



Fundamentals of Forest Roads



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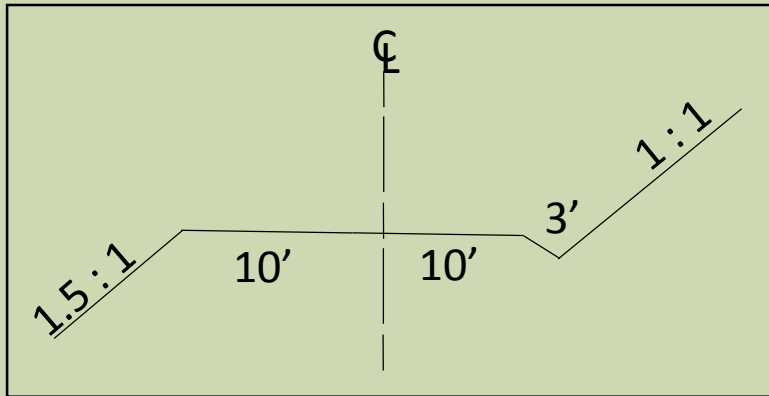
Road Standards Describe the “Quality” of the Road

Factors in determining road standards

1. Volume & weight of traffic
 - Purpose
 - Tractor trailer/tandem
 - Time of use
2. Area to be accessed
 - 50 ac vs. 5,000 ac
3. Budget
 - Construction costs
 - Maintenance costs
4. Impact on water quality
5. Site features
 - Topography
 - Location of timber
 - Natural barriers (rock outcrops)
 - Sensitive areas (wetlands)
 - Human made features (boundaries, powerlines, cemetery)

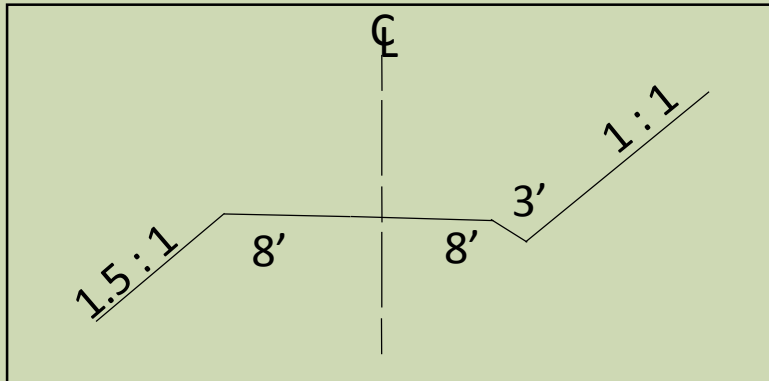


Most public & industrial landowners have published standards



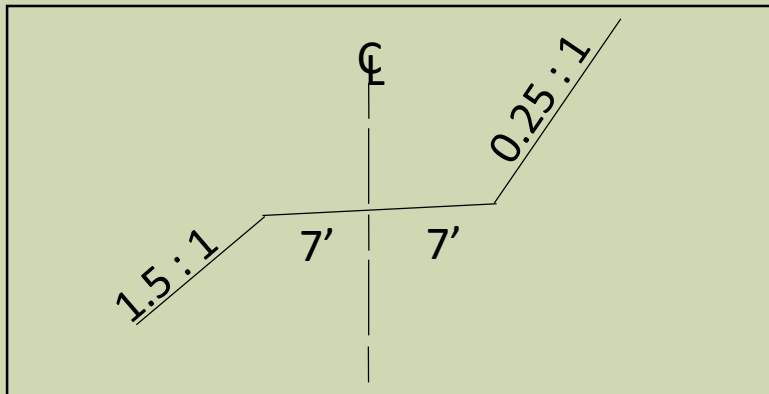
Primary or Class I roads

- Minimum curve radius = 100 ft
- Downhill gradient (loaded) = 8% (500 ft @ 12%)
- Uphill gradient (loaded) = 4% (500 ft @ 6%)



