Chemical Stabilization (CHS)

CS

Practice Description

Chemical erosion control on construction sites in the Southeast usually involves a water-soluble anionic polyacrylamide product referred to as PAM. It is used to minimize soil erosion caused by water and wind. PAM is typically applied with temporary seeding and or mulching on areas where the timely establishment of temporary erosion control is so critical that seedings and mulching need additional reinforcement. It may be used alone on sites where no disturbances will occur until site work is continued and channel erosion is not a significant potential problem.

Only PAM is currently included in this practice.

Planning Considerations

Anionic PAM is available in emulsions, powders, and gel bars or logs. Anionic PAM should be used in combination with other Best Management Practices. The use of seed and mulch should be considered for providing erosion protection beyond the life of the anionic PAM. If the area where PAM is applied is disturbed after the application, the application will need to be repeated.

Following are additional considerations to enhance the use of or avoid problems with the use of anionic PAM:

- Use setbacks when applying anionic PAM near natural water bodies.
- Decreased performance by the PAM can be expected if the PAM is exposed to ultraviolet light or if there is a delay between mixing the PAM with water and applying it to the exposed soil.

- When used in flow concentration channels, PAM's effectiveness for stabilization is decreased.

- If seed is applied with the anionic PAM, mulch should be used to protect the seed.

- Never add water to PAM; add PAM slowly to water. If water is added to PAM, the PAM tends to clot and form "globs" that can clog dispensers. This will result in an increased risk of under-application of the product.

- Only use anionic PAM; not all polymers are PAM.

- Requests to use other products on permitted sites should be made to the Mississippi Department of Environmental Quality.

Design Criteria

Application rates shall conform to manufacturers' guidelines for application. The following specific criteria shall be followed:

Only the anionic form of PAM shall be used. Cationic PAM is toxic and shall NOT be used.

PAM and PAM mixtures shall be environmentally benign, harmless to fish, wildlife, and plants. PAM and PAM mixtures shall be non-combustible.

Anionic PAM, in pure form, shall have less than or equal to 0.05% acrylamide monomer by weight, as established by the Food and Drug Administration and the Environmental Protection Agency.

To maintain less than or equal to 0.05% of acrylamide monomer, the maximum application rate of PAM, in pure form, shall not exceed 200/pounds/acre/year. Do not over apply PAM. Excessive application of PAM can lower its infiltration rate or increase suspended solids in water, rather than promoting settling.

Users of anionic PAM shall obtain and follow all Material Safety Data Sheet requirements and manufacturers' recommendations.

Additives such as fertilizers, solubility promoters or inhibitors, etc. to PAM shall be non-toxic.

The manufacturer or supplier shall provide written application methods for PAM and PAM mixtures. The application method shall ensure uniform coverage to the target and avoid drift to non-target areas including waters of the state. The manufacturer or supplier shall also provide written instructions to ensure proper safety, storage, and mixing of the product.

Gel bars or logs of anionic PAM mixtures may be used in ditch systems. This application shall meet the same testing requirements as anionic PAM emulsions and powders.

To prevent exceeding the acrylamide monomer limit in the event of a spill, the anionic PAM in pure form shall not exceed 200 pounds/batch at 0.05% acrylamide monomer or 400 pounds/batch at 0.025% acrylamide monomer.

Application

Prior to the start of construction, the application of PAM should be designed by a qualified design professional and plans and specifications should be available to field personnel.

The application should conform to the design and specifications provided in the plans.

Site Preparation

Prepare site following design and specifications.

Equipment Preparation

If using a liquid application system, pump a surfactant through the injection system before and after injecting concentrated liquid PAM into sprinkler-irrigation systems to prevent valves and tubing from clogging.

PAM used in hydroseeding applications should be the last additive to the mix.

After use, rinse all PAM mixing and application equipment thoroughly with water to avoid formation of PAM residues. Rinse residue should be applied to soil areas to create binding to the soil structure and increase erosion reduction.

PAM Application

Site testing for a PAM product should be conducted before PAM application to verify PAM-product performance and test reports (recommendations) should be supplied to the design professional and contractor before product application.

Toxicity reports, following EPA/600/4-90/027F 24 Hr. Acute Static Screen Toxicity Test (daphnia sp.), should be provided by the supplier to the contractor before application of a PAM product (this is to assure that PAM applications from the recommended product will be non-toxic).

PAM should be mixed and/or applied in accordance with all Occupational Safety and Health Administration (OSHA) Material Safety Data Sheet requirements and the manufacturers' recommendations for the specified use conforming to all federal, state and local laws, rules and regulations.

Emulsion batches should be mixed following recommendations of a testing laboratory that determines the proper product and rate to meet site requirements.

Never add water to PAM, but instead add PAM slowly to water.

Dry form (powder) may be applied by hand spreader or a mechanical spreader.

Mixing with dry, silica sand will aid in spreading. Pre-mixing of dry form PAM into fertilizer, seed, or other soil amendments is allowed when specified in the design plan. Application method should ensure uniform coverage to the target area.

Installation Verification

Check all components of the practice during installation to ensure that specifications are being met.

Common Problems

Consult with a qualified design professional if any of the following occur:

Problems with application equipment clogging.

Application specifications for PAM cannot be met; alternatives may be required. Unapproved application techniques could lead to failure.

Visible erosion occurs after application.

Maintenance

An operation and maintenance plan must be prepared for use by the operator responsible for PAM application. Plan items should include the following items:

Reapply PAM to disturbed or tilled areas that require continued erosion control.

Maintain equipment to provide uniform application rates.

Rinse all PAM mixing and application equipment thoroughly with water to avoid formation of PAM residues and discharge rinse water to soil areas where PAM stabilization may be helpful.

Downgradient deposition from the use of PAM may require periodic sediment removal to maintain normal functions.

References

BMPs from Volume 1

Chapter 4

Mulching (MU)	4-48
Temporary Seeding (TS)	4-103

Dust Control (DC)

Practice Description

Dust control includes a wide range of techniques that prevent or reduce movement of wind-borne soil particles (dust) during land disturbing activities. This practice applies to construction routes and other disturbed areas where on-site and off-site damage or hazards may occur if dust is not controlled.

Planning Considerations

Construction activities that disturb soil can be a significant source of air pollution. Large quantities of dust can be generated, especially in "heavy" construction activities such as land grading for road construction and commercial, industrial, or subdivision development.

The scheduling of construction operations so that the least amount of area is disturbed at one time is important in planning for dust control.

The greatest dust problems occur during dry periods. Therefore, to the extent practicable, do not expose large areas of bare soil during drought conditions.

Where wind erosion is a potential cause of dust problems, preserving vegetation should be considered as a passive measure. Leave undisturbed buffer areas between graded areas wherever possible.

Installing temporary- or permanent- surface stabilization measures immediately after completing land grading will minimize dust problems.

Design Criteria and Construction

Dust-control requirements should be designed by a qualified design professional and plans and specifications should be made available to field personnel prior to start of construction. Whenever possible, leave vegetated-buffer areas undisturbed between graded areas.

Scheduling

Schedule construction operations so that the smallest area is disturbed at any one time.

Permanent Methods

Vegetative Cover

For disturbed areas not subject to traffic, vegetation provides the most practical method of dust control. Establish vegetative cover according to the *Permanent Seeding* or *Temporary Seeding Practice*.

Topsoiling

This entails covering the surface with less erosive soil material. See *Topsoiling Practice* for guidance.

Stone

Stone used to stabilize construction roads can also be effective for dust control. Stone should be spread a minimum of 6″ thick over construction roads in the disturbed area. For heavily traveled roads or roads subjected to heavy loads, the stone thickness should be 8″ to 10″. A non-woven geotextile meeting the requirements shown in the Table DC-1 for Class IV geotextiles should be used under the rock when the subgrade is soft or the blow count is less than 10.

Temporary Methods

Mulches

Mulch offers a fast, effective means of controlling dust when properly applied. See *Mulching Practice* for guidelines on planning and installing the practice.

Temporary Vegetative Cover

For disturbed areas where no activity is anticipated for 14 days or longer, temporary seeding can effectively control dust. Establish vegetative cover according to *Temporary Seeding Practice* guidelines.

Calcium Chloride

Calcium chloride may be applied by mechanical spreader as loose, dry granules or flakes at a rate that keeps the surface moist, but not so high as to cause water pollution or plant damage. Sites may need to be retreated because the product degrades over time.

Table DC-1 Requirements for Nonwoven Geotextile

Property	Test method	Class I	Class II	Class III	Class IV [1]
Tensile strength (lb) [2]	ASTM D 4632 grab test	180 minimum	120 minimum	90 minimum	115 minimum
Elongation at failure (%) [2]	ASTM D 4632	≥ 50	≥ 50	≥ 50	≥ 50
Puncture (pounds)	ASTM D 4833	80 minimum	60 minimum	40 minimum	40 minimum
Ultraviolet light (% residual tensile strength)	ASTM D 4355 150-hr exposure	70 minimum	70 minimum	70 minimum	70 minimum
Apparent opening size (AOS)	ASTM D 4751	As specified max. no.40 [3]	As specified max. no.40 [3]	As specified max. no.40 [3]	As specified max. no.40 [3]
Permittivity sec–1	ASTM D 4491	0.70 minimum	0.70 minimum	0.70 minimum	0.10 minimum

Table copied from NRCS Material Specification 592.

[1] Heat-bonded or resin-bonded geotextile may be used for classes III and IV. They are particularly well suited to class IV. Needle-punched geotextile are required for all other classes.
[2] Minimum average roll value (weakest principal direction).
[3] U.S. standard sieve size.

Spray-on Adhesives

Spray-on adhesives may be used on mineral soils for dust control. Traffic must be kept off treated areas to prevent the product from becoming ineffective. Examples of spray-on adhesives for use in dust control are listed in Table DC-2.

Table DC-2 Spray-on Adhesives for Dust Control on Mineral Soil

Material	Water Dilution	Type of Nozzle	Apply Gal/Ac
Latex Emulsion	12.5:1	Fine Spray	235
Resin In Water	4:1	Fine Spray	300

Chemical Stabilization (CHS)

PAM may be used on mineral soils for dust control. Traffic must be kept off treated areas to prevent the product from becoming ineffective. The manufacturer or supplier shall provide written application methods for PAM and PAM mixtures. The application method shall ensure uniform coverage to the target and avoid drift to non-target areas including waters of the State. The manufacturer or supplier shall also provide written instructions to ensure proper safety, storage, and mixing of the product. Refer to the *Planning Considerations for Chemical Stabilization* (*PAM*) *Practice* for planning considerations before deciding to use this product.

Sprinkling or Irrigation

Sprinkling is especially effective for dust control on haul roads and other traffic routes. Sprinkle the site until the surface is wet. Repeat as needed. Also, bare areas may be kept wet with irrigation to control dust as an emergency treatment.

Tillage

Tillage is used to roughen the site and bring clods and moist soil to the surface. This is a temporary emergency measure that can be used on large, open, disturbed areas as soon as soil blowing starts. Begin tilling on the windward edge of the site. The depth of tillage is determined by the depth to moist soil and the amount of moist soil desired at the surface. In sandy soils, the depth to moist soil may make tillage impractical.

Barriers

A board fence, wind fence, sediment fence, hay bales, or similar barriers can control air currents and blowing soil. Place barriers perpendicular to prevailing air currents at intervals about 15 times the barrier height.

Figure 1 Sand Fence (http://www.gulfmex.org/crp/7004/fence.jpg)

Street Cleaning

Use a street sweeper to remove the source materials.

Maintenance

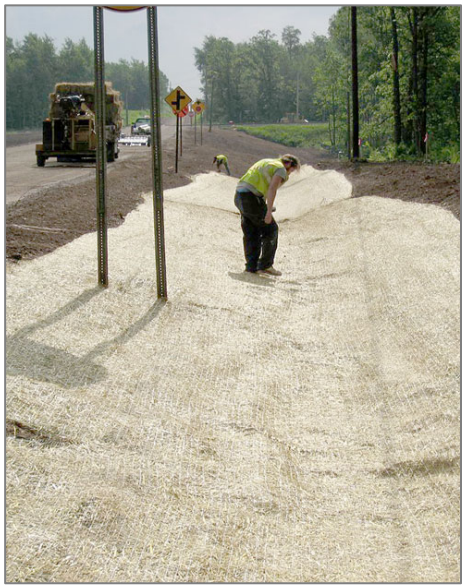
Check construction site during vehicular traffic or windy conditions to see if measures are working adequately. Maintain dust-control measures continuously throughout dry-weather periods, until all disturbed areas have been stabilized.

References

BMPs from Volume 1

Chapter 4

Erosion Control Blanket (ECB)



Practice Description

To aid in controlling erosion on critical areas by providing a protective cover made of straw, jute, wood or other plant fibers; plastic, nylon, paper or cotton. This practice is best utilized on slopes and channels where the erosion hazard is high, and plant growth is likely to be too slow to provide adequate protective cover. Erosion control blankets are typically used as an alternative to mulching but can also be used to provide structural erosion protection. Some important factors in the choice of a blanket are: soil conditions, steepness of slope, length of slope, type and duration of protection required to establish desired vegetation, and probable sheer stress.

Planning Considerations

Care must be taken to choose the type of blanket that is most appropriate for the specific project needs. Fourteen classes of erosion control blankets are discussed in this practice. Manufacturer's instructions and recommendations, as well as a site visit by the qualified design professional and site-plan reviewer are highly recommended to determine a product's appropriateness.

Temporary Erosion Control Blankets

Benefits of using temporary, erosion-control blankets include the following:

- Protection of the seed and soil from raindrop impact and subsequent displacement.
- Thermal consistency and moisture retention for the seedbed area.
- Stronger and faster germination of grasses and legumes.

- Spreading stormwater runoff to prevent rill erosion of slopes.
- Prevention of sloughing of topsoil added to steeper slopes.
- Because temporary blankets will deteriorate in a short period of time, they provide no enduring reduction in erosion potential.

Table ECB-1 Types of Erosion Control Blankets

Type of Erosion Control	Main Use	Comments
Netting	Synthetic or natural fiber mesh installed over disturbed area to hold organic mulch and/or seed in place.	Provides minimal structural erosion resistance. Mulch applied using standard procedures.
Biodegradable Erosion Control Blanket	Natural fiber blanket held together by netting to provide temporary erosion protection on slopes up to 1:1; and channels with permissible shear stress up to 4 lbs./ft.	Provides 1- to 5-year protection from erosion. Metal staples used as anchors.
Permanent Erosion Control Blanket	Synthetic blanket material which provides permanent erosion control on slopes up to 1:1; channels with increased water flow velocities and increased shear stress.	Provides minimal protection from wave action around ponds and lakes. Permanent erosion control blankets extend the limits of vegetation. Metal staples used as anchors.
Turf Reinforcement Mat	3-dimensional permanent synthetic mat that provides a matrix to greatly reinforce the root system of the desired vegetation for permanent erosion protection in high flow channels and on critical slopes.	Provides a substantial increase in erosion resistance. May provide erosion protection equivalent to stone or concrete liners.

Permanent Erosion Control Blankets

Permanent erosion control blankets are also known as permanent-soil reinforcing mats or turf-reinforcement mats. Roots penetrate and become entangled in the matrix, forming a continuous anchorage for surface growth and promoting enhanced energy dissipation.

Benefits of using permanent, erosion-control blankets, in addition to the benefits gained from using a temporary blanket include the following:

Sediment from stormwater flows is deposited in the matrix providing a fine soil-growth medium for the development of roots.

In stormwater channels, blankets and the vegetative-root system form an erosion resistant cover which resists hydraulic uplift and shear forces of channel flows.

Tables ECB-2 and ECB-3 give typical applications of the different classes of erosion control blankets.

Table ECB-1 Temporary Erosion Control Blanket Classes and Applications

Class	Application
1.A	Designed for use on geotechnically stable slopes with gradients up to 5:1 and channels with shear stresses up to .25 pounds per square foot.
1.B	Designed for use on geotechnically stable slopes with gradients up to 4:1 and channels with shear stresses up to .5 pounds per square foot.
1.C	Designed for use on geotechnically stable slopes with gradients up to 3:1 and channels with shear stresses up to 1.5 pounds per square foot.
1.D	Designed for use on geotechnically stable slopes with gradients up to 2:1 and channels with shear stresses up to 1.75 pounds per square foot.
2.A	Designed for use on geotechnically stable slopes with gradients up to 5:1 and channels with shear stresses up to .25 pounds per square foot.
2.B	Designed for use on geotechnically stable slopes with gradients up to 4:1 and channels with shear stresses up to .5 pounds per square foot.
2.C	Designed for use on geotechnically stable slopes with gradients up to 3:1 and ch stresses up to 1.5 pounds per square foot.
2.D	Designed for use on geotechnically stable slopes with gradients up to 2:1 and channels with shear stresses up to 1.75 pounds per square foot.
3.A	Designed for use on geotechnically stable slopes with gradients up to 5:1 and channels with shear stresses up to .25 pounds per square foot.
3.B	Designed for use on geotechnically stable slopes with gradients up to 1.5:1 and channels with shear stresses up to 2 pounds per square foot.
4	Designed for use on geotechnically stable slopes with gradients up to 1:1 and channels with shear stresses up to 2.25 pounds per square foot.

Table ECB-3 Permanent Erosion Control Blanket Classes and Applications

Class	Application
5.A	Designed for use on geotechnically stable slopes with gradients up to 0.5:1 and channels with shear stresses up to 6 pounds per square foot.
5.B	Designed for use on geotechnically stable slopes with gradients up to 0.5:1 and channels with shear stresses up to 8 pounds per square foot.
5.C	Designed for use on geotechnically stable slopes with gradients up to 0.5:1 and channels with shear stresses up to 10 pounds per square foot.

Design Criteria and Construction

Prior to the start of construction, the application of erosion control blankets should be designed by a qualified design professional and plans and specifications should be available to field personnel.

Site Preparation

Grade the site in accordance with the approved design to a smooth and uniform surface, free of debris.

Add and incorporate topsoil where needed.

Make sure seedbed is firm, yet friable.

General

All blankets shall be nontoxic to vegetation and to the germination of seed and shall not be injurious to the unprotected skin of humans. Erosion control products shall be of sufficient strength to hold the prepared ground and, if applicable, cover material (mulch, sod, etc.) in place until an acceptable growth of natural or planted material is established.

Erosion control products shall be identified by a classification designation (Class 1.A, 1.B, 1.C, etc.) where the classification is based on the physical properties of the product.

Class Designations and Durability

Erosion control products shall have the configurations and durability as shown in Tables ECB-4 and ECB-5.

Table ECB-4 Typical Configuration and Durability of Temporary Erosion Control Blankets

Class Designation	Usual Configuration	Typical Durability
1.A Ultra-short term mulch control netting	Mulch control netting consisting of rapidly degrading photodegradable synthetic mesh or woven biodegradable natural fiber netting.	3 months
1.B Ultra-short term netless erosion control blanket	An erosion control blanket composed of processed rapidly degrading natural and/or polymer fibers mechanically interlocked or chemically adhered together to form a continuous matrix.	3 months
1.C Ultra-short term single net erosion control blanket or open weave textile	An erosion control blanket composed of processed degradable natural and/or polymer fibers mechanically bound together by a single rapidly degrading, synthetic or natural fiber netting to form a continuous matrix. Or an open weave textile composed of processed rapidly degrading natural or polymer yarns or twines woven into a continuous matrix.	3 months
1.D Ultra-short term double net erosion control blankets	An erosion control blanket composed of processed natural or polymer fibers mechanically bound between 2 rapidly degrading, synthetic or natural fiber nettings to form a continuous matrix.	3 months
2.A Short-term mulch control netting	Mulch control netting consisting of photodegradable synthetic mesh or woven biodegradable natural fiber netting.	12 months
2.B Short-term netless erosion control blanket	An erosion control blanket composed of processed degradable natural and/or polymer fibers mechanically interlocked or chemically adhered together to form a continuous matrix.	12 months
2.C Short-term single net erosion control blanket or open weave textile	An erosion control blanket composed of processed degradable natural and/or polymer fibers mechanically bound together by a single degradable, synthetic or natural fiber netting to form a continuous matrix. Or an open weave textile composed of processed degradable natural or polymer yarns or twines woven into a continuous matrix.	12 months
2.D Short-term double net erosion control blanket	An erosion control blanket composed of processed natural or polymer fibers mechanically bound between 2 synthetic or natural fiber nettings to form a continuous matrix.	12 months
3.A Extended-term mulch control netting	Mulch control netting consisting of a slow degrading synthetic mesh or woven natural fiber netting.	24 months
3.B Extended-term erosion control blanket or open weave textile	An erosion control blanket composed of processed slow degrading natural and/or polymer fibers mechanically bound together between 2 slow degrading synthetic or natural fiber nettings to form a continuous matrix. Or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.	24 months
4 Long-term erosion control blanket or open weave textile	An erosion control blanket composed of processed slow degrading natural and/or polymer fibers mechanically bound together between 2 slow degrading synthetic or natural fiber nettings to form a continuous matrix. Or an open weave textile composed of processed slow degrading natural or polymer yarns or twines woven into a continuous matrix.	36 months

Table ECB-5 Typical Configuration and Durability of Permanent Erosion Control Blankets

Class Designation	Usual Configuration	Typical Durability
5.A Permanent turf reinforcement mat	A non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement.	Permanent
5.B Permanent turf reinforcement mat	A non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement.	Permanent
5.C Permanent turf reinforcement mat	A non-degradable turf reinforcement mat with sufficient thickness, strength and void space for permanent erosion protection and vegetation reinforcement.	Permanent

Materials Physical Requirements

A properly designed erosion control blanket installation requires selection of a product manufactured with physical properties to withstand the stresses the product will be subjected to for the design life of the product. Table ECB-6 gives the minimum physical requirements for each class of blanket.

Table ECB-6 Minimum Physical Requirements For Erosion Control Blankets

	Property				
Class	Minimum Tensile Strength (pounds/ft.) (ASTM D 4595) [1]	Minimum Permissible Shear Stress (pounds/sq. ft.) (ASTM D 6460)[2, 5]	Maximum "C" Factor for Temporary Products (ASTM D 6459)[3, 5]	UV Stability (Minimum % tensile retention) for Permanent Products (ASTM D 4355) (500 hour exp.)	Minimum Thickness (inches) For Permanent Products (ASTM D 6525)[4]
1.A [6]	5	0.25	0.10 @ 5:1	N/A	N/A
1.B	5	0.50	0.10 @ 4:1	N/A	N/A
1.C	50	1.50	0.15 @ 3:1	N/A	N/A
1.D	75	1.75	0.20 @ 2:1	N/A	N/A
2.A [6]	5	0.25	0.10 @ 5:1	N/A	N/A
2.B	5	0.50	0.10 @ 4:1	N/A	N/A
2.C	50	1.50	0.15 @ 3:1	N/A	N/A
2.D	75	1.75	0.20 @ 2:1	N/A	N/A
3.A [6]	25	0.25	0.10 @ 5:1	N/A	N/A
3.B	100	2.00	0.25 @ 1.5:1	N/A	N/A
4	125	2.25	0.25 @ 1:1	N/A	N/A
5.A [7]	125	6.00	N/A	80	0.25
5.B [7]	150	8.00	N/A	80	0.25
5.C [7]	175	10.00	N/A	80	0.25

1 Minimum average roll values, machine direction. For turf reinforcement mats used in field conditions with high loading and/or high survivability requirements tensile strengths of 3000 pounds/ft or greater.

