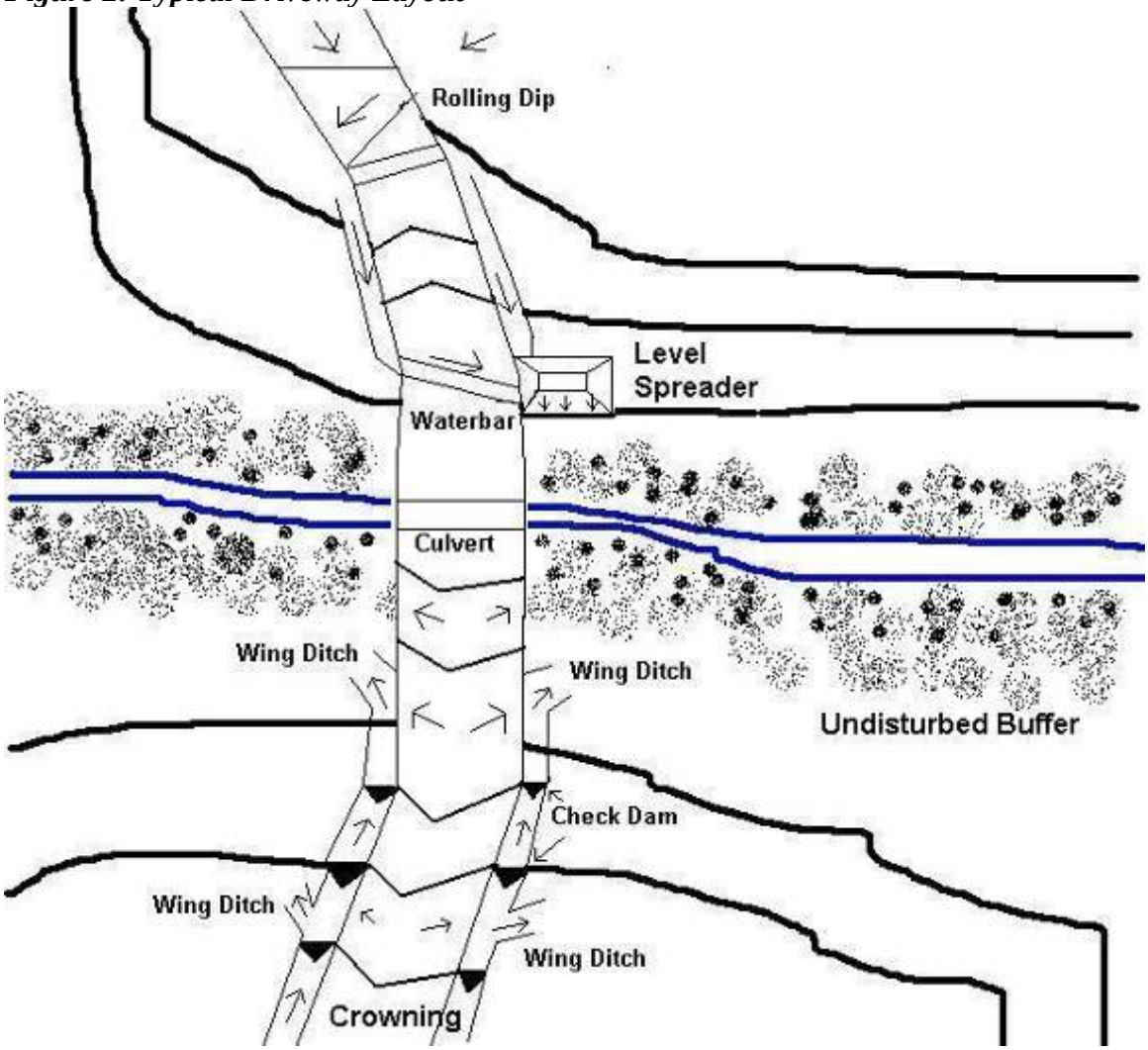
Suggested
Stormwater Management Practices
For
Private Driveways and Roads

These practices are necessary to satisfy the water quantity and water quality criteria of the Rappahannock Stormwater Ordinance. These practices maintain dispersed flows and prevent environmental damage due to erosion and increased runoff from development. These practices may be used for in-lieu-of agreements or residential site plan submissions.

