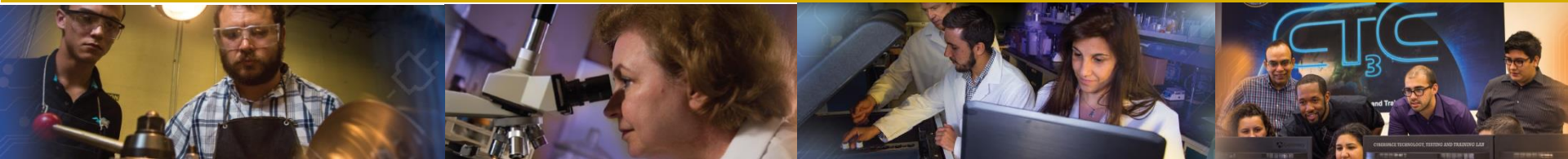




2D Dam-Break Analysis of L Lake and PAR Pond Dams Using HEC-RAS

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DOE-FIU Science and Technology Workforce Development Program
Applied Research Center
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Introduction

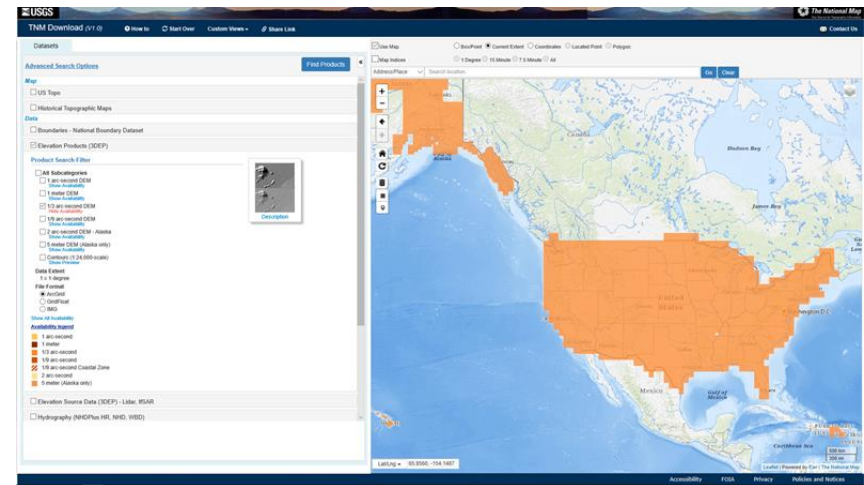
- In 1991 a dam-break study by Bechtel Savannah River Inc. was conducted for the high hazard dams located at L Lake and PAR Pond on the Savannah River Site. Two scenarios were considered, over topping from a Probable Maximum Flood (PMF), and a fair-weather dam-break for either or both dams. Unfortunately, no inundation map was developed from the study. The purpose of this project was to redo the original dam-break study with improved data and methodology to generate Inundation maps to assist with emergency response and evacuation plans.
- The Hydrologic Engineering Center's River Analysis System (HEC-RAS) is a free to download river analysis modeling program developed by the US Army Corps of Engineers capable of 1D and 2D hydraulic calculations. Version 5.0.7 (released March 2019) was used for this project.



Geometric Data



- The 1991 study used cross section data to model the river.
 - Some cross-sections were synthesized.
 - Old input data not 100% compatible with HEC-RAS and incomplete.
- Instead of cross sections, DEM data from the USGS was used for floodplain.
 - 1/3 arc-second (~10m) DEM.
 - No bathymetry data.



