OKLAHOMA COOPERATIVE EXTENSION SERVICE

Using Vegetation for Erosion Control on Construction Sites

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Erosion and sediment control on construction sites is a critical issue. Construction activities account for about five percent of the nonpoint source (NPS) impacts to our Nation's surface waters. Runoff from construction sites is by far the largest source of sediment in urban areas under development. Four primary factors determine the potential for erosion—soil type, vegetative cover, topography, and climate. **This fact sheet explains the importance of vegetative cover, its role in erosion control, and its establishment on construction sites.**

What is Soil Erosion?

Soil erosion is the process by which wind, water, ice, and gravity wear away the land's surface. Sediment pollution is soil out of place. There are two categories of erosion—natural erosion and accelerated erosion. Natural erosion and soil formation are essential landscape processes and are in balance when the soil surface thickness remains fairly constant over time. Vegetative cover is the biggest factor in this balance; anything that disturbs it tends to accelerate erosion. Accelerated erosion is most often caused by a disturbance or alteration of the landscape, such as floods, earthquakes, or construction activities. The typical construction site can erode at a rate as high as 100 to 500 tons/acre/year. This is 100 times greater than erosion from cropland and 2,000 times greater than erosion from woodland.

Types of Erosion

Splash, rill, gully, and channel erosion are depicted in Figure 1. **Raindrop splash erosion** is caused by the impact of raindrops that detach soil particles. **Sheet erosion** transports soil particles in the shallow flow of water as it runs off the land. **Rill erosion** is caused by flowing water concentrating in small channels. **Gully erosion** occurs where rills become larger and deeper. Finally, **channel erosion** results from high velocities and volumes of flow.

Of all the types of erosion, splash erosion from raindrop impact causes the most problem. Raindrops strike the earth at about 20 mph—10 to 100 times faster than flowing water.

Influence of Vegetation and the Impact of Rain on Soil

Vegetation intercepts rain, reducing its energy and preventing splash erosion. It also slows runoff, reduces sheet erosion, and anchors and reinforces the soil with its root system. Figure 2 shows how erosion rate decreases as the soil is covered by vegetation.

Surface water runoff from vegetated areas is much less than that from bare soil due to a combination of surface roughness, infiltration, and interception. Runoff generally does not exceed 10 to 20 percent of the rainfall received on small watersheds covered with trees or grass. Without vegetation, however, this could be as high as 60 to 70 percent.

Water moving across a bare soil surface erodes soil and transports particles already detached. Vegetation limits the capacity of flowing water to detach soil particles and transport

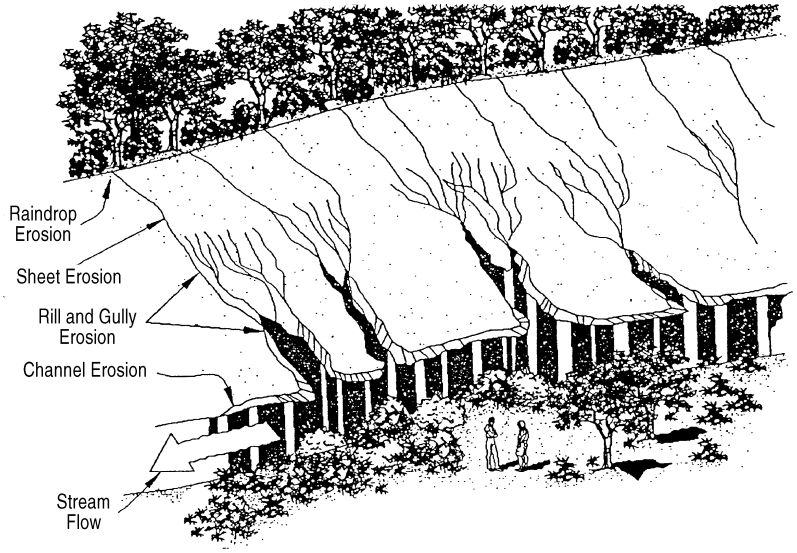


Figure 1. Types of erosion. *(Michigan Department of Natural Resources, 1975)*

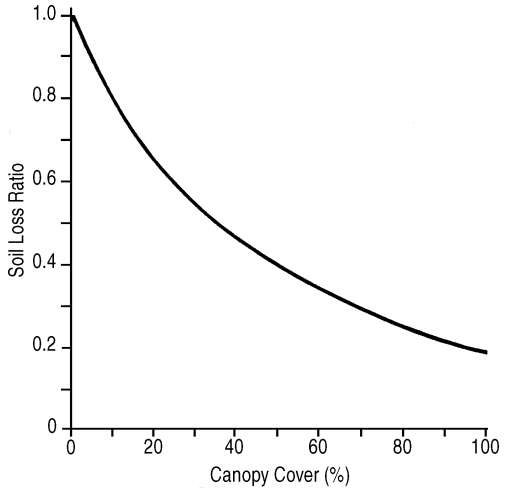


Figure 2. Change in erosion rate due to increasing vegetative cover. *(Coppin and Richards, 1990)*

sediment by decreasing runoff volume, slowing velocity, and protecting the soil surface from flowing water.

