Unit 06:
Current and Future Developments for DSS-WISE Web

WEB-BASED FLOOD INUNDATION MODELING WITH DSS-WISE WEB

A SHORT COURSE ON RECENT UPDATES WITH HANDS-ON TRAINING

Developed by

NATIONAL CENTER FOR COMPUTATIONAL HYDROSCIENCE AND ENGINEERING

THE UNIVERSITY OF MISSISSIPPI

For

FEDERAL EMERGENCY MANAGEMENT AGENCY

Technical Workshop

September 3rd, 2026
Raleigh Convention Center
500 S. Salisbury Street, Raleigh, NC 27601

Agenda

Time	Topic
8:30 AM – 9:20 AM	Introduction/Overview of DSS-WISE Web
9:20 AM – 9:45 AM	Simulation scenario setup and data entry
9:45 AM – 9:55 AM	SHORT 10 MINUTE BREAK
9:55 AM – 10:20 AM	Understanding simulation outputs
10:20 AM – 11:20 AM	Hands-on exercises using the new system features
11:20 AM – 11:30 AM	SHORT 10 MINUTE BREAK
11:30 AM – 11:45 AM	Tips and Tricks/Advanced Techniques
11:45 AM – 12:15 PM	Current and Future Developments for DSS-WISE Web
12:15 PM – 12:30 PM	Questions / Discussion

Current/Upcoming Enhancements and Improvements

Simulation & Analysis

- Levee Breach Calculator
- Cascading dam failures
- Culvert flow modeling
- HCOM enhancement

Data Integration & Access

- Improved USGS 3DEP data
- Load past simulation results on Viewer
- User-supplied data overlays
- Inflow hydrographs & USGS gage integration
- HCOM updated to use 2020 Census Block Data

System & Reporting

- Hybrid cloud compute capability (current/future)
- Improved simulation report maps
- High-priority simulations

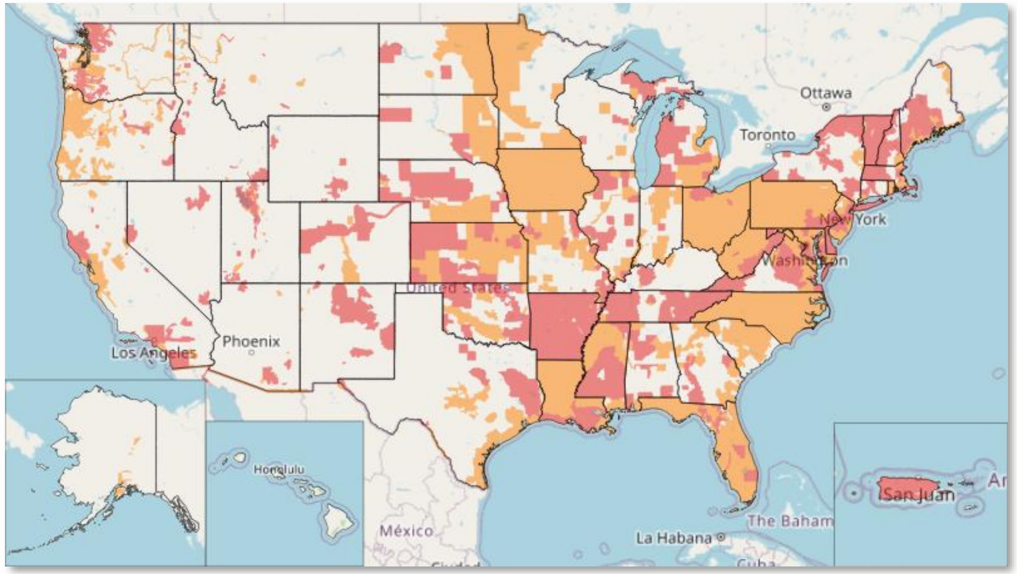
Acknowledgements: Funded by ERCD, DHS S&T, and FEMA NDSP inter-agency agreement.

Current Developments (DSS-WISE Web 4.1)

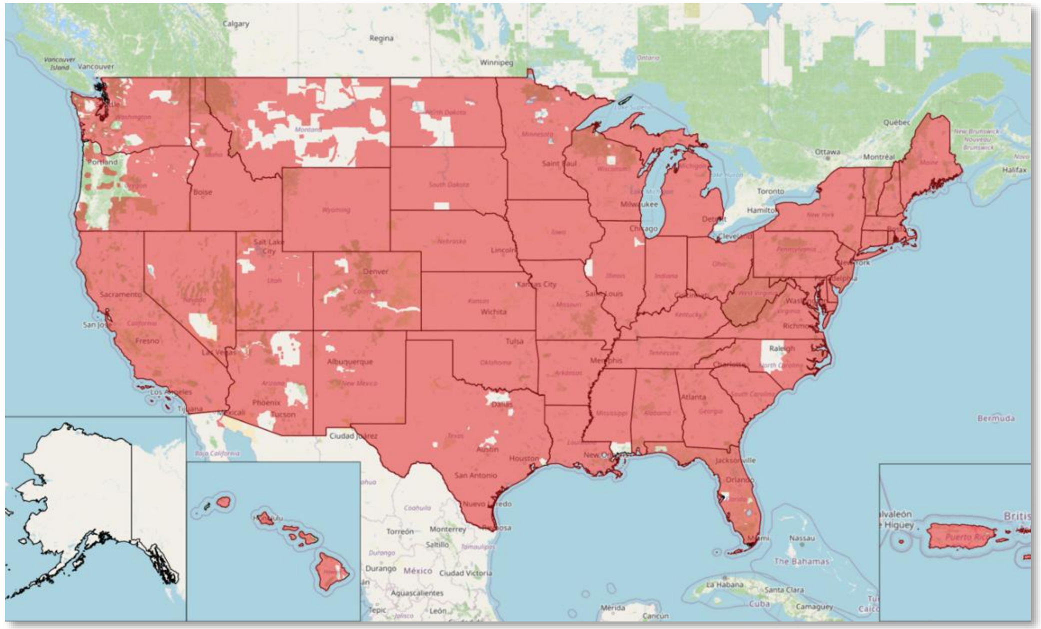
Improved USGS 3DEP Data and Processing

Develop the capability to better utilize the USGS 3D Elevation Program's (3DEP) 1-meter DEM dataset to generate the base level DEMs for simulations on the fly

Current high-resolution DEM data



Available high-resolution DEM data



Current 1m data released: **127,266** tiles totaling **30.9 TB**

- 1/9 arc-second
- 1-meter

- Newly-added 1-meter USGS 3DEP data will be processed and imported to the system on a frequent basis. As a result, groups with a 15-foot minimum cell size have been adjusted to 10 feet.
- Cloud-native data store to enable hybrid cluster integration and modular decoupling of system components

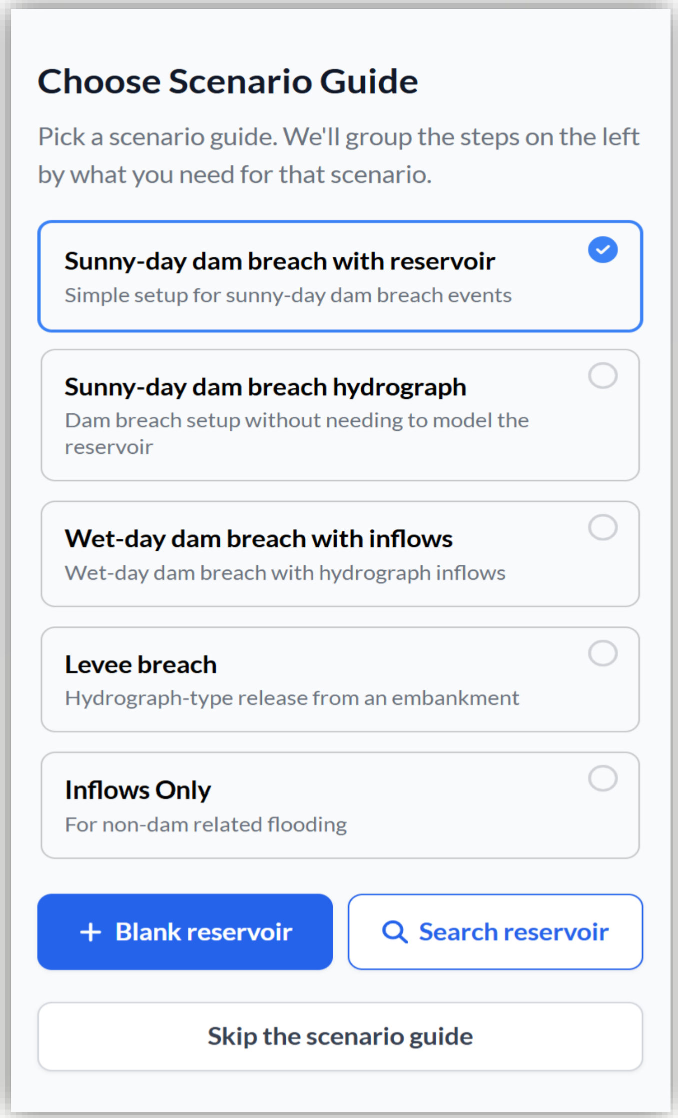
New Interface (Scenario-First Setup)

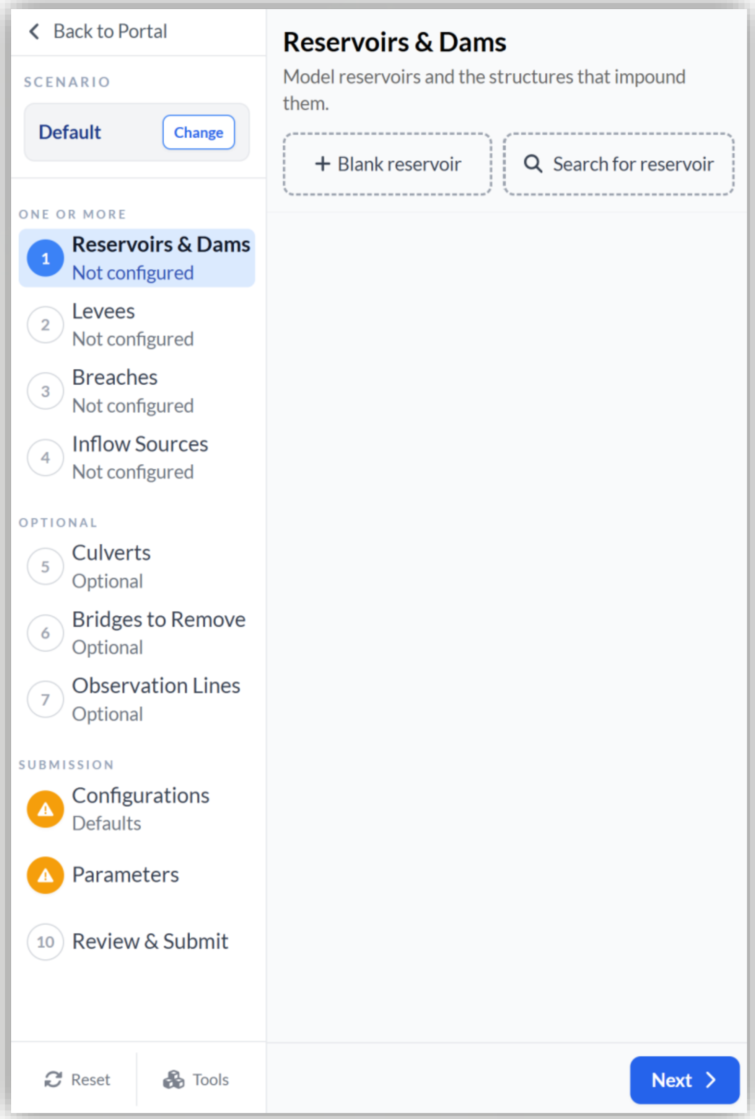
Users now **choose a scenario type** first (e.g., sunny-day dam breach, cascading failures, levee breach).

The guide then **creates defaults and orders the setup steps** for that scenario.

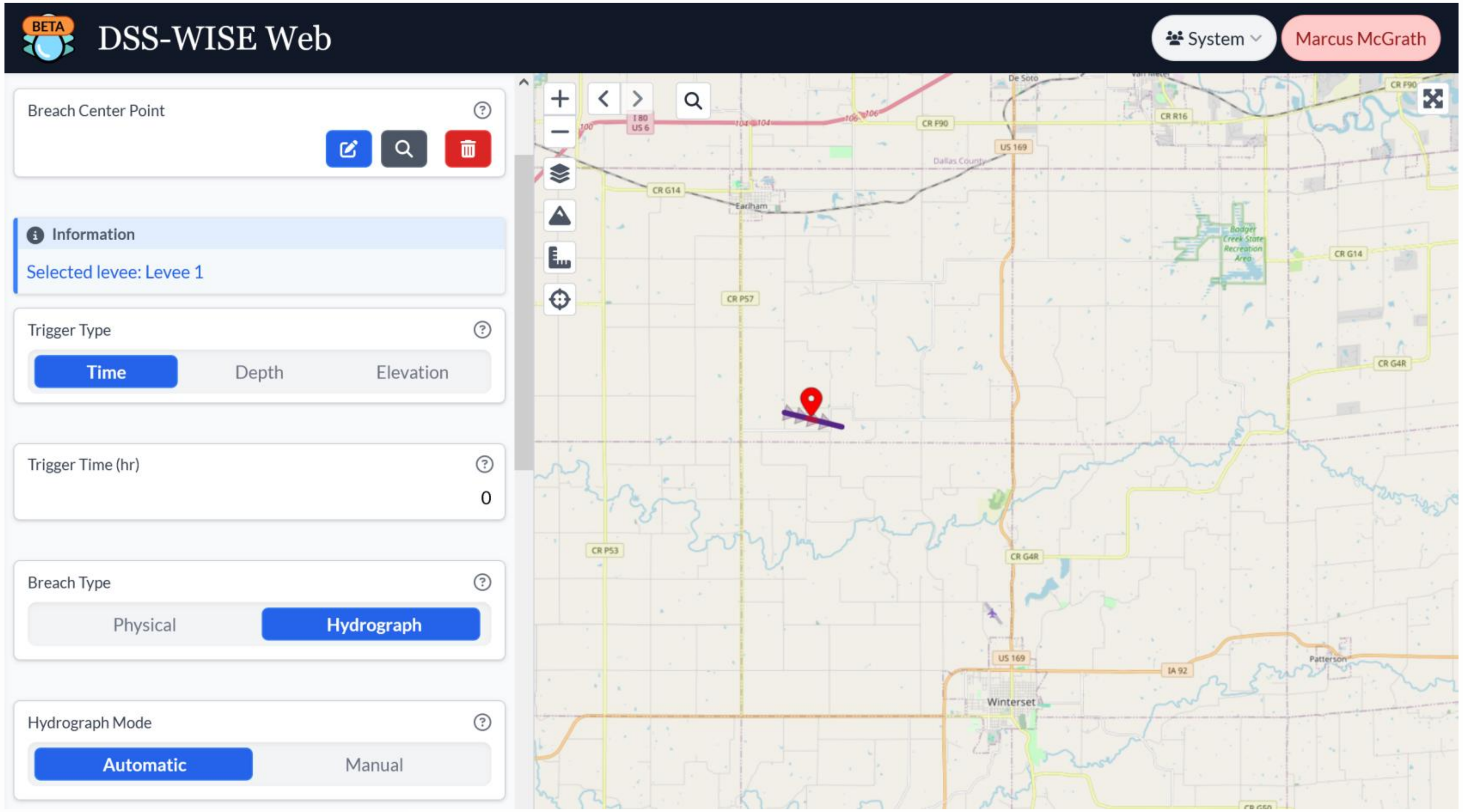
Benefits:

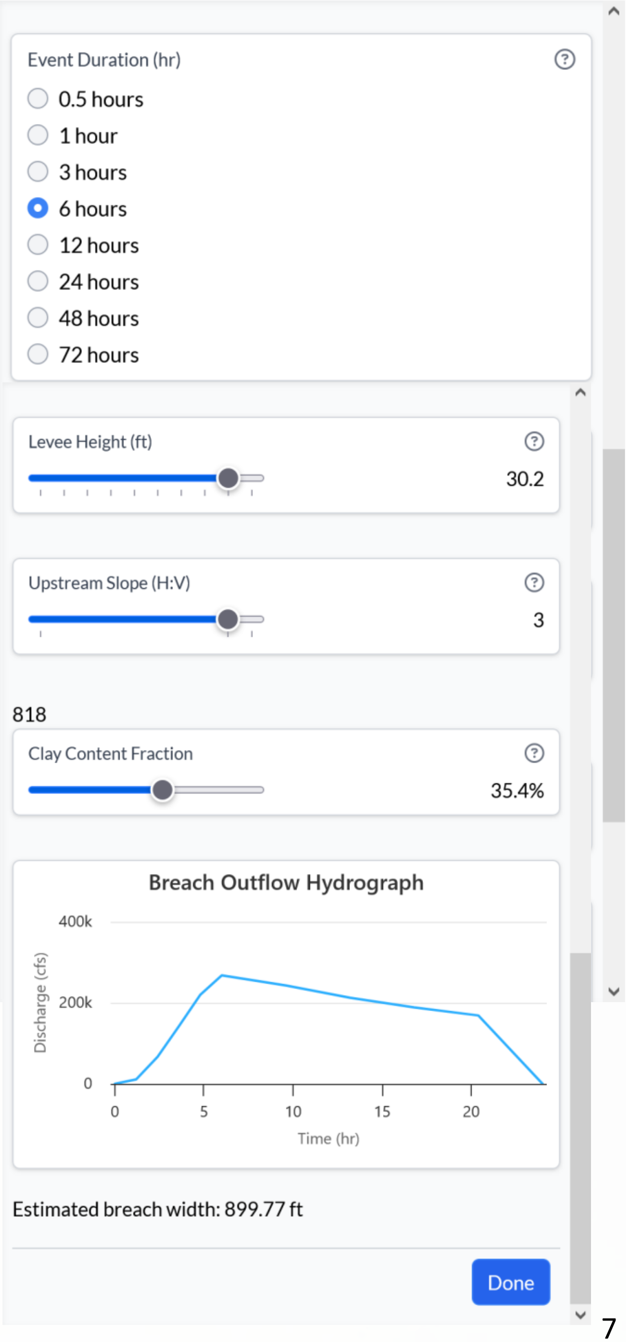
- Guided setup
- Recommended steps clearly separated from optional ones
- All steps remain available, whichever guide is chosen
- Workflows tailored to event type





Levee Breach Hydrograph Calculator





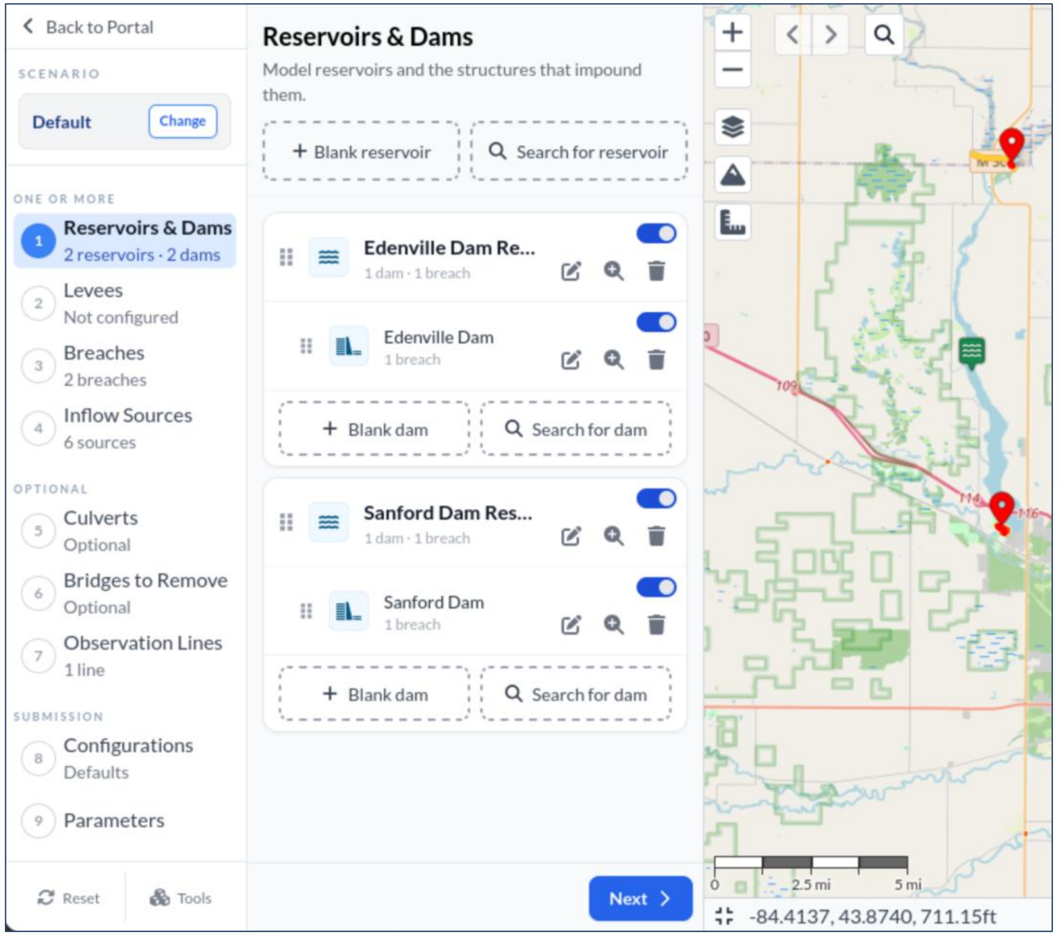
- Uses an **Artificial Neural Network (ANN)** to estimate levee breach outflow from **soil properties**, **embankment geometry**, and **flood conditions**
- Resulting hydrograph is released downstream of the selected breach location

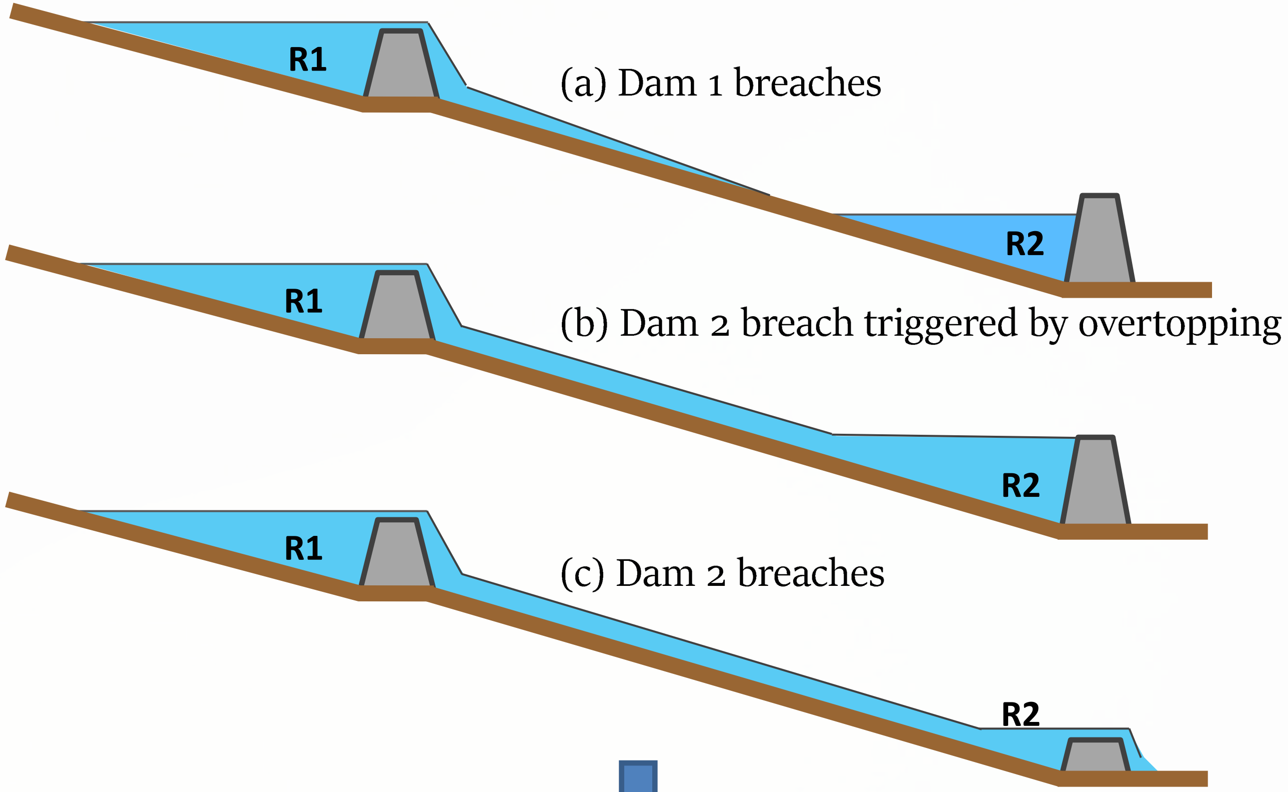
Improvements Based on User Feedback

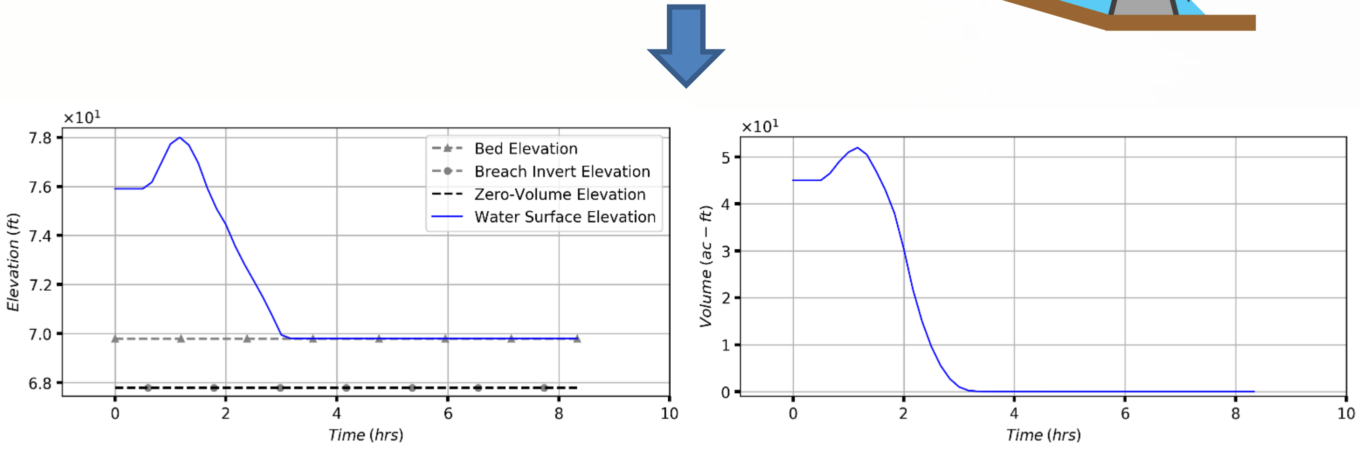
- Restored step navigation in Viewer
- Simplified Viewer Panel overview
- Layers panel can be docked
- Ability to search for a dam/reservoir and import from first step
- Made the scenario guide explicitly optional
- Made the downstream distance reference explicit and visible in simulation parameters step
- Added acquisition year overlay layer for USGS 3DEP 1-meter data

