

4.2.2 Water Management on Inactive Roads

Roads no longer used for active logging or not regularly maintained require deactivation to provide maintenance-free drainage pathways and slope stabilization. The aim is to reduce erosion and to protect the road investment. The degree of modification to the road prism depends on whether the road will be left open for limited access, (temporary, seasonal deactivation or semi-permanent, rotation deactivation), or whether the road is permanently deactivated (closed permanently). Various techniques are used to deactivate a road: constructing cross-ditches, removing culverts, pulling back unstable fill/sidecast, outsloping roads, removing berms and improving ditches.

Cross-ditches and water bars

The purpose of a cross-ditch is to intercept, direct and disperse surface water flow off a road and ditch water across a road to a stable site on the downhill side of the road. Very little maintenance is required when cross-ditches are properly constructed, placed in correct locations, spaced closely, or when vehicle traffic is light.

Cross-ditch construction

1. The cross-ditch is cut into the road bed from the cut bank or ditch line completely across the road surface, extending beyond the shoulder of the road.
2. Physical blockage of the ditch line down grade from the cross-ditch is required to deflect water flow into the cross-ditch.
3. The cross-ditch should be placed at a minimum skew of 30° to the ditch line – greater on steep road gradients.
4. The excavated material is spread on the downhill grade of the road creating a berm.
5. Water should always be dispersed onto a stable slope with vegetation or rip-rap protection.
6. The cross-ditch berm should dip to allow vehicle cross-over without destroying the ditch.
7. The cross-ditch must be cut to the depth of the ditch line to prevent water ponding and to ensure drainage from the ditch line.
8. Ensure that ditch water is not redirected into different drainage basins.

The purpose of a water bar is to capture and direct road surface water from the road into the ditch line or across the road surface beyond the shoulder of the road. Note: a water bar, unlike a cross-ditch, collects only road surface water and not water flowing down the ditch line.



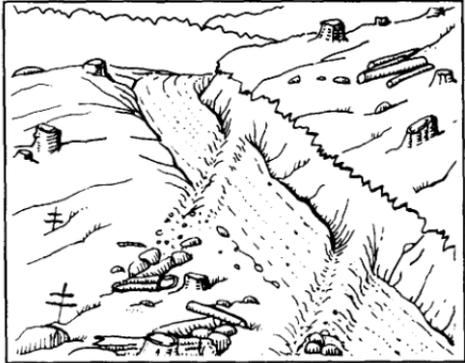
Slope drainage configurations

Various slope drainage configurations exist for cross-ditches.

The direction of water flow must conform to the topography or lay of the land.

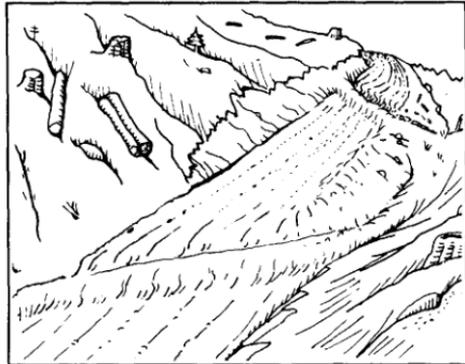
One-way water drainage

- Sidehill or contour cut road.
- Water is drained to one side along the natural hillslope drainage.



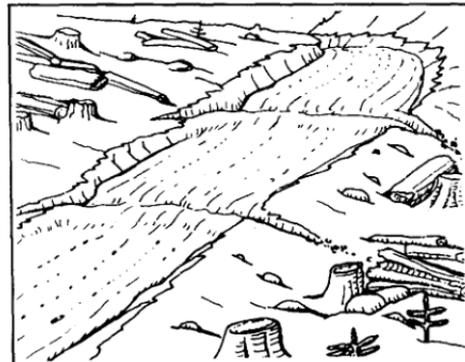
Two-way water drainage

- Road constructed in rolling terrain (shifting slope inclination).
- Water is drained to the road-side, dipping to the left or right into sites of natural hillslope drainage.



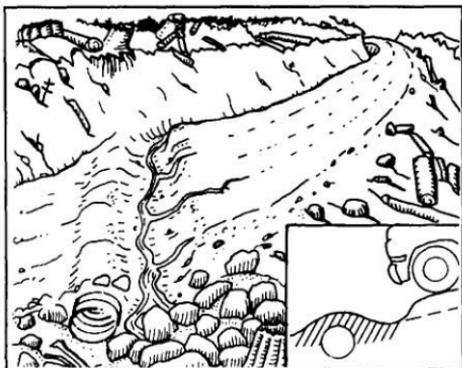
Thru-cut drainage

- Road grade follows the hillslope or cuts through a hillslope. Cutslopes on either side prevent drainage off the road.
- Water run-off on the site can only drain down the ditch line or along the road surface
- Cross-ditches cut in the road and through the cut banks permit water drainage off to either side of the road.



