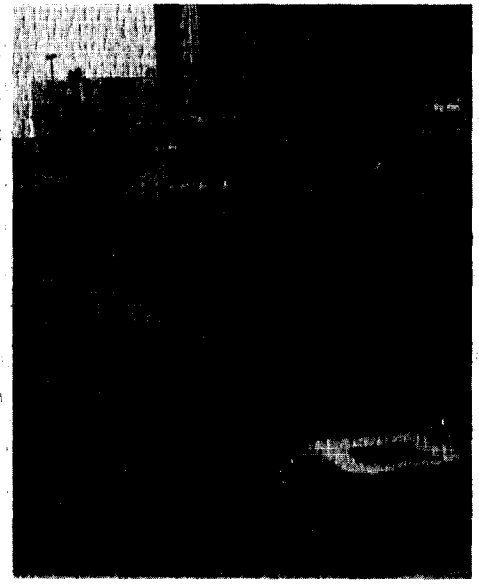
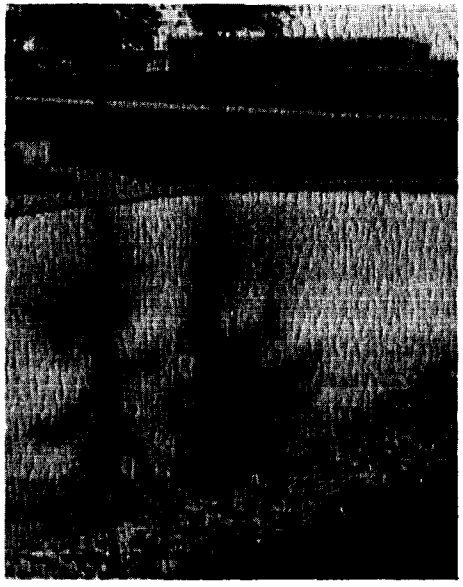
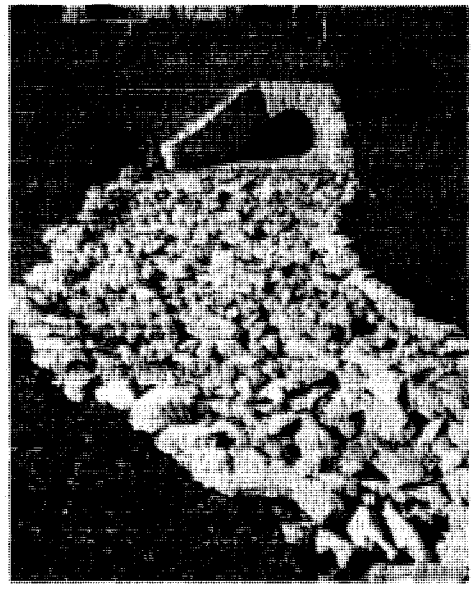
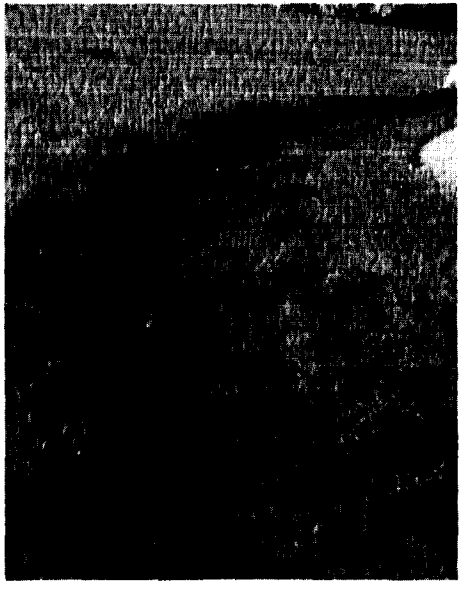
FIELD HANDBOOK
EROSION AND SEDIMENT CONTROL ON CONSTRUCTION SITES

Prepared by: Division of Conservation and Division of Water, NREPC.

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FOREWORD

Soil erosion from urban development areas has been rapidly increasing during the past twenty years. While under construction, these areas may lose from 10 to 20 times as much soil as similar farmland fields. Total average annual soil erosion from Kentucky construction sites has been estimated at 2.9 million tons. The resulting sediment is damaging and costly to both the developer and the downstream landowners and water users. Unwanted sediment may clog newly installed storm sewers and surface channels or damage adjacent properties. Sediment is by far (about 90%) the major solid pollutant in Kentucky's streams. It not only reduces water quality but also fills stream channels, lakes and reservoirs.

Although soil erosion cannot be stopped completely, it can be controlled by applying conservation principles and installing Best Management Practices. This field handbook has been developed to familiarize developers, urban planners, earth movers, and interested citizens about some of the major conservation practices for construction sites. For more information and detail, refer to the Kentucky Manual, "Best Management Practices for Construction Activities", published by the Divisions of Conservation and Water (1983).

Since this is a voluntary program in most all of Kentucky, we solicit your support in reducing construction-site erosion.

We appreciate the assistance of the conservation districts, U. S. Soil Conservation Service, Homebuilders Association of Kentucky, and others who helped make this handbook a reality.

William Zimmerman
Project Manager

FOLLOW SEDIMENT CONTROL PRINCIPLES AND REDUCE NEED FOR BEST MANAGEMENT PRACTICES

* Relate Development to Site

  - Recognize site limitations, utilize site potentials.

* Grade Only Where Necessary

  - Grade smallest practical area at one time.

* Slow or Retain Surface Water Runoff

  - This reduces soil erosion and sedimentation.

* Retain Existing Vegetation

  - Especially on steep slopes and along streams.

* Revegetate Areas As Soon As Possible

  - Vegetation is the best erosion control.

