APPENDIX F

TIMBER SUITABILITY, TOTAL TIMBER SALE PROGRAM, VEGETATION MANAGEMENT PRACTICES

This appendix is provided as a reference in implementing the Plan and to maintain a strong tie between the Plan and the analysis required by the National Forest Management Act. Specifically, the subjects of this appendix are those shown in the title: namely (a) the analysis of forestlands for their suitability to have a sustained yield timber harvest regime; (b) an estimated total sale program for the preferred alternative, including estimates of product and species group volumes; and (c) vegetation management practices applicable to the forest types and ecological conditions of the Forests.

Some of this material is an extract from Appendix B of the EIS – Description of the Analysis Process, and is therefore somewhat redundant. Appendix B is also the place to read about the minute details of how the Continuous Inventory of Stand Condition (CISC) database was used, the details of the FVS growth and yield simulations, and the details of the SPECTRUM model formulation

I. TIMBER SUITABILITY

The National Forest Management Act (NFMA) of 1976 requires an analysis of National Forest lands to examine their 'suitability' for 'sustained yield' 'timber production' (Office of the Federal Register, 1994). The Act also specifically defines these terms. These definitions are as follows:

suitability - The appropriateness of applying certain resource management practices to a particular area of land, as determined by an analysis of economic and environmental consequences and the alternative uses foregone. A unit of land may be suitable for a variety of individual or combined management practices.

sustained yield - The achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the National Forest System without impairment of the productivity of the land.

timber production - The purposeful growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs, bolts, or other round sections for industrial or consumer use. For purposes of this subpart, the term timber production does not include production of fuelwood."

Note that both 'suitability' and 'sustained yield' are defined to mean more than just timber production. Suitable, for example, can refer to appropriateness of designation of a stream as a National Wild and Scenic River. In actual practice, however, since each of these terms have historically been used most frequently in connection with timber management they are often understood to be timber and forestry terms. Recent usage is more in line with NFMA in that sustainability is referred to in a holistic way to mean all resources.

It is also very important to understand that sustained yield for timber refers specifically to the orderly, planned and recurrent harvest of living trees. On lands found to be not suitable for sustained yield as a result of suitability analysis, "*... salvage sales, sales necessary to protect other multiple-use values, or activities that meet other objectives on such lands if the forest plan establishes that such actions are appropriate....*" are permitted by the Act *(36 CFR 219.27 (C) (1))*. However, decisions made by authority higher than the Regional Forester may impose greater restrictions on harvest than would the NFMA. In those cases, such decisions will take precedence over the forest planning process. This is because the Regional Forester is the Deciding Official on a forest plan and does not have the authority to re-decide an earlier decision made by higher authority. For example, Experimental Forests - designated by the Chief - may permit the use of timber harvest to create the conditions desired for a research program or project, or to protect from insects or disease. Congressionally-designated Scenic Areas, Wild and Scenic Rivers, or National Recreation Areas may or may not have wording permitting some type of timber harvest. For this reason, having lands identified as 'unsuitable' at any stage of suitability analysis should *not* be understood as *always* meaning that *no* timber harvest whatsoever can occur on those lands. Rather it means; (1) there are no timber program plans for harvest volume from those lands, and (2) the planned timber program harvest rate (volume per year or per decade) has normally been set so as to not exceed the growth rate of trees on the 'suitable' land base; that is, the harvest level is sustainable when only the suitable land base is considered. Timber harvest volumes from 'unsuitable' lands are incidental, generally not 'regular' in occurrence, and do not increase or decrease the sustainable level of harvest which may occur on 'suitable' lands.

The Act divides the complete suitability analysis into three parts; designated within Section 219.14 "*Timber resource land suitability*" as paragraphs (*a*), (*b*), and (*c*). In use, these three divisions have come to be called "stage one", "stage two" and "stage three", respectively. These names stem from the analysis being 'staged' in that the three were originally planned to proceed in order; first stage one, then stage two, and finally stage three. Stage two builds on stage one and stage three builds on stage two. At each of the three stages, the analysis used to acheive the intended result of that stage is different. However, the stages do not conflict but are rather a complementary set which build step by step to a comprehensive look at which lands should be planned for a sustained yield timber harvest program. The criteria used,

examples of land meeting each criteria, and the outcome of each stage are explained later in this report in greater detail.

The Forest Service has set direction in Forest Service Handbook (FSH) 2409. 13 "Timber Resource Planning Handbook" for carrying out the suitability analysis required by the National Forest Management Act. The Handbook contains the 'how to' of efficiently carrying out the stated requirements and intent of the law (FSH 2409.13).

A major tool used to help perform the timber suitability analysis was an Oracle database pronounced "SISK" and spelled C.I.S.C. This acronym stands for Continuous Inventory of Stand Conditions. The CISC database has numerous fields of attribute data for each forest cover type mapped on the Forests. Data has historically been kept current by periodic field inventory and data edits using standardized definitions, codes, and data collection procedures. CISC data is the most comprehensive, accurate and detailed record available of tree cover characteristics at the scale of the entire forest. This statement remains true even though in the last ten years inventory has fallen somewhat behind natural dynamics of storms, insects, disease, and other disturbances. This factor was considered and allowed for in the timber analysis.

The level of detail of CISC data is typically for individual areas of from ten to forty acres with relatively low variability (homogeneity) in forest community characteristics. These units are called stands. Some pre-1980 data is for large stands of one hundred acres or more but these are generally within already withdrawn areas, primarily Wilderness. In some exceptional cases stands less than five acres will be recognized in the database. But areas this small are not feasible to show on large-scale GIS maps covering entire Districts. In short, the data is not perfect but provides a fine level of resolution which is more than sufficient for timber modeling at landscape scale. (Refer to the EIS Apendix B for more details about CISC.)

STAGE ONE ANALYSIS

The primary outcome of stage one suitability analysis is the identification of the acreage of National Forest unsuitable for timber production. That acreage is obtained by summing the acres of each stand in the CISC database meeting any one of six criteria for unsuitability. A secondary outcome is the identification of the acreage "tentatively suitable" for timber management. Tentatively suitable acres are those left after stage one unsuitable acres have been subtracted from total National Forest acreage. The tentatively suitable acreage figure is carried forward into stage two analysis. Stage one unsuitable acreage is dropped from modeling timber production but, if within the Regional Forester's authority, can be re-considered for a new and different land allocation to uses other than sustained yield timber production.

1. CRITERIA

The Act stipulates four criteria for identifying unsuitable land. But FSH 2409.13, WO Amendment 2409.13-92-1, Effective 8/3/92 identifies two more criteria. These additional criteria are consistent with the intent of stage one analysis in the Act. In applying any of these criteria, cost efficiency is *not* a consideration.

The primary data source for the screening of National Forest System lands against each of the criteria was the computerized CISC database. The major reason for relying on it is that it includes a datafield called "Land Classification", shortened in day-to-day use to 'Land Class'. This data field has three-digit classification codes which correspond to each one of the NFMA or Forest Service Handbook criteria for stage one analysis. These codes are detailed in the Forest Service R8 "*Silvicultural Examination and Prescription FIELD BOOK*" dated 6/92. These codes also include information useful to the other stages of suitability analysis. Before the data was used, an extensive editing effort went into being sure these codes were consistently used and up to date. The details of that effort are in Appendix B of the EIS or in the planning process record. Once the data had been edited, there was a clear correlation between land classification and the criteria of the NFMA as shown in the table below.