As shown in Figure 3, infiltration rate increases under vegetation. Plant roots create openings or cracks where roots have decayed, increase surface roughness, lower the density of the soil, and improve the structure of surface soils. This increase in the infiltration rate of rainfall and surface flow increases the moisture content of the soil. Plant roots also physically anchor the soil from movement induced by gravity, raindrop impact, or surface runoff.

Laterally spreading root systems, especially rhizomes, are more effective in reducing surface erosion than vertically structured ones with tap roots. Roots form a backbone of fibers of relatively high tensile strength and adhesion within a matrix of lower tensile strength. The sheer strength of the soil mass is enhanced by the presence of a root matrix. Figure 4 shows different patterns of root growth. Erosion control plantings should have relatively deep, branched root systems.

Restoration

Measures that stabilize, maintain, and protect existing vegetation include stockpiling topsoil for reuse, seeding or sodding, and selecting plants and a planting design appropriate for the site. First, conduct a detailed site appraisal to identify the conditions and environmental factors that can restrict or promote the growth of vegetation. These factors include:

- Soil types, fertility, pH, climate (temperature and moisture).
- Slopes.
- Roles and functions of the vegetation.
- Properties required of the vegetation and thus the types needed (herbaceous, shrubby, woody, etc.).
- Ecological and plant community factors for long-term stability.
- Long-term management objectives and review requirements for maintaining the vegetation.

Native Species

Use species that are native to the area whenever possible. A native plant landscape is naturally water conserving. They are adapted to local rainfall averages and, once established, do not need supplemental watering. Native grasses and wildflowers provide seasonal color and species diversity and are low maintenance.

Natural landscaping is an excellent example of how to create less intensively managed landscapes, which help reduce maintenance costs, conserve natural resources, increase biodiversity, and benefit wildlife.

Native plants are adapted to local rainfall and, once established, do not need supplemental watering.

Plant Material Selection

Except where a manicured lawn is needed, it is unlikely that one species alone will fulfill all site requirements. Mixtures of

Vegetation increases the strength of the soil by reinforcement from fibrous roots and anchoring from tap roots, thereby contributing to its stability.