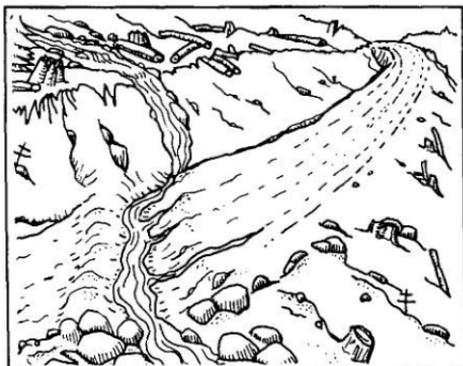
Typical cross-ditch locations

Several locations typically require cross-ditches. These are sites where natural drainage patterns have been disrupted by road construction. The best approach is to simply restore the natural flow patterns and prevent water from entering new channels. Five key locations require cross-ditches: culvert sites, stream crossings, sites where piping is evident, road junctions, and on thru-cuts. Cross-ditch locations should be identified and marked on the ground with flagging tape or, ideally, with spray paint from start to finish. Do not leave cross-ditch locations to the equipment operator's discretion.



Culvert sites

- Construct as a typical cross-ditch.
- Be sure to block culvert.
- Install cross-ditches more frequently than culverts.
- Culvert may be left in if road is to be re-opened shortly, or removed for use at another location.



Subsurface piping or ephemeral streams

- Locate slightly down grade of a site of subsurface piping or ephemeral stream channel to ensure catchment of flow.
- Ensure that a ditch block is in place.

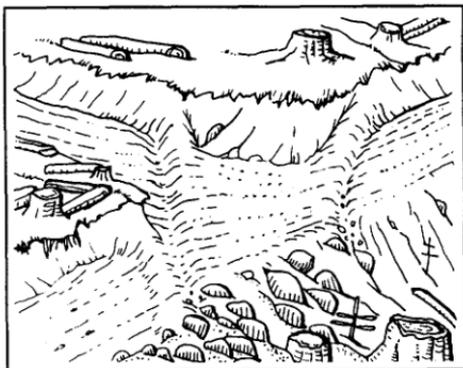
Thru-cuts and switchbacks

- Design specific drainage solutions for each site.
- Locate cross-ditches on the road grade above the thru-cut.
- General cross-ditch placement in the switchback extends from the lower ditch line at the end of the thru-cut, across the road shoulder.
- Ensure that water is dissipated to a stable site.



Road junctions

- Control drainage from two directions.
- Junctions require specific drainage solutions—several combinations may exist.
- Use typical cross-ditch construction.
- Ensure that drainage is adequate.



Stream fords

- Remove log-bridge or culvert.
- Dig dip to allow vehicle passage (2 WD or 4 WD).
- Riprap stream to reduce erosion.
- Place berm on down-hill side of ford to prevent water jumping the bank.
- Locate a cross-ditch above ford to reduce sediment.



Factors to consider when selecting locations:

LOCATION of natural drainage channels and identifiable water source areas
VOLUME of storm runoff channelized by road: <ul style="list-style-type: none">• intercepted ephemeral streams• surface runoff• subsurface seepage and piping• road surface water
DRAINAGE outlets (gullies, streams, depressions)
PREVENT ditchwater redirection into another drainage basin
PRESENCE OF STABLE sites where water can be directed
PRESENCE OF ROLLING dips in road grade already draining water

Cross-ditch spacing

The frequency and spacing of cross-ditches must be matched with the natural drainage requirements of the terrain. There is **no set spacing**. The purpose of a cross-ditch is to prevent channelized water buildup from causing mass wasting or surface erosion. Frequent cross-ditches are optimal since they reduce the volume of water any single ditch must handle and keep the channel's original drainage capacity from being exceeded.

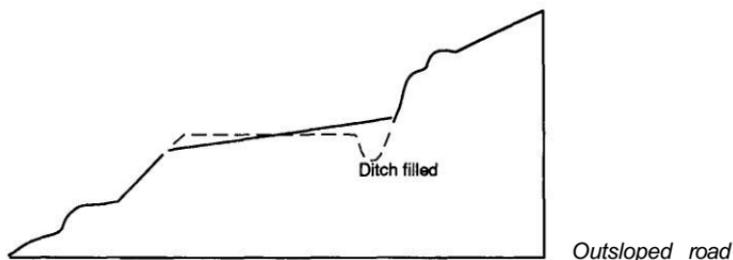
Rule of thumb for cross-ditch spacing

Closer cross-ditch spacing is necessary where: water flow is fastest, as on steeper hillslopes; water volume is greatest, as in mid- to lower positions; and soils are susceptible to erosion. Finer soils are more erodible than coarser, rocky soils.

