

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE GENERAL SPECIFICATION**

**FOREST STAND IMPROVEMENT  
(Ac.)  
CODE 666**

**GENERAL SPECIFICATIONS**

Procedures, technical details, and other information listed below provide additional guidance for carrying out selected components of the named practice. This material is referenced from the conservation practice standard for the named practice and supplements the requirements and considerations listed therein.

**NON-COMMERCIAL PRACTICE COMPONENTS**

Practices are often performed on young stands to manipulate the stocking rate or control undesirable vegetation before the trees reach merchantability. Release components may include precommercial thinning, chemical release, or prescribed burning.

**Precommercial Thinning**

Precommercial thinning may be needed in dense, natural stands and in plantations where the number of planted trees has been augmented with natural regeneration from surrounding stands. Precommercial thinning is justified if the stand contains 1,500 or more seedlings per acre.

This type of thinning will be performed when the natural seedlings are well established but before they reach three inches in diameter at breast height. The most effective results are achieved between ages two and five years. Delaying precommercial thinning can sharply reduce growth and increase thinning costs.

Pine trees may be removed mechanically by use

of a rotary mower, bulldozer, disk, or drum chopper or by use of hand tools such as machete, axe, brush hook, and similar tools. Equipment used will depend upon the size of the trees, the size of the area to be treated, site conditions, and the economic limitations of the landowner.

Strips of trees 8 to 10 feet wide will be removed from the stand to leave strips of young trees 1 to 3 feet wide as growing stock. These strips may then be cross-thinned in a checkerboard pattern to further reduce the number of trees per acre when the original stocking is extremely high. The residual clumps of trees will be 1 to 3 feet square in area. The clumps can be thinned with hand tools so that one dominant tree per clump remains. The residual stocking will be 500 to 700 trees per acre for pine and 302 to 436 trees per acre for hardwoods.

Precommercial thinning will be done from mid-October through March when soil moisture conditions permit use of the selected equipment. This timing will reduce the danger of insects and disease.

Cut trees are generally left on the ground. The construction and maintenance of firebreaks is strongly recommended due to high fuel levels and wildfire potential following the thinning (Refer to the practice standard for Firebreak, Code 394).

Repeat treatments may be necessary in shortleaf pine stands due to the sprouting potential.

Precommercial thinning in hardwood stands will be accompanied with herbicide use. Mechanical removal of the unwanted trees alone will cause sprouting instead of death of the trees and will result in a thicker stand after treatment.

Guidance for selection of the proper herbicide, rates, and timing of the application will be obtained from Recommended Chemicals for Weed and Brush Control: MP-44 Arkansas. Landowners will be advised to follow label directions carefully to avoid unsafe use of the chemical.

### **Chemical Release**

Chemical herbicides may be applied to a forest stand to remove undesirable trees. Advantages of using chemical methods of release are that chemicals control vegetation with little soil disturbance; they can be used on steeply sloping land where equipment limitations are severe; they may be applied over large acreage quickly; landowners with small tracts can treat their property themselves; selectivity of the chemicals allows targeting specific types of problem vegetation; and chemical treatments may be used when mechanical methods are impractical or are not cost-effective.

Timing of the chemical application is often critical. There are differences in the susceptibility of the various target species to different herbicides which influence the proper timing of application. Most hardwood species are more susceptible to chemical action in the spring or early summer, but they can be treated at other times.

The success of chemical release depends upon correct formulation and application. Refer to Cooperative Extension's Recommended Chemicals for Weed and Brush Control: Arkansas (MP-44) for specific herbicide recommendations.

Landowners will always be cautioned of the necessity for following label directions for proper herbicide application and safety

considerations. Chemicals will be used only in accordance with all limitations of EPA, the manufacturer, and state and federal regulations.

Chemical herbicides can be applied by tree injection, foliar spraying, basal application, and soil application.

