Acknowledgements

Preparation of this field manual was funded in part through a grant from the U.S. Environmental Protection Agency to the Georgia Department of Natural Resources, Environmental Protection Division, under Provisions of Section 319(h) of the Federal Water Pollution Control Act (Clean Water Act), as amended. Contract number GAEPD 751-80001.

The Georgia Resource Conservation and Development Council (RC&D) Inc. acknowledges the contributions of the Georgia Better Back Roads Committee for guidance and technical support in the preparation of this manual. Members of the Better Back Roads Committee include:

Association of County Commissions of Georgia
American Public Works Association Georgia Chapter
Georgia Department of Transportation
Georgia Department of Natural Resources
Georgia Forestry Commission
Georgia Resource Conservation and Development Council
Georgia Soil and Water Conservation Commission
USDA Forest Service
USDA Natural Resources Conservation Service
US Environmental Protection Agency
US Fish and Wildlife Service

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May
2009

Georgia Better Back Roads Field Manual

"Driving Home the Point of Clean Water"

Georgia Resource Conservation
& Development Council, Inc.

Table of Contents

Introduction

Georgia is rich with an abundance and diversity of aquatic life from cold water trout streams in the mountains to the wide diversity of coastal and estuarine species along the coast. Sediment from roads and ditch banks contribute a heavy load to adjacent streams and our state waters. Sediment has a detrimental effect on fish and other aquatic life by either smothering habitat or interfering with feeding and reproduction due to high turbidity. Sediment has an economic impact. Sediment increases maintenance costs for local and state governments due to plugged culverts and ditches, basins and reservoirs, and equipment maintenance. Sediment is fast becoming a source of property damage litigation cases.

Sediment from dirt roads ranks second only to row cropping as a primary source of sediment loading in the state. There are more than 70,000 miles of streams in the state, about 4.8 million acres of wetlands, more than 425,000 acres of public lakes and reservoirs, about 545,000 acres of estuaries, and 100 miles of coastline. Of the stream miles in the state, about 12,000 miles have been assessed by EPD (2002) with 1300 miles being listed as biologically impaired by some type of pollutant, often sediment.

Nationally, there are more than 4 million miles of improved roads in the U.S. which include 44,000 miles in the interstate system. In Georgia, there are more than 88,000 miles of paved roads, and more than 28,000 miles of unpaved roads (2006 GDOT Road Data). This unpaved roads mileage does not include private driveways in the state.

This manual is arranged into five sections. Each section can be quickly found by looking for the red tab key on the side of the manual. Sections of this manual include:

(1) Road surface conditions and maintenance operations
(2) Road drainage issues
(3) Slope stabilization and erosion control
(4) Road materials and additives
(5) References, websites, and glossary

Each section is divided into topics to define or describe the topic; give general comments or common causes related to the topic; present "better" practices that reduce or eliminate the pollution cause(s); and show photos, sketches, diagrams, or tables to illustrate better maintenance practices. Details of some practices which are also common to erosion control on construction sites are given as reference to the "Manual for Erosion and Sediment Control in Georgia".

Disclaimer: This manual is NOT intended to be a design manual for construction or material specifications. All design work for roads, stream crossings, culverts, and permanent sediment traps must be done by **qualified professionals**.

Photo: Courtesy of Two Rivers RC&D Council

Goal: Clean Water
Coastal Estuary – McIntosh County, Georgia
Photo: By Sandy Jones, Courtesy of Seven Rivers RC&D Council

Section 1.
Road Surface Conditions and Maintenance Operations

Section 1.

General Comments: Road Surface Maintenance

Well maintained unpaved road; wide, grassed, no ditches.
Monroe County, Georgia
Photo: Courtesy of Two Rivers RC&D Council

Better Practices:

- **Best roadbed** surface materials have some plasticity, i.e., includes fines and clays.
- **Blended composite** roadway surfaces include coarse aggregates and fine clay-rich soils, e.g., 5-15% fines as a binder material.
- **Well graded** surfaces of 3-5% cross-slopes are best for in-sloping, out-sloping, or crowned road surface to drain water off road surface.
- **Wide, vegetated** right of ways are ideal for gentle, overland rainwater runoff dispersion.
- **Avoid concentrated flow** (channelized runoff).
- **Grade or maintain** road surfaces before significant potholes, washboarding, or ruts form.
- **Do not** grade during extended dry periods.
- **Avoid** blading, grading, or dragging for 48 hours following 1 inch of rain or during freezing temperatures.
- **Limit blading and grading** to times of optimal moisture content (see aggregate topic).
- **Do not disturb** road sections which do not need maintenance.

General Comments (continued)

Maintenance not needed on this section.
Murray County, Georgia
Photo: Courtesy of Limestone Valley RC&D Council

Surface "problem" Conditions

- **Washboarding** indicates a lack of surface cohesion resulting from loss of fines and can be corrected by scarifying (breaking, cutting) the road surface.
- **Ravelling** is a loss of coarser aggregates and can be corrected by grading or blading with the addition of fines of other binders.
- **Slipperiness** is caused by excessive fine aggregates in the road surface and can be corrected by grading or blading to mix surface fines and coarse aggregates and then compacting the surface.
- **Dust** is an indication of the loss of fine binder materials and can be corrected by adding water or other short-term chemical additives.

Basic Maintenance Operations

- **Blading** or smoothing – moving loose materials on road surface.
- **Grading** or reshaping – cutting into road crust.
- **Adding** – hauling and blending new materials into the road.

Washboarding

Description: Series of ridges and depressions across road surface.

Washboarding; lack of surface cohesion.
Photo: Courtesy of Limestone Valley RC&D Council

Causes:

- Loss of fines, especially during very dry conditions.
- Excessive vehicle speeds and traffic volumes.

Better Practices:

- Blade when damp, ***only if*** sufficient surface fines are still present.
- Scarify road surface ***if*** excessive loss of surface fines has occurred to re-mix, re-grade, re-establish crown, and recompact surface.

Scarify surface to re-mix surface fines.
Photo: Courtesy of Two Rivers RC&D Council

Section 1.

Ravelling

Description: Loss of coarser aggregates.

Causes: Loss of coarse aggregates after fine binder aggregates have been lost due to erosion or dust.

Road surface ravelling; coarse aggregates worn away by traffic.
Photo: Courtesy of Two Rivers RC&D Council

Better Practices: Blade with addition of fines.

Mixing fines back into road surface.
Photo: Courtesy of Two Rivers RC&D Council

Surface Distortions

Description: Surface depressions at an angle to traffic flow.

This distortion was cut into the road surface by operating motor grader too fast. The angle of depressions matches the angle of the moldboard.

Source: Federal Highway Administration, South Dakota LTAP Manual

Causes:

- Blading operation speeds too fast.
- Moldboard angle (pitch and tilt) too great.
- Blading when not necessary.
- Blading when too wet or too dry.

Surface Distortions (continued)

Better Practices:

- Maximum blading or dragging speed of ***3-5 mph***.
- Tilt moldboard blade at ***30-40 degrees.***
- Adjust angle of front wheels ***10-15 degrees*** toward direction of roll.
- ***Don't blade*** for the sake of blading.
- ***Don't blade*** in extended dry periods (contributes to loss of fines).
- Periodically blade against traffic flow.
- Use carbide tipped blades.
- Maintain recommended equipment tire pressure.

Blading against traffic flow can reduce surface distortions. Monroe County, Georgia

Photo: Courtesy of Two Rivers RC&D Council

Section 1.

Potholes

Description: Small depressions or voids in road surface one or more inches deep.

This road section suggests poor road drainage.
Photo: Courtesy of Limestone Valley RC&D Council

Causes:

- Excessive soil moisture content.
- Poor drainage/lack of crown.
- Poorly graded aggregates.
- High speed traffic.

Better practices:

- Patch and compact with graded material.
- Spot grading for individual or small sections.
- Re-grade, re-crown, and re-compact in extended sections of potholes to mix aggregates for a better graded road fill.
- Install underdrain if necessary to drain and/or improve sub-grade drainage.

Depressions

Description: Areas of road surface or sub-grade made weak by poor drainage, depressing under vehicle weights.

Poor drainage causing weak sub-grade and road surface from vehicle weights during “dry” periods.
Photo: Courtesy of Two Rivers RC&D Council

Causes:

- Poor surface drainage.
- Weak strength soils and/or sub-grade.

Better Practices:

- Fill, grade, and compact with well graded aggregate.
- Use underdrains or cross drains to improve drainage.
- Use geo-textile to improve strength and drainage.

Rutting

Description: Longitudinal depressions in wheel paths.

Inadequate surface water control and crowning contributed to this forest road rut.
Photo: Courtesy of Limestone Valley RC&D Council

Causes:

- High moisture content in subsurface base.
- Inadequate surface thickness.
- Heavy traffic loads.
- Poor surface drainage.

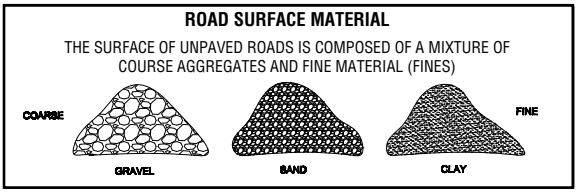
Better Practices:

- ***DO NOT*** simply fill with stone or soil.
- Add suitable material, grade, and roll surface.
- Crown surface if necessary.
- Re-mix and blade, or grade surface in severe situations.
- Add geo-textile or drain system in situations of repeated or sustained rutting.

Section 1.

Aggregates

Description: Any of various loose particulate material used on road base or surface such as sand, gravel, or pebbles.



Source: LV RC&D adapted from Choctawhatchee, Pea, Yellow Rivers Watershed Management Authority

General Comments:

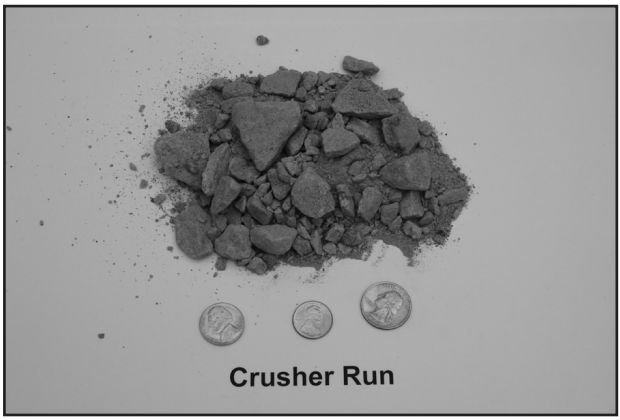
- Good gradation of a road is a mixture of coarse (gravel, stone), sand, and fines (clay). Problems arise when there is a loss or predominance of one material or another.
- Coarse aggregate increases the strength of road fill soils, improves traction, is less erosive, and reduces road surface degradation.
- Sand helps clay soils drain better; and clays help retain moisture in coarse materials.
- Fines (clay) act like cement holding the aggregate together. Dust indicates fines are blowing away. Insufficient fine material prevents formation of a crust, reduces capacity to maintain moisture, and contributes to loss of cohesion, and compaction of road material.
- Conduct road maintenance operations during optimal moisture content.