The practices listed here are not comprehensive, and alternative practices may be appropriate for the site. Consult the Virginia Stormwater Management Handbook or the County for additional design options.
http://www.dcr.virginia.gov/soil_&_water/stormwat.shtml

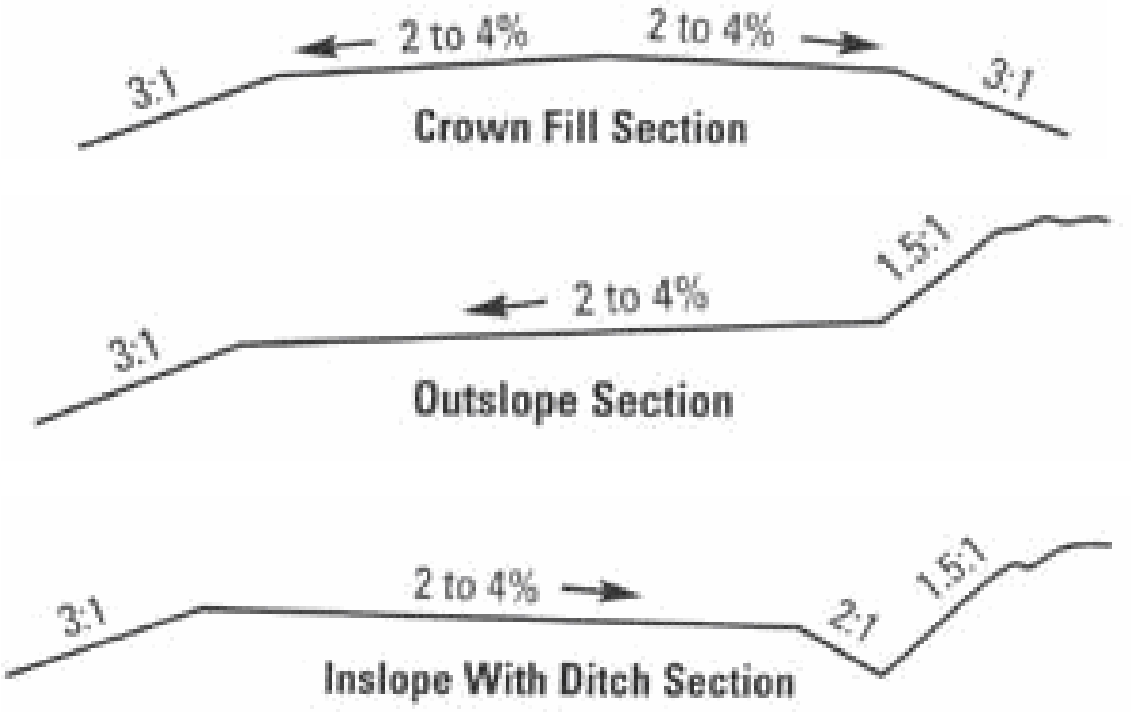
Figure 2: Typical Driveway Layout



Driveway practices:

- ❖ Wing Ditches
- ❖ Rock Check Dam
- ❖ Level Spreaders
- ❖ Rolling and Broad Dips
- ❖ Waterbar
- ❖ Cross Ditching or Cross Culvert
- ❖ Adequate Roadbed Preparation (Crowning or sloping)
- ❖ Filter Strips
- ❖ Undisturbed Buffer

Roadbed Preparation (Crowning, In-sloping, and Out-sloping)



What is it? Crowning, in-sloping, and out-sloping are grading techniques that provide roadbed drainage.

Purpose: Proper grading prevents the ponding of water on the road and prevents erosion of the roadbed. When water ponds on the road, the roadbed can become saturated and ruts can form. Improper grading that does not control the runoff can erode the roadbed and shoulders.

Limitations: Bedrock depth, Slope, Soil drainage, and length of flow.

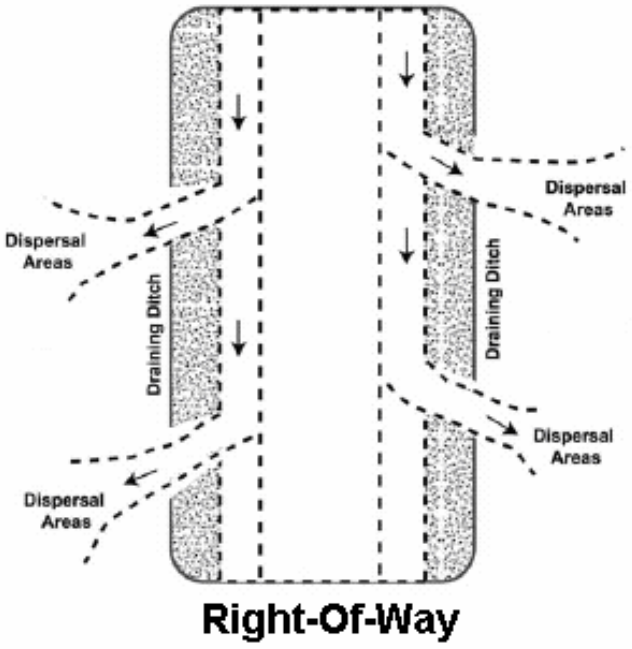
Materials: As noted in the above diagram. A minimum of six inches of gravel can be applied to the roadbed for a base.

