

Prediction of Erosion from Forest Road Networks

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Roads are widely acknowledged as a major source of sediment to headwater streams in forests. While a number of tools have evolved to evaluate individual road segments, many questions exist about the interaction of road networks and stream networks at larger scales. A number of ad-hoc hypotheses have emerged to use GIS layers to roughly estimate road contributions to sediment for watersheds, but validation of such models is difficult without detailed observations of as-built condition and performance of forest road drainage systems. We present analysis of detailed measurements from five watershed scale road inventory projects using the Geomorphic Road Analysis and Inventory Package (GRAIP, <http://www.fs.fed.us/GRAIP/>). The common outcome of all analyses is that a small fraction of the road network and their associated drainage is responsible for the great majority of fine sediment inputs. Stream crossings not only represented a dominant location of sediment delivery, but nearly a quarter had a high risk of becoming plugged and overtopped or a potential for flow diversion down the road after plugging. In some locations, gully risks showed threshold-like behavior relative to a combination of contributing road segment length and the slope of the discharge hillslope. Using insights gained from the detailed inventories, we developed a method to subsample segments in a road network to infer sediment inputs to the stream network. Validation of the approach shows good agreement with observations, with proportional errors becoming small with increasing watershed size.