Table F-1: Stage One Timber Suitability Analysis Criteria and Associated CISC Land Class Codes.

Stage 1 Unsuitability Criteria	Land Class Codes
1. Not forest land	Series 100 and 200, code 865
2. Withdrawn by Congress, Secretary of Agriculture, or Chief of the Forest Service	Series 300
3. Incapable of Producing Crops of Industrial Wood	Code 900
4. Technology not available to produce timber without irreversible resource damage to soils productivity or watershed conditions	Code 720
5. No reasonable assurance that such lands can be adequately restocked within 5 years after final harvest	Code 710
6. Inadequate response information	Code 740

The criteria and their order from the Handbook are detailed below with examples for each. In stage one analysis, these criteria are applied in the order shown.

(1) <u>The lands are not forest</u>.

The Act defines forest land as "*Land at least 10 percent occupied by forest trees of any size or formerly having had such tree cover and not currently developed for non-forest use. Lands developed for non-forest use include areas for crops, improved pasture, residential, or administrative areas, improved roads of any width, and adjoining road clearing and powerline clearing of any width*.(36 CFR 219.3)" The specific non-forest uses listed are not all inclusive. Water bodies, areas of exposed rock without a tree cover, or wildlife openings are other possible examples. FSH 2409.13 further clarifies that 'occupancy' of forest trees is to be by canopy cover of live forest trees at maturity; the minimum mapping size is one acre or greater *"...consistent with Regional mapping standards..."*; and that *"...unimproved roads, trails, streams, and clearing in forest areas..."* be classified as forest *"...if they are less than 120 feet in width."* Improved and unimproved

roads are not defined. In the suitability analysis, the land area in roads at least 120 feet wide was not calculated. Very little National Forest land area would meet this criteria on either the Chattahoochee or the Oconee.

The primary type of non-forest land on both the Chattahoochee and the Oconee is waterbodies; that is, ponds and lakes. Administrative sites included District offices, District work centers, and Camp Frank G. Merrill on the Chattahoochee, and were considered non-forest, though this distinction was not always completely clear. We simply considered that an administrative site, by its very nature, is not a place to plan for sustained yield harvest.

(2) The forest land has been withdrawn from timber production by an Act of Congress, direction of the Secretary of Agriculture or direction by the Chief of the Forest Service.

This category affects the greatest number of acres. General examples of such withdrawals are units of the National Wilderness Preservation System designated by acts of Congress and Research Natural Areas designated by the Chief. In addition, Experimental Forests - also designated by the Chief - are considered withdrawn if management objectives preclude timber production on a regulated basis (FSH 2409.13). These management objectives are set by the Research Branch of the Forest Service and not by the National Forest System. On the Oconee Ranger District, the Hitchiti Experimental Forest is considered withdrawn while the Scull Shoals Experimental Forest is not. Other specific examples of withdrawn lands on the Chattahoochee NF are the Coosa Bald Scenic Area, the Ed Jenkins National Recreation Area, and the Chattooga Wild and Scenic River; each designated by Congress.

Lands where management activities are strongly limited to meet the requirements of other Acts, such as the National Historic Preservation Act, the Endangered Species Act, or the Clean Water Act are not considered a 'withdrawal' under this criteria even though meeting the requirements of the law may preclude timber harvest. These situations are dealt with in the Regional Forester's decisions on plan land allocations.

The details of this category are shown here as baseline data against which to monitor changes and to provide a benchmark for understanding the situation at the time the plan was done.

The Chattahoochee data was updated between draft and final to reflect acquisitions since January 2000. The Oconee data had not been affected in that time and was not changed.

Table F-2. Detail of Chattahoochee National Forest Stage 1 Unsuitable Criteria 2 '*Withdrawn by Congress, Secretary of Agriculture, or Chief of the Forest Service*' 17 September 2003

Category and Names of Areas	Withdrawn By	Acres
National Wilderness Preservation System		
Blood Mountain	Congress	7,736
Brasstown	Congress	13,406
Cohutta	Congress	35,484
Ellicott Rock	Congress	2,007
Mark Trail	Congress	17,077
Raven Cliffs	Congress	9,309
Rich Mountain	Congress	10,540
Southern Nantahala	Congress	11,555
Tray Mountain	Congress	10,425
		Subtotal 117,539
National Wild & Scenic River System		
Chattooga River	Congress	6,887
		Subtotal 6,887
Other Congressionally-Designated Areas		
Ed Jenkins National Recreation Area	Congress	23,449
Coosa Bald Scenic Area	Congress	7,044
		Subtotal 30,493
Other Areas		
Sosebee Cove	Chief	74
Cedar Mountain	Chief	18
		Subtotal 82
		TOTAL 155,001

Source: GIS 'stands' data layer as modified for Plan revision September 2003

The details of acres within criteria 2 '*Withdrawn by Congress, Secretary of Agriculture, or the Chief* [of the Forest Service]' for the Oconee National Forest are shown in the following Table.

Table F-3. Detail of Oconee National Forest Stage 1 Unsuitable Criteria 2 '*Withdrawn by Congress, Secretary of Agriculture, or Chief of the Forest Service,*' July 23, 2002

Names of Areas	Withdrawn By	Acres
Hitchiti Experimental Forest	Chief	4,666
Murder Creek Research Natural Area	Chief	1,007
		TOTAL 5,673

Source: Plan revision GIS stands data layer July 2002.

As previously mentioned, the Scull Shoals Experimental Forest, though Chief-designated, is not being included in Criteria 2 because management of it is not inconsistent with sustained yield harvest.

(3) The forest land is incapable of producing crops of industrial wood.

This category is not stipulated in the Act but rather has been identified by the Forest Service in FSH 2409.13 as a category consistent with the intent of stage one analysis. The primary criteria is that the species of trees growing on these lands are not currently utilized nor likely to be within the next ten years; that is, there is no market for the species. Note that the ability of the site itself to grow wood (productivity) is not what is being considered.

On the Chattahoochee or Oconee NF, each species of tree capable of forming a forest cover is currently utilized; that is, the wood products industry does not reject any wood because of its species alone.

(4) Technology is not available to ensure timber production without irreversible resource damage to soils productivity, or watershed conditions.

This criteria actually has two parts; (a) availability of technology, and (b) irreversible damage to soils productivity or watershed conditions. These are addressed individually below.

FSH 2409.13 defines available technology as *"technology that is in use or that current research and experience indicates is feasible to use … for the site, species, and other factors involved."* It further clarifies that current use need not be within the Forest or Region. However, current untested technology is not to be considered nor is there speculation about future development of new technology.

For irreversible damage, an interdisciplinary team determines "… *whether or not it is possible to carry out the activities involved in timber production …*" without such damage. At a minimum, the Handbook requires consideration of the activities for access, harvesting, slash disposal, and regeneration. However slash disposal is a Western practice not used on either the Chattahoochee or Oconee NF.

