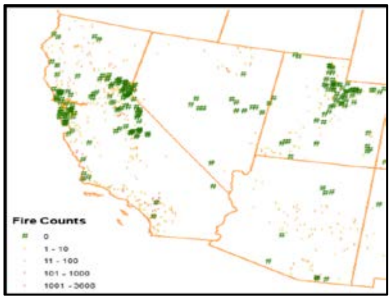
US Army Corps
of Engineers®
Engineer Research and
Development Center

POST-WILDFIRE HYDRAULICS AND HYDROLOGY NUMERICAL MODELING

Need

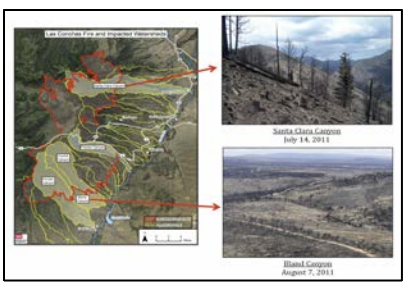
The amount and intensity of large wildfires in the U.S. have become a major concern, espically in the western US. During the past decade every western state experienced a rise in the number of large fires, according to the National Interagency Fire Center. Immediately following a wildfire, vegetation is removed, organic soil horizons are reduced to ash, and hydrophobic soils combine to result in significant increased water and sediment discharge to include; destructive floods, debris-flows, mud flows, and debris-floods. In the years following a wildfire, ecotone shifts, post-fire rill and gully formation, in-channel erosion, and deposition dramatically alter the geomorphic (i.e., morphology) and hydrologic system response.



Post-wildfire floods generate gravity driven surface runoff and erosion events that involve complex mixtures of water, ash, sediment, and entrained debris (i.e., destroyed upstream infrastructure, woody debris, and 'car-size' boulders). Hydrologic and hydraulic models are useful tools for assessing wildfire impacts to flood risk management (FRM), with an increasing need to develop and improve post-wildfire numerical modeling capabilities with USACE models.

R&D is conducted to apply the best science and engineering to advance decision-support technologies to identify the FRM risks, potential impacts, and resulting watershed benefits as a function of project-level actions.

Approach



In most of the western U.S., post-wildfire recovery can take decades, posing potential long-term operation and management concerns for USACE and other federal, state, and local agencies. This effort aims to improve understanding wildfire effects and enhancement of numerical capabilities to assist with planning, management, and mitigation in post-wildfire environments using cost-effective science-based approaches and smart integrated numerical methods. Current R&D is focused on enhancements to the following USACE models:

- 1D & 2D Hydrologic Engineering Center River Analysis System (HEC-RAS)
- 2D Adaptive Hydraulics (AdH)
- Sediment Transport Library (SEDLIB)
- 2D Gridded Surface Subsurface Hydrologic Analysis (GSSHA)
- 1D Hydrologic Engineering Center Hydrologic Modeling System (HEC-RAS)

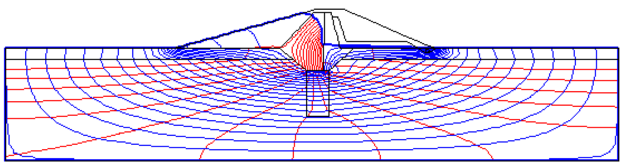
Outcomes

In most of the western U.S. wildfires represent a significant shock (or perturbation) to natural systems that dramatically alter the geomorphology, hydrology, and sedimentation regimes of effected watersheds. Future R&D will focus on enhancing our modeling capabilities to quantify post-wildfire effects on hydrologic and hydraulic response, geomorphic evolution, and sedimentation processes. The research will generate studies related to:

- Cost-effective (in situ and remotely sensed) data acquisition and processing methods;
- Better understanding of the long-term geomorphic effects and subsequent recovery processes in post-fire environments;

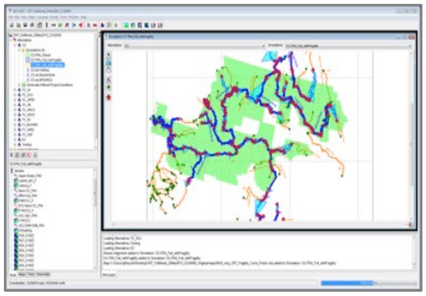
- Hydrological physical process, empirical approaches, and numerical modeling; and
- Hydraulics and sediment transport physical processes and numerical modeling.

New research needs are continually submitted by USACE FRM Communities of Practice to develop new tools and to focus future research investigations and products into these arid regions. Statements of Need can be submitted by USACE on the R&D Gateway (https://gateway.erdc.dren.mil/son/index.cfm?Cop=Flood&Option=Start).



R&D has advanced numerical models to accurately represent transient seepage flow through levees.

Field Research Facility in Duck, NC



Risk and uncertainty frameworks linked with numerical modeling and economics

More Information

Ian E. Floyd, Ronald Heath, and Nawa Pradhan, wiki page links, l information

For more information on FRM R&D, see the ERDC FRM wiki: https://wiki.erdc.dren.mil/Flood_and_Coastal_Storm_Damage_Reduction_Research_Program