

Post-fire precipitation thresholds and treatment efficacy from plot to watershed-scale

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Abstract. Colorado's Front Range watersheds provide the majority of municipal water supplies for downstream communities. Many of these watersheds have been affected by wildfire, and mulch treatments have often been applied to reduce post-fire impacts on downstream water supplies. Post-fire mulching has been shown to be effective at reducing hillslope-scale erosion; however, information on treatment efficacy across watersheds is needed to understand effects on downstream water supplies. Precipitation is one of the most important drivers of post-wildfire runoff and erosion, and we hypothesized that (1) post-fire runoff and erosion are threshold processes requiring a threshold amount or intensity of rainfall throughout the Colorado Front Range, and (2) that precipitation thresholds required for sediment delivery will change with the size of contributing areas. The objectives of this study were to: (1) identify whether or not runoff, erosion, and sediment delivery can be predicted by precipitation thresholds within 3 recent Front Range fires (i.e., Bobcat, Hayman, and High Park), (2) compare identified thresholds across plot to watershed scales (e.g., <0.01 – 1500 ha) for varied levels of mulch treatment, and (3) develop a tool to estimate the probability that precipitation events will exceed thresholds in future fire areas. Precipitation thresholds for the maximum intensity over 15-minute intervals (mm hr^{-1}) were identified for all events with runoff and erosion; we found: (1) thresholds increased from post-fire year 0 to 2, (2) similar thresholds across spatial scales, (3) treatments increased thresholds only in post-fire year 0, (4) thresholds for post-fire year 0 were exceeded throughout the entire Front Range during a 1-year storm, and (5) thresholds for post-fire years 1 and 2 were exceeded throughout most of the Front Range during a 10-year storm. This understanding of precipitation thresholds for runoff and sediment delivery across spatial scales and levels of mulch treatment will help land managers identify where and when rain events are likely to cause post-fire flooding or sediment problems for prioritization of treatments to those areas with lower thresholds.