

Practice no. 6.11

PERMANENT SEEDING



Permanent vegetation controls erosion by physically protecting a bare soil surface from raindrop impact, flowing water, and wind. Vegetation binds soil particles together with a dense root system, and reduces the velocity and volume of overland flow. It is the preferred method of surface stabilization wherever site conditions permit.

Permanent seeding of grasses and legumes is the most common and economical means of establishing protective cover. The advantages of seeding over other means of establishing plants include the relatively small initial cost, wide variety of grasses and legumes available, lower labor input, and ease of application. Problems to consider are potential for erosion during the establishment period, the need to reseed areas, seasonal limitations on seeding dates, weed competition, and the need for water during germination and early growth.

Give special attention to selecting the most suitable plant material for the site and intended purpose. Good seedbed preparation, adequate liming and fertilization, and timely planting and maintenance are also important.

Permanent seeding of slopes requires use of a protective mulch until grass becomes established.



S

Sodding is an erosion control practice, especially effective where immediate cover is required. It allows the use of vegetation to protect channels, spillways, and drop inlets where design flow velocities may reach the maximum allowable for the type of vegetation to be used. Sodding should also be considered in locations where a specific plant material cannot be established by seed or when immediate use is desired for aesthetics such as landscaping.

Some additional advantages of sod are nearly year-round establishment capability, less chance of failure, freedom from weeds, and immediate protection of steep slopes. Disadvantages include high installation costs, especially on large areas, and the necessity for irrigation in the early weeks. Sod also requires careful handling and is sensitive to transport and storage conditions. Soil preparation, installation, and proper maintenance are as important with sod as with seed.

Choosing the appropriate type of sod for site conditions and intended use is of utmost importance.



Sodding is an effective way to immediately stabilize a critical area (Source: NC DOT).

Practice no. 6.13

**TREES, SHRUBS, VINES,
AND GROUND COVERS**



Trees, shrubs, vines, and ground covers can provide superior, low-maintenance, long-term erosion protection. They may be particularly useful where site aesthetics are important.

Woody plants and ground covers are particularly adapted for use on steep or rocky slopes where maintenance is difficult, in shaded areas, for wildlife habitat improvement, as windbreaks or screens, and for other special landscape uses.

There are many different species of plants from which to choose, but care must be taken in their selection. It is essential to select planting material suited to both the intended use and specific site characteristics. None of these plants, however, is capable of providing the rapid cover possible by using grass and legumes. Vegetative plans must include close-growing plants or an adequate mulch with all plantings of trees, shrubs, vines, and ground covers.



Trees, shrubs, vines and ground covers, in combination with a suitable mulch, beautify and provide long-term protection to sloping areas.



Surface mulch is the most effective, practical means of controlling erosion on disturbed areas before establishing vegetation. Mulch protects the soil surface, reduces runoff velocity, increases infiltration, slows soil moisture loss, helps prevent soil crusting and sealing, moderates soil temperatures, and improves the microclimate for seed germination.

Organic mulch such as straw, wood chips, and shredded bark are effective for general use where vegetation is to be established. In recent years a variety of mats and fabrics have been developed that make effective mulches for use in critical areas such as waterways and channels. Various types of tacking and netting materials are used to anchor organic mulches. Netting is generally not effective when used alone.

Mechanical mulches, such as gravel, are used in critical areas where conditions preclude the use of vegetation for permanent stabilization.



Mulch must be held in place—especially on slopes (source: NC DOT).

Practice no. 6.15

RIPRAP



A properly designed layer of stone can be used in many ways and in many locations to control erosion and sedimentation. Riprap protects the soil surface from direct erosive forces. It is often used on steep cut-and-fill slopes subject to severe weathering or seepage, for channel liners, for inlet and outlet protection at culverts, for streambank protection, and to protect shore lines subject to wave action.

Well-graded riprap forms a dense, flexible, seal-healing cover that will adapt well to uneven surfaces. Care must be exercised in the design so that stones are of good quality, sized correctly, and placed to proper thickness. Riprap should be placed on a proper filter material of sand, gravel, or fabric to prevent soil "piping."



Riprap can be used to line slopes or channels to prevent erosion.

