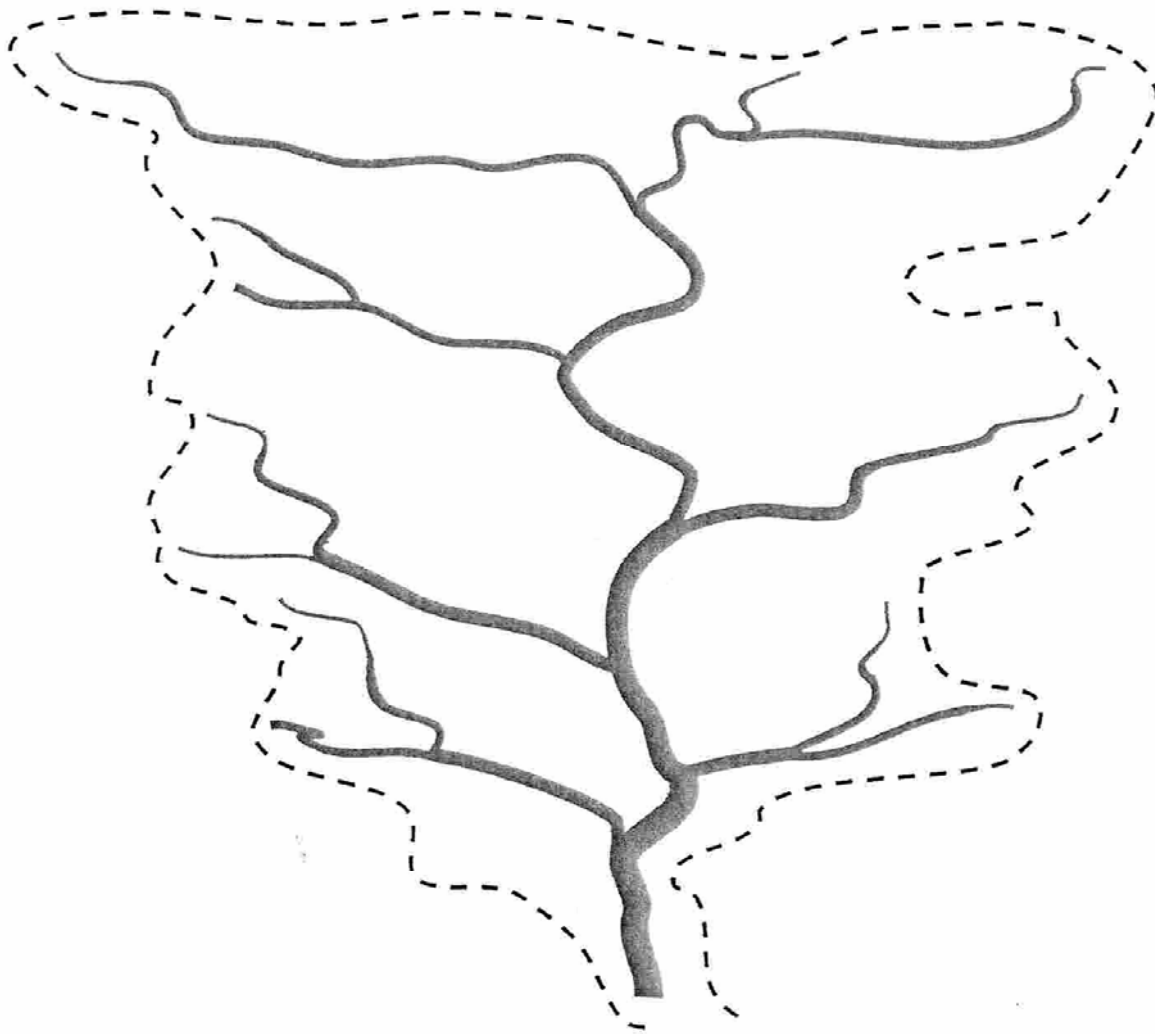


Guidebook of Best Management Practices for Michigan Watersheds



Michigan Department of Environmental Quality,
Surface Water Quality Division

Russell J. Harding, Director
John Engler, Governor



Reserved

Selected Reference Sections

The Manistee Conservation District has provided the applicant with the following selected reference material which was obtained from the Michigan Department of Environmental Quality web site. Some of this information maybe dated and our intention is for you to use this information as a guide while determining your building plans in a Critical Dune Area of Michigan. The following information will assist you in making informed decisions about your property's development while at the same time protecting a valuable Michigan natural resource.

1. Critical Areas Stabilization
2. Land Clearing
3. Tree Protection
4. Dune/ Stabilization
5. Tree, Shrubs, and Ground Covers

Reserved

Critical Area Stabilization

Description

Critical area stabilization is stabilizing areas which are highly susceptible to erosion by implementing one or more vegetative or structural BMPs. For the purposes of this BMP, critical areas include areas with highly erodible soils, long or steep slopes, droughty soils, excessively wet soils, soils that are very acidic or alkaline, slopes immediately adjacent to waterbodies or wetlands, fill areas and areas subject to concentrated flows.

Other Terms Used to Describe

High-Risk Erosion Areas
Critical Area Seeding

Pollutants Controlled and Impacts

Protecting critical areas is one of the most effective means of preventing sediment from entering surface waters. Properly established vegetation used to protect critical areas will also help absorb nutrients and reduce flows from steep slopes.

Application

Land Use

Applicable to all land uses.

Soil/Topography/Climate

This practice is particularly important on soils that are excessively wet, droughty, or which are subject to erosion even during a light to moderate rainfall.

When to Apply

Critical erosion areas should be identified during the planning stages of the project or proposed earth change activity. All possible measures should be taken not to disturb these areas. If it is necessary to disturb these areas, attention should be given to protecting them immediately.

Where to Apply

Apply on any area which is difficult to stabilize.

Relationship With Other BMPs

See the "Specifications" section, below.

Specifications

Planning Considerations:

For vegetative practices:

1. All critical areas should be protected from pedestrian access using Construction Barriers.
2. If possible, divert concentrated flows away from critical areas, at least until the vegetation is established. Follow specifications in the Diversions BMP.
3. Select and apply seed and legumes according to specifications in the Seeding BMP. Be sure to select plant species which are tolerant to the site condition.
4. Mulching should be done on seeded areas according to specifications in the Mulching BMP.
5. Sodding should be done according to the Sodding BMP to stabilize areas quickly. Rows of sod can be alternated with rows of seeded areas to stabilize the area more quickly.
6. Dune/sand areas should be stabilized following specifications in the Dune/Sand Stabilization BMP.
7. Trees, shrubs and ground covers should be selected and planted based on the Trees, Shrubs and Ground Covers BMP. Note that Soil Conservation Service soil surveys include species of trees, shrubs and ground covers that work well in each soil texture.

For structural practices:

1. Consider using Grade Stabilization Structures to take concentrated flows from one elevation to the other.
2. Consider using Riprap on slopes adjacent to watercourses and wetlands, and Slope/Shoreline Stabilization on steep slopes and slopes adjacent to cut and fill slopes. The Slope/Shoreline Stabilization BMP includes information on seawalls/retaining walls, revetments, and gabions.
3. Consider using terraces or benches to slow runoff velocities.
4. Consider using Buffer/Filter Strips to control erosion resulting from sheet flow.
5. Subsurface Drains may be needed where water movement may cause seeps or soil slippage. Grassed Waterways may need to be tiled to ensure the vegetation is established.

Site Preparation:

For vegetative practices:

1. Soil tests should be done to determine the nutrient and pH content of the soil. Depending on the results of soil tests, Soil Management may be necessary to adjust the soil pH to between 6.5 and 7.0 (for most conditions). All soil deficiencies should be addressed following the Soil Management specifications.
2. Follow the site preparation sections in the BMPs being used for vegetative establishment.

For structural practices:

Follow the procedures in the selected BMP.