Installation:

- Crowned sections can be graded where there is adequate drainage away from either side of the roadbed. Ridges and Floodplains. Ditches on both side are encouraged where practicable.
- Out-sloping and In-sloping are used along narrow valleys and hillsides or where sensitive areas require manipulation of the road drainage.
- Use Out-sloping where slopes are 3:1 and vegetation is uniform and stable. This technique can be used to disperse runoff into naturally occurring swales or depressions. On inside curves, out-sloping can be effective to shed runoff. Integration of a French drain can increase effectiveness.
- Use In-sloping when ditch conveyance is more effective, and where slope drainage is expected to washout the roadbed. This technique concentrates runoff in a conveyance system (ditch). On outside curves, in-sloping can be effective to prevent erosion. Integration of cross-drains, waterbars, and dips can be effective to disperse the concentrated ditch runoff.

Wing Ditch

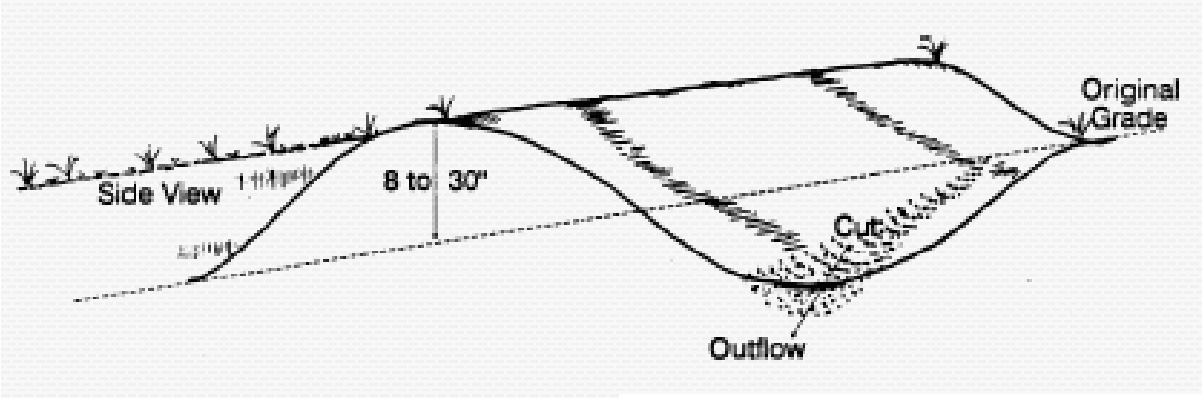
Slope Range		Maximum Distance Between Wing Ditches/ Turnouts (Feet)
Flat	2%	250
	3%	220
	4%	190
	5%	160
Moderate	6%	144
	7%	128
	8%	112
	9%	96
Steep	10%	80
	11%	60



What is it? Graded ditch turnouts.
Purpose: Wing Ditches disperse concentrated ditch flows by reducing the length of flow into more manageable and less erosive dispersal areas. The wing ditch reduces flow velocities.
Limitations: Bedrock depth, Slope, and adequate dispersal areas. The dispersal areas should have uniform and stable vegetation and does not cross property lines. Off-site dispersal areas may need drainage easements.
Materials: As noted in the above diagram. Rip rap can be used to protect fill slopes.
Installation:

- Acquire permission and a drainage easement to disperse runoff onto an adjacent property.
- The dispersal area should be vegetated, stable, and relatively flat.
- The wing ditch should begin at the same depth as the road ditch.
- Angle away from the road to direct all the water from the road ditch.
- Curve the wing ditch across the hill to flatten out the grade in the ditch. Do not turn it back uphill.
- Blend or feather the end onto a stable outlet to spread the water as much as possible.
- Avoid building wing ditches directly into streams. If possible provide a vegetated buffer between the outfall and stream channel.
- On sloping roads, angle the wing ditch at 30 to 45 degrees and slope at 2 percent less than the natural contour.
- Wing Ditches can be integrated with Level Spreaders, Waterbars, and Dips to provide a stable outlet.