2 Minimum shear stress the rolled erosion control products or turf reinforcement mats can sustain without physical damage or excess erosion (>.5″ of soil loss) during a 30 minute flow event in large scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using Erosion Control Technology Council Test Method no. 3. For temporary products the permissible shear stress levels were established for each class based on historical experience with products characterized by Manning's roughness coefficients in the range of 0.03 to 0.05.

3 "C" factor calculated as ratio of soil loss from rolled erosion control product protected slope (tested at the specified gradient) to soil loss from unprotected (control) plot in large scale testing. These performance test values should be supported by periodic bench scale testing under similar test conditions and failure criteria using Erosion Control Technology Council Test Method no.2.

4 Minimum average roll values.

5 Other large scale test methods may be determined acceptable.

6 Obtain maximum "C" factor and allowable shear stress for mulch control nettings with the netting used in conjunction with pre-applied mulch material.

7 For turf reinforcement mats containing degradable components, all property values must be obtained on the non-degradable portion of the matting alone.

Product Placement

The erosion control product should be placed immediately after completion of the preparation of the area where the product will be placed.

Follow the manufacturer's recommendations for installation or use the following instructions. If there is a conflict, follow the manufacturer's recommendations. Strips shall be rolled out flat, parallel to the direction of flow, in flumes and ditches. On steep cut or fill slopes, strips shall be rolled out flat, and perpendicular to the direction of flow to reduce rill erosion. When 2 or more strips are required to cover an area, they shall overlap at least 3″ (75 mm); however, excelsior blankets will not require lapping but are to be butted together and stapled with half of each staple located in each of the adjoining blankets. Ends of strips shall overlap at least 6″ (150 mm) with the upgrade section on top. The upslope end (anchor slot) of each strip shall be buried in 6″ (150 mm) vertical slots, and soil tamped firmly against it. Figure ECB-1 shows typical erosion control blanket installation. When conditions are warranted by the opinion of the qualified design professional, any other edge exposed to excessive flow shall be buried as noted above. The erosion control product shall be spread evenly and smoothly, and shall be in contact with the soil at all points. The product should not be stretched tight in such a manner that the material "tents" over the soil surface. If the manufacturer's recommendations for installation of the erosion control product are different that those given here, the Contractor will be required to follow the more stringent of the two.

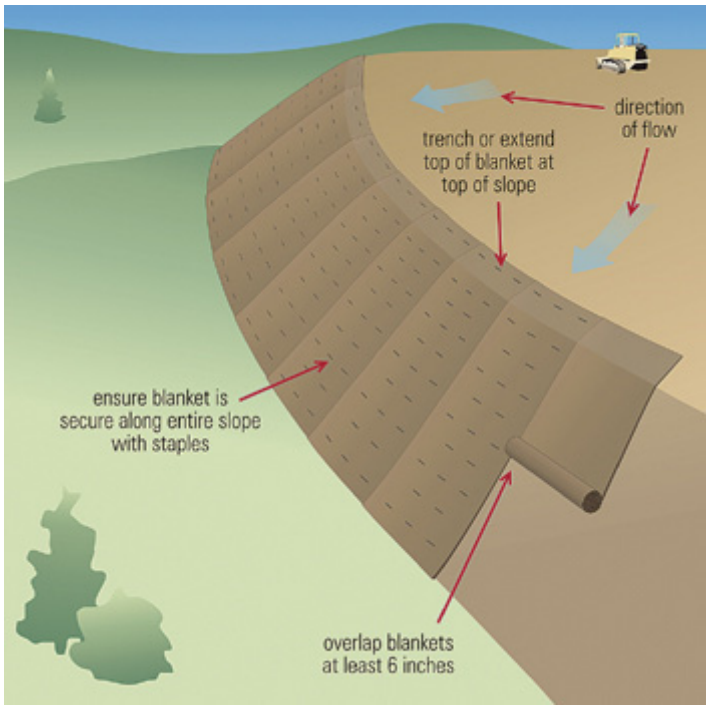


Figure ECB - 1 Erosion Control Blanket Placement (Source: EPA)

Check slots shall be 24″ (600 mm) minimum width and separate strips of erosion control product placed at right angles to the direction of water flow immediately prior to placing the general covering of the product. Check slots shall be made by burying a tight fold of

the product vertically in the soil a minimum of 6″ (150 mm) deep, and tamping and stapling the fold in place. Check slots shall be placed so that one check slot, junction slot, or anchor slot of the erosion control product occurs every 50 feet (15 m) of slope. If the manufacturer's recommendations for the installation of check slots are different than those given here, the Contractor will be required to follow the more stringent of the two.

Each strip shall be stapled in 3 rows, at each edge and the center, with staples spaced not more than 3 feet (900 mm) longitudinally. Check slots and ends of strips shall be stapled at 9″ (225 mm) intervals across their width.

For temporary blankets, staples should be U-shaped wire with an 11-gauge thickness or greater. Staples should be of sufficient thickness for soil penetration without undue distortion. The legs of the staples shall be at least 6″ long with a crown of 1″. Appropriate biodegradable staples can be used in lieu of wire staples.

Permanent blankets shall be anchored in one of two ways. Blankets can be anchored using sound wood stakes, 1″ by 3″ stock sawn in a triangular shape. The length of the stakes shall be from 12″ to 18″ depending upon the soil compaction at the site. Stakes shall be installed on 4 feet centers along each edge of the blanket. Blankets can also be anchored using U shaped staples of 11 gauge steel or greater with a minimum leg length of 8″ and a 2″ crown.

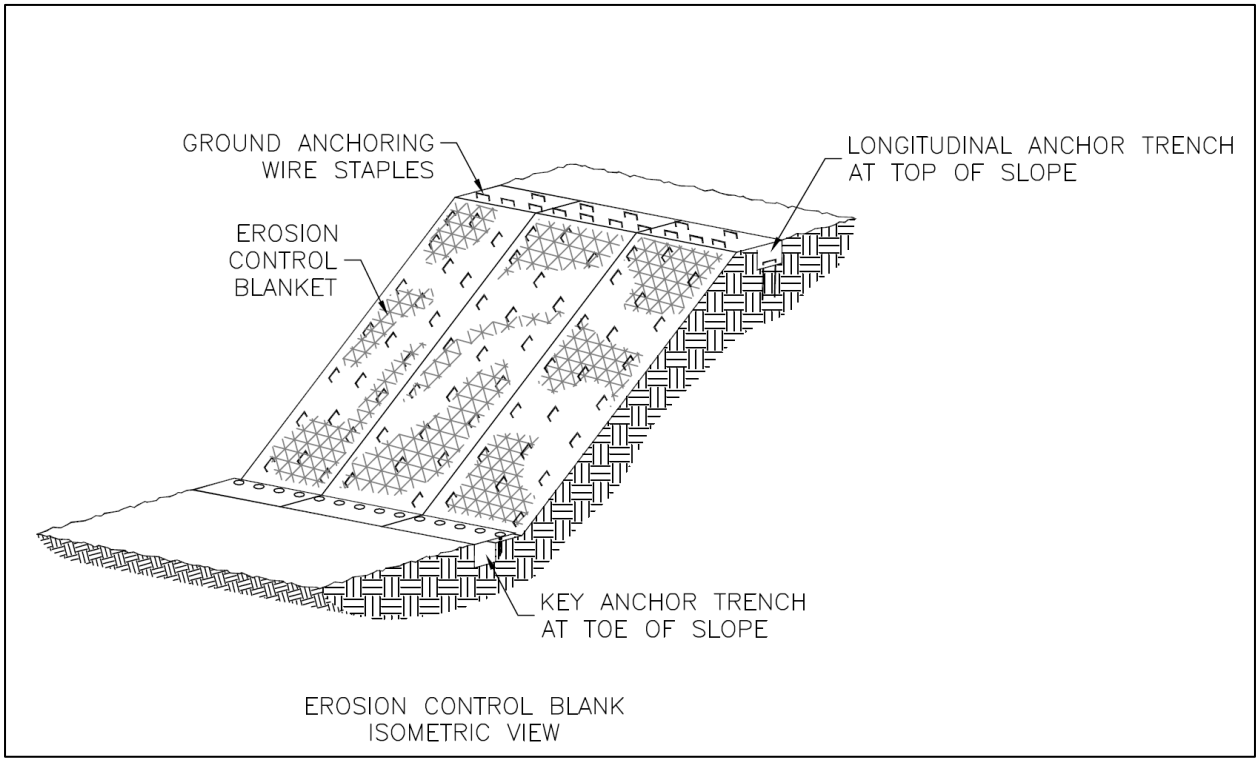


Figure ECB - 2 Erosion Control Blanket Detail

Construction Verification

Check finished grade, dimensions and staple spacing of erosion control blankets. Check materials for compliance with specifications.

Common Problems

Consult with a qualified design professional if any of the following occur:

Movement of the blanket or erosion under the blanket is observed.

Poor contact between the soil and the erosion control blanket results in surface water flowing under rather than over the blanket, causing erosion; retrench or reanchor to direct water over blanket.

Blanket inadequately or improperly stapled results in tenting, blanket movement or displacement; reinstall and ensure blanket is properly anchored.

Unstable slope results in blanket or slope failure; determine cause of slope failure, stabilize slope and reinstall blanket.

Variations in topography on site indicate erosion control mat will not function as intended; changes in plan may be needed, or a blanket with a shorter or longer life may be needed.

Design specifications for seed variety, seeding dates or erosion control materials cannot be met; substitution may be required. Unapproved substitutions could result in failure to establish vegetation or breach of contract.

Maintenance

Inspect after storm events until vegetation is established for erosion or undermining beneath the blankets. If any area shows erosion, pull back that portion of the blanket, add tamped soil and reseed; then resecure the blankets.

If blankets should become dislocated or damaged, repair or replace and resecure immediately.

References

BMPs from Volume 1

Chapter 4

Land Grading (LG)	4-16
Mulching (MU)	4-48

Housekeeping Practices (HK)

HK

Practice Description

Housekeeping practices describes the various activities and measures, in addition to the specific practices used for erosion and sediment control that are essential during construction for the protection of environmental quality. Housekeeping is applicable at all construction sites.

Planning Considerations

In addition to the sediment- and erosion-control practices included in the manual that deal directly with sediment and erosion control, some general housekeeping practices are essential to the pollution prevention aspect of a Stormwater Pollution Prevention Plan. Housekeeping addresses these practices. Included in the practice are the following different areas:

- Inspection and Maintenance Procedures
- Materials Inventory
- Spill Prevention and Material Management Practices
- Spill Controls
- Hazardous Products
- Air Emissions (excessive odor)
- Other Good Housekeeping Practices (i.e. fugitive spray, excessive noise and aesthetics)

Design Criteria

Inspection and Maintenance Procedures

The following inspection and maintenance procedures need to be followed to maintain adequate sediment and erosion controls:

- All control measures need to be inspected at least once per week and following any accumulation of rainfall of 1/2″ or more within a 24-hour period.
- All measures need to be maintained in good working order. If a repair is necessary, it should be initiated within 24 hours of report.
- Silt fence and straw bales need to be inspected weekly for proper anchorage and leakage underneath. Silt fencing should also be inspected for tears.
- Built-up sediment needs to be removed from silt barriers when it has reached ½ of the height of the barrier. Sediment needs to be placed in a stabilized site to prevent re-entry into the same site or another entrapment area.
- Sediment basins need to be inspected for depth of sediment on a monthly basis and built-up sediment needs to be removed when ½ of the basin volume is filled.
- Temporary and permanent seeding and plantings need to be inspected for bare spots, washouts and healthy growth. A person should be designated to be responsible for maintaining planted areas until growth has reached 1″ in height and the area planted has 70% ground cover.

Materials Inventory

A materials list should be compiled for items that will be stored outside on the site during construction. For example:

_____ Pipe, fittings and joint compounds for underground utility piping
_____ Gravel and stone bedding material
_____ Concrete forming materials
_____ Other (specify) _____
_____
_____
_____

NOTE: Fuels, oils and other petroleum products; forming oils and compounds; fertilizers; pesticides; strippers; detergents; cleaners; or any other hazardous or toxic compounds should not be stored outside on the site unless specifically agreed upon by all responsible parties, including those persons responsible for enforcing local ordinances and policies. On-site storage should meet all local, state and federal rules regarding secondary containment. Additionally, local ordinances may require fencing and security measures for storage of these products.

Spill Prevention and Material Management Practices

Petroleum Products

All vehicles kept on the site need to be monitored for leaks and receive regular preventive maintenance to reduce the chance of leakage. A Spill Prevention Control and Countermeasures (SPCC) plan should be developed for the facility to address the safe storage, handling and clean up of petroleum products and other chemicals. Petroleum products should be stored in tightly sealed containers, that are clearly labeled. If petroleum products are stored on site, a secondary containment facility will be required if the cumulative storage capacity of all tanks, greater than 55 gallons, at the site exceeds 1,320 gallons.

Fueling & Servicing

No fueling, servicing, maintenance, or repair of equipment or machinery should be done within 50 feet of a stream, or within 100 feet of a stream classified for public water supply (PWS), with special designation, protected vegetation (tree drip-line), or a sinkhole.

Mud Tracking

A stabilized construction entrance needs to be designated on the plan. The practice construction exit pad provides design details for planning such an entrance.

Only designated entrances should be used for construction access to the site. The General Contractor should be responsible for keeping mud cleaned from adjoining streets on a daily basis if needed.

Concrete Trucks

Concrete trucks should be allowed to wash only in locations where discharge is directed to a sediment basin. It is not permissible to discharge concrete wash directly to streams or storm drains. Alkalinity and chemical additives could be harmful to fish, stream bottom macroinvertebrates and wildlife.

Disposal of Oil

No fuels, oils, lubricants, solvents, or other hazardous materials can be disposed of on the site. All hazardous material must be properly disposed of in accordance with State law.

Trash/Solid Waste

The General Contractor is responsible for disposing of all solid waste from the site in accordance with State law. Dumpsters or other collection facilities must be provided as needed. Solid waste may not be buried on the site.

Sanitary Waste

The General Contractor is responsible for providing sanitary facilities on the site. Sanitary waste may be disposed only in locations having a State permit.

Other Discharges

Water for pressure testing sanitary sewers, flushing water lines, sand blasting, concrete cleansing, etc., may be discharged only in approved areas. Discharge of hydrostatic test water may require additional permitting, particularly if chlorinated public water is used.

Spill Controls

In addition to the good housekeeping practices and material management practices listed previously, the following procedures need to be followed for spill prevention and clean-up:

- Manufacturer's recommended methods for spill cleanup needs to be clearly posted and site personnel need to be made aware of the procedures and the location of the information and cleanup supplies. Refer to material safety data sheets (Material Safety Data Sheet).

- Material and equipment necessary for spill cleanup needs to be kept in the material storage area on-site. Equipment and materials include, but are not limited to; brooms, dust pans, mops, rags, gloves, goggles, absorbent clay (kitty litter), sand, sawdust, absorbent mats, and plastic and metal trash containers specifically for this purpose.

- All spills need to be cleaned up immediately after discovery and properly containerized for proper disposal. Burial is not acceptable.

- The spill area must be kept well ventilated and personnel need to wear appropriate protective clothing to prevent injury from contact with a hazardous substance.

- Spills of toxic or hazardous material must be reported immediately to the appropriate state or local government agency, regardless of the size.

- The spill prevention plan needs to be adjusted to include measures to prevent this type of spill from being repeated, and the plan needs to show how to clean up the spill if another one does occur.

Contaminated Soils

Removal of contaminated soils and underground storage tanks should be based on information provided by the Mississippi Department of Environmental Quality following a proper site assessment.

Hazardous Products

Products must be kept in original containers unless they are not resealable. If product is transferred to a new container, it must be properly marked and labeled.

Original labels and material safety data sheets should be retained.

If surplus product must be disposed, disposal must be done in accordance with Mississippi Department of Environmental Quality regulations.

Air Emissions

Open burning must meet the criteria found in the State of Mississippi's Air Emissions Regulations found in APCS-1, Section 3.7. Other considerations are discussed below.

Burning

Burning on the site may require a permit from the Mississippi Forestry Commission. County or city ordinances may also apply. Starting disposal fires with diesel fuel or old tires is not a recommended practice. The use of burn pits with fans to generate hot disposal fires decreases the fire disposal time and minimizes smoke.

Dust Control

Apply measures that minimize dust. Stabilizing areas with mulch as soon as possible can minimize dust. Watering should be provided in unstabilized areas (See *Dust Control Practice*).

Other Good Housekeeping Practices

In addition to the foregoing, the following good housekeeping practices need to be followed during the construction of the project:

- An effort should be made to store only enough products to do the job.
- All materials stored on-site should be stored in a neat, orderly manner in their appropriate containers and, if possible, under a roof or other enclosure.
- Products should be kept in their original containers with the original manufacturer's label.
- Whenever possible, all of a product should be used up before disposing of the container.
- Manufacturer's recommendations for proper use and disposal must be followed (see Material Safety Data Sheet).
- The site superintendent should inspect daily to ensure proper usage, storage and disposal of materials.
- Fertilizers need to be applied only in the minimum amounts recommended by the manufacturer.
- All paint containers need to be tightly sealed and stored when not required for use. Excess paint shall not be dumped into the storm sewer system but should be properly disposed of according to manufacturer's instructions (see Material Safety Data Sheet) and State regulations.
- The site should be kept clean and well groomed (trash picked up regularly, weeds mowed and signs maintained).
- Offsite fugitive spray from dust control, sand blasting and pressure washing must be minimized to the extent possible.
- Locate activities that generate odors and noise as far from surrounding properties as possible (this item includes portable toilets, burn sites, fueling areas, equipment repair areas and dumpsters).

References

BMPs from Volume 1

Chapter 4

Dust Control (DC) 4-29

Mulching (MU)

Practice Description

Mulching is the application of plant residues such as straw or other suitable materials to the soil surface. Mulch protects the soil surface from the erosive force of raindrop impact and reduces the velocity of overland flow. It helps seedlings germinate and grow by conserving moisture, protecting against temperature extremes and controlling weeds. Mulch also maintains the infiltration capacity of the soil. Mulch can be applied to seeded areas to help establish plant cover. It can also be used in unseeded areas to protect against erosion over the winter or until final grading and shaping can be accomplished except in areas with concentrated flow.

Planning Considerations

Surface mulch is the most effective, practical means of controlling runoff and erosion on disturbed land prior to vegetation establishment. Mulch absorbs the energy associated with raindrops and thereby minimizes soil-particle detachment, which is the initiation step of erosion.

Mulch also reduces soil moisture loss by evaporation, prevents crusting and sealing of the soil surface, moderates soil temperatures, and provides a suitable microclimate for seed germination.

Organic mulches such as straw, wood chips and shredded bark have been found to be very effective mulch materials. Materials containing weed and grass seeds that may compete with establishing vegetation should not be used. Also, decomposition of some wood products can tie up significant amounts of soil nitrogen, making it necessary to modify fertilization rates or add fertilizer with the mulch.

A variety of erosion-control blankets have been developed in recent years for use as mulch, particularly in critical areas such as waterways and channels. Various types of netting materials are also available to anchor organic mulches.

The choice of materials for mulching should be based on soil conditions, season, type of vegetation to establish, and size of the area. Properly applied and tacked mulch is always beneficial. Mulching is especially important when conditions of germination are not optimum, such as midsummer and early winter, and on difficult sites with cut slopes, or fill slopes and droughty soils.

Straw is the most commonly used material in conjunction with seeding. Wheat straw is the mostly commonly used straw, and can be spread by hand or with a mulch blower. If the site is susceptible to blowing wind, the straw should be tacked down with a tackifier, a crimper, or a disk to prevent loss. Some site developers always require that straw mulch be tacked by an approved method.

Wood chips are suitable for areas that will not be closely mowed, and around ornamental plantings. Chips do not require tacking. Because they decompose slowly, they must be treated with 12 pounds of nitrogen per ton to prevent nutrient deficiency in plants. They can be an inexpensive mulch if the chips are obtained from trees cleared on the site.

Wood fiber refers to short cellulose fibers applied as a slurry in hydroseeding operations. Wood-fiber hydroseeder slurries may be used to tack straw mulch on steep slopes, critical areas, and where harsh climatic conditions exist.

Compost, peanut hulls, and pine straw are organic materials that potentially make excellent mulches but may only be available locally or seasonally. Creative use of these materials may reduce costs.

Jute mesh or the various types of netting is very effective in holding mulch in place on waterways and slopes before grasses become established.

Erosion-control blankets promote seedling growth in the same way as organic mulches and are suited for use in areas with concentrated flows (see *Erosion-Control Blanket Practice*).

Design Criteria and Installation

Mulching should be designed by a qualified design professional and plans and specifications should be made available to field personnel prior to start of construction.

Site Preparation

Divert runoff water from areas above the site that will be mulched.

Remove stumps, roots, and other debris from the construction area.

Grade area as needed to permit the use of equipment for seeding, mulching, and maintenance. Shape area so that it is relatively smooth.

If the area will be seeded, follow seeding specifications in the design plan and apply mulch immediately after seeding.

Spreading the Mulch

Select a mulch material based on the site and practice requirements, availability of material, and availability of labor and equipment. Table MU-1 lists commonly used mulches.

Uniformly spread organic mulches by hand or with a mulch blower at a rate which provides about 75% ground cover. When spreading straw mulch by hand, divide the area to be mulched into sections of approximately 1000 sq. ft. and place 70-90 pounds of straw (1 ½ to 2 bales) in each section to facilitate uniform distribution. Caution, an over-application of wheat straw will reduce stand success – do not over-apply wheat straw when mulching a seeding application!

Anchor straw- or wood-cellulose mulch by one of the following methods:

- Crimp with a weighted, straight, notched disc or a mulch-anchoring tool to punch the straw into the soil.

- Tack with a liquid tackifier designed to hold mulch in place. Use suitable spray equipment and follow manufacturer's recommendations.

- In more erosive areas, cover with netting, using a degradable natural or synthetic mesh. The netting should be anchored according to manufacturer's specifications (see *Erosion-Control Blanket Practice*).

- On steep slopes and other areas needing a higher degree of protection, use one of the following: 1) heavy natural nets without additional mulch; 2) synthetic netting with additional mulch or; 3) erosion control mats/blankets. These areas include grassed waterways, swales and diversion channels.

- Install netting and mats/blankets according to manufacturer's specifications making sure materials are properly anchored (see *Erosion-Control Blanket Practice*).