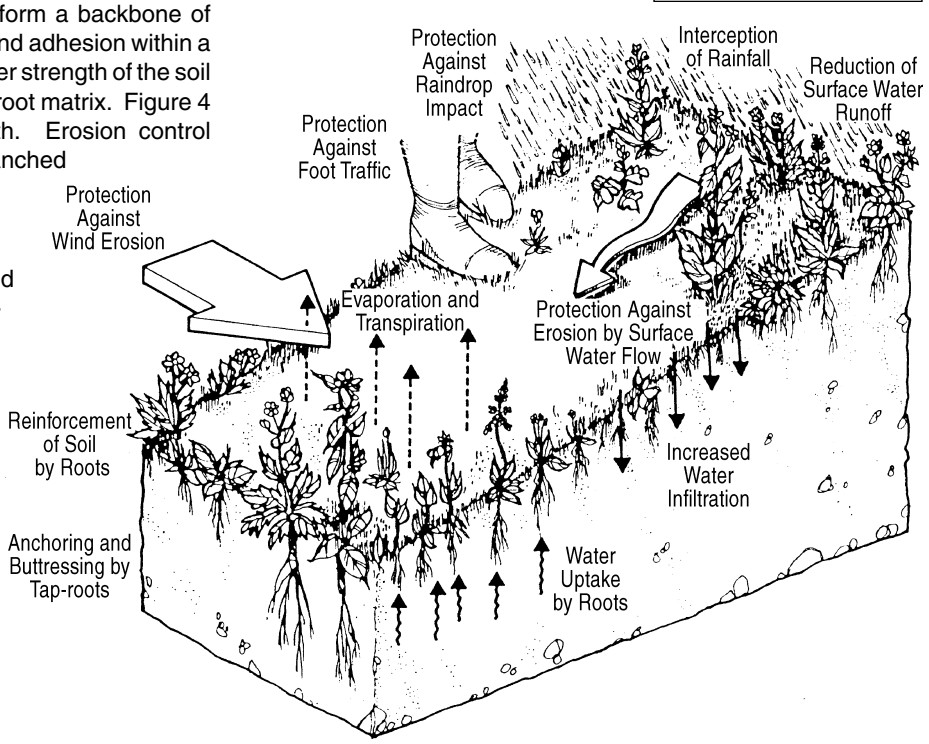
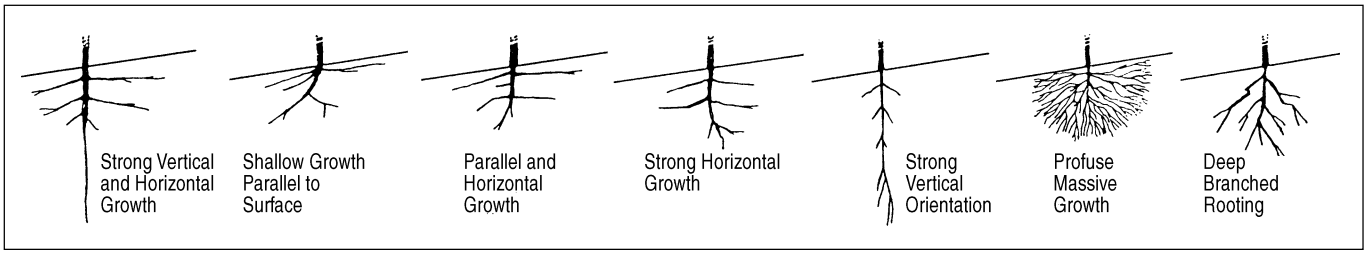


Figure 3. Some influences of vegetation on the soil. *(Coppin and Richards, 1990)*

Figure 4. Different patterns of root growth. *(Coppin and Richards, 1990)*



species with complementary characteristics allow vegetation to fill voids and respond to varying environmental conditions. Mixtures should be designed with the plant community and the environmental dynamics in mind. The proportion of each species will depend on the role each plays, its competitive ability, and succession status.

Grasses are usually selected as the main component of ground cover. They can be mixed with 10 to 50 percent legume and other herbaceous species. Legumes should usually be a significant component of mixtures, particularly on soils with low fertility. A nurse crop such as annual rye grain can hold soil in place, allowing a perennial to germinate when weather conditions change. Nurse species density should be kept to a low proportion, 10 percent or less, so that they do not dominate the area and suppress more slowly growing species. A diverse mixture of grasses, legumes, forbs, and shrubby species with a range of 6 to 10 species will allow for variability and flexibility in site conditions. Mixtures with a majority of shrubby species would be more suitable where deeper rooting is required.

Trees are an excellent means of improving the appearance of the landscape and disguising its scars. Trees have greater rooting depth and are able to penetrate moisture levels inaccessible to shallow-rooted vegetation. By reinforcing to greater depths, trees add stability to slopes. However, trees are less effective than grass in stabilizing against erosion. Therefore, it is recommended that areas designated for trees be planted with grass. To avoid competition with trees, give preference to lower- and slower-growing grasses, or phase trees in gradually after the area is stabilized.

Tree Protection

When existing trees are left on a site, they require protection from construction activities. Compaction and grading close to trees often cause trees to decline and die. Sometimes the damaged trees die slowly, after construction is finished.

Roots of established trees cannot tolerate significant changes in soil depth. Removing soil can sever and expose the root system and render the tree structurally unstable. Digging out large areas near trees can also adversely change the water table leading to a tree's demise. Soil should not be piled (even temporarily) over roots of trees. This can produce anaerobic conditions resulting in the suffocation of roots.

Vehicles driven or parked near trees results in soil compaction. Soil becomes more dense, restricting the movement of water and gases. This reduces the capacity of the roots to absorb moisture, oxygen, and nutrients.

It is impossible to avoid all site disturbance during construction, but measures can be taken to diminish tree injury. Leave the soil beneath the trees undisturbed and mark off the area with stakes and tape. When lowering the grade, terrace around the tree and support the soil with a retaining wall.

Table 1. Seed rates to use for vegetative cover.