DS

Coastal dunes protect backshore areas from ocean storms, shoreline erosion, and encroachment by migrating sand. Adapted native vegetation can be used to stabilize coastal dunes and sandy areas disturbed by construction, and to rebuild frontal dunes. In North Carolina the perennial grasses American beachgrass, sea oats, and bitter panicum are the primary dune stabilizers, and have been extensively planted for this purpose. Vegetative planting is the most effective way to establish these grasses. Primary considerations in planning dune grass plantings include finding a source of plant material and timing plantings so they have maximum chance of success.

American beachgrass is excellent for initial dune stabilization, but is often not persistent. If 10% sea oats and bitter panicum are included in beachgrass plantings these will fill in bare spots and provide persistent cover.

Sand fences accelerate sand accumulation and can be used in combination with vegetation to rebuild frontal dunes. Dune grasses grow upward through accumulating sand to hold it as the dune grows.



Dune stabilization with appropriate vegetation impedes sand migration, and helps maintain a buffer against wave overwash.

Practice no. 6.17

ROLLED EROSION CONTROL PRODUCTS



Many different types of rolled erosion control products are used to prevent erosion and hold seed and mulch in place on steep slopes and in channels so that vegetation can become well established. These products are temporary degradable or long-term nondegradable material manufactured or fabricated into rolls designed to reduce soil erosion and assist in the growth, establishment and protection of vegetation. Use the RECP's to help permanent vegetative stabilization of slopes 2:1 or greater and with more than 10 feet of vertical relief, as well as, channels when runoff velocity exceeds 2 feet per second on bare earth during the 2-year rainfall event.

Installation is critical to the effectiveness of these products. When close ground contact is not properly achieved, runoff can concentrate under the product, causing significant erosion. Monitor the products on a regular basis to avoid significant problems caused by rainfall.



Rolled erosion control products hold seeds and mulch in place until vegetation is able to establish on steep slopes or channels.



Diversions are among the most effective and least costly practices for controlling erosion and sedimentation. They can be permanent or temporary and can serve special purposes such as diversion dikes or right-of-way diversions.

Temporary diversions may be planned to function one year or more, or may be rebuilt at the end of each day's operation to protect freshly graded cuts or fills. Temporary diversions are used above disturbed slopes to prevent flow across unprotected slopes, to reduce slope length, and to divert excess runoff away from level areas. Diversions help maintain good working conditions and reduce erosion potential. A diversion may also serve as a sediment trap when overexcavated and located on relatively flat grade adjacent to a sediment fence.

Temporary diversions are usually constructed by excavating a channel and using the spoil to form a ridge or dike on the downhill side. It is important that diversions be designed, constructed, and maintained properly since they concentrate flow and increase erosion potential if failure occurs. Outlets for diversions must be stable for the expected flow and reinforced before the diversion is installed.



Temporary diversion across a slope helps prevent sheet and rill erosion.

Practice no. 6.21

PERMANENT DIVERSIONS



Permanent diversions subdivide a development site and control the direction and velocity of runoff throughout the life of the development. They should be located during initial site planning, and sloped and stabilized as appropriate to enhance site appearance. Permanent diversions may be used as temporary diversions until the site is stabilized and then completed as a permanent measure.

Permanent diversions may control runoff above steep slopes, across long slopes, below steep grades, and around buildings to other areas subject to damage from runoff. The capacity of the diversion should be based on the runoff characteristics of the completed site and the potential damage from runoff after development.

Functional need, velocity control outlet stability, site aesthetics, and maintenance requirements are key considerations in the planning and design of permanent diversions.



Permanent diversion controls the direction and velocity of runoff for erosion control and flood protection.



The diversion dike is a special application of a temporary or permanent diversion. It differs from other diversions in that the location and grade are usually fixed, and the design cross section, method of stabilization, and outlet requirements are designed for the existing topography at the work boundary or property boundary.

Diversion dikes may be located at the upslope side of a construction site to limit inflow or at the downslope side to divert sediment-laden runoff to on-site sediment traps. Diversion dikes do not usually encircle the entire work area. Caution must be exercised in the design to be certain that the diverted flow will not cause flood damage in adjacent areas.

Diversion dikes must be vegetated immediately after construction, and the channel area stabilized according to flow conditions.

Frequent maintenance inspection and immediate damage repair is of prime importance.



Diversion dike protects work areas and prevents sediment from leaving the site.