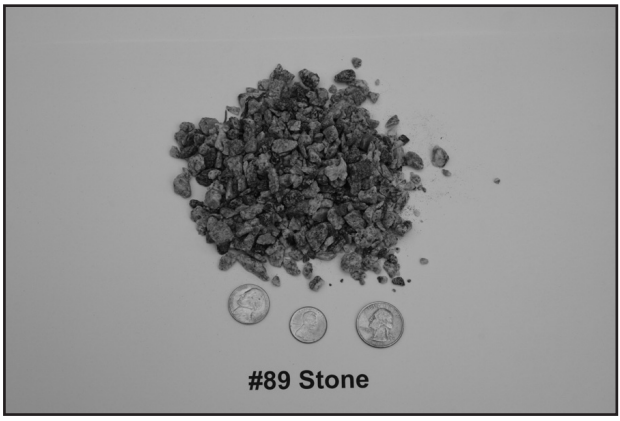
  Tip: Grab a handful of material and make into a ball. If the material sticks together when you open your hand you have good moisture content. If it falls apart it is too dry. If water runs out between your fingers, it is too wet.

Source: US Environmental Protection Agency

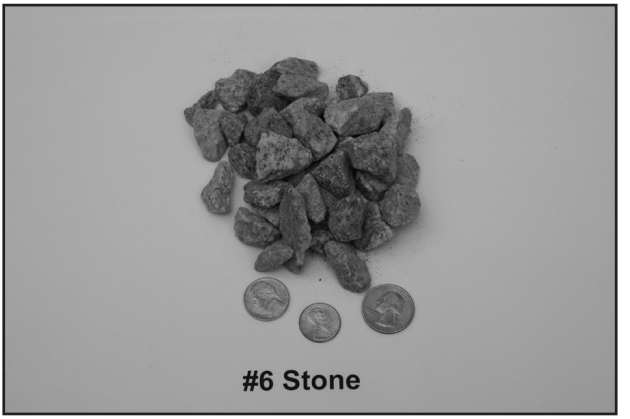
Aggregates (continued)

Examples of Aggregate Stone Sizes in Georgia



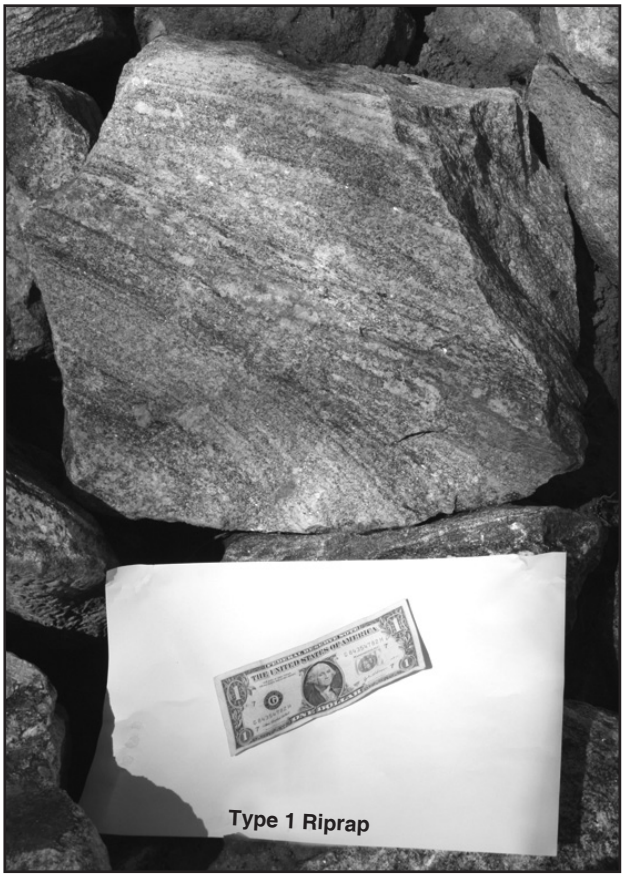


Aggregates (continued)



Aggregates (continued)

Type 3 Riprap
(Surge Stone)



Type 1 Riprap

Photo series: Courtesy of Two Rivers RC&D Council

Approximate Sizes of Coarse Aggregates (adapted from GDOT Sections 800, 805)

Typical Reference Name	Approximate Size (inches)	Comments/other names
GAB	varies	graded aggregate; crusher run; includes fines
# 89 stone	0.05 - 0.4	used around under drains and for paving
# 7 stone	0.2 - 0.5	used for pipe bedding and for paving
#57 stone	0.2 - 1	used for pipe bedding
# 6 stone	0.4 - 0.75	seldom used
# 5 stone (un-washed)	0.5 - 1	most commonly used for road surfaces and paving
# 3 stone	3" - 4"	most commonly used on forest roads and construction entrances
Riprap Type I	12" - 24"	most commonly used for outlet protection
Riprap Type III	6" - 12"	surge stone
"Shot" rock	> 36"	boulder sized

Section 1.

Blading

Description: Using an earthmoving blade to move loose surface materials from high spots or road sides without cutting into the road crust to fill or smooth surface irregularities.

Blading to move surface materials; note slight tilt of front wheels.
Photo: Courtesy of Two Rivers RC&D Council

General Comments:

- Note this is not the same as “grading” which does cut into the road crust i.e. the compacted, durable, impermeable layer at or below the road surface.
- Sometimes referred to as “dragging” or “smoothing”.

Better Practices:

- Adjust ***moldboard*** angle between ***30 and 40 degrees.***
- Tilt ***front wheels*** slightly ***10 to 15 degrees*** in direction of aggregate roll.
- Generally operate ***3 mph*** in second gear.
- **Do not** blade in extended dry weather.
- **Do not** blade within 48 hours after ***1-inch*** rain or during freezing temperatures.
- Ideal time for blading or dragging is soon after a rain while surface is moist but not wet.
- Periodically blade against traffic flow to prevent aggregate drifting.

Grading

Description: The cutting, redistribution, and re-compacting of the road surface crust, or adding new road material to obtain or change roadway shape and profile.

Note tilt of front wheels and grading against traffic flow.
Photo: Courtesy of Two Rivers RC&D Council

General Comments: This is not the same as "blading or dragging" which does not cut into the road crust.

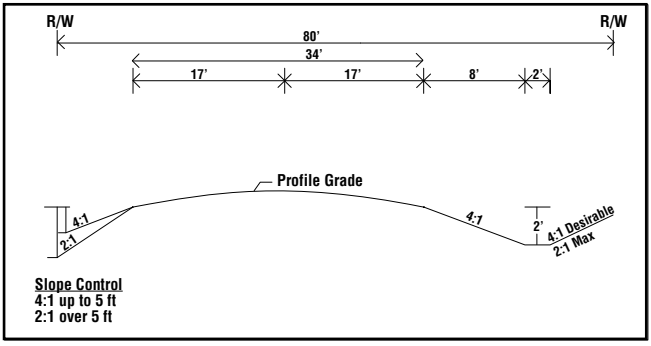
Better Practices:

- Perform with outer edge of moldboard at the edge of road surface.
- Tilt moldboard backward with sufficient down pressure to produce cutting action.
- Scarify (rake) existing road surface before adding new material to "blend" materials.
- Add new materials by running dump truck down center of roadway and then blending with scarified surface using a grader.
- Compact entire width of disturbed roadway before end of day.
- Re-establish drainage to ditches or other outlets.
- If road ditch is not to be re-worked, keep minimum one-foot distance from ditch line to avoid disturbance, and then bring road surface back to and slightly above ditch line to avoid false ditch along roadway.
- Avoid leaving a "windrow" of material along road edge which can act as a dam.
- Grade only when needed.

Crowns

Description: Center of the road is higher than the outer edges to aid in drainage.

General Comments: Crowns are first line of defense against water and subsequent problems with poor drainage causing softening of road crust, rutting, potholes, and depressions.



Example of typical road crown profile.
Source: Limestone Valley RC&D adapted from GDOT

Problems:

- Over time the crown will lose its shape and may become "rounded" (parabolic).
- Parabolic crown may also be caused by worn cutting edge in center of blade.

Better Practices:

- Maintain a cross slope drop of ½ inch to ¾ inch per foot from center to edge of road; or 4-6 inch drop for an 8-foot lane.
- Maintain straight-edge on grader blades (use cutting torch to straighten edge whenever center wear is ½ to ¾ inch or more).
- Use blade with carbide bits (resists wearing).

Re-shaping Crowns

Re-shaping crown step 1: cutting road surface.

Re-shaping crown step 2: re-distributing road surface.

Re-shaping crown step 3: re-mixing road surface.

Crowns (continued)

Re-shaping crown step 4: final shaping.

Re-shaping crown: completed.

Photo series: Courtesy of Two Rivers RC&D Council

Shoulders

Description: The edge of the roadway between the traveled portion and the drainage.

General Comments: Functions of the shoulder are to: (1) support the edge of the traveled portion of the road; (2) provide a safety area for drivers; and (3) carry water away from the road surface. In relation to the roadway edge, the shoulder should be **no higher** than the roadway creating a berm which may pool water, **or lower** than the roadway which creates a drop-off from the driving surface.

Problems:

- Secondary ditches (other terms: false ditch, berms, or curbs).
- Water channels through secondary ditch creating additional erosion along the roadway.
- Water collects on road edge and then seeps into subgrade.

Causes of problems:

- Cutting too deep at the shoulder line with the toe of the moldboard.
- Losing material from the toe of grader's moldboard.
- Cutting edge is not reasonably straight, i.e., greater than ½ to ¾ inch wear on blade.
- Excessive "whip-off" of loose material by fast traffic resulting in "piling" along edge.
- Heavy loads on roads with weak subgrades shoving shoulder area up.
- Traveling near shoulders causing ruts in roadway and shoving shoulder area up.

Shoulders (continued)

Better Practices:

"Pull and Cover" Steps:

- Existing surface gravel is cut loose and windrowed to opposite side of road.
- Cut secondary ditch slightly deeper, place material in roadway.
- Pull material from high shoulder into cut and work into cut.
- Cover with windrowed gravel and restore proper crown to roadway. Note: material from high shoulder may not be suitable to be re-used on roadway.

Example of "pulling" ditch and re-establishing crown.
Monroe County, Georgia
Photo: Courtesy of Two Rivers RC&D Council

Intersections

Description: An area of maintenance concern where roads meet

Better Practices

Controlled intersection: Side road traffic has to stop or yield.

- Primary road retains crown.
- Side roads eliminate crown gradually 100 feet from intersection.
- Side roads should be flat and match primary road at intersection.

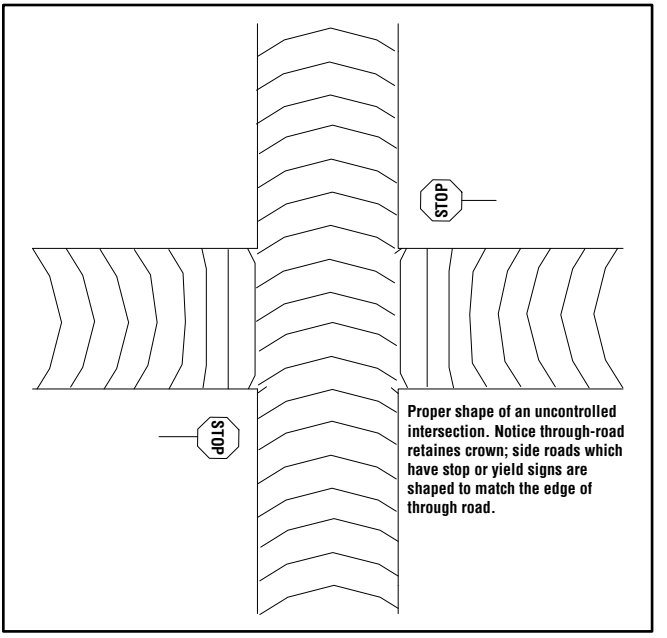


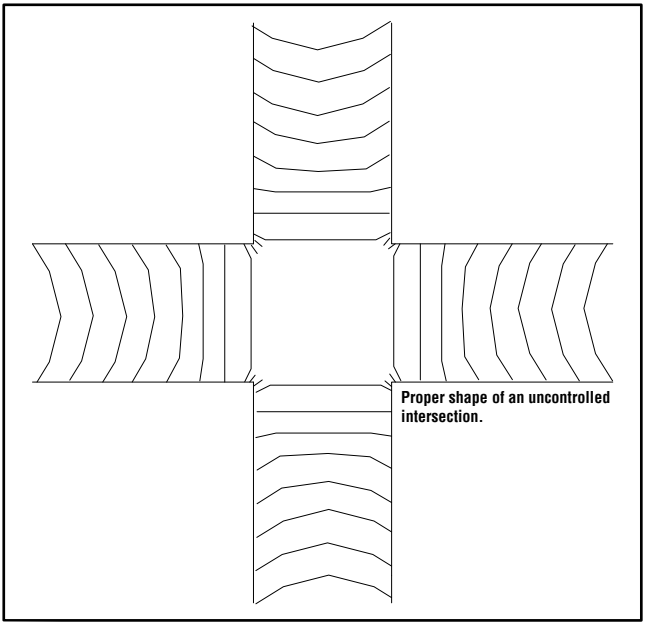
Illustration of proper crown shape at controlled intersections. Curved lines indicate road crowns at intersection.