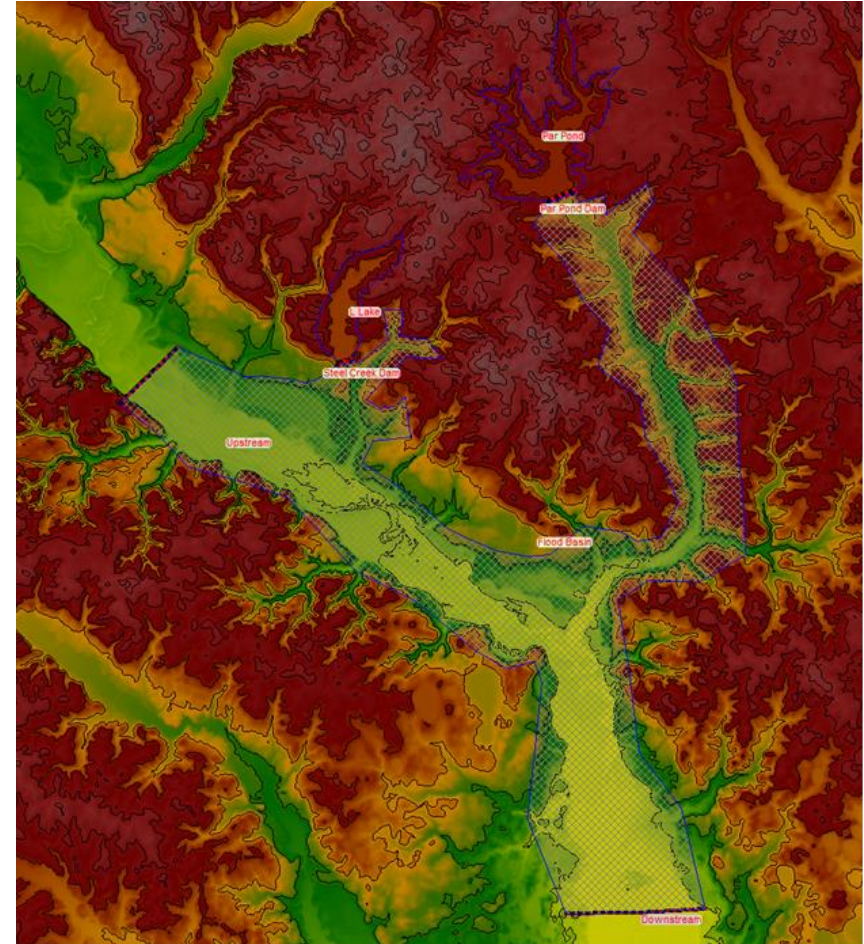
<https://viewer.nationalmap.gov/basic/>



Geometric Data



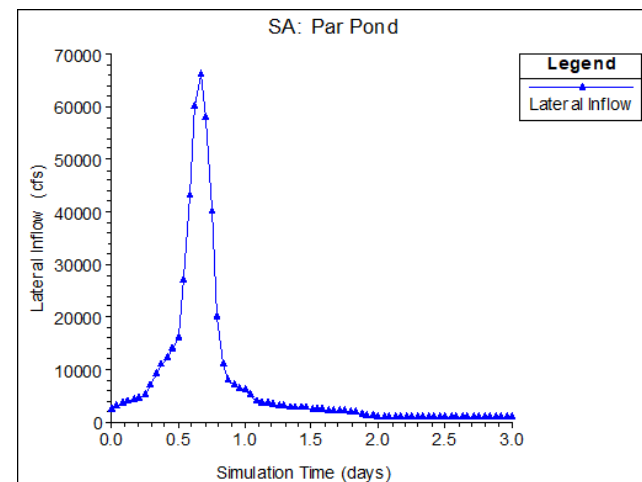
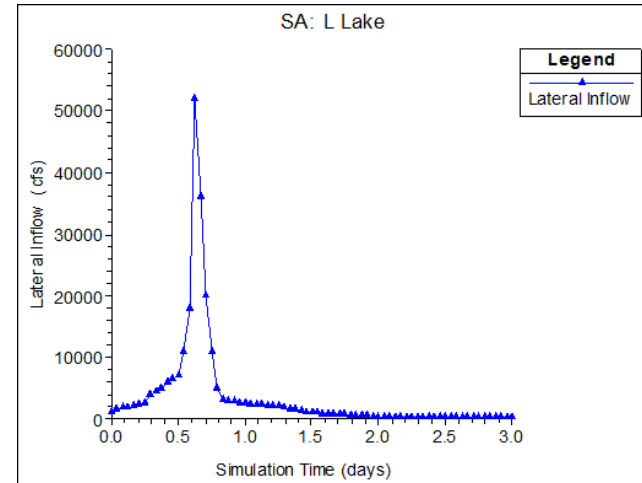
- 2D flood basin was drawn based on terrain contours.
 - Elevation range ~60-300 ft.
 - Single Manning's n value.
 - 250x250 ft grid size.
- Storage areas were inputted as 1D.
 - No bathymetry data.
 - Inflow, outflow, volume vs surface area, and initial water surface elevation (WSE) data was available.