**Tree Injection.** Chemical injection can be used to select individual medium-to-large size trees for removal. Tree injectors are used to apply a herbicide through cuts in the bark of the tree. A basal injector or a hypo-hatchet may be used. Injections should be made at 2 to 3 inch intervals completely around the tree. Difficult to control species may need a continuous cut rather than spaced cuts. Injection should be done during the active growing season.

Investment cost is low for a landowner to purchase a hypo-hatchet and herbicide to perform the labor involved. Other tools such as a hatchet and plastic squeeze bottle can be used. The hatchet can be used to cut into or "frill" the tree, and the squeeze bottle would then be used to immediately squirt the chemical into the frill.

**Foliar Spraying.** Spraying herbicides can be done aerially from fixed-wing aircraft or helicopter and from the ground by sprayers attached to backpacks, ATV's, tractors, skidders, or other ground equipment. This is one of the fastest methods of brush control in pine stands.

Foliar spray for release will be applied during late summer or early fall before leaves begin to change colors.

The potential for spray drift onto untargeted and/or sensitive areas will be considered during practice planning.

Use of qualified and experienced applicators will help avoid this problem.

**Basal Spraying.** Basal bark application is usually applied to stems 6 inches in diameter or

smaller. The herbicide mixture is applied with a backpack sprayer to the bottom 1-2 feet of the stem. The stem will be wet on all sides.

If the trees are 1-2 inches in diameter and have smooth bark, a 1-1/2 to 2 inch wide band will be sprayed halfway around the stem. The herbicide will spread around the stem to completely encircle it.

Basal spraying will be done in late spring or early summer.

**Soil Application.** Herbicide treatment to individual stems can also be accomplished through soil application of chemical formulations. This type application is performed in the early growing season (mid-March to early May).

The chemicals are washed into the soil by rain water and are absorbed by the tree's root system. Surrounding trees may also be damaged by this treatment due to this washing action. The landowner will be informed of this potential damage when soil application of herbicides is planned.

Soil applied herbicides will not be used near streams and other water bodies where there is potential for runoff transportation of the chemicals into the water during rain events. Soil leaching potential will also be considered.

### **Prescribed Burning**

Prescribed burning may be used in pine stands to remove hardwood species and other ground vegetation that do not facilitate the intended purpose of the practice.

Fire can be used for regeneration purposes in hardwood stands, but it will not be used in stands containing high-quality crop trees unless the primary objective is wildlife management. The landowner will be informed of the potential damage to hardwood stands in which prescribed burning is planned.

Refer to the practice standard for Prescribed Burning, Code 338, for specifications and precautions associated with prescribed burning.

Arkansas law requires the landowner to notify Arkansas Forestry Commission's fire dispatch center before burning in woodland areas. The toll free telephone number for this is 1-800-830-8015. The landowner will always be informed of this requirement when prescribed burning is planned.

### **COMMERCIAL PRACTICE COMPONENTS**

Cutting in merchantable forest stands is done periodically to concentrate growth on crop trees, reduce susceptibility to diseases and insects, remove suppressed and dying trees, remove low-quality trees, improve growth of herbaceous plant material beneficial for livestock and/or wildlife forage, adjust species composition, regenerate the stand, and/or increase economic gain for the landowner.

These harvesting components to improve forest conditions may include intermediate thinnings, harvest/regeneration cuts, salvage cuts, and sanitation cuts.

It is important to plan harvest treatments and proceed with practice installation carefully to avoid damage to the site. It may be years before a forest recovers from improper harvesting practices. Soil conditions and limitations will dictate the season to conduct harvest activities with the least site disturbance. Refer to associated practices such as Forest Harvest Trails and Landings (Code 655), Critical Area Treatment (Code 342), and Riparian Forest Buffer (code 392) for further guidance.

Timber sales should always be made on a competitive bid basis to protect the landowner's economic investment in the forest stand, and a timber contract should always be used to define

the rights and responsibilities of both the seller and the buyer. The contract will protect other resources on the property which are important to the landowner's objectives. Property boundaries should be clearly marked and maintained to avoid conflict and misunderstandings with neighboring landowners.