Source: Limestone Valley RC&D adapted from Federal Highway Administration, South Dakota LTAP Manual

Better Practices

Uncontrolled intersection: All traffic stops or yield at intersection.

- All roads gradually eliminate crowns 100 feet from intersection.
- Intersection is flat, but not lower than roads (to avoid collecting water).
- Eliminate crown from all directions approaching the intersection.



Proper crown shape at uncontrolled intersections. Curved lines indicate road crowns at intersection.
Source: Limestone Valley RC&D adapted from Federal Highway Administration, South Dakota LTAP Manual

Better Practices

Intersection with paved surfaces: such as bridge decks, driveways, railroads, paved roads

- Eliminate crown gradually 100 feet from intersection.
- Gravel road should match paved surface at intersection.
- Avoid gravel on paved surface.
- Use backdragging to fill potholes at edge of pavement, i.e., moldboard lifted up and set down in front of material to "pull" gravel back onto gravel road.
- Contact railroad or your supervisor ***immediately*** if rails are snagged or damaged.

Gravel to pavement problems: potholes.

Replace and back-drag gravel from pavement.
Source: Federal Highway Administration, South Dakota LTAP Manual

Sensitive Areas: Wetlands

Description: Areas vulnerable to road runoff due to proximity to water bodies and limited space for road runoff control or treatment.

Unpaved road adjacent to wetland (right shoulder); note vegetated shoulder, banks and ditch to trap sediment. Lamar County, Georgia
Photo: Courtesy of Two Rivers RC&D Council

General Comments:

- **Avoid** discharge to wetlands.
  - Stabilize road and ditch banks.
  - Maintain vegetated ditches.
  - Use turnouts to stable, mature vegetated areas.
- **Minimize** discharge to wetlands.
  - Use vegetated filter strips.
  - Use permanent sediment traps. (will require regular maintenance).
- **Mitigate** wetland damage.
  - Last resort; costly.
  - Requires permits.

Better Practices (any one or combination):

- **Gravel** or do road surface treatment a minimum of **100 feet** above discharge outlet(s).
- **Hydro-seed** and mulch ditch banks a minimum of **300 feet** upstream of discharge outlet(s).
- Use **rock filter dam** upstream of discharge outlet.

Rock Filter Dam

General Comments:

- Minimum top width of 6 feet
- Center at least 6 inches lower than outer edges
- Edges not higher than natural channel banks
- Side slopes 2:1 of flatter
- Remove sediment when ½ full of original storage.

General comments adapted from Field Manual for Erosion and Sediment Control in Georgia, Georgia Soil and Water Conservation Commission.

Example of rock filter dam (Rd) installed at drainage ditch outlet to live stream.
Harris County, Georgia
Photo: Courtesy of Two Rivers RC&D Council

Fords

Description: Fords and low-water crossings are shallow stable stream crossings used on very low volume roads with stable creek bottoms and side approaches.

Example of concrete low-water crossing; note downstream edge is protected from scouring with riprap or gabions.
Source: USDA Forest Service

General Comments:

- Fords are not a preferred practice.
- Locate on low streambanks where channel is well confined.
- Locate on narrow, shallow streams with bedrock bottom or coarse, stable bottom.
- Approach at grades of 3% or less, and at right angles to stream flow.
- Use gravel or rock-filled Geoweb®, or concrete pads for crossing.
- Stabilize approaches with rock at least 50 feet from both sides of bank.
- Stabilize downstream edge.
- High maintenance: inspect edges, approaches, and road surface; repair quickly; remove trash/debris.

Culverts

Description: Large pipe or concrete box to convey water under road.

The problem of culverts; they are barriers to fish passage.
Photo: Courtesy of Limestone Valley RC&D Council

General Comments:

- Single large pipes are preferred over multiple smaller diameter pipes to minimize plugging.
- Road crossing should be perpendicular to natural stream channel.
- Fish passage design is a consideration in several Georgia streams.
- Bottomless arch culvert, concrete, or high density plastic pipe are preferred material for stream crossing. “Bottomless” culvert means the culvert extends over the natural channel material.
- Install headwalls (concrete) or extend culvert beyond toe of roadway and stabilize with geo-textile and riprap.
- Align culverts in middle and bottom of natural stream channel.

Better Practices:

Example of fish passage culvert.
Pickens County, Georgia
Photo: Courtesy of GDOT

Example of bottomless culvert; note natural bottom material remains exposed.
Cherokee County, Georgia
Photo: Courtesy of GDOT

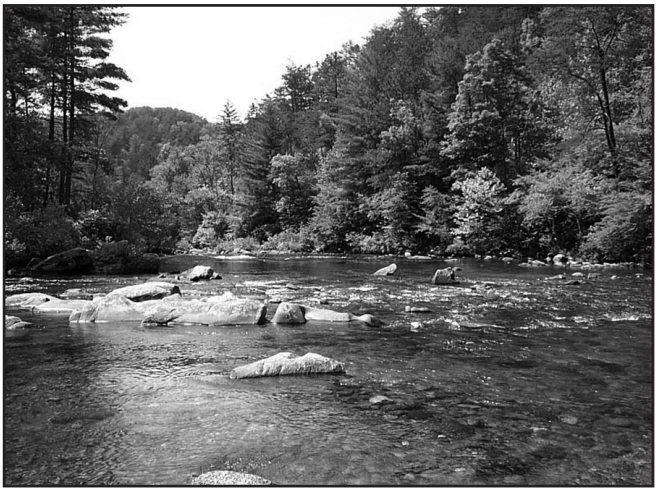
Bridges

Description: A stream crossing constructed "outside" of the stream channel.

General Comments:

- Preferred practice to culverts or fords.
- Ideally located at *narrow, straight, uniform channel* in area of *stable bottom* of bedrock or coarse materials.
- Span is long enough to *avoid constricting natural active channel* (bank full) flow.
- Approaches are *armored* with concrete wing walls, gabions, riprap, or vegetation (preferred).
- *Inspect* bridge (approaches, footings) every 2-4 years for scour and repair as needed.

Example of low arch bridge; note span is outside of stream channel.
Cherokee County, Georgia
Photo: Courtesy of GDOT

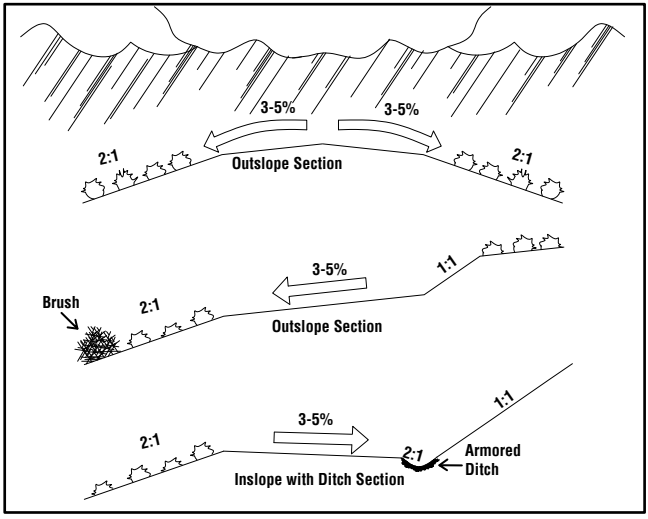


Goal: Clean Water
Conasauga River – Murray County, Georgia
Photo: Courtesy of Limestone Valley RC&D Council

Section 2.
Drainage

Drainage: General Comments

"Keep water **OFF** your road, **OUT** of your road, and **AWAY** from your road." *New Hampshire Highway Department Handbook 1916*



Typical road surface drainage options.
Source: Limestone Valley RC&D Council adapted from Keller and Sherar, USDA Forest Service

Better Practices:

- Maintain "sheet flow" (thin, evenly spread) water as much as possible by controlling ditch shape, bottom slope, and width to reduce "concentrated flow" (forceful, high velocity).
- Maintain positive surface drainage with an out-sloped or crown roadway section.
- Avoid in-sloping roads when possible (requires careful ditching and culvert cross-drains).
- Avoid steep grades, i.e., less than 10% south of fall line; less than 18% north of fall line.
- No discharge of concentrated flow to sensitive areas such as streams, wetlands, estuaries.

Drainage: General Comments (continued)

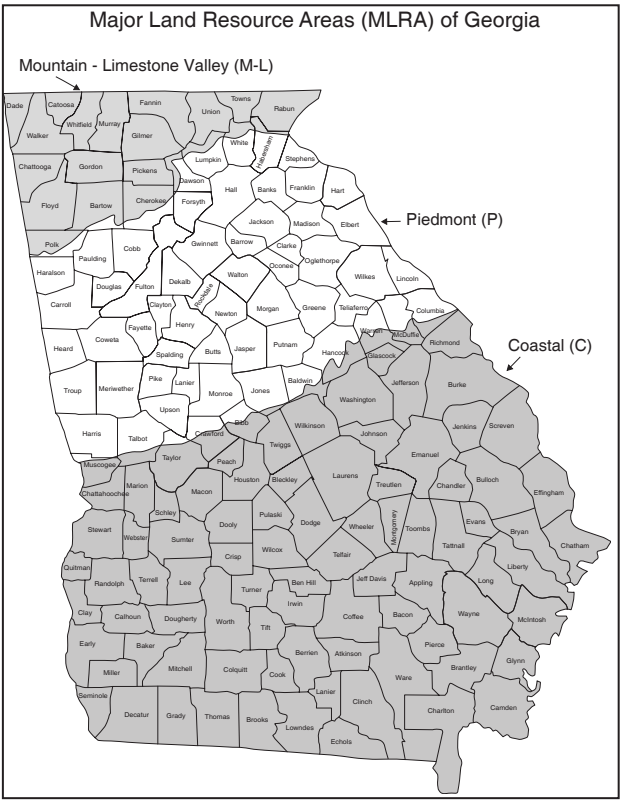


Illustration of major land divisions of Georgia as indicated by shaded areas.

Source: Adapted from Manual for Erosion and Sediment Control in Georgia, GSWCC

Notes:

M-L is Mountain, Blue Ridge, and Limestone Valley Region. Drainage ranges from slow to very rapid. Saturated soil layers (seasonal water table) are typically 24 to greater than 80 inches below the surface.