Table MU-1 Mulching Materials and Application Rates

Material	Rate Per Acre and (Per 1000 ft.^{2})	Notes
Straw with Seed	1 ½-2 tons (70 lbs-90 lbs)	Spread by hand or machine to attain 75% groundcover; anchor when subject to blowing.
Straw Alone (no seed)	2 ½-3 tons (115 lbs-160 lbs)	Spread by hand or machine; anchor when subject to blowing.
Wood Chips	5-6 tons (225 lbs-270 lbs)	Treat with 12 lbs. nitrogen/ton.
Bark	35 cubic yards (0.8 cubic yard)	Can apply with mulch blower.
Pine Straw	1-2 tons (45 lbs-90 lbs)	Spread by hand or machine; will not blow like straw.
Peanut Hulls	10-20 tons (450 lbs-900 lbs)	Will wash off slopes. Treat with 12 lbs. nitrogen/ton.

Liquid-mulch binders can also be used to tack mulch subject to being blown away by wind. Applications of liquid-mulch binders and tackifiers should be heaviest at the edges of areas and at crests of ridges and banks, to resist wind. Binders should be applied uniformly to the rest of the area. Binders may be applied after mulch is spread or may be sprayed into the mulch as it is being blown onto the soil. Applying straw and binder together is the most effective method. Liquid binders include an array of commercially available synthetic binders.

Straw mulch may also be anchored with lightweight plastic, cotton, jute, wire or paper netting which is stapled over the mulch. The manufacturer's recommendations on stapling netting should be followed.

Verification of Installation

Check materials and installation for compliance with specifications.

Common Problems

Consult with qualified design professional if either of the following occurs:

Variations in topography on site indicate the mulching materials will not function as intended; changes in plan may be needed.

Design specifications for mulching materials or seeding requirements cannot be met; substitution may be required. Unapproved substitutions could result in erosion or seeding failure.

Problems that require remedial actions:

Erosion, washout and poor plant establishment; repair eroded surface, reseed, re-mulch and anchor mulch.

Mulch is lost to wind or stormwater runoff; reapply mulch and anchor appropriately by crimping, netting or tacking.

Maintenance

Inspect all mulched areas periodically and after rainstorms for erosion and damage to the mulch. Repair promptly and restore to original condition. Continue inspections until vegetation is well established. Keep mower height high if plastic netting is used to prevent netting from wrapping around mower blades or shaft.

References

BMPs from Volume 1

Chapter 4

Erosion-Control Blanket (ECB)	4-33
Permanent Seeding (PS)	4-53
Temporary Seeding (TS)	4-103

Permanent Seeding (PS)

PS

Practice Description

Permanent seeding is the establishment of perennial vegetation on disturbed areas from seed. Permanent vegetation provides economical long-term erosion control and helps prevent sediment from leaving the site. This practice is used when vegetation is desired and appropriate to permanently stabilize the soil.

Planning Considerations

The advantages of seeding over other means of establishing plants include the smaller initial cost, lower labor input, and greater flexibility of method.

Disadvantages of seeding include potential for erosion during the establishment stage, seasonal limitations on suitable seeding dates, and weather-related problems such as droughts.

The probability of successful plant establishment can be maximized through good planning. The selection of plants for permanent vegetation must be site specific. Factors that should be considered are types of soils, climate, establishment rate, and management requirements of the vegetation. Other factors that may be important are wear, mowing tolerance, and salt tolerance of vegetation.

Plant selection for permanent vegetation should be based on plant characteristics, site and soil conditions, time of year of planting, method of planting, and the intended use of the vegetated area. Climate factors can vary widely in Mississippi. Important plant attributes are discussed in *Vegetation Establishment for Erosion and Sediment Control* in Chapter 2.

Plant selection may include companion plants to provide quick cover on difficult sites, late seedings, or where the desired permanent cover may be slow to establish. Annuals are usually used for companion plants and should be selected carefully to prevent using a species that provide so much competition that it prevents the establishment of the desired species.

Seeding properly carried out within the optimum dates has a higher probability of success. It is also possible to have satisfactory establishment when seeding outside these dates. However, as plantings are deviated from the optimum dates, the probability of failure increases rapidly. Seeding dates should be taken into account in scheduling land-disturbing activities.

Site quality impacts both short-term and long-term plant success. Sites that have compacted soils, soils that are shallow to rock, or have textures that are too clayey or too sandy should be modified whenever practical to improve the potential for plant growth and long-term cover success.

The operation of equipment is restricted on slopes steeper than 3:1, severely limiting the quality of the seedbed that can be prepared. Provisions for establishment of vegetation on steep slopes can be made during final grading. In construction of fill slopes, for example, the last 4-6″ might not be compacted. A loose, rough seedbed with irregularities that hold seeds and lime and fertilizer is essential for hydroseeding. Cut slopes should be roughened (see *Land Grading Practice*).

Proper mulching is critical to protect against erosion on steep slopes. When using straw, anchor with netting. On slopes steeper than 2:1, jute, excelsior, or synthetic matting may be required.

The use of irrigation (temporary or permanent) will greatly improve the success of vegetation establishment.

Design Criteria and Installation

Prior to start of construction, plant materials, seeding rates and planting dates should be specified by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the installation process.

Permanent seeding should be done during the specified planting period whenever possible. When sites are only available for planting outside of the recommended planting period, either an out-of-season permanent seeding, a temporary seeding, mulching or chemical stabilization will be more appropriate than leaving the surface bare for an extended period. If lime and fertilizer application rates are not specified, take soil samples during final grading from the top 6″ in each area to be seeded. Submit samples to a soil testing laboratory for lime and fertilizer recommendations.

Scheduling

The schedule for work at the site should consider the recommended planting period and whenever practical, the site work should accommodate seeding during the recommended planting period.

Plant Selection

Select plants that can be expected to meet planting objectives. To simplify plant selection, use Figure PS-1 Geographical Areas for Species Adaptation and Table PS-1, Commonly Used Plants for Permanent Cover. Mixtures commonly specified by the Mississippi Department of Transportation are an appropriate alternative for plantings on rights-of-ways. Additional information related to plantings in Mississippi is found in Chapter 2 under the section *Vegetation for Erosion and Sediment Control*.

The plants used for temporary vegetation may be used for companion plants provided the seeding rate is reduced by one half. See the *Temporary Seeding Practice* for additional information on establishing temporary vegetation. **Ryegrass or other highly competitive plants should not be used as a companion plant**.

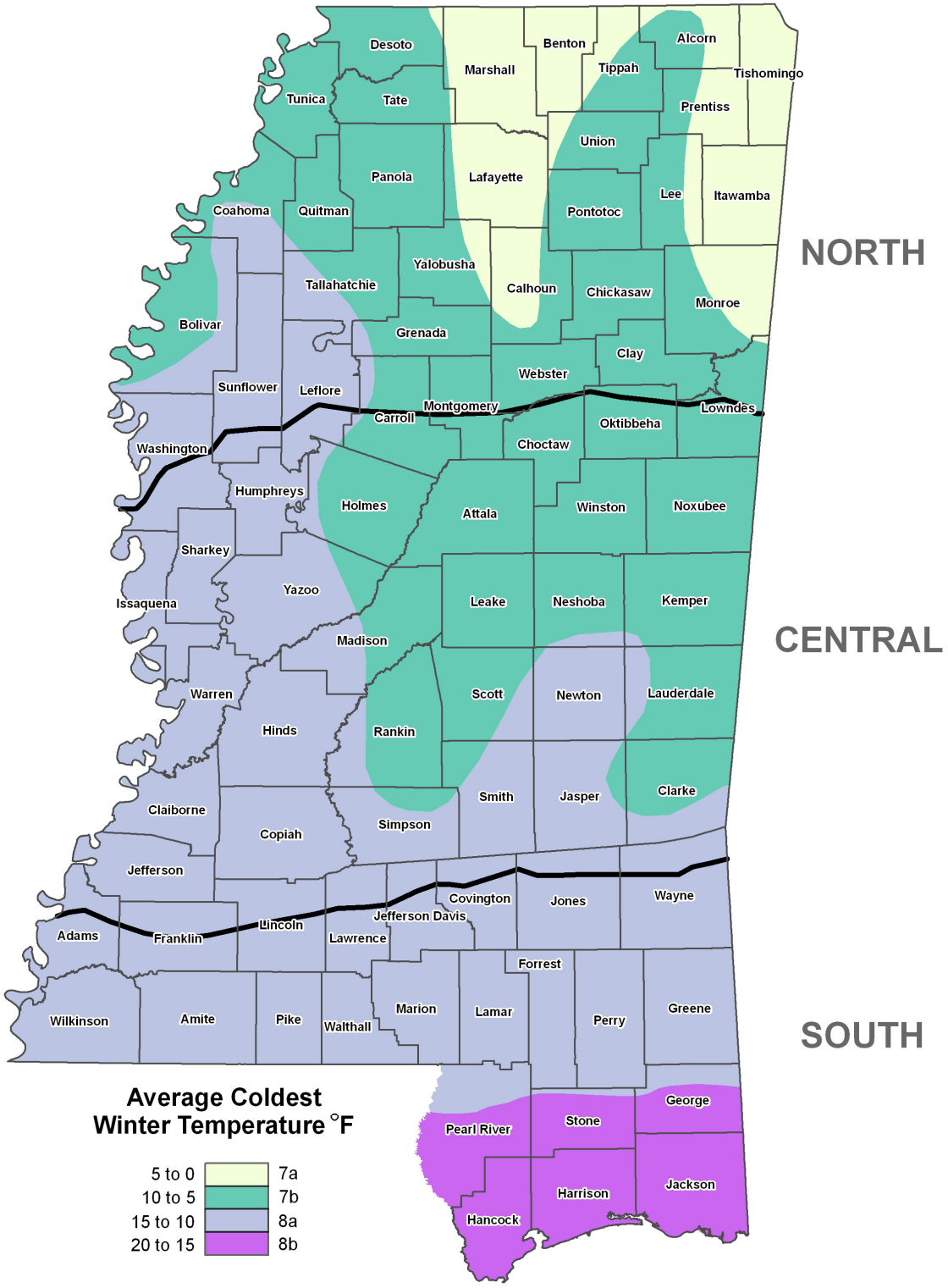


Figure PS-2 Geographical Areas for Species Adaptation

Table PS-1 Commonly Used Plants for Permanent Cover with Seeding Rates and Dates

Species	Seeding Rates/Ac	Planting Time	Desired pH Range	Fertilization Rate/Acre	Method of Establish-ment	Zone of Adaptability	Native / Introduced
Common Bermuda	15 lbs. alone 10lbs. mix	3/1 – 7/15 9/1 – 11/30	6.0 – 7.0	600 lbs. 13-13-13	Seed or sod	All	Introduced * Potential for Invasive-ness
Bahia	40 lbs. alone 30 lbs. mix	3/1 – 7/15 9/1 – 11/30	6.0 – 7.0	600 lbs. 13-13-13	Seed	Central and South	Introduced
Fescue	40 lbs. alone 30 lbs. mix	9/1 – 11/30	6.0 – 7.0	600 lbs. 13-13-13	Seed	North and Central	Native
Saint Augustine	--	3/1 – 7/15	6.0 – 7.0	600 lbs. 13-13-13	Sod only	Central and South	Native
Centipede	4 lbs. alone 2.5 lbs mix	3/1 – 715	6.0 – 7.0	600 lbs. 13-13-13	Seed or sod	All	Introduced
Carpet Grass	15 lbs. alone 10 lbs. mix	3/1 – 7/15	6.0 – 7.0	600 lbs. 13-13-13	Seed or sod	All	Native
Zoysia Grass	--	3/1 – 7/15	6.0 – 7.0	600 lbs. 13-13-13	Sod only	All	Introduced
Creeping Red Fescue	30 lbs. alone 22.5 lbs. mix	9/1 – 11/30	6.0 – 7.0	600 lbs. 13-13-13	Seed	All	Native
Weeping Lovegrass	10 lbs. alone 5 lbs. mix	3/1 – 7/15	6.0 – 7.0	600 lbs. 13-13-13	Seed	All	Introduced
***Wheat**	90 lbs. alone	9/1 – 11/30	6.0 – 7.0	600 lbs 13-13-13	Seed	All	Native
***Ryegrass**	30 lbs.	9/1 – 11/30	6.0 – 7.0	600 lbs 13-13-13	Seed	All	Native
***White Clover**	5 lbs.	9/1 – 11/30	6.0 – 7.0	400 lbs 6-24-24	Seed	All	Introduced
***Crimson Clover**	15 lbs.	9/1 – 11/30	6.0 – 7.0	400 lbs 6-24-24	Seed	All	Introduced
Sericea Lespedeza	40 lbs.	3/1 – 7/15 9/1 – 11/30	6.0 – 7.0	400 lbs. 13-13-13	Seed	All	Introduced
***Hairy Vetch**	30 lbs.	9/1 – 11/30	6.0 – 7.0	400 lbs 6-24-24	Seed	All	Introduced
***Browntop Millet**	40 lbs. alone 15 lbs. mix	4/1 – 8/30	6.0 – 7.0	600 lbs 13-13-13	Seed	All	Introduced

* Note on Annuals: For permanent seeding, annuals can only be used in a mixture with perennials.

Seedbed Requirements

Establishment of vegetation should not be attempted on sites that are unsuitable due to compaction or inappropriate soil texture, poor drainage, concentrated overland flow, or steepness of slope until measures have been completed to correct these problems. To maintain a good stand of vegetation, the soil must meet certain minimum requirements as a growth medium. A good growth medium should have these attributes:

- Sufficient pore space to permit root penetration.
- Enough fine-grained soil material (silt and clay) to maintain adequate moisture and nutrient supply.
- Sufficient depth of soil to provide an adequate root zone. The depth to rock or impermeable layers such as hardpans should be 12″ or more, except on slopes steeper than 2:1 where topsoiling is not feasible.
- A favorable pH range for plant growth, usually 6.0-6.5.
- Sufficient nutrients (nitrogen, phosphorus and potassium) for initial plant establishment.
- Freedom from large roots, branches, stones, or large clods. Clods and stones may be left on slopes steeper than 3:1 if they are to be hydroseeded.

If any of the above attributes are not met; i.e., if the existing soil is too dense, coarse, shallow or acidic to foster vegetation – chiseling, topsoil, or special amendments should be used to improve soil conditions. The soil conditioners described below may be beneficial or topsoil may be applied (for guidance on topsoiling see *Topsoiling Practice*). These amendments should only be necessary where soils have limitations that make them poor for plant growth or for turf establishment.

- Peat-appropriate types are sphagnum moss peat, reed-sedge peat, or peat humus, all from fresh-water sources. Peat should be shredded and conditioned in storage piles for at least 6 months after excavation.
- Sand-should be clean and free of toxic materials.
- Vermiculite-use horticultural grade.
- Rotted manure-use stable or cattle manure not containing undue amounts of straw or other bedding materials.
- Thoroughly rotted sawdust-should be free of stones and debris. Add 6 lbs of nitrogen to each cubic yard.

Soil Amendments

Liming Materials

Lime (Agricultural limestone) should have a neutralizing value of not less than 90 percent calcium carbonate equivalent and 90 percent will pass through a 10-mesh sieve and 50 percent will pass through a 60-mesh sieve.

Selma chalk should have a neutralizing value of not less than 80-percent calcium carbonate equivalent and 90 percent will pass through a 10-mesh sieve.

Other liming materials that may be selected should be provided in amounts that provide equal value to the criteria listed for agricultural lime or be used in combination with agricultural limestone or Selma chalk to provide equivalent values to agricultural limestone.

Plant Nutrients

Commercial grade fertilizers that comply with current Mississippi Fertilizer Laws should be used to supply nutrients required to establish vegetation.

Rates of Soil Amendments

Lime and fertilizer needs should be determined by soil tests. Soil testing is performed by the Mississippi State University Extension Service Soil Testing Laboratory and provides recommendations based on field tests on Mississippi soils. The local county Cooperative Extension Service can provide information on obtaining soil tests. Commercial laboratories that make recommendations based on soil analysis may be used.

When soil tests are not available, use the following rates for application of soil amendments.

Lime (Agricultural Limestone or Equivalent – see Liming Materials)

Sandy soils: Use 1 ton/acre (exception on sandy soils – if the cover will be tall fescue and clover use 2 tons/acre).

Clayey soils: 2 tons/acre.
(Do not apply lime to alkaline soils).

Fertilizer

Grasses alone: Use 400 lbs/acre of 8-24-24 or the equivalent. Apply 30 lbs of additional nitrogen when grass has emerged and begun growth (approximately 0.8lbs/1000 ft^2).

Grass-legume mixtures: Use 800 to 1200 lbs/acre of 5-10-10 or the equivalent.

Legumes Alone: Use 800 to 1200 lbs/acre of 0-10-10 or the equivalent.

Note: Fertilizer can be blended to meet exact fertilizer recommendations. Take soil test recommendations to local fertilizer dealer for bulk fertilizer blends. This may be more economical than bagged fertilizer.

Application of Soil Amendments

Apply lime and fertilizer evenly and incorporate into the top 6″ of soil by disking, chiseling, or other suitable means during seedbed preparation. Operate machinery on the contour.

Seedbed Preparation

Install necessary sediment-control practices before seedbed preparation and complete grading according to the approved plan.

Grade and loosen the soil to a smooth, firm surface to enhance rooting of seedlings and reducing rill erosion. Break up large clods and loosen compacted, hard, or crusted-soil surfaces with a disk, ripper, chisel, harrow or other tillage equipment. Avoid preparing the seedbed under excessively wet conditions. Operate the equipment on the contour.

For broadcast seeding and drilling, tillage, as a minimum, should adequately loosen the soil to a depth of at least 6″, alleviate compaction, and smooth and firm the soil for the proper placement of seed.

For no-till drilling, the soil surface does not need to be loosened unless the site has surface compaction.

Incorporate lime and fertilizer to a depth of at least 6″ with a disk or rotary tiller on slopes of up to 3:1. On steeper slopes, lime and fertilizer may be applied to the surface without incorporation. Lime and fertilizer may be applied through hydroseeding equipment; however, fertilizer should not be added to the seed mixture during hydroseeding. Lime may be added with the seed mixture.

Planting Methods

Seeding

Use certified seed for permanent seeding whenever possible. Certified seed is inspected by the Mississippi Crop Improvement Association to meet high quality standards and will be tagged with a "Certified Seed" tag. (Note: all seed sold in Mississippi is required by law to be tagged to identify seed purity, germination, and presence of weed seeds. Seed must meet state standards for content of noxious weeds.)

Seeding dates are determined using Figure PS-1 and Table PS-1.

Inoculate legume seed with the *Rhizobium* bacteria appropriate to the species of legume. Details of legume inoculation are located in Chapter 2 in the part on *Vegetation for Erosion and Sediment Control* under Inoculation of Legumes.

Seed should be uniformly planted with a cyclone seeder, a drill seeder, a cultipacker seeder, or by hand on a fresh, firm, friable seedbed. If the seedbed has been sealed by rainfall, it should be disked so the seed will be sown into a freshly prepared seedbed.

When using broadcast-seeding methods, subdivide the area into workable sections and determine the amount of seed needed for each section. Apply one-half the seed while moving back and forth across the area, making a uniform pattern; then apply the second half in the same way, but moving at right angles to the first pass.

Cover broadcast seed by raking or chain dragging; then firm the surface with a roller or cultipacker to provide good seed contact. Small grains should be planted no more than 1″ deep and grasses and legume seed no more than ½″ deep.

Hydroseeding

Surface roughening is particularly important when hydroseeding, as a roughened slope will provide some natural coverage for lime, fertilizer, and seed. The surface should not be compacted or smooth. Fine seedbed preparation is not necessary for hydroseeding operations; large clods, stones, and irregularities provide cavities in which seeds can lodge.

Mix seed, inoculant if required, and a seed carrier with water and apply as a slurry uniformly over the area to be treated. The seed carrier should be a cellulose fiber, natural wood fiber or other approved fiber mulch material which is dyed an appropriate color to

facilitate uniform application of seed. Use the correct legume inoculant at 4 times the recommended rate when adding inoculant to a hydroseeder slurry. The mixture should be applied within one hour after mixing to reduce damage to seed.

Fertilizer should not be mixed with the seed-inoculant mixture because fertilizer salts may damage seed and reduce germination and seedling vigor.

Fertilizer may be applied with a hydroseeder as a separate operation after seedlings are established.

Agricultural lime is usually applied as a separate operation and spread in dry form. It is not normally applied with a hydraulic seeder because it is abrasive and, also, may clog the system. On the other hand, liquid lime is applied with a hydraulic seeder but because of cost is used primarily to provide quick action for benefit of plants during their seedling stage with the bulk of liming needs to be provided by agricultural lime. Dry lime may be applied with the fertilizer mixture.

Sprigging

Hybrid Bermuda grass cannot be grown from seed and must be planted vegetatively. Vegetative methods of establishing common and hybrid Bermuda grass, centipede grass and zoysia include sodding, plugging and sprigging (see *Sodding Practice*).

When sprigs are planted with a sprigging machine, furrows should be 4-6″ deep and 2 feet apart. Place sprigs no farther than 2 feet apart in the row and so that at least one rooting node is in the furrow.

Broadcasting of sprigs is not recommended as the practice requires additional vegetative material and is an unreliable method of planting. Hand planting of sprigs is recommended instead with furrows 4-6″ deep and 2 feet apart. Place sprigs no farther than 2 feet apart in the row and so that at least one rooting node is in the furrow.

Mulching

The use of mulch provides instant cover and helps ensure establishment of vegetation under normal conditions and is essential to seeding success under harsh site conditions (see *Mulching Practice*). Harsh site conditions include slopes steeper than 3:1 and adverse soils (shallow, rocky, or high in clay or sand). Areas with concentrated flow should be treated differently and require sod, a hydromulch formulated for channels or an appropriate erosion control blanket.

Irrigation

Moisture is essential for seed germination and vegetation establishment. Supplemental irrigation can be very helpful in assuring adequate stands in dry seasons or to speed development of full cover. It is a requirement for establishment of vegetation from sod and sprigs and should be used elsewhere when feasible. However, irrigation is rarely critical for low-maintenance vegetation planted at the appropriate time of the year.

Water application rates must be carefully controlled to prevent runoff. Inadequate or excessive amounts of water can be more harmful than no supplemental water.

Installation Verification

Check materials and installation for compliance with specifications during installation of products.

Common Problems

Consult with a qualified design professional if the following occurs:

Design specifications for seed variety, seeding dates or mulching cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

Seeding at the wrong time of the year results in an inadequate stand. Reseed according to specifications of a qualified design professional (see recommendations under *Maintenance*)

Inadequate mulching results in an inadequate stand, bare spots or eroded areas-prepare seedbed, reseed, cover seed evenly and tack or tie down mulch, especially on slopes, ridges and in channels (see recommendations under *Maintenance*).

Maintenance

Generally, a stand of vegetation cannot be determined to be fully established until vegetative cover has been maintained for 1 year from planting.

Reseeding

Inspect seedlings monthly for stand survival and vigor. Also, inspect the site for erosion.