Cost efficiency is not a factor in meeting either the overall lack of technology criteria or its subparts; that is, 'feasibility' is not economic feasibility because that is what stage two analysis evaluates. For example, helicopter logging is available technology which would result in no direct soils or watershed condition damage on the harvest unit. It is physically 'feasible' in that it has been used. It can be used to meet this criteria at stage one even though many areas do not have the timber value to be economically feasible for helicopter logging; that is, costs exceed value. Similarly, the costs of environmental mitigation are not considered at stage one. Therefore the IDT concluded that there were no lands for which technology was not available.

The IDT also considered irreversible damage to soil productivity. This level of damage would be considered irreversible, because the resource has been destroyed or removed, or has deteriorated to the point that renewal can occur only over a much extended period or at great expense. The concern considered on the Chattahoochee was the occurrence of mass failures or the soil sliding downhill and reaching a stream or creating an un-vegetated area that eroded with sediment reaching the stream. Mass failures have historically occurred on the Chattahoochee, typically in hurricane-related rainfall or intense thunderstorms that produce rains exceeding ten inches in a twenty-four hour period or equivalent. These storm events have been rare, however, a small number of landslides have been documented occurring within the Tennessee River basin on slopes in excess of 60 percent and on granite or gneiss geology. Typically a weakening of a toe slope position due to heavy inflows of moisture has triggered the landslides. The weight of the soil mass simply cannot hold on the slope angle

and gives way to slide down slope and create a landslide. Documented slides are generally less than 100 yards long, moving soil, rock and vegetation material down slope to a final angle of repose, or flat slope.

Road building across slopes greater than 60-percent could be a problem if the geology or soils were unstable, such as when the rock strata are aligned parallel with the ground surface. Road construction is not anticipated across these conditions; however any proposal for road construction across slopes that steep would require interdisciplinary planning that would consider the landslide hazard. Without considering costs and with the availability of helicopter or cable logging, the IDT concluded that there were no National Forest system lands on the Chattahoochee that met the criteria for withdrawal from suitability due to irreversible damage.

(5) <u>There is not reasonable assurance that such lands can be adequately restocked within five years after final harvest.</u>

This is a criteria of the Act. The Act defines "*adequate restocking*" as meaning "*...the cut area will contain the minimum number, size, distribution, and species composition of regeneration as specificied by regional silvicultural guides for each forest type. (36 CFR 219.27 (c) (3)"* at the time of final harvest. The Act further stipulates that "*five years after final harvest*" is five years after each of; clearcutting, final overstory removal in shelterwood cutting, seed tree removal in seed tree cutting, or selection cutting. FSH 2409.13 provides additional clarification as follows:

"Current research and experience provide the basis for determining whether or not the planned practices are likely to be sucessful at the time the final harvest is planned. If existing knowledge is not adequate for determining which practices will be sucessful on certain lands, but on-going research should resolve this question before the scheduled final harvest, then, include the applicable lands as tentatively suitable, but maintain them as a separate, noninterchangeable component of the allowable sale quantity.... Such assurance applies to normal conditions for the site and does not constitute a guarantee. Abnormal conditions, such as drought, disease, or other unplanned events, may preclude meeeting this requirement, Identify forest lands failing to meet this requirement as unsuitable for timber production. Cost efficiency is not a factor in this determination."

The NFMA has required the annual collection and reporting to the Sectretary of Agriculture of first and third year survival of planted stands and fifth year stocking on naturally regenerated stands since 1976. Chattahoochee and Oconee NF personnel have been collecting this information for twenty-four years. In all that time, no stand has failed to be adequately restocked with commercially valued species by the fifth year after final harvest. Survival of planted trees has been poor after the first year in some cases due to weather, seedling physiology, insects, mammal feeding, or other factors but these problems have been easily corrected.

(6) There is inadequate response information.

This is not a criteria of the Act but rather is identified by Forest Service policy in Forest Service Manual (FSM) 2409.13 where, in Chapter 21.5 the following direction is given:

"*Identify forest land as unsuitable for timber production if there is not adequate information available, based on current research and experience, to project* [timber growth] *responses to timber management practices. Until such time as adequate response data are available, identify these lands as needing further inventory, research, or information and do not consider them part of the tentatively suitable land base."*

The insertion of "timber growth" in this Manual quote is a Regional Office clarification. It follows logically from the earlier use of the 'adequate restocking' criteria. If land can be adequately restocked, then the next question is how the trees will grow beyond the 'five years after final harvest'.

FSM 2409.13 gives two Western examples; pinyon-juniper and mesquite, which might fit this category. It also calls for giving "*…special attention to lands classified as incapable of producing 20 cubic feet/acre/year if they formerly met this criterion and where previously part of the timber base.*" Forested lands incapable of producing more than 20 cubic feet per acre per year (productivity class 7) are rare on the Chattahoochee and do not occur on the Oconee National Forest. On the Chattahoochee the acres identified is rock outcrops. These are widely scattered patches of less than stand size. Their cumulative acres outside of withdrawn areas are shown as meeting this criteria. There was no land meeting this criteria on the Oconee.

In addition, FSH 2409.13 identifies a category called "*physically suitable forest land*". These are *"… lands for which technology is available to ensure timber production without irreversible resource damage to soils productivity, or watershed conditions, and lands for which the possibility of adequate restocking within 5 years is reasonably sure."*

2. RESULTS

Results of the complete suitability analysis for each of the Chattahoochee and Oconee National Forests are displayed in table form below. This organization replicates that recommended in the Timber Management Planning Handbook.

Note that because the criteria are applied in sequence the acreages shown for each category are not necessarily all the acres that occur on each Forest would meet each criteria considered separately; that is, the categories may overlap. For example, Wilderness Areas on the Chattahoochee include 1,626 acres of rock outcrops. Outside of withdrawn areas, acres of rock outcrops are included in the 'inadequate response' category.

Table F-4 Summary of Acres by Timber Suitability Analysis Land Classifications for the Chattahoochee National Forest 17 Sept. 2003

Total national forest land as of September 2003	750,767
Criteria 1 - Non-forest land	-2,126
Forest land	748,641
Criteria 2 - Forest land withdrawn from timber production	-155,001
Criteria 3 - Forest land not capable of producing crops of industrial wood	0
Forest land physically unsuitable:	0
Criteria 4 - irreversible damage likely to occur	0
Criteria 5 - not re-stockable within 5 years	0
Criteria 6 - Forest land - inadequate information	-4,327
Result of Stage One - Tentatively suitable forest land	589,313
Result of Stage Three - Forest land not appropriate for timber production (net)	-222,117
Total suitable forest land (net)	367,196
Unsuitable forest land	383,571

Source: Plan revision GIS stands database September 2003.

The stage three and the total suitable results each initially included their portion of the 4,327 acres of 'rocklands'. This was because these rocklands are less than stand size and are embedded like raisins inside all prescriptions outside of the 'withdrawn' category. As indicated by the (net) in the table, the acres of each category was reduced for the rocklands within them.

Table F – 5: Summary of Acres By Timber Suitability Analysis Land Classifications for the Oconee National Forest 17 Sept. 2003

Total national forest land	115,215
Criteria 1 - Non-forest land	-2,216
Forest land	112,999
Criteria 2 - Forest land withdrawn from timber production	-5,673
Criteria 3 - Forest land not capable of producing crops of industrial wood	0
Forest land physically unsuitable:	0
Criteria 4 - irreversible damage likely to occur	0
Criteria 5 - not re-stockable within 5 years	0
Criteria 6 - Forest land - inadequate information	0
Result of Stage One - Tentatively suitable forest land	107,326
Result of Stage Three - Forest land not appropriate for timber production (net)	-13,427
Total suitable forest land (net)	93,902
Unsuitable forest land	21,313

Source: Plan revision GIS stands data layer September 2003.