Water Bar



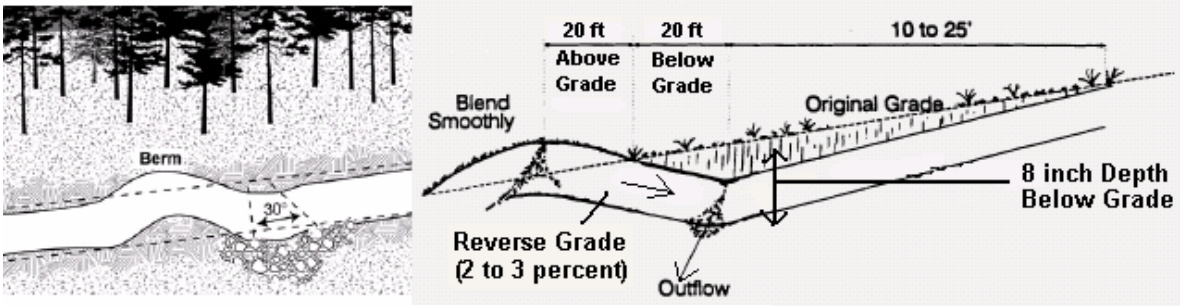
What is it? Diversion berm built across the roadbed.
Purpose: Waterbars gather and shed surface runoff off the roadbed. Waterbars can divert runoff from an inside ditch to an adequate outfall. Reduces runoff flow lengths and velocity.
Limitations: Bedrock depth, slope of outfall, and traffic. High vehicle traffic can damage these structures.
Materials: As noted in the above diagram. Use of a gravel berm, or timber diversion may be more effective for erosive soils.
Installation:

- Angle the berm across the roadbed in the down-gradient direction. An angle between 30 and 45 degrees is most effective.
- Tie the upper end into the inside ditch's bank, when present.
- Outlet should be open and extend far enough off the roadbed into a stable and undisturbed area. Outlet should have a grade 2 percent less than natural grade.
- Follow the waterbar spacing guide below on long sloping roadbeds.

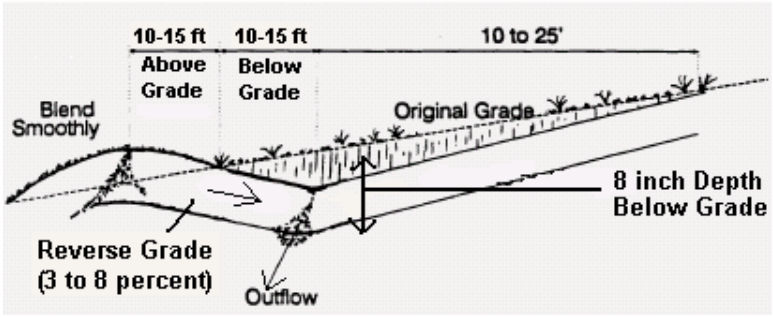
Spacing Guide

	Road Grade	Distance (Feet)
Flat	2%	250
	3%	220
	4%	190
	5%	160
Moderate	6%	144
	7%	128
	8%	112
	9%	96
Steep	10%	80
	11%	60

Broad-Base Dip



Rolling Dip

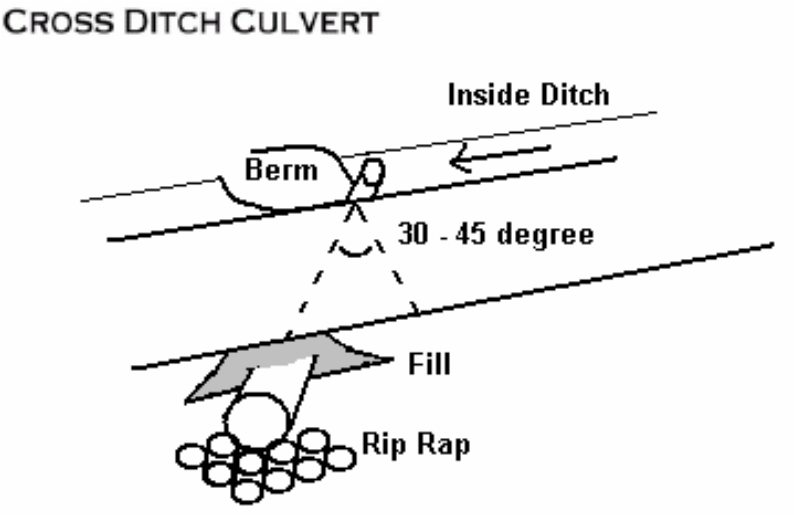


What is it? Broad-Base Dip drains water from the roadbed while allowing vehicles to maintain safe traveling speed. Rolling Dip is a broad-base dip with a water bar berm.
Purpose: Dips gather water and divert it safely off the roadway. Dips provide cross-drainage of inside ditches.
Limitations: Bedrock depth, slope of outfall, and traffic. This practice should not be used to handle live (constantly running) water.
Materials: As noted in the above diagram.
Installation:

- Broad-Base Dip must be used on roads where gradients are 8 percent or less.
- Rolling Dip must be used on roads where gradients are 15 percent or less.
- Angle the dip across the road in the direction of flow. An angle between 30 and 45 degrees is most effective.
- The dip will be out-sloped, the road will not be out-sloped.
- Blend the berm to as gentle a slope as possible to ease traveling.
- Either an energy absorber, such as rip rap, can be installed at the dip outfall.
- Follow the Dip spacing guide below on long sloping roadbeds.

Spacing Guide

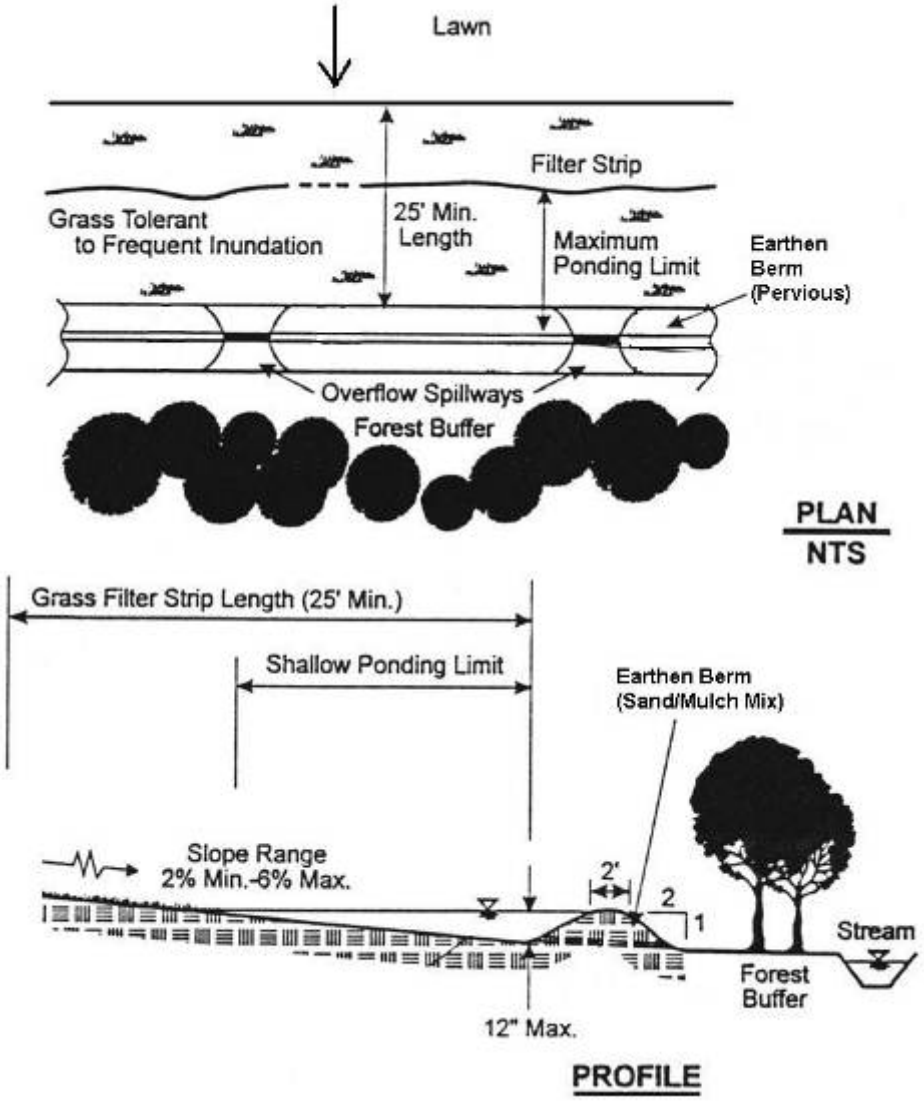
	Road Grade	Distance (Feet)
Flat	2%	300
	3%	233
	4%	200
	5%	180
Moderate	6%	167
	8%	150
Steep	9%	144
	11%	136
	13%	131
	15%	127