For landowners with wildlife habitat management as a primary or secondary objective, plan retention of a sufficient number of den trees, snags, and roost trees. Generally speaking, four or more den trees per acre will be sufficient for this purpose. Habitat enhancement practices will increase the demand and competition for den trees as will proximity to permanent water sources.

Woody habitats well interspersed with old fields, smaller crop fields, and pastures that are near water sources will concentrate demand for the den trees.

A variety of cavity opening sizes will increase utilization by diverse wildlife species. The higher the number of den trees left, the greater chances of the dens being used by a variety of wildlife.

**Intermediate Thinnings**

Cuts which manipulate conditions in a stand during the time period between regeneration establishment and final harvest of the trees are called intermediate thinnings. This type of thinning is generally done to control the spacing, quality, and species composition of the stand to attain the intended purpose of the practice. Intermediate treatments should be an integral part of the management plan to ensure the health and productivity of the forest.

Trees to be targeted for removal during improvement thinnings include:

- Suppressed trees that will not live until the next thinning;
- Trees with injuries resulting from fire, ice, insects, lightning, etc.;
- Poorly formed trees (forked, crooked, etc.) that have a low value;
- Trees which are not well adapted to the site and have a resultant low growth rate or poor form;
- Mature trees which have begun to decline in vigor; and
- Tree species which do not supplement the objectives of the landowner.

Refer to the following tables for guidance on the number and spacing of trees per acre remaining after improvement cuttings. Residual stocking rates are based on diameter spacing guides or basal area spacing guides. These guides indicate the space required by a tree to maintain growth and vigor between cuttings.

Basal Area 80 Residual Spacing Guide for Pines and Cedar\*:

<b>DBH (In)</b>	<b>Average Spacing BA 80</b>	<b># Trees per acre</b>	<b>Spacing By D+X</b>
4	7	888	D+3
6	11	360	D+5
8	14	222	D+6
10	18	135	D+8
12	21	99	D+9
14	25	70	D+11
16	28	55	D+12
18	32	42	D+14
20	35	36	D+15

\*For basal area guides other than 80, use the following:

- BA 50 = D X 2.20
- BA 60 = D X 2.00
- BA 70 = D X 1.85
- BA 90 = D X 1.65
- BA 100 = D X 1.45

### D+6 Residual Spacing Guide for Pines and Cedar:

DBH (In)	Average Spacing (Feet)	# Trees per acre	Basal Area
4	10	436	38
6	12	303	59
8	14	222	78
10	16	170	93
12	18	135	105
14	20	109	116
16	22	90	126
18	24	76	134
20	26	65	142

See Tables 1 and 2 for mixed hardwood residual spacing guides, Tables 3 and 4 for cottonwood residual spacing guides, and Table 5 for black walnut residual spacing guide.

The length of time between intermediate thinnings (cutting cycle) depends upon the species being managed, the site index of the soil, the volume necessary for an economically feasible harvest operation, timber price fluctuations, and the opportunity to harvest depending on site conditions. Table 6 lists approximate cutting cycles for various tree species and thinning guides in healthy, fully-stocked stands. These cutting cycles are based on the length of time required for pine trees to accrue two inches of diameter growth and for hardwoods to accrue four inches of diameter growth.

The timing of the first thinning will depend upon merchantability of the products, site productivity, and size of the trees. First thinnings should be made just prior to overcrowding and reduction of diameter growth, and before the live crown ratio is reduced to below 35 percent of total height. This will generally be between 13 and 15 years of age on productive pine sites and 17 to 25 years on hardwood sites.

### Harvest/Regeneration Cuts

Harvest and regeneration cuts are made when the forest stand has reached economic and/or physiological maturity. The timing of this type of cut will depend not only on the forest conditions but also on landowner objectives and economic considerations.

The harvest method used will determine the regeneration options available to the landowner to establish a new stand (Refer to Tree/Shrub Establishment, Code 612). It is more feasible for the landowner to determine the preferred regeneration method and use an appropriate harvest system to facilitate that method.