Secondary or Class II roads

- Minimum curve radius = 50 feet
- Downhill gradient (loaded) = 10% (500 ft @ 12%)
- Uphill gradient (loaded) = 6% (500 ft @ 8%)



Branch or Class III roads

- Minimum curve radius = 50 ft
- Downhill gradient (loaded) = 12% (500 ft @ 16%)
- Uphill gradient (loaded) = 4% (500 ft @ 10%)



The Majority of Current Forest Road Work Involves

1. Maintenance of existing roads

- Grading
- Adding gravel
- Cleaning and replacing culverts
- Improving drainage by cleaning ditches and repairing water control structures
- Repairing stream crossings
- Repairing gates

2. Constructing temporary access roads

- Harvest operations (skid trails and some haul roads that will be retired)
- Specialized activities (habitat management, fire control)

3. Retiring problematic sections & constructing new roads to solve a specific problem

- Major drainage issues
- Too steep for operation
- Curvature too excessive for operation



Plan the Location of Branch Roads and Skid Trails



The Goal of Reconnaissance is to identify:

- Alternative routes
- Major control points
 - Saddles, Rock outcrops, Ridges
 - Boundary lines
 - Stream crossings
 - Unstable soil
 - Switchback areas
- Proper runoff control
- Estimates of grades required to connect control points

Office Reconnaissance

- Topographic maps
- Aerial photos (Google Earth)
- Soil Survey Maps
- ****NEW FPPT**** (more on that later)

Field Reconnaissance

- Walk the site



Properly Located and Constructed/Maintained Roads Provide Benefits

1. Access

- Most property is less valuable without some form of road access

2. Reduces harvesting costs and increases the number of working days

- Increased stumpage
- Minimizes damage to vehicles and equipment

3. Compliance with the various federal & state laws

- Mud on road
- FPGs & GS

4. Emergency access

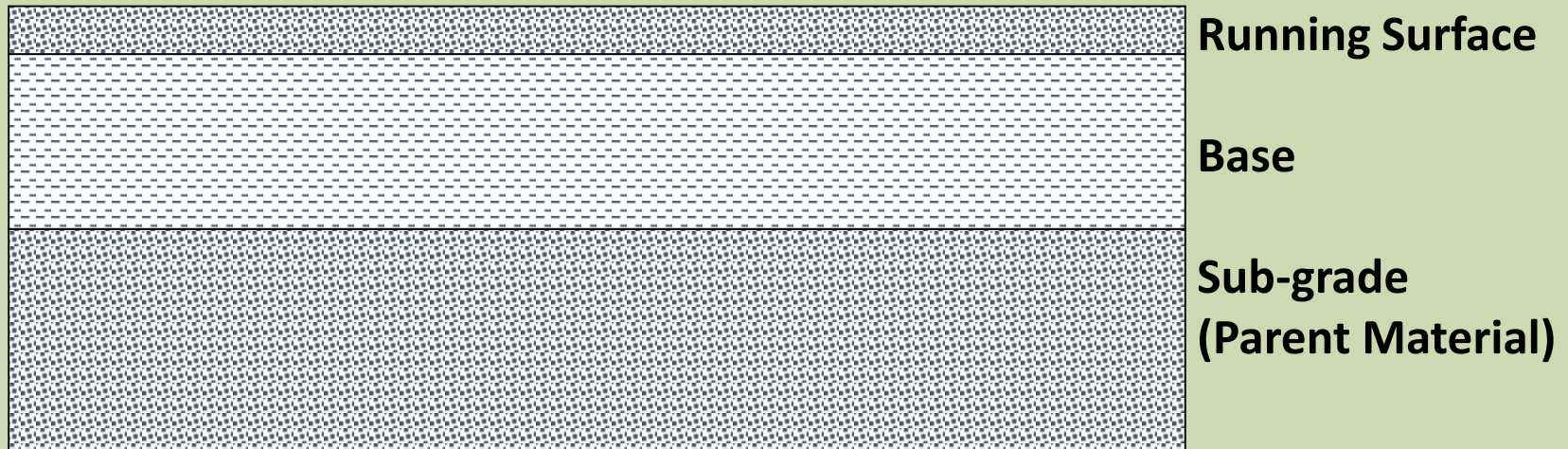
- Fire
- Salvage
- Rescue

5. Reduced road costs

- Decreased road lengths
- Avoid problem area where you could have to spend \$\$\$\$
- Reduces equipment time