Stage 2 Analysis

The second phase of suitability analysis is economic and is where the costs of operations are brought in. This portion of the analysis is fully described in detail in Appendix B of the EIS. It is not replicated here but rather summarized.

The economic analysis was comprehensive for all the cost factors '*...attributable to timber production...'* in the words of the NFMA. It included vegetation inventory, National Environmental Policy Act (NEPA) compliance, timber sale preparation costs, timber sale administration, road construction and reconstruction, and reforestation. Reforestation costs were on an acre basis. Timber sale preparation, timber sale administration, and road construction or reconstruction costs were on a volume basis. None of these costs were varied among alternatives. Costs were generated from historic records and inflated or deflated to a common base year. The economic analysis was done within the SPECTRUM model using stands as the most basic unit but aggregating those that were comparable in all significant respects into timber analysis units.

Each timber analysis unit had associated with it a range of silvicultural prescriptions, each prescription having associated yield tables. The range of silvicultural prescriptions was developed to be compatible with the silvics of the species and to range from relatively low to relatively high cost. Throughout all alternatives, the same prescription set remained available to the same timber analysis unit. But the acres of each analysis unit modeled for sustained yield harvest varied by alternative. The economic analysis identified, as one outcome of several, those lands that were not cost effective using any of the silvicultural prescriptions modeled.

The major result was to show relatively few acres on the Chattahoochee that did not have a cost effective prescription ad none on the Oconee. In addition, their pattern of distribution was widely scattered. There were no 'clumps' that would have indicated an opportunity to improve the alternatives by a re-allocation to a non-timber output management prescription. The IDT concluded that economic efficiency had been dealt with strategically and future projects could refine its consideration site specifically if needed.

In addition, between draft and final the decision was made to not model sustained yield from slopes greater than or equal to 45-percent slope. These slopes require an overhead cable or helicopter logging system. These lands were not reallocated to a management prescription that was not appropriate but they were given a low intensity management regime. It is these areas more than any other that have the greatest likelihood of requiring new road construction or extensive reconstruction of existing roads to reach cable setup locations. This decision removed some, but not all, of the not cost effective land.

STAGE 3 SUITABILITY

From the tentatively suited acres are subtracted lands for which a planned, periodic timber harvest would preclude the achievement of other non-timber management objectives. In tables F-4 and F-5, these are the "Forest land not appropriate for timber production" category. These lands are within the decision authority of the Regional Forester to plan for a sustain yield harvest regime or not. In the 1985 plan, these lands were called "not appropriate – other objectives cannot be met". This judgment was made as part of the process of crafting the individual management prescriptions.

In the table below, the unsuitable management prescriptions within the Regional Forester's decision authority; that is, the 'not appropriate for timber production' prescriptions and the net acreage of each are identified for the plan for each of the Chattahoochee and the Oconee. Net acres do not include 'rocklands'. These figures are the basis for monitoring changes in plan allocations that would affect estimated harvest volumes.

Table F-7: Management Prescriptions Allocated to an Emphasis Not Appropriate for Timber Production for Each of the Chattahoochee and the Oconee.

MRx. ID	Management Prescription Name	Net Acres
CHATTAHOOCHEE NATIONAL FOREST		
0	Custodial Management	1,926
1.B	Recommended Wilderness Study Areas	7,920
2.B.1	Recommended Wild & Scenic Rivers - Wild Segment	2,120
2.B.2	Recommended Wild & Scenic Rivers - Scenic Segment	524
3.D	Proposed Ed Jenkins NRA Addition	2,029
4.A	Appalachian Trail Corridor	16,553
4.D	Botanic & Zoologic Areas	3,159
4.E.1	Cultural & Heritage Areas	191
4.F	Scenic Areas	18,020
4.F.2	Regional Forester Scenic Areas	4,728
4.H	Outstandingly Remarkable Streams	17,597
4.I	Natural Areas with Few Open Roads	17,484
6.B	Areas Managed to Restore or Maintain Old Growth Characteristics	27,129
7.E.1	Dispersed Recreation Areas	74,153
9.F	Rare Communities	425
12.A	Remote Backcountry Recreation - Few Open Roads	28,143
	Chattahoochee Total 'Not Appropriate for Timber Production'	224,744
OCONEE NATIONAL FOREST		
0	Custodial Management	142
2.B.2	Recommended Wild & Scenic Rivers - Scenic Segment	4,854
4.D	Botanic & Zoologic Areas	1,215
4.E.1	Cultural & Heritage Areas	111
4.H	Outstandingly Remarkable Streams	4,450
5.A	Administrative Sites	102

6.B	Areas Managed to Restore or Maintain Old Growth Characteristics	1,617
7.E.1	Dispersed Recreation Areas	917
9.F	Rare Communities	19
	Oconee Total 'Not Appropriate for Timber Production'	13,427

Source: Plan revision GIS stands data layer September 2003.

Table F-8: Management Prescriptions Suitable for Timber Production for Each of the Chattahoochee and the Oconee.

MRx. ID	Management Prescription Name	Net Acres
CHATTAHOOCHEE NATIONAL FOREST		
4.F.1	Scenic & Wildlife Management Areas	18,342
6.D	Core Areas of Old Growth Surrounded by Extended Forest Rotations	594
7.A	Richard Russell & Ridge/Valley Scenic Byway Corridors	12,399
7.B	Scenic Corridors and Sensitive Viewsheds	16,545
7.E.2	Dispersed Recreation Areas with Vegetation Management	22,438
8.A.1	Mid to Late Successional Forest Emphasis	68,202
8.A.2	Area Sensitive Mid to Late Successional Forest Emphasis	23,658
8.E.3	High Elevation Early Successional Habitat	6,581
9.A.1	Source Water Protection Watershed	9,302
9.A.3	Watershed Restoration Areas	17,596
9.H	Management, Maintenance, and Restoration of Plant Associations to Their Ecological Potential	171,705
	Chattahoochee Suitable Forest Land	367,362
OCONEE NATIONAL FOREST		
3.B	Scull Shoals Experimental Forest	4,690
7.E.2	Dispersed Recreation Areas with Vegetation Management	8,100
8.D	Red-cockaded Woodpecker Habitat Management Area	31,209
8.D.1	Red-cockaded Woodpecker Sub-Habitat Management Area	15,408
9.H	Management, Maintenance, and Restoration of Plant Associations to Their Ecological Potential	34,495
	Oconee Suitable Forest Land	93,902

Source: Plan revision GIS stands data layer September 2003.

II. PROJECTED HARVEST LEVELS

From the prescriptions and acreages identified above, SPECTRUM models estimates of timber volume production were generated. Details of model formulation are in Appendix B of the EIS 'Description of the Analysis Process'.