What is it? A culvert pipe placed in a ditch or dry swale.
Purpose: Cross-ditch culvert diverts inside ditches to an adequate outfall. These culverts shorten ditch flow lengths and reduce runoff accumulation.
Limitations: Bedrock depth, width of road, fill cover depth, and width of inside ditch. The culvert design and installation is different for draining springs/seep or crossing live (constantly flowing) water, these culverts need to be perpendicular and sized appropriately.
Materials: As noted in the above diagram: metal/concrete/plastic pipe, gravel or fill bedding, and rip rap.
Installation:

- Cross-ditch culverts should be installed at an angle of 30 to 45 degrees with the direction of flow.
- Install the culvert at a minimum of 0.5 percent and maximum of 2 percent slope.
- Pipe length should be long enough for both ends to extend at least one foot beyond side slope of fill.
- 1 foot of fill per 1 foot culvert diameter should cover the culvert.
- Provide a stabilized outlet. Use rip rap underlined with filter fabric or another structure such as a level spreader to disperse runoff and reduce flow velocities.
- Provide inlet protection measures during construction to prevent clogging.
- A berm can be used to prevent flow from bypassing the structure. An overflow mechanism may be needed in the berm for larger storm events.
- For cross-ditch culvert spacing follow the waterbar spacing guide.

Undisturbed Buffer or Filter Strip



What is it? This technique disperses runoff to reduce flow velocities prior to entering an undisturbed buffer or stream channel.

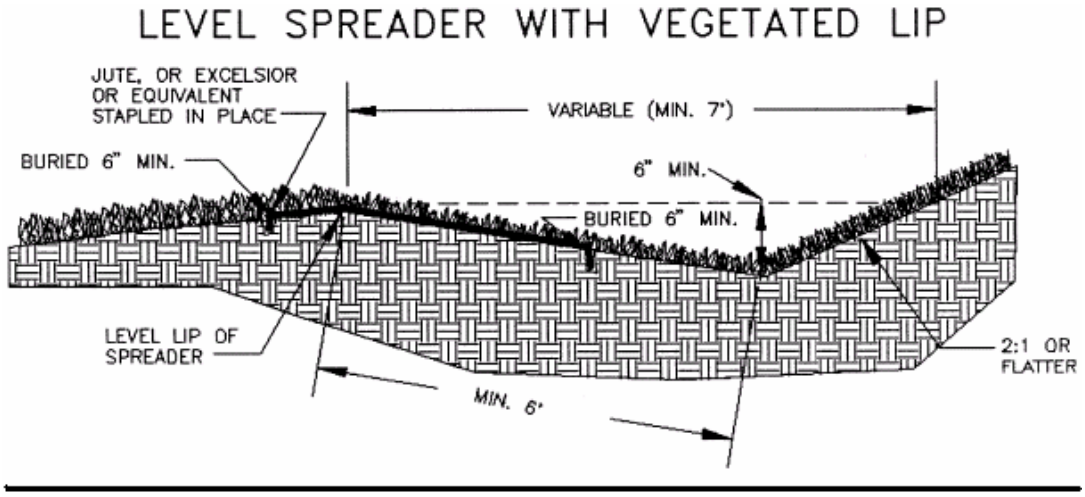
Purpose: To disperse runoff into sheet flow and to prevent erosion of the established buffer. Increase filtering capacity of the buffer. This practice is recommended where concentrated runoff could not be dispersed.

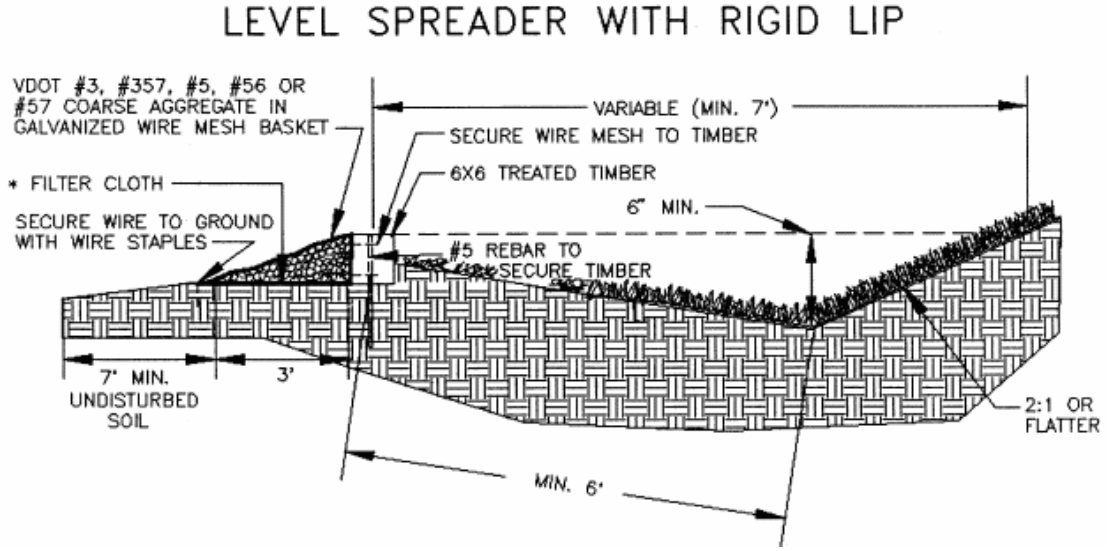
Limitations: Slope and the location of other structures in the yard.