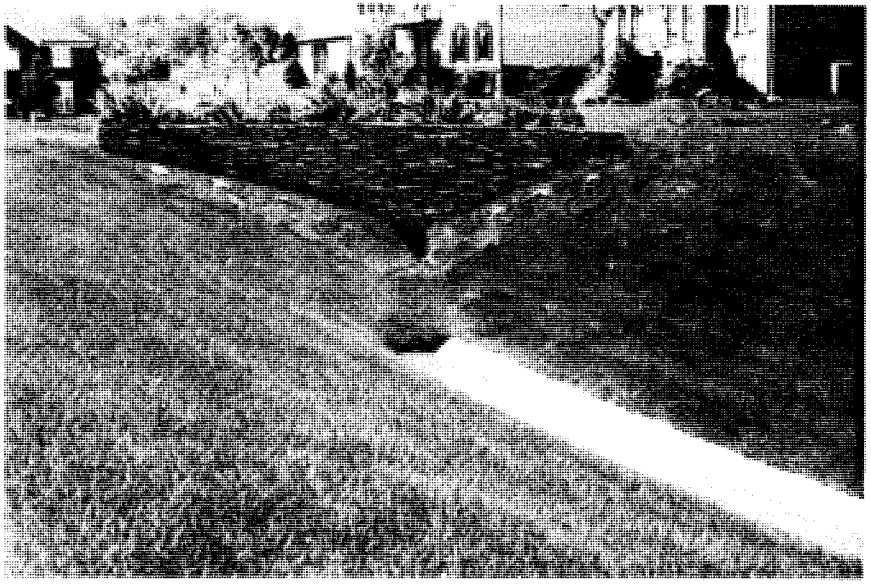
* Install Necessary BMP's Before Stripping Vegetation

  - Use practices to prevent problems from arising.

CONTENTS

GRASSES AND LEGUMES - PERMANENT SEEDING

Establishing a permanent grass and/or legume cover either by standard seeding methods or by hydroseeding.



A permanent, vigorous, bluegrass lawn is a most effective way to reduce soil erosion to a minimum.

A properly established lawn will not only stabilize the soil on gently sloping areas, but also on rather steep slopes - if seeding recommendations are followed closely. Grasses and legumes also enhance the natural beauty of the development and help improve the urban wildlife habitat.

Good management, including proper mowing and fertilization, irrigation, weed and insect control, will extend longevity with continued attractiveness.

FOUR OUTSTANDING GRASSES/LEGUMES

Species	Site Condition	Maintenance
Kentucky Bluegrass	Sunny Good soils	Frequent mowing desirable
Creeping Red Fescue	Semi-shady Good soils	Frequent mowing desirable
KY 31 Tall Fescue	Steep - droughty or wet soils	Occasional mowing on critical slopes
Crownvetch	Very steep, droughty or rocky soils	Do not mow

ESTABLISHMENT

- On sloping areas, first install needed surface water system to protect new seeding.
- If unfavorable soil conditions exist, add 4 to 6 inches of topsoil; use topsoiling BMP recommendations.
- Apply lime and fertilizer according to soil tests.
- Prepare the soil by disking or other methods to work in the fertilizer and to form a loose seedbed for planting.
- Seed; use recommended rates and seeding dates.
- Mulch; use mulching BMP recommendations.
- Water as needed to keep the upper 3" to 4" moist.

If hydroseeded, use about four times the normal seed rate, and always include adequate fertilizer and mulch.

MAINTENANCE:

Mowing - Do not mow newly seeded bluegrass or red fescue until it is four inches tall. Crownvetch must never be mowed. KY 31 tall fescue may be mowed for appearance, or only occasionally, according to the site and the owner's desires.

Fertilization - Annual fertilization is generally advisable at a rate of about 400 lbs. per acre (15-15-15) for grasses and 400 lbs. per acre (0-15-15) for legumes or use a soil test.

GRASSES - TEMPORARY COVER

Establishing a temporary vegetative cover with fast growing annual grasses or small grains.

Annual ryegrass on the left of the photo greatly reduces sediment from the roadside ditch, while bare soil on the right continues to erode.

A temporary grass seeding is an inexpensive, short-term (3 to 12 months), vegetative erosion control practice. Some typical conditions requiring temporary seeding are any bare soil areas or rough graded areas which will be regraded within a year, cuts and fills that may be reworked and/or permanently seeded later, topsoil stockpiles or other sediment producing areas.

SEEDING RATES AND DATES

Species	Seeding Rate lbs-acre	Seeding Dates
Annual Ryegrass	40	2/15-6/15
KY 31 Tall Fescue and	40	2/15-6/15 or
Rye (grain)	80	8/16-11/15
Rye (grain)	120	8/16-11/15
Spring Oats	96	2/15-6/15

ESTABLISHMENT

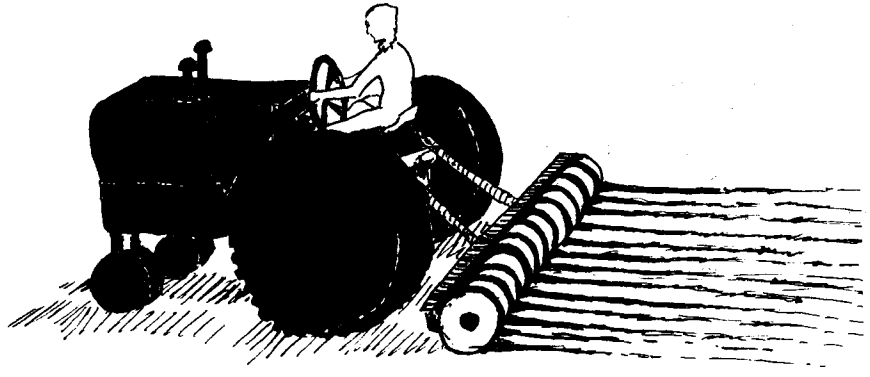
- Remove loose rock, roots, construction debris, etc., from soil surface layer (upper 6").
- Apply lime and fertilizer according to soil test for quick plant growth.
- Disk or loosen upper 4" for seedbed.
- Seed correct grass species; check rates and dates.
- Mulch, especially on slopes or during dry seasons.
- Water to speed germination and growth.