Road Layers



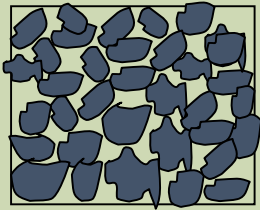
Running surface can be composed of different combinations of gravel (ABC, crusher run, etc) or may be absent

Base should consist of coarse particles with sufficient fines to maximize density, but not lose the strength of the rock

Sub-grade is the native material underneath a road. **This material is compacted prior base aggregate application**

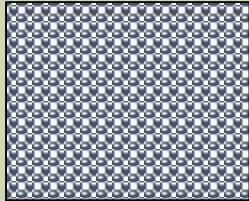


Strength of Material



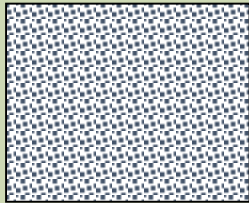
**Large
Gravel**

Base
35 - 60 %



**Small
Gravel**

25 - 40%



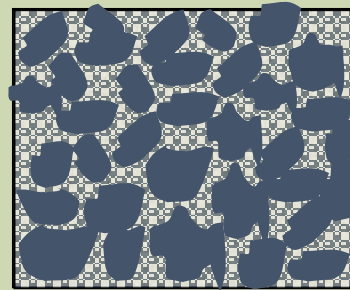
Sand

8 - 15%



**Silt &
Clay**

5 - 10%



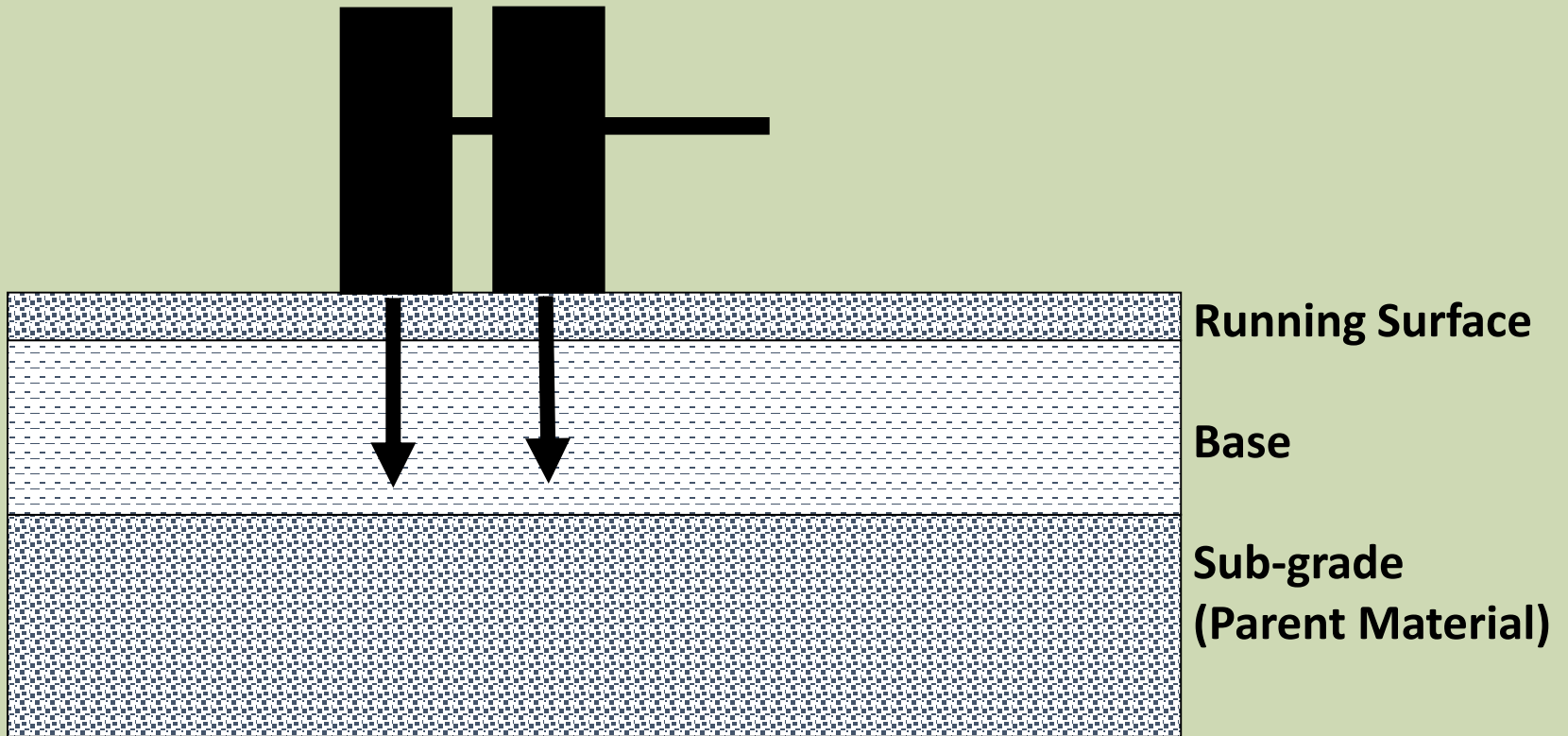
Weakness cause by:
'Gaps' (poor compatibility)

