



Cost of Retiring Skid Trails and Haul Roads

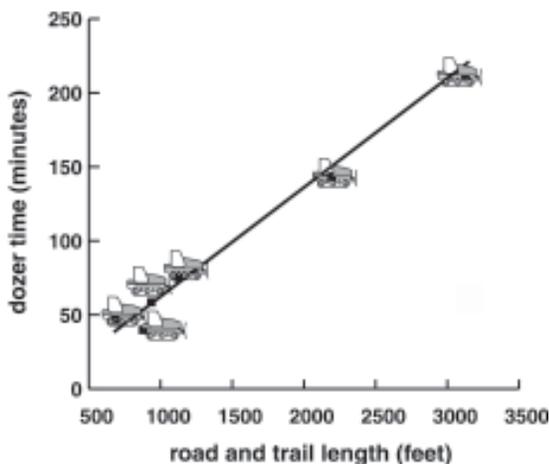
Jeff Stringer

Meeting Kentucky's requirements for retiring skid trails and roads is a major cost that loggers face when implementing BMPs. A research study of Kentucky logging operations (see side bar) was recently conducted to determine the time required and the cost of reshaping haul roads and skid trails, building water bars, and seeding. The study also provides information to help you determine if your retirement operations are being run as cost effectively as possible.

Retirement Summary

Retiring haul roads and skid trails requires that ruts are filled, berms are removed, and permanent water control structures such as water bars are built. Generally bulldozers are used for this work in eastern Kentucky and in wheeled skidders are used in western Kentucky. The majority of the loggers in our study used dozers and our data for dozer operations are better than for skidder operations. Figure 1 shows how much time the loggers in our study took to retire skid trails and haul roads using a bulldozer.

Figure 1. Reshape and Water Bar Time



The graph shows that for every 1000 feet of road or trail retired it took an average of 51 minutes to build water bars and reshape the surface. Notice that the loggers were very consistent in the amount of time taken to complete reshaping and water barring. Due to this high degree of consistency we believe that the 51 minutes per 1000 feet is a reasonable figure for estimating retirement costs under average to good soil and rutting conditions. This is

especially so if the conditions you are working with are similar to those encountered in our study. The trails and roads were dry to moderately moist, they had an average width of 16 feet and an average slope of 22 percent (ranging 0 to 53 percent), ruts ranged from 2 to 27 inches deep with an average of 12 inches, and a moderate amount of brush and laps was present. All of the previously mentioned items will affect the speed at which work can be completed. Some factors that DID NOT effect the time it took for retirement work to be completed were: number of years logging, years using BMPs, horsepower, and slope of the hillside. The table at the top of the next page (Table 1) shows the factors that we found most affected the amount of time it took to retire skid trails and roads based on the use of a dozer or a skidder.

Our study indicates that retirement work completed with skidders is affected by many more factors compared to dozer operations. This may well be due to the fact that wheeled skidders are not designed for earth work and thus are susceptible to a number of factors that can slow work compared to dozers. An ex-

Logging BMP Cost Study

In 2000 the University of Kentucky completed a research project to determine the costs of retiring skid trails and haul roads in Kentucky. Ten logging jobs were visited by a research forester, and retirement operations were filmed, including reshaping roads and skid trails, building water bars, and seeding. We also obtained other information, including the amount of rutting present, soil moisture, width of the trails and roads, size of water bars constructed, type of equipment used, and experience of the equipment operator.

The film of these operations was analyzed in detail at UK with a technique called *time/motion analysis*. Time/motion analysis is used for looking at a repetitive activity, such as building a water bar, and determining how much time each movement of equipment required. Use of this technique allowed us to determine how efficient each operator was in building water bars and reshaping roads and trails.

From this information we were able to determine an average and a range of times for reshaping road and skid trails, constructing water bars, and seeding. We were also able to determine what factors are most likely to drive up the cost of retirement BMPs.

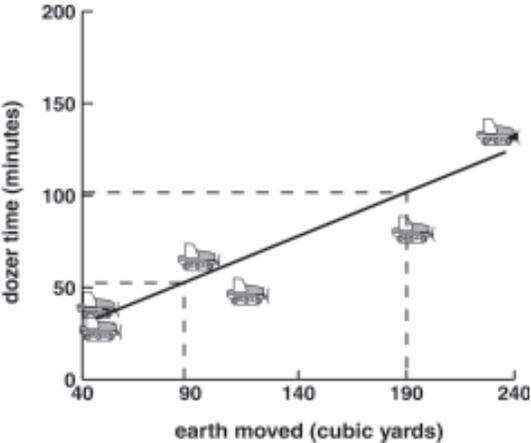
	Dozer	Skidder
length retired		
total earth moved		
water bar construction time		
% slope of surface		
trail width		
soil moisture ¹		
horsepower		
% slope of hill		
years in logging		
experience with BM Ps		
experience with equipment		