If stand is inadequate identify the cause of failure (choice of plant materials, lime and fertilizer quantities, poor seedbed preparation or weather) and take corrective action. If vegetation fails to grow, have the soil tested to determine whether pH is in the correct range or nutrient deficiency is a problem.

Stand conditions, particularly the coverage, will determine the extent of remedial actions such as seedbed preparation and reseeding. A qualified design professional should be consulted to advise on remedial actions. Consider drill seeding where possible.

Eroded areas should be addressed appropriately by filling and/or smoothing, and reapplication of lime, fertilizer, seed and mulch.

Fertilizing

Satisfactory establishment may require refertilizing the stand in the second growing season. Follow soil test recommendations or the specifications provided to establish and maintain the planting.

Mowing

Mow vegetation on structural practices such as embankments and grass-lined channels to prevent woody plants from invading.

Other areas should be mowed to compliment the use of the site.

Certain species can be weakened by mowing regimes that significantly reduce their food reserves stored for the next growing season: fescue should not be mowed close during the summer; sericea should not be mowed close in late summer.

Bermuda grass is tolerant of most mowing regimes and can be mowed often and close, if so desired, during its growing season.

References

Volume 1

Chapter 2

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Chapter 4

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Appendix G

MDOT Vegetation Schedule	G-1

Preservation of Vegetation (PV)

Practice Description

Preservation of vegetation is the avoidance of an area during land disturbing and construction activities to prevent mechanical and other injury to desirable plants in the planned landscape. The practice provides erosion and sediment control and is applicable where vegetative cover is desired and the existing plant community is compatible with the planned landscape.

Planning Considerations

Preservation of vegetation requires good site management to minimize the impact of construction activities on existing vegetation.

Plants to save should be identified prior to any construction activity.

Proper maintenance, especially during construction, is important to ensure healthy vegetation that can control erosion.

Different species, soil types, and climatic conditions will require different maintenance activities.

Design Criteria and Installation

Preservation requirements should be designed by a qualified design professional and plans should be made available to field personnel prior to start of construction

Mark Plant Area for Retention

Groups of plants and individual trees to be retained should be located on a plan map. Limits of clearing should be planned outside the drip line of groups or individual trees to be saved. The clearing should never be closer than 5 feet to the trunk of a tree.

Flagging or other appropriate means of marking the site of the groups of plants and individual trees to be retained should be required before construction begins. Individual trees to be retained should be marked with a highly visible paint or surveyor's ribbon in a band circling the tree at a height visible to equipment operators.

Plant Protection

Restrict construction equipment, vehicular traffic, stockpiles of construction materials, topsoil etc., from the areas where plants are retained and restrict these activities from occurring within the drip line of any tree to be retained. Trees being removed shall not be pushed into trees to be retained. Equipment operators shall not clean any of their equipment by slamming it against trees to be retained.

Restrict burning of debris within 100 feet of the plants being preserved. Fires shall be limited in size to prevent damage to any nearby trees.

Toxic material shall not be stored any closer than 100 feet to the drip line of any trees to be retained. Toxic materials shall be managed and disposed of according to state laws.

Fencing and Armoring

Groups of plants and trees should be protected by fencing or armoring where necessary (See Figure PV-l). The following types of fencing or armoring may be used:

- Board Fence; a board fence may be constructed with 4″ square posts set securely in the ground and protruding at least 4 feet above the ground. A minimum of 2 horizontal boards should be placed between the posts. The fence should be placed at the limits of the clearing around the drip line of the tree. If it is not practical to erect a fence at the drip line, construct a triangular fence near the trunk. The limits of clearing will still be the drip line as the root zone within the drip line will still require protection.

- Cord Fence; Posts at least 2″ square or 2″ in diameter set securely in the ground and protruding at least 4 feet above the ground; posts should be placed at the limits of clearing with 2 rows of cord ¼″ or thicker at least 2 feet apart running between posts with strips of surveyor's tape tied securely to the string at intervals of 3 feet or less.

- Earth Berms; Temporary earth berms may be constructed. The base of the berm on the tree side should be located along the limits of clearing. Earth berms may not be used for this purpose if their presence will create drainage patterns that cause erosion.

- Additional Trees; Additional trees may be left standing as protection between the trees to be retained and the limits of clearing. However, in order for this alternative to be used, trees in the buffer must be no more than 6 feet apart to prevent passage of equipment and material through the buffer.

- Plan for these additional trees to be evaluated prior to the completion of construction and either given sufficient treatment to ensure survival or be removed.

- Trunk Armoring; As a last resort, a tree may be armored with burlap wrapping and 2″ studs wired vertically no more than 2″ apart to a height of 5 feet. The armoring should encircle the tree trunk. Nothing should ever be nailed to a tree. The root zone within the drip line will still require protection.

- Fencing and armoring devices should be in place before any construction work is done and should be kept in good condition for the duration of construction activities. Fencing and armoring should not be removed until the completion of the construction project.

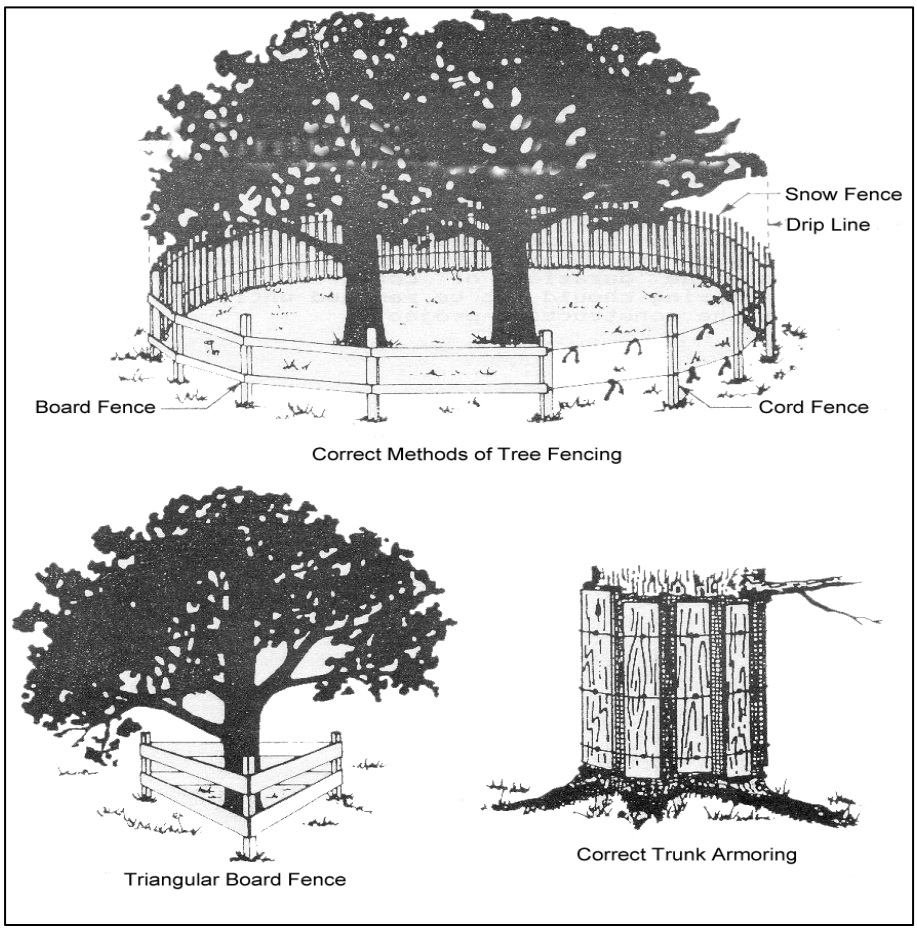

Figure PV- 1 Fencing and Armoring

Raising the Grade

When the ground level must be raised around an existing tree or group of trees, several methods may be used to insure survival.

A well may be created around a group of trees or an individual tree slightly beyond the drip line to retain the natural soil in the area of the feeder roots (see Figure PV-2).

When the well alternative is not practical or desirable, remove vegetation and organic matter from beneath the tree or trees for a distance of 3 feet beyond the drip line and loosen the surface soil to a depth of approximately 3″ without damaging the roots.

Apply fertilizer in the root area of the tree to be retained. A soil test is the best way to determine what type of fertilizer to use. In the absence of a soil test, fertilizer should be applied at the rate of 1 to 2 pounds of 10-8-6 or 10-6-4 per inch of diameter at breast height (dbh) for trees under 6″ dbh and at the rate of 2 to 4 pounds of 10-8-6 or 10-6-4 per inch of dbh for trees over 6″ dbh.

A dry well shall be constructed so as to allow for tree trunk diameter growth (see Figure PV-3). A space of at least 1 foot between the tree trunk and the well wall is adequate for old, slow growing trees. Clearance for younger trees shall be at least 2 feet. The well shall be high enough to bring the top just above the level of the proposed fill. The well wall shall taper slightly away from the tree trunk at a rate of 1″ per foot of wall height.

The well wall shall be constructed of large stones, brick, building tile, concrete blocks, or cinder blocks. Openings should be left through the wall of the well to allow for free movement of air and water. Mortar shall only be used near the top of the well and only above the porous fill.

Drain lines composed of 4″ high quality drain tiles shall begin at the lowest point inside the well and extend outward from the tree trunk in a wheel and spoke pattern with the trunk as the hub. Radial drain lines shall slope away from the well at a rate of ⅛″ per foot. The circumference line of tiles should be located beneath the drip line of the trees. Vertical tiles or pipes shall be placed over the intersections of the two tile systems if a fill of more than 2 feet is contemplated. Vertical tiles shall be held in place with stone fill. Tile joints shall be tight. A few radial tiles shall extend beyond each intersection and shall slope sharply downward to insure good drainage. Tar paper or its approved equivalent shall be placed over the tile and/or pipe joints to prevent clogging and large stone shall be placed around and over drain tiles and/or pipes for protection.

A layer of 2″ to 6″ stone shall be placed over the entire area under the tree from the well outward at least as far as the drip line. For fills up to 2 feet deep, a layer of stone 8″ to 12″ thick should be adequate.

A thick layer of this stone not to exceed 30″ will be needed for deeper fills. A layer of ¾″ to 1″ stone covered by straw, fiberglass mat, or a manufactured filter fabric shall be used to prevent soil from clogging the space between stones. Cinders shall not be used as fill material. Filling shall be completed with porous soil such as topsoil until the desired grade is reached. This soil shall be suitable to sustain specified vegetation.

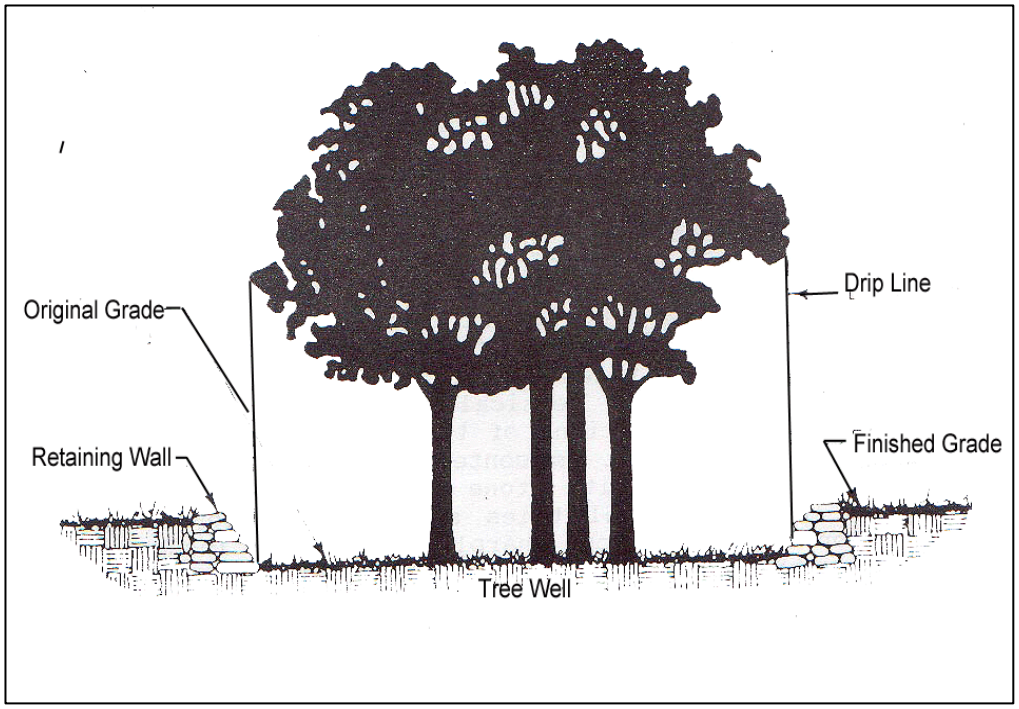

Figure PV- 2 Tree Well

Crushed stone shall be placed inside the dry well over the openings of the radial tiles to prevent clogging. The area between the trunk and the well wall shall either be covered by an iron grate or filled with a 50-50 mixture of crushed charcoal and sand to prevent anyone from falling into the dry well.

Where water drainage through the soil is not a problem, coarse gravel in the fill may be substituted for the tile. This material has sufficient porosity to ensure air drainage. Instead of the vertical tiles or pipes in the system, stones, crushed rock and gravel may be added so that the upper level of these porous materials slants toward the surface in the vicinity below the drip line.

Raising the grade on only one side of a tree or group of trees may be accomplished by constructing only half of one of these systems.

Lowering the Grade

Shrubs and trees shall be protected from the harmful grade cuts by the construction of a tree wall (see Figure PV-4). Following excavation, all tree roots that are exposed and/or damaged shall be trimmed cleanly and covered with moist peat moss, burlap or other suitable material to keep them from drying out.

The wall shall be constructed of large stones, brick, building tile, concrete block or cinder block. The wall should be backfilled with topsoil, peat moss, or other organic matter to retain moisture and aid in root development. Apply fertilizer and water thoroughly. The tree plants should be pruned to reduce the leaf surface in proportion to the amount of root loss. Drainage should be provided through the wall so water will not accumulate behind

the wall. Lowering the grade on one side of the tree or group of trees can be accomplished by constructing only half of this system.

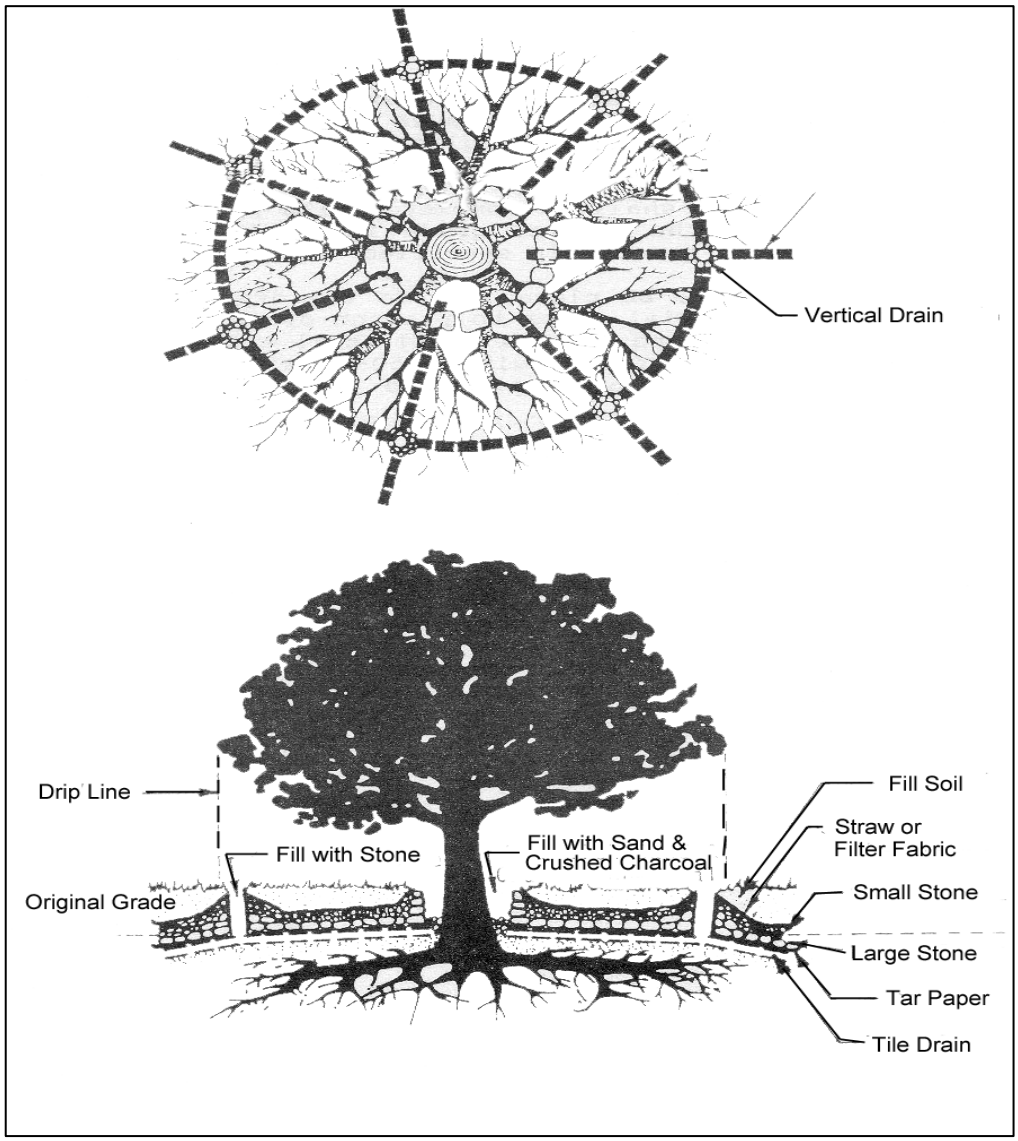

Figure PV- 3 Tree Well Detail

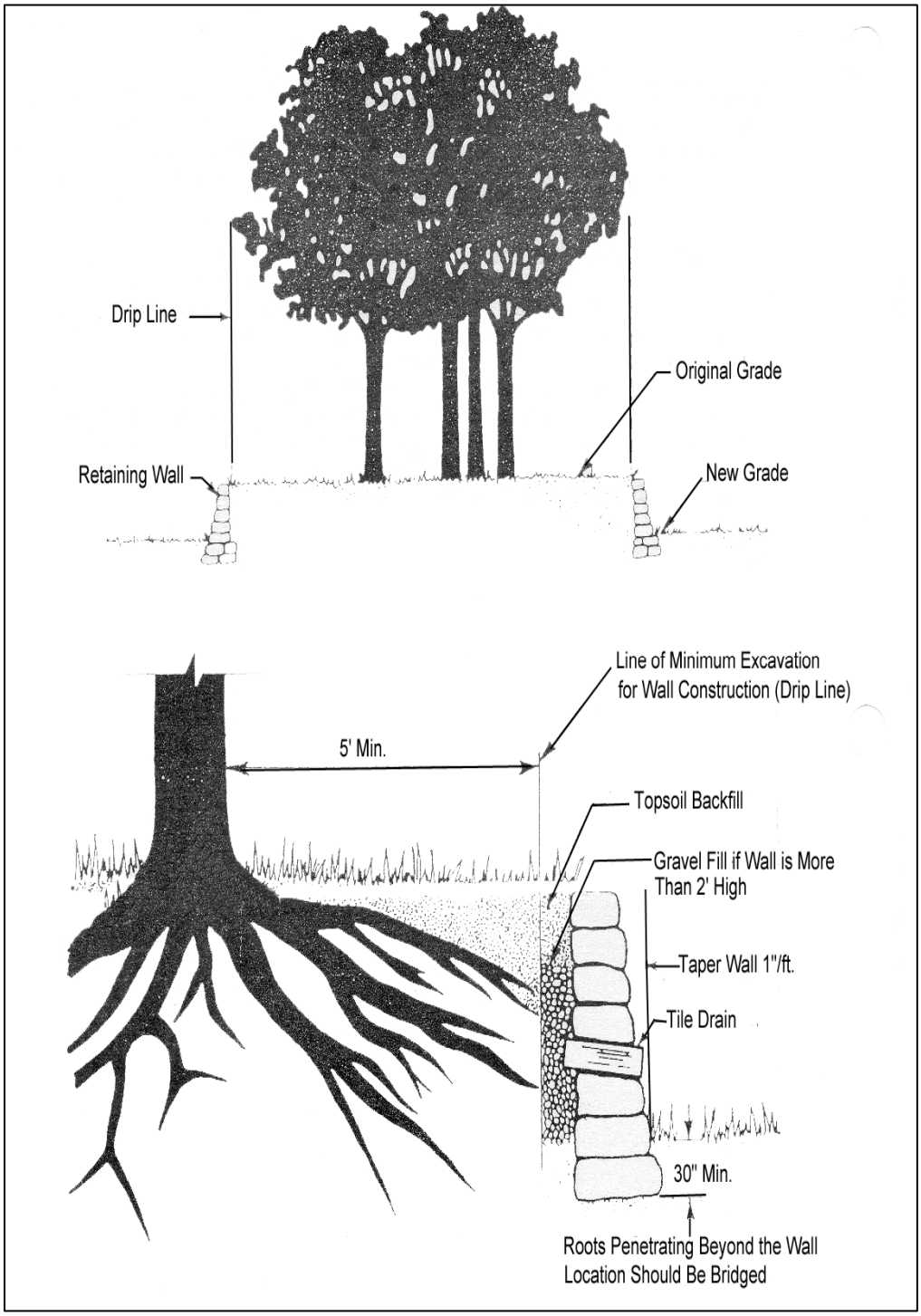

Figure PV- 4 Tree Wall Detail

Trenching and Tunneling

Trenching should be done as far away from the trunks of trees as possible, preferably outside the branches or crown spreads of trees, to reduce the amount of root area damaged or killed by trenching activities. When possible trenches should avoid large roots or root concentrations. This can be accomplished by curving the trench or by tunneling under large roots and areas of heavy root concentration. Tunneling under a species that does not have a large tap root may be preferable to trenching beside it as it has less impact on root systems (see Figure PV-5).

Roots should not be left exposed to the air but should be covered with soil as soon as possible or protected and kept moist with burlap or peat moss until the trench or tunnel can be filled. The ends of damaged and cut roots shall be cut off smoothly and moist peat moss, burlap or topsoil should be placed over the exposed area.

Trenches and tunnels shall be filled as soon as possible. Care should be taken to ensure that air spaces are not left in the soil. Peat moss or other organic matter shall be added to the fill material as an aid to inducing and developing root growth. The tree should be fertilized and mulched to stimulate new root growth and enhance general tree vigor. If a large part of the root system has been damaged the crown leaf surface area should be reduced in proportion to the root damage. This may be accomplished by pruning 20-30 percent of the crown foliage. If the roots are damaged during the winter the crown should be pruned before the next growing season. If roots are cut during the growing season, pruning should be done immediately.

