A decision algorithm for determining safe clearing limits for the construction of skid roads

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Abstract

The majority of the timber harvested in the United States is extracted by ground-based skidders and crawler/dozer systems. Ground-based systems generally require a primary transportation network (a network of skid trails/roads) throughout the area being harvested. Logs are skidded or dragged along these skid roads/trails as they are transported from where they were cut to landings where they are loaded onto trucks for transportation to processing plants (sawmills, paper mills, OSB plants, veneer mills, etc.). The degree of construction/excavation required on these skid roads/trails varies with terrain steepness and the size of machines that will use them and the size of logs being transported. The excavation/construction of these skid roads/trails can create certain hazards that if not dealt with or eliminated can damage property or threaten human lives. For example, in the White .vs. Wenturine Brothers Lumber, Inc., ICI Explosives, USA and American Forestry Consultants .vs. John Bouch case, skid road excavation undercut the lateral support of a tree that was left on a vertical cut bank. The tree later fell on a logger severely injuring the logger. In this article we briefly review skid road/trail construction methods, review safety regulations, and provide a decision algorithm for determining practical and safe clearing limits/guidelines for the construction of skid roads.

Introduction

Society is increasingly demanding more of the nation's forests with respect to wood products (veneer, sawlogs, pulpwood, fuelwood, etc.) and recreational opportunities (hiking, biking, horseback riding, snowmobiling, etc.). Increased access to and use of our forest resources requires a network of haul roads and skid roads/trails (Skelton 1949; Meyer 1970). Haul roads generally are permanent and well designed, and receive heavy vehicle use. Most skid roads/trails are temporary and often poorly designed, but vehicle traffic on these roads is light once harvested timber has been extracted. However, skid roads/trails (hereafter called trails) continue to be used for recreation activities such as hiking, hunting, and horseback riding even after many of them have been gated or otherwise blocked off.

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Most of the timber harvested in the United States is extracted by ground-based skidders and crawler/dozer systems. Grounded-based systems require a primary transportation network throughout the area being harvested (Wackerman et al. 1966; Pearce and Stenzel 1972). Following cutting, logs are skidded or dragged along these trails to the landing, where they are loaded onto trucks for transport to sawmills, paper mills, OSB plants, veneer mills, etc. (Conway 1976). The degree of construction/excavation required on these trails varies with the steepness of the terrain and the size of logs/logging vehicles (Wenger 1984). Excavation/construction can create certain hazards that if not eliminated can damage property and threaten human lives. In one incident that led to a court case (Melvin Willard White vs. Wenturine Brothers Lumber, Inc., ICI Explosives, U.S.A., and American Forestry Consultants, vs. John Bouch Logging, In the Court of Common Pleas of Westmoreland County, Pennsylvania, Civil Division No. G.D. 382-2000, 2003), excavation undercut the lateral support of a tree that was left on a vertical (vs. backsloped) cutbank. The tree later fell, severely injuring a logger. In this article we briefly review current trail construction methods, review safety regulations, and provide an algorithm for determining practical clearing limits/safety guidelines for trail construction.

Materials and methods

The construction of trails on flat or gentle terrain requires little excavation. Trees, vegetation, or other obstacles are simply pushed out of the way with a bulldozer to create a trail that can be negotiated with a skidder, crawler tractor, farm tractor, or forwarder. Construction on steep terrain requires considerable excavation and movement of earth. On such terrain, the trail must be carved out of the hillside, which moves or otherwise displaces obstacles such as soil, rocks, and trees. Most of this material is deposited on the downhill side of the road and the bulk sometimes is buried in the fill or used as a barrier to hold the fill in place (Wenger 1984).

The following variables should be considered in judging whether to remove a tree or other obstacle from a cutbank during or following trail excavation (LeDoux 2004a, LeDoux 2004b):

- Sideslope (%). Steep slopes (≥ 25%) are unstable and require more excavation on the uphill side and more fill on the downhill side. Very steep slopes require full bench roads.
- Soil, solid/loose. Loose rock, etc. moves easily.
- Distance from cutbank edge. The closer the tree/obstacle is to the cut edge, the more likely it will fall.
- Moisture/aspect. Once soils reach the plastic limit, they are nearly liquid in consistency.
- Size of tree/obstacle. The larger the tree/obstacle, the greater amount of mass is on the cutbank.
- Undercut roots/soil. These remove a tree’s attachment to the ground, undermining stability.
- Species of tree. Certain species are shallow rooted while others have deep taproots.
- Tree health/vigor. A sound, healthy tree with a full crown always has a strong anchoring mechanism (root system).
- Clearing limits. Should be set and maintained where applicable.