Flow Data

- Taken directly from original 1991 study:
 - Storage areas
 - Inflow hydrographs
 - Elevation vs volume curves
 - Outlet rating curves
 - Initial WSE
 - Savannah River
 - PMF: 87,100 cfs
 - Fair-weather: 9,000 cfs

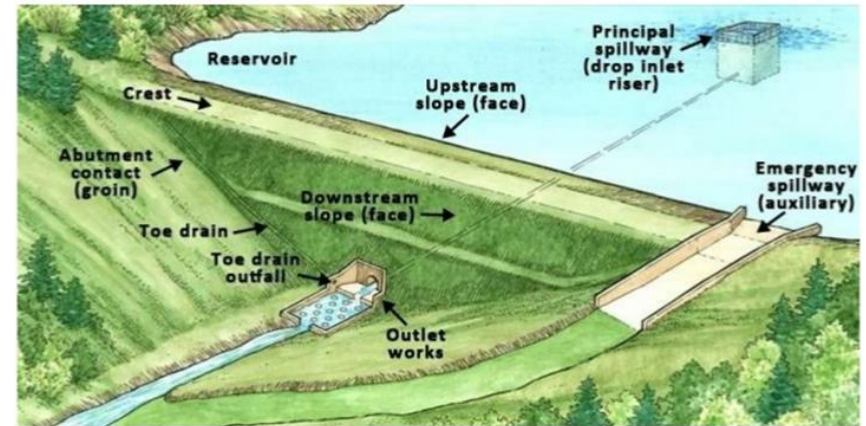




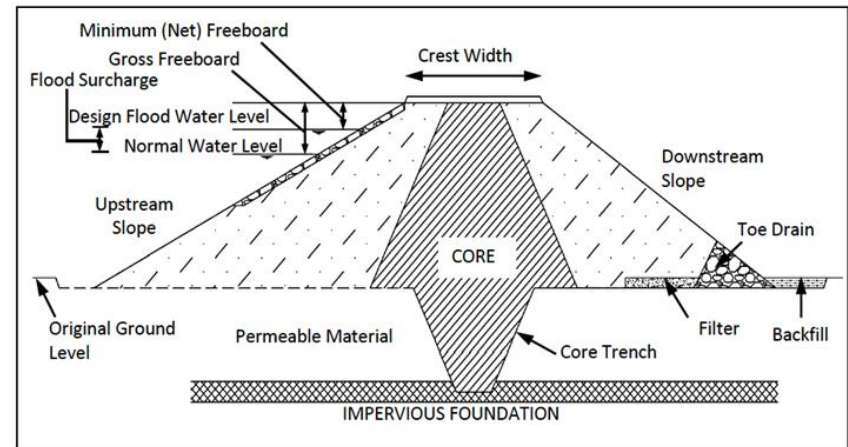
The Dams



- Earthen rockfill dams
- The Steel Creek dam at L Lake has 6 ft diameter conduit with an upper and lower sluice gate.
- PAR pond dam consist of a weir and sluice gate connected to an 8x8 ft channel.