May be hydroseeded, but if so, increase seed rate.

MAINTENANCE:

Water during droughty seasons. Do not mow small grain seedings.

SEEDBED PREPARATION



SODDING

The placing of a solid cover of grass turf over final graded and properly prepared soil areas.

Newly sodded lawn on the left eliminated soil erosion while bare soil on the right eroded severely - even though a gentle slope. Note small rills after a few rainstorms.

Sodding provides an immediate vegetative cover which can prevent soil erosion on steep slopes. It is often applied in small waterways that may be subject to gully erosion following normal seeding practices. This proves to be a rapid method of establishing a good lawn on level or moderate slopes.

LAYING SOD

- Test soil for fertilizer and lime and make necessary applications before sodding.

- If surface is dominantly subsoil, place 4-6" topsoil over the area.

- Disk or loosen soil surface, then smooth and firm.

- If dry, moisten just before sodding.

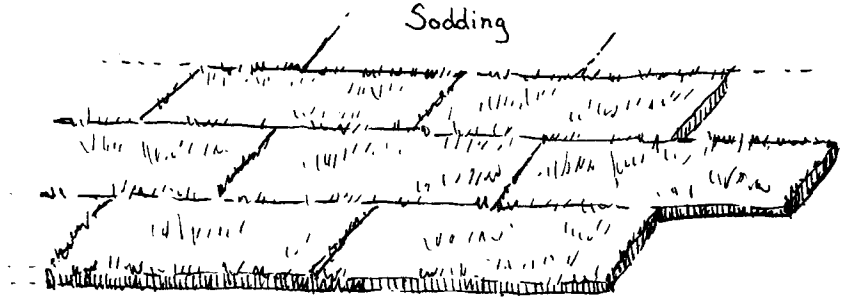
- Use vigorous, freshly cut, weed and pest-free sod - one to three years old.

- Lay sod across the slope with snug, staggered joints.

- Roll or tamp sod for solid root-soil contact.

- Use netting and/or staples or pegs on steep slopes or waterway areas.

- Water sod immediately and as needed during the first season.



MAINTENANCE:

- Allow grass to grow 4" before mowing, then cut as needed at 2" height. Irrigate during dry seasons. Control weeds and fertilize annually.

TOPSOILING

The stripping, storing and spreading of fertile topsoil over areas to be vegetated.

Stockpiling topsoil for future spreading on site.

Topsoiling will provide a more suitable soil medium if the existing surface is unfavorable for plant growth. Some examples of unfavorable soil characteristics are:

- excessively clayey, sandy or stony;
- a shallow depth to rock or other root limiting zones; and
- extremely acid or toxic conditions.

Topsoiling will greatly increase the success of establishing good vegetation, help reduce soil erosion, and enhance the beauty of the development.

TOPSOIL RECOMMENDATIONS

- The original surface soil is generally friable and higher in organic matter and nutrients. In this case, stripping the upper 8-10" and stockpiling for future spreading is the most economical method.

- When topsoil is hauled to the site, it should be checked for quality and plant growth potential. Soil texture (friability), acidity, organic matter and nutrient content are important factors. It should be free of weed seeds.

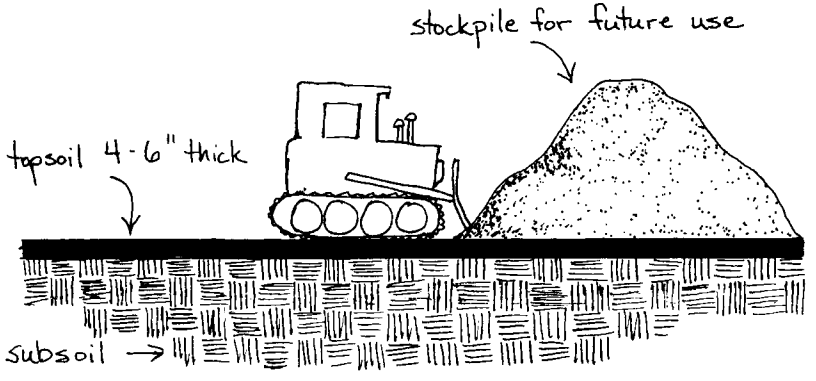
- Install needed Best Management Practices before spreading topsoil.

- After final grading, loosen and roughen the surface to insure good bonding with topsoil.

- Remove large rocks, roots and other debris.

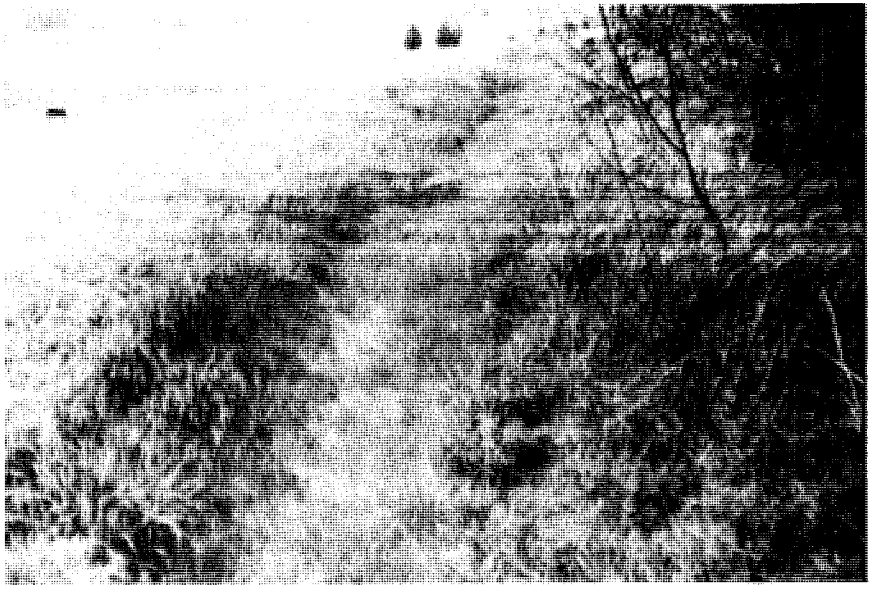
- Spread uniformly 4 to 6" thick over entire area.

