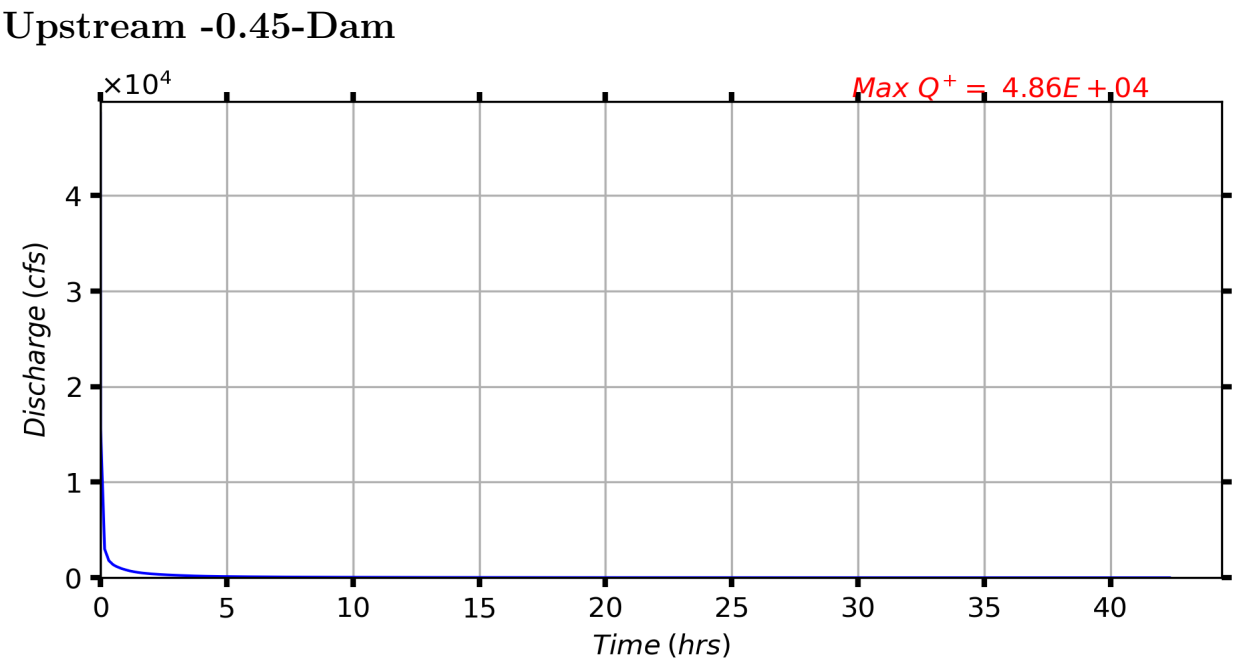

Figure 18. Discharge Measured at: Upstream -0.45-Dam.

Image Dimensions: N-S: 0.074 miles E-W: 0.295 miles

Figure 19. Observation Line: Upstream -0.45-Dam.

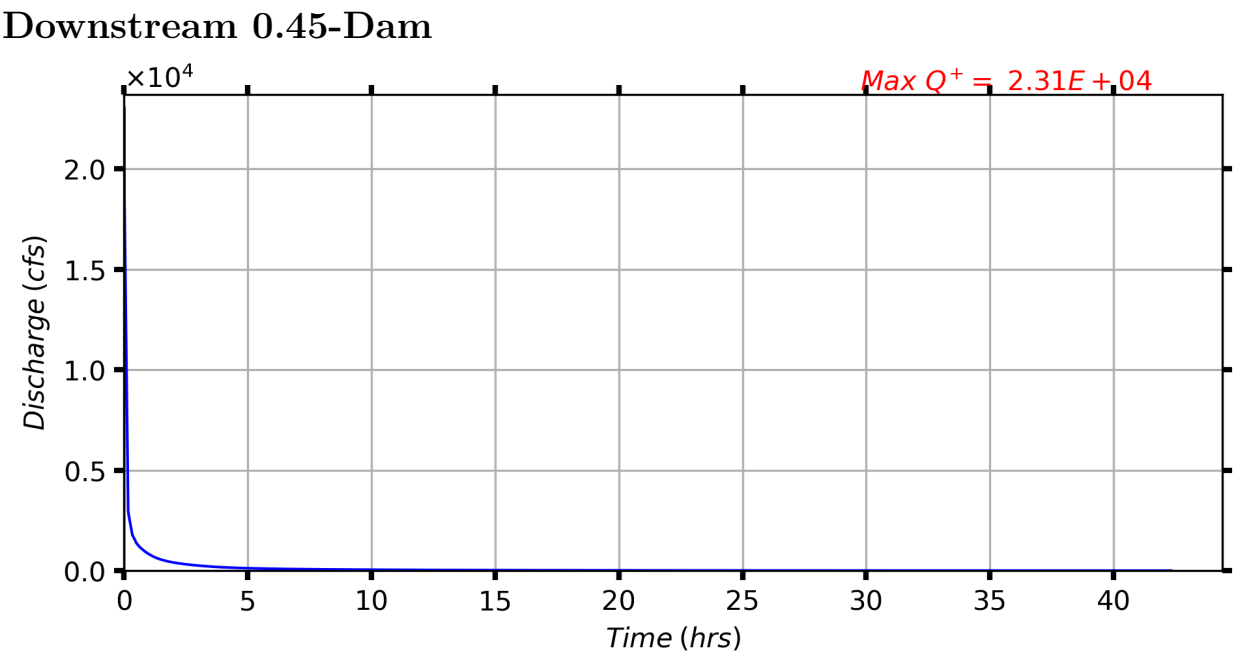

Figure 20. Discharge Measured at: Downstream 0.45-Dam.