Importance rating: XXX = very X X = moderate X = somewhat
¹ Our study did not include sites where soils were extremely wet.

ample is horsepower. Dozers are generally underutilized during retirement work, our data showed that on average operators only used one-half of the blade capacity when building water bars and reshaping, most probably due to the confined work area of a skid trail or road. This indicates that dozers can easily overcome obstacles, with spare horsepower. Skidders on the other hand are less efficient because they are maximizing their blade capacity and machine balance. It is also apparent that operator experience is much more critical for skidder operations compared to dozer operations.

The most important factor that effects how much time it takes to reshape and build water bars on a given section of road or trail is the amount of dirt that must be moved. Figure 2 shows just how much earth moving effects the amount of time taken to smooth and water bar 1000 feet of trail.

Figure 2. Amount of Earth Moved Effects Retirement Time



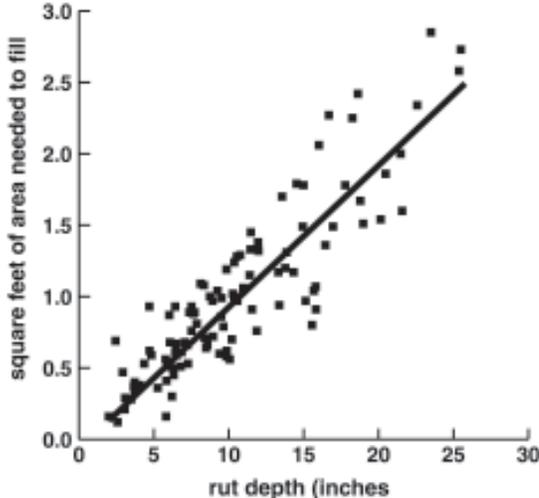
If the dozer operator only had to move 90 cubic yards during the retirement of 1000 feet of trail it would take approximately 50 minutes compared to an operator that has to contend with moving 190 cubic yards taking approximately 100 minutes. What affects the amount of



earth that has to be moved? RUTTING.

If a surface is deeply rutted and has excessive berms it takes much longer to resurface and build water bars than a surface that has little or no rutting. Figure 3 shows the relationship between rut depth and the square foot of void that has to be filled in to reshape a road or trail at any given point. Doubling the rut depth doubles the amount of earth

Figure 3. Rut Depth



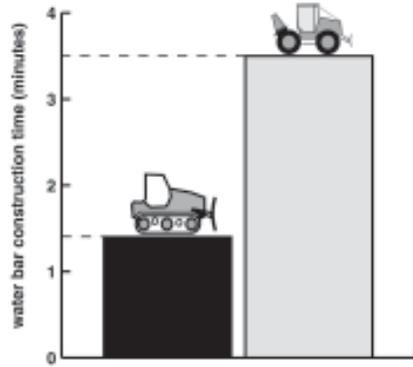
that has to be moved and increases the time for reshaping and water barring. The take home message, pay attention to rutting - it costs money.

Water Bars

The most common structure used to control water on retired skid trails is a water bar. Our study was able to provide some detailed time and cost information on water bar construction. Figure 4 shows the time it took on average for water bars to be constructed by dozers and by wheeled skidders.

On average dozers took 1.5 minutes per water bar and skidders took 3.5 minutes per bar. Further, dozers were able to easily construct adequate bars that were 3.5 feet tall on average and contained 6.2 cubic feet of dirt. Skidders struggled to make minimal water bars. On average skidders made bars that were 2 feet tall and had a volume of approximately 4 cubic feet. There was a large difference between operators when it came to the time it took them to build a water bar. The fastest dozer operator averaged 1 minute 10 seconds per water bar and the

Figure 4. Water Bar Construction Time for Skidders and Dozers



slowest averaged 2 minutes and 9 seconds. The fastest skidder operator averaged 2 minutes 53 seconds and the slowest 4 minutes 8 seconds, almost 2 minutes slower per bar than a dozer. It should be noted that a dozer operator was fairly consistent in the time it took to build a water bar. However, skidder operators varied quite a bit from one bar to the next. This again probably relates to the inadequacy of the skidder at moving earth.