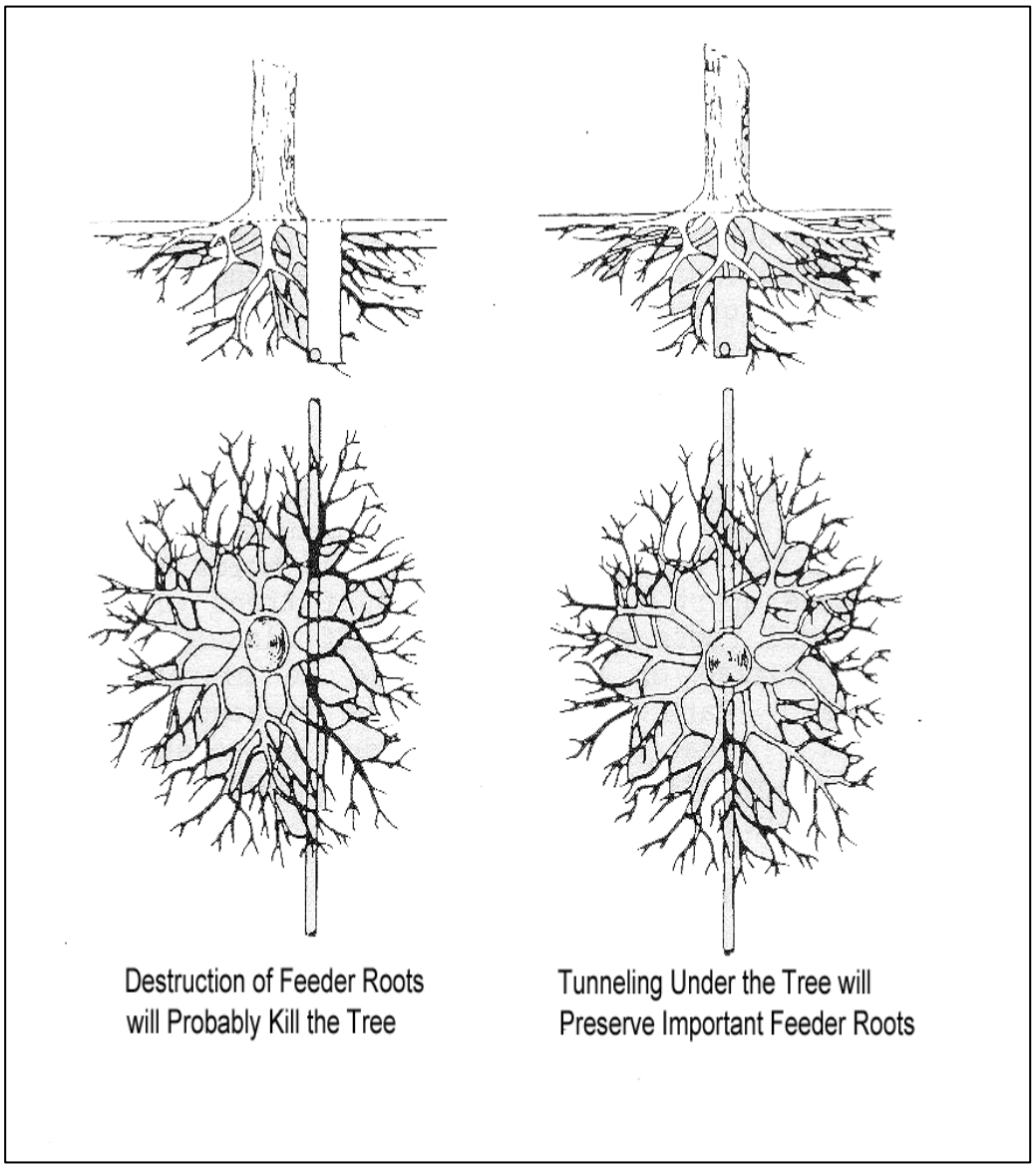

Figure PV- 5 Trenching vs. Tunneling

Treating Damaged Trees

When trees are damaged during construction activities certain maintenance practices can be applied to protect the health of the tree.

Soil aeration may be needed if the soil has been compacted. The soil around trees can be aerated by punching holes 1 foot deep and 18″ apart under the crown of trees with an iron pipe.

Damaged roots should be cut off cleanly and moist peat moss, burlap or topsoil should be placed over the exposed area. Bark damage should be treated by removing loose bark.

Tree limbs damaged during construction or removed for any other reason shall be cut off above the collar at the branch junction.

Trees that have been stressed or damaged should be fertilized to aid their recovery.

Trees should be fertilized in the spring or fall. Fall applications are preferred.

Fertilizer should be applied to the soil over the feeder roots. In no case should it be applied closer than 3 feet to the trunk. Root systems of trees extend some distance beyond the drip line. The area to be fertilized should be increased by ¼ the area of the crown. A soil test is the best way to determine what type of fertilizer to use. In the absence of a soil test, fertilizer should be applied at the rate of 1 to 2 pounds of 10-8-6 or 10-6-4 per inch of dbh for trees under 6″ dbh and at the rate of 2 to 4 pounds of 10-8-6 or 10-6-4 per inch of dbh for trees over 6″ dbh.

A ground cover or organic mulch layer should be maintained around trees to prevent erosion, protect roots and to conserve water.

Verification of Practice

Check to determine that specifications are met as the areas are identified for retention, as the plants are protected during construction and that damaged plants are treated or replaced.

Common Problems

Consult with a qualified design professional if any of the following occur:

Soil compaction appears to be retarding plant growth or affecting plant health.

Damage to plants appears to be severe and life threatening.

Plants appear to be of poor quality and are undesirable for retention.

Problems during construction that require remedial actions:

Erosion – eroded areas should be vegetated to grass or a suitable ground cover.

Severely damaged trees, shrubs or vines should be replaced.

Maintenance

Enhance and maintain plant growth and health according to the maintenance plan. This may involve applying fertilizer, spreading mulch and pruning trees and shrubs.

Replace dead plants as needed to maintain desired landscape cover. Additional information about plantings is found in practices *Permanent Seeding, Shrub, Vine and Groundcover Planting, and Tree Planting on Disturbed Areas*.

References

BMPs from Volume 1

Chapter 4

Retaining Wall (RW)

Practice Description

A retaining wall is a constructed wall used to eliminate steep slopes between areas that have abrupt changes in grade. This practice is used to replace cut or fill slopes in confined areas or where a wall is necessary to achieve stable slopes. A retaining wall can be constructed of reinforced concrete, treated timbers, gabions, reinforced earth (a system of face panels and buried reinforcement strips), and other manufactured products such as interlocking concrete blocks.

Planning Considerations

Retaining walls should be used in conjunction with steep cut or fill slopes, that may be unstable due to steepness, space limitations, or poor soil conditions to stabilize the site. Retaining walls may be used to relieve the need to construct cuts into steep hillsides or on small lots where fill toe-outs or slope cut-outs would go off of the property being developed. Retaining walls may be required to achieve the best or intended use of the property.

Retaining walls can be constructed from the following materials:

- Reinforced concrete
- Concrete cribbing
- Geotextile-wrapped face wall
- Geotextile-reinforced steep slopes
- Modular blocks
- Treated timbers

Each case is different and the type of retaining wall to be used should be selected by a qualified design professional based on the particular site conditions and what best meets the needs of the site. In most cases, treated timber is the least desirable material because of its potential to decay.

Figure 1: Retaining wall made of gabions

Design Criteria and Construction

The design of a retaining wall is or can be a complicated engineering procedure. There are many factors to consider. Each case is different and requires a different set of considerations and a different design.

The qualified design professional should consider the stresses and forces outside and within the wall as well as allowable height and minimum thickness. Other considerations are foundation design with respect to loadings, bearing values of soils and footing dimensions. Additional design factors include safety hazards, drainage aspects and appearance.

Each retaining wall requires a specific engineering design which requires the capabilities of a competent qualified design professional. Retaining walls are engineering structures that affect public property, life and welfare of citizens. Mississippi law which regulates the practice of professional engineering in the State of Mississippi must be followed on structures such as retaining walls. The State Board of Registration for Professional Engineers and Land Surveyors in Jackson is responsible for administering the provisions of the law.

Site Preparation

At least 3 days prior to construction, contact the Mississippi One-Call System, Inc (1-800-227-6477) to identify, locate and mark all underground utilities within the project area. See **Appendix C** for more information about Mississippi One-Call and utility markings.

Clear installation area of debris and obstacles, such as tree and stumps, that might hinder grading and installation of the wall.

Grading

Grade existing embankments according to the design plan to provide a stable slope until construction of the retaining wall is complete.

Grade the top of the embankments according to the design plan to direct stormwater runoff around the area where retaining walls are being constructed.

Installation of Wall

Concrete Wall Installation

The placement of reinforcing steel, the construction of forms, concrete batching, mixing, placement, curing, and finishing should be in accordance with the project specifications and the American Concrete Institute (ACI) standards. The concrete mix quantities, air entrainment, slump, temperature, and compressive strength should be in accordance with the plans for the job.

Compressive strength of the concrete should be verified by laboratory tests on representative cylinders made during concrete placement.

Drains and weep holes should be installed as shown on the design plans.

Modular Block Wall Installation

Prepare a leveling pad of compacted, crushed rock (typically 6″ thick and 18″ wide). Place the first row of modular blocks on the leveling pad (not a footing, as the geosynthetic reinforcement will bear the weight of the block and the backfill). Install additional modular blocks and geosynthetic reinforcement (geogrid or geotextile) according to design plans.

Timber Wall Installation

Timbers should be new pressure-treated (usually 0.6 pcf for ground contact) members having a design life consistent with that of the project and free of splits and deep cracks.

Proper tiebacks are essential to the stability of timber retaining

walls. Install tiebacks according to design plans.

Manufactured Products Installation

Specifications for manufactured products should be provided by the manufacturer or in the design plan. Inspect all such materials for damage prior to installation.

Drain Installation

Install drains as specified in the design plans.

Backfill Installation

Backfill for all wall types should be placed carefully in layers not exceeding 8″ (loose) and compacted with hand-operated tampers. The degree of compaction should be provided as specified in the design plans. Before compacting, the soil should be moistened or dried as necessary to obtain the optimum moisture content specified. Backfill should not be placed on surfaces that are muddy, frozen or contain frost or ice.

Backfill for retaining walls built of manufactured products such as reinforced earth or interlocking concrete blocks should be placed according to manufacturer's recommendations. Tiebacks or geosynthetic reinforcements should be placed as specified in the design plans.

Nonwoven geotextile fabric should be used behind timber or modular block walls to help keep soil in place.

Erosion Control

Stabilize all bare areas according to the vegetation plan.

Safety

Steep slopes are subject to collapse and can be a safety hazard to persons in the area. No person should work adjacent to steep slopes without shoring protection or properly sloping the embankment.

Construction Verification

Check finished retaining wall for conformance with design plans and specifications.

Check for cracks or movement of the retaining wall.

Common Problems

Consult with a qualified design professional if any of the following occur:

Variations in topography on site indicate retaining wall will not function as intended.

Seepage is encountered during construction. It may be necessary to install drains.

Poor foundation soils are encountered under the proposed wall location.

Design specifications for concrete, timbers, backfill or other materials cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

High soil and water pressures result in structural failure of the wall—consult qualified design professional and rebuild according to revised plan and specifications.

Maintenance

Inspect retaining walls periodically and after heavy rains for cracks, undercutting of the foundation, piping erosion, wetness or movement.

Repair problems determined during inspections. Repair cracks according to manufacturer's recommendations.

References

The following references may be useful in the application/installation of this practice.

BMPs from Volume 1

Chapter 4

Permanent Seeding (PS) 4-53

Appendices Volume

Appendix C

Mississippi One-Call & 811 Color Coding C-1

Shrub, Vine, and Groundcover Planting (SVG)

GC

Practice Description

Shrub, vine and groundcover planting is the practice of establishing shrubs, vines or groundcover to stabilize soil in areas where establishing grass is difficult and mowing is not feasible. The practice is especially suited for steep slopes where aesthetics are important. Incidental benefits include providing food and shelter for wildlife, windbreaks or screens and improved aesthetics.

Planning Considerations

Shrubs, vines and groundcovers provide alternatives to grasses and legumes as low-maintenance, long-term erosion control. However, they are normally planted only for special, high-value applications, or for aesthetic reasons, because there is additional cost and labor associated with their use.

Very few of these plants can be dependably planted from seed, and none are capable of providing the rapid cover possible with grasses. Consequently, short-term stabilization efforts must involve using dependable mulch along with special cultural practices to ensure establishment.

Shrubs vary in form and differ from most trees in that multiple stems arise from a common base.

Shrubs can be used to attain additional benefits including the following:

- Increase the aesthetic value of plantings
- Provide visual screening and protective barriers
- Enhance windbreaks
- Provide food and cover for wildlife
- Accelerate the transition to a diverse landscape
- Provide post-construction landscaping

Groundcovers differ in growth rate and shade tolerance. Some are suitable only as part of a high-maintenance landscape; others can be used to stabilize large areas with little maintenance.

Competition from volunteer plants inhibits development and maintenance of the groundcover. Thick durable mulch such as shredded bark (not chips) or pine straw can prevent erosion and reduce weed competition.

Mulch is beneficial to plants at most stages of development but is particularly important for new plantings.

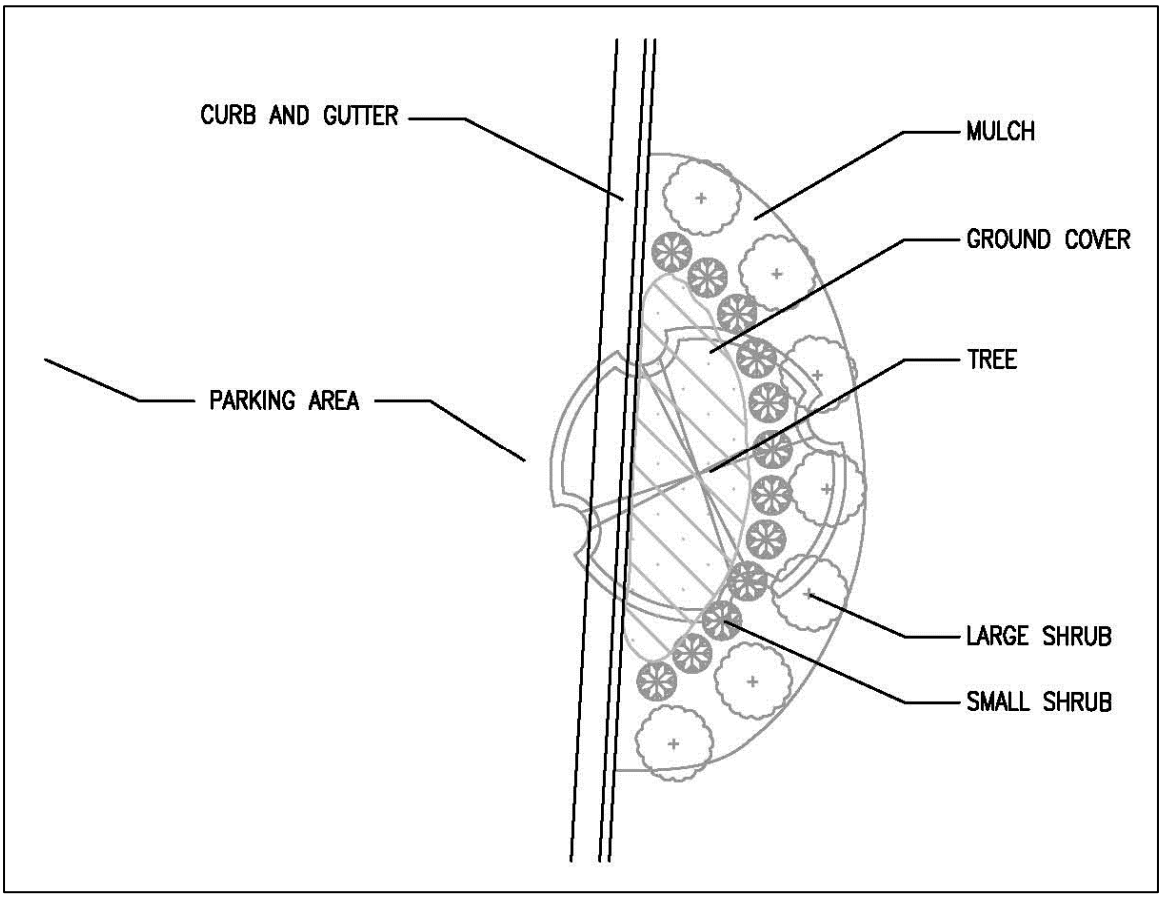

Figure SVG-1 Sample Planting Design Plan

Design Criteria

Plant Selection

Specific characteristics and requirements of recommended species are given in Tables SVG-1 through SVG-5 *Plants Suitable for Shrub, Vine and Groundcover Planting* in Mississippi. Other suitable plants may be identified by qualified design professionals based on plant suitability information including plant adaptation zones (see Figure SVG-2). Exotic invasive species should not be planted!

Site Preparation

Remove debris and other undesirable objects and smooth the area to accommodate the planting and mulching. Sites should be prepared in strips along the contour or at individual spots. Additional preparation will vary according to the type of plant and is discussed later under *Planting*.

On steep slopes, till the soil in contour rows or dig single holes for each plant. Blend the needed lime, fertilizer, and organic material with the soil removed from each hole or furrow. Mix fertilizer thoroughly with the soil before planting, and use it sparingly to avoid burning roots. To eliminate harmful competition from weeds, an appropriate preemergent herbicide may be useful if weeding is not practical.

Soil Amendments

Fertilizer and lime requirements are plant specific and the prescription for a planting should be based on a soil test or a plan prepared by a qualified design professional.

Soils low in organic matter may be improved by incorporating peat, compost, aged sawdust or well-rotted manure.

To eliminate competition from weeds, an appropriate preemergent herbicide may be useful if mechanical weeding is not practical or desired.

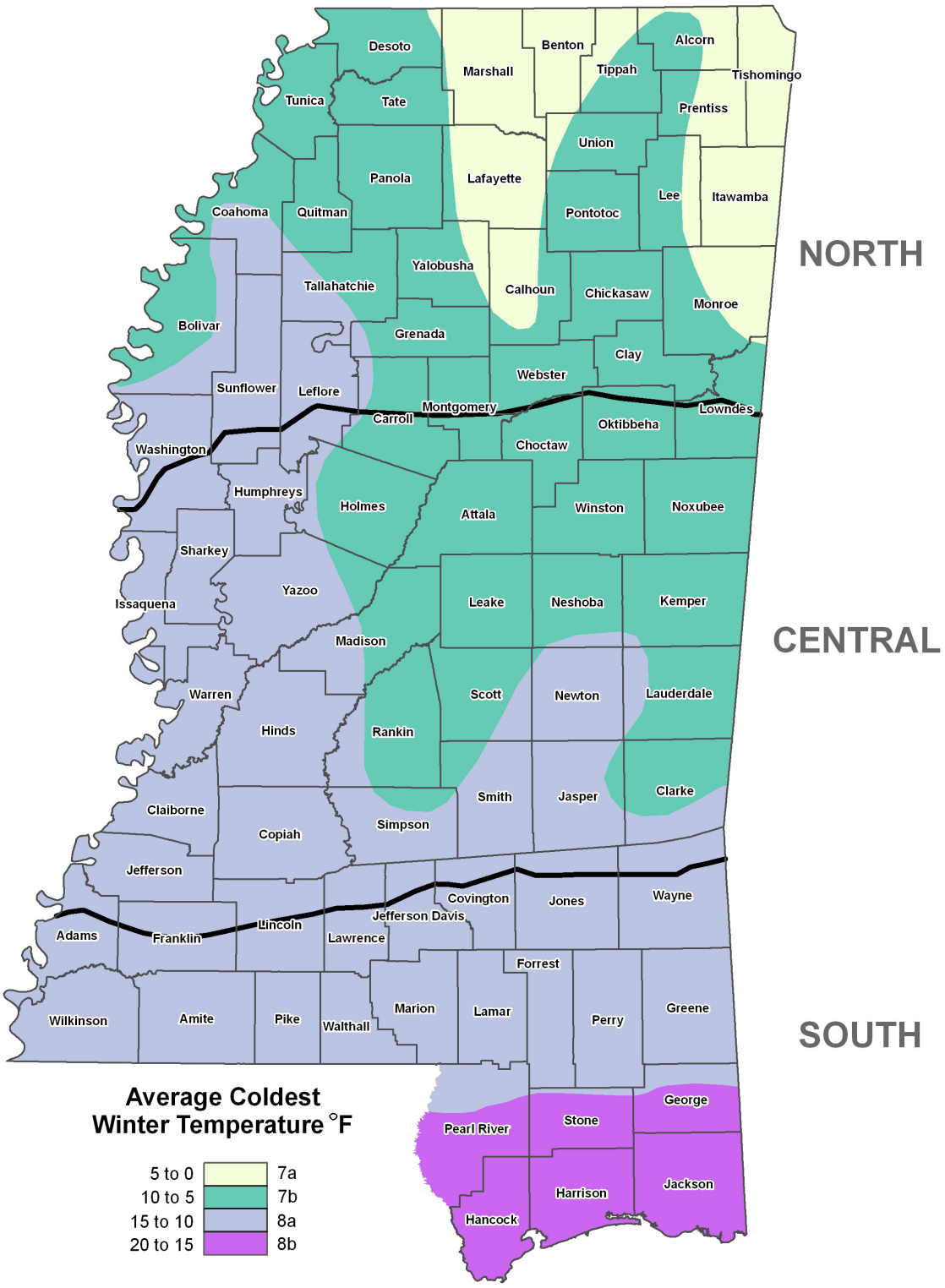

Figure SVG-2 Plant Adaption Zones

Table SVG-1 Plants Suitable for Groundcover Planting in Mississippi

Botanical Name and Common Name	Size	Foliage	Exposure	Native/ Introduced
Bugleweed *Ajuga reptans*	3″-6″	Deciduous	Shade	Introduced
Cast iron plant *Aspidistra elatior*	30″-36″	Evergreen	Shade	Introduced
Holly fern *Cyrtomium falcatum*	24″-30″	Evergreen	Shade	Introduced
English ivy *Hedera helix*	30-40 ft.	Evergreen	Shade	Introduced (May be Invasive)
Liriope a.k.a. Lillyturf *Liriope muscari*	12″-18″	Evergreen	Sun/Shade	Introduced
Moneywort *Lysimachia nummularia*	3″-18″	Deciduous	Sun/Part Sun	Introduced
Monkey grass *Ophiopogon japonicus*	6″-8″	Evergreen	Sun/Shade	Introduced
Stonecrop *Sedum acre*	4″-12″	Evergreen	Sun	Introduced
Asian jasmine *Trachelospermum asiaticum*	12″-10’	Evergreen	Sun/Shade	Introduced
Periwinkle *Vinca major*	12″-3’	Evergreen	Part Shade	Introduced (May be Invasive)
Littleleaf periwinkle *Vinca minor*	10″-3’	Evergreen	Part Shade	Introduced (May be Invasive)
Daylily *Hemerocallis spp.*	30″-36″	Evergreen/ Deciduous	Sun	Introduced
Wild ginger *Asarum canadense*	4″-6″	Evergreen	Shade	Native
Confederate jasmine *Trachelospermum jasminoides*	12″-10’	Evergreen	Sun	Introduced
Ardisia *Ardisia crenata*	24″-24″	Evergreen	Shade	Introduced
Japanese ardisia *Ardisia japonica*	10″-10″	Evergreen	Shade	Introduced
Butterfly iris *Bietes vegeta*	24″-24″	Herbaceous	Sun	Introduced
Louisiana iris *Iris spp.*	36″-36″	Evergreen	Sun	Introduced
Indigo *Indigofera kirilowii*	24″-24″	Deciduous	Part Shade	Introduced