<https://www.slideshare.net/RambabuPalaka/earthen-dam-79855045>



<http://www.revimage.org/types-of-filters-in-earth-dams/>



The Dams



Steel Creek Dam

<https://www.google.com/maps/@33.1621883,-81.634219,688m/data=!3m1!1e3>

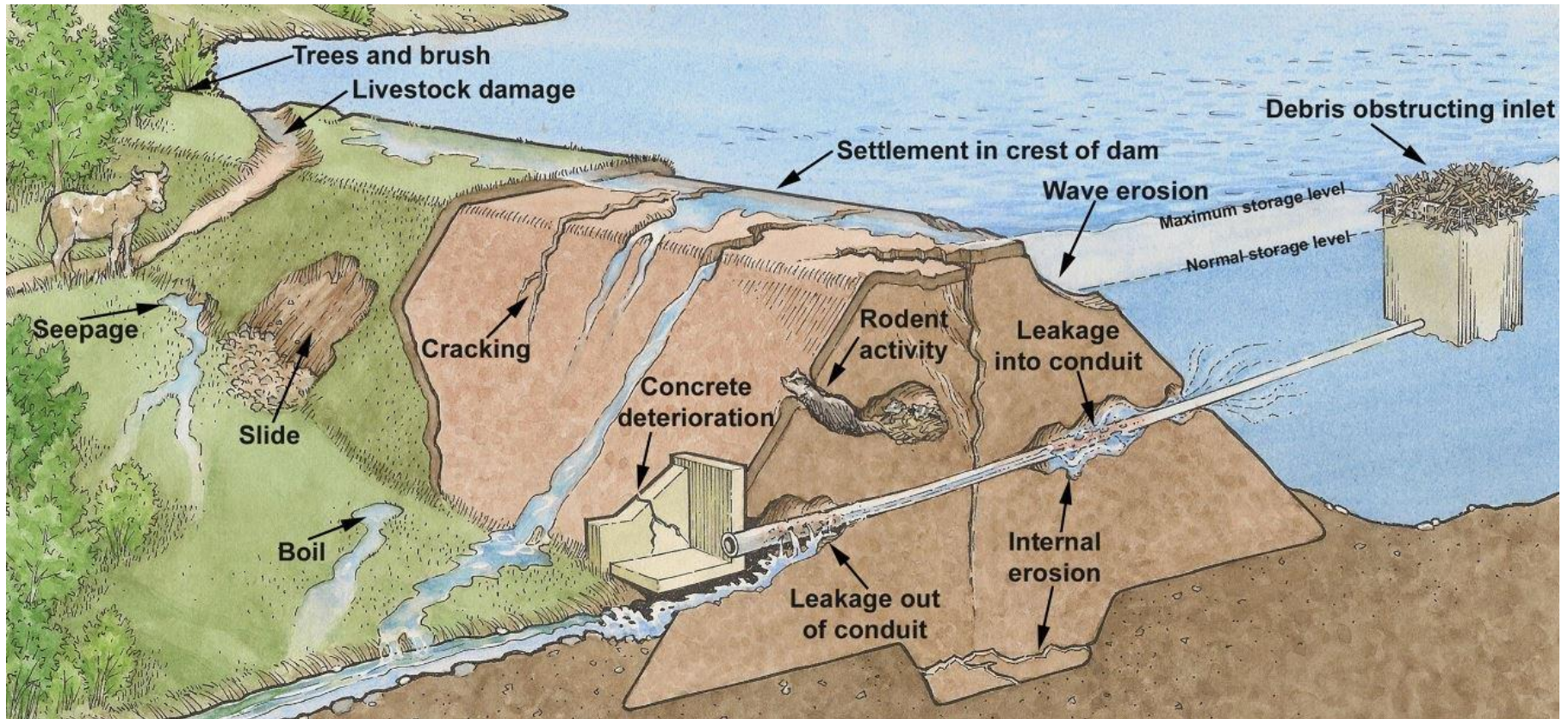
PAR Pond Dam



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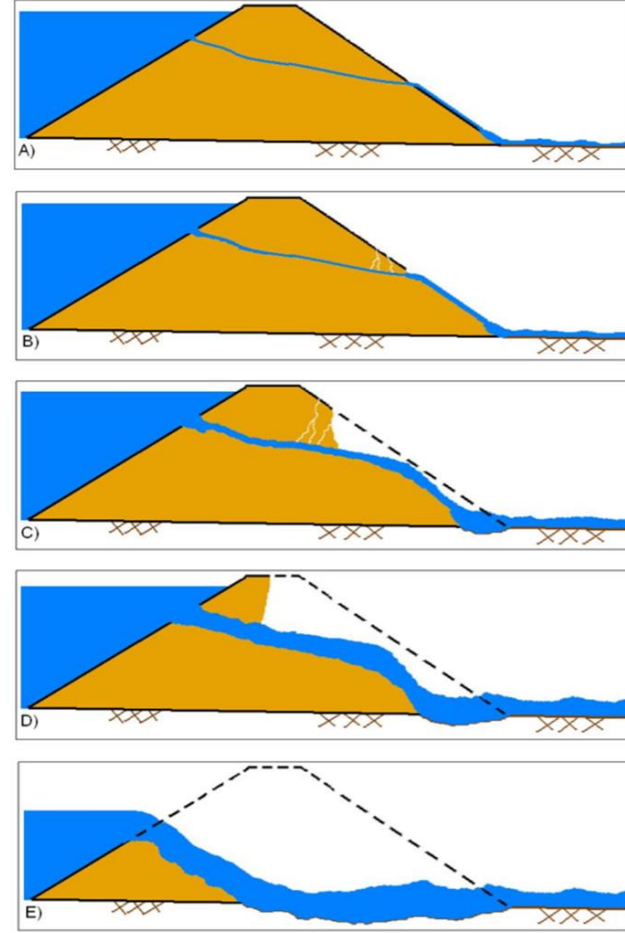