P is Southern Piedmont Region.
Drainage ranges from slow to rapid. Saturated soil layers are typically 20 to greater than 60 inches below the surface.

C is Coastal Plain, Sandhills, and Atlantic Coast Region. Drainage ranges from very slow to rapid. Saturated soil layers are typically 10 to 60 inches below the surface.

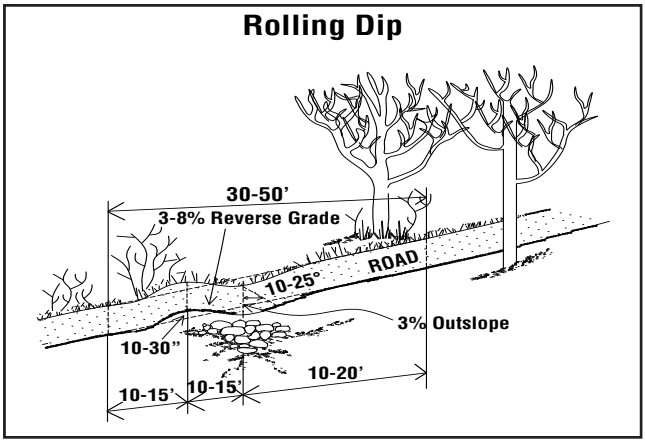
Broad-based Dips (or rolling dip)

Description: A surface drainage diversion built into the bed of a road to intercept and divert surface water out of the road while allowing vehicles to maintain normal speeds.

Example of broad-based dips.
Murray County, Georgia
Photo: Courtesy of Limestone Valley RC&D Council

Better Practices:

- Dips consist of a long down-slope approach section of 2-12%.
- Low out-sloped mid-section outlet of 3%.
- Short terminal section on reverse grade of about 3-8%.
- Stabilize outlet with vegetation, gravel, rock, or geo-textiles.
- Discharge to established vegetated areas.



Typical layout for rolling dips.
Source: Limestone Valley RC&D adapted from Georgia's Best Management Practices for Forestry

Broad-based Dips (continued)

General Rule for Spacing of Dips

Road Grade, percent	Distance between dips and turnouts, feet
3	235
4	200
5	180
6	165
7	155
8	150
9	145
10	140
12	135

Source: Adapted from Georgia's Best Management Practices for Forestry

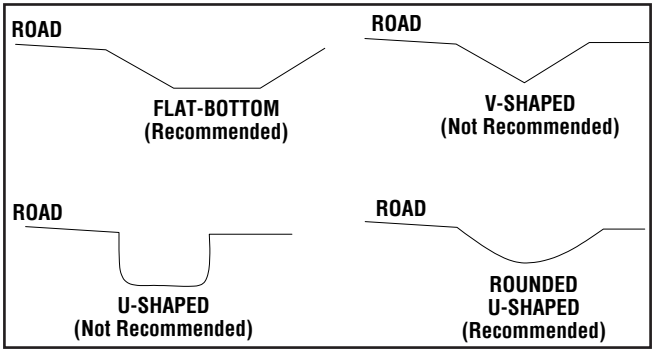
Section 2.

Ditches

Description: The most common drainage structure used to convey water from the roadway. Location, profile, shape, lining, and outlets contribute to a ditch that removes water efficiently without becoming an erosion or maintenance problem itself.

General Comments:

- Locate ditches on **upslope side** of road.
- Design and grade ditch and bank side slopes at **2:1 maximum slope**, i.e., 2 feet horizontal for each 1-foot vertical rise.
- Ditch bottom at least **2 feet wide** and 1-2 feet below road base.
- Ditch bottom should be **flat, parabolic, or rounded-U** shaped, **but NOT** straight U-shaped or V-shaped.
- Line ditches with **channel slopes less than 5%** with grass; greater than 5% with geo-textiles and rock, but NOT concrete.
- Provide **stable ditch** outlets to prevent standing water next to roadway (which can seep into and weaken road base).
- Install **frequent turnouts.**
- Use **drop inlet** structures and culverts for ditch grade control.



Recommended and not recommended common ditch shapes.
Source: Limestone Valley RC&D Council adapted from Choctawhatchee, Pea, Yellow River Management Authority

Ditches (continued)

Better Practices:

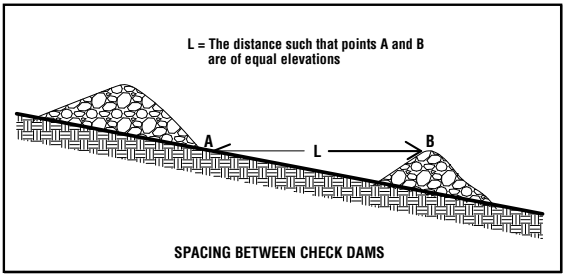
- Use rubber-tired excavator with articulated bucket to create ditches.
- Check all ditches and turnouts after major storms for sediment, debris, erosion, or collapse.
- Re-grade ditch **only when absolutely necessary and** line with **vegetation or stone immediately.**
- Limit re-grading to late spring or when weather pattern suggest high erosion potential will be minimal.
- Use "roll" ditch to get rounded-U shape (see following photos).
- **Revegetate**; seed and stablize as soon as possible (see grass seeding section pages 59-64).

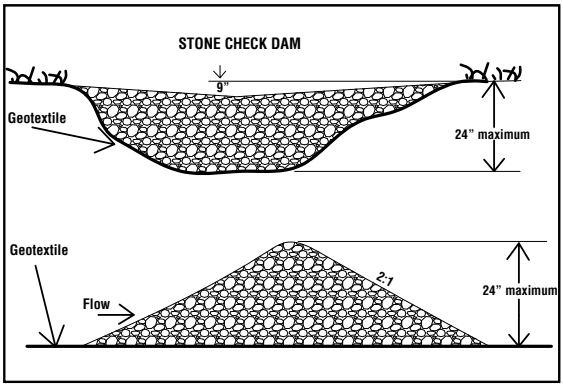
Using wheel for "shaping and tamping" ditch; creates a "roll" or "rounded U" shape ditch.
Meriwether County, Georgia
Photo: Courtesy of Two Rivers RC&D Council

Final shape of roll ditch is a rounded U-shape. This is a better design shape to distribute and reduce water's erosive energy. Ditch needs to be revegetated.
Meriwether County, Georgia
Photo: Courtesy of Two Rivers RC&D Council

Rock Check Dams

Description: A small barrier usually rock, constructed across a drainage ditch or area of concentrated flow to reduce energy of runoff water.





General spacing and layout of rock check dams (Cd).
Source: Limestone Valley RC&D Council adapted from Manual for Erosion and Sediment Control in Georgia, GSWCC

General Comments:

- Top of downstream dam should be at the same elevation as the toe of upstream dam.
- Maximum dam height of 2 feet at center of dam.
- Construct center at least 9 inches lower than outer edges.
- Extend across entire width of ditch.
- Make side slopes 2:1 or flatter.
- Use graded 2 inch to 10 inch stone, and geo-textile fabric between rock and soil base and sides.
- Inspect and repair side slopes, replace stone, and/or remove accumulated sediment (when ½ depth of original dam height is silted in).

Rock check dams (continued)

Eroded ditch in need of maintenance; tremendous source of sediment to state waters.
Photo: Courtesy of Two Rivers RC&D Council

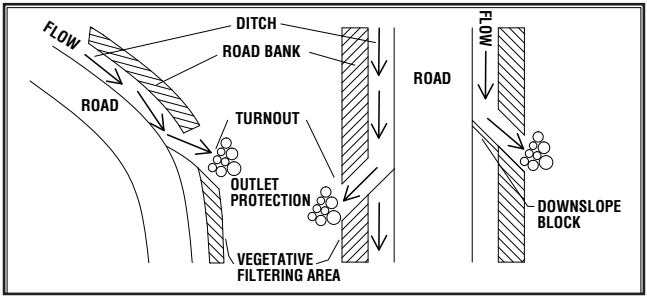
Example of check dams (Cd) in concentrated ditch flow.
Source: Manual for Erosion and Sediment Control in Georgia, GSWCC

Turnouts

Description: Extension of a road's ditch into a vegetated area to disperse water.

Turnout into stable vegetated outlet area.
Troup County, Georgia
Photo: Courtesy of Two Rivers RC&D Council

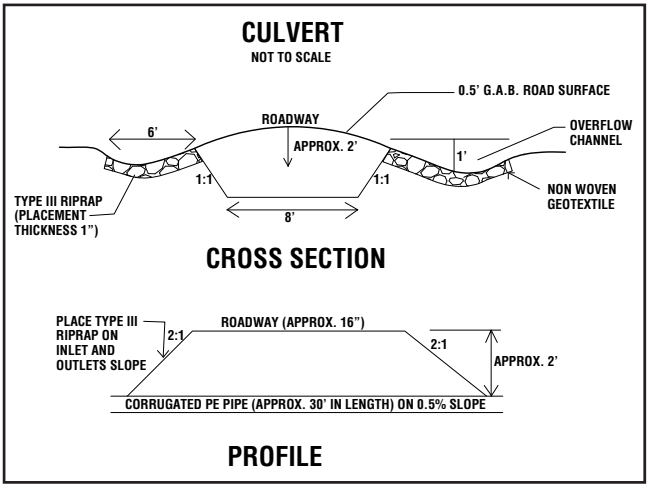
General Comment: The goal is to create a "sheet" flow discharge pattern (thin relatively uniform depth of runoff water) to vegetated adjacent areas.



Typical locations for turnouts (tail ditches).
Source: Limestone Valley RC&D adapted from Choctawhatchee, Pea, and Yellow Rivers Management Authority

Culverts and Cross Drains

Description: Metal, concrete, plastic, or constructed box-type conduit used to carry water under roads.



Typical layout profile for culverts and drains.
Source: Limestone Valley RC&D adapted from Manual for Erosion and Sediment Control in Georgia, GSWCC

General Comments:

Cross drain culverts

- Sized for 25-year 24-hour storm (Georgia's Best Management Practices for Forestry, 1999).
- Minimum pipe slope of 0.5% to allow for positive flow and self-cleaning.
- Minimum of 1-foot fill (2-foot preferred) over culvert.
- Space no more than 500 feet apart, closer on steeper slopes.
- Extend culvert pipe at least 2 feet beyond toe of road bank slopes.
- Protect outlets with rock, aprons, plunge pools, drains, geo-textiles, or discharge to stable vegetated areas.
- Pipe material should be resistant to abrasiveness of particles in the water.

Suggested Pipe Diameters Based on Drainage Area and Land Type*

Diameter inches	Rough, hilly country (acres)	Rolling farm land (acres)	Flat land (acres)
12	1	3	6
15	2	6	11
18	3	9	18
21	5	14	28
24	8	20	39
30	14	36	71
36	22	59	115
42	34	89	175
48	48	125	250
54	64	175	345
60	88	230	455
66	113	295	585
72	143	375	735
84	216	560	1110

*Note: This is intended to be a guide for field inspections and maintenance of culverts and **NOT** for design purposes. Sizing of culverts should be done by **qualified** individuals to account for design storm precipitation and runoff.

General Comments: Proper Installation of Pipes

- The spacing between pipes is equal to the diameter of the pipe up to pipes 36 inches in diameter. For example, 12-inch pipes are spaced 12 inches apart.
- The spacing between pipes equal to or greater than 36 inches in diameter should be 36 inches apart. For example, the spacing between 48-inch pipes is 36 inches.
- Use 1 foot (12 inches) of #5 stone for bedding under the pipe.
- Use #5 stone to backfill up to 1/2 the diameter of the pipe.

