

A GIS Tool to Analyze Forest Road Sediment Production and Stream Impacts

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Abstract: A set of GIS tools has been developed (Road Sediment Analysis Model, RSAM) to analyze and quantify the impacts of forest roads on forested watersheds. RSAM is organized into three modules. In the first module sediment production for each road segment is calculated from slope, length, road surface condition and road side drain vegetation. A GPS gathered road condition inventory provides surface and drain conditions, locations of drain points, information on connectivity between drain points and streams, and information on road stream crossings. Slope is obtained from the GIS by overlaying the road path on a Digital Elevation Model (DEM). Road sediment production is accumulated at each drain point by adding the sediment production draining to each drain point from different road segments. These drain point sediment loadings are then coupled with a DEM model for surface flow and used as inputs to a weighted flow accumulation function to calculate sediment load inputs to stream segments, also delineated based on the DEM. An option allows accumulation of all sediment produced or only sediment produced from drain points inventoried as connected to the stream. The second module analyzes the impact of forest roads on terrain stability. Terrain stability is assessed by calculating the specific discharge due to road drainage and using this, together with slope, as inputs to an infinite plane slope stability model. In the final module the inventory information on the fish passage status of stream crossings is used to demarcate contiguous clusters of stream habitat and assess the impact of fish passage barriers on the fragmentation of stream habitat. A map showing possible fish habitat clusters is obtained from the analysis. To ensure referential integrity between road segments, drain points and the stream network attributes, and to validate the road inventory dataset a relational database model framework is used. Preprocessing software has been developed to load the road inventory data into this framework and fulfill initial quality control and data validation functions. The sediment production, terrain stability and habitat cluster contiguity analyses then works off data from the relational database.

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