Table SVG-2 Plants Suitable for Vine Planting in Mississippi

Botanical Name and Common Name	Size	Foliage	Exposure	Support Needed	Native / Introduced
Coral vine *Antigonon leptopus*	Grows to 40’	Deciduous	Sun/Part sun	Yes	Introduced
Crossvine *Bignonia capreolatar*	Grows to 60’	Evergreen	Sun/Shade	No	Native
Trumpet creeper *Campsis radicans*	Grows to 30’	Deciduous	Sun/part sun	No	Native
Autumn clematis *Clematis paniculata*	Grows to 30’	Deciduous	Sun	Yes	Introduced
Yellow jessamine *Gelsemium sempervirens*	Grows to 25’	Evergreen	Sun/Part sun	Yes	Native
Climbing hydrangea *Hydrangea petiolaris*	Grows to 50’	Deciduous	Sun/Part Shade	No	Native
Coral honeysuckle *Lonicera sempervirens*	Grows to 20’	Evergreen	Sun/ Part shade	Yes	Native
Lady banks’ rose *Rosa banksiae*	Grows to 20’	Evergreen	Sun	Yes	Introduced
Confederate jasmine *Trachelospermum jasminoides*	Grows to 25’	Evergreen	Sun/Part sun	Yes	Introduced
Virginia creeper *Parthenocissus quinquefolia*	Grows to 40’	Deciduous	Sun/Shade	No	Native
Muscadine grape *Vitis rotundifolia*	Grows to 30’	Deciduous	Sun/Part sun	Yes	Native
American wisteria *Wisteria frutescens*	Grows to 30’	Deciduous	Sun/Part sun	Yes	Native (very aggressive)
Dutchman’s pipe *Aristolochia macrophylla*	Grows to 30’	Deciduous	Shade	Yes	Native
Passion flower *Passiflora incarnate*	Grows to 20’	Deciduous	Sun/Part sun	Yes	Native

Table SVG-3 Plants Suitable for Small Shrub Planting in Mississippi

Botanical Name and Common Name	Normal Height	Foliage	Exposure
Callicarpa Americana American Beautyberry	4-6 ft.	Deciduous	Part Shade
Calycanthus floridus Sweetshrub	6-10 ft.	Deciduous	Full Sun to Shade
Clethra alnifolia Summersweet	2-4 ft.	Deciduous	Full Sun to Part Sun
Fothergilla major Witch Alder	6-10 ft.	Deciduous	Full Sun to Part Sun
Gaylussacia dumosa Dwarf Huckleberry	4-6 ft.	Deciduous	Full Sun to Part Sun
Hydrangea quercifolia Oakleaf Hydrangea	6 ft.	Deciduous	Part Sun to Shade
Illicium floridanum Star Anise	8 ft.	Evergreen	Shade to Part Sun
Itea Virginica Virginia Sweetspire	3-6 ft.	Deciduous	Full Sun to Part Sun
Leucothoe axillaris Leucothoe	3 ft.	Evergreen	Full Sun to Part Sun
Lyonia lucida Lyonia	3 ft.	Evergreen	Part Sun to Shade
Sabal minor Dwarf Palmetto	6 ft.	Evergreen	Full Sun to Part Sun
Viburnum dentatum Arrow-wood Virburnum	5-9 ft.	Deciduous	Full Sun to Part Sun

Table SVG-4 Plants Suitable for Medium Shrub Planting in Mississippi

Botanical Name and Common Name	Normal Height	Foliage	Exposure
Aesculus pavia Red Buckeye	10 ft.	Deciduous	Full Sun to Part Shade
Baccharis halimifolia Groundsel Bush	12 ft.	Evergreen	Part Shade
Cephalanthus occidentalis Buttonbush	10 ft.	Deciduous	Full Sun to Part Sun (needs a lot of water)
Ilex verticillata Winterberry Holly	6-10 ft.	Deciduous	Full Sun to Part Sun
Rhododendron austrinum Yellow Native Azalea	12 ft.	Deciduous	Part Sun to Shade
Rhododendron canescens Honeysuckle Azalea	12 ft.	Deciduous	Part Sun to Shade
Styrax americana Snowbell	10 ft.	Deciduous	Full Sun to Part Sun
Vaccinium elliottii Elliott's Blueberry	12 ft.	Deciduous	Full Sun to Part Sun

Table SVG-5 Plants Suitable for Large Shrub Planting in Mississippi

Botanical Name and Common Name	Normal Height	Foliage	Exposure
Alnus serrulata Tag Alder	15 ft.	Deciduous	Sun to shade
Chionanthus virginicus Fringe Tree	20 ft.	Deciduous	Full Sun to Part Sun
Cliftonia monophylla Buckwheat Tree	6-12 ft.	Evergreen	Full Sun to Part Sun
Hamamelis virginiana Witch Hazel	8-20 ft.	Deciduous	Full Sun to Shade
Ilex coriacea Bigleaf Gallberry Holly	15 ft.	Evergreen	Full Sun to Part Sun
Kalmia latifolia Mountain Laurel	5-10 ft.	Evergreen	Full Sun to Part Sun
Osmanthus americanus American Sweet Olive	20 ft.	Evergreen	Full Sun to Part Sun
Rhododendron serrulatum Summer Azalea	15 ft.	Deciduous	Part Sun to Shade
Rhus typhina Staghorn Sumac	20 ft.	Deciduous	Full Sun to Part Sun
Vaccinium arboretum Tree Huckleberry	20 ft.	Evergreen	Full Sun to Part Sun

Table SVG-6 Plants Suitable for Ornamental Grass Planting in Mississippi

Botanical Name and Common Name	Height and Spread	Exposure
Andropogon virginicus Broomsedge	2-3 ft. / 1-2 ft.	Sun to Part Sun
Carex sp. Carex	1-1.5 ft. / 1.5 ft.	Sun to Shade
Pennisetum alopecuroides Fountain Grass	3 ft. / 4 ft.	Full Sun
Miscanthus sinensis Miscanthus (maiden grass)	4-7 ft. / 4-5 ft.	Full Sun to Part Sun
Cortaderia selloana Pampass Grass (Not reliable in North MS)	12 ft. / 6 ft.	Full Sun to Light Shade
Chasmanthium latifolium River Oats	2-5 ft. / 2-3 ft.	Full Sun to Partial Shade
Phalaris arundinacea Variegated Ribbon Grass	3-4 ft. / 4 ft.	Full to Partial Sun

Planting

In the absence of a site-specific planting plan consider the following guidelines.

Shrubs

Late winter (before leaves emerge) is the best time for planting deciduous shrubs and early fall is the best for evergreens. Shrubs grown and marketed in containers can be planted anytime during the year except when the ground is frozen.

Individual Shrubs with Root Ball

Provide a relatively large area for initial root development. The hole should be dug to a depth that allows the root ball to extend 1″ above the soil surface. The top diameter of the hole should be as big around as 2-3 times the diameter of the root ball. As soil is added the hole should be filled with water to moisten the soil until the filling of the hole is complete.

Shrubs in Prepared Beds

Till or spade a bed to a depth of 8″ to 12″. Contrary to the individual planting, soil amendments, such as peat or compost at a rate of 1 part amendment to 3 parts native soil, are beneficial to shrubs because they provide a uniform root environment across the bed area. Organic soil amendments enable plants to respond positively to water and fertilizers when they are applied. The hole for the shrub planted in a bed area should be a few inches wider in diameter than the root ball.

Plants in Containers

Remove container plants from their containers, cutting the container if necessary. If the plant is root-bound (roots circling the outside of the root ball), score the root-ball from top to bottom about 4 times, cutting about ¼ ″ deep with a knife, or gently massage the root ball until roots point outward. Place the shrub into the hole. Using only the native backfill, add soil back to the hole until it is ½ to ⅔ full. Water in the backfill soil around the root ball. Add soil to ground level and thoroughly water again. A small dike may be formed around the edge of the planting hole to hold water around the root ball if the plant is in sandy soils or on slopes. *Caution: in a dense clay soil, trapping additional water in the root zone can be detrimental because water drains poorly and creates an extended period of wetness*.

Bare Root Plants

Soak bare root plants in water. When planting, spread the roots in the hole and gradually add soil. Firm the soil, being careful to avoid breaking roots. Fill the hole with water, and allow it to drain. Then fill the hole with soil, and water again thoroughly.

Burlapped Plants

Cut any wire or string that is around plants stems. Do not remove the burlap. Fold the burlap back so it will be buried by soil. Burlap which is allowed to remain exposed after planting can act as a wick, causing the root ball to dry out. Follow the same procedure for filling the hole as that described for container plants.

Vine and Groundcovers

Most groundcovers are planted from container-grown nursery stock. Planting density determines how quickly full cover is achieved; a 1 foot spacing is often used for rapid cover. Large plants such as junipers can be spaced on 3 foot centers. Transplanting to the prepared seedbed can be done using a small trowel or a spade. Make a hole large enough to accommodate the roots and soil. Backfill and firm the soil around the plant, water immediately, and keep well watered until established. Water slowly and over longer periods to allow for infiltration and reduce runoff.

When to plant

Late winter (before leaves emerge) is the best time for planting deciduous shrubs and early fall is the best for evergreen shrubs. Assuming the plants are well-watered during the summer, shrubs grown in containers can be planted anytime during the year except when the ground is frozen.

Vines and groundcovers are best planted in early fall or early spring.

Mulching

Once plants are installed, add mulch. On steep slopes or highly erodible soils, install erosion control netting or matting prior to planting, and tuck plants into the soil through slits in the net. Plant in a staggered pattern (see *Mulching Practice* for more details on mulching).

Watering

Shrubs

Water shrubs immediately after planting and keep well watered for the first few weeks. Apply water weekly if rainfall does not supply 1″ of water per week. Be conscious of plants that have been in the ground for less than 1 year and water them regularly and thoroughly during extended dry periods.

Vines and Groundcover

Water vines and groundcover immediately after planting and keep well watered until established. Vines and groundcover need about an inch of water a week for the first 2 years after planting.

Verification of Practice

Check all components of the practice during installation to ensure that specifications are being met.

Common Problems

Consult with a qualified design professional if any of the following occur:

Soil compaction at planting time appears so significant that it will prevent adequate plant growth. Compaction should be addressed during site preparation.

Design specifications for plants (species, variety, planting dates) and mulch cannot be met. Unapproved substitutions could lead to failure.

Problems that require remedial actions:

Erosion, washout and poor plant establishment – repair eroded surface, replant, reapply mulch and anchor.

Mulch is lost to wind or stormwater runoffs – reapply mulch and anchor.

Maintenance

Replant shrubs, vines or groundcovers where needed to maintain adequate cover for erosion control. Repair eroded surfaces by reapplying the previous treatment and determine if an additional practice is needed, i.e. installing erosion netting. Maintain shrubs, vines and ground covers with applications of fertilizer and mulching. Reapply mulch that is lost to wind, stormwater runoff or decomposition.

Shrubs, vines and groundcovers need about an inch of water a week for the first 2 years after planting. When rain does not supply this need, shrubs should be watered deeply not less than once a week.

Fertilization needs should be determined by a professional because different plants have different needs. In the absence of a recommendation from a landscape professional, a soil test is the best way to determine what nutrient elements are needed. Fertilizer formulations of 12-4-8 or 15-0-15 can be used in the absence of a soil test. Apply 2 lbs of fertilizer per 1000 ft^2 of area.

References

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Sodding (SOD)

S

Practice Description

Sodding is the use of a transplanted vegetative cover to provide immediate erosion control in disturbed areas. Sodding is well suited for stabilizing erodible areas such as grass-lined channels, slopes around storm drain inlets and outlets, diversions, swales, and slopes and filter strips that cannot be established by seed or that need immediate cover.

Planning Considerations

Advantages of sod include immediate erosion control, nearly year-round establishment capability, less chance of failure than with seeding, and rapid stabilization of surfaces for traffic areas, channel linings, or critical areas.

Initially it is more costly to install sod than to plant seed; however, the higher cost may be justified for specific situations where sod performs better than a seeded cover. Sodding may be more cost-efficient in the long term.

Sod can be laid during the times of the year when seeded grasses may fail, provided there is adequate water available for irrigation in the early establishment period. Irrigation is essential at all times of the year to establish sod.

Sod placed around drop inlets can prevent erosion around the inlet and help maintain the necessary grade around the inlet.

The site to be sodded should be prepared for the sod before it is delivered so that the sod can be installed immediately. Leaving sod stacked or rolled can cause severe damage and loss of plant material.

Design Criteria and Installation

Prior to start of installation, design and installation guidelines should be specified by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the installation process.

Sod Selection

The species of sod selected should be adapted to both the site and the intended purpose. Species used in Mississippi include Bermuda, zoysia, centipede, St. Augustine, fescue, and Rye grass. Species selection is primarily determined by region, availability, and intended use. Use Tables SOD-l and SOD-2 and Figure SOD-1 for guidance in selecting and maintaining sod.

Table SOD-1 Grasses Adapted for Sodding in Mississippi

Species	Variety	Applications
Warm Season Grasses		
Bermuda Grass	La Prima, Yukon	Full Sun
Centipede	No Improved Varieties	Mostly Sunny to Full Sun
Zoysia	Zenith, Compadre	Mostly Sunny to Full Sun
St. Augustine	Bitterblue, Raleigh, Common	Partial Sun, Wet Areas
Cool Season Grasses		
Fescue – Turf Type	Combat Extreme	Partial Sun
Rye Grass	OSP Ryegrass	Winter Overseed

Surface Preparation

Prior to laying sod, clear the soil surface of trash, debris, roots, branches, stones, and clods larger than 2″ in diameter. Fill or level low spots in order to avoid standing water. Rake or harrow the site to achieve a smooth and mowable final grade. Apply appropriate soil amendments prior to final disking. Complete soil preparation by disking, chiseling or other appropriate means and then rolling or cultipacking to firm the soil. Limit the of heavy equipment on the area to be sodded, particularly when the soil is wet, as this may cause excessive compaction and make it difficult for the sod to penetrate the soil and develop the root system that it should attain.

Table SOD-2 Adaptation and Maintenance of Grasses Used for Sodding

Cool Season Grasses	Leaf Texture	Establish Rate	Nitrogen Use	Water Use	Drought Tolerance	Salinity Tolerance	Shade Tolerance	Fertility Needs	Wear Resistance	Mowing Height	Cold Tolerance	Acid Soil Tolerance	Thatching Tendency	Heat Tolerance
Bentgrass - Creeping	Fine	Moderate to Fast	Low to Moderate	High	Poor to Moderate	High	Poor to Moderate	High	Low	Low	Low	Medium to High	High	High
Bentgrass - Colonial	Fine	Moderate to Fast	Low	Moderate	Poor to Moderate	Moderate	Moderate	High	Low	Low	Low	Medium to High	High	High
Bluegrass - Kentucky	Moderate to Fine	Slow	Moderate to High	Moderate to High	Good	Moderate	Poor	Medium	Medium to High	Medium	High	Medium	Medium	Medium
Bluegrass - Rough	Moderate to Fine	Slow	Moderate to High	Moderate to High	Poor	Moderate	Excellent	Medium	Medium	Medium	High	Medium	Medium	Medium
Fescue - Chewings	Fine	Moderate	Moderate to Low	Moderate	Good to Excellent	Low	Excellent	Low	Low	Medium	Medium to High	Medium to High	Low to Medium	Low to Medium
Fescue - Hard	Fine	Slow to Moderate	Low to very Low	Moderate	Excellent	Low to Moderate	Excellent	Low	Low	Medium	Medium to High	Medium to High	Low to Medium	Low to Medium
Fescue - Creeping	Fine	Moderate	Low to Moderate	Moderate	Good	Low	Excellent	Low	Low	Medium	High	Medium to High	Low to Medium	Low to Medium
Fescue - Turf Type	Moderate to Coarse	Moderate	Moderate to High	Low to Moderate	Excellent	Low	Good to Excellent	Low to Medium	Medium to High	Medium to High	Medium	High	Low	High
Rye Grass - Perennial	Fine to Moderate	Very Fast	Moderate to High	Moderate to High	Good	Poor to Moderate	Poor to Moderate	Medium	Low to Medium	Low to Medium	Medium	Medium	Low	Medium to High
Warm Grasses	**Leaf Texture**	**Establish Rate**	**Nitrogen Use**	**Water Use**	**Drought Tolerance**	**Salinity Tolerance**	**Shade Tolerance**	**Fertility Needs**	**Wear Resistance**	**Mowing Height**	**Cold Tolerance**	**Acid Soil Tolerance**	**Thatching Tendency**	**Heat Tolerance**
Bahiagrass	Coarse to very Coarse	Slow to Moderate	Low	Low	Excellent	Excellent	Moderate to Good	Low	Medium to High	High	Low	Low	Medium to High	High
Bermudagrass	Fine to Moderate	Moderate to Fast	Moderate	Moderate to High	Excellent	Very Good	Poor	Medium	High	Low to Medium	Low to Medium	Medium	Medium	High
Blue Grama	Fine to Moderate	Slow to Moderate	Low	Low	Excellent	Moderate	Very Poor	Low	Low	High	High	Low	Low	High
Buffalograss	Moderate to Coarse	Slow to Moderate	Low	Low	Excellent	Moderate	Very Poor	Low	Low	High	High	Low	Low	High
St. Augustine Grass	Coarse	Moderate to Fast	Low	High	Low	Low	Excellent	Low	Medium to High	Low	Medium to High	Medium to High	High	Low
Centipedegrass	Moderate to Coarse	Slow	Low	Low	Good	Moderate	Moderate to Good	Low	Low	Medium to High	Medium to High	High	Medium	High
Seashore Paspalum	Moderate	Moderate	Moderate	Moderate	Excellent	Excellent	Good	Medium to High	Medium to High	Low	Medium	Low	Medium to High	High
Zoysia grass	Fine to Medium	Slow to Moderate	Moderate	Moderate	Excellent	Good	Moderate to Good	Low to Medium	Medium to High	Low to Medium	High	Low to Medium	Medium to High	High

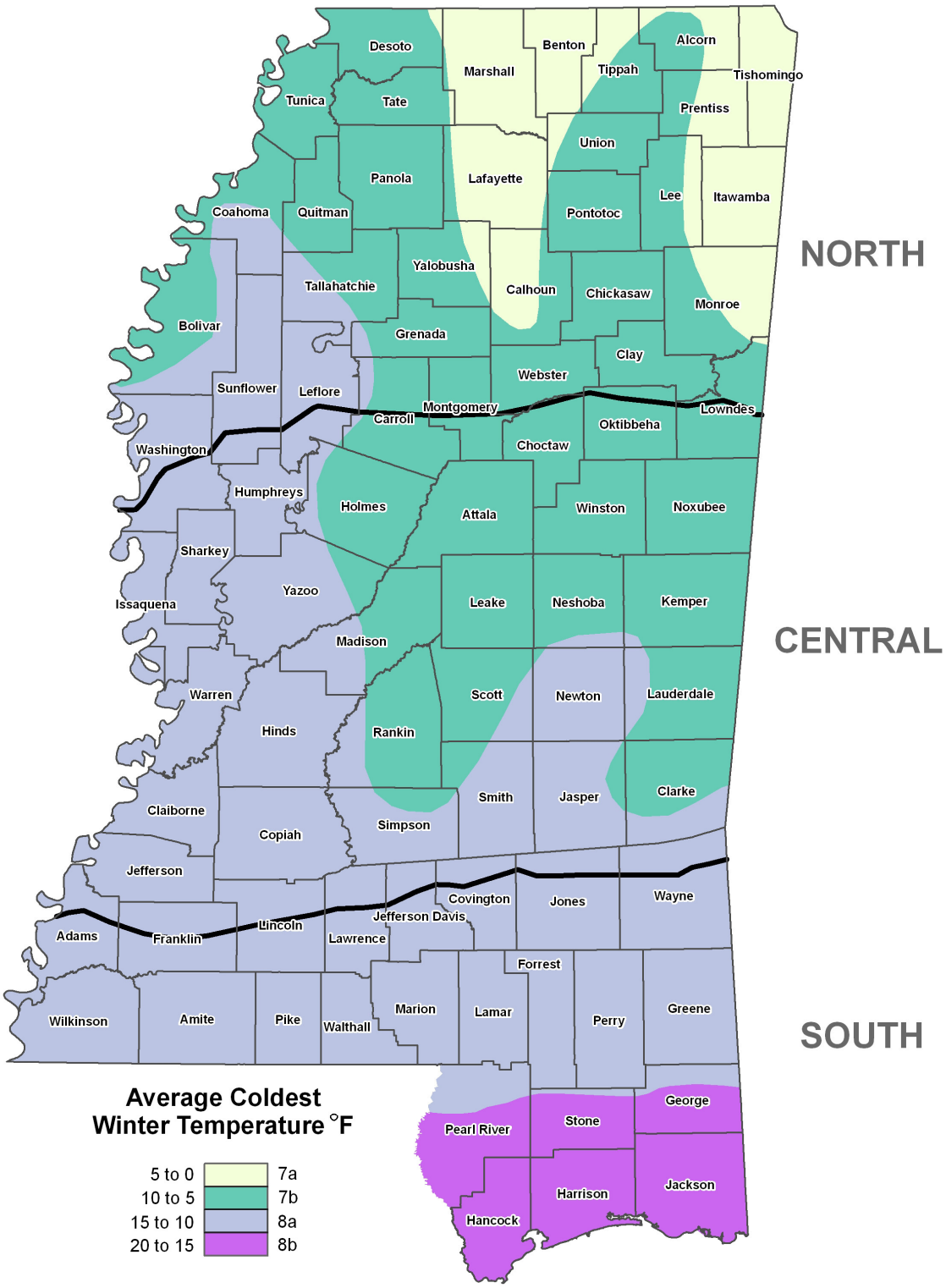


Figure SOD-1 Geographical Areas for Species Adaptation

Soil Amendments

Test soil to determine the requirements for lime and fertilizer. Soil tests may be conducted by Mississippi State University Extension Service Soil Testing Laboratory or other laboratories that make recommendations based on soil analysis. When soil test recommendations are unavailable, the following soil amendments may be sufficient:

- Agricultural limestone at a rate of 2 tons per acres (90lbs per 1000 sq. ft.). Other liming materials that may be selected should be provided in amounts that provide equal value to agricultural lime.