Culverts and Cross Drains—Inspections and Maintenance

Better Practices

- Inspect at least twice per year (spring and fall) and after major storm events.
- Look for signs of corrosion, joint separation, bottom sag, sediment buildup, blockage (debris), settling of fill.
- Inspect inlet and outlet channels for scour, blockage, bank erosion, debris, channel blockage, flow diversion.

Culvert Inspection and Maintenance Chart

What you observe:	Possible causes:	Fixes:
Scouring or erosion at the inlet	Ditch grade to steep Poor location or alignment with water flow Clogged pipe	Line inlet with stone Align culvert with stream flow Clean or flush culvert
Scouring or erosion at the outlet	Pipe slope too steep Pipe is too small	Add stone splash apron Consult with road engineer; replace with larger pipe if needed
Ponded or puddled water	Inlet is too high Ditch grade is too flat	Reset pipe to match channel Re-grade ditch (during dry weather) to maintain flow
Dented or crushed ends	Traffic or debris hitting ends	Replace or straighten back out Mark ends and/or protect
Heavy corrosion	Water through pipe is acidic or aggressive (loaded with sand and gravel)	Install a sleeve of PVC in existing pipe or replace with non-corrosive material such as PVC, aluminum, HDPE, concrete)
Piping (erosion/cavities) around outlet	Pipe is incorrectly installed resulting in water flowing outside of pipe	Re-install with proper bedding and compaction Install a headwall Consult with road engineer

Source: Adapted from Coastal and Satilla River SWCD

Culverts and Cross Drains Inspection and Maintenance (continued)

Problem: corroded metal pipe.
Fix: replace with corrosive-resistant pipe.
Photo: Courtesy of Two Rivers RC&D Council

Problem: water erosion around pipe; poor installation with fill.
Fix: reset pipe with proper bedding material and compaction.
Photo: Courtesy of Two Rivers RC&D Council

Culverts and Cross Drains Inspection and Maintenance (continued)

Problem: culvert is blocked with debris; ditch grade too steep.
Fixes: clean culvert; line culvert inlet with stone; use rock check dams for grade control.
Photo: Courtesy of Limestone Valley RC&D Council

Problem: ditch grade too flat.
Fix: re-grade ditch (during dry weather).
Photo: Courtesy of Limestone Valley RC&D Council

Culverts and Cross Drains Inspection and Maintenance (continued)

Problem: scouring at outlet; pipe too small.
Fix: add stone splash apron; consult road engineer.
Photo: Courtesy of Limestone Valley RC&D Council

Section 2.

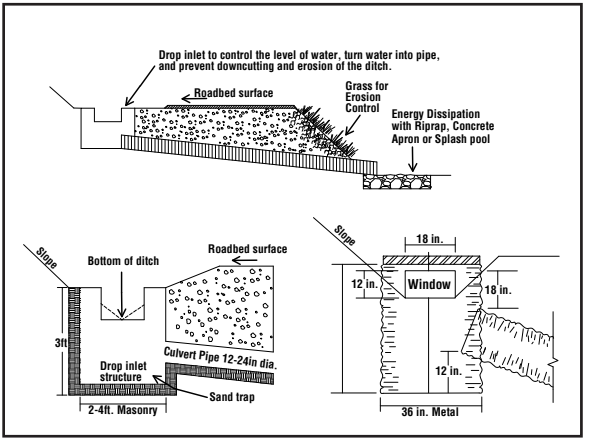
Drop Box Inlet Structures

Description: Structural devices used to convey runoff water from ditches and culverts in a stable, controlled manner to help dissipate water energy and prevent scouring, erosion, and sedimentation.

General Comments:

- An enclosed constructed or prefabricated structure of reinforced concrete, blocks, or plastic.
- Used to receive water from a ditch, culvert, or flume and safely "drop" the water to a lower downstream elevation release point (the drop reduces and helps dissipate water energy).
- Used in high to severe road cross-slope situations or where ditch slopes need to be reduced.

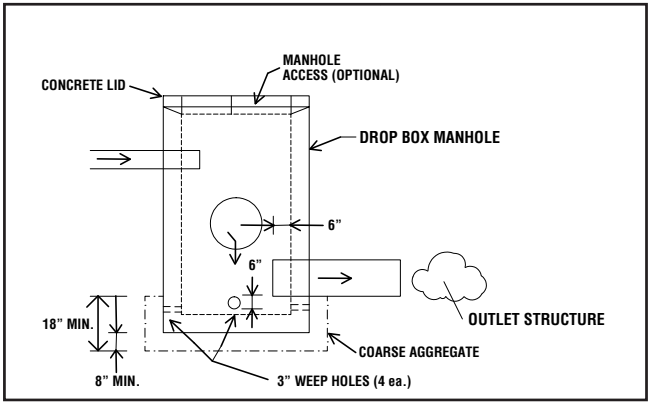
Example of inlet drop box.
Source: US Forest Service Low Volume Roads



Example diagram of "shallow-drop" box.
Source: Limestone Valley RC&D adapted from US Forest Service

Drop box (continued)

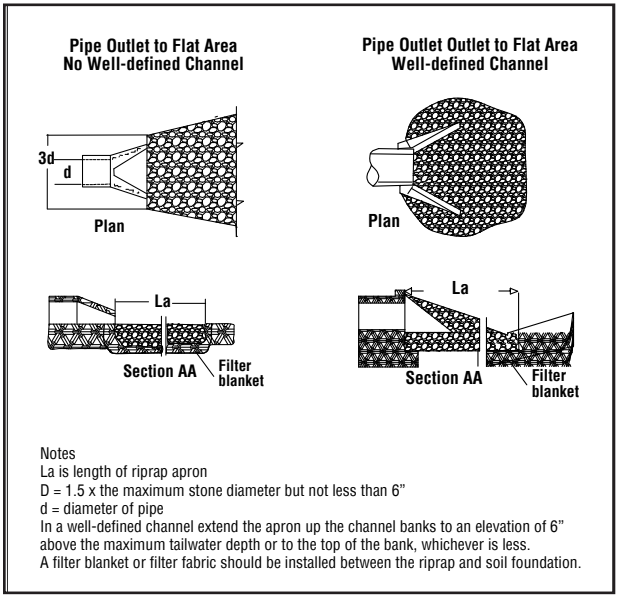
Example of drop inlet box structure.
Source: US Forest Service



Example of typical drop inlet box diagram.
Source: Limestone Valley RC&D Council adapted from Choctawhatchee, Pea, Yellow River Management Authority

Splash Aprons

Description: Paved or riprap channel placed downstream at culvert outlet to prevent scouring and erosion.



Notes
La is length of riprap apron
D = 1.5 x the maximum stone diameter but not less than 6"
d = diameter of pipe
In a well-defined channel extend the apron up the channel banks to an elevation of 6" above the maximum tailwater depth or to the top of the bank, whichever is less.
A filter blanket or filter fabric should be installed between the riprap and soil foundation.

Typical storm drain (St) outlet protection apron.
Source: Limestone Valley RC&D adapted from Manual for Erosion and Sediment Control in Georgia, GSWCC

Better Practices:

- If pipe slope is flatter and velocities are slower, then may not need a bigger pipe, and can discharge to stable vegetated areas.
- If pipe slope is steep, then a larger diameter pipe may be needed and armored outfall may be needed (consult with road engineer and design manuals).
- Rules of thumb for inspection:
  - Apron width 3x the pipe diameter
  - Apron length 6x the pipe diameter

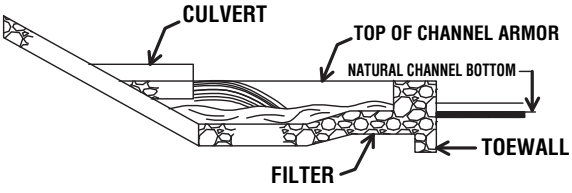
Example of outlet protection rock apron.
Source: Manual for Erosion and Sediment Control in Georgia, GSWCC

Plunge Basins (pools)

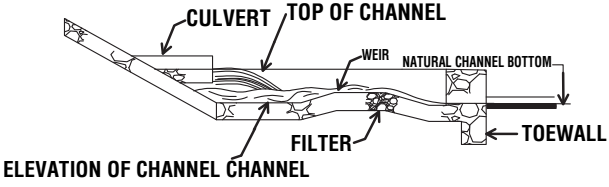
Description: Depressions located at high energy outlets to dissipate water energy.

General Comments:

- Underlain with filter fabric.
- Lined with riprap, mats, gabions.
- Designed by professional engineer.



Depressed Type Plunge Basin Illustration



Weir-formed Plunge Basin Illustration

Typical layout of plunge pool to reduce water energy.
Source: Limestone Valley RD&C Council adapted from Choctawhatchee, Pea, Yellow River Management Authority

Better Practices

- Reduce energy upslope with other practices than at outfalls.
- Inspect at lease twice per year or after extreme rain-runoff events.
- Remove debris from basins.
- Remove large woody vegetation (if rock-lined).
- Replace stones as needed.

Section 2.

Sediment Basins

Description: Constructed basin either excavated or dammed to settle and store suspended sediment from roads, banks, and ditches.

Ideal "Best" Practices:

- Permanent, effective treatment system.
- Requires regular maintenance.

Removal of stored sediment after ⅓ full.
Lamar County, Georgia
Photo: Courtesy of Two Rivers RC&D Council

Goal: Clean Water
Etowah River – Dawson County, Georgia
Photo: Courtesy of Chestatee - Chattahoochee RC&D Council

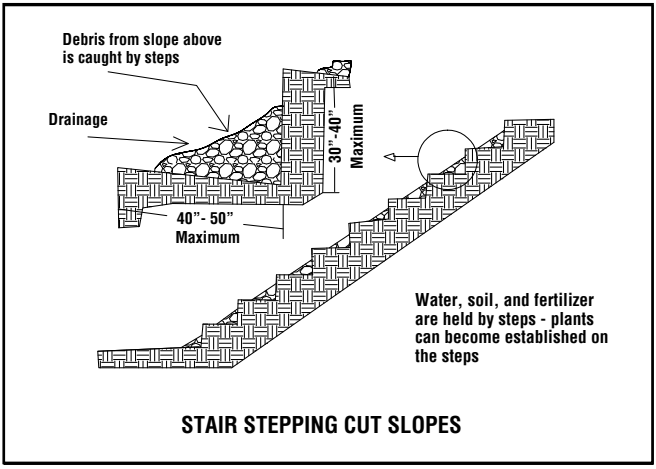
Section 3.
Slope Stabilization and Erosion Control

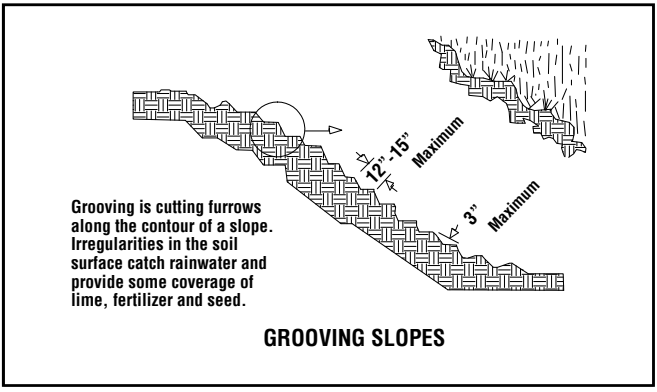
Terracing

Description: Practice of cutting and shaping slope to trap debris, particles, and intercept (slow) water.