Moisture

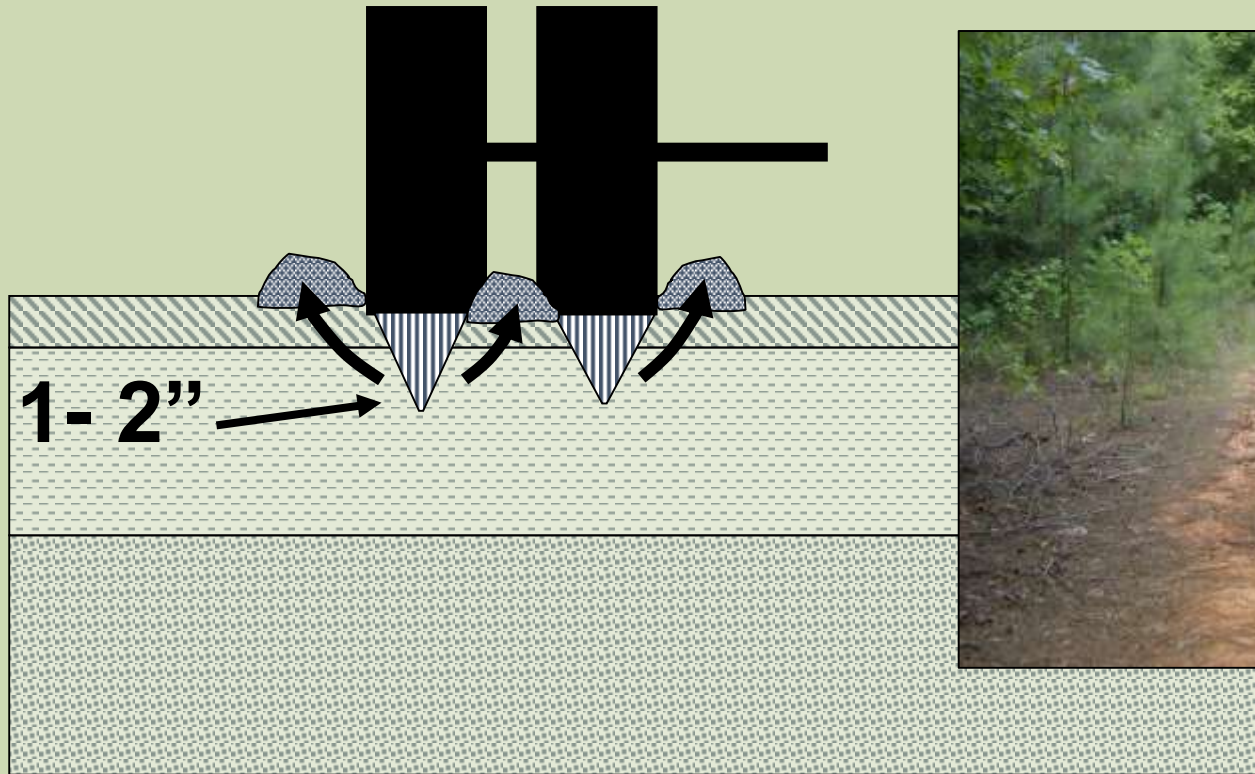


Road Loading Concept

Higher tire pressure = higher loading on the road



Road Surface Failures



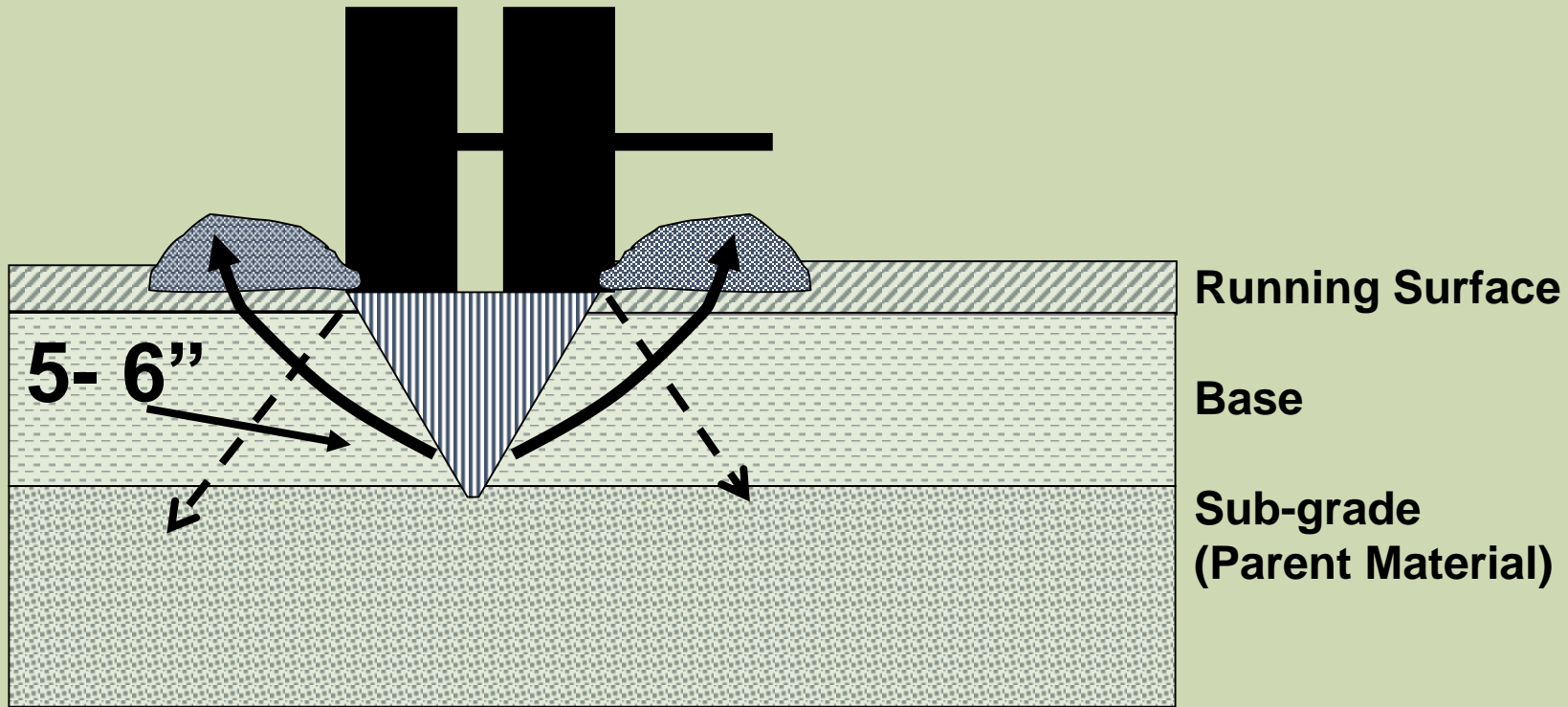
Temporary Solution = Add gravel

Longer term solution = Prepare and strengthen the road base

- Remove all organic matter
- Dig out 'wet spots' or provide additional drainage
- Remove low carrying capacity soils



Road Base Failures



Adding gravel may buy you a few uses, but it is not solving the problem