Design and Implementation:

The proper design and implementation of all BMPs used to stabilize critical areas should be done according to the specifications in the selected BMPs.

Maintenance**For vegetative practices:**

Periodic inspections should be scheduled to ensure the vegetation is maturing correctly and staying in place.

Once the vegetation is well established:

1. Consideration should be given to removing Construction Barriers. In some areas, it may be beneficial to leave the barriers in place.
2. Vegetation should continue to be watered, when appropriate, to a depth of 1 inch into the sod bed. Water uniformly. See the Lawn Maintenance BMP.
3. Vegetation should be mowed according to its intended use. Follow the mowing specifications in the Lawn Maintenance BMP.
4. Soil testing should be done periodically to determine if the soil requires additional fertilizer or lime. Follow specifications in the Soil Management BMP.
5. Pesticides should only be used following specifications in the Pesticide Management BMP.
6. Spot Seeding should be done as needed on small damaged areas.

For structural practices:

Follow maintenance procedures in the "Maintenance" section of each structural BMP.

Reserved

Land Clearing

Description

Land clearing is the removal of all woody and herbaceous plant material from a site to develop the site for other uses. Land clearing is divided up into two components, grubbing--which is removing roots and stumps by digging--and tree removal.

In regulated wetlands, clearing trees and shrubs with heavy equipment is not allowed without a permit from the State. Trees and shrubs can be cut by hand without a permit, but stump removal requires a permit.

Other Terms Used To Describe

Grubbing
Tree Removal

Pollutants Controlled and Impacts

Due to the nature of the activity, land clearing will expose soil to erosive forces. BMPs which help prevent erosion should be used in conjunction with proper land cleaning practices to keep soil onsite. One essential BMP is the Buffer/Filter Strip, which includes the minimum width of natural vegetation that should be left in place to protect water bodies. This is important because vegetation provides shade for rivers and other water bodies. When land clearing is done immediately adjacent to a water body, shade is reduced, resulting in increased stream temperatures. For some fish species such as trout, even slight changes in stream temperatures can be lethal.

In some instances, land clearing removes over-age, high canopy forest cover and opens up new land to reforestation or other land uses. Proper land clearing practices may increase the amount of sunlight and allow for a greater diversity of plant and animal associations.

Application

Land Use

Applicable to all land uses.

Soil/Topography/Climate

Cleared sites on heavy soils and steep slopes are more subject to erosion and may require additional BMPs to keep the soil in place. See the Critical Area Stabilization BMP for information on how to protect steep slopes.

When to Apply

Land clearing activities should not begin until the site has been assessed and the trees which have been selected for cutting have been tagged. Except on highway projects, large-scale sites should be cleared in phases to allow second phase work to proceed in the initially cleared area while clearing proceeds in other areas on-site. Land clearing during dry or frozen times will decrease compaction and potential water quality problems from runoff.

Where to Apply

This BMP applies to all construction sites.

Relationship With Other BMPs

BMPs that may be needed in conjunction with land clearing include:

- Access Roads
- Critical Area Stabilization
- Slope/Shoreline Stabilization
- Buffer/Filter Strip
- Filters (Filter Fencing)
- Staging and Scheduling

Specifications

Planning Considerations:

Forestry operations. The MDNR is currently developing BMPs for forestry operations. Upon their availability, any land clearing done as part of a forestry operation should be done following the guidance in the forestland BMP manual. As interim guidance: a plan should be developed which specifies the kinds and location of timber which will be salvaged, the location of haul roads and skid trails, the width of the natural buffer zone which remains around all water bodies, and the method (where applicable) proposed to cross any water bodies. The method of disposing of all material which will not be salvaged should also be specified. The plan should also include the BMPs which will be used to protect the cleared area from erosion.

When clearing land **for golf courses**, the golf course architect should take full advantage of opportunities to establish clearing edges so that natural tree specimens and vegetative edges create visually attractive golf holes. Selecting the final edge of the fairway should be dependent upon species size, age condition, design intent and visual impact. It is not uncommon to shift golf holes to preserve a single key tree.

Other non-forestry land clearing activities should be done so that valuable, healthy and aesthetically pleasing trees are kept in place. Leaving standing trees is also economically advantageous to the developer. Healthy trees should be identified and protected following specifications in the Tree Protection BMP. Where possible, preserve a natural Buffer/Filter Strip above and below the graded area and adjacent to all water bodies. Always try to avoid clearing to the water's edge.

1. Where it is necessary to develop to the water's edge, filter fencing should be used. See Filters BMP.
2. Stage the construction site so that only part of the site is being cleared at any given time. This will reduce the amount of time soil is exposed to erosive forces. Follow examples in the Staging and Scheduling BMP.
3. Diversions may be needed to intercept and divert runoff to Stabilized Outlets.

4. All debris should be kept out of surface water. If possible, leave some debris on the ground to decrease runoff and increase shade for seedlings. See the "Disposal Options" section, below.
5. Exposed soil should be temporarily seeded to prevent further erosion from the site. Follow specifications in the Spoil Piles and Seeding BMPs. Other BMPs may also be necessary to keep soil on the site.

Grubbing:

Grubbing is removing roots and stumps by digging. Grubbing is done to remove grasses, shrubs and small trees.

Grubbing should be carefully monitored near lakes and streams to protect the water's edge. Where possible, it is recommended that total clearing not take place to the water's edge. If it is necessary to clear to the edge, clear by hand cutting to preserve the bank.

Tree Removal:

1. The preferred method of tree removal is to cut the tree and remove the stump in a separate operation. This allows the tree to be used for commercial purposes such as lumber, firewood, or mulch. All stumps that need to be removed from a site should be removed at the same time to decrease the time soil is exposed.
2. The less preferred option is to remove the entire tree (including stump) in one operation.
3. The operation of heavy equipment too close to the tree may result in possible tree loss later because of soil disruption, compaction and trunk damage. It is recommended that, within reasonable limits, all heavy equipment operations be limited to outside the drip line of all trees to be preserved. (The drip line is the area from the trunk of the tree outward to a point at which there is no longer any overhanging vegetation).
4. In forested wetlands, shallow-rooted species are protected by each other from potential wind damage. Whenever trees are removed from a forested wetland, the possibility of blow downs or windthrow increases. Shallow rooted species are also protected by edge trees, which shield the prevailing wind side of the woodlot. It is helpful to leave as many edge trees as possible on the prevailing wind side of the cleared area.

Disposal Options:

Where possible, all stumps, roots, logs, brush, limbs, tops and other debris resulting from the clearing or thinning operation should be disposed of by reducing the material by processing through a chipping machine. The chips should be disposed of as mulch (see the Mulching BMP), as part of a landscaping plan (where applicable), outside the right-of-way, or in other approved areas. Organic material may also be composted. See the Organic Debris Disposal BMP for more information on organic debris disposal options.

Note that tree tops, stumps and field stone which are cleared and piled in suitable areas can improve habitat for wildlife such as rabbits, raccoons, snakes, salamanders, toads and frogs.

Maintenance

Land clearing itself requires no maintenance except maintenance of the equipment used in the land clearing operation. Tree Protection, which is an important part of land clearing, should be done throughout the clearing stages. It is also important to maintain all other temporary and permanent BMPS which are used in conjunction with the land clearing BMP to prevent soil erosion and sedimentation. This includes maintaining appropriate Buffer/Filter Strip widths.

Tree Protection

Description

Protecting trees during construction activities is done to preserve their health and ensure their vitality after construction.

Other Terms Used to Describe

Tree Preservation

Pollutants Controlled and Impacts

Trees should be considered for preservation because:

- They stabilize the soil and prevent erosion
- They reduce stormwater runoff by intercepting rainfall and promoting infiltration
- They moderate temperature changes, promote shade, and reduce the force of wind
- They provide buffers and screens against noise and visual disturbance, and provide some privacy
- They filter pollutants from the air and produce oxygen
- They provide a habitat for animals and birds
- They increase property values and improve site aesthetics

Application

Land Use

This practice is used most often on construction sites.