Materials: None. Use natural materials onsite.

Installation:

- Most effective if implemented at the edge of the cleared lot.
- Disturbance of the buffer to achieve this design is <u>not</u> recommended.
- Earthen berm constructed of natural materials onsite (mulch/sand/earth).
- Build the overflow spillways similar to level spreaders with a long lip cut into the berm.
- Beware of flooding structures upstream. Should be temporary ponding, install drain pipes through berm if ponding is problem.





What is it? A graded shallow depression with a long overflow lip. The lip can either be rigid or vegetated.

Purpose: The level spreader is dispersion technique that reduces flow velocity and allows sedimentation to occur.

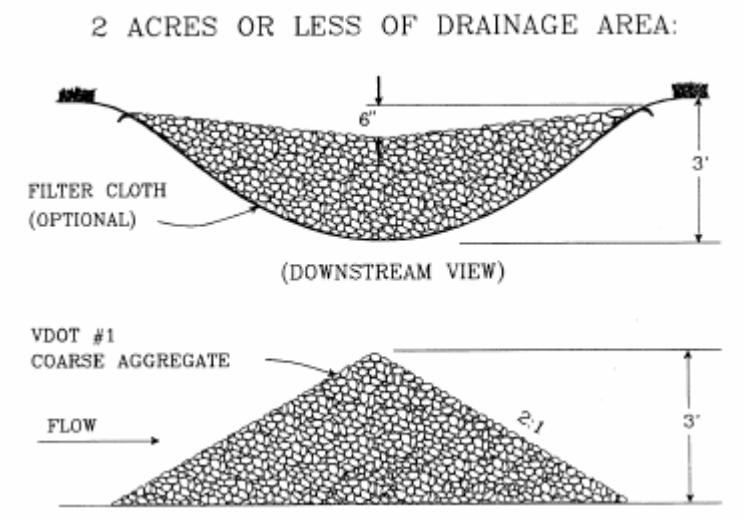
Limitations: Bedrock depth, width of ditch, width of road and right-of-way, and adequate stable slope.

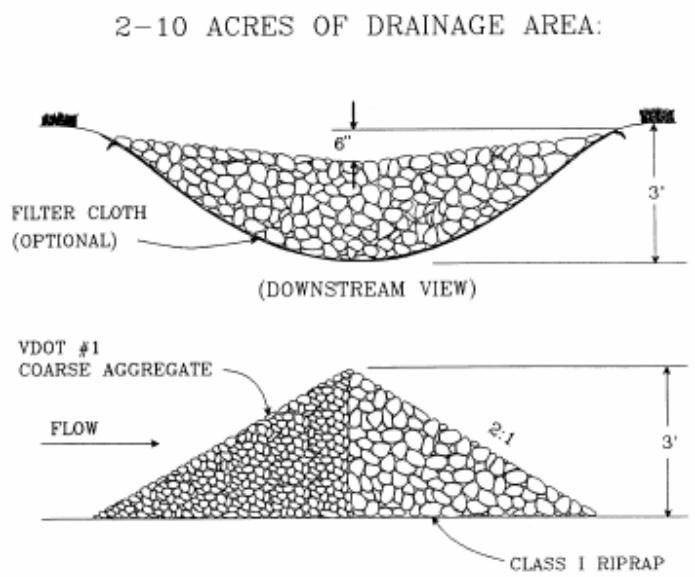
Materials: As noted in the diagram above: erosion control netting, gravel, and optional timber or concrete.