These variables were used to construct a decision/flow diagram algorithm that can be used to help loggers/managers and folks involved in skid trail construction to define safe clearing limits. A dozer operator could use this algorithm to quickly decide if a potentially hazardous tree should be felled, felled and grubbed out, or left alone during the construction process. The decision algorithm could also be used post construction to decide on potential hazard trees/obstacles that result from everyday operating conditions and on the job shifting changes.

Results

Figure 1 integrates the above variables and is useful for setting practical and safe clearing limits for trail construction as it addresses decisions on removing trees within and adjacent to the cross section for trails with vertical or backsloped cutbanks.

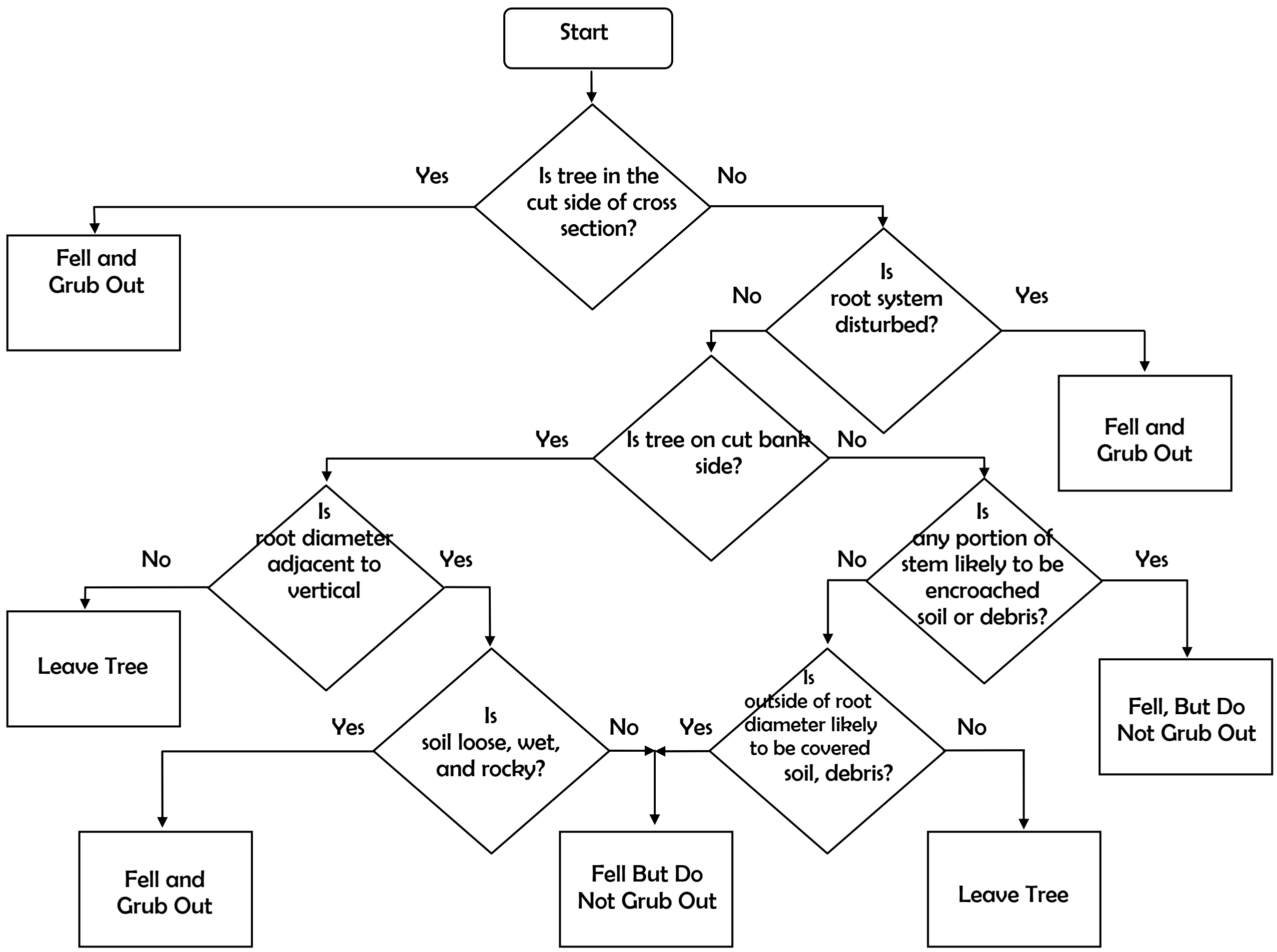

Figure 1. Decision chart for determining practical and safe clearing limits for skid road/trails with backsloped or vertical cutbanks and fill slopes.

Discussion

Few guidelines on clearing limits for forest haul roads (Anonymous 1983; Wenger 1984; OSHA 2000, 2001) are applicable to trails. The general recommendation is that “all snags, danger trees, loose rocks, stumps or other