Soil/Topography/Climate

This practice is especially important in areas subject to windthrow, where trees removed in the upland area may cause a domino effect in the lower area. It is also important on highly erodible soils, where tree roots help stabilize soils and prevent erosion.

When to Apply

Apply during site evaluation before any construction is done on the site. During site evaluation, note where valuable trees are located and incorporate them into the overall construction design.

Where to Apply

Apply anywhere trees are in need of protection.

Relationship With Other BMPs

Tree protection should be done before any Land Clearing or Grading Practices are done. Construction Barriers are often used in conjunction with tree protection.

Specifications

Note that much of the information below was derived from the North Carolina Erosion and Sediment Control Planning and Design Manual.

Planning Considerations:

When selecting trees to be protected, consider:

1. Tree vigor. Preserve healthy trees. Sick trees or those damaged beyond repair can be left for wildlife, or removed. Trees lacking vigor include those with dead branches, small annual twig growth, stunted leaf size, sparse foliage, and pale foliage color. Trees with hollow or rotten trunks also should be removed.
2. Tree age. Older trees are usually more aesthetically pleasing, but often require more maintenance than younger trees.
3. Tree species. Protect trees which are most suitable for the site development.
4. Tree aesthetics. Protect trees which are aesthetically pleasing.
5. Wildlife benefits. Protect trees which are preferred by wildlife for food, cover or nesting. Evergreens are important for cover during the winter months. Hardwoods are more valued for food. A mix of evergreens and hardwoods is usually most beneficial.

Design Considerations:

When designing a construction site in wooded areas, consider:

1. Leaving critical areas (such as floodplains, steep slopes and wetlands) with as many desirable trees as possible in their natural condition.
2. Locating roadways, storage areas and parking areas away from valuable trees.
3. Selecting trees to be preserved before siting roads, buildings, or other structures.
4. Minimizing trenching in areas with trees. Multiple utilities should be placed in the same trench.
5. Equipment, structural materials, topsoil and fill dirt should never be stored in the drip line of the tree.
6. When the construction plan calls for lowering or raising the grade around trees, see the specifications for tree wells and tree walls in the Grading Practices BMP.

Implementation:

See Exhibit 1 for examples of several types of tree protection methods.

1. Never excavate, traverse, or fill closer than the drip line of trees to be saved.
2. Trees which will be preserved should be marked with a bright color paint or surveyor's ribbon applied in a band circling the tree at a height visible to equipment operators.

3. (Construction) Barriers for tree protection should never be placed within the drip line of the tree.
4. Don't cut roots in the drip line.
5. Never nail boards or wire to the trees, as this will make them more susceptible to disease, insect damage and decay. As a last resort, a tree trunk can be armored with burlap wrapping and 2-inch studs wired vertically no more than two inches apart to a height of five feet encircling the trunk.

After Construction:

Once construction is complete, you can remove all temporary tree protection devices. Inspect all trees to ensure they are in good health. Repair all damaged roots and branches:

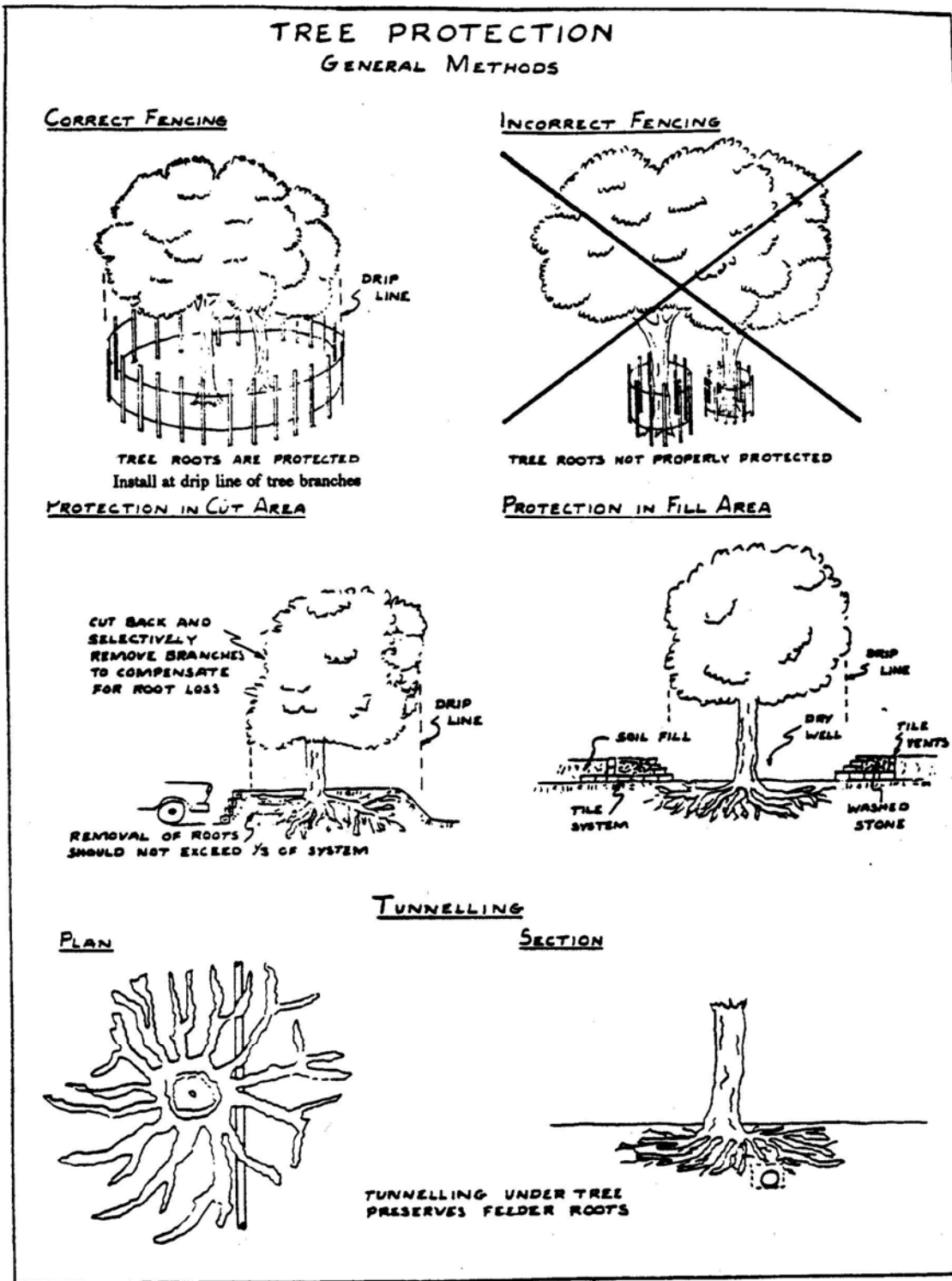
1. Repair roots by cutting off the damaged areas and painting them with tree paint. Spread peat moss or moist topsoil over exposed roots.
2. Repair damaged bark by trimming around the damaged area (as shown in Exhibit 2). Taper the cut to provide drainage. Paint with tree paint.
3. Cut off all damaged tree limbs above the tree collar at the trunk or main branch. Use three separate cuts to prevent bark from peeling off healthy areas of the tree. (See Exhibit 2).
4. Trees which are severely damaged should be removed and replaced with similar species, with trunk diameters at least 2 inches.
5. Soil over the root zone which has become compacted should be aerated by punching holes in it with suitable equipment.

Exhibits

Exhibit 1: Tree Protection, General Methods, Detail TP-1. Construction Project Evaluation Manual. MDNR, Land and Water Management Division.

Exhibit 2: Repairing Damaged Tree Limbs. North Carolina Erosion and Sediment Control Planning and Design Manual.