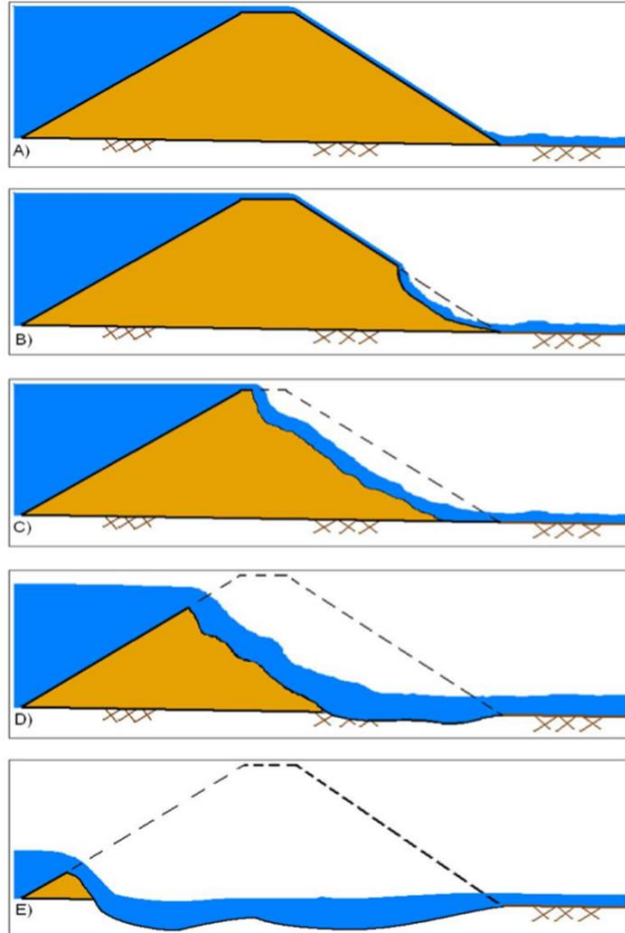
Dam Failure Examples



<https://theconstructor.org/water-resources/causes-failures-earthfill-dams/2287/>



Breach Processes used in HEC-RAS



<https://www.hec.usace.army.mil/publications/TrainingDocuments/TD-39.pdf>

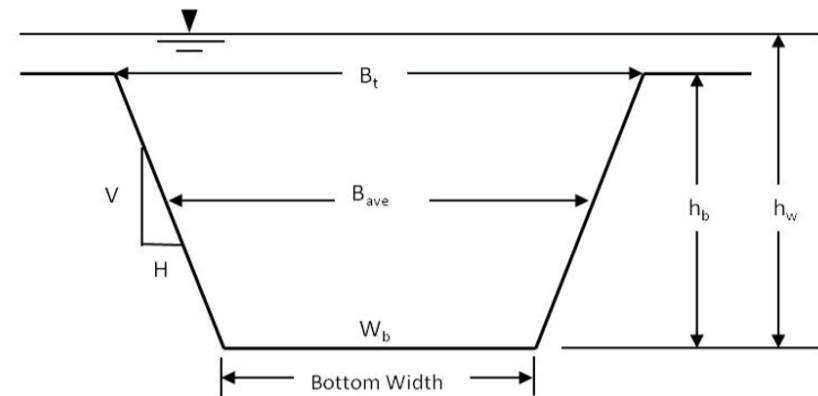
- Overtopping (left) and Pipe Failure (right)