- Fertilizer at a rate of 1000 lbs per acre (25 lbs per 1000 sq. ft.) of 10-10-10.

- Equivalent nutrients may be applied with other fertilizer formulations. The soil amendments should be spread evenly over the treatment area and incorporated into the top 6″ of soil by disking, chiseling or other effective, means. If topsoil is applied, follow specifications given in the *Topsoiling Practice*. Minor surface smoothing may be necessary after incorporation of soil amendments.

Installing the Sod

A step-by-step procedure for installing sod is illustrated in Figure SOD-2 and described below.

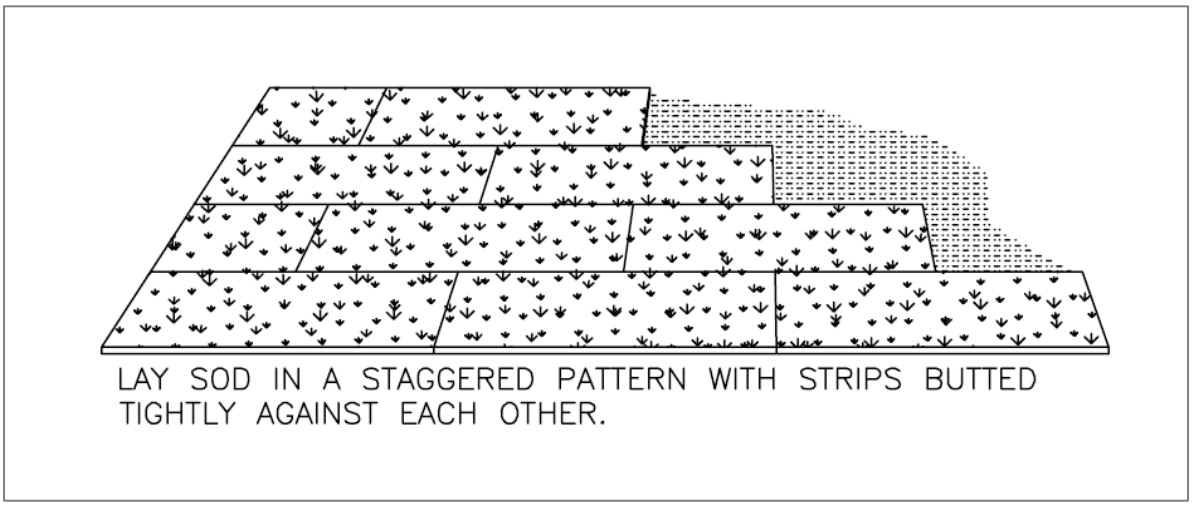


Figure SOD-2 Typical Installation of Grass Sod

Moistening the sod after it is unrolled helps maintain its viability. Store it in the shade during installation.

Rake the soil surface to break the crust just before laying sod. During the summer, lightly irrigate the soil, immediately before laying the sod to cool the soil and reduce root burning and dieback.

Do not lay sod on gravel, frozen soils, or soils that have been recently sterilized or treated with herbicides.

Lay the first row of sod in a straight line with subsequent rows placed parallel to and butting tightly against each other. Stagger strips in a brick-like pattern. (see Figure SOD – 2). Be sure that the sod is not stretched or overlapped and that all joints are butted tightly to prevent voids. Use a knife or sharp spade to trim and fit irregularly shaped areas.

Install strips of sod with their longest dimension perpendicular to the slope/waterflow direction. On slopes 3:1 or greater, in grass swales or wherever erosion may be a problem, secure sod with pegs or staples. Jute or other netting material may be pegged over the sod for extra protection on critical areas (see Figure SOD – 3).

As sodding of clearly defined areas is completed, use a weighted roller on the sod to provide firm contact between roots and soil.

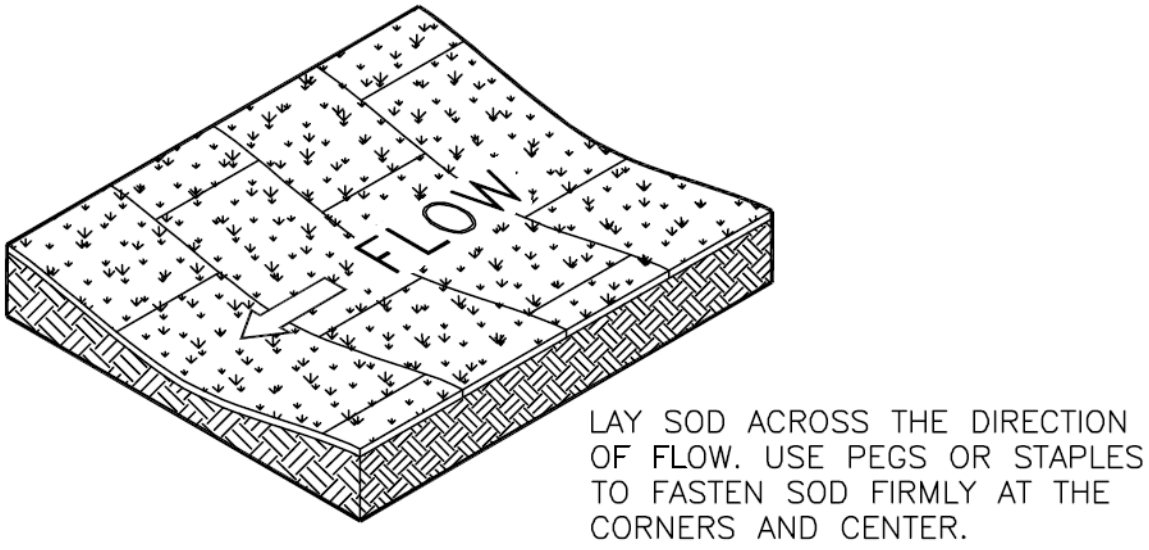


Figure SOD-3 Installation of Sod in Areas with Channel Flows

Irrigation

Immediately after laying the sod, roll or tamp it to provide firm contact between roots and soil, then irrigate sod deeply so that the underside of the sod pad and the soil 6″ below the sod is thoroughly wet.

Keep sodden areas moist to a depth of 4″ until the grass takes root. This can be determined by gently tugging on the sod. Resistance indicates that rooting has occurred.

Mowing should not be attempted until the sod is firmly rooted, usually in 2 to 3 weeks.

Construction Verification

Check materials and installation for compliance with specifications.

Common Problems

Consult with a qualified design professional if any of the following occur:

Variations in topography on site indicate the sodding materials will not function as intended; changes in plan may be needed.

Design specifications for sod variety cannot be met or irrigation is not possible; substitution or seeding may be required. Unapproved substitutions could result in erosion or sodding failure.

Sod laid on poorly prepared soil or unsuitable surface and grass dies because it is unable to develop a root system with the soil: remove dead sod, prepare surface properly and resod.

Sod not adequately irrigated after installation; may cause root dieback or grass does not root rapidly and is subject to drying out: irrigate sod and underlying soil to a depth of 4″ and keep moist until roots are established.

Sod not anchored properly may be loosened by runoff: use guidance under Site Preparation to repair the damaged areas, lay healthy sod, anchor properly and irrigate as planned.

Slow growth due to lack of nitrogen: apply additional fertilizer.

Maintenance

- See Table SOD-2 for maintenance guidelines for sod.
- Keep sod moist until it is fully rooted.
- Mow to a height of 2″ to 3″ after sod is well-rooted, in 2 to 3 weeks. Do not remove more than ⅓ of the leaf blade in any mowing.
- Permanent, fine turf areas require yearly fertilization. Fertilize warm-season grass in late spring to early summer; cool-season grass in early fall and late winter.

References

BMPs from Volume 1

Land Grading (LG)	4-16

Surface Roughening (SR)

Practice Description

Roughening a sloping bare soil surface with horizontal depressions helps control erosion by aiding the establishment of vegetative cover with seed, reducing runoff velocity, and increasing infiltration. The depressions also trap sediment on the face of the slope. This practice is especially appropriate for soils that are frequently disturbed and on piles of excavated soils.

Roughening methods include stair-step grading, grooving and tracking. Equipment such as bulldozers with rippers or tractors with disks may be used. The final face of the slopes should not be bladed or scraped to give a smooth hard finish.

Planning Considerations

Surface roughening should be considered for all slopes. The amount of roughening required depends on the steepness of the slope and the type of soil. Stable sloping rocky faces may not require roughening or stabilization, while erodible slopes steeper than 3:1 require special surface roughening.

Design Criteria and Installation

Surface roughening is to be done only after cuts and fill are to final grade and shape.

Cut Slope Roughening (Areas not to be mowed)

Use stair-step grades or groove cut slopes with a gradient steeper than 3:1. Use stair-step grading on any erodible material soft enough to be ripped with a bulldozer. Do not make

individual vertical cuts more than 2 feet in soft materials or more than 3 feet in rocky materials.

Grooving

Grooving uses machinery to create a series of ridges and depressions that run across the slope (on the contour). Groove using any appropriate implement that can be safely operated on the slope, such as disks, tillers, spring harrows, or the teeth on a front-end loader bucket. Do not make such grooves less than 3 inches deep nor more than 15 inches apart.

Fill Slope Roughening (Areas not to be mowed)

Place fill slopes with a gradient steeper than 3:1 in lifts not to exceed 9 inches, and make sure each lift is properly compacted. Insure that the face of the slope consists of loose, uncompacted fill 4 to 6 inches deep. Use grooving, as described above, to roughen the face of the slopes, if necessary. Do not blade or scrape the final slopes face.

Cuts, Fills, and Graded Areas That Will Be Mowed

Make mowed slopes no steeper than 3:1. Roughen these areas to shallow grooves by normal tilling, dishing, harrowing, or use of cultipacker-seeder. Make the final pass of any such tillage implement on the contour. Make grooves formed by such implements close together (less than 10 inches) and not less than 1 inch deep. Excessive roughness is undesirable where moving is planned.

Roughening with Tracked Machinery

Limit roughening with tracked machinery to sandy soils to avoid undue compacting of the soil surface. Tracking is generally not as effective as other roughening methods described. Operate tracked machinery up and down the slopes to leave horizontal depressions in the soil. Do not back-blade during the final grading operation.

Seeding

Immediately seed and mulch roughened areas to obtain optimum seed germination and growth.

Common Problems

Tracking in the wrong direction, perpendicular to the slope, can accelerate rill erosion.

Figure 3 Rill Erosion

Maintenance

Inspect roughened areas after storms to see if re-roughening is needed. Regular inspection should indicate where additional erosion and

sediment-control measures are needed. If rills appear, fill, regrade, and reseed them immediately. Use proper *Dust Control* methods.

References

BMPs from Volume 1

Temporary Seeding (TS)

TS

Practice Description

Temporary seeding is the establishment of fast-growing annual vegetation from seed on disturbed areas. Temporary vegetation provides economical erosion control for up to a year and reduces the amount of sediment moving off the site.

This practice applies where short-lived vegetation can be established before final grading or in a season not suitable for planting the desired permanent species. It helps prevent costly maintenance operations on other practices such as sediment basins and sediment barriers. In addition, it reduces problems of mud and dust production from bare soil surfaces during construction. Temporary or permanent seeding is necessary to protect earthen structures such as dikes, diversions, grass-lined channels and the banks and dams of sediment basins.

Planning Considerations

Temporary vegetative cover can provide significant short-term erosion and sediment reduction before establishing perennial vegetation.

Temporary vegetation will reduce the amount of maintenance associated with sediment basins.

Temporary vegetation is used to provide cover for no more than 1 year. Permanent vegetation should be established at the proper planting time for permanent vegetative cover.

Certain plants species used for temporary vegetation will produce large quantities of residue which can provide mulch for establishment of the permanent vegetation.

Proper seedbed preparation and selection of appropriate species are important with this practice. Failure to follow establishment guidelines and recommendations carefully may result in an inadequate or short-lived stand of vegetation that will not control erosion.

The selection of plants for temporary vegetation must be site specific. Factors that should be considered are types of soils, climate, establishment rates, and management requirements of the vegetation. Other factors that may be important are wear, mowing tolerance, and salt tolerance of vegetation.

Seeding properly carried out within the optimum dates has a higher probability of success. It is also possible to have satisfactory establishment when seeding outside these dates. However, as plantings are deviated from the optimum dates, the probability of failure increases rapidly. Seeding dates should be taken into account in scheduling land-disturbing activities.

Site quality impacts both short-term and long-term plant success. Sites that have compacted soils should be modified whenever practical to improve the potential for plant growth.

The operation of equipment is restricted on slopes steeper than 3:1, severely limiting the quality of the seedbed that can be prepared. Provisions for establishment of vegetation on steep slopes can be made during final grading. In construction of fill slopes, for example, the last 4-6″ might not be compacted. A loose, rough seedbed with irregularities that hold seeds and fertilizer is essential for hydroseeding. Cut slopes should be roughened (see practice *Land Grading*).

Good mulching practices are critical to protect against erosion on steep slopes. When using straw, anchor with netting or asphalt. On slopes steeper than 2:1, jute, excelsior, or synthetic matting may be required to protect the slope.

The use of irrigation (temporary or permanent) will greatly improve the success of vegetation establishment.

Design Criteria and Installation

Prior to start of installation, plant materials, seeding rates and planting dates should be specified by a qualified design professional. Plans and specifications should be referred to by field personnel throughout the installation process.

Scheduling

Plantings should be made during the specified planting period if possible. When sites become available to plant outside of the recommended planting period, either temporary seeding, mulching or chemical stabilization will be more appropriate than leaving the surface bare for an extended period. If lime and fertilizer application rates are not specified, take soil samples during the final grading operation from the top 6″ in each area to be seeded. Submit samples to a soil testing laboratory for lime and fertilizer recommendations.

Plant Selection

Select plants that can be expected to meet planting objectives. To simplify plant selection, use Table TS-1, *Commonly Used Plants for Temporary Cover* and Figure TS-1, *Geographical Areas for Species Adaptation and Seeding Dates*. Seeding mixtures commonly specified by the Mississippi Department of Transportation are an appropriate alternative for plantings on rights-of-ways. Additional information related to plantings in Mississippi is found in Chapter 2 in the section *Non-woody Vegetation for Erosion and Sediment Control*.

Table TS-I Commonly Used Plants for Temporary Cover

Species	Seeding Rates/Ac	Planting Time	Desired pH Range	Fertilization Rate/Acre	Method of Establishment	Zone of Adaptability
Wheat	90 lbs. alone	9/1 – 11/30	6.0 – 7.0	600 lbs. 13-13-13	Seed	All
Ryegrass	30 lbs.	9/1 – 11/30	6.0 – 7.0	600 lbs. 13-13-13	Seed	All
White Clover	5 lbs	9/1 – 11/30	6.0 – 7.0	400 lbs. 13-13-13	Seed	All
Crimson Clover	25 lbs. alone 15 lbs. mix	9/1 – 11/30	6.0 – 7.0	400 lbs. 13-13-13	Seed	All
Hairy Vetch	30 lbs.	9/1 – 11/30	6.0 – 7.0	400 lbs. 13-13-13	Seed	All
Browntop Millet	40 lbs. alone 15 lbs. mix	4/1 – 8/30	6.0 – 7.0	600 lbs. 13-13-13	Seed	All

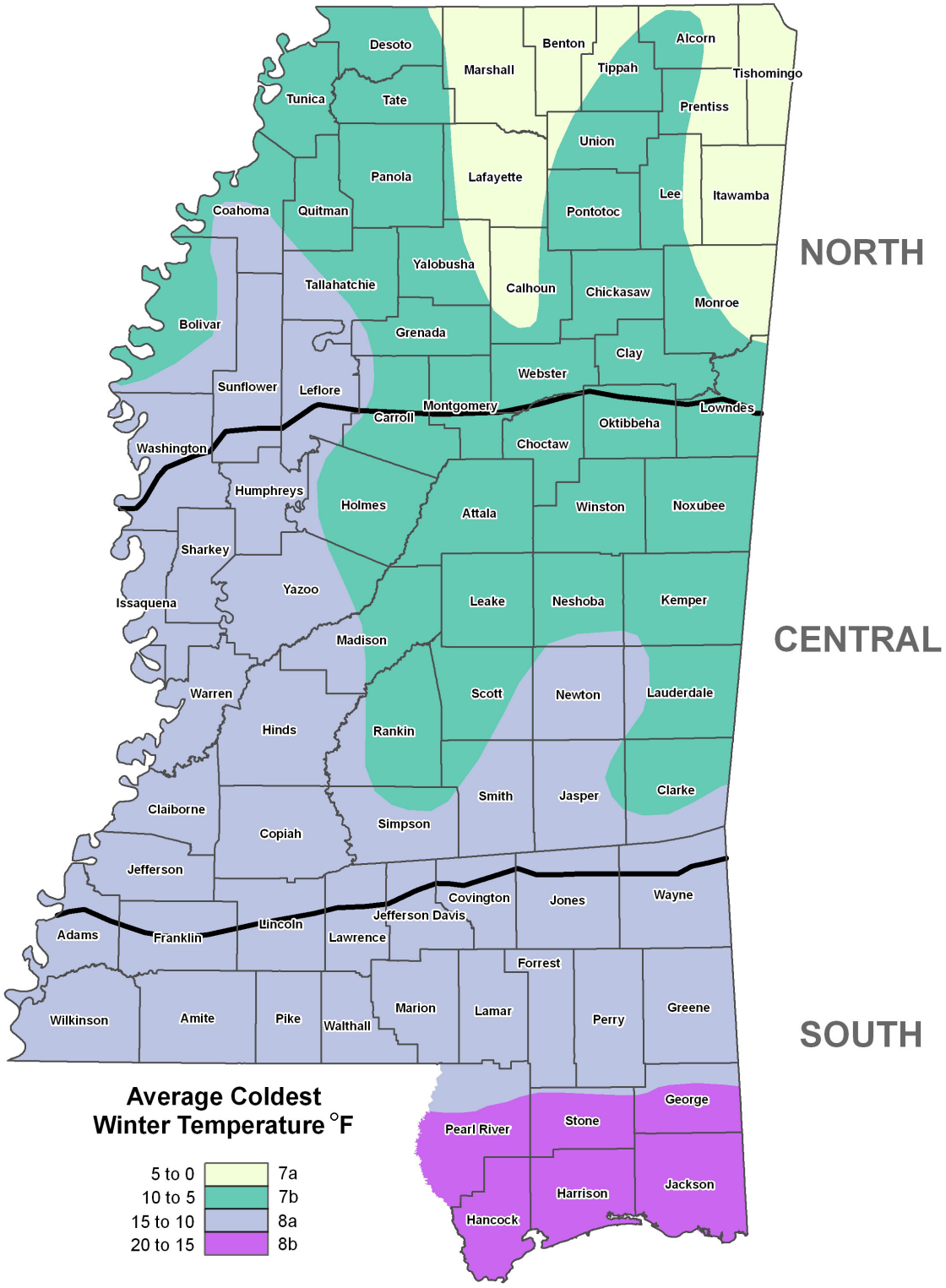


Figure TS- 1 Geographical Areas for Species Adaptation

Site Preparation and Soil Amendments

Complete grading and shaping before applying soil amendments, if needed, to provide a surface on which equipment can safely and efficiently be used to apply soil amendments and accomplish seedbed preparation and seeding. Incorporate lime and fertilizer into the top 6″ of soil during seedbed preparation.

Lime

Apply lime according to soil-test recommendations. If a soil test is not available, use 1 ton of agricultural limestone or equivalent per acre on coarse-textured soils and 2 tons per acre on fine textured soils. Do not apply lime to alkaline soils or to areas that have been limed during the preceding 2 years. Other liming materials that may be selected should be provided in amounts that provide equal value to the criteria listed for agricultural lime or be used in combination with agricultural limestone or Selma chalk to provide equivalent values to agricultural limestone.

Fertilizer

Apply fertilizer according to soil-test results. If a soil test is not available, apply 8-24-24 fertilizer.

When vegetation has emerged in a stand and is growing, 30 to 40 lbs/acre (approximately 0.8 lbs/1000 ft^2) of additional nitrogen fertilizer should be applied.

Note: Fertilizer can be blended to meet exact fertilizer recommendations. Take soil-test recommendations to local fertilizer dealer for bulk-fertilizer blends. This may be more economical than bagged fertilizer.

Seedbed Preparation

Good seedbed preparation is essential to successful plant establishment. A good seedbed is well pulverized, loose, and smooth. If soils become compacted during grading, loosen them to a depth of 6″ to 8″ using a ripper or chisel plow.

If rainfall has caused the surface to become sealed or crusted, loosen it just prior to seeding by disking, raking, harrowing, or other suitable methods. When hydroseeding methods are used, the surface should be left with a more irregular surface of clods.

Planting Methods

Seeding

Evenly apply seed using a cyclone seeder (broadcast), drill seeder, cultipacker seeder, or hydroseeder. Broadcast seeding and hydroseeding are appropriate for steep slopes where equipment cannot operate safely. Small grains should be planted no more than 1″ deep, and grasses and legumes no more than ½″ deep. Seed that are broadcast must be covered by raking or chain dragging, and then lightly firmed with a roller or cultipacker.

Hydroseeding

Surface roughening is particularly important when hydroseeding, as a roughened slope will provide some natural coverage for lime, fertilizer, and seed. The surface should not be compacted or left smooth. Fine seedbed preparation is not necessary

for hydroseeding operations; large clods, stones, and irregularities provide cavities in which seeds can lodge.

Mix seed, use an inoculant if required, and mix a seed carrier with water and apply as slurry uniformly over the area to be treated. The seed carrier should be a cellulose fiber, natural-wood fiber or other approved fiber-mulch material which is dyed an appropriate color to facilitate uniform application of seed. Use the correct legume inoculant at 4 times the recommended rate when adding inoculant to a hydroseeder slurry. The mixture should be applied within one hour after mixing to reduce damage to seed.

Fertilizer should not be mixed with the seed-inoculant mixture because fertilizer salts may damage seed and reduce germination and seedling vigor. Fertilizer may be applied with a hydroseeder as a separate operation after seedlings are established.

Mulching

The use of an appropriate mulch provides instant cover and helps ensure establishment of vegetative cover under normal conditions and is essential to seeding success under harsh site conditions (see the *Mulching Practice* for guidance). Harsh site conditions include the following: slopes steeper than 3:1 and adverse soils (soils that are shallow to rock, rocky, or high in clay or sand). Areas with concentrated flow should be treated differently and require a hydromulch formulated for channels or use of an appropriate erosion control blanket.

Verification of Installation

Check materials and installation for compliance with specifications during installation of products.

Common Problems

Consult with a qualified design professional if the following occurs:

Design specifications for seed variety, seeding dates or mulching cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

Seeding outside of the recommendations results in an inadequate stand. Reseed according to specifications of a qualified design professional (see recommendations under Maintenance).

Maintenance

Reseeding

Inspect seedings weekly until a stand is established and at least monthly thereafter for stand survival and vigor. Also, inspect the site for erosion.