Saving Time on Water Bars

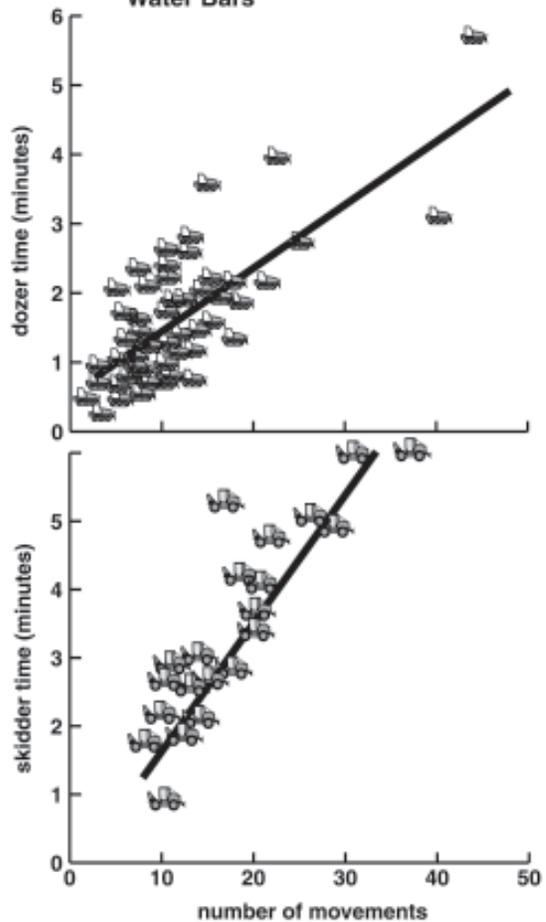
Our research showed that the amount of time taken to construct a water bar is directly related to how many movements the operator made to get the job done. Figure 5 shows the relationship between the time it takes to build a water bar and the number of movements the operator made.

If you can make a water bar with 10 movements our data shows that your total construction time will be about 1 minute. If you make 20 movements your time will be over 2 minutes. This adds up. The question becomes how many movements are actually required to make a water bar under typical conditions. In our research we analyzed each movement of the machine and the determined the amount of time the movement took and the affect the movement had on completion of the finished water bar.

If a movement of the machine contributed to the development of the water bar to a significant degree (as indicated by the amount of dirt moved, berm cleared or necessary positioning movement) it was considered useful to the completion of the water bar. The other movements were considered auxiliary



Figure 5. Number of Movements to Construct Water Bars



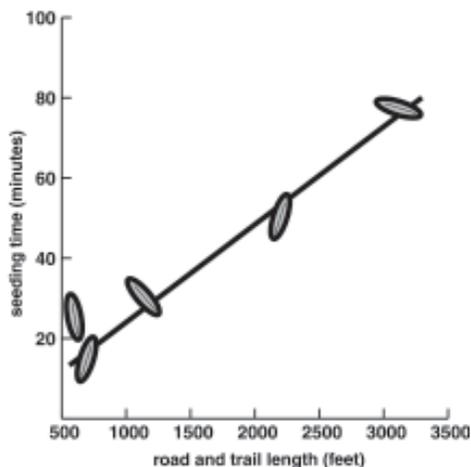
movements. Our analysis showed that typically it takes a dozer between and 4 and 5 forward movements to complete a well constructed water bar. If you combine these movements with the necessary backward movements our analysis indicates that you should be able to complete a typical water bar under average conditions in less than 10 total movements. Over 1/2 of the water bars that we analyzed required more movements than this and in many cases these movements were unnecessary. Our analysis shows that there is room to save time by analyzing your construction technique.

Seeding Skid Trails

Retirement requires the seeding of sediment producing and erodible roads, trails, and landings. The cost of seeding is related to the amount of seed used and the time it takes to spread the seed. In our study we determined the time it took to seed skid trails and roads, the length and width of the seeded area, and the pounds of seed used. Our analysis showed that the time it takes to use a handheld broadcast seeder was very similar among the loggers. However, the amount of seed used was not. Figure 6 shows the amount of time taken to seed.

For every 1000 feet of 16 foot wide road or trail that was seeded it took an average of 27 minutes. Loggers

Figure 6. Seeding Time



were very consistent with this. However, we found that some of the loggers were using as little as 22 lbs of seed per treated acre while some were using up to 152 lbs. The average cost of seed used in this study was \$6.50 per 10 lbs. Using this amount the cost of seed for 1000 feet of trail or road was \$5.15 for the logger using the low rate and \$35.57 for the logger using the high rate. (Note: the BMP manual recommends a rate of 30 lbs. which would cost \$7.02). While using extra seed can be good at times we found that a number of loggers were using well in excess of what was needed and thus driving costs up.