Installation:

- Level spreader constructed on undisturbed soil (not fill material).
- Construct a transition section from the ditch to spreader, blend to match grade.
- Construct the lip at a 0 % grade to insure uniform spreading.
- Erosion control netting should extend 6 inches over the lip and buried 6 inches.
- Securely entrench the rigid lip at least 2 inches below grade and anchor. Coarse aggregate should be placed at the top, behind the lip and extend at least 3 feet.
- Level Spreader pool and lip should be 10 to 20 feet long depending on expected flows.
- Seed and stabilize upon completion.

Rock Check Dam

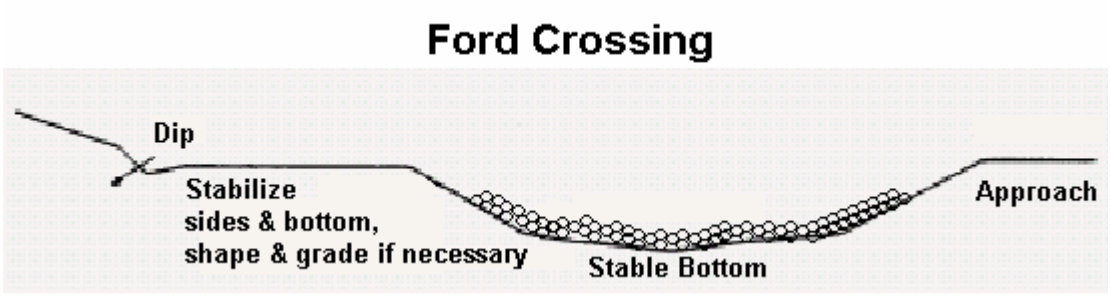


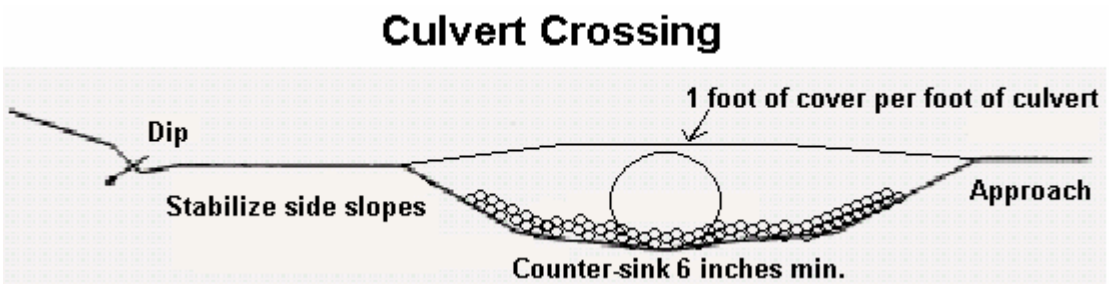


What is it? Check dams are v-shaped overflow structures constructed on gravel, timber, or concrete place in side ditches.
Purpose: Check dams create flow barriers in the ditch to slow channel velocity and allow sedimentation.
Limitations: Source of gravel and width of ditch.
Materials: As noted in the diagram above: gravel and filter fabric
Installation:

- Do not use Check Dams in live (constantly moving) watercourses.
- Drainage area should not exceed 2 acres when using VDOT #1 Coarse Aggregate and should not exceed 10 acres when using Class I Riprap combination.
- Maximum height of the Check Dam is 3 feet.
- Center of the dam should be at least 6 inches lower than outer edges.
- The base of the Check Dam can be keyed into the soil approximately 6 inches and underlined with filter fabric.
- Maximum spacing should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.

Stream Crossing (Fords and Culverts)





What is it? A stabilized area (Ford) or structure (Bridge or Culvert) constructed across a stream channel.
Purpose: Stream crossing provides access to a parcel. Following these guidelines will reduce streambank and streambed erosion.
Limitations: Bedrock, adequate slope, stream size, and stream pattern.
Materials: As noted in the diagram above: culvert, gravel, and filter fabric
Installation:

- Crossing should be perpendicular to stream flow and only in straight sections.
- The crossing should have low banks and a solid streambed (riffles are preferred).
- The driveway approach should be about 50 feet on both sides with reasonable slope.
- Install wing ditches, waterbars, dips, and level spreaders before the crossing. These structures should disperse runoff into an established and stable stream buffer.
- Fords should utilize non-woven filter fabric under a 6-inch base of stone (VDOT #1).
- Fords should not be used for stream flows exceeding 6 fps.
- Culverts should be counter-sink a minimum of 6 inches, depending on culvert diameter.
- 1 foot of fill per 1 foot culvert diameter should cover the culvert.
- Stream crossing method should not impede the movement of aquatic life.