Exhibit 1



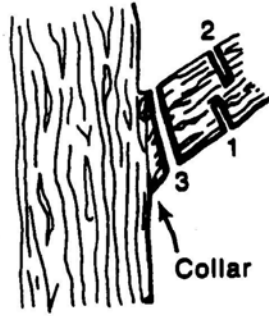
Source: Construction Project Evaluation Manual. Michigan Department of Natural Resources, Land and Water Management Division.

Exhibit 2

Repairing Damaged Tree Limbs



Incorrect

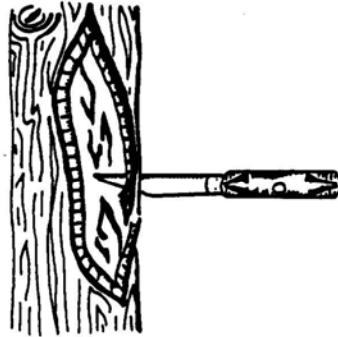


Correct

Trim bark wounds with a tapered cut, then apply tree paint.



Tree wound



Trim and taper

Prune damaged branches with three cuts to avoid peeling bark from the tree trunk when limb falls.

Source: North Carolina Erosion and Sediment Control Planning and Design Manual

Reserved

Dune/Sand Stabilization

Description

Dune/sand stabilization involves using structural controls and native vegetation to stabilize, build, or repair dunes. This BMP is used to stabilize sandy areas disturbed by construction activities, and to protect roads, buildings and valued areas from encroachment by blowing sand.

There are 275,000 acres of designated dune areas in Michigan, 70,000 acres of which are critical dunes. Critical dunes are unique, sensitive and easily erodible dunes which are protected under the amendments (P.A. 146 and 147) to the Sand Dune Protection and Management Act. Almost all activities conducted in critical dunes will require permits from the Michigan Department of Natural Resources, Land and Water Management Division. **Other Terms Used to Describe**

Live clumps of grasses are also referred to as sprigs. Planting these clumps of grasses can be referred to as sprigging, plugging, or wattling.

Pollutants Controlled and Impacts

Stabilization of dunes and other sandy areas can prevent shoreline and stream bank erosion. In areas subject to strong winds, this BMP will also keep soil from blowing off the ground and potentially being deposited in nearby wetlands, watercourses, roads, and sewers.

Application

Land Use

This BMP is most applicable to recreation areas, open areas, transportation, golf courses and construction sites.

Soil/Topography/Climate

Only certain plant species may be used to stabilize dunes. See the "Specifications" portion of this BMP.

When to Apply

When possible, this BMP should be applied before serious dune/sand erosion problems occur.

Where to Apply

Apply on coastal foredunes and any other areas where stabilization of sand is necessary.

Relationship With Other BMPs

Slope/Shoreline Stabilization and Trees, Shrubs and Ground Covers are used to stabilize dune/sand. Fences (see Construction Barriers BMP) are also useful in protecting dunes.

Specifications

Planning Considerations:

It is important to remember that dunes are unique and sensitive ecosystems. While stabilizing a dune, every effort should be made to protect the integrity of the natural dune ecology.

Below are several practices which can be used to stabilize dunes. Refer to the underlined BMP for additional information.

1. Vegetative establishment can be done by planting native grasses, trees, shrubs or ground covers.

American beach grass is the most commonly used dune grass in Michigan and has proved to be the best plant for initial stabilization of moving sand. It and any other **native species** should be purchased commercially from a reputable Michigan supplier. Dune grass should be planted after September 1 and before the ground becomes frozen. Spring plantings before May 1 are also possible. Planting procedures are discussed below.

Select appropriate trees, shrubs, and ground covers following the guidance provided in county soil surveys. If soil surveys are not available, follow the general guidance below:

In loamy sand, plant Red pine, White pine and Jack pine. In sand, use Jack pine.

Trees and shrubs that can be used on wet spots of shifting sands are: Cottonwood, Shrub willow, and Dogwoods.

Tree species adapted to sand dune plantings adjacent to large lakes are: Cottonwood, Birch, White pine, White oak, and bigtooth aspen.

Select individual trees, shrubs and ground covers following specifications in the Trees, Shrubs and Ground Covers BMP. Plants and protective material should be kept moist and protected from drying until the time of planting. Each plant should have at least one live rhizome and sufficient root stock to ensure continued growth following transplanting. Planting procedures are discussed below.

2. Stabilization using revetments, seawalls, groins and breakwalls should be done following specifications in the Slope/Shoreline Stabilization BMP.
3. Snow fencing or other similar fences may be used to help protect eroding areas, either alone or in conjunction with vegetative and other structural controls. Fences are also used to protect newly sprigged areas. Follow specifications in the Construction Barriers BMP.

Planting Dune Grasses:

1. Except for smoothing areas which have been impacted by construction activities, no other ground preparation is usually required. Liming and other soil amendments are also not usually needed prior to planting.
2. A narrow tile spade, planting bar, or tree planter may be used for planting trees in large areas. Sand must be moist enough that it will not run back into the hole before the plant is set.
3. Grass should be planted in a staggered or diamond pattern for maximum erosion control. Holes should be spaced 18" apart in areas where wind velocities and sand movement are high. This equates to about 40,000-60,000 culms per acre. (A culm is a single stem with roots attached). Space culms 24" apart in areas not directly exposed to strong wind (about 22,000-33,000 culms per acre).
4. The holes for plants should be between 8-10 inches deep. This depth is important to prevent the base of the stem from drying out, and to prevent the entire plant from blowing out. The plant should be placed in the resulting opening, with the crown slightly below the surrounding ground. (See Exhibit 1). Be sure dry surface sand doesn't enter the freshly opened hole.
5. Plant 2-3 culms per hole. On large areas which will be planted over several years, start plantings on the windward side.
6. Once the plant is placed in the hole, tamp the soil as shown in Exhibit 1. Sand should be firm and moist around roots, with no air pockets near the base of the plants.
7. Do not trim freshly planted plants.
8. Mulch between plants to protect plantings against rain and wind. Mulch should be applied and anchored following specifications in the Mulching BMP.

Planting Dune Trees and Shrubs:

1. Trees can be hand planted in beachgrass after it has controlled sand movement, but before the grass becomes too dense. This may be done about 2 years after planting beachgrass. Space trees 6'x 6' to 8'x 8'.
2. When planting trees in open blow areas without beachgrass, apply a brush mulch. Lay the brush with the butts to the wind and the tops over the butts. Space trees as above.
3. Blowing areas can also be controlled by planting two or more rows of trees each year, beginning on the windward side and progressing across the area as it is stabilized. Space trees at 4'x 6', staggered in rows.

For the installation of structural dune stabilization techniques, refer to the appropriate BMP.

Maintenance

If any of the cover is lost or destroyed, replant immediately. Replace dead plants with native species following the procedures above. Do not mulch or mow dune vegetation. Keep pedestrians and traffic off the area being stabilized.