Before reviewing numbers output by the model, it is important to understand some aspects of its behavior that are built in. The National Forest Management Act requires that National Forest management; (a) be managed to ensure a 'non-declining even flow' of timber, and (b) generally not exceed a 'long term sustained yield capacity'. Non-declining even flow means that within the long term sustained

yield productive capacity of the land, harvest levels may go up but never down. This requirement was originally specified in order to provide stability to a wood-using economy. Long-term sustained yield (LTSY) is defined in the NFMA implementing regulations as "*the highest uniform wood yield from lands being managed for timber production that may be sustained under a specified management intensity consistent with multiple-use objectives."* The LTSY is a single, unvarying value calculated considering the entire modeling period; or – in our case – 200 years, so as to avoid harvest levels that would exceed the potential growth capability of the land to re-grow considering the variation in amount of forest cover, differential growth rates by species, varying site productivities by species, and the variation in growth rates for the same species at different ages.

The volume by decade across several decades is called a 'base sale schedule' which is defined in 36 CFR 219.3 as '*A timber sale schedule formulated on the basis that the quantity of timber planned for sale and harvest for any future decade is equal to or greater than the planned sale and harvest for the preceding decade, and this planned sale and harvest for any decade is not greater than the long-term sustained yield capacity.'* In implementation of this plan, a target volume could be proportioned annually to each District to produce within Plan constraints. Proportioning would be based on such things as acres of suitable prescriptions as modified by needs such as insect or disease management. The volume for the first decade alone is typically called the 'ASQ.' The term stands for 'allowable sale quantity'. The allowable sale quantity is defined at *36 CFR 219.3* as '*The quantity of timber that may be sold from the area of suitable land covered by the forest plan for a time period specified by the plan.*' Note that ASQ is for suitable land only.

Table F-9 below shows estimated volume by each of the four major product and species groups and by both 'green' and salvage volumes for the first decade only. The sum of these two program components is the total sale program. Values shown are decadal because annual fluctuations can be expected that would produce departures on an annual basis but monitoring of sale program level is against the decadal ASQ. Salvage volume is an estimate only. It was calculated by using a 0.5-percent per year rate of natural disturbance for approximately all unsuitable acres that permit salvage harvest. The early-successional wildlife habitat objective of 0 to 4-percent (option 2) was used as the surrogate to estimate the appropriate acreage. That is, the acreage of unsuitable management prescriptions with this wildlife habitat objective were summed for the area to be considered for salvage volume over and above green harvest the area estimated to receive salvage was multiplied by an average per acre volume figure to derive a salvage total. That total was proportioned to the four product groups in two steps; (1) an estimated 60-percent overall was estimated to be pine salvage, and (2) volume was proportioned to product groups using the same proportions as their occurrence in the 'green' program. In the green program, pine is 63-percent of the total.

Using an annual rate as a basis for salvage estimation is not meant to imply that salvage will occur in that manner. Rather salvage will be episodic with some years having none, some years having minor amounts, some years having a significant

proportion, and some years being all salvage. For instance, with southern pine beetle epidemics occurring about every seven years, if there were no salvage in intervening years from other causes, a 3.5-percent (7 years X 0.005/year) area of host type salvaged would fit the average. That amount is consistent with experience of the amount of host type affected in an outbreak.

Table F-9: Estimated Chattahoochee-Oconee NF Total Sale Program in MMCF for Decade 1.

Program	LTSY (MMCF/ decade)	Hardwood (MMCF/decade 1)		Softwood (MMCF/decade 1)	
		Sawtimber	Pulpwood	Sawtimber	Pulpwood
Green (ASQ)	160	21	12	64	12
Salvage	n/a	12	4	19	4
Program By Product		33	16	83	16
Total Sale Program					148

Source: SPECTRUM model outputs September 2003.

Table F-10: Estimated Chattahoochee-Oconee NF Total Sale Program in MMBF for Decade 1.

Program	LTSY (MMBF/ decade)	Hardwood (MMBF/decade 1)		Softwood (MMBF/decade 1)	
		Sawtimber	Pulpwood	Sawtimber	Pulpwood
Green (ASQ)	880	116	66	352	66
Salvage	n/a	66	22	104	22
Program By Product		182	88	456	88
Total Sale Program					814

Source: SPECTRUM model outputs September 2003.

III. VEGETATION MANAGEMENT

The implementing regulations for the National Forest Management Act at 36 CFR (Code of Federal Regulations) 219.15 require that

"The vegetation management practices chosen for each vegetation type and circumstance shall be defined in the forest plan with applicable standards and guidelines and the reasons for the choices."

The focus here is on chosen practices and the reasons for the choices. At a strategic plan level, the choices are defined only to the level of recommending some practices and not others. At project-level planning, further documentation may be required, such as complying with the National Forest Management Act requirement of

optimality in the use of clearcutting. Management practices are identified here for eleven woody vegetation types or type groups as either recommended, recommended with conditions, or not recommended, Circumstances are the biology of the various species, legal constraints such as compliance with the Endangered Species Act, social concerns as identified by plan issues, physical practicality, economic practicality, and constraints imposed by individual management prescriptions. Applicable standards are in chapters 2 and 3 of the plan. Guidelines are generally in Plan implementation guidance, however some general guidance is also provided in this document on the calculation of early successional habitat.

More detail is being given here than is absolutely necessary. This is being done for the benefit of the general public as well as for non-foresters within the Forest Service or co-operating agencies. The detailed information forms the context and background for the reasons for choosing specific vegetation management practices.

This section of this appendix evaluates various practices to manage forests and gives the reasons for recommending or not recommending them. The evaluation applies primarily to lands allocated to management direction that includes planned, sustained yields of wood products; that is, 'suitable' lands. But it also applies to those lands without planned periodic timber harvest (unsuitable lands) where manipulation of tree cover is needed on an unscheduled basis to reach desired conditions. Recommending a practice is primarily based on the biology of the tree species: otherwise known in forestry terminology as 'silvics'. Silvics is '*the study of the life history and general characteristics of forest trees and stands, with particular reference to environmental factors, as a basis for the practice of silviculture.'*

Silviculture is *"The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis."* (The Dictionary of Forestry, Society of American Foresters, 1998). Silviculture is applied ecology. It is a specialization within a larger field called 'vegetation management'. Vegetation management generally is concerned with all types of plants such as turf grasses, pasture grasses, forests, agricultural crops, and ornamentals. Silviculture is concerned with woody plants and more specifically with trees. The terms 'silviculture' and 'forestry' are sometimes used inter-changeably they are so closely related, though in fact silviculture is only one facet of forestry.

In practice, 'classic' silviculture is often modified for other values, especially on National Forest. For example, trees may be left un-harvested for wildlife food production; to reduce visual contrasts; to provide visual variety of form, color, or texture; to provide future wildlife dens, and so on. In the past ten to fifteen years, traditional forestry terminology has become less and less descriptive of intention. Various wordy modifiers have been introduced to try to sort out the confusion but without complete success.

The basic unit of silvicultural practice is the 'stand'. A stand is defined as a vegetation community sufficiently homogeneous in characteristics to be identified

from its neighboring communities. Characteristics considered in delineating a stand within Forest Service practice are many and include species composition, age, density, and tree quality. Additional characteristics may be considered such as slope, moisture regimes, or ecological potential for growing a different community. On the Chattahoochee and Oconee typical stand sizes range from ten to thirty acres and the total number of stands mapped by field inventory as of the year 2000 was about 23,000 distributed among forty-four individual forest cover types. A complex mosaic of conditions at a landscape scale of several thousands of acres is the typical environment in practicing silviculture.