Cascading dam failures

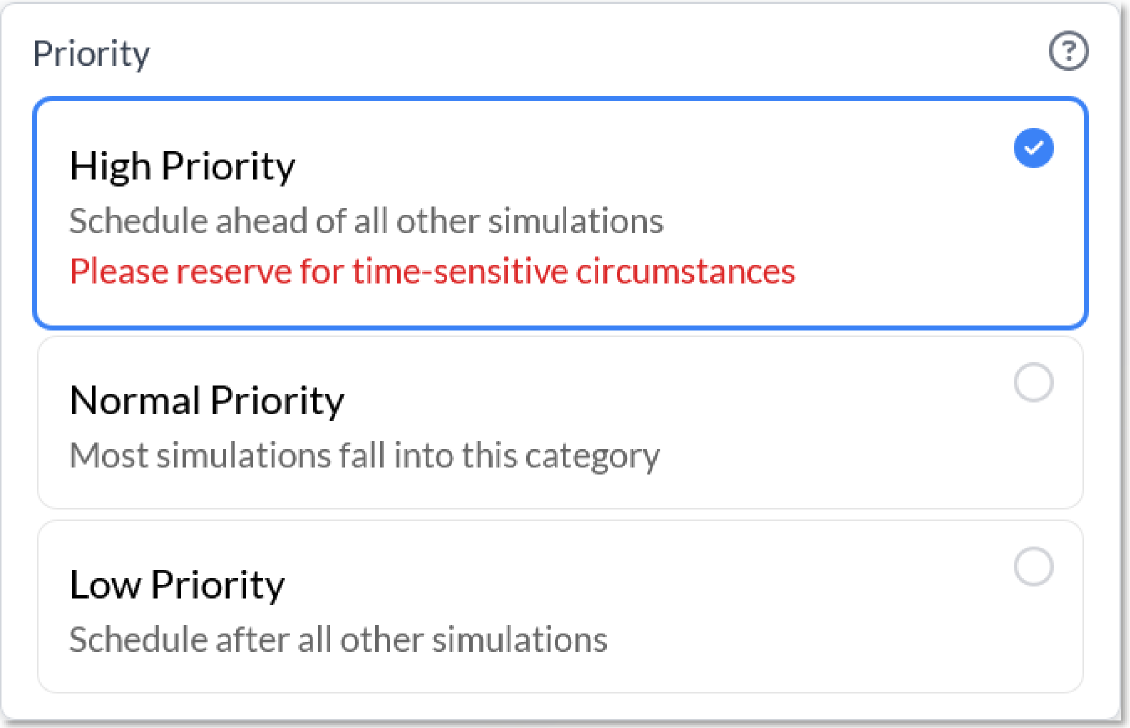
Develop the ability to model cascading dam failures







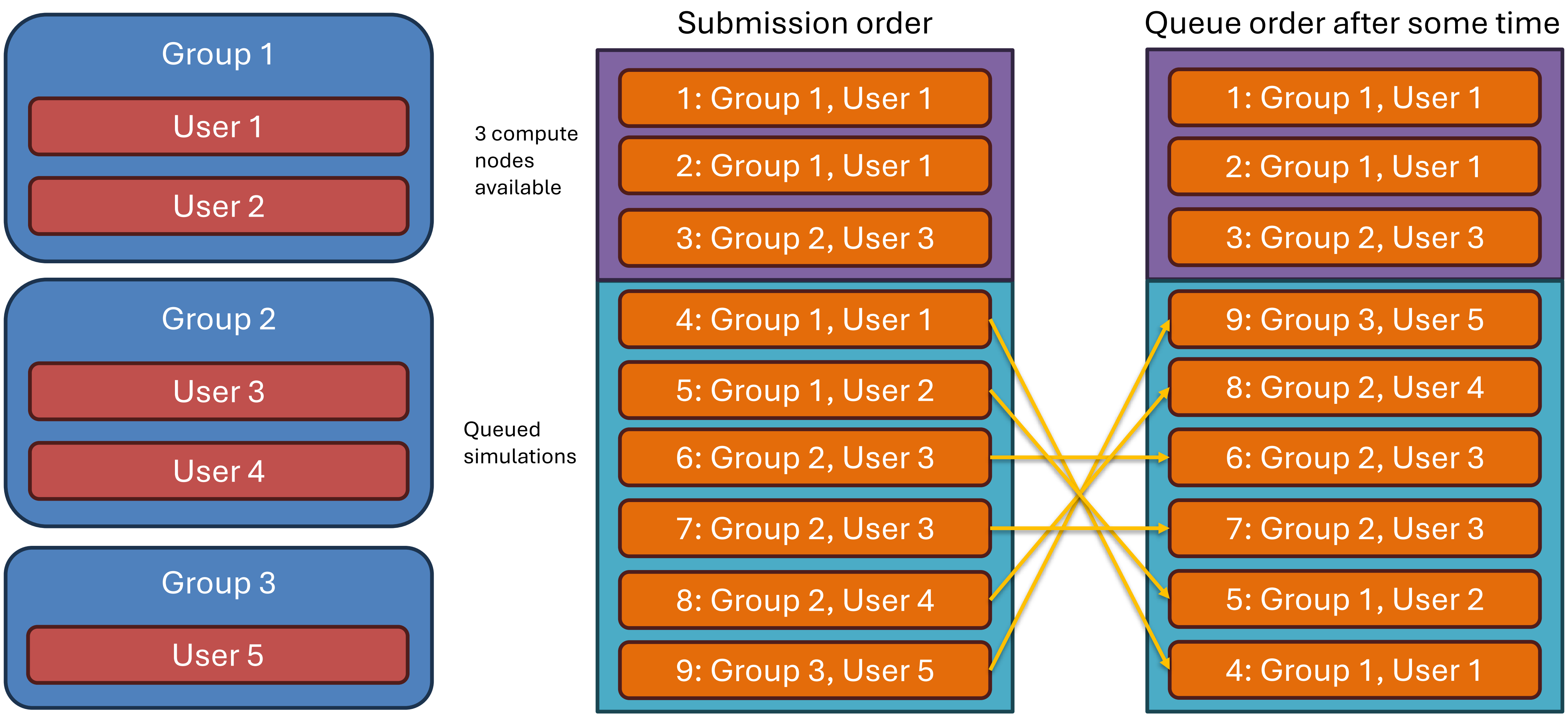
High-priority simulations



Develop the ability for privileged users to submit high-priority simulations that run in the cloud on the fastest available compute nodes

- Users will be able to request high-priority status for emergencies without requiring administrator intervention
- Simulation request is then routed to the fastest available cloud compute node

Simulation scheduling algorithm updated



Improvements to maps in simulation report product

Improve map image outputs for PDF report for increased spatial awareness and fidelity.

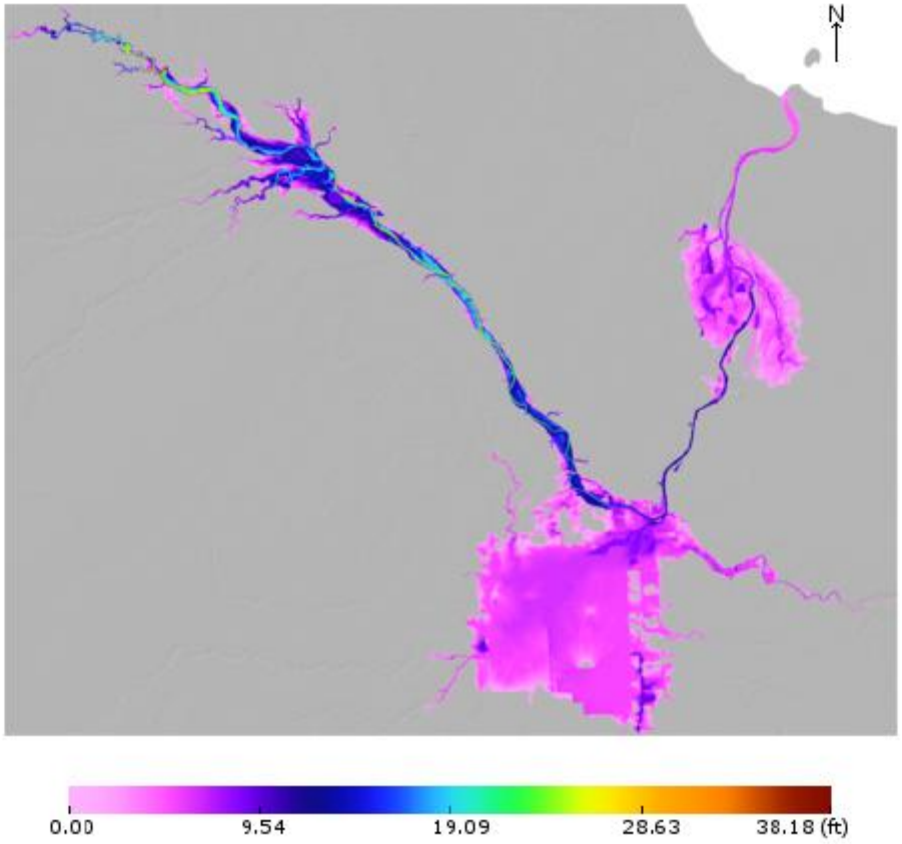
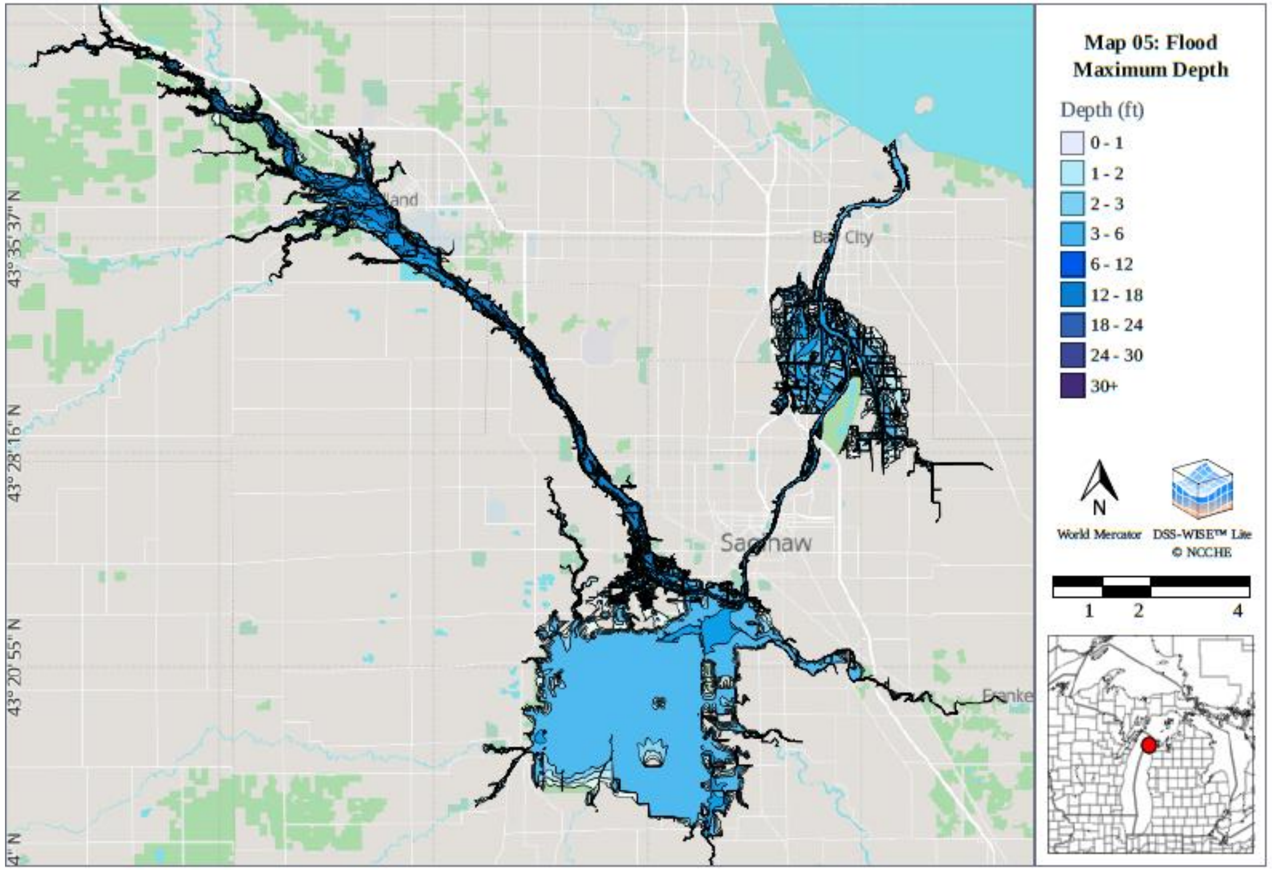


Image Dimensions: N-S: 31.791 miles E-W: 38.686 miles
Figure 5. Maximum Flood Depth Map.