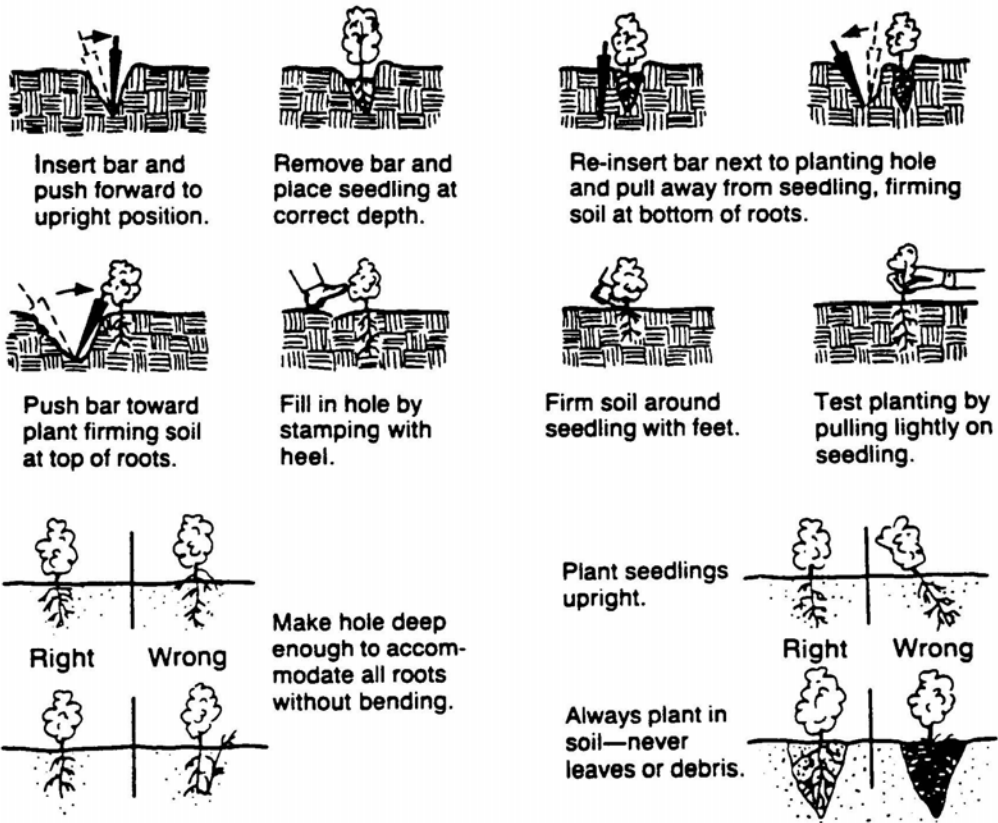
Exhibits

Exhibit 1: A Method for Planting Bare-Root Seedlings and Sprigs of Grasses. North Carolina Erosion and Sediment Control Planning and Design Manual.

Exhibit 1

A Method for Planting Bare-Root Seedlings and Sprigs of Grasses

A method of hand planting bare-root seedlings and sprigged grasses is shown below. With a planting bar/iron or shovel/spade, make a notch in the soil no less than 8 inches deep. Place the roots in the notch to the same depth as the plant was in its original growing container. Firm soil around the roots by pressing the notch closed. Water immediately, and mulch, where necessary, within 2 feet of the plant. Since fertilizers tend to dry out young seedlings, do not fertilize bare-root seedlings until the end of the first year.



Source: North Carolina Erosion and Sediment Control Planning and Design Manual, as modified from the Va. Div. of Forestry.

Reserved

Trees, Shrubs and Ground Covers

Description

This BMP addresses the selection and maintenance of woody plant materials, including trees, shrubs, and ground covers. Seed selection is discussed in the Seeding BMP, and sod selection in the Sodding BMP.

Trees, shrubs and ground covers can be used on steep or rocky slopes where mowing is not feasible. Once trees, shrubs and ground covers are well established they:

- help stabilize the soil, reducing both wind and water erosion
- reduce stormwater runoff by intercepting rainfall and promoting infiltration
- filter pollutants from the air and produce oxygen
- moderate temperature changes and provide shade
- provide some privacy
- improve aesthetic values and increase property values

In addition, ground covers can provide stabilization in areas which are heavily shaded.

Other Terms Used to Describe

Landscape Planting
Landscaping

Pollutants Controlled and Impacts

Tree, shrub and ground cover plantings: protect the soil from wind and water erosion, thereby reducing sedimentation in surface waters; utilize nutrients, thereby minimizing nutrient loading to surface water and nitrate leaching to groundwater; and filter soil that has eroded.

Application

Land Use

The BMP is applicable to all land uses.

Soil/Topography/Climate

Soils, topography and climate will all be considerations in selecting the appropriate trees, shrubs and ground covers for the site.

When to Apply

Plantings are usually done in the spring or fall, based on the following dates and depending on the type of vegetation.

Spring: April 15 - May 30
Fall: September 1 - October 30

Winter and summer plantings are generally not as successful.

Where to Apply

Apply at all sites where landscape planting will minimize soil erosion and/or enhance aesthetic values.

Relationships With Other BMPs

This BMP should also be used when trees, shrubs or ground covers are accidentally damaged during Land Clearing operations. Trees, shrubs and ground covers are often incorporated into sites which need Critical Area Stabilization.

Specifications

Planning Considerations:

Wherever possible, **preserve existing woody vegetation**. Existing vegetation is more aesthetically pleasing, costs less than purchasing new species, and provides immediate shade, canopy and habitat. The identification of trees which should be preserved is discussed in the Tree Protection BMP.

For New Plantings:

1. Selection of appropriate species should be based on the following:

Soil texture. Some species will grow best in certain soil textures. Information on soils for many counties is available from the local Soil Conservation District office. The Appendices include an update of the soils information that has been entered in the Department's land resources database.

Soil tests may be needed to determine if nutrients or fertilizers need to be added to the site. All additions to the soil should be based on the results of soil tests. Follow the specifications in the Soil Management BMP.

Exhibit 1 can be used as a starting point for selecting trees and shrubs based on soil conditions.

Exhibit 2 can be used as a starting point for selecting ground covers based on soil conditions.

Drainage classification. Drainage classification is reflective of the soil moisture condition of the soil. For example, species such as white birch will grow best if soil moisture is high. Other species such as Jack pines will "drown" and die in soils of high water content. Be sure to take the drainage classification of soils into consideration when selecting trees and shrubs.

Native species. The type of vegetation which exists in the area is a good indicator of plants which will likely have good survival rates. These indicator species provide information on soil texture, drainage class, and fertility. Native vegetation or plant materials with similar requirements can then be used.

Purpose (Use). The purpose for which the plant is being used should also be considered. If the plant is being added for shade, trees with fuller canopies should be selected. If the plant is being added to control soil erosion, then its rate of growth, type of root system, ground covering characteristics, and spacing between plants are important factors.

2. Because of the spacing required between many shrubs and trees, and because it takes time for most woody species to "take hold," soil erosion between plants may occur. To prevent erosion, mulch all sites which will be planted with woody species. See the Mulching BMP.
3. On steep slopes, stagger plantings and consider using erosion control mats or netting prior to placing to keep soil from eroding. Mats and netting should be slit to accommodate the shrubs. See the Filters BMP for information on the proper selection of nets and mats.
4. For areas in which trees or shrubs will be planted, any seeding that is done to help stabilize the area should consist of the least competitive plant species. Species such as tall fescue, which produces vigorous early growth, is highly competitive with tree seedlings and therefore should not be used. Species such as annual lespedezas, which starts growing relatively late in the spring, is much less competitive.
5. Any pruning that needs to be done should be completed before planting occurs and should be done by persons experienced in pruning.

For deciduous trees: Prune to balance the loss of roots so as to retain the natural form of the plant type. The height ratio of the crown to the trunk after pruning should be approximately one-third crown to two-thirds trunk. The primary leader should not normally be cut back. Branches to be removed should be cut off flush with the trunk or main branch.

For deciduous shrubs: Prune by removing all dead wood and broken branches, thinning out entire canes where they are too thick, cutting back or removing unsymmetrical branches and sufficient other growth to ensure healthy and symmetrical growth of new wood. Shrubs should be pruned so that they form a loose outline conforming to the general shape of the shrub type.

Evergreen trees and shrubs: Evergreens should be pruned only to remove broken or damaged limbs.

6. In windy areas or where plantings will be done in stages, always begin planting on the windward side and progress across the area as it is being stabilized. Stagger trees in rows.

Trees:

Selecting Individual Trees:

Large nursery trees usually come with the roots and attached soil wrapped in burlap. As a rule of thumb, the soil ball of containerized and burlapped trees should be 12 inches in diameter for each

inch of trunk diameter. Keep the soil around the roots moist until the tree is planted. Bind branches with soft rope to prevent damage during transport.