… to meet the diverse needs and values of landowners and society…

Silviculture is a *means.* Good silviculture has been characterized as that which best meets the objectives of the owners. For example, the principles and practices of silviculture are equally useful in managing for conditions that do not include timber harvest. On the National Forest, the owner of record for legal purposes is the United States. Actually, however, the owners are the American public. The Forest Service administers the land for the uses and benefits of the public as the steward of a public trust. With over 260 million Americans, desires for goods or services from the forest are many and varied. Some of them require the practice of silviculture. Some of them do not.

controlling the … growth,

The primary basis for all vegetation management is plant physiology. It may be assumed that plants of one kind or another will use all available growth resources. It is also true that plants vary in the exact nature of the growth resources they require. Silviculture is about making growth resources more available to the desired woody species (primarily trees) than to their competitors. Growth resources are nutrients, light, water, and physical space. Of particular importance is each species response to light, since it is the basis of photosynthesis. Some species, called ‘tolerant’ can grow under the shade of a canopy. Other species, called ‘intolerant’ cannot. The variability of growth factors in the physical environment and the variability in their use among tree species form the complex basis of silvicultural practice. In addition, silviculture is also concerned with protection from insects or disease, economics, and the non-market values obtained from the forest. When all of these are combined, a very challenging management environment results.

Shown in the following table are the shade tolerance rankings of the common tree species of the Chattahoochee and Oconee in order from most to least shade tolerant. Of particular importance is the number of species that are either very tolerant or tolerant that are typically small understory trees; for example, dogwood, sourwood, and hornbeam. Other tolerant species that are capable of becoming overstory trees yet occur most frequently as understory stems because they are able to establish and persist in those conditions. In the table, the canopy position a species is *capable* of reaching is shown as ‘O’ for ‘overstory’ and ‘U’ for ‘understory’. See also the tables

in the Forest Cover topic of the EIS for details of the number of stems by species in the old growth communities of the Chattahoochee and Oconee.

Table F-11: Shade Tolerance Ratings and Typical Canopy Positions of Common Species on the Chattahoochee and Oconee National Forests.

Species	Canopy Position	Shade Tolerance	Species	Canopy Position	Shade Tolerance
Hemlock	O	Very tolerant	Black oak	O	Intermediate
Sugar Maple	O	Very tolerant	White pine	O	Intermediate
Persimmon	O	Very tolerant	Northern red oak	O	Intermediate
American beech	O	Very tolerant	Hackberry	O	Intermediate
White ash	O	Very tolerant	Cucumbertree	O	Intermediate
Ash	O	Very tolerant	Sycamore	O	Intermediate
American hornbeam	U	Very tolerant	Chestnut oak	O	Intermediate
American holly	U	Very tolerant	Red cedar	O	Intolerant
Florida maple	U	Tolerant	Virginia pine	O	Intolerant
Red maple	O	Tolerant	Birch sp.	O	Intolerant
Green ash	O	Tolerant	Black birch	O	Intolerant
Blackgum	O	Tolerant	Sweetgum	O	Intolerant
Basswood	O	Tolerant	Blackjack oak	O	Intolerant
Elm	O	Tolerant	Post oak	O	Intolerant
Winged elm	O	Tolerant	Pitch pine	O	Intolerant
Southern magnolia	U	Tolerant	Yellow poplar	O	Intolerant
Boxelder	O	Tolerant	Shortleaf pine	O	Intolerant
Buckeye	O	Tolerant	Loblolly pine	O	Intolerant
Eastern redbud	U	Tolerant	Table Mt. pine	O	Intolerant
Silverbell	U	Tolerant	Black walnut	O	Intolerant
Eastern hophornbeam	U	Tolerant	Black cherry	O	Intolerant
Mulberry	O	Tolerant	Chinkapin oak	O	Intolerant
Sourwood	U	Tolerant	Swamp chestnut oak	O	Intolerant
Laurel oak	O	Tolerant	Water oak	O	Intolerant
Dogwood	U	Tolerant	Sassafrass	O	Intolerant
Hickory	O	Intermediate	Scarlet oak	O	Very intolerant
White oak	O	Intermediate	Black locust	O	Very intolerant
Southern red oak	O	Intermediate	Willow	O	Very intolerant

Source: Species list from Forest Inventory and Analysis plot data, shade tolerance ratings from USDA Forest Service, 1990. Silvics of North America, Volume 1, Conifers. Agriculture Handbook 654. Russell M. Burns and Barbara H. Honkala, Technical Coordinators. Page 646-649 'Summary of Tree Characteristics'

Note that in Table F-11 that understory species are limited to the tolerant or very tolerant categories; that is, they can establish and grow in shade. Note also that of forty-seven total overstory species, sixteen of them or 34-percent are either tolerant or very tolerant. Only ten species, or 21-percent, are intermediate. Forty-two percent, or twenty species, are intolerant. In general, the oaks are intermediate in tolerance, except for scarlet oak, and the pines are intolerant, except for white pine. Together, these two species groups account for most of the forest cover on both the Chattahoochee and the Oconee.

controlling the establishment… on a sustainable basis

First and foremost, silviculture is concerned with being able to replace the tree cover removed by cutting or natural catastrophe back on the same area, provided it was ecologically well-suited to that situation to begin with and it met the objectives of the owners. This is the 'establishment' part of the definition. Sustaining a particular vegetation community on the landscape by 'natural' means requires that it be able to replace itself by new young forest if the canopy is removed, whether by human

agency or natural events. Conditions necessary for regeneration are: (1) a source of seeds; (2) seed production in excess of natural loss; (3) a receptive seedbed such that seed germinates then becomes established in mineral soil as new plants before seed energy is expended, (4) a switch to photosynthesis on its own; (5) continued light regimes of wavelengths that support photosynthesis for that species; and (6) height growth into the main canopy. For the major tree species groups of the Southern Appalachians and Piedmont; the oaks and yellow pines, achieving these conditions requires at least two further conditions; (1) some form of competition control, and (2) one or more mechanisms which episodically create gaps in the main overstory canopy.

Tree species have various reproductive 'strategies'. Some species rely on establishment from seed with little 'lag time' between seed production and establishment on a receptive seedbed. An example is Virginia pine. It is a prolific seed producer every year and is therefore always ready to seize an opportunity to establish itself. Some species establish from seed in micro-habitats and their numbers increase slowly over time. An example is hemlock that is able to establish and persist as a seedling on the forest floor underneath other species. Some species establish and grow for a time, then dieback and re-sprout over and over. The sprouts can grow very fast in height if they sprout when conditions are very favorable. However if they dieback and re-sprout in shade, these sprouts cannot respond with rapid height growth if given more light, nutrients, and growing room. Oaks and hickories typically exhibit this pattern. A few species rely on vegetative reproduction in which pieces of the parent tree break off, root, and become a new tree. An example is willow. It is typical for many (but not all) trees to use more than one strategy but with one being primary. For example, short-leaf pine establishes from seed but when young can re-sprout if top killed such as by fire. The key concept is: (a) the ability to establish, and (b) the ability to persist.

