RTI FACT SHEET **#19**
Rural forest community issues *2003*

A Systems Approach to Sediment Reduction from Forest Roads with Cross Drains – CulSed

By Florentiu Damian

Forest roads are built to provide transportation routes for timber harvests, forest management, recreation, fire access and other needs. A high density of forest roads in some areas, coupled with intense traffic has caused environmental problems related to sedimentation. Fine sediment in solution with run-off generated by roads is sometimes transported into adjacent streams, leading to water quality degradation and damage to aquatic habitat. Public concerns about such potential impacts have resulted in regulatory design restrictions to reduce harmful impacts from forest roads. Various road construction techniques like road abandonment, gating, road resurfacing, cut slope re-vegetation and sediment trapping, intended to counteract sedimentation, have been applied with mixed results. When a systems approach is employed for road design, cross drains can be customized as a technique to reduce sedimentation at less cost than default regulations that are based upon prescriptive spacing.

Why cross drain systems?

Cross drain systems are necessary for maintaining natural water flows, preventing drainage ditch overflow and road surface saturation. When cross drains are constructed, sediment reduction can be achieved by dispersing sediment-laden water onto vegetated slopes that filter ditchwater before it reaches neighboring streams. Current forest practice rules impose a particular set of restrictions on forest road construction and cross drain system design. In most cases, cross drains are to be spaced at regular prescribed intervals along a forest road to disperse ditchwater runoff onto the forest floor. The distance between culverts is determined as a function of road grade, side slope, average distance above streams, road surface condition and use, precipitation, and soil erosion potential. However, the prescriptive approach to cross drain placement when compared with customized cross drain placement based upon sediment flow analysis can produce more sediment and increase road construction cost (Figs. 1 and 2).

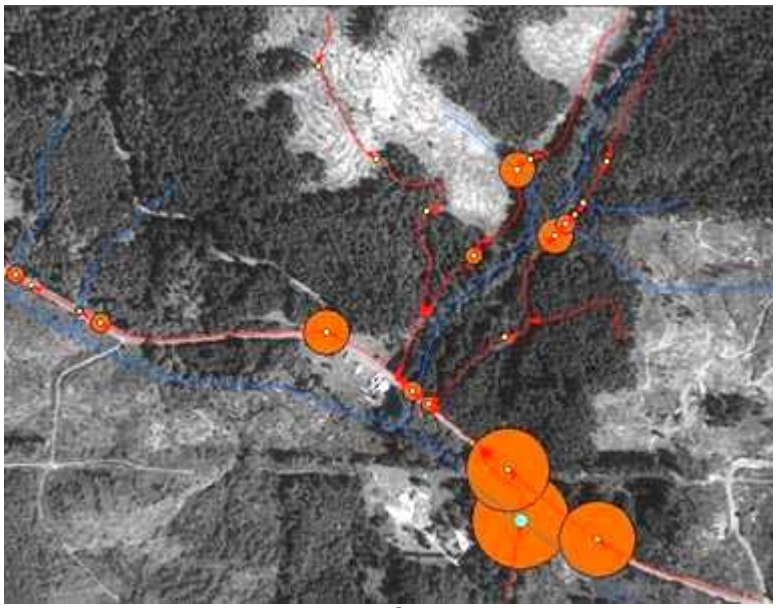

Figure 1 - Sediment delivery from road network with 16 culverts in place.

Strategic location of the culverts in a cross drain system can have a significant impact on reducing sedimentation without interfering with road drainage functions. Location of cross drain culverts customized to local ditchwater and sediment flow conditions may result in maximum efficiencies and reduced cost if road designers have access to sediment calculators. A handful of computerized tools have been designed for analyzing sedimentation from forest roads. Unfortunately, currently available road design tools are difficult to use for cross drain spacing analysis. A specific cross drain analysis tool that is easy to use could help road designers minimize road construction costs while protecting water quality in forested streams.

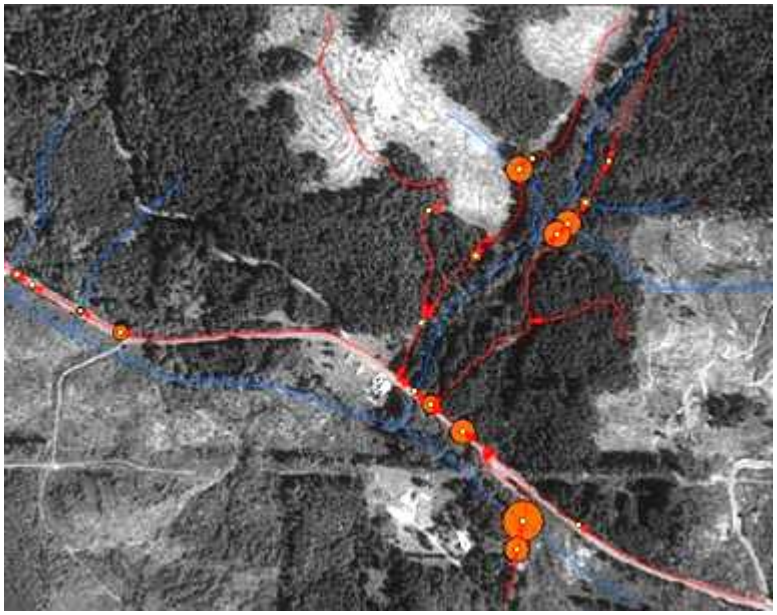

Figure 2 - Sediment delivery from road network with 13 culverts in place.

What is CulSed?

CulSed is a new decision support tool for cross drain culvert design developed by research assistants and staff at the Rural Technology Initiative (RTI). This software can be used to evaluate the sediment delivered to the stream at each cross drain location based on road and stream geometry, terrain morphology and user input sediment-producing road characteristics. CulSed is a specialized graphical user interface (GUI) for a sediment model that is used in a geographic information system (GIS) with topographical, hydro, and road layers. The probable sedimentation at each cross drain location is automatically calculated and drawn on screen with proportional symbols (Fig. 1). Evaluating relative sediment impacts from a road network becomes a user-friendly exercise. The click and drag function is used to simulate moving a culvert on screen to a different location along the road. Instant recalculation of the sediment load results in a resizing of proportional flow symbols. CulSed enables users with little technical training to find near optimal cross drain locations. Fig. 2 displays a reduction in sedimentation for this sample road system of approximately 57% from the default WA Forest Practice rules approach presented in Fig 1. Using CulSed to assist design, a reduction in sedimentation was achieved while the number of culverts needed was reduced as well. If this design had been available at time of construction, road-building costs could have been reduced.

CulSed is simple to use but requires accurate road geometry, stream and digital terrain data for a successful analysis. Sediment values associated with each cross drain are modeled estimates for relative comparison of cross drain location alternatives. RTI researchers are using CulSed to evaluate cross-drain placement strategies in support of non-industrial forestland alternative plans.

Contacts: For more information visit the RTI website at **www.ruraltech.org** or contact Luke Rogers, Rural Technology Initiative, University of Washington; (206) 543-7418; lwrogers@u.washington.edu