General Comments:

- Slopes seeded and mulched.
- May be referred to as grooved, serrated, or stepping slopes, depending on width of "cuts".





Typical serrated (grooved) slope stabilization layout, a surface roughening (Su) practice.

Source: Limestone Valley RC&D adapted from Manual for Erosion and Sediment Control in Georgia, GSWCC

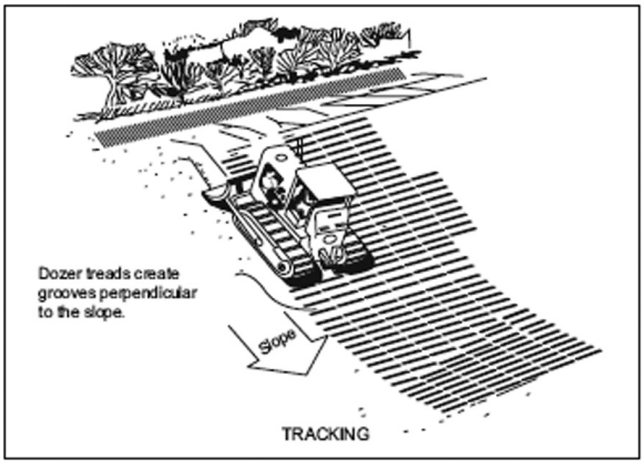
Terracing (continued)

Example of terraced slope.
Photo: Courtesy of GDOT

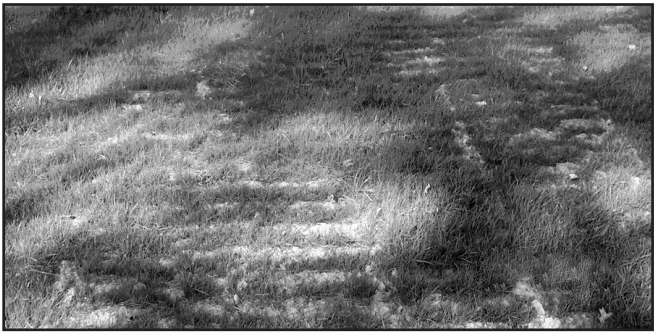
Section 3.

Tracking

Description: Running tracked vehicle such as a dozer, up and down a slope to create small depressions across a slope.



Source: Manual for Erosion and Sediment Control in Georgia, GSWCC



Example of 1-month old tracking with grass cover establishment for slope stabilization.
Whitfield County, Georgia
Photo: Courtesy of Limestone Valley RC&D Council

Gabions

Description: Rock filled wire baskets used to stabilize slopes.

Example of gabions along forest service road.
Source: US Forest Service

General Comments:

- Off-set and anchored to slope.
- Most common method.
- Labor intensive to install.
- Relatively expensive (materials, installation).

Vegetation: Grass Seeding

General Comments: Vegetation Alternatives

- **Grass seeding (and mulching)**—the most efficient and cost effective method for stabilization which should always be considered first and wherever possible.
- **Live stakes**—cuttings of pruned tree branches ½ to 1-1/2 inches diameter and 2-3 feet long, usually willow, alder, or dogwood.
- **Fascines or live bundles**—long bundles 5-30 feet long and 6-8 inches in diameter of live branches tied together with growing tips all oriented in the same direction, and partially laid into bank.

Better Practices:

- Use tables on pages 63-64 as a guide to select grasses and for recommended planting rates and dates accord ing to region of the state.
- Use native grasses for row maintenance and wildlife benefits.
- Use companion or mixture of compatible grasses.
- Use “fresh” seed, i.e., look for germination test date on seed label. Georgia recommends seed that has a test within 9 months of planting (older seed has much lower germination rate).
- Scarify (rake) or trench crusted or sealed soil; do **NOT** simply throw seed on ground.
- Apply by hand, cyclone seeder, or hydro-seeder.
- If using hydro-seeder, do not allow mixture to sit at site longer than 1 hour.
- Apply agricultural lime at a rate of 1-2 tons per acre (0.5 tons if hydro-seeding).
- Mulch at a rate of 2 tons per acre with dry straw; 2-1/2 tons per acre with dry hay; or wood fibers (note: add fiber mulch to hydro-seeding mix).
- Anchor mulch with netting, mesh or mats, or tackifiers.
- Use mats on slopes steeper than 2.5:1 or for heights greater than 10 feet.
- Hydro-seed **when seeds will germinate within 14 days.**
- Apply mulch to prevent erosion and hold seed for germination.

Better Practice: Native grass species are preferred

Perennial Grasses:	**Comments:**
Little Bluestem	warm season; medium height (2-3 feet)
Switchgrass	warm season; tall (5-6 feet); can be aggressive
Yellow Indiangrass	warm season; tall
Eastern gamagrass	warm season; tall
Big Bluestem	warm season; tall
Panicum anceps	common name “beaked” panic grass; warm season; medium height
Virginia wild rye	cool season; medium height
Purpletop	warm season
Cutover muhlygrass	warm season; low growing (1-2 feet)
Legumes:	
Lespedeza hirta	common name “hairy” lespedeza; warn season; tall
Lespedeza capitata	common name “round -head” lespedeza; warm season; tall
Forbes:	
Asters	warm season; medium height

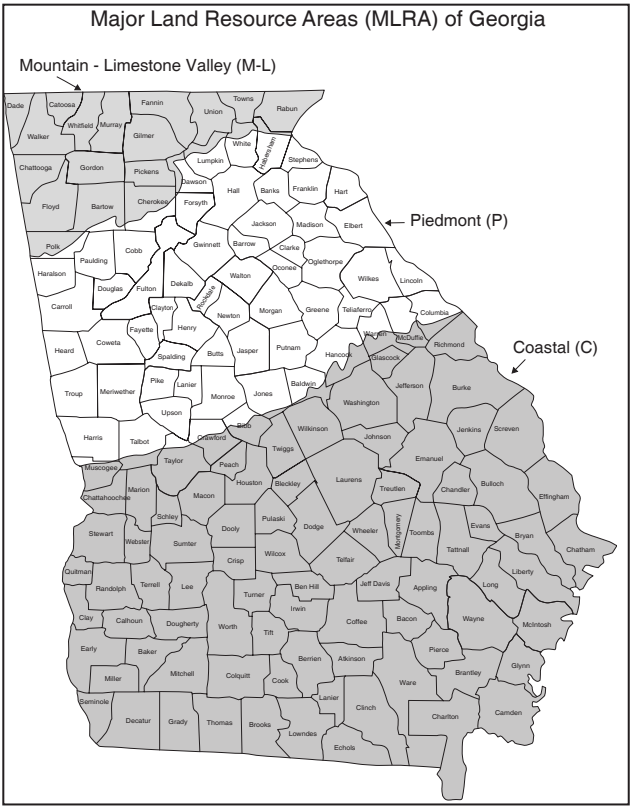
Source: US Fish and Wildlife Service (personal communication, March 2008) and adapted from Maryland and Georgia NRCS

Grass seeding (continued)

General Comments:

- May take several years to establish; warm season grasses typically take 2-3 year; cool season grasses typically take 1-2 years.
- Commercial availability may be limited; consult local natural resource agent for guidance.
- Native grasses typically prefer full sun and are adaptable for a variety of soil and site conditions.
- Height of some native grasses may present roadside visibility and safety concerns.
- Recommended seeding rate 8-12 pounds per acre on prepared seed bed.
- Mixture of grasses is preferred; annual ryegrass may be needed as initial erosion control cover.
- Use bio-mat especially on slopes greater than 2.5 to 1 or slopes greater than 10 feet high; however, most native grasses must have less than18” cover.

Vegetation: Grass seeding (continued)



Planting dates based on resource areas of Georgia (see following tables)

Source: Limestone Valley RC&D adapted from Manual for Erosion and Sediment Control in Georgia, GSWCC

Notes:
M-L is Mountain, Blue Ridge, Limestone Ridge and Valley Region.
P is Southern Piedmont Region.
C is Coastal Plain, Sand Hills, and Atlantic Coast Region.

Vegetation: Grass seeding (continued)

Suggested species, seeding rates and dates for erosion control:

Species	Rates per Acre	Rates per 1,000 sqft	Planting Dates M-L	Planting Dates P	Planting Dates C	Comments
Bahia, Pensacola: Alone or with temp. cover With other perenn.	60 lbs. 30 lbs.	1.4 lbs. 0.7 lbs	---	4/1 - 5/31	---	Low growing; sod producing; will spread into Bermuda lawns
Bahia, Wilmington: Alone or with temp. cover With other perenn.	60 lbs. 30 lbs.	1.4 lbs 0.7 lbs	3/15 - 5/31	3/1 - 5/31	---	Same as above
Bermuda, common (hulled seed) Alone With other perenn.	10 lbs 6 lbs	0.2 lbs 0.1 lbs	---	4/1 - 5/31	3/15 - 5/31	Quick cover, low growing, sod forming, needs full sun
Bermuda, common (unhulled seed) With temp. cover With other perenn.	10 lbs 6 lbs	0.2 lbs 0.1 lbs	---	10/1 - 2/28	11/1 - 1/31	Plant with winter annuals; plant with Tall Fescue
Tall Fescue: Alone With other perenn.	50 lbs 30 lbs	1.1 lbs 0.7 lbs	3/1 - 4/15 or 8/15 - 10/15	9/1 - 10/15	---	Can be mixed with perennial Lespedezas or Crown Vetch; **not** for droughty soils or heavy use areas
Lespedeza Sericea (scarified)	60 lbs	1.4 lbs	4/1 - 5/31	3/15 - 5/31	3/1 - 5/15	Widely adapted maintenance; takes 2-3 years to establish; inoculate seed with EL innoculant; mix with Weeping Lovegrass, common Bermuda, Bahia, Tall Fescue
Lespedeza Sericea (unscarified)	75 lbs	1.7 lbs	9/1 - 2/28	9/1 - 2/28	9/1 - 2/28	Mix with Tall Fescue or winter annuals
Seed-bearing hay	3 tons	138 lbs	10/1 - 2/28	10/1 - 1/31	10/15 - 1/15	Cut when seed is mature but before it shatters; add Tall Fescue or winter annuals

Grass seeding (continued)

Suggested species, seeding rates and dates for erosion control:

Species	Rates per Acre	Rates per 1,000 sqft		Planting Dates P		Comments
Lespedeza Ambro Virgata or Appalow (scarified) (unscarified)	60 lbs 75 lbs	1.4 lbs 1.7 lbs		3/15 - 5/31 9/1 - 2/28		Spreading growth with height of 18" - 24" good in urban areas; slow to develop good strands; mix with Weeping Lovegrass Common Bermuda, Bahia, Tall Fescue or winter annuals; do not with Sericea Lespedeza, inoculate with El inonculant
Lespedeza, shrub plants (L. Bicolor, L. Thumbergii)	3' x 3' spacing	3' x 3' spacing		11/1 - 3/15		Plant in small clumps for wildlife food and cover
Lovegrass, Weeping Alone With other perenn.	 4 lbs 2 lbs	 0.1 lbs 0.05 lbs		3/15 - 5/31		Quick cover; drought tolerant; grows well with Sericea Lespedeza on road banks and other steep slopes; short-lived
Panicgrass, coastal Altlantic	20 lbs	0.5 lbs		3/1 - 4/30		Grows well on coastal sand dunes; mix with Sericea Lespedeza **but not** on sand dunes

Source: Adapted from Manual for Erosion and Sediment Control in Georgia, GSWCC.