Where reproduction that can be counted on to be competitive is in place prior to the intent to regenerate a stand, it is called 'advance reproduction'. Using it to regenerate a new stand may require cutting or burning it to stimulate competitive sprouts. But for species such as hemlock, beech, or sugar maple; retaining large (greater than or equal to 4" dbh) advance reproduction is key to keeping it competitive in a new stand.

controlling the establishment..

Establishing a new forest means securing the desired number, species, and distribution of free-to-grow trees. As part of natural dynamics, several hundreds of young stems of the desired species are required to reach a target composition in a mature forest approximately one hundred years later. Re-stocking may be accomplished by either natural or artificial means. In simplest terms, 'natural regeneration' means without planting or seeding. Artificial regeneration means with planting of nursery-grown seedlings or planting of seed. As part of the regeneration process, areas being reforested are usually 'site prepared'. Site preparation is for the purpose of creating an available growing niche in both above-ground and below-

ground space. In part, that usually requires some form of competition control. Methods of site preparation include mechanical, chemical, prescribed burning, or some combination. Even with site preparation, competition may grow faster than new seedlings and begin shading them. For some species such as the yellow pines, a 'release' treatment removes this competition and overhead shade. Release may be by hand tool or mechanical cutting, prescribed burning (if fire tolerance of desired trees exceeds that of competitors), herbicide, or grazing (if desired trees are avoided). Release treatments also include managing species composition by removing some species and favoring others. On National Forest, release typically favors both oaks and pines in mixture on dry sites; that is, there is no intent to create or maintain single-species stands.

The Forest Service is directed by the National Forest Management Act to re-establish stands within 5 years of the final harvest. Final harvests are clearcuts, seedtree removals, and shelterwood removals. Uneven-aged harvest is not subject to this requirement.

controlling the… growth, composition, health, and quality of forests and woodlands

Once a new forest is established, it is tended through a series of 'intermediate treatments'. They are called intermediate because they occur between establishment and final harvest. The earliest treatments are either 'pre-commercial' or 'non-commercial' thins. Thinning is reducing the number of stems and selectively removes slow–growing, damaged, diseased, poorly-formed, and low-quality stems; as well as species not a part of the desired composition. A pre-commercial thin removes trees not yet of a size to be sold as a product. A non-commercial thin removes trees of a size large enough to be sold as a product but without a sale because of market conditions, access, or other factors that make it infeasible. Between one and three Thinning timber harvest may also be used at intervals of from ten to twenty years. Each time a harvest occurs, it is called a 'harvest entry' or simply an 'entry'. Pruning may also be used to remove limbs within approximately thirty feet of the ground. The purpose of pruning is to allow for more knot-free wood to be grown on the lower bole of pruned trees. Knot-free wood, especially in hardwoods, has the highest value.

Harvest occurs using logging systems. These are of two basic kinds; (a) ground-based, and (b) aerial. Ground-based systems move harvested trees using wheeled or tracked equipment from the tree stump to where they are loaded on trucks. Ground-based systems are the most commonly used. Aerial systems move trees suspended above the ground. The three basis systems are; cable, balloon, and helicopter. In the Eastern US, cable has historically been used for high-value timber in otherwise inaccessible locations. Inaccessibility may be because of a lack of roads or because of operating limits of ground-based equipment. For example, cable logging has historically been reserved for slopes too steep for rubber-tired skidders to travel overland, or above about 40-percent. With cable systems, trees are moved to loading areas by means of an overhead cable.

OVERVIEW OF SILVICULTURAL SYSTEMS

Individual silvicultural practices are integrated into comprehensive 'systems'. A silvicultural system is the complete regime of vegetation community tending from tree establishment to final harvest. Silvicultural systems were originally developed in Europe for European species and conditions during the Middle Ages, and then adapted in the early twentieth century to American species and conditions. In either case, first the individual silvicultural treatments and later their coalescing into a complete system was, to a greater or lesser degree, a mimicry of what was at first observed in nature then later studied, measured, and recorded through forestry field work and scientific research. Over the years of application and development, the total range of practices as well as the intensity within them has widened. Private sector landowners with small acreages may use low-cost, extensive methods. Forest industry may use very intensive practices, including genetic crosses and fertilization. The Forest Service is in approximately the middle or below of the full range and the trend over the past fifteen years has been toward less intense practices.

Silvicultural practice is grouped into 'even-aged' and 'uneven-aged' categories. These categories are sometimes called a 'system' and sometimes the individual methods within each category are called a 'system'. In the strictest technical sense, the latter is the most correct. A system consists of an integrated series of individual treatments that take a stand from its initial establishment until it is harvested for the establishment of a new forest; that is, a final harvest. Traditionally, the name of the final harvest method is applied to the entire system; for example, a 'single-tree selection system'. The basic final harvest options form a continuum from a relatively low to a relatively high degree of disturbance; that is tree removal and site preparation. From least to most complete tree removal these final harvest options are; single-tree selection, group selection, shelterwood, seedtree, and clearcut. Response to catastrophic natural events may involve salvage that is not a silvicultural system or removing diseased trees in a sanitation cut is not a system. Salvage or sanitation cutting may be used in any one of the other systems in response to epidemics of insect or disease or catastrophic damage of some kind. Depending upon the severity of the damage, the original silvicultural system may have to be abandoned because it is infeasible to continue to implement it. Of the silvicultural systems, single-tree and group selection are 'uneven-aged' systems intended to create an intermingling of the desired trees of at least three distinct ages. The other three systems are 'even-aged' and result in an intermingling of trees of at most two distinct ages. The primary difference between these two is the scale of the distribution of this age and size variation.

Uneven-aged and even-aged management will each be discussed separately in general terms as a lead-in to the evaluation of specific systems within each.

Uneven-aged Management (UEAM) Systems

In uneven-aged stands with only the desired trees counted, the greatest number of stems is in the smallest diameters then the numbers steadily decrease as diameters increase. (Desired trees are those capable of forming a main, high canopy; that is, not including woody shrubs or small understory trees such as dogwood.) When graphed as points of the number of stems in each diameter class and the points connected by a line, the desired result is a smoothly-curving line descending steeply from left to right and gradually becoming flatter and flatter. In forestry terms, this is the classic 'reverse J-shaped curve' of stand structure. These stands have a great variety of stem density, tree heights, and continuity of the canopy at the scale of several hundreds of acres. When an uneven-aged stand is 'balanced', that is, has the appropriate number of stems in each size class, the line is a smooth curve. In actual practice, only an approximation of this ideal is ever reached.

The idea of uneven-aged management is elegant in its simplicity; replace each cut tree with a new one while maintaining a mature tree cover. But they are the most difficult silvicultural systems to use. Their use is complicated by biological, physical, economic, and administrative factors.

Biologically uneven-aged management is typically difficult to begin. The buildup of tolerant midstory and understory species and accumulations of thick layers of organic debris on the forest floor due to fire exclusion often precludes new seedling establishment of the overstory species. Understory control for seedling establishment and development (stand pre-conditioning) for all but the most tolerant species will be required initially and will require repeated treatments. Without managing the understory, seedlings die once seed energy is expended because they cannot switch to photosynthesis on their own. If seedlings do establish, overhead shade retards their development. Some species, such as the yellow pines, die within a few years in shade. Other species, such as the oaks, may persist in shade but become incapable of response to increased light if the canopy is subsequently reduced. These are non-competitive with faster-growing species and cannot reach the main canopy. If, however, they are top-killed, their sprouts can be competitive because of having a well-established root system. The key is both to have seedlings establish *and* to ensure their continued growth into the main canopy. The earliest 'red flags' of a failing UEAM system are either: (a) a failure to have previously-inventoried regeneration develop into the next diameter class, or (b) no regeneration present in the understory following a harvest entry.