Maximum Flood Depth

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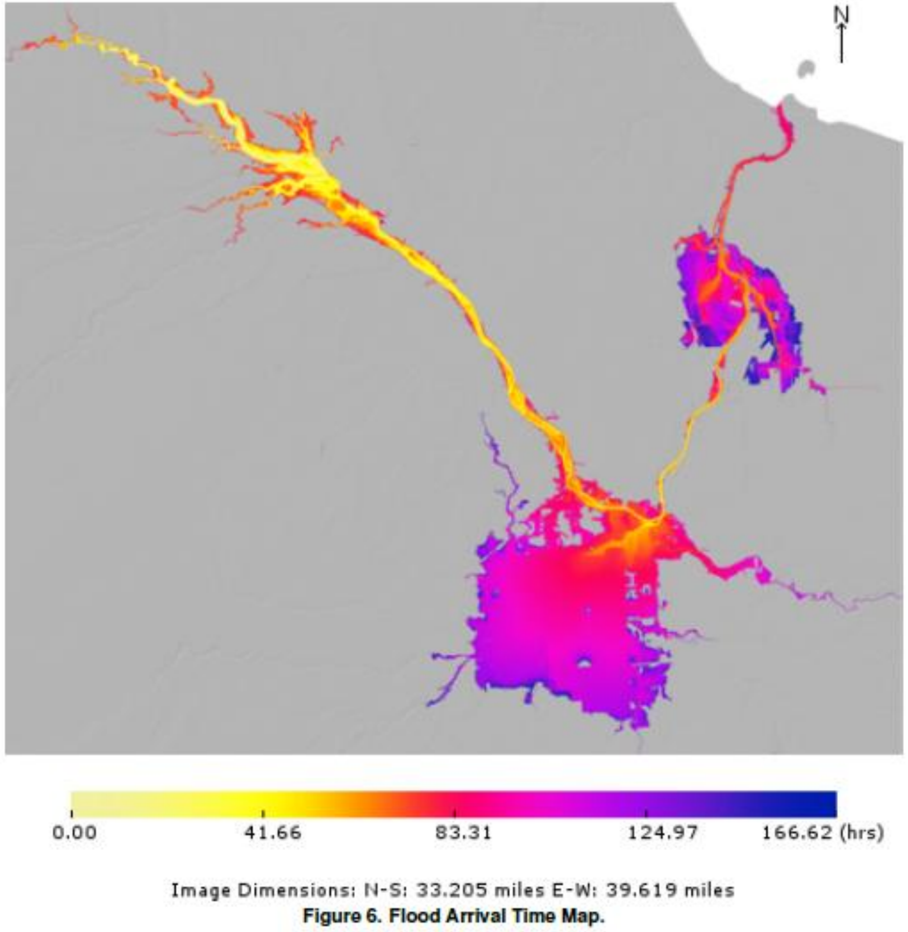
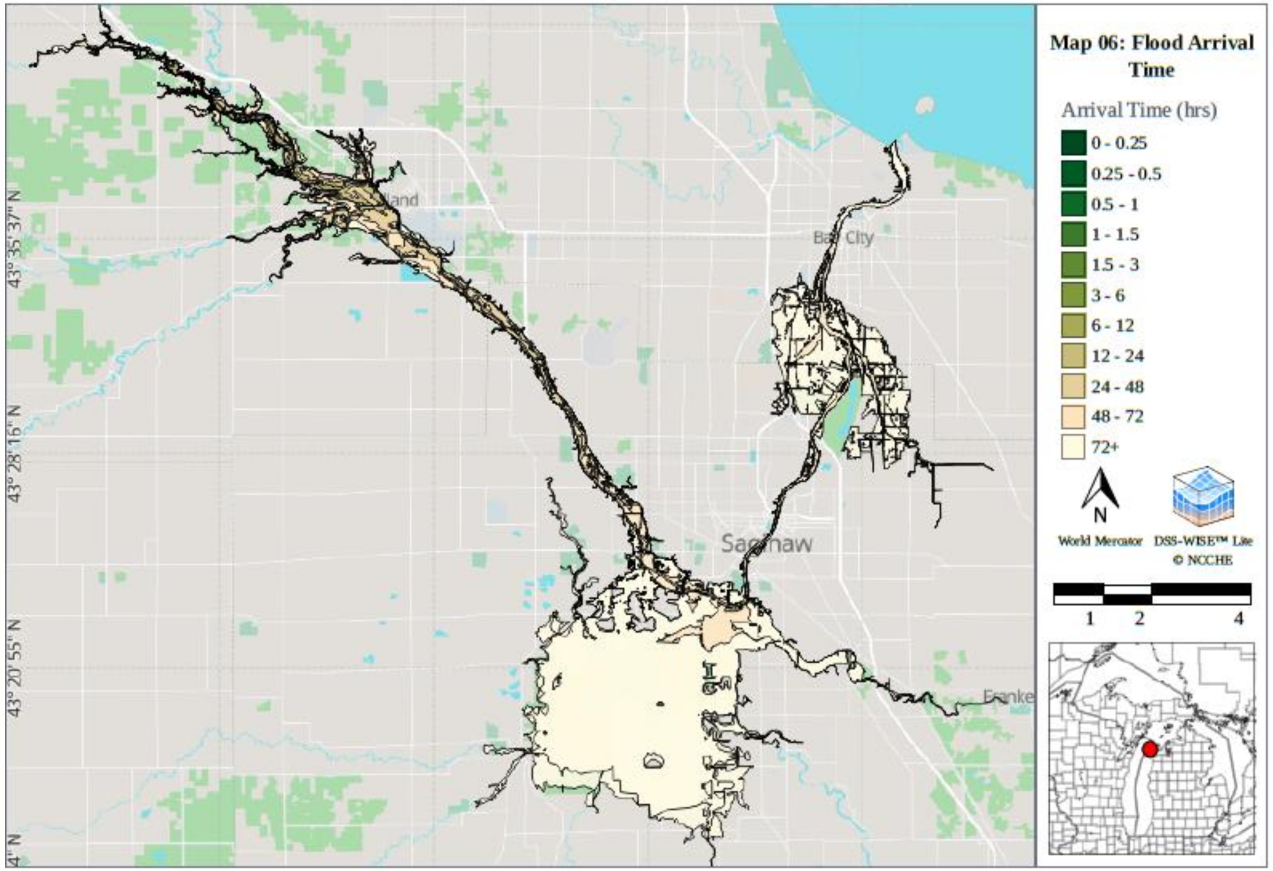
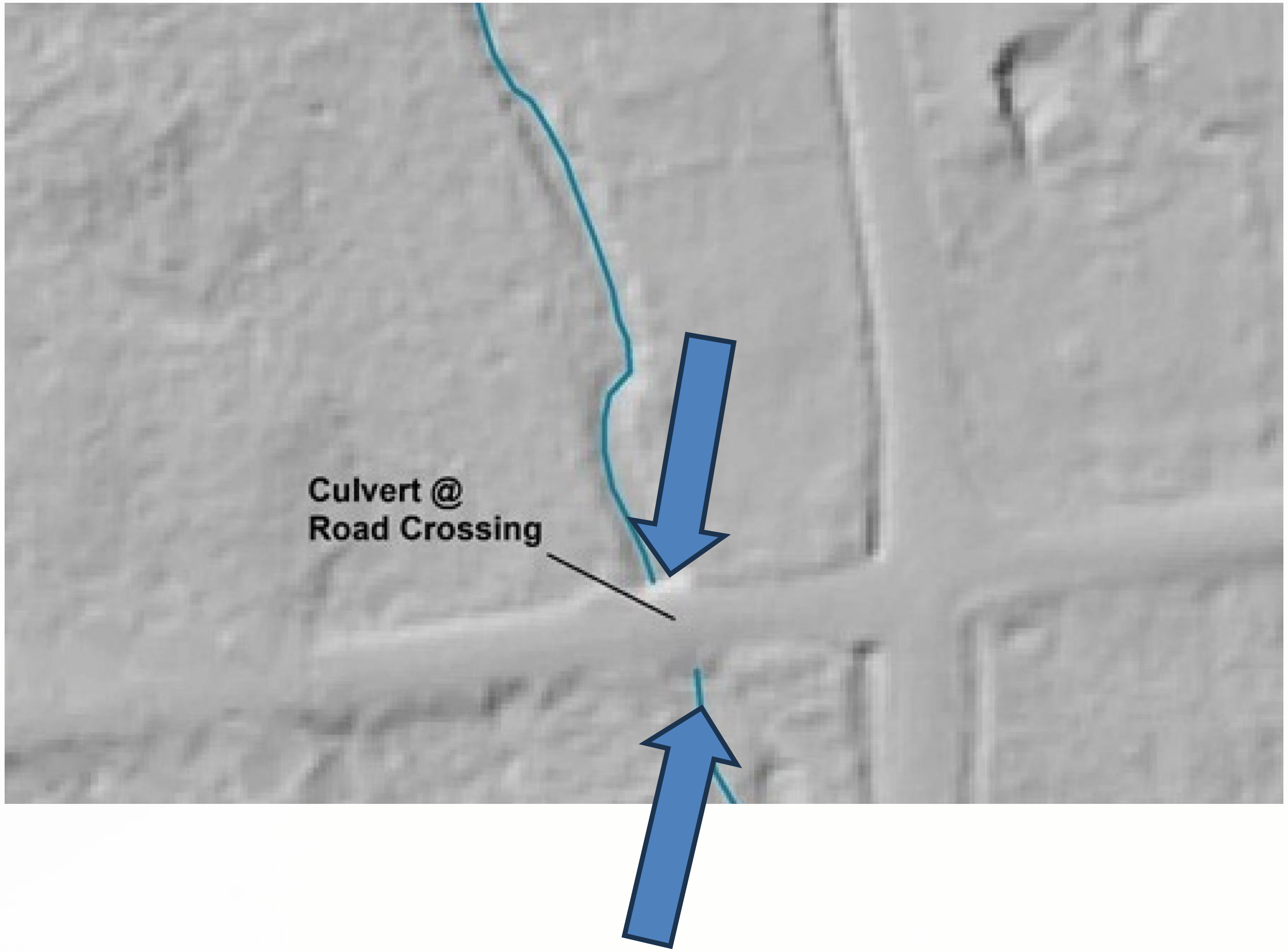




Flood Arrival Time

Modeling flow through culverts

Enhance the way simulations model culverts by using a new method.



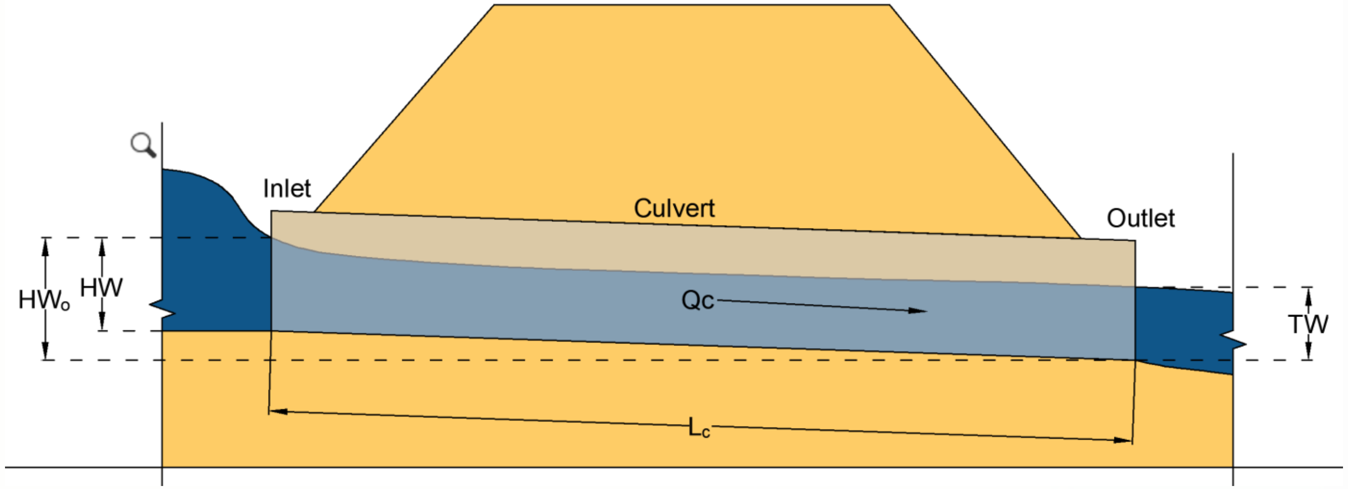
User can select upstream and downstream locations for hydraulic connectivity

Culvert parameters govern flow between the two sides

Culvert Implementation Details

Flow Inputs and Control

- Discharge is calculated from headwater (HW) and tailwater (TW) elevations.
- A rating table for discharge is developed and is bilinearly interpolated to get discharge through the culvert at each time step
- Only discharge is transferred between the source and sink; momentum is not transferred.
- Both inlet-control and outlet-control discharges are calculated, and the smaller value determines the controlling discharge.
- Inlet control occurs when the culvert barrel can convey more flow than the inlet will accept.
- Outlet control flow occurs when the culvert barrel cannot convey as much flow as the inlet opening will accept.



Culvert Implementation Details (cont.)

Inlet Control

- Calculated using the FHWA HDS-5 inlet control equations which depend on type of culvert and submergence.
- K, M, c, Y are empirical constants, which vary depending on culvert shape, materials and inlet edges (Taken from Table A.1 HDS-5).

For unsubmerged conditions:

$$\frac{HW_{unsub1}}{D} = \frac{H_c}{D} + K\left(\frac{Q}{A\sqrt{D}}\right)^M - 0.5S$$

$$\frac{HW_{unsub2}}{D} = K\left(\frac{Q}{A\sqrt{D}}\right)^M$$

For submerged conditions:

$$\frac{HW_{sub}}{D} = c\left(\frac{Q}{A\sqrt{D}}\right)^2 + Y - 0.5S$$

Outlet Control

- Evaluated using the Bernoulli energy equation.
- Partially full outlet-controlled flow is evaluated using the backward direct-step method beginning at the downstream end and working backward toward the culvert inlet.

$$HW_o + \frac{v_{inlet}^2}{2g} = TW + H_{Loss}$$

User Inputs for Culverts

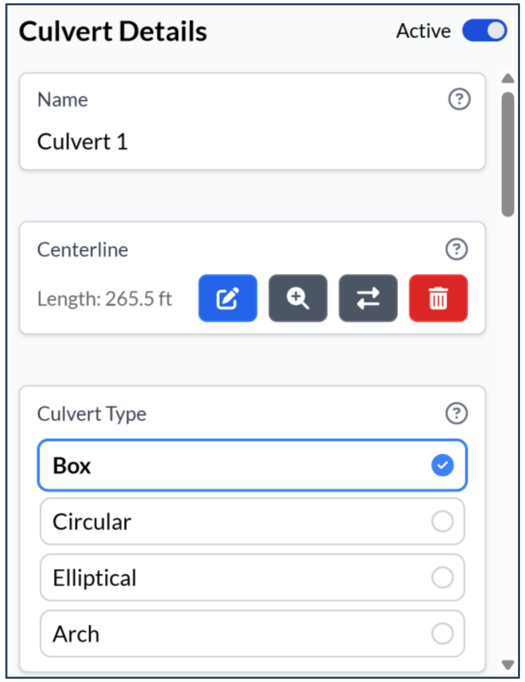
- The users have two sets of inputs, mandatory and advanced inputs
- The advanced parameters are set to default values (based on the mandatory parameters) unless changed by toggling advanced mode