Harvest methods fall into two general categories: Those which allow regeneration of even-aged forest stands and those which result in uneven-aged forest stands. Even-aged stands are created through use of clearcuts, seed tree cuts, and shelterwood cuts. Uneven-aged stands result from selection harvesting.

**Clearcutting.** Clearcutting removes all merchantable trees in the stand in one cut. This method is used for establishing a new stand of shade-intolerant tree species such as pines or oaks either through natural seeding/sprouting or through planting. The harvest is generally followed by site preparation practices (Refer to Tree/Shrub Site Preparation, Code 490).

The type of clearcut harvest made is determined by site conditions and the landowner's economic situation. Choices available include clearcutting an entire stand at a time or clearcutting a stand in strips or blocks over several cuts.

Clearcutting the entire stand at once may be done when sufficient seed or seedlings are in place to regenerate the stand or when tree planting is planned.

Strip, block, or patch cutting is used when seed from adjacent stands will be utilized to restock the area.

Clearcutting in pine stands with seed in place before they germinate. This cutting is done during a 4 to 5 month winter logging period. Site conditions and soil limitations during this period will determine the practicality of this method. Cutting with seedlings in place is done during the summer following seed germination. Both systems require ample seed crops and involve a high risk because they provide a one-time chance for successful natural regeneration unless seed is available from adjacent stands.

Adjacent seed sources may be utilized when strips or blocks are cut perpendicular to prevailing winds so that the harvested areas are regenerated from blown seed. The cut areas should not be wider than 3 to 4 times the height of the trees to be used as a seed source. The area should be site prepared prior to seed fall. This method may be used for pine and light-seeded hardwoods.

Successful clearcutting and regeneration in hardwood stands may be attained through seedlings in place plus naturally occurring root and stump sprouts. The seedlings in place (advance regeneration) must be at least 4-1/2 feet tall and 1 inch in root collar diameter prior to the cut.

A clearcut site is aesthetically less pleasing for a short period following the harvest. The initial negative impact will be lessened by planning the size, shape, and location of the clearcut to blend more naturally with the landscape.

A patchwork of clearcuts resulting from harvests conducted at different times will provide a more diverse habitat for wildlife than one single large clearcut. Landowners with a wildlife management objective in addition to their timber management goals may wish to consider this alternative.

**Seed Tree Cuts.** Seed tree cuts are the most frequently used method of natural regeneration for southern pines. This method consists of

involves cutting the trees after the seeds fall but leaving enough seed-producing trees scattered over the area to ensure adequate stocking. The seed trees are later removed to eliminate shading effects when the seedlings are 2 to 3 years old.

The area should be prescribed burned prior to the seed tree cut to prepare a seedbed and control competing vegetation (Refer to Prescribed Burning, Code 338). The regeneration cut will be timed so that seeds will be dispersed on a site freshly scarified by logging.

The minimum number of recommended seed trees per acre necessary for satisfactory regeneration of pines is as follows:

DBH (In)	Loblolly Pine	Shortleaf Pine
10	12	20
12	9	14
14	6	12
16+	4	12

Residual basal area will be 15 square feet per acre or less. Seed trees will be dominant trees of good form and quality with seed-producing capabilities. They will be well-distributed over the area to be regenerated.

The seed trees will be susceptible to lightning strikes and windthrow when the cut is complete. They should not be left in place longer than 2 to 3 years.

**Shelterwood Cuts.** Shelterwood cuts are similar to seed tree cuts, but more trees are left to regenerate the stand and to serve as a canopy shelter for the germinating seedlings. This method is well suited for naturally regenerated southern pines. Leaving more trees after the harvest helps suppress the development of competing vegetation, and it also reduces the risks associated with poor seed crops during regeneration efforts. Removing the residual trees does cause damage to the seedlings, however.

Approximately 20 to 30 square feet of basal area per acre will remain when the initial cut is complete. This basal area equates to 37 to 55 10-inch trees, 25 to 38 12-inch trees, 19 to 28 14-inch trees, or 14 to 17 16-inch trees left per acre. The residual trees will be removed when the seedlings are 2 to 3 years old.