Practice no. 6.23

RIGHT-OF-WAY DIVERSIONS (Water Bars)



Narrow rights-of-way on long slopes used by vehicles can be subject to severe erosion. Surface disturbance and tire compaction promote gully formation by increasing the concentration and velocity of runoff.

Right-of-way diversions or water bars limit the accumulation of erosive volumes of water by diverting surface runoff at predesignated intervals. Water bars are constructed by forming a ridge or ridge and channel diagonally across the sloping right-of-way. Each outlet should be stable, considering the cumulative effect of upslope diversion outlets. The height and side slopes of the ridge and channel are designed to divert water and allow vehicles to cross.

Right-of-way diversions (water bars) prevent erosion from long narrow slopes.





Grass-lined channels resemble natural systems, and are usually preferred where design velocities are suitable. Select appropriate vegetation and construct channels early in the construction schedule before grading and paving increase runoff rates.

Generally, grass-lined channels are constructed in stable, low areas to conform with the natural drainage systems, but they may also be needed along roadways or property boundary. To reduce erosion potential, design the channel to avoid sharp bends and steep grades.

The channel cross section should be wide and shallow with relatively flat side slopes so surface water can enter over the vegetated banks without erosion. Riprap may be needed to protect the channel banks at the intersections where flow velocities approach allowable limits and turbulence may occur.



Grass-lined channels are preferred where flow velocities are within permissible limits.

Practice no. 6.31

RIPRAP-LINED AND PAVED CHANNELS



RR



P

Where flow velocities exceed allowable limits for grass-lined channels, more durable liners such as riprap or paving should be used.

Riprap liners are considered flexible and are usually preferred to rigid liners. Riprap is less costly, adjusts to unstable foundation conditions, is less expensive to repair, and reduces outlet flow velocity.

Paved channels are preferred where space is limited, slopes are very steep, or the channel setting warrants the use of special paving materials. Care must be exercised to see that foundation conditions are stable and high exit velocities can be controlled to protect the receiving stream.

Riprap or paved channels can be constructed with grass-lined side slopes where site conditions warrant.

Riprap or paved channels are necessary where flow velocities are too high for vegetation.





A temporary flexible tubing, designed to convey concentrated runoff down the face of a disturbed slope, is an effective gully prevention practice especially in the early stages of project development. Temporary slope drains are usually installed in conjunction with temporary diversions that are located above cut or fill slopes. They may also serve as outlets for natural drainageways.

It is important that these temporary structures be sized, installed, and maintained properly as their failure will usually result in severe erosion of the slope. Proper backfilling and compaction are essential. Slope drains must extend downslope to stable outlets, or special outlet protection must be provided.

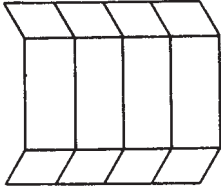
Temporary slope drains are often replaced with permanent structures when final grading is complete.

Temporary slope drain conveys concentrated flow safely down a steep slope until permanent measures are installed.



Practice no. 6.33

PAVED FLUMES (Chutes)



Paved flumes are small concrete-lined channels designed to convey storm runoff down steep slopes. They are part of the permanent erosion control system for the development.

Paved flumes or chutes can be readily installed in most locations, offer large freeboard capacity at low cost, are less subject to failure from blockage than closed drains, and require little maintenance.

In planning paved flumes, give special attention to flow entrance conditions, stability of the foundation, outlet energy dissipation, and freeboard capacity.

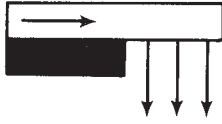
The upper portion of the side slopes may be grassed to improve appearance and reduce cost.

Paved flumes carry high velocity flows down steep slopes as part of the permanent erosion control system.



Practice no. 6.40

LEVEL SPREADER



Level spreaders provide a non-erosive outlet for concentrated runoff by dispersing flow uniformly across a stable slope. They are relatively low-cost structures designed to release small volumes of water safely. The drainage area should be limited to 5 acres, and the size of the spreader based on design runoff.

Construct level spreaders in undisturbed soil. The lip must be level to ensure uniform spreading of storm runoff, and the outlet slope uniform to prevent the flow from concentrating. Water containing high sediment loads should enter a sediment trap before release in a level spreader.



Level spreader releases flow from a diversion onto a uniform stable area.