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Effects of contrasting wildfire severity on soil water repellency and implications for hydro-geomorphological response

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Fire-induced or enhanced soil water repellency is often viewed as a key cause for the substantial increases in runoff and erosion following severe wildfires. In this study, the effects of different fire severities on soil water repellency are examined in eucalypt forest catchments in the Sandstone Tablelands near Sydney, at sites burnt in 2001 and 2003. For sites affected by different burn severities and long-unburnt control sites, repellency persistence was determined *in situ* and in the laboratory for surface and surface soil (n=846) using the Water Drop Penetration Time (WDPT) test. All long-unburnt samples were found to be water repellent, with severe to extreme persistence ($>$ 900 s) being dominant for surface (0-2.5 cm) and slight to moderate persistence (10-900 s) for subsurface (2.5-5 cm) soil, indicating naturally very high 'background' levels of repellency. In contrast to the generation or enhancement reported from most forest fires in previous work, burning caused widespread destruction of repellency. The mineral soil depth to which repellency was destroyed (0.5-5 cm) was found to increase with burn severity. Below this charred wettable layer, persistence of pre-existing water repellency increased. Two years after burning, there was little change in the wettability of surface soil, but subsoil repellency persistence was reduced. Differences like these in such a hydrologically important soil characteristics might be expected to have

important ramifications as regards hydro-geomorphological response. Certainly, the additional storage capacity provided by the wettable surface soil in the case of soil subject to high fire severity delays overland flow generation for modest rainfall intensities. With the heavy rainfall quantities (commonly $>$50 mm in 24 hours) that are characteristic of the study area, this storage capacity is soon exceeded and the ubiquitous presence of repellency below the surface soil becomes the important aspect of soil wettability affecting overland flow. This conclusion is supported by there being no distinct difference between post-fire burnt topsoil losses derived from areas of different fire severity and water repellency characteristics.