Smaller nursery trees are usually sold in plastic containers as balled and burlapped stock, or as bare-root stock (seedlings):

Container-grown plants should have grown in the container for at least one growing season. If plants have been in the container too long they will show "pot-bound" root ends.

Balled and burlapped plants should be planted prior to "bud break." If planted in the fall, balling operations should not begin until after the plants have begun to "harden off." All plants should be dug and transported so that the ball is moist, and protected from rain or sudden changes in the weather.

Bare-root plants should only be handled in early spring, late fall or late winter. These plants should meet the following criteria to prevent a high rate of mortality:

Seedlings should be fresh smelling. Sour odor indicates that the seedlings have been stored too long and have begun to rot. Trees stored at correct temperatures will be free of mold.

The roots must be moist and glistening white when stripped of bark. Using a knife or fingernail, strip the bark off the root, working from base to tip. If the roots appear yellow, brown or have brown spots, the stock is badly damaged and has little chance of survival. Check the roots of several seedlings.

Buds must be firm, with no evidence of new growth.

Seedlings should be packed and shipped in wet moss or other medium, and kept cool (less than 34 degrees F) and moist prior to and throughout the planting process. Moss-packed seedlings should be kept in their container and kept moist. Clay-packed seedlings should not be watered, but should be covered with burlap if they are not to be planted soon after they are purchased.

Store packages of seedlings in a shaded location out of the wind.

Seedlings should be planted as soon as possible after they are received. If planting is delayed longer than four days after seedlings are received, "heel" the seedlings in a shaded area and keep moist. To heel in seedlings, dig a trench in soil that is shaded or in a well-ventilated enclosure. Place seedlings in the trench and cover the roots with soil. Replant when planting conditions allow.

Site Preparation: Dig a hole at least deep enough and wide enough to hold the entire root ball. The final level of the root ball's top should be level with the ground surface. Keep topsoil separate from the subsoil. If the soils are clay, dig a deeper hole and backfill with some of the topsoil.

Planting: Although the planting seasons for deciduous plants is between March 1 and October 1 or until the prepared soil becomes frozen, spring and fall are the best times to plant. Planting of evergreens should occur between March 1 and June 1, before new growth occurs.

Trees in containers and burlap will need to be planted individually. See Exhibit 3 and follow the steps below:

Trees in containers should be removed carefully so that all roots and soil remain attached. It may be easiest to cut the container. On balled and burlapped trees, loosen the twine and burlap at the top and check to make sure no other wrapping is present before planting.

Depending on the type of subsoil, it may be beneficial to mix a little peat moss into the soil.

The dug hole should be such that the plant is planted at the same depth as the original container.

Add water to settle the soil and eliminate air pockets. Once the water is drained off, lower the tree into the hole, backfill half way, and pat firm. Water again. Once the water is drained again, remove the burlap from ball and burlapped trees from around the trunk and the upper half of the ball. Fill the hole so that it is filled even with the ground line.

Backfill the hole and pat the soil firm. Leave a small depression around the tree so that water can run into the depression.

Add mulch around the tree to reduce competition from unwanted vegetation and to help prevent roots from drying out.

Bare-root seedlings should not be pruned prior to planting, except for broken or damaged roots. Plants can be planted either by hand or by machine. On large sites where slopes do not prohibit machinery, bare-root seedlings can be planted in furrows using a tree-planting machine.

A method of hand planting bare-root seedlings is shown in Exhibit 4. Plants should be set at a depth equal to the depth in their original location. The exposed roots should be held firmly in the proper position, with the roots spread out. The prepared soil should be watered around the roots and thoroughly firmed at intervals during the process of backfilling. Sufficient water should be used to ensure the soil is thoroughly saturated.

Spacing and Rates of Planting:

The proper spacing and rates of planting various tree species are shown in Exhibit 5.

Tree seedlings should *not* be fertilized during the first 12 months following planting because fertilizer tends to dehydrate newly planted trees.

Mulch between plants to prevent soil from eroding. Follow specifications in the Mulching BMP.

Plants Located on Slopes:

For plants located on slopes, a berm of prepared soil should be constructed halfway around each plant on the down-slope side. The berm of prepared soil should have an inside diameter equal to that of the planting hole, and a maximum height of 6 inches. Soil should not spill down-slope more than 18 inches.

Wrapping trees:

Trees should be wrapped within one week following planting. Trunks should be carefully wrapped beginning at the base of the trunk just above the roots and below the normal ground line, and should extend upward in a spiral with an overlap of one-half the width of the strip. The portion of the wrapping below the finished grade should be covered with soil. The paper should be held securely in place with masking tape.

Staking trees:

Newly planted trees often need to be staked for support. Trees which need to be staked should be secured with stakes and guy wires. Cushion the tree against the wire by placing old garden hose or equivalent between the tree and wire. See Exhibit 3.

Shrubs:

Selecting Shrubs:

For erosion control purposes, and when more than one species can be used, make the final species selection using the following characteristics:

- fast growing
- easy to establish
- have large lateral spread or prostrate growth (i.e. will grow outwardly to provide more cover)
- disease and insect resistant
- ability of the roots to fix nitrogen
- adaptation to a broad range of soil conditions

Like small trees, nursery shrubs usually come in plastic containers or as bare-root stock.

Site Preparation and Planting:

Follow the tree planting procedures for "Trees in containers and burlap," above. See Exhibit 3. Space shrubs approximately three feet apart.

It is important to mulch the entire area to keep other plants from competing with the desired plant and to cover exposed soil. See the Mulching BMP for mulching specifications.

Ground Covers:

Selecting Ground Covers:

When ground covers are to be used to help stabilize soils, select fast-growing, evergreens that require little maintenance.

Site Preparation:

The dense growth of ground covers requires that they have good soil. Well-drained soils high in organic matter work best. Make soil additions based on the results of soil tests. See the Soil Management BMP.

On steep slopes, till the soil in contour rows, or dig individual holes for each plant. Blend soil additions into the soil.

Planting:

Most ground covers are planted from container-grown nursery stock. Transplanting to the seedbed can be done using a small trowel or spade. Dig a hole large enough to accommodate the roots and soil. Backfill and firm the soil around the plant. Water immediately.

Space between plants based on how quickly full cover is achieved, usually between 1 and 3 feet apart.

Like with trees and shrubs, ground covers will be better protected from competitive species if the area is mulched. See the Mulching BMP for mulching specifications.

Maintenance

For New Plantings:

1. Check survival the first and second year and replant where survival is poor.
2. Where needed, control competing vegetation the first 2 or 3 years, preferably by mulching or cultivating.
3. Exclude livestock from all plantings.

For All Trees, Shrubs and Ground Covers:

Trees:

Seedlings are subject to competition with invading grasses and other vegetation. For hardwoods, vegetation must be controlled for at least three growing seasons. For conifers, vegetation must be controlled for at least two growing seasons. Mulch to prevent competition, or mow or clip competitive vegetation, where possible. Use herbicides only where mulching has failed and mowing and clipping are not possible. Follow guidelines in the Pesticide Management BMP.

Where soil tests indicate fertilizers are needed, fertilize in late fall or early spring before leaves emerge. For evergreens, use only 1/2 the recommended amount of fertilizer. Use a punchbar, crowbar or auger. Make holes about 18 inches deep and about 2 feet apart around the drip line of each tree. Distribute fertilizer evenly among the holes to bring it in contact with trees roots. Store and mix fertilizers following specifications in the Fertilizer Management BMP.

Ideally, newly planted trees should receive an inch of water each week for the first two years after planting. When rain does not supply this need, and where possible, the tree should be watered deeply but not more often than once per week.

Trees should be protected and unhealthy limbs cut following procedures in the Tree Protection BMP. Train and prune black walnut and other hardwoods to produce straight, single stemmed trees.

Christmas tree shearing should begin after the third year. Refer to the Soil Conservation Service Technical Guide, #660, Woodland Pruning.