- Test topsoil and apply lime and fertilizer before seeding or sodding.



DIVERSION

A diversion is an earth channel constructed across a slope with a ridge on the lower side.



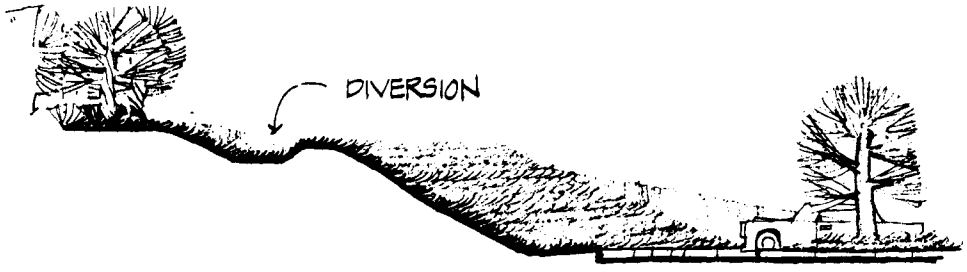
Permanent grass diversion at top of slope above the new Kentucky State Library.

Diversions serve to intercept surface water runoff, and channel it around the slope to a safe, stabilized outlet.

Diversions are often located near the top of a hill to reduce the amount of surface water running over a recently graded and bare, unvegetated slope. They may also be used at intervals across the middle of the slope to reduce the amount of runoff on the lower slope. The outlet may lead into a sediment basin or retention pond.

They are generally vegetated especially if planned for over a year's protection. Diversions may be designed as a permanent best management practice. If temporary, vegetation may be unnecessary.

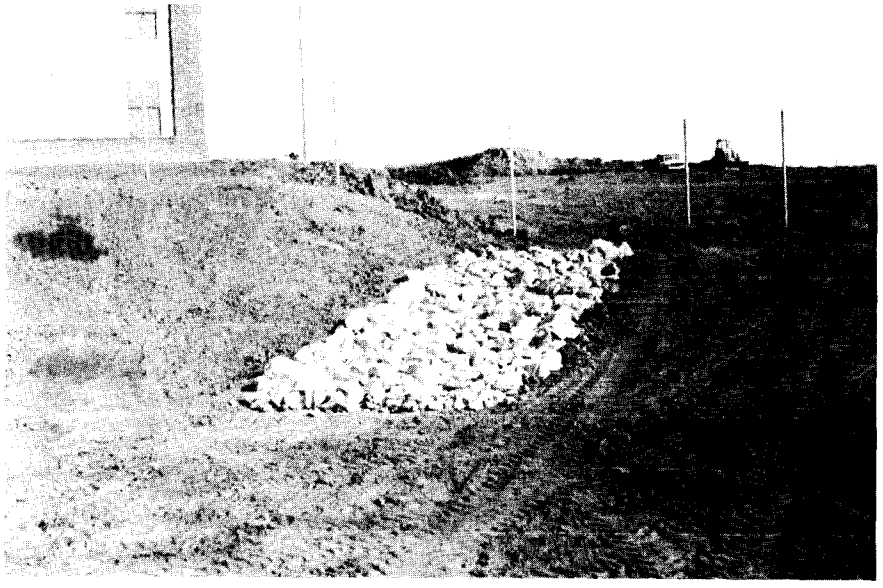
HILLSIDE CROSS SECTION



SECTION OF DIVERSION AT TOP OF SLOPE

RIPRAP

A layer of loose angular stone used to protect the soil from erosion by concentrated surface runoff water, or to help prevent streambank erosion.



A riprap liner on a short waterway that will carry high velocity, concentrated runoff to a lower elevation.

Riprap is placed on steep slopes, streambanks, drainageways, roadbanks, storm drain outlets, or similar concentrated runoff flow areas where vegetation is difficult to establish or is an inadequate method of erosion control. Riprap also allows surface water to percolate into the underlying soil.

DESIGN RECOMMENDATIONS

Stone or Rock

Stone size varies according to velocity; use the following general guide.

Velocity	Stone Diameter
6 feet/second	5 inches
10 feet/second	14 inches
12 feet/second	20 inches

Thickness of riprap should be 1.5 times the maximum stone diameter, but not less than 6 inches.

Stone should be hard and angular to resist water action and weathering.

Stone should be well graded so that openings between larger stones are filled with smaller stones.

Filter Blanket

- Use a bedding blanket (at least 3" thick, of KY DOT #2 coarse aggregate) under the riprap to prevent soil movement through the rock.
- Plastic filter cloth may be used in place of the above rock aggregate.

Slope

- Banks or slope should be no steeper than 1½:1.

- Excavate 1½-3' trench at the toe of the slope and fill with riprap.

MAINTENANCE:

Inspect site annually or after intense rains and repair or replace dislodged stone.

SEDIMENT BASIN

An excavated basin or an earthen dam across a drainageway to catch and retain sediment.

A sediment basin being converted to a permanent stormwater retention basin. This site was recently seeded - note the good straw mulch.