Besides the information presented in this article, our study also found several cost saving measures for loggers in the study. For example, the use of an ATV seeder. We also found that loggers that integrated retirement BMPs into the harvesting operations were able to reduce overall costs. Retiring as soon as the final skidding was completed on a trail reduced the cost of moving equipment back into areas at the end of a harvest.

Time Summary

Our analysis showed that on average Kentucky loggers took approximately 51 minutes to reshape and build water bars on 1000 feet of 16 foot wide trails and roads. These same loggers took on average 27 minutes to hand seed 1000 feet of trail or road.

Based on the results of the study cost savings for retirement work could consistently be obtained by:

1. **Minimizing rutting and development of excessive berms while skidding**
2. **Analyzing water bar construction and reducing the number of unnecessary equipment movements**
3. **Applying the proper amount of seed**

Overall Costs

Based on the information from our study we also calculated some overall costs figures for retirement work. (Note: It is important to remember that this figure is an average and that poor planning and logging during wet weather can increase this number significantly.)

Total cost per acre, assuming average soil and rutting conditions and average skid trail densities (1 mile of trail and roads that require retiring per 36 acres of timber) were approximately \$10 per acre for reshaping and water barring and \$ 2.60 for reseeded for a total retirement cost of \$12.60 per acre.

Cost per thousand board feet was also determined. If you assume average harvest production rates and a harvest of 2,700 board feet Doyle per acre, reshaping and water barring costs \$3.75 per 1000 board feet and seeding approximately \$1.00 for a total of \$4.75 per thousand.

Percentage of gross revenues, assuming average harvest and retirement conditions is approximately 3% for a typical timber harvest.

While this study was directed towards determining the costs of retiring skid trails and haul roads it is also important to remember that BMPs require more than just retirement. Total BMPs costs include items such as the construction and retirement of improved stream crossings, cost of maintaining and working in SMZs, debris management in streams, as well as work completed to control drainage during operations and retiring landings.

Continuing Education Exam

Cost of Retiring Skid Trails and Haul Roads Exam

If you complete the exam and receive a score of 80% or higher
you will achieve 1 credit hour toward your CE credits.

Name: _____

Phone #: _____

Address: _____

KML Designation #: _____

The following questions are based on information found in LogJam article "Cost of Retiring Skid Trails and Haul Roads. Please circle the correct response

1. Retiring haul roads and skid trails requires

- A. Ruts to be filled
- B. Berms to be removed
- C. Water bars or other water control structures to be built
- D. All of the above

2. The most important factor for either a dozer or a wheeled skidder that effects how much time it takes to reshape and build water bars is

- A. Operator experience
- B. Slope
- C. Amount of dirt that must be moved
- D. A and B

3. What effects the amount of dirt that has to be moved when retiring haul roads and skid trails directly?

- A. Weather at the time of retirement
- B. Rutting
- C. Soil type

4. What is the most common structure used to control water on retired skid trails?

- A. Broad based dips
- B. Silt traps
- C. Water bars
- D. None of the above

5. Cost savings for retirement work could be obtained by:

- A. Minimizing rutting
- B. Reducing unnecessary movements of dozer/skidder during water bar construction
- C. Applying the proper amount of seed
- D. All of the above

6. One factor that DID effect the time it took for retirement work to be completed with a dozer was:

- A. Number of years logging
- B. Years using BMPs
- C. Slope of hillside
- D. Total amount of earth moved

True or False (circle either T or F)

7. Skidders are more efficient at making water bars than dozers.....T or F

8. Research shows that the amount of time taken to construct a water bar is directly related to how many movements the operator made to get the job done.....T or F

9. Using the correct seeding rates for revegetation of skid trails can save you time and money.....T or F

10. Based on data from the research study, the average overall cost of retirement of skid trails and haul roads is \$12.60/acre....T or F

11. Total cost of BMPs only includes retirement of trails, roads and landings...T or F

12. The average rut for harvests in Kentucky was found to be 27 inches deep.....T or F

13. A surface (road or trail) that is 1000 ft. long and 16 ft. wide is approximately 1/3 of an acre.....T or F

14. With typical conditions and harvest situations retirement of skid trails and haul roads cost about 15% of your gross revenue for an average harvest.....T or F

15. Doubling the rut depth doubles the amount of earth that has to be moved and increases the time needed for reshaping and water baring.....T or F

Send completed exam to:

**Kentucky Master Logger Office
U.K. Department of Forestry
213 T.P. Cooper Bldg.
Lexington, KY 40546-0073**