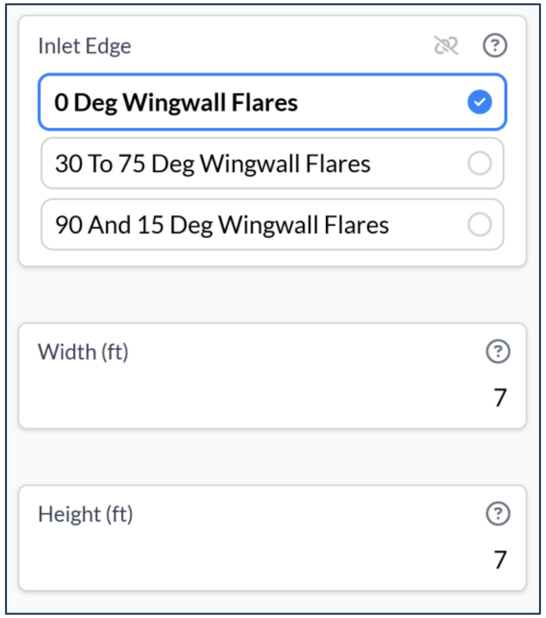
Mandatory Parameters

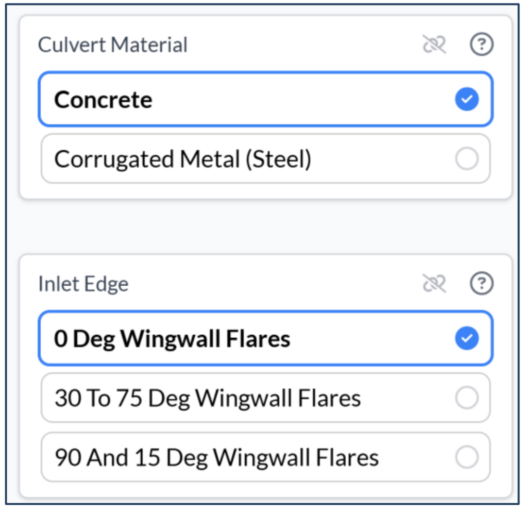
- Centerline drawn on map
- Type of culvert (Box, Circular, Elliptical, or Arch)
- Culvert dimensions
- Culvert Material (Concrete, Steel, or Plastic)
- Inlet Edge (Depends on culvert type and material)

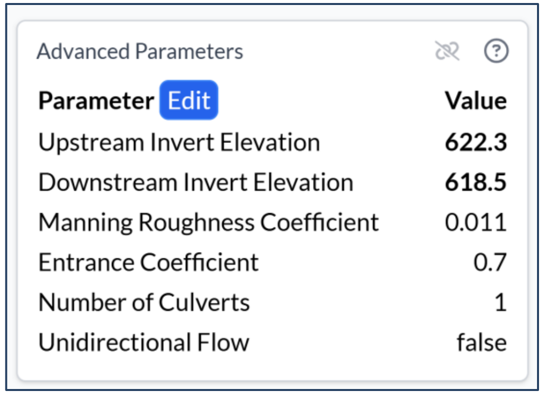
Advanced Parameters

- Upstream and Downstream invert elevations (Based on centerline and the DEM)
- Manning's Roughness Coefficient (Based on culvert material)
- Entrance Coefficient (Based on Inlet Edge)
- Number of Culverts (Default = 1)
- Unidirectional Flow (Default = False)



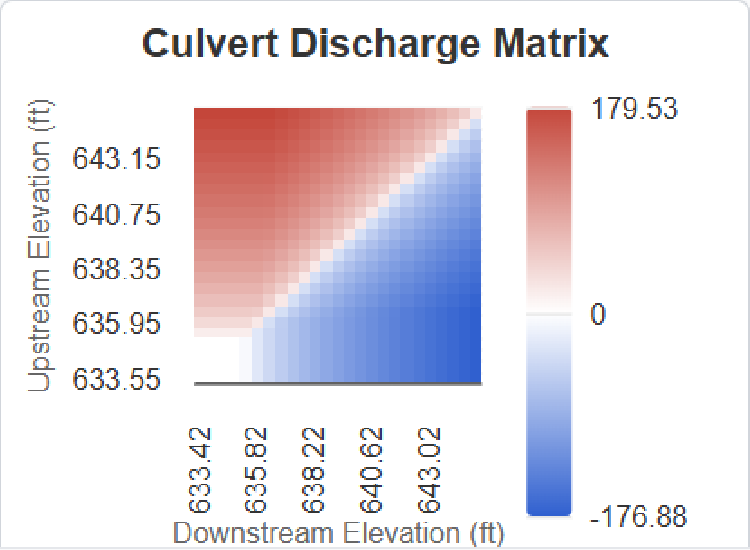


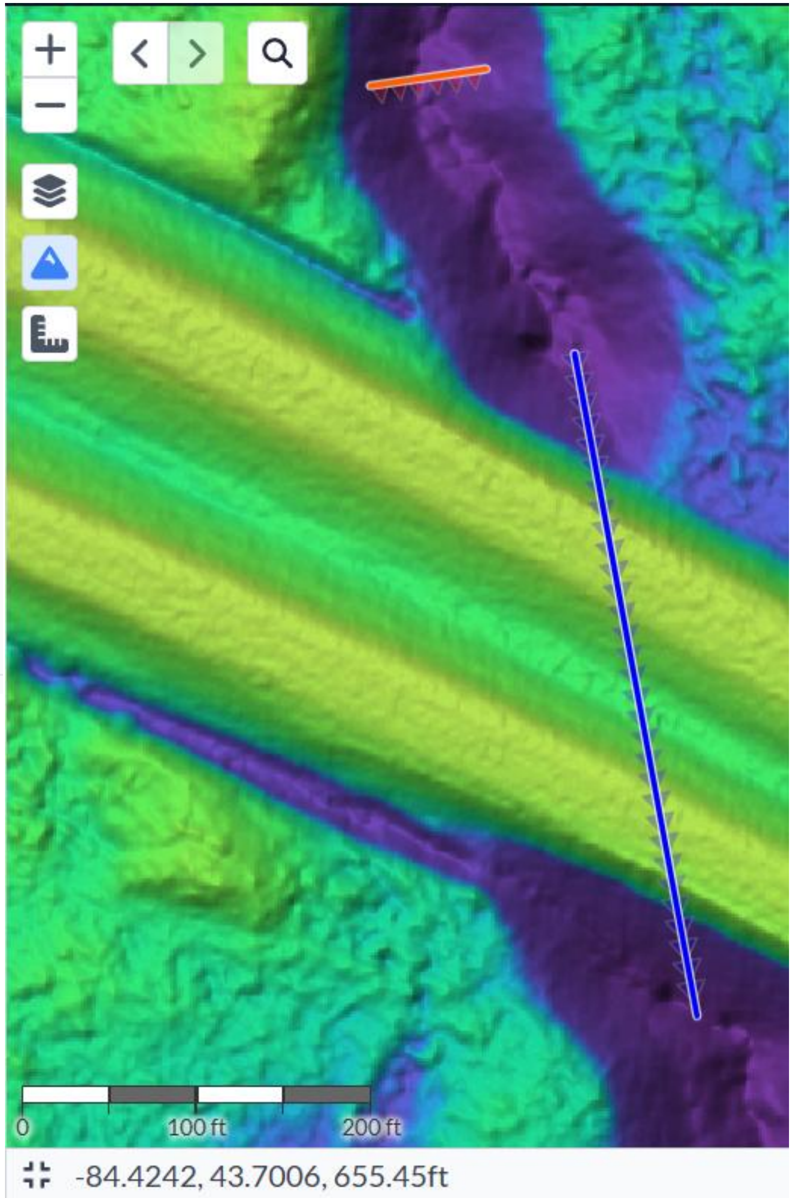




User Inputs for Culverts (cont.)

- Once all mandatory parameters are entered, the system automatically generates a culvert discharge matrix.
- The discharge matrix updates in real time, adjusting instantly whenever the user modifies any of the input values.
- The discharge through the culvert is reported as a time series graph to the user.





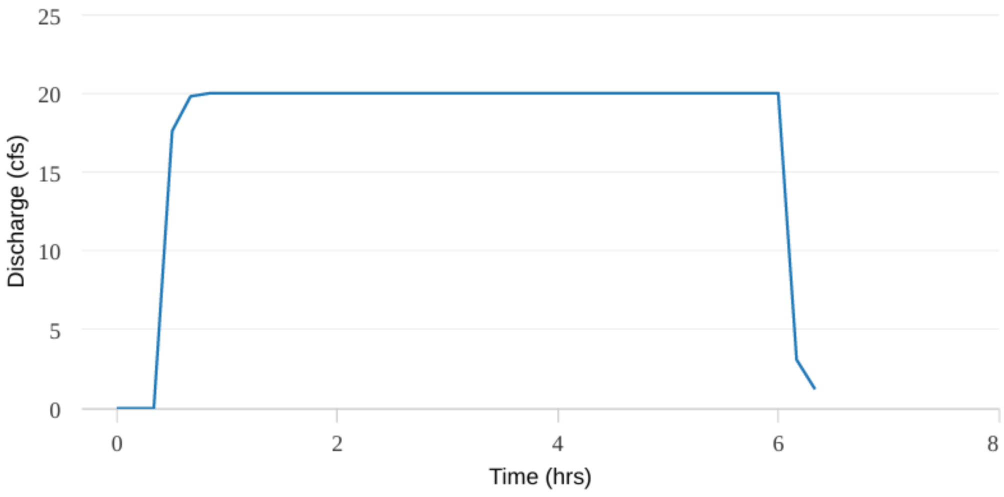
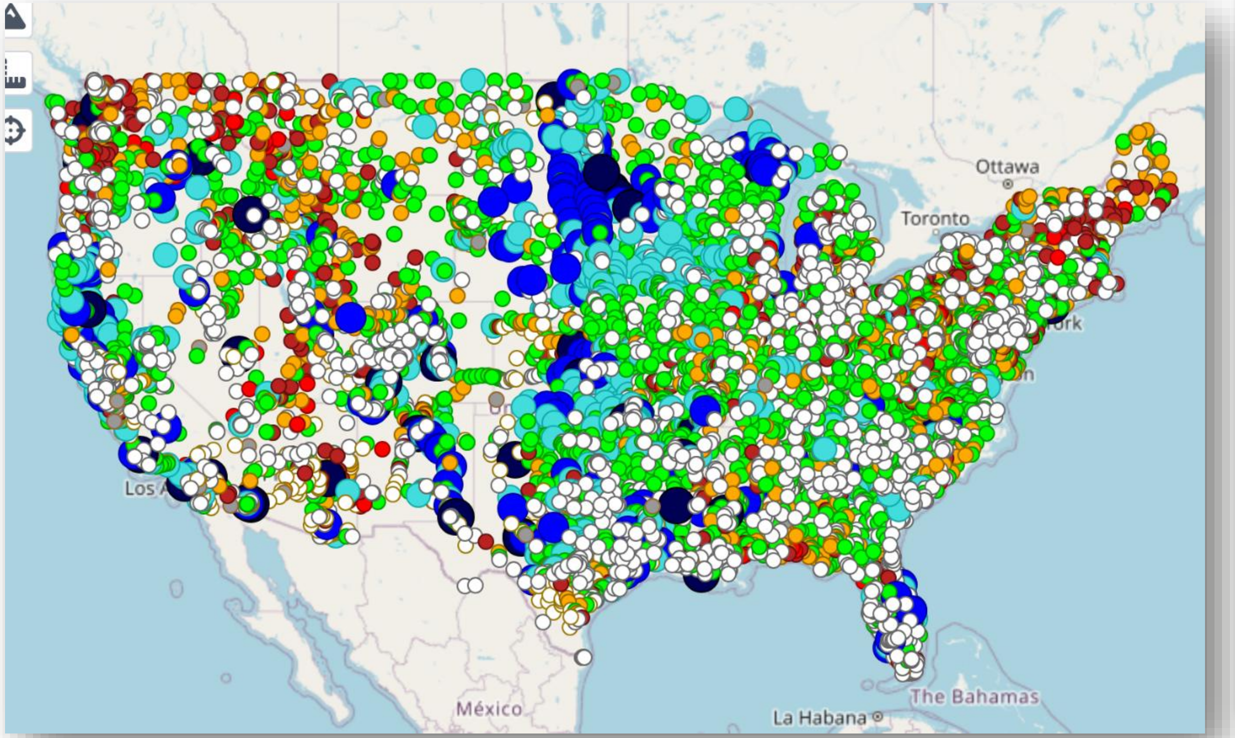
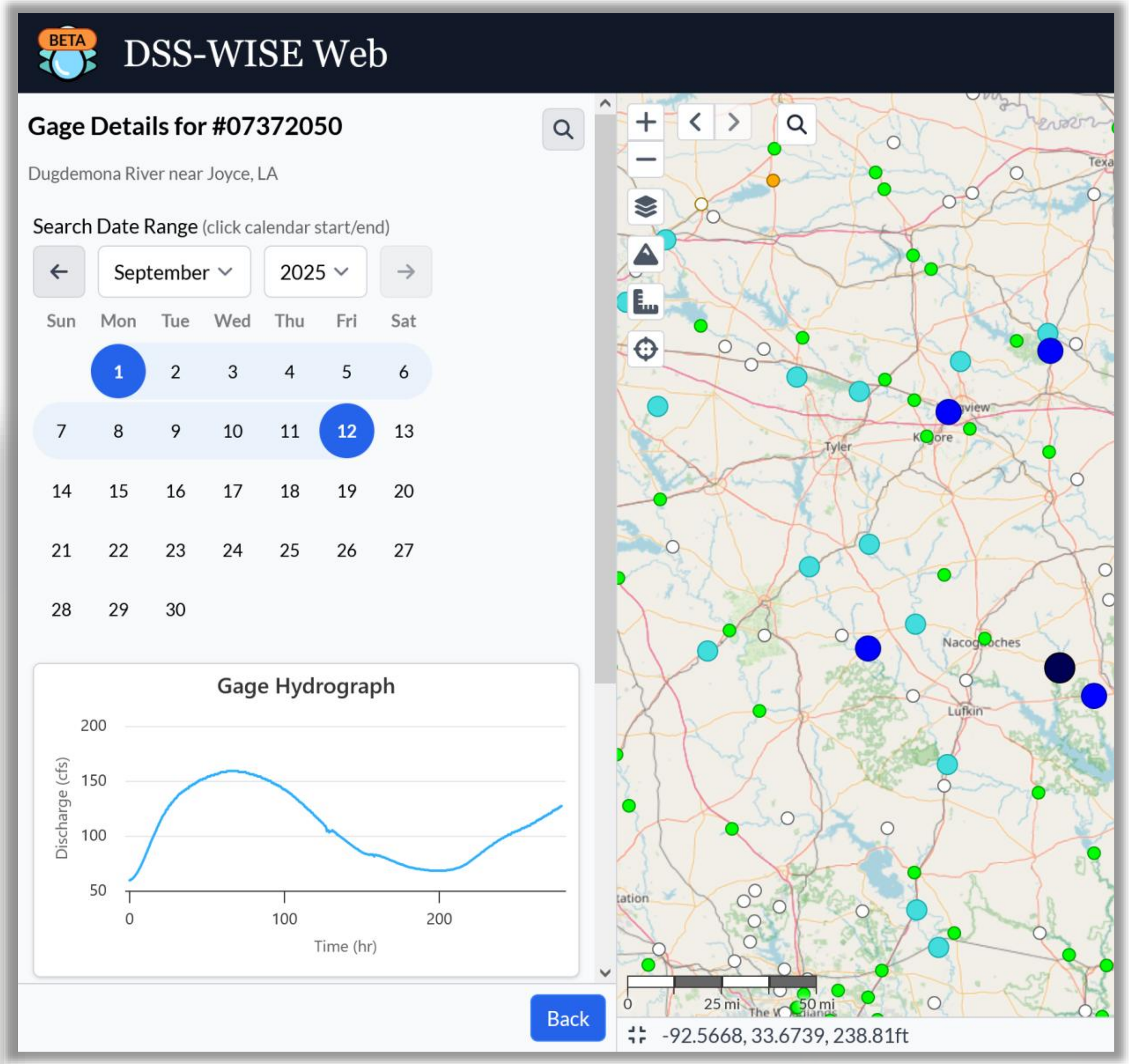


Figure 6: Discharge through culvert: Culvert 1

Inflow hydrographs & USGS stream gage integration

Develop the capability for users to automatically import this USGS stream gage data for use in their simulations instead of having to obtain it manually.





search for the stream gage

view and select a window of time for historical discharge data

import it as a new inflow hydrograph

Active Developments (DSS-WISE Web 4.2)

Potential Loss of Life Module

PLL Introduction and Background

The potential loss of life module is a new feature integrated into the Decision Support System for DSS-WISE web platform.