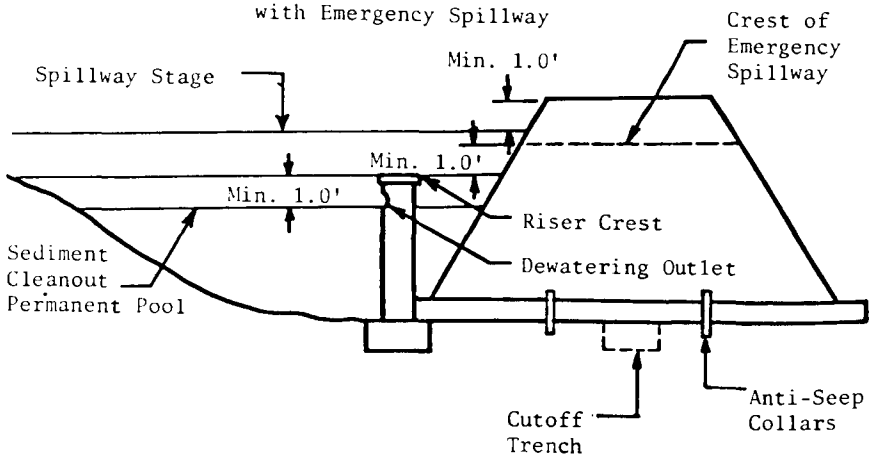
A sediment basin may be temporary and removed within 12 to 24 months or it may be permanent and converted to a stormwater retention basin or an urban pond. The primary purpose is to detain sediment laden water long enough for most of the sediment to settle out. A well-designed basin reduces downstream damages including siltation of channels, waterways, lakes and reservoirs. A permit and compliance with state design criteria must be met for structures that may have a significant damage potential.

SOME BASIC DESIGN CONSIDERATIONS

- Most effective location is in natural drainageways or low areas below highly erosive areas.
- Consider all complementary BMP's such as diversions, seeding and mulching, etc., for maximum benefits.
- Compute capacity based on estimated sediment yield.
- Basin length should be twice the width, when possible.
- Scarify area of future fill before placement.
- Fill should not contain roots, vegetation or large stones.
- Place fill in 6" layers and compact.
- Every basin should have both a principal and emergency spillway.

*** Refer to a design handbook and/or an engineer for specific site specifications.

SEDIMENT BASIN SCHEMATIC ELEVATION
with Emergency Spillway



MAINTENANCE:

A regular inspection schedule should be set up.
- Also additional inspection after rainstorms, with a close check of the embankment and spillways for erosion, as well as sediment accumulation in the basin.
- Remove sediment when two-thirds capacity is reached.
- After construction site is stabilized, the embankment and silt deposits should be leveled and seeded.

SEDIMENT TRAP

A small temporary ponding area, generally an earthen and/or rock embankment across a swale.

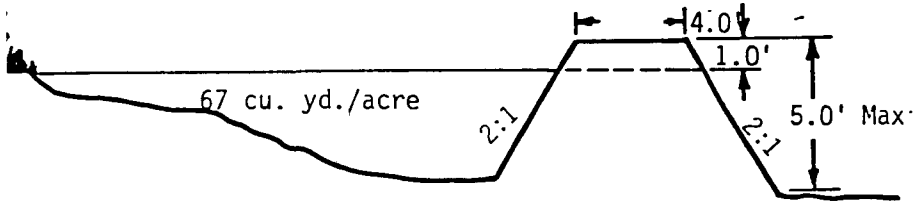
Even a "rough" looking earth embankment can be placed across a small drain to catch and hold sediment. This one protects the road at the right of the photo. Always provide a spillway at least one foot below the top of the dam.

Sediment traps are built as temporary measures (usually less than 18 months) that are easily and quickly built below high sediment producing areas. Several small sediment traps may be used in a series along an individual hillside drainageway. Although the engineering specifications may not be as precise as for a large sediment basin, traps can be very effective in retaining sediment on the construction site. They require frequent inspections, and need to be cleaned out regularly after most rainstorms.

LOCATION AND CONSTRUCTION GUIDELINES

The best location is in a swale or small drainageway - having less than a five-acre watershed. The embankment area should be cleared and grubbed - with all vegetation and roots removed. The volume of the sediment storage should be 60 cubic yards per acre of drainage area to be most effective. Clear the trees from the sediment storage area to facilitate future cleanouts. The maximum height of the dam is five feet with an outlet one foot below the top. The sideslopes are best 2:1 or flatter.

TEMPORARY SEDIMENT TRAP



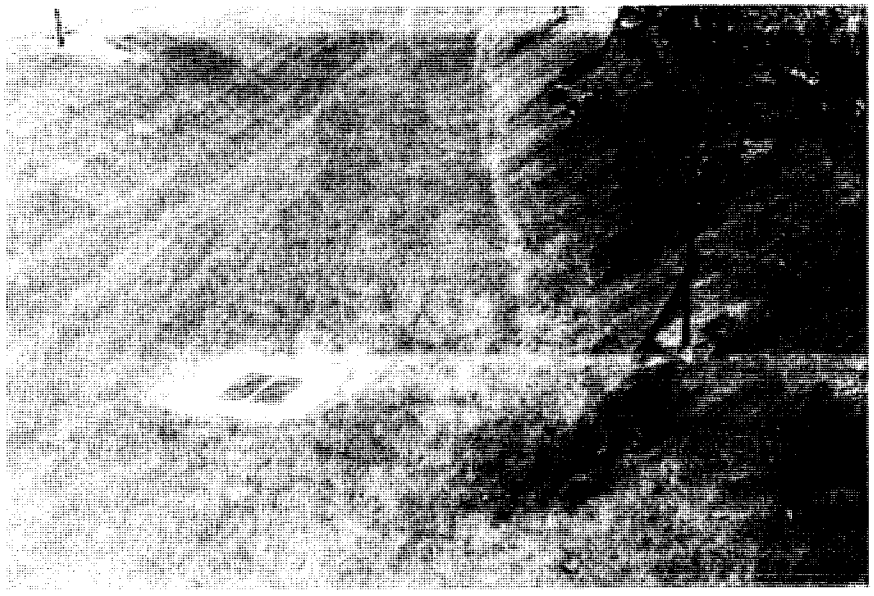
Cross-Section

MAINTENANCE:

The sediment should be removed from the trap when it becomes about 50 percent filled. Regular inspection and removal of sediment is of most importance. Spread the accumulated sediment in an area of low erosion potential and vegetate as soon as possible. Check the structure, especially the outlet. Repair structure if damaged - maintain outlet at approximately one foot below the top of dam.