Solution = Strengthen the road base

- Add coarse gravel if absent in the base
- Place geotextile if there is a weak base or moisture issue
- Compact road base with roller packers (or trucks)



Geotextile Products Can Reduce Gravel Replacement Costs

1. **Separates:** Keeps gravel and soil from mixing
2. **Supports:** On soft soil, geo-products allow gravel to support loads without sinking
3. **Filters Water:** Many of these products allow water to pass through (this is why they can be used for stream crossings). They also trap sediment
4. **Reinforces:** Geo-products reinforce unstable soils such as road cuts



Water Control on Roads

No matter how well the road is laid out or built, if it does not have adequate water control, it will not remain a serviceable road for long.

Good road drainage allows rapid disposal of surface water without scouring or puddling



Common water control structures include:

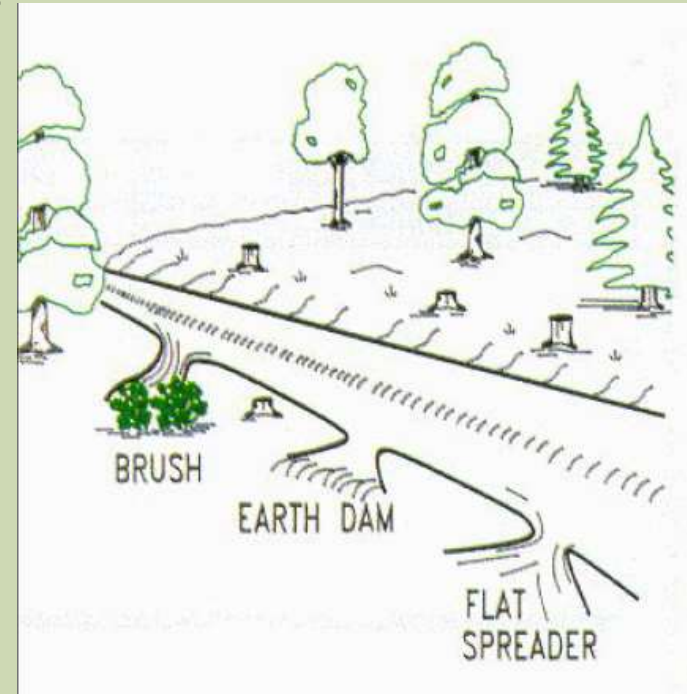
- Water turnouts/kickoffs
- Waterbars
- Broad based dips
- Rolling dips
- Culvert cross drains