Disturbed area Stabilization with permanent vegetation (DS3)

Silt Fences

Description: Temporary structures supported by steel or wood posts used to slow velocity of runoff and cause sediment to deposit or be filtered out of sheet flow runoff.

General Comments:

- Silt fences are not to be used in concentrated (channel) flow situations.
- Silt fences do **NOT** replace check dams to control erosion in ditches.

Better Practices:

- Use **Type "C"** silt fence in sensitive areas such as wetlands, stream crossings, and construction of turn-outs.
- Use following table as a guide for placing silt fences on slopes i.e. this is the maximum distance between rows of fences going upslope.
- Inspect after each rain event, and repair or clean immediately.
- Remove sediment from behind fences when sediment is 1/2 the height of fence.
- Remove fence and sediment when project is completed. Do not leave fence in place; it will fail at some point.

Placement Criteria and Guide for Silt Fence Use in Georgia.

Land Slope (percent)	Maximum Slope Length Behind Fence, (feet)
< 2	100
2 to 5	75
5 to 10	50
10 to 20	25
> 2	15

Source: Field Manual for Erosion and Sediment Control in Georgia, GSWCC

Silt fences (continued)

Silt Fence Installation

- Use where slope gradient is steeper than 3:1 or slope heights are greater than 20 feet.
- Start post installations at center of lowest point for fence and work out.
- Space posts 6 feet apart, and at least 1.5 feet deep.
- Trench fence **6-inches** deep.
- Place at least 2 inches of fabric into direction of flow in trench to hold fabric in place during runoff.
- Cover and tamp trench soil.

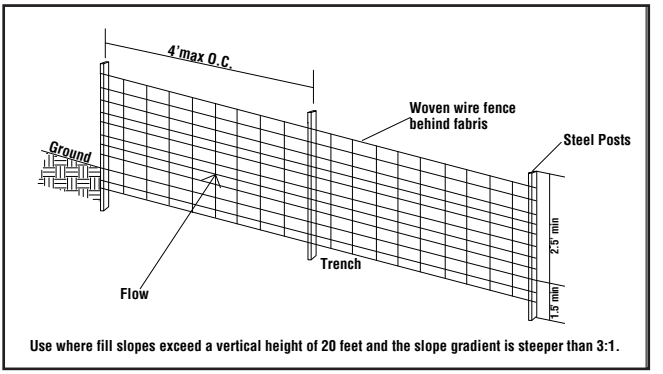


Illustration of Type C silt fence.
Source: Limestone Valley RC&D adapted from Manual for Erosion and Sediment Control in Georgia, GSWCC

Example of type “C” sediment barrier silt fence (Sd1-C). Note that the fence is slightly angled into the direction of runoff.
Source: Field Manual for Erosion and Sediment Control in Georgia, GSWCC

Hay and Straw Bales

Description: A ***very*** temporary structure to slow runoff velocity and cause sedimentation and filtering of runoff water.

General Comments:

- Place bales in single row, lengthwise on contour.
- Embed in soil to a depth of 4 inches, slightly tilted uphill.
- Use two wood stakes or bars into each bale to secure.
- Replace as needed; generally replace after rain/runoff events.

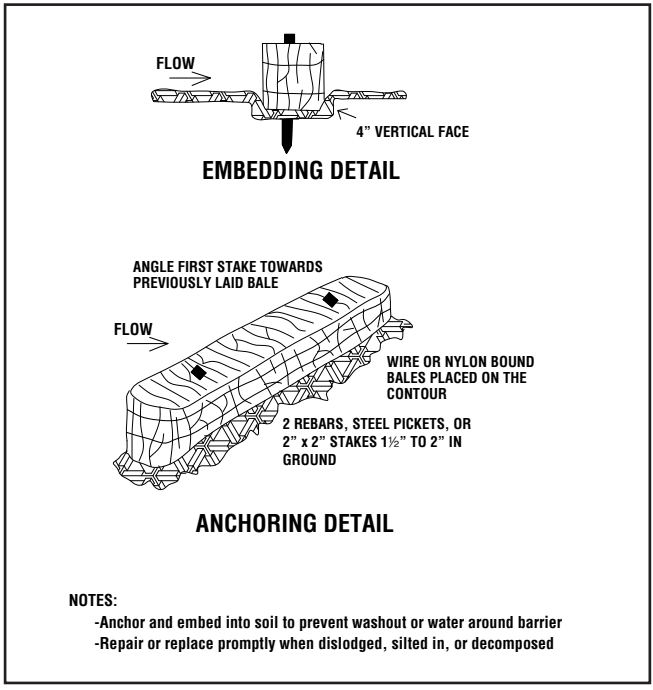


Illustration of bales for temporary erosion control, sediment barrier with hay or straw bales (Sd1-b).
Source: Limestone Valley RC&D adapted from Manual for Erosion and Sediment Control in Georgia, GSWCC

Section 3.

Matting and Blankets

Description: Protective coverings made of a variety of materials used to establish permanent vegetation on slopes.

Example of installation of jute (wood fiber) matting, erosion control blanket/matting (Mb).
Source: Field Manual for Erosion and Sediment Control in Georgia, GSWCC

General Comments: Installation

- Prepare and seed area.
- Trench and bury (with dirt) matting or blanket at top of slope.
- Overlap sides of matting 4 inches and anchor with pins.
- Overlap ends of matting 12 inches and anchor with pins (when slope requires more than one length or run).
- Stake according to manufacturer's instructions.

General Comments: Inspection and Maintenance

- Inspect periodically and after rain events until vegetation is firmly established.
- Look for eroding or exposed areas.
- Spot patch and stabilize (re-seed and mulch) as soon as possible.
- Re-anchor (stake) matting on restored sections.

Goal: Clean Water
Berry College Water Falls – Floyd County, Georgia
Photo: Courtesy of Rolling Hills RC&D Council

Section 4.
Materials and Additives

Section 4.

Geo-textiles

Description: Synthetic fibers manufactured in a woven or loose non-woven pattern to form a blanket-like product.

Better Practices:

- Use under rock-lined channels.
- Use under soft spots or where “soft” road materials are present.
- Use to cover cross-drains and/or culverts in roads where road cover may be minimal.
- Check for products, applications, and specifications on Georgia Department of Transportation listing of Materials and Qualified Products List (QPL). Reference website: http://tomcat2.dot.state.ga.us/thesource/specs/index.

For example and further reference:

- QPL #62 for blankets
- QPL # 49 for matting
- (Materials) Section 800 for coarse aggregate
- (Materials) Section 805 for Riprap

Dust Controls

General Comments:

Dust controls (Du) are a variety of products sold under various trade names. Dust indicates a lost to the air of fine particles which are needed as part of a good surface mix to help "bind" the road and provide road surface cohesion. It is a nuisance condition to the public that most captures attention. However, it represents a potential road surface condition that ultimately leads to road surface problems.

The following is a list of dust control product categories. All are **relatively expensive**, have a **short-term duration**, and may be feasible to apply only in severe situations or extremely sensitive areas. Before using any dust control agent check the materials safety data sheets (MSD). Names and terms generally used for dust control agents include:

- **Chlorides—**typically calcium chloride which acts to absorb moisture from the air to control dust
- **Emulsifiers—**typically petroleum-based which act to provide a protective binding and/or coating on the road surface
- **Resins—**a family of materials including pine tree sap which is formulated into a modified emulsion which penetrates road surface to bind with aggregates; some resins may be appropriate for environmentally sensitive areas around streams and wetlands e.g. Road Oyl ®
- **Lignin Sulfates—**typically a by-product of the pulp wood industry sprayed on road surface and then mixed in the top few inches of surface
- **Latex—**a name collectively given to a group of preparations of stable polymers dispersed in water
- **Binders—**a generic term referring to any material used to hold loose road particles together
- **Water—**a very short-term dust control practice

Dust Controls (continued)

Petroleum emulsion application.
Harris County, Georgia
Photo: Courtesy of Two Rivers RC&D Council

Lignin sulfate application; treated area “darker” than side road.
Johnson County, Georgia
Photo: Courtesy of Pine Country RC&D Council

Latex emulsion application.
Marion County, Georgia
Photo: Courtesy of Two Rivers RC&D Council

Calcium chloride application.
Photo: Courtesy of Central Savannah RC&D Council

Goal: Clean Water
Pond in Treutlen County, Georgia
Photo: Courtesy of Pine Country RC&D Council

Section 5.
References

"Georgia's Best Management Practices for Forestry", Georgia Forestry Commission, January 1999.

"Manual for Erosion and Sediment Control in Georgia" Georgia Soil and Water Conservation Commission Amended, 2000 (commonly referred to as "Green book")

"Field Manual for Erosion and Sediment Control in Georgia", Georgia Soil and Water Conservation Commission 4th Edition, 2002 (commonly referred to as "Field manual")

"Gravel Roads Maintenance and Design Manual", US Federal Highway Administration and South Dakota Local Transportation Assistance Program, November 2000

"Low Volume Roads Engineering Best Management Practices Field Guide", Gordon Keller and James Sherar, USDA Forest Service, July 2003

"Environmentally Sensitive Maintenance for Dirt and Gravel Roads", Alan L. Gesford and John A. Anderson, US EPA and Pennsylvania Department of Transportation, March 2006

"Comparing Warm - Season and Cool - Season Grasses for Erosion Control, Water Quality, and Wildlife Habitat" Conservation Fact Sheet, Natural Resource Conservation Service (NRCS) Maryland, January 2004

"Recommended Practices Manual a Guideline for Maintenance and Service of Unpaved Roads", Choctawhatchee, Pea, and Yellow River Watershed Management Authority, February 2000

"Unpaved Public Roads Best Management Practices Demonstration Guidelines for Erosion and Sediment Control to Improve Water Quality", Coastal and Satilla River Soil and Water Conservation Districts, January 2002

Section 5

Websites

www.gaepd.org
(Georgia Environmental Protection Division homepage)

www.ga.nrcs.usda.gov/contact/directory/rcddir.html
(website for Georgia RC&D Council offices)

www.dot.state.ga.us
(Georgia Department of Transportation homepage)

http://tomcat2.dot.state.ga.us/thesource/specs/index
(Georgia Department of Transportation listing of qualified products and materials)

www.gfc.state.ga.us/ForestManagement/documents/GeorgiaForestryBMPManual.pdf ("Georgia's Best Management Practices for Forestry")

www.gaswcc.org/docs/Field_manual_4ed.pdf
("Field Manual for Erosion and Sediment Control in Georgia")

www.gaswcc.org/docs/green_book_5ed.pdf
("Manual for Erosion and Sediment Control in Georgia")