WATERWAYS, GRASS

A surface drainage course, protected by suitable vegetation, for the safe disposal of runoff water.

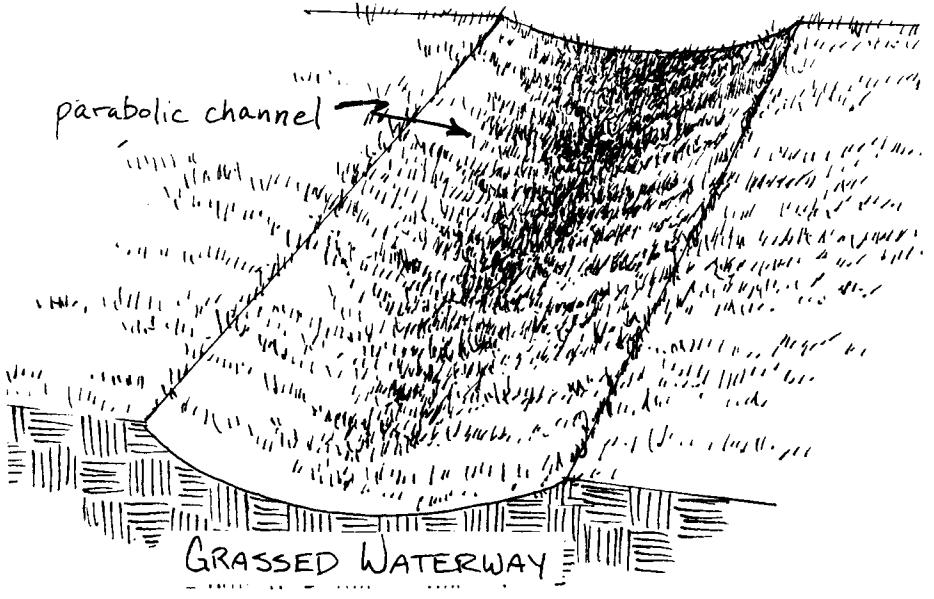


Grass waterway leading to the stormwater inlet in foreground.

Natural waterways should be utilized as much as possible in the design of the complete stormwater management plan. On some construction sites, due to extensive grading, newly constructed or enlarged waterways may be needed to handle the increased surface runoff. Grass waterways may be used in place of curbs, gutters and underground storm sewers with considerable construction cost reductions. Other advantages are reduced runoff velocities and increased infiltration of water.

CONSTRUCTION GUIDELINES

- The minimum capacity should be that needed to pass a 24-hour, 10-year frequency storm.
- The maximum velocity is four feet per second for seeded vegetation and six feet per second if sodded.
- The cross section may either be parabolic or trapezoidal.
- The minimum depth and width should be designed according to engineering standards.
- If seepage or a high water table is present, subsurface drainage is recommended.
- The outlet must be constructed and stable before the waterway.
- Special waterway protection (as temporary diversions, jute netting, or straw bales) is often needed until vegetation is established.

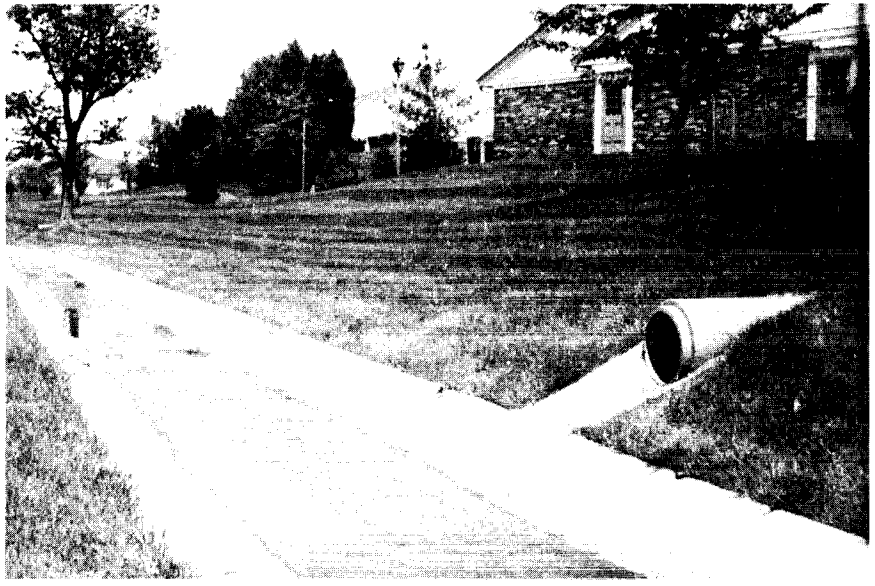


MAINTENANCE:

- Check vegetation and maintain vigor by soil amendments.
- If bare spots are found, seed and mulch or sod immediately.
- Keep waterway clear of debris and sediment.
- Mow regularly to control brush and weeds.

WATERWAY, LINED

A permanently installed, riprap or concrete lined, surface stormwater conveyance channel.