Water Control on Roads

Water Turnouts

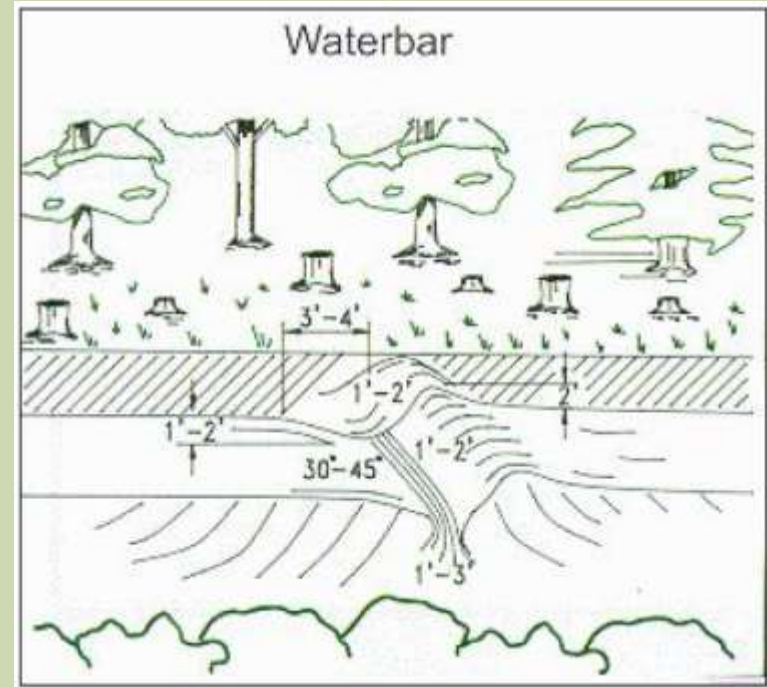
- This is a shallow trench that diverts runoff off of the road or trail
- Should make use of the natural topography
- Ideal angle is 15-30 degrees downslope
- Allow water to enter the turnout at the same grade as the road
- Avoid directing runoff onto soft soil or fills
- Can be used in conjunction with ditches
- Will fill in over time, may need maintenance



Water Control on Roads

Waterbars

- Constructed across the entire road surface
- Tie in to the uphill slope
- Earthen hump should be firm/hardened
- 15 to 30 degree angle
- Slight trench on the uphill side to gather and divert runoff (2-3% slope)
- Outlet should not direct runoff into a stream
- Can be used to retire roads and skid trails (use a taller hump to prevent traffic)



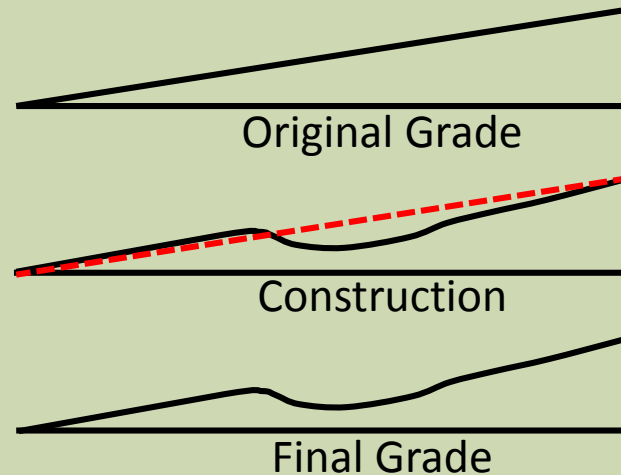
Water Control on Roads

Broad Based Dips

- Constructed at a right angle to the road surface and across the full width of the road
- Shallow dip is 15-20 ft long excavated on the uphill end
- Downhill end has a slight hump
- Bottom of the dip is outsloped
- Used when continued use is expected
- Use on roads with grades less than 12%