Eroded areas should be addressed appropriately by filling and/or smoothing, and a reapplication of lime, fertilizer, seed and mulch.

A stand should be uniform and dense for best results. Stand conditions, particularly the vegetative coverage, will determine the extent of remedial actions, such as seedbed preparation and reseeding. A qualified design professional should be consulted to advise on remedial actions. Consider no-till planting.

Fertilizing

If vegetation fails to grow, have the soil tested to determine whether its pH is in the correct range or whether nutrient deficiency is a problem.

Satisfactory establishment may require refertilizing the stand, especially if the planting is made early in the planting season. Follow soil-test recommendations or the specifications provided to establish the planting.

Mowing

Temporary plantings may be mowed and baled or simply mowed to complement the use of the site.

Millet, rye, and wheat may be mowed, but no lower than 6″ (closer mowing may damage the stand).

Ryegrass is tolerant of most mowing regimes and may be mowed often and as close as 4″ to 6″ if this regime is started before it attains tall growth (over 8″).

Bermuda grass is tolerant of most mowing regimes and can be mowed often and close, if so desired, during its growing season.

References

Volume 1

Chapter 2

Vegetation for Erosion and Sediment Control 2-10

Chapter 4

Land Grading (LG) 4-16
Topsoiling (TSG) 4-20
Mulching (MU) 4-48
Permanent Seeding (PS) 4-53

Appendices Volume

Appendix G

MDOT Vegetation Schedule G-1

Tree Planting On Disturbed Areas (TP)

Practice Description

Tree planting on disturbed areas is planting trees on construction sites or other disturbed areas to stabilize the soil. The practice reduces erosion and minimizes the maintenance requirements after a site is stabilized. The practice is applicable to those areas where tree cover is desired and is compatible with the planned use of the area, particularly on steep slopes and adjacent to streams. Tree planting is usually used with other cover practices such as permanent seeding or sodding.

Planning Considerations

Control grass and legume cover when seeded in combination with planted trees to reduce competition for moisture, nutrients and sunlight.

Select trees that are adapted to soil and climate.

Avoid planting species that are invasive or may become a nuisance.

Avoid trees that have undesirable characteristics.

Select trees that will improve aesthetics and provide food and cover for wildlife.

Design Criteria and Installation

Tree-planting requirements should be designed by a qualified design professional and plans and specifications should be made available to field personnel prior to start of planting.

Planting Bare-rooted Tree Seedlings

Site Preparation

Compacted soil should be ripped or chiseled on the contour to permit adequate root development and proper tree growth. Debris should be removed from the site to facilitate tree planting.

Planting Methods

Tree seedlings may be planted by hand or machine. Any tool or piece of equipment that gives satisfactory results may be used. Dibble bars, mattocks, augers, post-hole diggers and shovels may be used to plant trees by hand. Wildland tree-planting machines should be used on rough areas or areas with clayey or compacted soils. Old-field tree planters should be limited to areas with light soils that are not compacted. On sloping land, planting should be done on the contour. Bare-rooted tree-seedling planting techniques are outlined in Figure TP-1. Additional planting techniques for bare-root plants are available on MDOT drawing PD-1 found at the end of this practice.

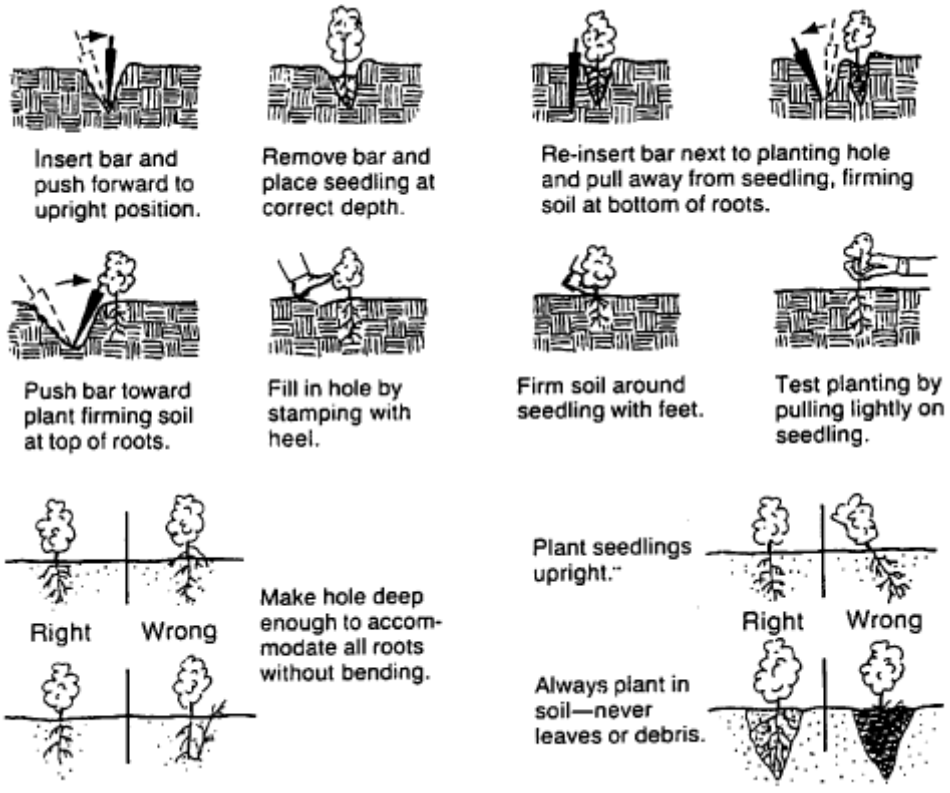


Figure TP- 1 Planting Bare-Root Seedlings

When to Plant

Bare-root seedlings should be planted from December 1 to March 15. Planting should be done when the soil is neither too dry nor too wet. Planting should be avoided during freezing weather and when the ground is frozen.

Planting Rate

To control erosion, pines should be planted at a rate of 600 to 700 trees per acre and hardwoods should be planted at a rate of 300 to 500 trees per acre. Severely eroding areas should be planted at the rate of 600 to 900 trees per acre for both pine and hardwood species.

Depth of Planting

Trees should be planted deeper than they grew in the nursery. Plant small stock 1″ deeper and medium to large stock ½″ deeper. On most soils, longleaf pine seedlings should be planted ¼″ deeper than they grew in the nursery.

Condition of Roots

Roots should be planted straight down and not twisted, balled, nor U-shaped. Soil should be packed firmly around the planted seedlings. No air pockets should be left in either machine furrows or holes made by planting tools.

Care of Seedlings

The roots of seedlings must be kept moist and cool at all times. After lifting, seedlings should not be exposed to sun, wind, heat, dry air or freezing cold before they are planted. Baled seedlings may be kept up to 3 weeks if they are properly stacked, watered, and kept in a cool place. When planting is delayed, the roots of seedlings should be covered with moist soil (heeled-in) or the seedlings should be placed in cold storage.

During planting, the roots of seedlings must be kept moist and only one seedling should be planted at a time. At the end of each day, loose seedlings should be either repacked in wet moss or heeled-in.

Mulching

Mulching may be necessary on sloping land to reduce erosion. Mulch with wood chips, bark, pine needles, peanut hulls, etc. to a depth of no more than 3″. Mulch should not be placed against the trunk of the tree.

Planting Balled and Burlapped and Container-Grown Trees

The best time to plant hardwood trees is in late winter (before leaves emerge) and the best time to plant evergreens is in early fall. However, these plants may be planted anytime of the year except when the ground is frozen. Watering is essential during dry periods.

Site Preparation

The planting hole should be dug deep and wide enough to allow proper placement of the root ball. The final level of the root ball's top should be level with the ground surface (See Figure TP-2).

As the hole is dug, the topsoil should be kept separate from the subsoil. If possible, the subsoil should be replaced with topsoil. If topsoil is unavailable, the subsoil can be improved by mixing in ⅓ volume of peat moss or well-rotted manure.

Heavy or poorly drained soils are not good growth media for trees. When it is necessary to transplant trees into such soils, extra care should be taken.

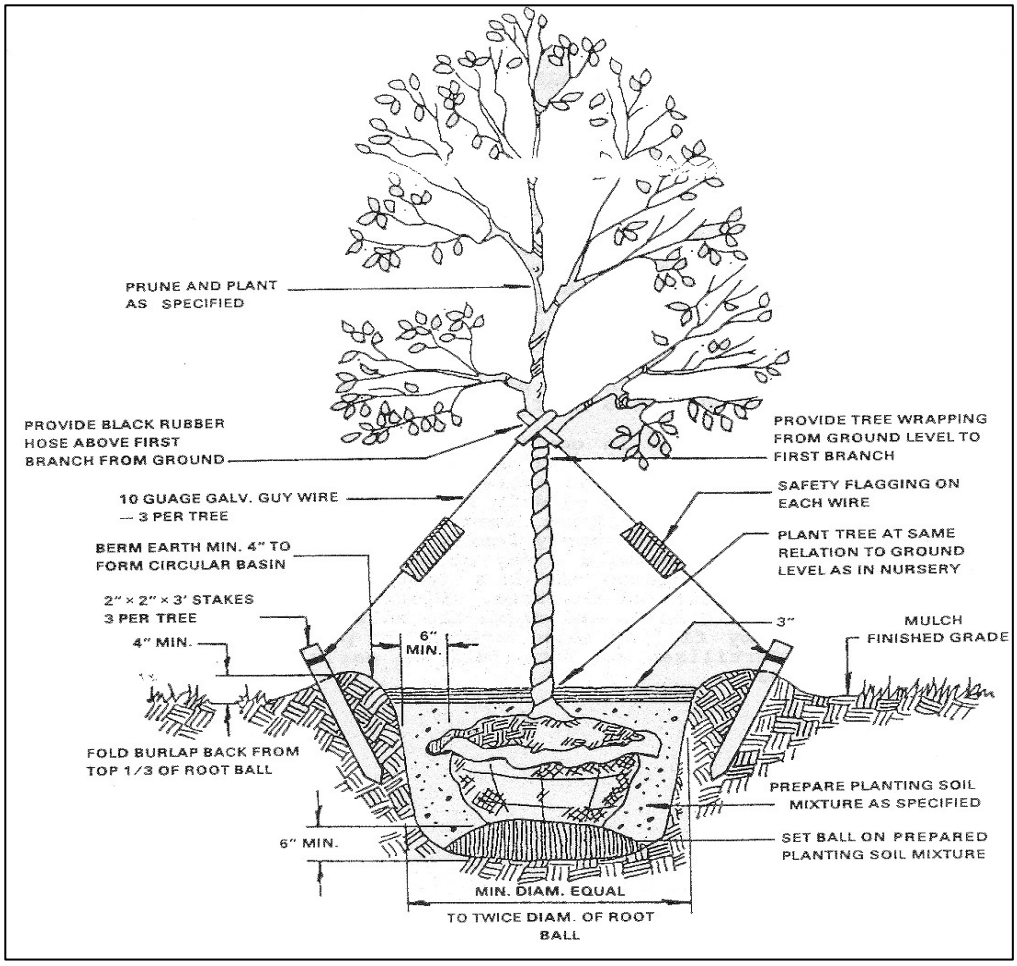


Figure TP- 2 Tree Planting Diagram

Tree Preparation

The proper digging of a tree includes the conservation of as much of the root system as possible, particularly the fine roots. Soil adhering to the roots should be damp when the tree is dug, the tree roots should be kept moist until planting. The soil ball should be 12″ in diameter for each inch of diameter of the trunk. The tree should be carefully excavated and the soil ball wrapped in burlap and tied with rope. Use of a mechanical tree spade is also acceptable.

Any trees that are to be transported for a long distance should have the branches bound with a soft rope to prevent damage.

Planting the Tree

Depth of planting must be close to the original depth. The tree may be set just a few inches higher than in its former location, especially if soil is poorly drained. Do not set the tree lower than before. Soil to be placed around the root ball should be moist but not wet.

Set the tree in the hole and if the tree is balled and burlapped, remove the rope which holds the burlap. Loosen the burlap and remove completely if practical. Do not break the soil of the root ball. Fill the hole with soil halfway and add water to settle the soil and eliminate air pockets. When the water has drained off, fill the hole the remainder of the way. Use extra soil to form a shallow basin around the tree. This will help retain water.

Newly planted trees may need artificial support to prevent excessive swaying. Stakes and guy wires may be used (see Figure TP-2). Guying should be loose enough to allow some movement of the tree. Planting and guying techniques for balled and burlapped and container plants are available on MDOT drawing PD-1 found at the end of this practice.

Mulching

Mulching may be necessary on sloping land to reduce erosion and should be used around balled and burlapped trees and container grown trees to help conserve soil moisture and reduce competition from weeds and grass. Apply mulch using wood chips, bark, pine needles, peanut hulls etc. to a depth of no more than 3″. Mulch should not be placed against the trunk of the tree.

Verification of Installation

Check all components of the practice during installation to ensure that specifications are being met.

Common Problems

Consult with a qualified design professional if any of the following occur:

Soil compaction can prevent adequate tree growth. Compaction should be addressed during site preparation.

Design specifications for trees (species, planting dates) and mulch cannot be met; substitutions may be required. Unapproved substitutions could lead to failure.

Problems that require remedial actions:

Erosion, washout and poor tree establishment – repair eroded surface, replant, reapply mulch and anchor.

Mulch is lost to wind or stormwater runoff – reapply mulch and anchor.

Maintenance

Replant dead trees where needed to maintain adequate cover for erosion control.

Periodic fertilization may be beneficial on poor sites to maintain satisfactory tree growth. Transplanted trees should be fertilized 1 year or so after planting. A soil test is the best way to determine what elements are needed. Fertilizer formulations of 10-8-6 or 10-6-4 can be used in the absence of a soil test. About 2 lbs. of fertilizer should be used for each inch of tree diameter measured at 4.5 feet above the ground.

Fertilizer must come in contact with the roots to benefit a tree. The easiest way to apply fertilizer is to simply broadcast it under the tree and over the root system. As a tree grows, the roots will grow well beyond the drip line. This should be taken into account when applying fertilizer by the broadcast method. Another way to apply fertilizer is to make holes in the tree's root area with a bar or auger. Holes should be 18″ deep, spaced about 2 feet apart, and located around the drip line of the tree. Distribute the fertilizer evenly into these holes and close the holes with the heel of the shoe or by filling with topsoil or peat moss. Trees should be fertilized in late winter or early spring before leaves emerge.

References

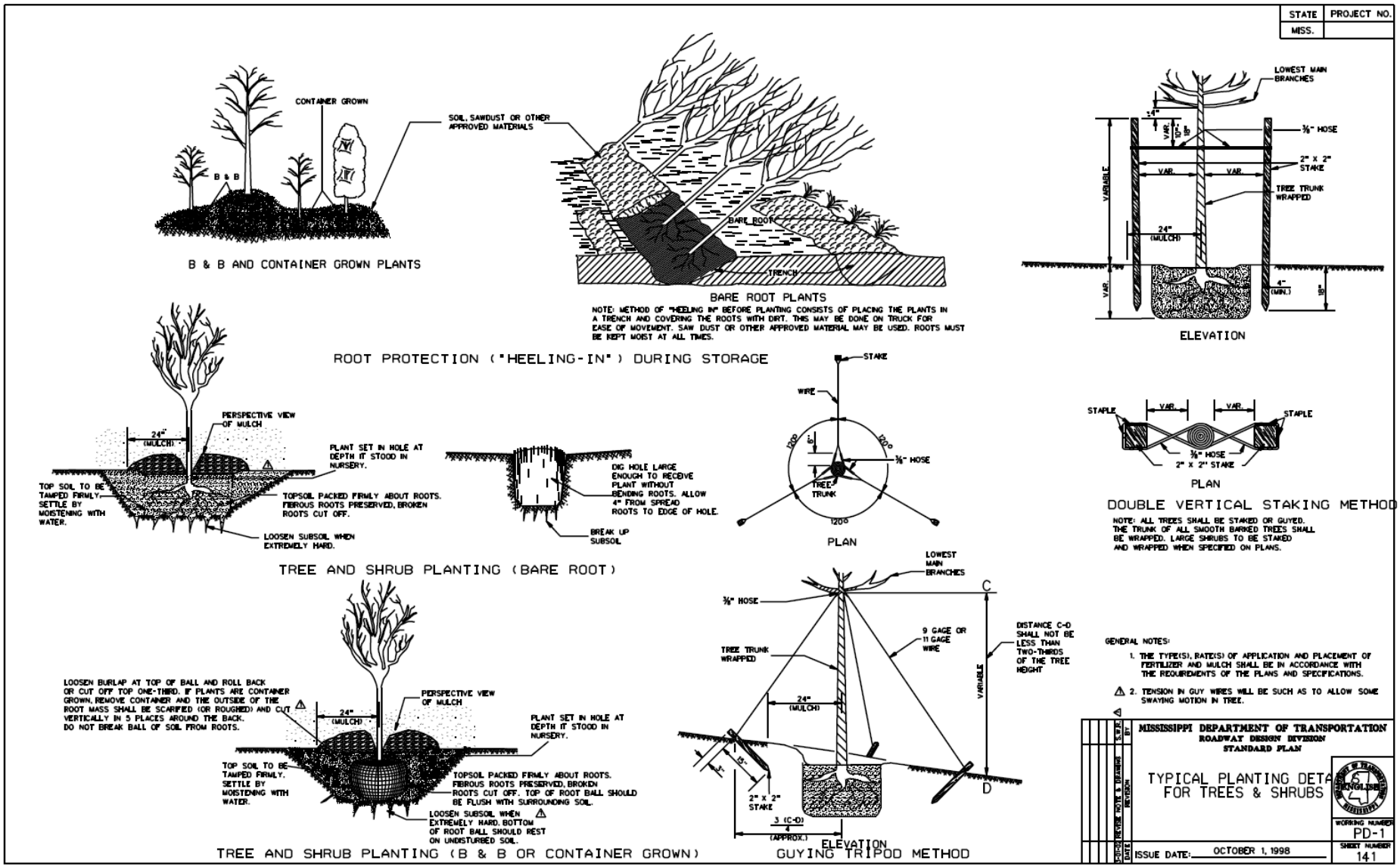
BMPs from Volume 1

Chapter 4

Mulching (MU) 4-48

MDOT Drawing PD-1

Typical Planting Details for Trees and Shrubs 4-116


STATE
MISS.
PROJECT NO.
CONTAINER GROWN
B & B
SOIL, SAWDUST OR OTHER APPROVED MATERIALS
B & B AND CONTAINER GROWN PLANTS
BARE ROOT
TRENCH
BARE ROOT PLANTS
NOTE: METHOD OF "HEELING IN" BEFORE PLANTING CONSISTS OF PLACING THE PLANTS IN A TRENCH AND COVERING THE ROOTS WITH DIRT. THIS MAY BE DONE ON TRUCK FOR EASE OF MOVEMENT. SAW DUST OR OTHER APPROVED MATERIAL MAY BE USED. ROOTS MUST BE KEPT MOIST AT ALL TIMES.
ROOT PROTECTION ("HEELING-IN") DURING STORAGE
LOWEST MAIN BRANCHES
VARIABLE
VAR.
⅜" HOSE
2" X 2" STAKE
TREE TRUNK WRAPPED
24" (MULCH)
4" (MIN.)
ELEVATION
PERSPECTIVE VIEW OF MULCH
24" (MULCH)
PLANT SET IN HOLE AT DEPTH IT STOOD IN NURSERY.
TOP SOIL TO BE TAMPED FIRMLY. SETTLE BY MOISTENING WITH WATER.
TOPSOIL PACKED FIRMLY ABOUT ROOTS. FIBROUS ROOTS PRESERVED, BROKEN ROOTS CUT OFF.
LOOSEN SUBSOIL WHEN EXTREMELY HARD.
DIG HOLE LARGE ENOUGH TO RECEIVE PLANT WITHOUT BENDING ROOTS. ALLOW 4" FROM SPREAD ROOTS TO EDGE OF HOLE.
BREAK UP SUBSOIL
TREE AND SHRUB PLANTING (BARE ROOT)
STAKE
WIRE
⅜" HOSE
TREE TRUNK
120°
PLAN
STAPLE
VAR.
STAPLE
⅜" HOSE
2" X 2" STAKE
PLAN
DOUBLE VERTICAL STAKING METHOD
NOTE: ALL TREES SHALL BE STAKED OR GUYED. THE TRUNK OF ALL SMOOTH BARKED TREES SHALL BE WRAPPED. LARGE SHRUBS TO BE STAKED AND WRAPPED WHEN SPECIFIED ON PLANS.
LOOSEN BURLAP AT TOP OF BALL AND ROLL BACK OR CUT OFF TOP ONE-THIRD. IF PLANTS ARE CONTAINER GROWN, REMOVE CONTAINER AND THE OUTSIDE OF THE ROOT MASS SHALL BE SCARIFIED (OR ROUGHED) AND CUT VERTICALLY IN 5 PLACES AROUND THE BACK. DO NOT BREAK BALL OF SOIL FROM ROOTS.
PERSPECTIVE VIEW OF MULCH
24" (MULCH)
PLANT SET IN HOLE AT DEPTH IT STOOD IN NURSERY.
TOP SOIL TO BE TAMPED FIRMLY. SETTLE BY MOISTENING WITH WATER.
TOPSOIL PACKED FIRMLY ABOUT ROOTS. FIBROUS ROOTS PRESERVED, BROKEN ROOTS CUT OFF. TOP OF ROOT BALL SHOULD BE FLUSH WITH SURROUNDING SOIL.
LOOSEN SUBSOIL WHEN EXTREMELY HARD. BOTTOM OF ROOT BALL SHOULD REST ON UNDISTURBED SOIL.
TREE AND SHRUB PLANTING (B & B OR CONTAINER GROWN)
LOWEST MAIN BRANCHES
C
⅜" HOSE
9 GAGE OR 11 GAGE WIRE
DISTANCE C-D SHALL NOT BE LESS THAN TWO-THIRDS OF THE TREE HEIGHT
TREE TRUNK WRAPPED
VARIABLE
24" (MULCH)
D
2" x 2" STAKE
3 (C-D) 4 (APPROX.)
ELEVATION
GUYING TRIPOD METHOD
GENERAL NOTES:
1. THE TYPE(S), RATE(S) OF APPLICATION AND PLACEMENT OF FERTILIZER AND MULCH SHALL BE IN ACCORDANCE WITH THE REQUIREMENTS OF THE PLANS AND SPECIFICATIONS.
2. TENSION IN GUY WIRES WILL BE SUCH AS TO ALLOW SOME SWAYING MOTION IN TREE.
MISSISSIPPI DEPARTMENT OF TRANSPORTATION
ROADWAY DESIGN DIVISION
STANDARD PLAN
TYPICAL PLANTING DETAILS FOR TREES & SHRUBS
ENGLISH
WORKING NUMBER
PD-1
ISSUE DATE: OCTOBER 1, 1998
SHEET NUMBER
141