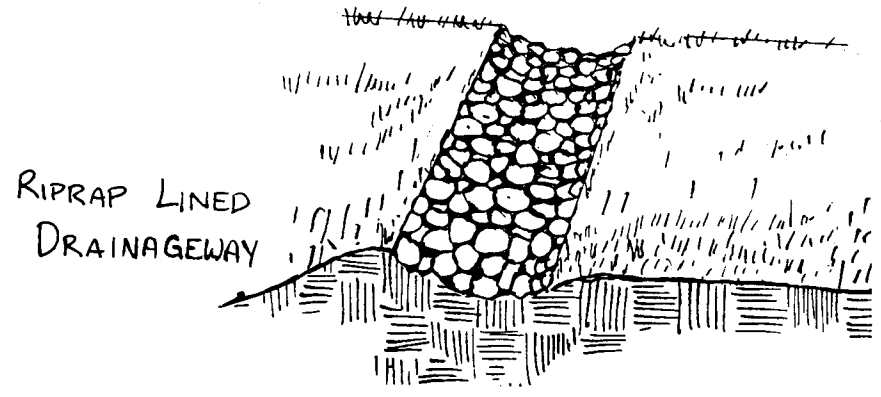


Concrete lined waterway needed due to rather constant surface flow. Note concrete pipe outlet from adjacent paved parking area.

Lined waterways must often be installed at urban development sites, especially in man-made channels that have high runoff velocities, and increased runoff from streets, rooftops and other impermeable surfaces. Riprap is often preferred over concrete to help reduce water velocity and it usually has a more natural appearance. Asphalt is the least acceptable as a lining. Linings are nearly always required when slopes are steep or soils are toxic or extremely erosive.

CONSTRUCTION GUIDELINES

- If possible, locate in natural drainageways or swales; however, any man-made channel may be used.
- Capacity should be large enough to pass a 24-hour, 10-year frequency storm.
- Velocity is generally not a problem, except at the outlet - where energy dissipators are often required to slow the water velocity as it leaves the waterway.
- Trapezoidal, parabolic or Vee cross sections may be used.
- Refer to riprap guidelines for stone size and thickness.
- Subgrade should be compacted and moistened before pouring concrete lined channels.
- Concrete should be at least 4" thick and meet other KY-DOT standards, including transverse and expansion joints.



MAINTENANCE:

- Check riprap channels periodically and after severe rainstorms for scouring under rocks and for dislodged rocks. Repair as needed.
- Check concrete channels for scouring or undermining along the edges and at the outlet. Repair immediately.
- Sediment and debris should be removed from the channel.

MULCHING

The application of plant residues or other non-vegetative materials to reduce soil erosion and to aid in seed germination.

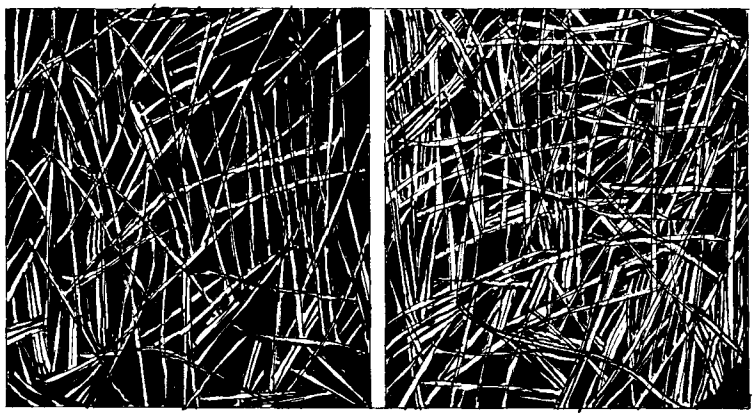
Example of an adequate straw mulch on a newly seeded construction site. Note the very fine plastic netting used to hold the straw in place and the pocket comb to indicate size and amount.

Mulch is generally used immediately after new grass and/or legume seedings to hold the seed in place, help retain soil moisture, and insulate the seed from heat - all of which increase germination and early plant growth. Mulch is used alone on bare soil surfaces to control soil erosion by reducing raindrop splash, slowing surface water runoff and increasing water percolation. Thicker mulch applications often help reduce mud and soil deposits on new construction materials, as lumber, brick and roofing.

TYPICAL MULCH AND APPLICATION RATES

Type	Quality	1000 sq.ft.	Acre
Small grain straw, grass or hay straw	Dry, free of weed seed	75-100#	1½-2 ton
Wood fiber cellulose	Air dry and non-toxic	25-40#	1,400-1,600#
Corn stalks	Dry, cut in 4-6" lengths	185-275#	4-6 tons
Asphalt spray	Refer to label	5 gal.	200 gal.

SCHEMATIC STRAW MULCH RATES



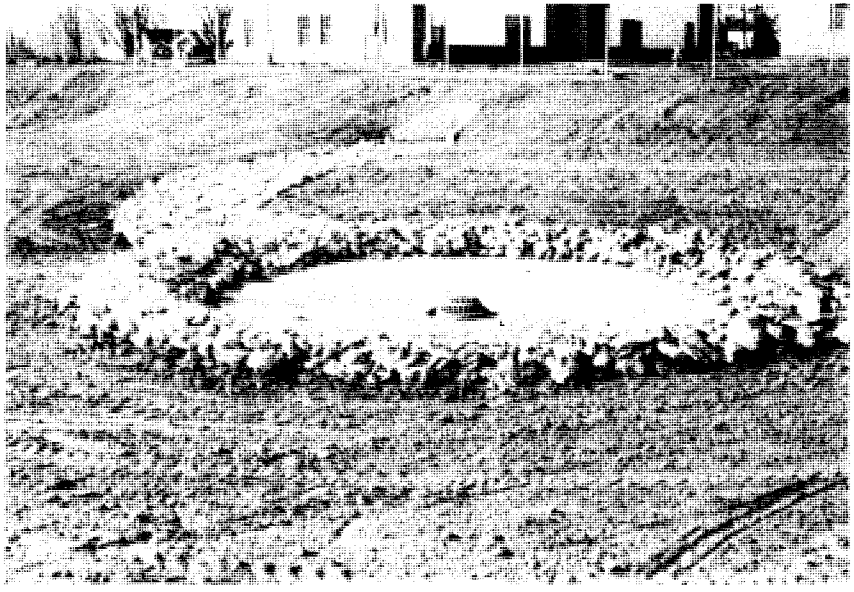
40# per 1000 sq. ft. 80# per 1000 sq. ft.