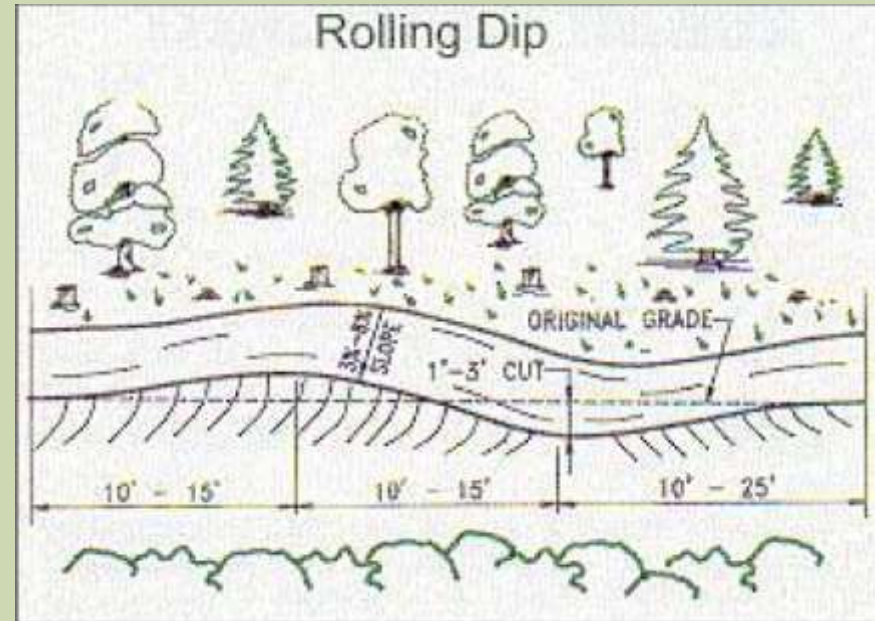
Photo credit, VA DOF



Water Control on Roads

Rolling Dips

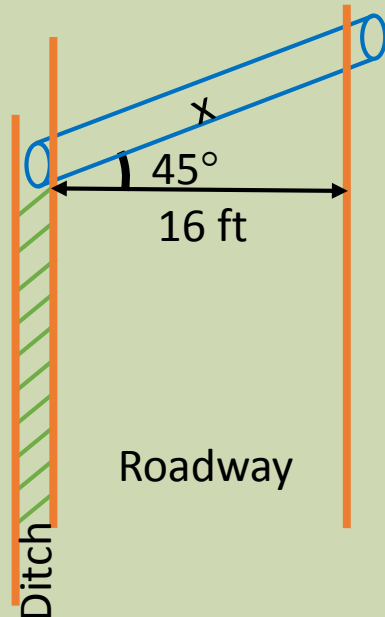
- A cross between a waterbar and a broad based dip
- Used on steeper roads in place of culvert cross drains
- Road is built up above the original grade then cut down below the original grade
- Has a reverse grade greater than a broad based dip, which requires slower traffic speeds (3-8%)



Water Control on Roads

Cross Drains

- Carries runoff out of an inside ditch line
- Cover pipes with fill at least 1-ft of fill
- Use 12 to 15-in diameter pipes
- Stabilize soils where applicable
- Angle pipes 30-45 degrees across the road
- Set at 2-4% downhill grade
- Can use an armored drop inlet if the outlet would be higher than inside ditch



What Are Some General BMPs for Roads



Construct roads at the minimum width to reduce impact (10-14 light use; 14-20 heavy use)

Keep road grades gentle

Limit cut/fill slope heights

In low lying areas, keep the roadbed as close to the original ground level as possible

Consider full bench construction in sloping terrain, so that the roadbed sits entirely upon solid undisturbed soilbank

Monitor road conditions and take prompt action

Close access to avoid unnecessary use

Maintain daylight on heavily used roads



Implementing Effective BMPs Lead to

- Fewer Days Lost to Weather-related Down Time
- Protected/Maintained Water Quality
- Sustained Site Productivity
- Legal Compliance
- Public and Landowner Approval
- Professional Improvement
- Less Damage to Equipment