The purpose of this module is to assist dam safety professionals and emergency managers in assessing the human consequences of dam failure scenarios.

The inclusion of PLL extends the capabilities of DSS-WISE by directly estimating the potential loss of human life resulting from a flood event.

Background:

The methodology behind the PLL module is based on the Reclamation Consequence Estimating Methodology, which was developed through analysis of numerous historical dam-break and extreme flooding events.

The RCEM approach recognizes three key factors influencing life loss:

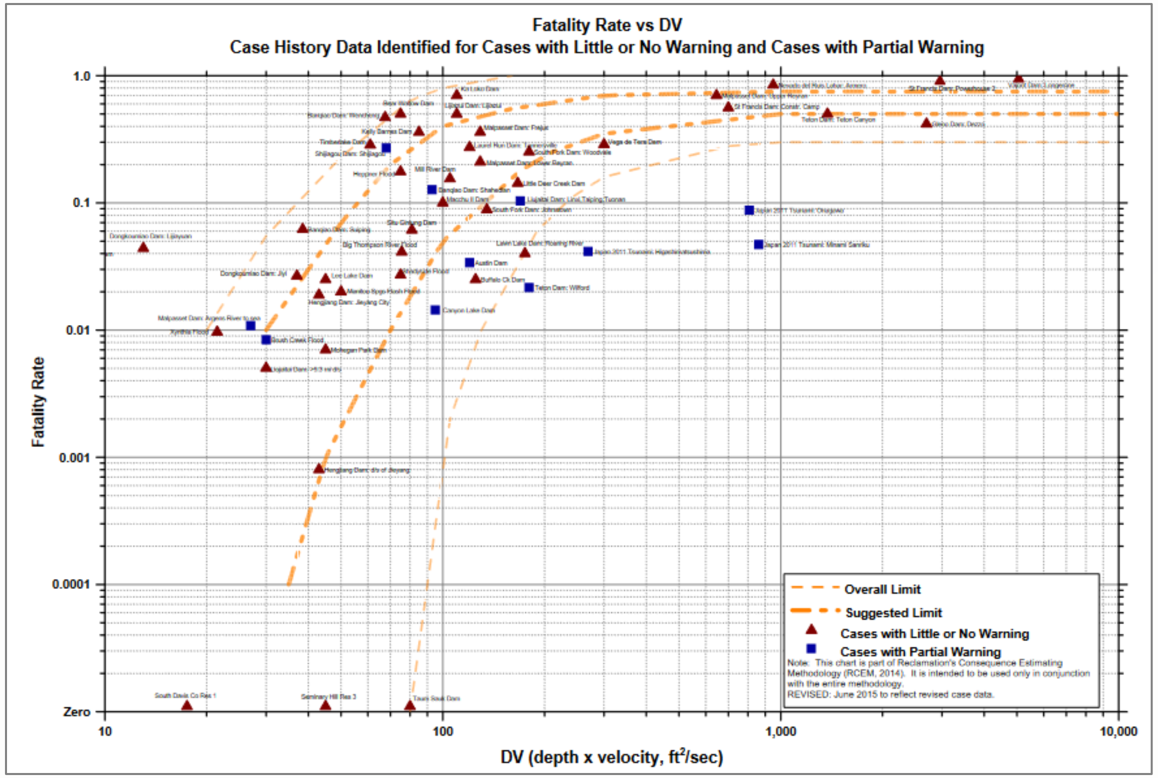
- Flood severity
- Warning time
- Degree of Community understanding

Using these factors RCEM developed two empirical charts for selecting fatality rates:

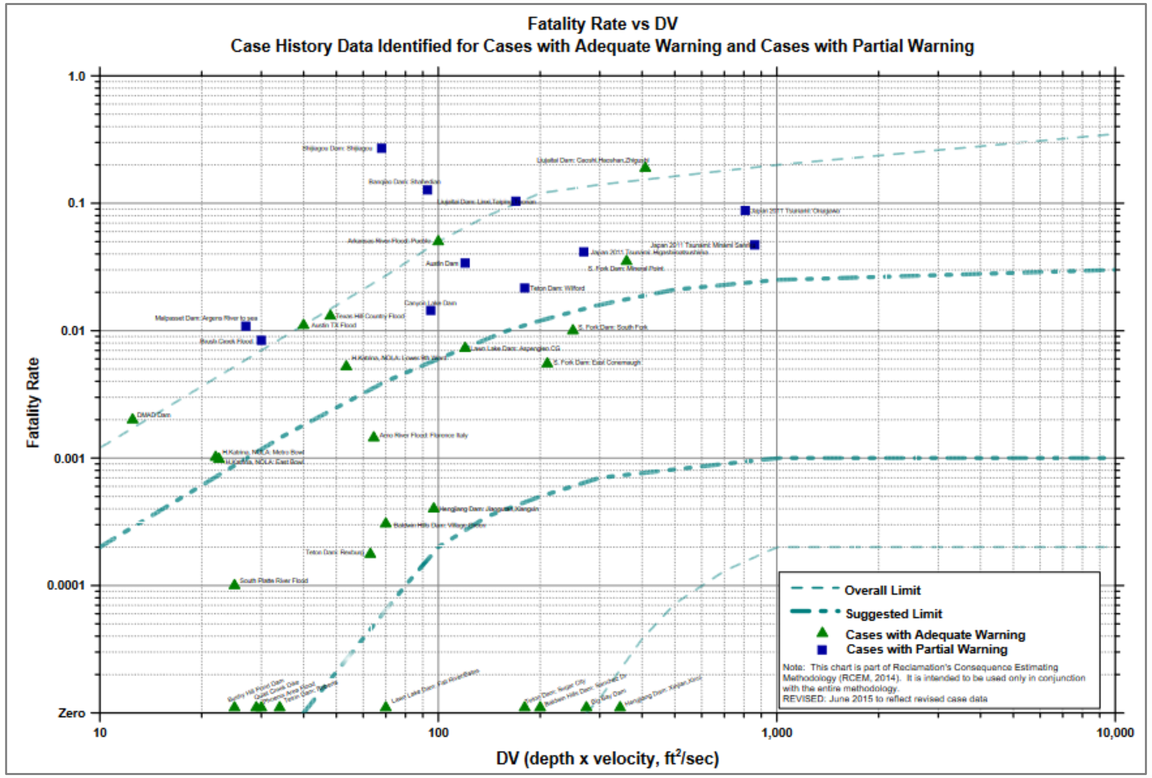
- Fatality Rate versus Depth-Velocity for little to no warning
- Fatality rate versus Depth-Velocity for adequate warning

RCEM Fatality Rate Curves

Fatality Rate vs DV
(Little or No Warning and Partial Warning)



Fatality Rate vs DV
(Adequate Warning and Partial Warning)



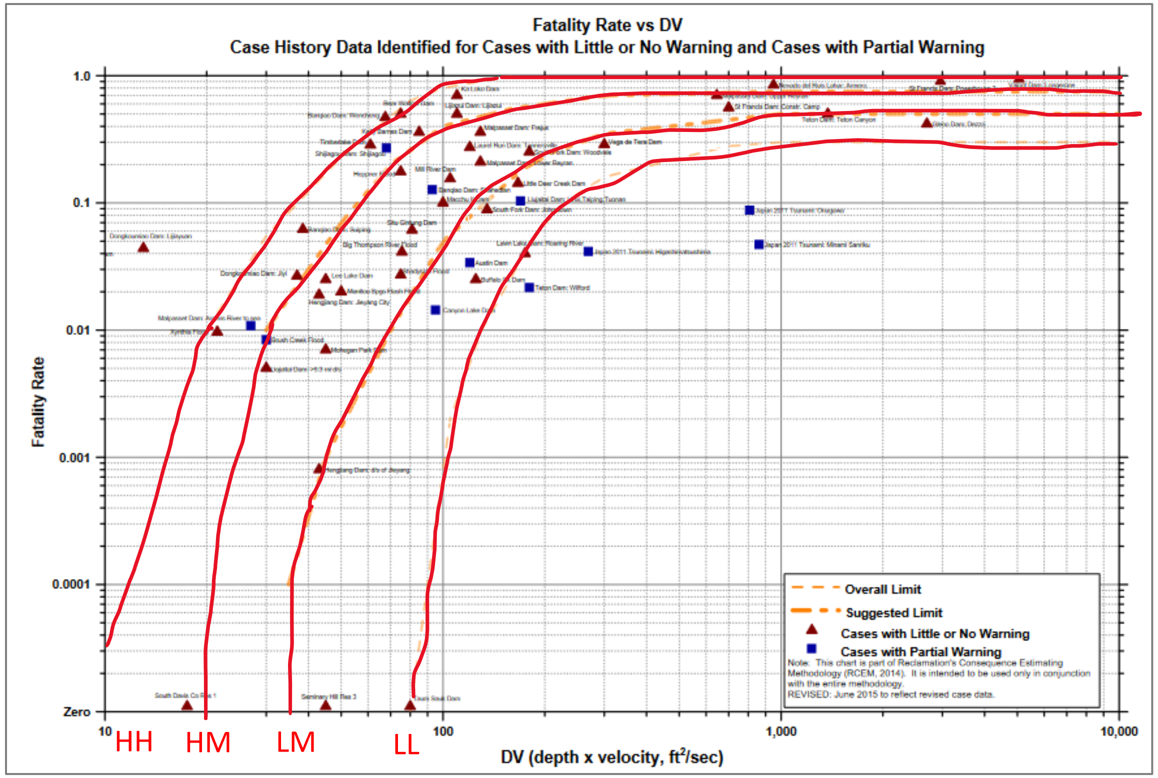
- USBR (2015) methodology
- Users will receive a range of estimated fatality rate and potential Loss of Life (LOL) information for a variety of severity and warning times

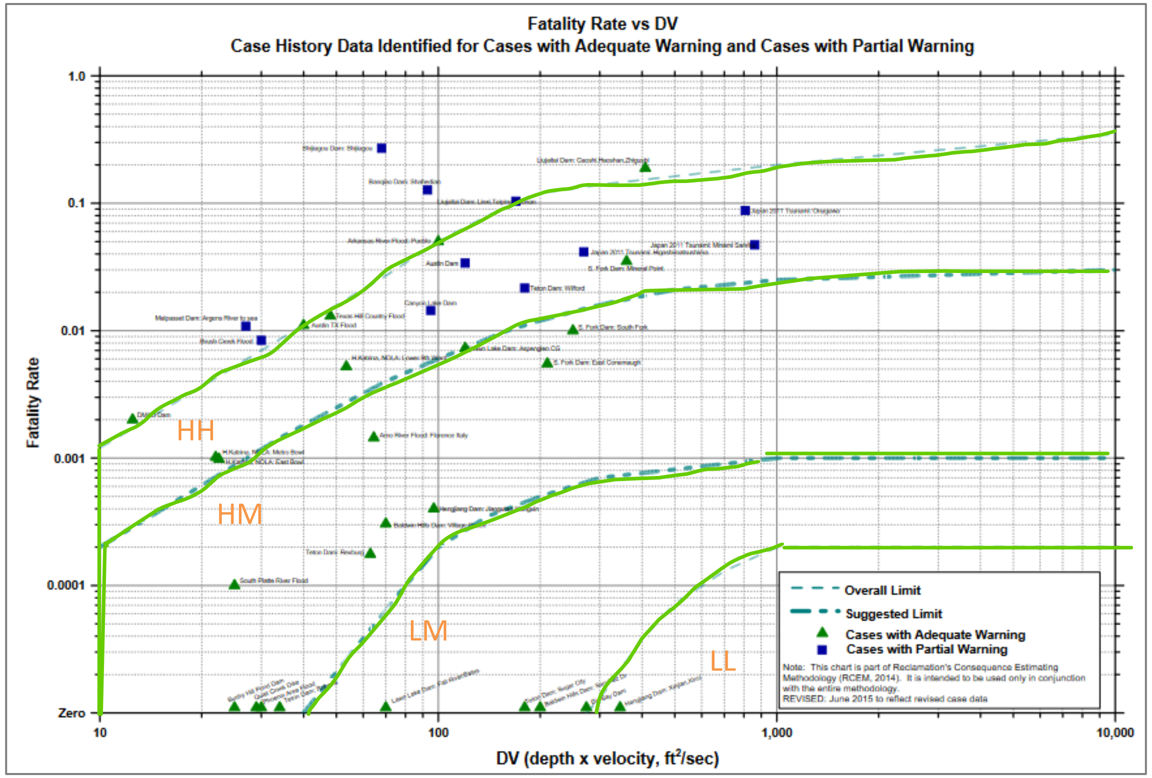
PLL Methodology

In our implementation, the fatality rate boundaries identified in the RCEM were refined into four severity ranges:

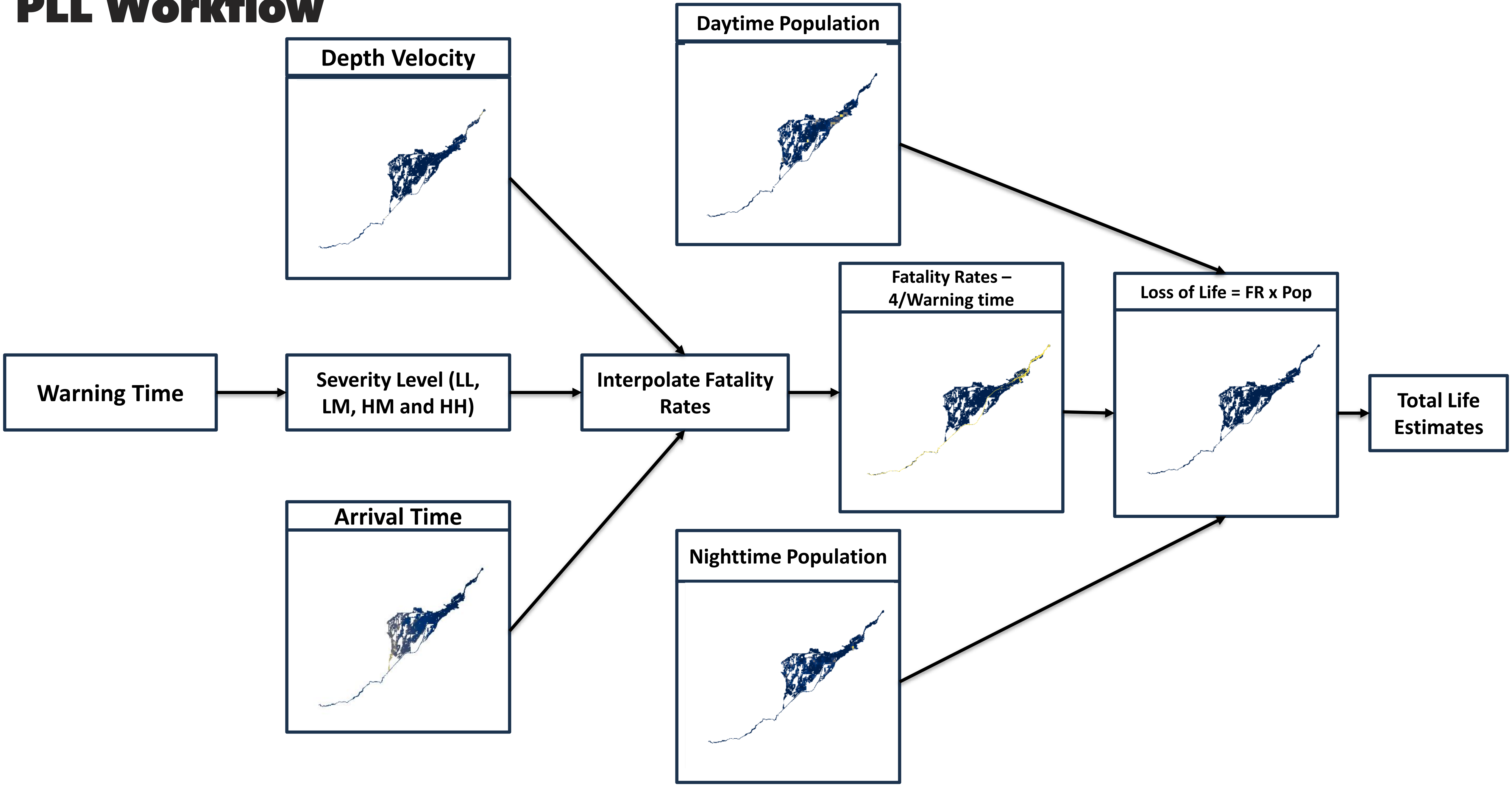
– Low-Low (LL) severity, Low-Medium (LM) severity, High-Medium (HM) severity, High-High (HH) severity

For each of these ranges, depth-velocity thresholds were determined, and corresponding fatality rate curves were defined separately for both Little to no Warning and Adequate Warning cases.





PLL Workflow



PLL Analysis Outputs

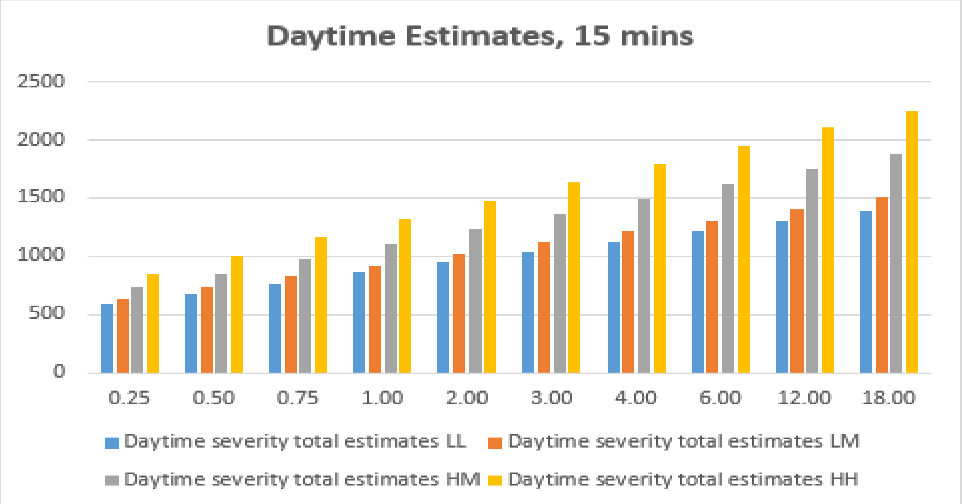
The output to the user is a comprehensive set of loss of life estimates for the given flood scenario. The results are provided in a tabular and report formats, enabling dam safety officials and emergency planners to quickly review the sensitivity of loss of life estimates.

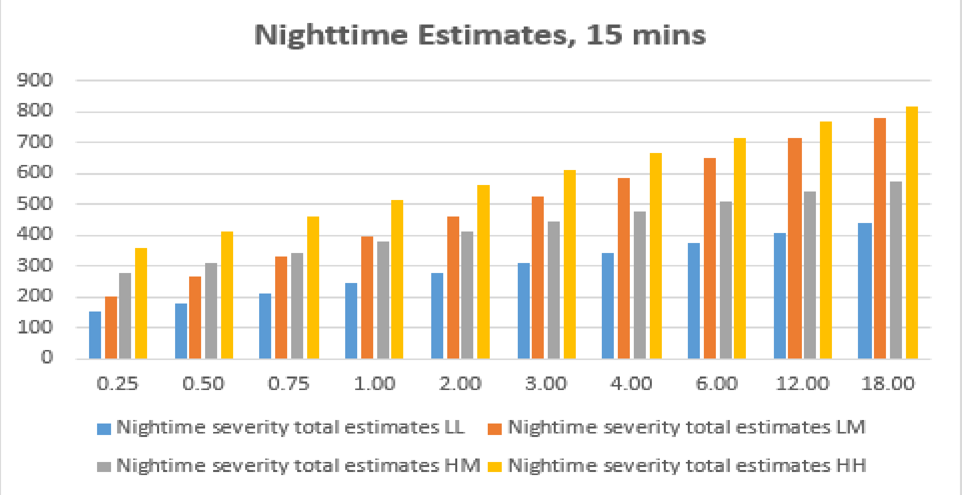
Example: PLL estimates for warning time = 15 mins

PLL Estimates for Warning time = 15 mins

Flood Time (Hrs)	Daytime severity total estimates LL	LM	HM	HH
0.25	591	634	727	845
0.50	680	731	855	1002
0.75	769	828	983	1159
1.00	858	925	1111	1316
2.00	947	1022	1239	1473
3.00	1036	1119	1367	1630
4.00	1125	1216	1495	1787
6.00	1214	1313	1623	1944
12.00	1303	1410	1751	2101
18.00	1392	1507	1879	2258

Flood Time (Hrs)	Nightime severity total estimates LL	LM	HM	HH
0.25	150	203	278	359
0.50	182	267	311	410
0.75	214	331	344	461
1.00	246	395	377	512
2.00	278	459	410	563
3.00	310	523	443	614
4.00	342	587	476	665
6.00	374	651	509	716
12.00	406	715	542	767
18.00	438	779	575	818

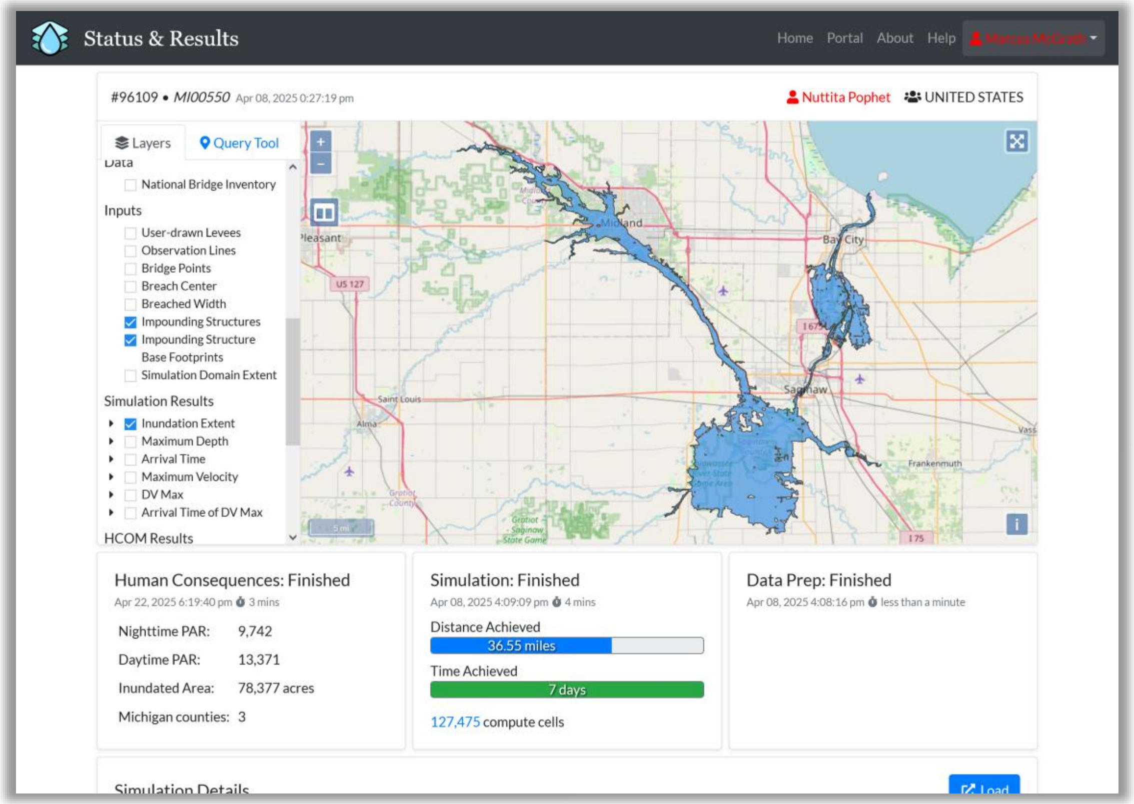




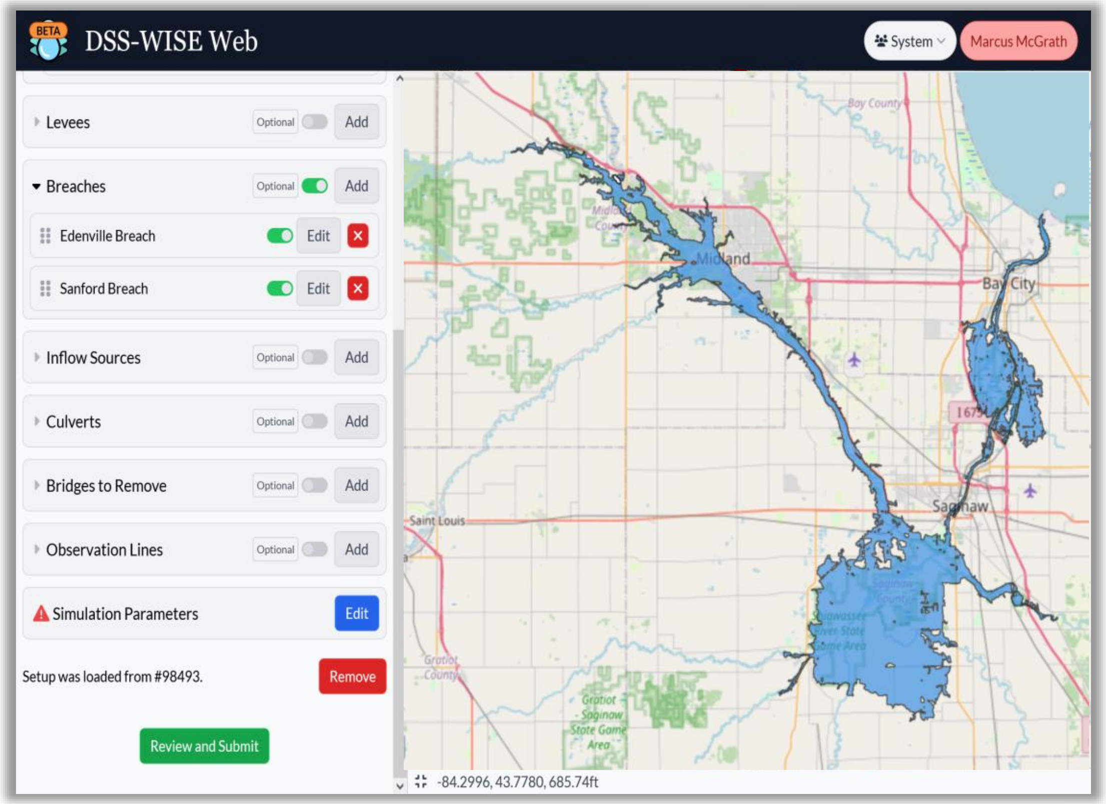
Load past simulation results on Viewer

Develop the ability for a user to load the results of a previous simulation on the Viewer during setup.