Shrubs:

Maintenance of shrubs, including watering and fertilizing, depends upon the species. Maintain mulch around the base of each plant to reduce weed competition and retain moisture. See the Mulching BMP. Fertilizers are usually needed only once every 3 years or so, depending on the results of soil tests. Pruning should be done as needed to remove dead limbs.

Ground Covers:

Most ground covers need yearly trimming to promote growth. Trim back from trees, flower beds, fences, and buildings. Add additional mulch as needed until the area is completely stabilized. Like shrubs, fertilizers may only be needed once every 3-4 years, depending on the results of soil tests.

Organic Debris Disposal:

Any organic debris which results from pruning, trimming or any other vegetative maintenance should be disposed of following specifications in the Organic Debris Disposal BMP.

Exhibits

Exhibit 1: Selecting Trees and Shrubs. USDA Soil Conservation Service Technical Guide, #342.

Exhibit 2: Selecting Ground Covers. USDA Soil Conservation Service Technical Guide, #342.

Exhibit 3: Planting Balled-and-Burlapped and Container-Grown Shrubs and Trees. North Carolina "Soil Erosion and Sediment Control Planning and Design Manual," as modified from the Virginia Division of Forestry.

Exhibit 4: A Method for Planting Bare-Root Seedlings and Sprigs of Grasses. Modified from the North Carolina "Erosion and Sediment Control Planning and Design Manual."

Exhibit 5: The Proper Spacing and Rates of Planting. USDA Soil Conservation Service Technical Guide, #612.

Exhibit 1 Selecting Trees and Shrubs

Soil Condition	Trees 1	Shrubs 2
1. Well and moderately well drained sand and loamy sand (coarse textured soils)	Austrian pine Jack pine* Red pine White pine* Black locust Cottonwood	Hawthorn Crabapple Tatarian honeysuckle Staghorn sumac Serviceberry
2. Well and moderately well drained, moderately coarse to moderately fine textured soils (sandy loam, loam, silt loam and clay loam)	Red pine White pine* Cottonwood Norway spruce* Jack pine* White spruce* Black locust Sugar maple*	Gray dogwood Crabapple
3. Well and moderately well drained clay and silty clay (fine textured soils)	White pine* Norway spruce* Black locust White spruce* Sugar maple* Red pine Cottonwood	Silky dogwood Tatarian honeysuckle Crabapple
4. Excessively wet (poorly drained) organic soils	Northern white cedar* White spruce* Red maple Silver maple Swamp white oak* Pin oak**	American cranberry bush Redosier dogwood Gray dogwood "Indigo" silty dogwood Nannyberry Viburnum
5. Excessively wet (poorly drained) mineral soils	Northern white cedar* Silver maple	Nannyberry Viburnum "Indigo" silky dogwood Redosier dogwood American cranberry bush
6. Excessively wet (poorly drained) pH>7.4	Northern white cedar* White spruce*	Nannyberry Viburnum

1 For other species, refer to section II-H of the SCS Technical Guide, or the appropriate county soil survey, as available from the USDA Soil Conservation Service.

2 Indicates species best suited for wildlife food or cover.

* Indicates species best suited for wildlife food or cover.

** Tamarack and willow may also be used, where available.

Source: USDA, Soil Conservation Service Technical Guide #342

**EXHIBIT 2
SELECTING GROUND COVERS**

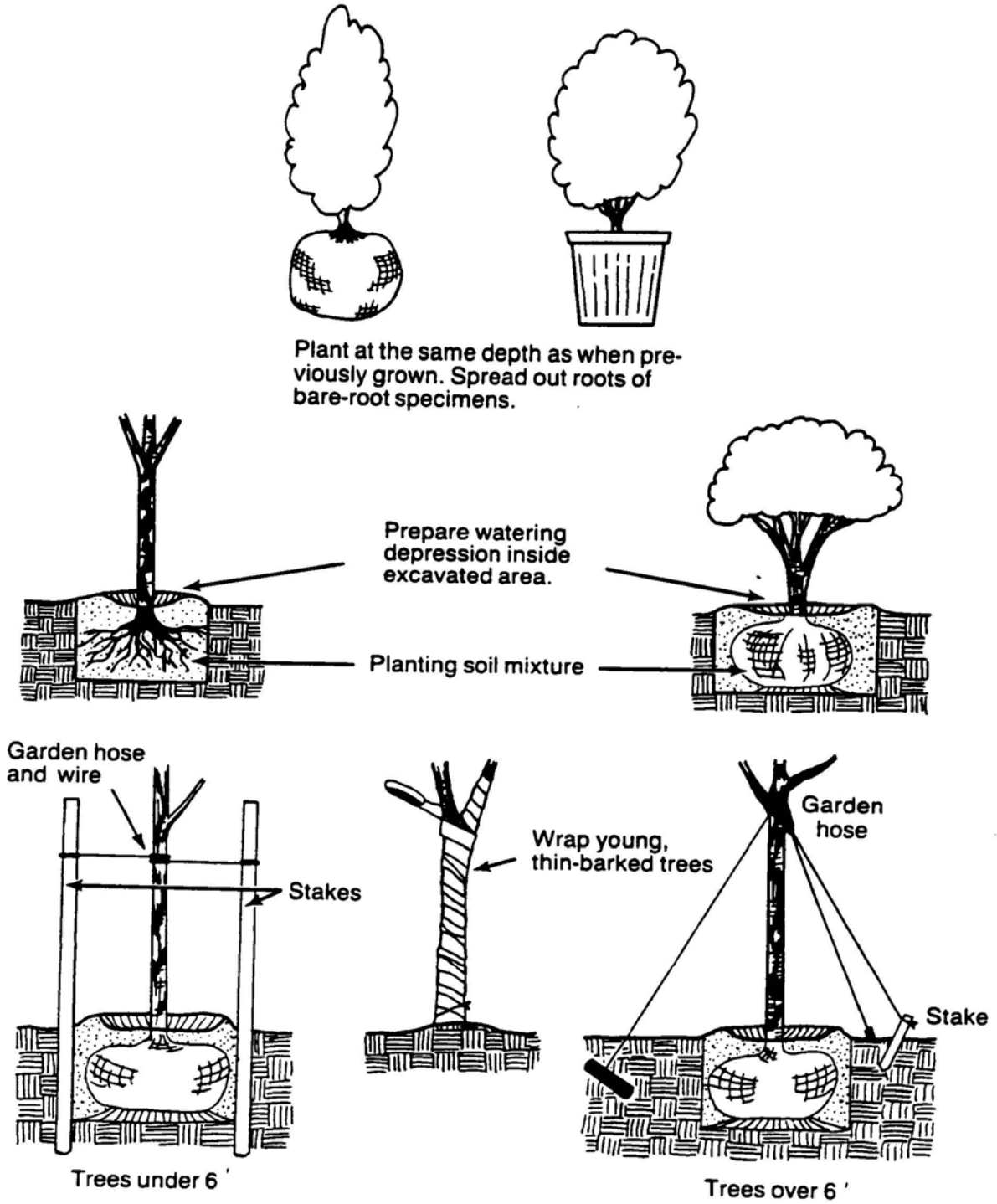
Plant	Height (inches)	Sun	Partial Shade	Shade	Soil	
Buglewood (carpet bugle) (<i>Ajuga reptans</i>)	4 to 8	X	X	X	most soils	One of the best perennials; spreads rapidly. Parent plant has deep deep green foliage, blue flowers. Gaiety and Metallica Crispa varieties have bronze-purple leaves. Silver Beauty's foliage is cream and light green. Alba is white-flowered.
English Ivy (<i>Hedera helix</i>)	6 to 8	X	X	X	rich, well-drained	Semievergreen to evergreen; covers large or small areas. Look for Improved varieties: Baltic, Thornapple, Wilson and others.
Japanese Spurge (<i>Pachysandra terminalis</i>)	up to 6		X	X	fertile, moist	Universally popular evergreen herb. Some plants have small, spiked white flowers sometimes followed by white berries in the fall. Improved forms Green Carpet, Silver Edge.
Juniper* (<i>Juniperus horizontalis</i>)	12 to 18	X	X		dry areas	Creeping, soft-textured plant; light green to steel blue needles frequently turn purple in winter. Waukegan variety is good. Japanese garden variety is very compact.
Juniper* (<i>J. sabina tamariscifolia</i>)	up to 24	X	X		dry areas	Sometimes called Tamarix Savin juniper. Needle-like silver-green eaves. A good spreader for slopes; use as foreground for deciduous trees or complete ground cover.
Lily-of-the-Valley (<i>Convallaria majalis</i>)	6 to 10		X	X	rich, moist	Fragrant white bell-like flowers; Rosea variety has purplish-pink flowers.
Periwinkle (myrtle) (<i>Vinca minor</i>)	up to 6		X	X	moist, well-drained	Almost universally used. Dislikes humid conditions. Good on slopes, level land or as a backdrop for bulbs. Bowles, a superior variety, has glossier leaves, larger blue flowers. Golden Bowles has gold and yellow foliage with white flowers.
Stoncrop, Goldmoss (<i>Sedum acre</i>)	up to 4	X	X		stony, sandy, dry	Mats of tiny foliage, good between stepping stones and in crevices. Spreads rapidly and can become a weed in grass. The sedum variety, Dragon's Blood, is known for its reddish-brown inch-high foliage and carmine flowers.
<i>Sedum album</i>	up to 4	X	X		sandy, well-drained	Forms mats of attractive dark-green to red foliage on creeping stems. Not as likely to invade grass areas as stoncrop.