Breach Parameters

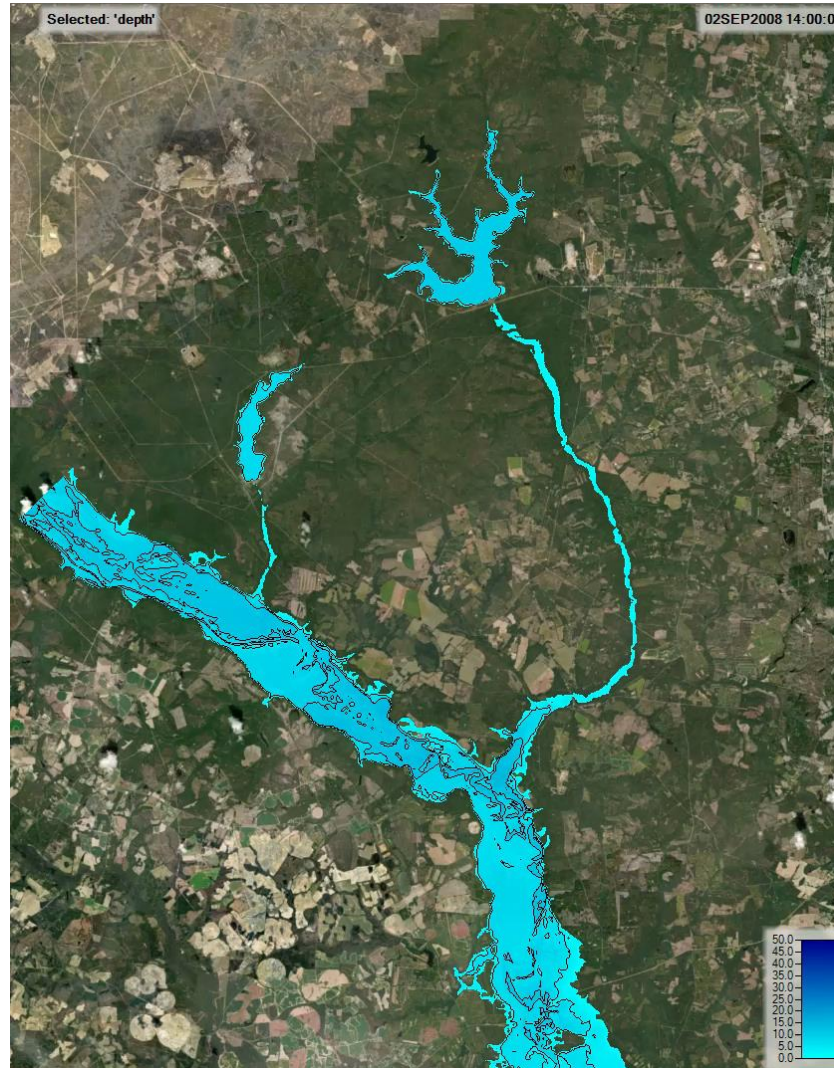


Parameter	Definition
B_t	Top width of breach
B_{ave}	Average width of breach
W_b	Bottom width of breach
V/H	Side slope
h_b	Height of Dam
h_w	Water surface elevation
t_b	Breach formation time