Status & Results Page



DSS-WISE Web Viewer

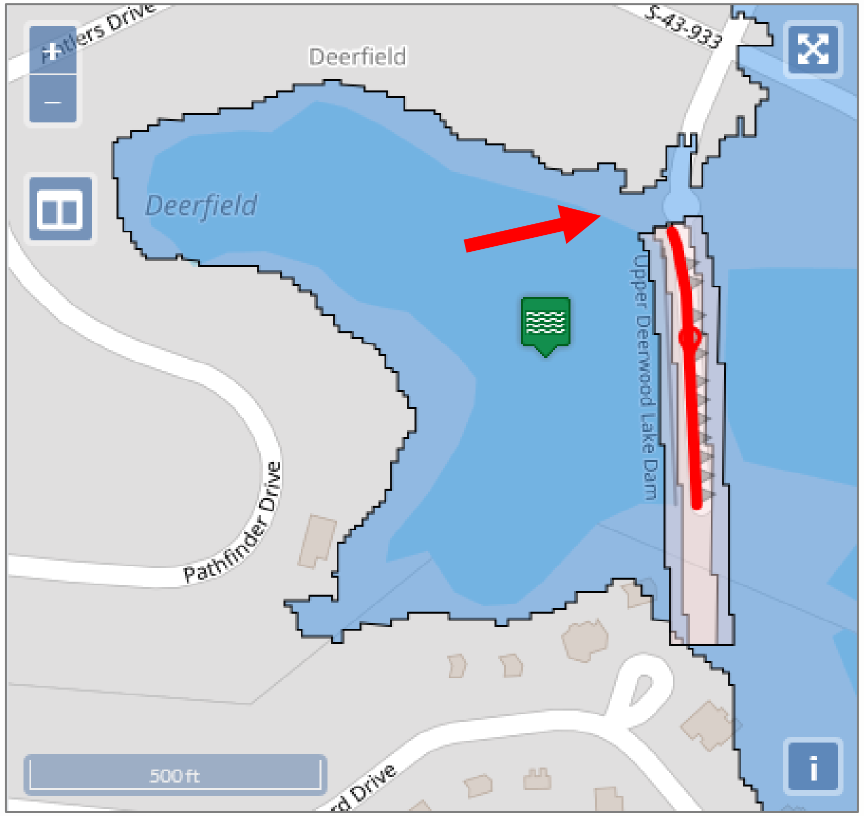


- Results/errors from previous simulations will be visible during setup
- Empowers users to extract the most value from their simulation results
- Reduces user frustration
- Improves user awareness/understanding of the model

Load past simulation results on Viewer

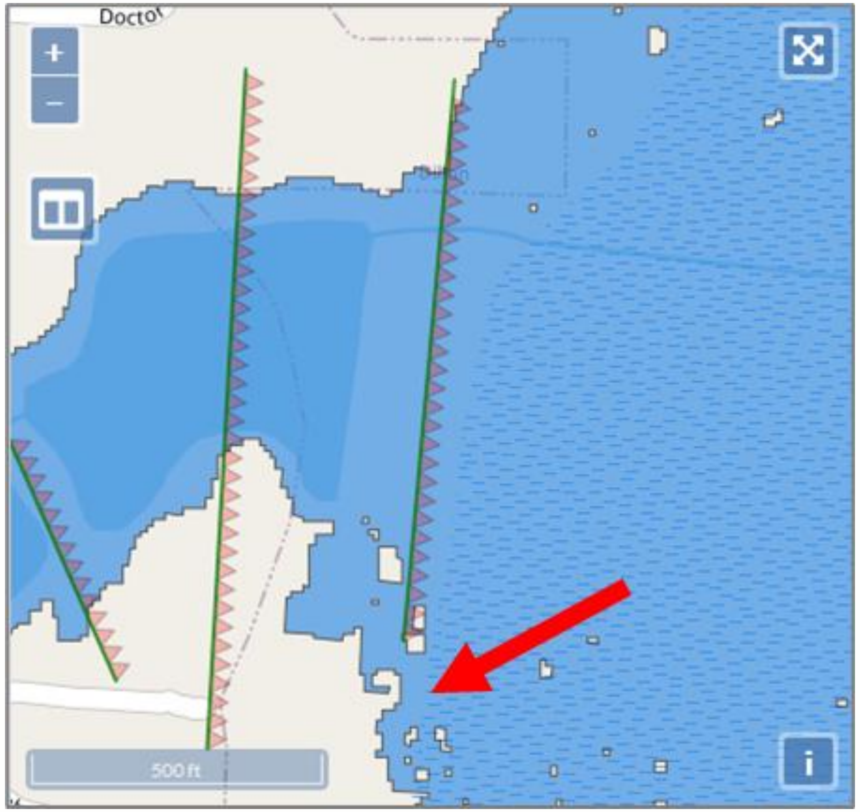
Examples of how previous results guide setup in the Viewer.

Extend the dam to fully contain the reservoir



Flood extent shows where water escapes, guiding dam extension.

Extend the observation line to capture the full flood cross-section



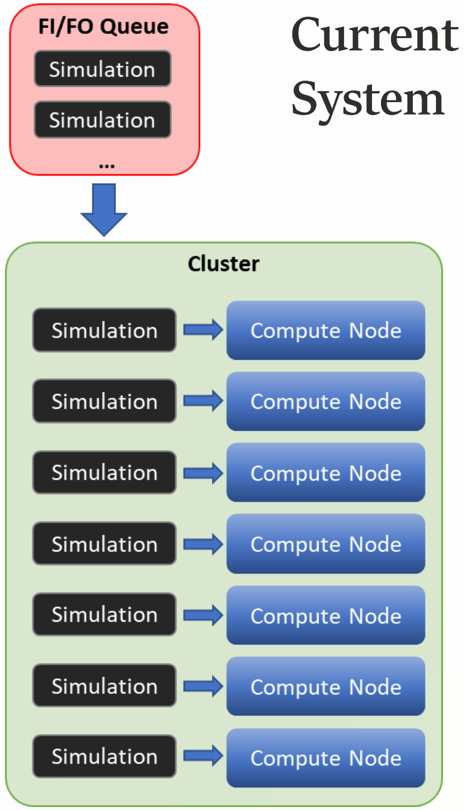
Flood extent highlights where coverage is incomplete, guiding line adjustment.

Hybrid cloud compute capability

current and future systems

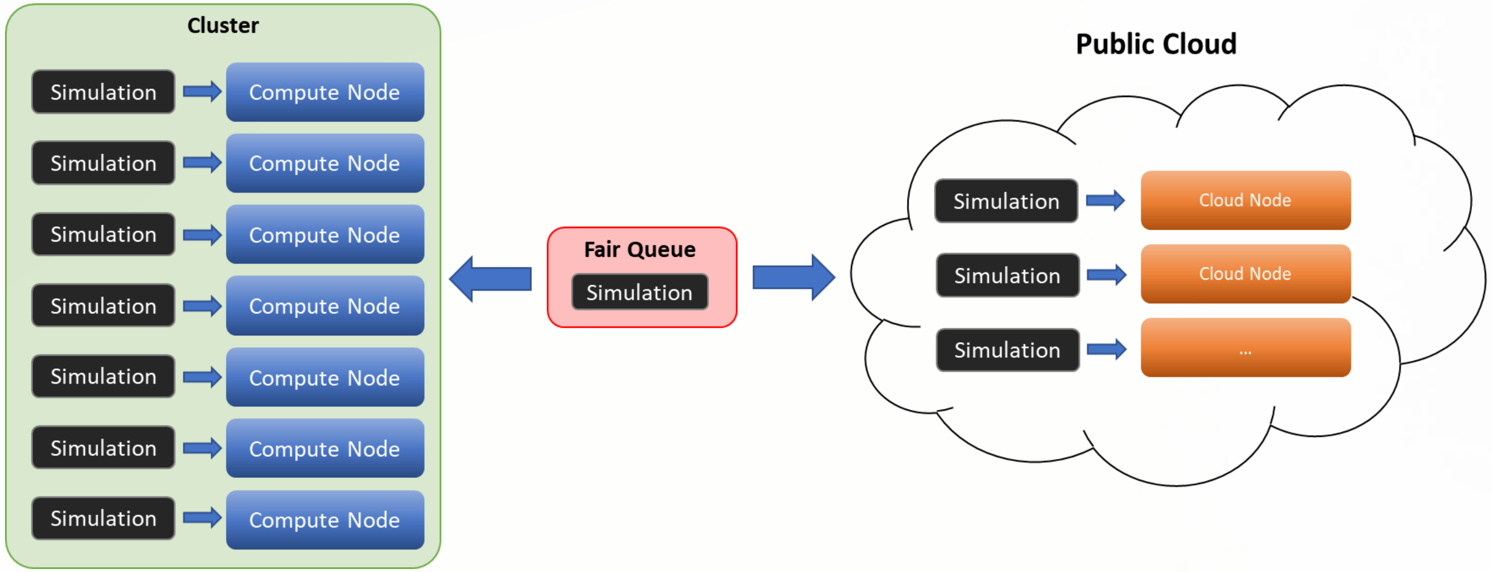
Develop the capability to utilize a hybrid cloud solution for DSS-WISE Web simulations

Current System



Currently, simulations wait in a queue until resources become available

Future Enhancement

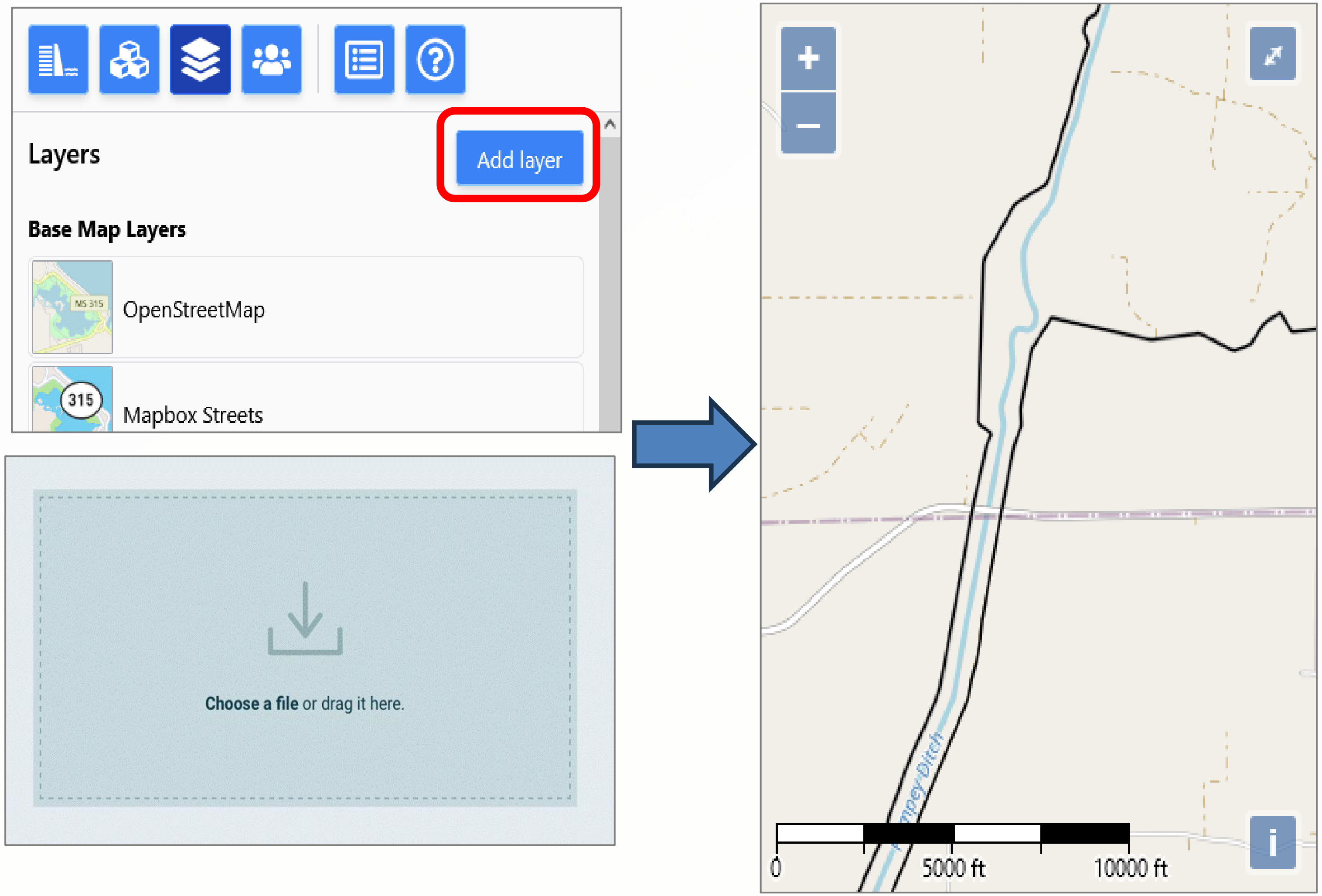


- Cloud nodes will be created on-demand to **minimize queue wait time**.
- High-priority simulations are assigned to fastest possible instances.
- **Fair queueing** via dynamic reordering and heuristics

User-supplied data overlays during simulation setup

Develop the capability for users to upload their own GIS overlay data onto the Viewer during simulation setup.

- “Bring your own data” approach
- Enhance awareness and understanding



QUESTIONS?

Email: **admin@dsswiseweb.ncche.olemiss.edu**

Take our survey about the 4.1 beta system and new features:

Helpful Links:

1. Beta system:
   https://dsswiseweb-beta.ncche.olemiss.edu
2. v4.1 User Manual:
   https://s3.ncche.olemiss.edu/public/documents/DSS-WISE_Web_v4.1_User_Manual.pdf
3. v4.1 Survey:
   https://uofmississippi.qualtrics.com/jfe/form/SV_ekWpgOPRhicbrKK