unstable material shall be removed or cleared for a safe distance back from roadsides or roadside banks when they present a hazard to users of roadways", and that "brush foliage or debris which would obstruct the view of a vehicle operator on roadway intersections or on sharp curves shall be cleared and all possible precautions shall be taken to relieve the hazard of such conditions" (Anonymous 1983).

Conclusion

The construction/excavation of skid roads/trails creates certain safety hazards that can be eliminated and/or mitigated by observing practical and safe clearing limits during and after trail construction/excavation. The decision chart included in this article should be helpful in determining guidelines that will result in a safer workplace. On a practical level, if there are doubts about a tree's stability, that tree should be removed. It is beyond the scope and space allowed for this report to detail the development and theory behind this decision algorithm. However, for a more detailed explanation of the development and examples of use of the decision algorithm see (LeDoux 2004a).

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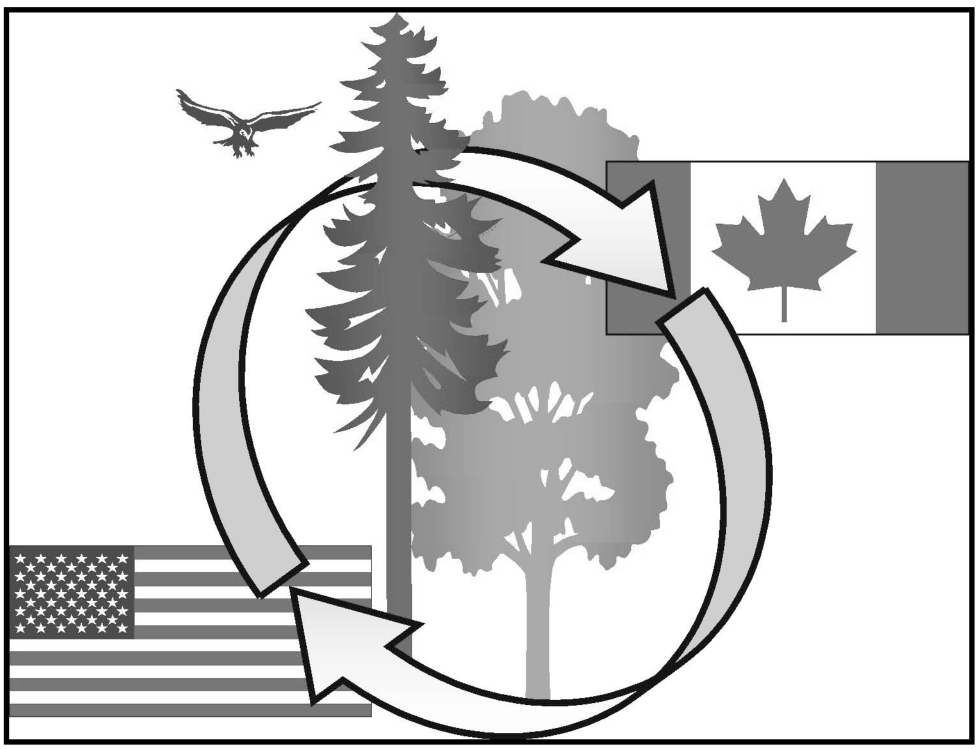

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