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The Application of a WEPP Technology to a Complex Watershed Analysis

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Forest restoration activities are essential in many forest stands, where previous management and fire suppression has resulted in stands with high density, diseased trees and excessive fuel loads. Trying to balance the watershed impacts of restoration activities such as thinning, selective harvesting, and prescribed fire against the significant impact of wildfire is challenging. The process is further aggravated by the necessity of a road network if management activities include timber removal.

We propose to present an approach to a watershed analysis for a 3400-ha of fuel reduction project within an 18,0000-ha sensitive watershed in the Nez Perce National Forest in Northern Idaho, USA. The FlamMap fire spread model was first used to predict the distribution of potential fire severity on the landscape for the current fuel load, and for a landscape that had been treated by thinning and/or prescribed fire. FlamMap predicts the flame length by 30-m pixel as a function of fuel load and water content, wind speed, and slope steepness and aspect. The flame length distribution was then classified so that the distribution of burn severity (unburned, low, moderate and high severity) was similar to the distributions observed on recent wildfires in the Forest. The flame length classes determined for the current fuel loads were also used for the treated condition flame lengths, where predominantly unburned or low severity fire severities were predicted. The burn severity maps were uploaded to a web site that was developed to provide soil and management files reflecting burn severity and soil texture, formatted for the Geospatial interface to the Water Erosion Prediction Project (GeoWEPP). The study area was divided into 40 sub watersheds under 2.5 km2 each for GeoWEPP analysis. GeoWEPP was run for an undisturbed forest; for the burn severity following wildfire for the current and treated fuel loads; for prescribed fire, either broadcast or jack pot burn; and for thinning either by tractor or by skyline logging. The GeoWEPP erosion estimates by hillslope polygon were merged with the proposed treatment polygons to produce maps of erosion for each condition for each treatment polygon. Road network erosion was estimated using a new online GIS tool to estimate road segment length and steepness, and linking those topographic values to the WEPP model for erosion prediction by road segment.

The results were summarized and compared to earlier estimates of sediment delivery using a locally-developed cumulative watershed effects analysis. The results were similar from both tools, in spite of using very different erosion estimation methods, and similar to regional observations of forest watershed sediment delivery ($\sim$12.5 Mg/sq km). The study found that the erosion risk from wildfire was 5 times greater than sediment generated by forest management, justifying the proposed restoration activities to reduce fire risk. Sediment generated from the road network, however, was unacceptably high suggesting that methods improve road erosion prediction and/or to reduce road erosion are warranted.