WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: KY1982

Title: Retirement and restoration of forest roads in steep terrain: Influence on nonpoint source pollution and hillslope hydrology

Focus Categories: Hydrology, Nutrients

Keywords: forest hydrology, road restoration, nutrient cycling, sediment transport

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Non-Federal Matching Funds: $22,312

Congressional District: Sixth

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Abstract

The USDA Forest Service has recently come under fire to protect roadless areas and to retire or possibly restore roads that receive little use. Forest roads constructed as a result of harvesting operations severely disturb soil which leads to enhanced nonpoint source pollution and altered hillslope hydrology. Current best management practices (BMPs) for forest road retirement in Kentucky and many other states are effective at reducing nonpoint source pollution but sediment fluxes can still be on the order of 10 to 40 times those in unharvested systems the first few years after harvest. Also, none of the current forest road BMPs specifically address the recovery of soil properties, normal hillslope hydrology, and site productivity. It is critical that we develop new road closure techniques to lessen the transport of sediment and nutrients and minimize the altering of hillslope hydrology. In this study we will investigate the effects of road restoration (recontouring) and a new technique for road retirement (subsoiling) on hillslope hydrology, the transport of sediment and nutrients and soil productivity.

Three sections of forest roads in NE Kentucky have been chosen that have approximately a 10% grade on hillslopes ranging from 30-50%. Each road section has three duplicated, randomly placed experimental treatments including (1) cover crops only (KY BMP), (2) deep tillage and cover crops, and (3) re-contouring and cover crops. An undisturbed hills lope site at a similar landscape position as the road section is also instrumented at each site and is considered as a reference. Road sections are 200 m long with six 25 m treatment plots (duplicate of treatments 1-3) with treatment plots separated by 5 m buffers. Treatments and instrumentation were installed the winter and spring of 2000. Recontoured treatments were installed with a front-end loader. For the deep tillage treatment we used in a winged subsoiler from Oregon specifically developed for forest road retirement. Time and cost data was collected during the installation of the treatments. Hillslope hydrological and water sampling instrumentation includes TDR probes and suction cup lysimeters installed at 15 and 25 cm soil depth. Sets of TDR probes and suction cups are installed 3 m above, 3 m below and in the center of road treatments and on the reference hillslope. Soil moisture is measured (with TDR) and suction cups are sampled on a biweekly schedule and after precipitation events greater than ~1.25 cm (1/2 inch). Surface runoff diversion plots (~ 8 m2) are constructed and graded to collect road surface runoff that is measured for volume and analyzed for

sediment and nutrient concentration. Surface runoff collected with the diversion plots and interflow waters collected with the suction cups is analyzed for pH, conductivity, alkalinity, TSS, TDS, NO3, NH4, PO4, Ca, Mg, K, Na and TOC. Soil physical properties (bulk density, particle size and soil resistance measured with a cone penetrometer) and soil chemistry (pH, plant available nutrients, organic carbon and cation exchange capacity) measurements were made within the road surface prior to plot installation. Subsequent measurements of soil physical and chemical properties will be conducted to characterize recovery. Twenty tulip poplar (Liriodendron tulipifera L.) and eastern white pine (Pinus strobus L.) seedlings were planted in each plot during the spring of 2000. Seedling dimensions will be measured at the end of each growing season for the duration of the study. At the end of the second growing season a subset of seedlings will be destructively sampled for foliar nutrients, leaf area, and stem and root biomass.

The specific objectives of this project are to: 1) examine how hillslope restoration and deep subsoiling affect the transport of sediment and nutrients from forest roads; 2) examine how hillslope restoration and deep subsoiling affect hillslope hydrology and soil moisture; and 3) identify amelioration techniques that efficiently and effectively improve soil properties and seedling growth on severely disturbed areas.