Plant Name	*Rate per Acre*	*Rate per 1,000 sq. ft.*	*Planting Date*
Temporary Species:			
Annual rye	40 lbs.	1.0 lb.	Feb.-April Sept.-Nov.
Rye grain	120 lbs.	3.0 lb.	Aug.-Nov.
Wheat	120 lbs.	3.0 lbs.	Aug.-Nov.
Sorghums	80 lbs.	2.0 lbs.	Mar.-Sept.
Sweet clover	20 lbs.	0.5 lbs.	Sept.-Oct.
Sudan grass	40 lbs.	1.0 lb.	Apr.-Sept.
Millet	60 lbs.	1.0 lb.	Apr.-Sept.
Cowpeas	60 lbs.	1.0 lb.	May-June
Permanent Species:			
Lawn grasses:			
Bermudagrass*	80 lbs.	2.0 lbs.	April-July
Bluegrass	160 lbs.	4.0 lbs.	March-May Sept.-Nov.
Perennial Rye	200 lbs.	5.0 lbs.	Sept.-Dec.
Fescue	200 lbs.	5.0 lbs.	March-May Sept.-Nov.
Zoysia	80 lbs.	2.0 lbs. 2-3 sq. yd. sod if sprigging	April-July
Natives:			
Buffalograss**	80 lbs.	2.0 lbs.	April-June
Bluestem	40 lbs.	1.0 lb.	March-June
Lespedeza	40 lbs	1.0 lb.	April-June
Weeping lovegrass	40 lbs.	1.0 lb.	April-June

* Most seeded bermudagrass is not winter hardy. One of the best ways to plant is by spreading topsoil that contains bermudagrass stolens and rhizomes.

** Buffalograss should not receive more than 2 lbs./1,000 sq.ft. of Nitrogen.

(Source: Oklahoma County Conservation District)

Table 2. Vegetation management.

Vegetation Type	*Establishment Method*	*Aftercare*	*Management*
Grass or grass-legume swards	Seeding	Fertilizing; mowing to encourage tillering.	Soil fertility management. Cut or graze to maintain desired height and prevent scrub invasion. Removal of noxious or undesirable weeds.
Diverse herbaceous swards	Seeding, maybe some planting	Mowing to control nurse species, fertilizing.	Cutting, grazing, or burning to prevent succession to scrub; timing is important to allow desired species to flower and set seed. Removal of noxious or undesirable weeds.
Short shrubs	Seeding, maybe some planting	Fertilizing, weed control may be necessary on fertile soils.	Depends on whether succession to trees is necessary. If not, the occasional cutting or burning, the regime depends on the species.
Trees and shrubs	Seeding	Little, maybe fertilizing and weed control.	Maybe some selective weeding and fertilizing around individual plants. Selective thinning of seedlings to obtain desired balance of species.
	Planting	Weed control, replacement, pruning, fertilizing, maintaining protection.	Fertilizing as necessary, thinning to encourage proper stand structure, removal of nurse species. Coppicing of some species for dense, shrubby cover.

(Source: Coppin and Richards)

Avoid cutting off root systems by carefully tunneling under roots instead of trenching through them. For more information, see OSU Extension Facts F-6429, "Site Disturbance and Tree Decline."

It is impossible to avoid site disturbance during construction, but measures can be taken to diminish the injury to trees.

Site Preparation

Careful site preparation will enhance vegetation growth and help to overcome problems that often arise on construction sites. The method of vegetation establishment, to a large extent, will dictate surface preparation. A smooth finish is only required where the vegetation is to be closely mown, or in water channels to reduce surface roughness. Drilling seed requires a reasonably level surface with loose tilth, but a rough surface will work for broadcast or hydroseeding.

For best results, spread four to six inches of topsoil. Fertilize according to soil test recommendation, or apply 10 lbs. per 1,000 sq. ft. of a balanced fertilizer, such as 10-10-10 or 13-13-13. Seed with an appropriate mix for the site. Table 1 shows the seeding rates to use for vegetative cover. Mulch with straw at two square bales per 1,000 sq. ft. Water gently as needed to keep the soil moist until the grass is about two inches tall.

Plant Spacing

Plant spacing will depend on the type of vegetation required. Shrubs are planted more closely than trees, from two to five feet apart, depending on the species. For planting wooded areas, space trees six to 10 feet apart, depending on the species. On slopes where stability of the surface soil layers is critical, avoid digging a row of pits across the slope. This can introduce a weakened zone that may slough when water enters the pits. Plant spacing and pattern should be carefully considered to avoid such potential failure zones.

Vegetation Management

A planned management program must be designed to take into account the desired functions of the vegetation, the soil and climatological conditions of the site, and the management capacity of the owner or maintaining authority. Table 2 summarizes the main management activities for different vegetation types.

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