Controlling water flow by sloping road grades

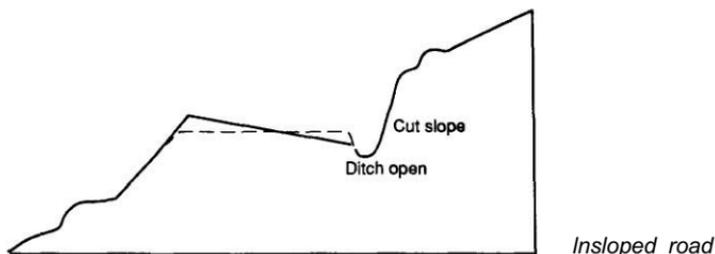
Outsloped roads

Grading the road surface so it slopes from the cutbank to the road shoulder creates an outsloped surface. Outsloping is effective on road gradients of less than 5% when hillslope gradient is less than 20%. To be effective, the outslope must be sufficient to drain water off the surface, but if visible to the eye, it is too steep for an active road. Outsloping is most effective where cut bank slumping will eventually plug the ditch line. Outsloping reduces the number of cross drains required except where low grades can pond water. Berms must be removed or opened to allow water to flow off the road.



Insloped roads

Insloping is used along short sections of road to keep road ditch water from flowing onto unstable fill-slopes. The road is sloped inward from the shoulder to the ditch.



Roads permanently closed

Roads constructed for temporary access through unstable terrain are permanently closed after logging. Maintenance costs are too high to keep the road open even for limited access. The conditions where roads normally require permanent deactivation include:

ROADS constructed as spurs
EXTREMELY STEEP SLOPES
INCOMPETENT BEDROCK — no firm bench
EXCESSIVE SIDECAST and fill in unstable positions
POTENTIAL for large fill or sidecast failures
TENSION CRACKS along sections of road
HIGH TO EXTREME landslide or surface erosion hazard
ROAD CONSTRUCTED for temporary access



Before

Note:

- Excessive sidecast
- Incompetent bedrock
- Tension cracks; potential for a large failure
- Lack of adequate drainage
- The presence of seepage water through fill/sidecast
- Organic debris incorporated in fill



After

- Fill and sidecast materials pulled back onto the road surface
- Cutbank overhangs are removed
- Drainage provided to prevent water ponding
- Organic debris removed from fill
- Revegetation undertaken

4.3 SLOPE PROTECTION THROUGH VEGETATION ESTABLISHMENT

Seeding with grasses and legumes reduces surface erosion and helps alleviate site nutritional problems. Planting with shrubs adds vegetative cover and stronger root systems, which in turn enhance slope stability. The prompt reforestation of clearcuts with closely planted vigorous stock assists in the re-establishment of a root network on unstable sites. If not controlled, surface erosion and small shallow slope failures can lead to larger problems which cannot be controlled. Large scale erosion requires applied engineering technology to correct and control. The terms "bioengineering" and "biotechnical slope protection" refer to the use of vegetation and structural slope protection to arrest and prevent slope failure and surface erosion.

4.3.1 Planning

Planning is required for the successful implementation of a revegetation program. Seeding should be an integral part of forestry operations, and not used as an afterthought once soil exposure and erosion occur. Before undertaking seeding ask a person with local experience for advice. Local knowledge based on successes and failures of projects is invaluable.

4.3.2 Site Preparation for Seeding

Seeding is best completed immediately after construction. Rough surface grooves act as miniature checks for seed, fertilizer and rain water, creating a favorable environment for seed germination. However, a slope must be mechanically stable before seeding. This is accomplished by controlling surface water drainage, removing cutbank overhangs, reducing slope angles, and benching.

4.3.3 Seed Application Methods

Two basic methods are used to apply seed:

DRY SEEDING
HYDRAULIC SEEDING

DRY SEEDING is done with rotary disk and air blown seeders. The methods are less costly than hydraulic seeding, but are limited to rough soil surfaces and gentler slopes.

Rotary disk seeders spread seed and fertilizer by centrifugal force. The simplest seeder is a cyclone-type handseeder.

Larger equipment is adapted for trucks, all-terrain vehicles, and aerial application.

Air blown seeders use air to blow or shoot seed and fertilizer a distance of 5-8 m. Equipment is adapted for trucks and all-terrain vehicles.

HYDRAULIC SEEDING, or hydroseeding, is the application of seed in a water slurry that contains fertilizer, soil binder, and/



Cyclone handseeder



Hydraulic seeding