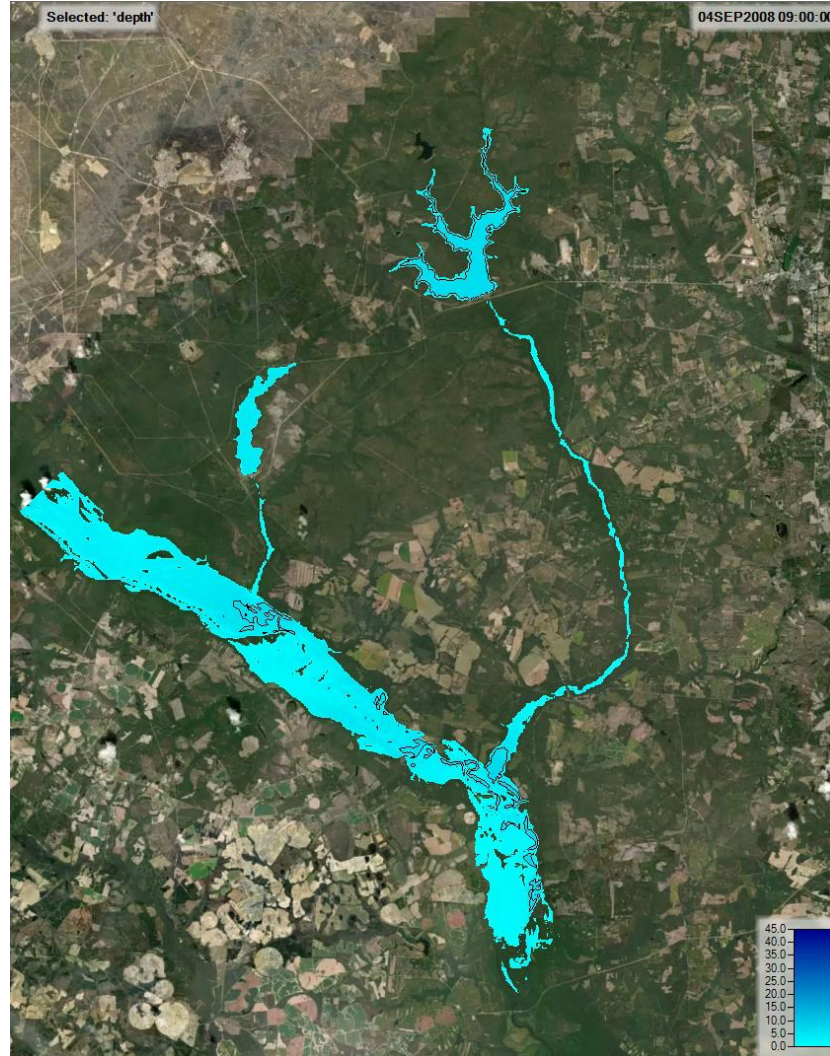


Dual Dam Failure Under PMF Conditions



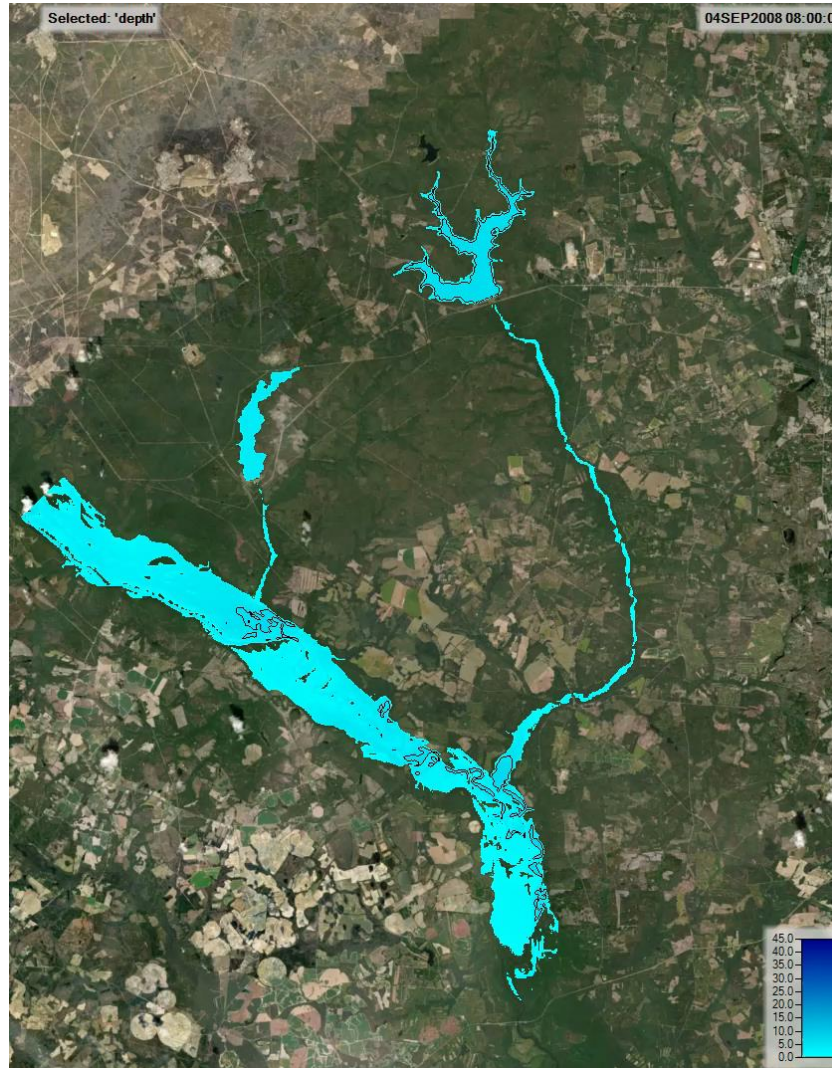


Dual Dam Failure Under Fair-Weather Conditions



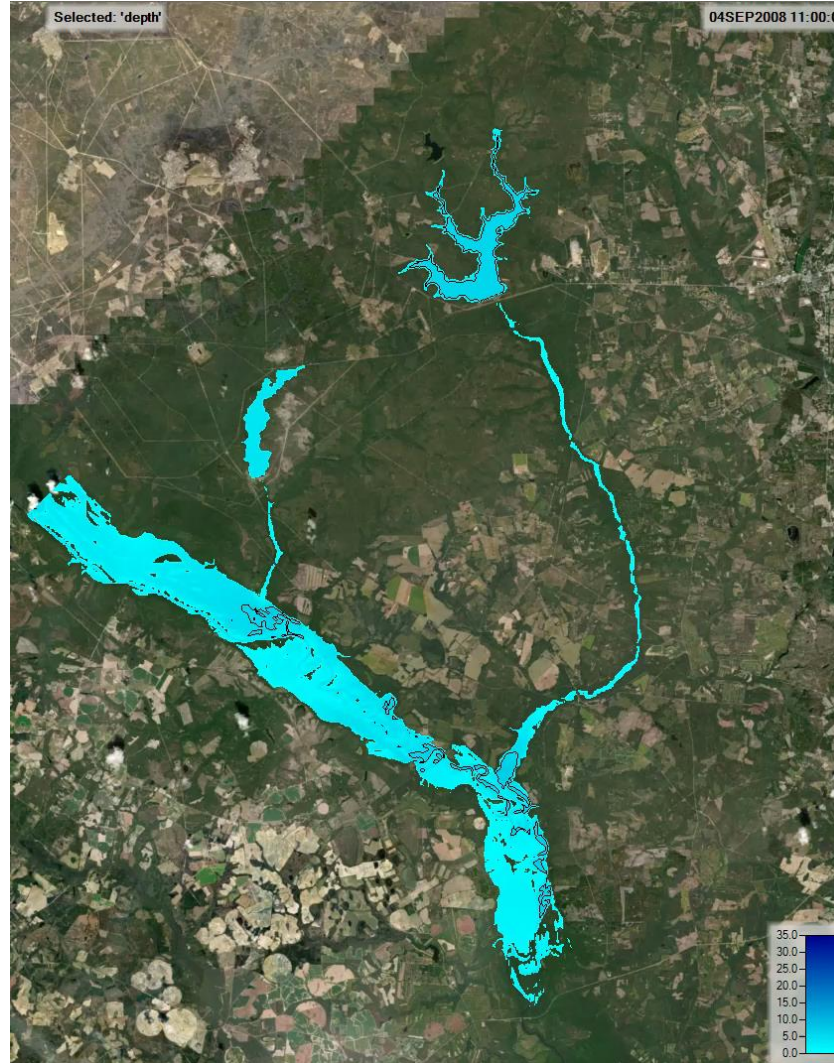


Steel Creek Dam Failure Under Fair-Weather Conditions





PAR Pond Dam Failure Under Fair-Weather Conditions





Acknowledgements

- **SRNL Mentors**
 - Dr. Grace Maze
- **FIU ARC Mentors**
 - Angelique Lawrence
- **DOE-FIU Science and Technology Workforce Development Program**
- **Sponsored by the U.S. Department of Energy, Office of Environmental Management, under Cooperative Agreement #DE-EM0000598.**