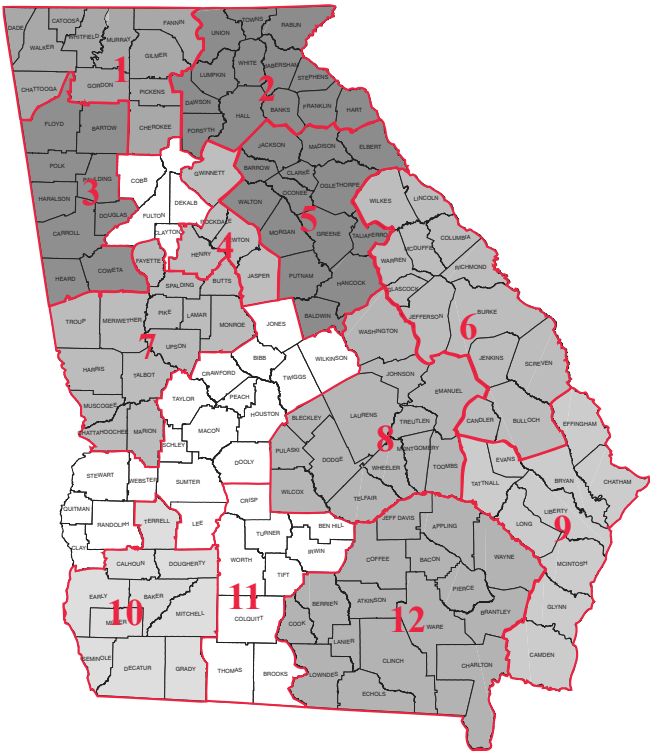
www.epa.gov/owow/nps/sensitive/sensitive.html
("Environmentally Sensitive Maintenance for Dirt and Gravel Roads")

www.epa.gov/owow/nps/gravelroads
("Gravel Roads: Maintenance and Design Manual")

www.lignin.info/roads.html
(Lignin Institute website)

www.betterroads.gcn.publishing.com/content
(Better Roads website for government and contractors)

Georgia RC & D Boundaries



Legend:

1 - Limestone Valley
2 - Chestatee Chattahoochee
3 - Rolling Hills
4 - Upper-Ocmulgee
5 - Oconee River
6 - Central Savannah River
7 - Two Rivers
8 - Pine Country
9 - Coastal Georgia
10 - Golden Triangle
11 - Mid South (proposed)
12 - Seven Rivers

Source: NRCS Water Resources Team
Athens, Georgia
Contact: www.ga.nrcs.usda.gov/contact/directory/rcddir.html

Quick Reference--Glossary of terms

Aggregate – various loose particulate materials such as sand, gravel, or stones

Apron – an erosion control device placed at or below the elevation of an area of high velocity water flow such as culvert outlets

Articulated bucket – an excavating bucket hinged and jointed at the end of an operating arm, which is also hinged and jointed

Back blading – practice of pulling soil or debris away from an area with the blade on the ground surface

Backhoe – a tractor with a hinged boom and bucket with movable jaws

Blading – use of an earthmoving blade to smooth high spots and irregularities in road surface to restore the crown without cutting into the road crust. Sometimes it is referred to dragging, but this is NOT the same as "grading" which cuts into the crust.

Bench – a horizontal or nearly so surface or step in a slope

Berm – a narrow shelf or rise that breaks the continuity of a slope

Best management practices – a series of practices or combination of methods or measures used to prevent water pollution including structural and non-structural controls, operations, or procedures

Binder – a material used to hold loose road materials together

Broad-based dip – a long, low sloped surface drainage diversion built into the road bed used to intercept and divert water flow out of the road while allowing normal vehicle speeds to be maintained. Also referred to as a rolling dip.

Brush barrier – linear pile of limbs, tree tops, logs, and other forest debris used to slow, diffuse, or intercept sediment in runoff

Buffer strip – the transitional land area between a stream or other water body and the adjacent land use that is used to intercept, trap, or filter sediment and other pollutants in surface runoff

Canopy cover – the amount of ground (or stream) shading provided by trees and shrubs

Channel – a natural or man-made ditch that conveys water in a concentrated flow pattern

Quick Reference--Glossary of terms

Cohesion – the attraction on a molecular level that holds particles together

Compaction – process by which soil particles and/or aggregates are rearranged to decrease space between particles thereby increasing material strength and resistance to water infiltration

Cross-drain – a conduit through which ditch flow is directed under the road surface to the opposite side of the road

Crust – the compacted, durable, impermeable layer of an unpaved road usually at or just below the road surface

Culvert –a metal, concrete, or plastic conduit used to convey water under a road; differing from a bridge in that a culvert is usually placed entirely below the road surface

Detention structure – a basin or pond used to temporarily hold and then gradually release stormwater at a controlled rate

Ditch – man-made water course to convey runoff water

Ditch line – the top edge of a ditch's side slope where runoff falls into the ditch channel

Diversion – a channel with an associated berm or dike across or at the bottom of a slope to intercept and divert runoff into the channel

Dragging - use of an earthmoving blade to smooth high spots and irregularities in road surface to restore the crown without cutting into the road crust. Sometimes this is referred to blading, but this is NOT the same as "grading" which cuts into the crust.

Drop inlet – a structure designed to drop water from one level to another in a drain intending to dissipate surplus water energy and minimize downstream erosion

Embankment – a structure of soil, aggregate, or rock constructed above the natural ground surface

Energy dissipater – a device used to reduce the energy of flowing water such as stilling basins and plunge pools

Ephemeral stream – commonly referred to as drains, draws, or dry washes that typically do not have a well defined channel and flow only during and for short periods after precipitation, but may have leaf litter/piles in the flow area

Quick Reference--Glossary of terms

Erosion – the process by which soil particles are detached and transported by water, wind, ice, and gravity to a point downslope or downstream

Estuary – an inlet or arm of the sea where tides meet river currents

Filter strip – a long vegetative area planted to slow, trap, and filter pollutants transported in overland runoff

Gabion – large, multi-celled woven wire mesh baskets filled with rock to stabilize steep or highly erosive slopes

Geo-textile – manufactured fabrics used to improve the load capacity of roads or base materials

Gradient – the change in elevation per unit of length; the slope

Grading – cutting, redistribution, and re-compaction of road crust (often adding new road material) to re-shape the roadway profile

Gully – a highly eroded, swell defined channel

Headwall/header – a structure built at the inlet of a culvert of concrete or rock to protect the inlet from erosion

Hydroseeding – sowing of grass seed (may also include lime, fertilizer, or mulch) by pressurized water hose

Inslope – the feature of a road surface that slants to the inner or uphill side of a road to direct and concentrate runoff into a ditch

Intermittent stream – a watercourse that flows in a well-defined channel during wet seasons of the year

Live stakes – living, freshly cut branches of woody trees and shrubs used to establish a vegetative slope

Mold board – the iron plate (blade) of a dozer or motor grader which turns over the earth

Motor grader – a long wheel-base tractor with a long adjustable moldboard blade mounted underneath and forward of the driver's seat used to construct and smooth surfaces of roadways

Mulching – any loose covering of soil with organic or artificial materials to conserve soil moisture, hold soil in place, and minimize soil temperature fluctuations

Nonpoint source pollution – water pollution that is induced by precipitation and runoff not traceable to any discrete, identifiable source but coming from a multitude of individual sources. This pollution is best controlled by BMPs (best management practices) on the land

Outlet – the point of water discharge from a pipe, culvert, stream, lake, reservoir or estuary

Outslope – the feature of a road surface that slants to the outer or downhill side of a road to facilitate diffuse runoff flow drainage into stable vegetated areas. Outsloping road design is an alternative to crowned roadbeds or insloped to ditches

Perennial stream – a watercourse that flows in a well-defined channel most of the year under normal precipitation patterns

Permeability – capacity of soil to pass the flow of water through pore spaces

Plunge pool – a device used to dissipate flowing water energy with a variety of materials e.g. concrete, rip rap

Pollutants – any natural or man-made material that contaminates water for human use or stresses/kills aquatic life

Riparian buffer – the strip of undisturbed vegetated (usually matured trees, shrubs, grasses) land between the water body and adjacent land use

Riprap – rock and other large aggregate placed on soil surfaces to resist water energy

Road crown – the convex (curved) section or outline of the road surface

Runoff – the portion of precipitation that is discharged into a stream from adjacent land areas

Scarify – to break the road surface with a narrow blade

Sediment – soil particles that have been detached and transported into water during erosion

Sheet flow – runoff that flows in a thin layer over the ground surface

Shoulder – the edge of the roadway between the traveled portion of the roadway and the drainage

Silt fence – a manufactured fabric used to catch storm runoff and soil particles

Slope – the degree of deviation of ground surface from horizontal expressed as a ratio or percentage. The first number is the horizontal distance (run) and the second number is the vertical distance (rise). For example 2:1 means for every 2-foot horizontal distance the slope “rises” one-foot. 50 percent is another way to express this slope.

Quick Reference--Glossary of terms

Slope board – a device usually of wood, used to confirm the cross slope of a road, ditch, or bank

Soil bioengineering – use of live woody vegetative cuttings to repair or stabilize slopes often in combination with other "non" riprap alternatives

Spoil – the soil or rock material excavated from a ditch, canal, pond, basin, or hill

Storm frequency – the statistical average (water flow) expected for a probability storm event. For example, a 10-year storm means the water flow at a particular bridge (or other site) has a 10 percent probability of occurring in any given year

Sub-base – the drainage layer of a road between the road surface and existing ground

Swale – an elongated depression (usually grass or pebbles) to convey, spread, and slow stormwater runoff discharge to a primary drainage

Tamp – repeated light strokes to force (aggregates) in place

Terrace – an embankment or combination of embankments and channels across a slope (generally following a contour) to control erosion by diverting or storing runoff instead of letting it flow uninterrupted down the slope

Toe of slope – the base of a slope (hill, streambank, or embankment)

Tracking – the process of running a tracked vehicle such as a dozer up and down a slope

Turbidity – measure of water clarity effected by suspended silt, sediment, and other particles in the water

Turn-out – the extension of the road's drainage ditch into a matured, established vegetative area to disperse and filter stormwater runoff

Water bar – a hump or small dam-like surface drainage structure used to close roads or trails and divert runoff

Under-drain – a drain placed under the road surface

Vegetated structures – a structure with living plant materials incorporated into the structure. For example grass swales, log cribs, coir (coconut) logs used at toe of slopes

Waters of the state – any and all rivers, streams, creeks, branches, ponds, lakes, reservoirs, drainage systems, springs, wells and other bodies of surface or subsurface water natural or artificial lying within or forming part of the boundaries of the state which are not entirely confined and retained completely upon the property of a single individual, partnership, or corporation

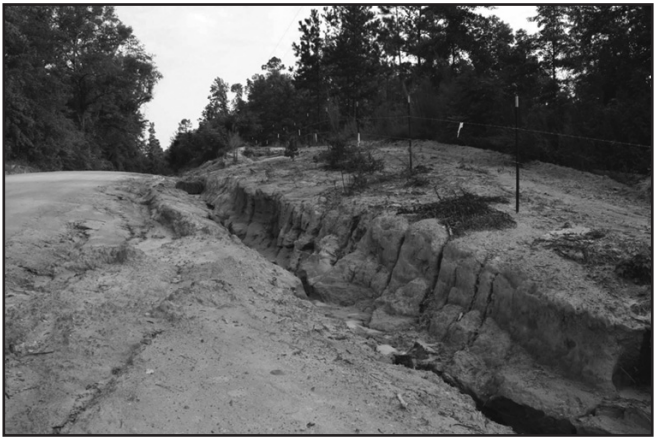
Water quality – a term used to describe the chemical, physical, and biological characteristics of water with respect to its suitability for a particular purpose such as human water supply, agricultural, industrial, and aquatic life support

Watershed – the land area that drains to a given point on a stream, lake, or estuary

Wetland – land that has a wet and spongy soil such as swamps, bogs, wet floodplains, or marshes

Windrow – logging debris and un-marketable woody material that is piled into rows for decomposition or burning

Georgia Better Back Roads Project



Before Implementation: Eroding road surface, road banks, and ditches

After Implementation: Better Back Roads BMPs;

- **Road re-surfacing** with grading, blading, aggregate gradation, crown and shoulder re-shaping.
- **Road bank re-shaping** and stabilization with hydro-seeding and mulching.
- **Ditch stabilization** with geo-textiles and type 1 riprap.

Photos: Courtesy of Two Rivers RC&D Council