Bridging the Gap Between Science and Policy in Fluvial Hazard Zones

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Abstract

In many of Colorado's mountain communities, damages from flooding result from erosion and sedimentation processes, rather than from inundation alone. This makes it more difficult to demonstrate the cost effectiveness of mitigation options like property acquisition, when seeking flood mitigation assistance (FMA) grants from FEMA. This is because the avoided flood damages that feed into the benefit-cost calculation are expressed as a simple function of inundation depth, rather than including damages from other fluvial hazards like erosion and sedimentation.

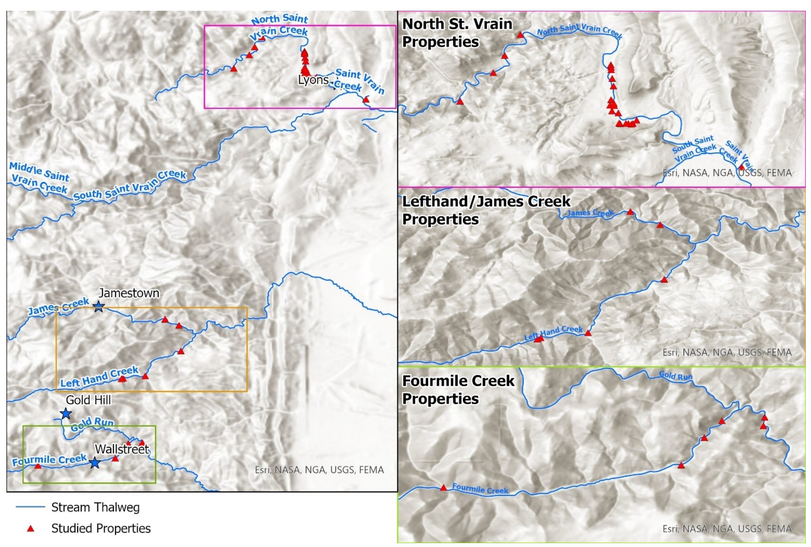
To evaluate the potential impacts of this effect, we conducted a pilot study of mountain properties in Boulder County to compare actual damages sustained in the 2013 flood vs the damages that would have been predicted by FEMA's Benefit Cost Analysis Toolkit for a flood of the same magnitude. Our analysis shows a systematic under-prediction of damages using the BCA toolkit, which means that the calculation of avoided damages when proposing mitigation projects will underestimate the value of those projects. This highlights a key challenge to securing FEMA mitigation funding in mountain communities.

Data and Methods

Database of Property Losses

Our core dataset for this analysis was a database of properties in Boulder County that sustained substantial losses in the 2013 flood event. This database contained flood loss information for 35 properties located primarily in mountainous locations of western Boulder County (**Figure 1**). For each property, we obtained information on the address, the structure design (e.g., 1-story or 2-story), and the fractional loss incurred during the 2013 event as determined by the substantial damage estimation (SDE) method.

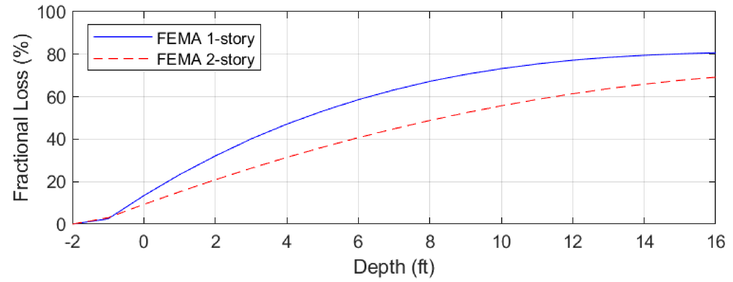
For a subset of the properties, the SDE reports also provided a field-based estimate of the floodwater depth relative to the first floor elevation. All of the findings in this report are based on analysis of the properties for which SDE reports were available.



Data and Methods (2)

Estimating Fractional Loss

- We used the depth-damage curves embedded in the FEMA benefit cost analysis tool to estimate the fractional loss to the property from a flood with that depth.
- We use the generic depth-damage curves built into the FEMA BCA tool to ensure compatibility with the methods used to evaluate FMA grant eligibility.



Documenting Flood Impacts

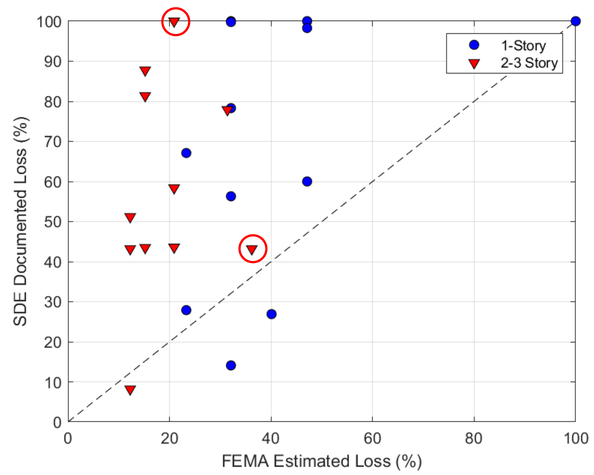
We used the information contained in the SDE reports to document actual damages sustained by each property. Data included:

- Field photographs of property damage
- Field-determined estimates of fractional loss at each property.
- Google Earth imagery documenting the condition of the flooded waterway before and after the flood event.

Results

Predicted vs Observed Fractional Loss

- Of the 24 properties with reliable flood depth data, 20 of them (83%) reported fractional losses greater than the loss predicted using the FMA methodology
- This result was independent of property type



Results (2)

Flood Loss Mechanisms

- Properties with SDE reported losses similar to FEMA estimates typically had no evidence of structural damage
- Google Earth imagery for these properties showed that erosion and sedimentation did not infringe on the building footprint

- Properties with SDE reported losses much greater than FEMA estimates typically had clear structural damage
- Google Earth imagery for these properties showed channels migrated through the building footprints

Summary

- Erosion and sedimentation processes during mountain flood events increase building damages significantly relative to "clear water" flooding processes alone
- Because the depth-damage functions embedded in the FMA application process do not account for these hazards, it may be difficult for mountain and piedmont communities to secure federal grants to move properties out of harm's way
- There is a clear need to "operationalize" Colorado's FMZ mapping protocol to better quantify the probability of these hazards and incorporate them into benefit-cost calculations

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