APPLICATION GUIDELINES

- If the site is subject to soil erosion, install temporary diversions or other water control measures above and within the area to be mulched.
- Select the type of mulch and the rate according to the needs and site conditions.
- Application may be by hand, blower or other machines.
- If straw, spread uniformly so that 80-90 percent of ground is covered. Anchor mulch with asphalt or plastic spray, netting, or pegs and twine.

STORM DRAIN INLET FILTER

A sediment filter or an excavated area around a storm drain inlet.

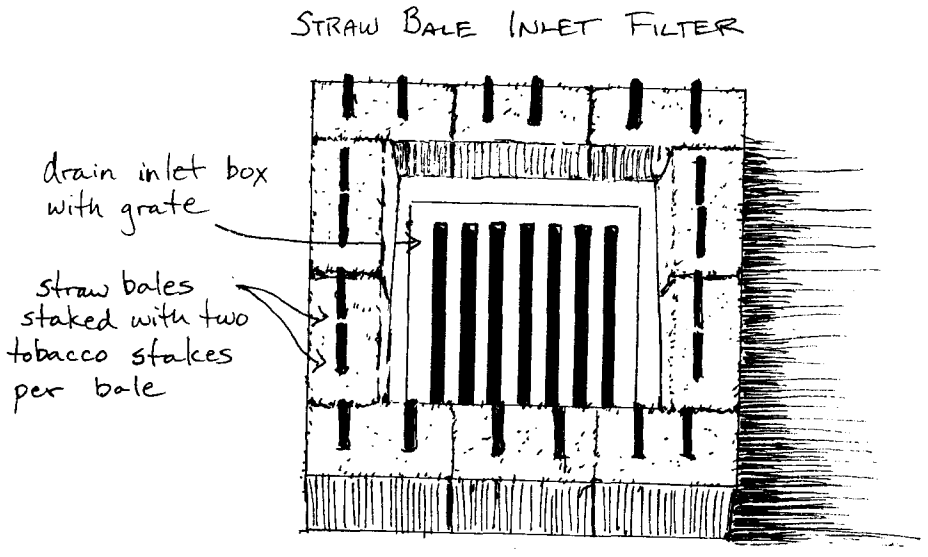


A ring of limestone riprap around a storm drain inlet will reduce sediment entering from the surrounding final graded, newly seeded area.

When the storm drainage system is installed before the construction site is completely stabilized, the chances are great that sediment will enter the system and may completely clog the drains. Inlet filters will keep out or reduce the sediment at the inlet site. There are many types ranging from straw bales, sod, gravel or stone, or concrete block to simple excavations that catch and detain sediment.

CONSTRUCTION GUIDELINES

- Generally there should be no more than one acre drainage area above each inlet. If a larger drainage area exists, consider installing sediment traps or a sediment basin.
- The diagram below illustrates one of the many different designs of a simple straw bale installation.



MAINTENANCE:

- Inspect inlet filters periodically, and especially after heavy rains.
- Repair straw bales, rock gravel or other devices if filters are loosened by water, causing large cracks or openings.
- If filtering devices become clogged, either clean sediment out or replace filter.
- Remove inlet filter when surrounding area has been stabilized.

STRAW BALE BARRIER

A temporary row of straw bales, placed across a slope or at intervals across small waterways or swales.

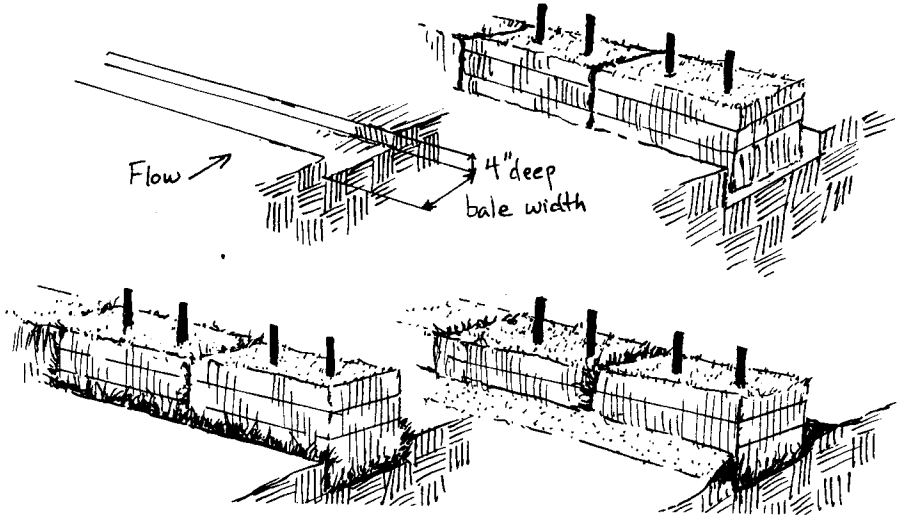
A line of straw bales protecting a lake off to the left of the photo. Note nearly 12" of sediment caught by the center bales from the land grading on the right.

Their main purpose is to slow surface water runoff, and to detain and trap sediment from highly erosive areas.

Straw bales should be placed lengthwise, on the contour, and in a single row. The ends of the bales are to be tightly abutted together. The bales should be placed in a shallow trench (about 4") and backfilled a few inches on the uphill side to prevent undercutting. Two tobacco stakes (or similar size) need to be driven through each bale to anchor them firmly. Angle stakes toward the previously laid bale. Wedge loose straw between bales, if necessary.

1. Excavate the trench.

2. Place and stake straw bales.



3. Wedge loose straw between bales.

4. Backfill and compact the excavated soil.

Check bales after each rainfall and repair or replace any damaged bales. Remove accumulated sediment; never allow sediment to reach higher than half the bale height. When construction has been completed, remove bales, smooth accumulated sediment, and revegetate immediately.