Image Dimensions: N-S: 0.074 miles E-W: 0.298 miles

Figure 21. Observation Line: Downstream 0.45-Dam.

4.8 Breaching Reservoir Time History

The reservoir water surface elevation as a function of time was computed by summing the water depth and bed elevation at a regular interval at the user-specified reservoir point.

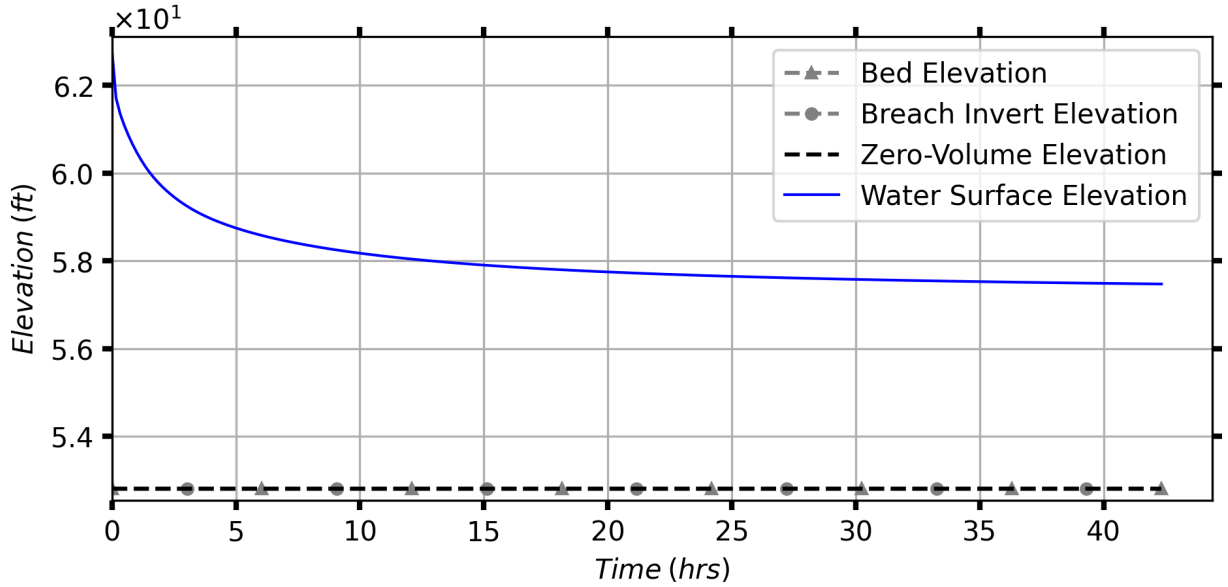

Figure 22. Reservoir Water Surface Elevation.

The reservoir volume as a function of time was computed by the following formula: $V_t = V_{init} - V_{net}$, where V_t is the reservoir volume at a given time, V_{init} is the reservoir's initial imposed volume, and V_{net} is the net volume that has crossed downstream across any part of the breaching structure's centerline up to that point. Since this only considers water which has completely exited the breach, it should be taken as an approximation.

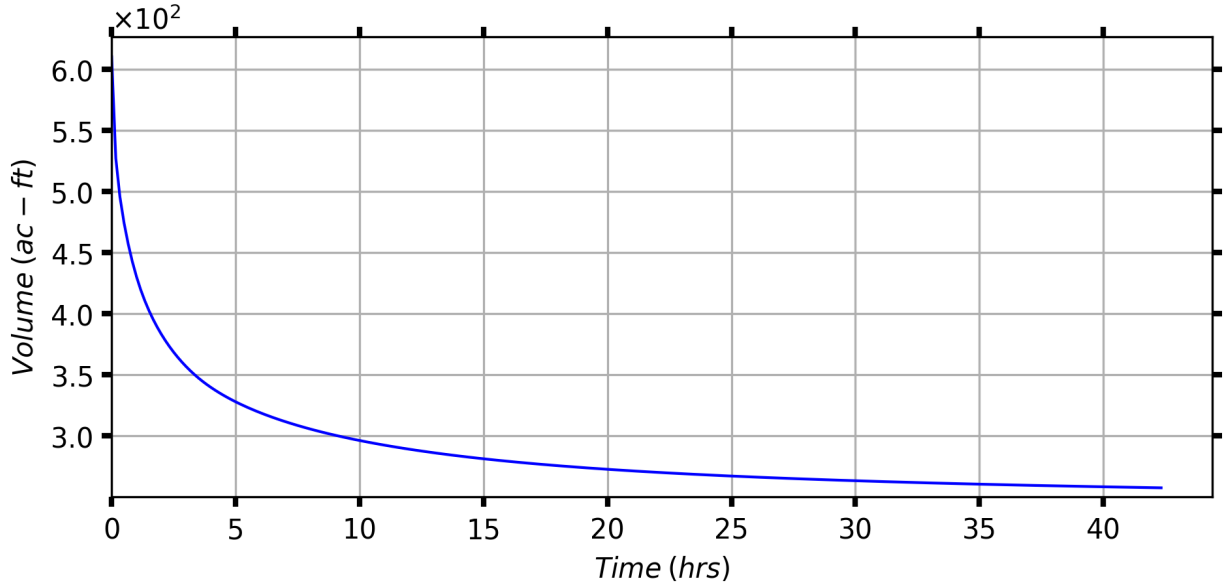

Figure 23. Reservoir Volume.

4.9 Downloading Simulation Results

The simulation results can be accessed at the following web address:

`https://dsswiseweb.ncche.olemiss.edu/download`

Job ID: 7228