**Selection Harvests.** Selection harvesting involves periodic cutting of selected trees from all merchantable diameter classes. This method maintains an uneven-aged stand.

Harvested volumes in fully stocked stands should generally approximate growth for the cutting cycle. In stands that are not fully stocked, only a portion of the growth is cut. The cutting cycle will approximate that discussed for intermediate treatments.

Slow-growing, poor quality, or undesirable trees will be cut, and the best trees will be left to improve quality and growth.

Harvest tree selection will be done either by targeting single individual trees or by removing a group of trees to create openings or gaps in the forest canopy. The openings provide freedom

Table 1: Basal area residual spacing guide for mixed hardwoods:

<b>DBH (Inches)</b>	<b>Average Spacing BA 80 DX1.75</b>	<b># Trees per acre</b>	<b>Spacing by D+X</b>
8	14	222	D+6
10	18	135	D+8
12	21	99	D+9
14	25	70	D+11
16	28	55	D+12
18	32	42	D+14
20	35	36	D+15

from competition for the natural establishment of shade-intolerant tree species. In this manner, a diversity of age and size class is maintained. A group selection cut provides better regeneration opportunities for both pines and oaks than single tree selection because larger openings are created for these shade intolerant species.

**Salvage/Sanitation Cuts.** Salvage cutting is the removal of trees damaged by insects, disease, ice, tornadoes, fire, and other disasters to obtain economic gain before tree value is lost. Sanitation cutting is the removal of trees attacked by insect or disease. The cutting is done to stop the infestations and is usually not expected to bring high economic benefits to the owner due to the emergency considerations of the operation.

These cuts usually remove trees in the oldest and largest size category. This removal is important in maintaining the health and productivity of the stand.

Dead and dying trees may be left in the stand for wildlife nesting/roosting habitat when their retention does not endanger the health of the remaining trees.

Table 2: D+8 residual spacing guide for mixed hardwoods:

<b>DBH (Inches)</b>	<b>Average Spacing D+8</b>	<b># Trees per acre</b>	<b>Basal Area per acre</b>
8	16	170	59
10	18	135	73
12	20	109	86
14	22	90	96
16	24	76	105
18	26	65	115
20	28	55	120

Table 3: D+11 residual spacing guide for cottonwood:

<b>DBH (Inches)</b>	<b>Average Spacing D+11</b>	<b># Trees per acre</b>	<b>Basal Area per acre</b>
6	17	151	30
10	21	99	54
14	25	70	75
18	29	51	90
22	33	40	106

Table 4: Basal area residual spacing guide for cottonwood:

<b>DBH (Inches)</b>	<b>Average Spacing BA 70 DX1.85</b>	<b># Trees per acre</b>	<b>Spacing by D+X</b>
6	11	360	D+5
10	19	121	D+9
14	26	65	D+12
18	33	40	D+15
22	41	26	D+19

Table 5: Residual spacing guide for black walnut:

<b>DBH (Inches)</b>	<b>Average Spacing</b>	<b># Trees per acre</b>	<b>Basal Area per acre</b>
6	D+10	170	33
8	D+12	109	38
10	D+14	76	41
12	D+16	55	44
14	D+18	42	45
16	D+21	32	45
18	D+24	25	44
20	D+25	22	48

Table 6: Cutting Cycle (Years) for various forest types and thinning guides:

<b>Forest Type And Guide</b>	<b>Site Index 30</b>	<b>40</b>	<b>50</b>	<b>60</b>	<b>70</b>	<b>80</b>	<b>90</b>	<b>100</b>	<b>110</b>	<b>120</b>
Pine D+6 or Basal Area 80	---	---	9	8	7	6	5	5	5	4
Cedar D+6 or Basal Area 80	16	12	8	---	---	---	---	---	---	---
Mixed Hardwoods D+11 or BA	---	---	9	8	7	6	5	5	---	---
Cottonwood D+11 or BA 70	---	---	---	---	---	---	7	6	5	4