* Indicates species best suited for wildlife cover.

Source: USDA, Soil Conservation Service Technical Guide #342.

Exhibit 3

Planting Balled-and Burlapped and Container-Grown Shrubs and Trees

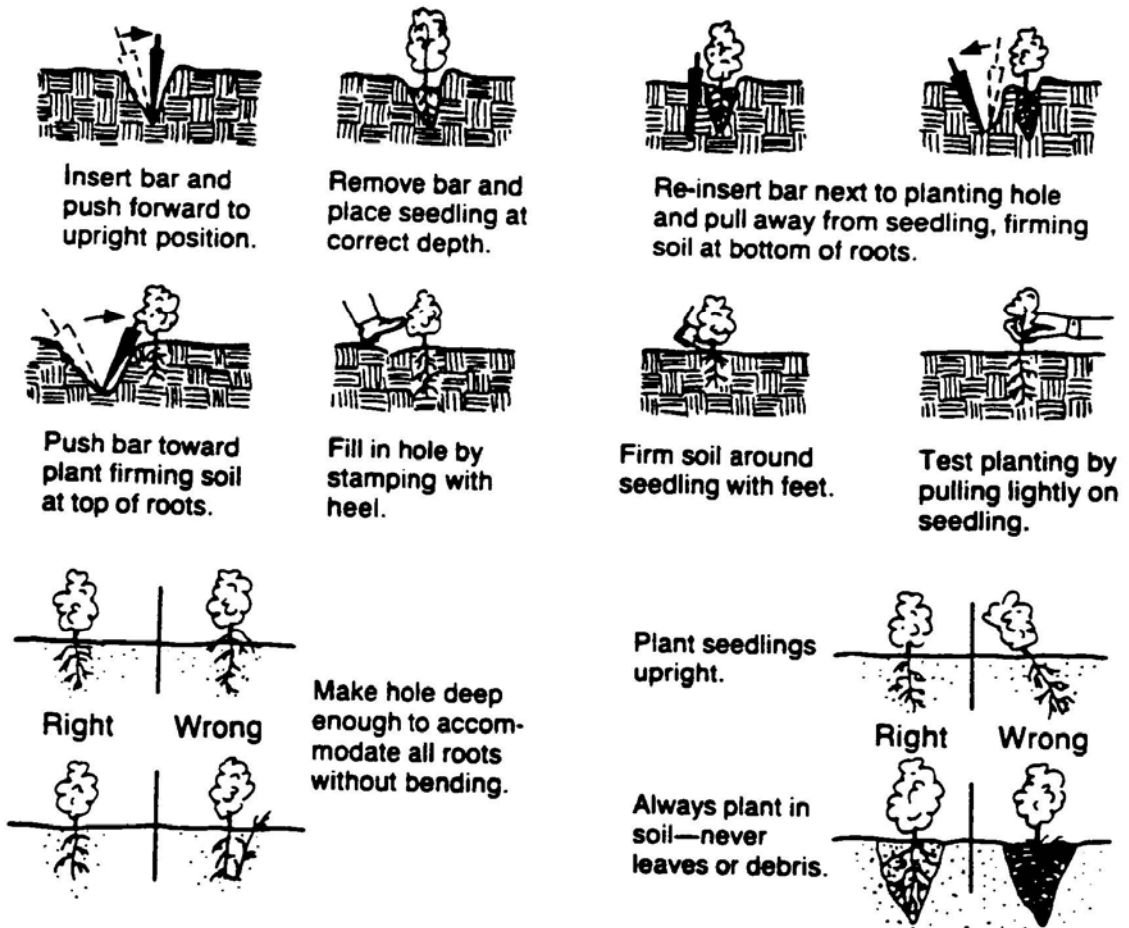


Source: North Carolina Erosion & Sediment Control Planning & Design Manual, as modified from the Virginia Division of Forestry.

Exhibit 4

A Method for Planting Bare-Root Seedlings and Sprigs of Grasses

A method of hand planting bare-root seedlings and sprigged grasses is shown below. With a planting bar/iron or shovel/spade, make a notch in the soil no less than 8 inches deep. Place the roots in the notch to the same depth as the plant was in its original growing container. Firm soil around the roots by pressing the notch closed. Water immediately, and mulch, where necessary, within 2 feet of the plant. Since fertilizers tend to dry out young seedlings, do not fertilize bare-root seedlings until the end of the first year.



Source: North Carolina Erosion and Sediment Control Planning and Design Manual, as modified from the Va. Div. of Forestry.

Exhibit 5

Spacing and Rates of Planting Several Tree Species

Species	Recommended Spacing (Open Planting)		Approx. No. Trees Needed	Acceptable Range
	Between Rows	In Rows	Per Acre	In Rate Per Acre
Jack Pine	8 feet	5 feet	1,050	900-1,200
Spruce & N. White-Cedar	8 feet	6 feet	900	800-1,000
Red Pine	8 feet	7 feet	800	700-950
White Pine	8 feet	7 feet	800	700-950 ¹
Hardwood Trees (including black walnut)	10 feet	10 feet	430	400-500 ²
Hardwood Shrubs	6 feet	5 feet	1,450	1200-1800

^{1/} Planting white pine is recommended primarily for understocked wooded areas from Jackson County north because of the white pine weevil. The number of seedlings required for interplanting on a per acre basis will usually be less in a wooded area. Most seedlings should be planted in the small openings where they will have significant amounts of sunlight. From Jackson County south, planting white pine in open fields is an acceptable practice, as well as interplanting.

^{2/} The spacing for hardwood trees depends upon several factors. Hardwood trees will not grow and develop well when spaced as closely together as conifers; however, competing vegetation is much more detrimental to hardwood plantations particularly in the establishment period. The closer spacing is recommended where the vegetation will only be controlled for approximately 3 years. The close spacing will enable the hardwood crowns to close more quickly and shade out the competing vegetation. Closer spacing will, however, require thinning at an earlier date. Wider spacing requires controlling the vegetation more than 3 years or until the crowns close, which may take up to 6 years. The closer spacing is an alternative to controlling the vegetation for longer periods of time.

Source: USDA Soil Conservation Service Technical Guide #612