Physically, stands managed by UEAM methods need to be readily accessible and also on terrain permitting ground-based logging systems. Repeated harvest entries on a comparatively short cycle (in comparison to even-aged management) creates a need for an established system of log landings, skid trails, and access roads. But the low volumes removed make high-cost developments such as road construction economically infeasible. Cable logging systems are not practical because of the near-impossibility of physically moving trees through a relatively dense residual stand, damage to residual trees, and high costs with low revenues.

Economically, UEAM systems are hampered by the need to tend the entire stand in each harvest entry. Stand-tending includes removing sub-merchantable stems, pole-sized stems, small sawtimber stems, and large sawtimber stems all in one operation. Of these, the large sawtimber with the highest product value is the smallest number of stems removed. Most material is in smaller diameters with lower values. For the system to remain viable, these stems and their effects cannot be ignored.

Administratively, uneven-aged systems are more complex to plan and implement. Inventories need greater detail and more intense sampling. Careful consideration needs to be given to the layout of roads, skid trails, log landings, and stream crossings as they are expected to be used over and over. The need for large contiguous areas of homogenous conditions conflicts with complex terrain, dense stream networks, small stand sizes, and large numbers of forest cover types. These complexities require flexibility in implementation and an adaptability in personnel that takes some time to develop.

Single-tree selection

With a single-tree selection system, harvest is of either individual trees or of a small group of typically two or three trees. The size of the opening created in the main canopy is smaller in any dimension than the height of trees in the stand. The forest floor within the opening remains shaded from the sides, but the light intensity is higher than it was before because at some time in day the sunlight shines into the gap. The system mimics the 'gap dynamics' in nature of the death of single large trees, the windthrow of a large tree that then knocks down others as it falls, lightening strikes, non-epidemic southern pine beetle spots, root disease, and other small scale natural events.

For most of our species in the Southern Appalachians and Piedmont, there is a narrow range of *biologically valid* parameters for single-tree selection. Management parameters of the system include; the largest tree, the timing of harvest entry, and the number of stems left. Of these, the number of stems left has the most to do with the success or failure of the system. If the values of these parameters are set so as to create a 'window' of conditions outside the ability of the species to adapt and grow, the system must fail. The smallest 'window' is with the most shade intolerant species and it gradually widens with increasing shade tolerance.

A fine balance is needed between establishing desired regeneration and providing for its development or so stimulating competition that desired trees are overwhelmed. The system as implemented needs to be robust enough to accommodate failures to secure regeneration in any one cycle without causing the whole system to fail. If operating near the biological limits of species, single-tree selection will require more intensive treatments for site preparation, release, pre-commercial thinning, and non-commercial thinning to first establish regeneration and then to maintain its development into the canopy. The biology of the desired overstory composition is very likely to over-ride concern for operability and cost-efficiency in the selection of working parameters; that is, treatments that are costly to implement or have a low return in revenues will have to be done for the system to be viable. Encumbering the

system with numerous other constraints such as retention of future den trees, visual quality mitigations, and so on could easily, if misapplied, cause the system to fail.

Single-tree selection has been successfully used in Arkansas with shortleaf pine, showing that it can be done even with very intolerant species. However, the ecological conditions there are very different from the Chattahoochee or the Oconee.. For example, average annual rainfall is approximately 45 inches, compared to between 55 and 75 inches per year in Georgia. Stands typically have les s understory hardwood competition. Even so, the successful use of single-tree with yellow pine has also required broadcast herbicide treatments of hardwood mid- and understory. Currently, burning is showing some promise in replacing herbicide use but in Georgia eight to ten cycles of dormant season burning and felling or injection of stems in the 4-inch to approximately 8-inch diameter range (dbh.) can be expected to be required before hardwood competition control is adequate to secure regeneration and its development. Mechanical treatment of understory, prescribed burning, and thinning together could be used to accelerate development of desired conditions, particularly if growing season burning could be part of the mix because it is much more effective in controlling hardwood than is dormant season burning alone.

Single-tree selection is being attempted – so far unsuccessfully - in Appalachian oak on the Bent Creek Experimental Forest on the outskirts of Asheville, North Carolina. Single-tree began there in the late 1940's and after thirty years there had been very little recruitment of new regeneration into the canopy. In the 1970's, the tolerant hardwood understory was treated with herbicides. Since that time, regeneration status has improved by it is still too early to tell if it will develop into the main canopy.

Administratively, single-tree selection requires more detailed data collection and analysis. A sample of all stems must be taken and compiled into a representative 'picture' of the existing condition. The data also has to be systematically analyzed and compared to the desired 'reverse J-shaped curve' distribution then targets set for residual stem numbers by diameter class to reach it. Marking trees to be cut requires either experience with the system or continuous monitoring of results. Even then treatments typically produce only an approximation of the target distribution and must be continually adjusted at each entry. Particularly difficult is converting an even-aged stand structure to an uneven-aged one because there are large excesses of stems in some diameters and large deficits in others. The conversion process can take thirty years or more. Natural disturbance at any time could, and often would, so change the stand structure that significant re-adjustments would be needed, including ending single-tree selection and switching to another system.

When single-tree selection is used with species of intermediate tolerance or intolerant species and type conversion is not an objective, it is likely that no more than three age classes can be created and maintained. The more age classes that are attempted to be created and maintained, the more demanding and unforgiving (less robust) the system will become and thus the more likely it will be that some entries will not result in regeneration, harvest volume will be inoperable, etc If only

three age classes are created and maintained, harvest entry intervals will either not be uniform or will occur approximately every twenty to thirty years.

Group selection

In the group selection system, harvest is of small, scattered 'groups' of trees. The group size varies from approximately one acre to about two acres. Typically, the micro-climate within the group is modified by the surrounding stand. The system mimics such natural events as thunderstorm micro-bursts, 'hot spots' in wildfires, insect attacks, or other events that affect groups of trees. Few, if any, residual trees are left within the groups. As group size increases, it begins to blur into even-aged systems. For example, it is but a small step from groups of 1 to 3 acres to 'patch clearcuts' of 3 to 5 acres.

The group selection system is intermediate between single-tree selection and even-aged systems. Biologically, it provides better conditions for more intolerant species, but still not optimum. Physically, well-roaded and contiguous areas of several hundred acres on gentle to moderate terrain are still needed. Economically, volumes harvested are low per unit area and can be expected to result in lower prices bid. The system is not difficult administratively as it does not require the detailed data collection and analysis of single-tree selection. Separate records are not kept of individual groups and after about three harvest entries they tend to start losing their identity.

Even-aged Management (EAM) Systems

In traditional even-aged silviculture, stands are 'rotated'; that is, harvested and replaced on a pre-planned basis. When a stand reaches a specified 'rotation age' it is scheduled to be harvested. Harvest scheduling is relatively simple in concept since in any given year the area harvested is equal to the acres divided by the rotation age. For example, if the rotation age is 70 years and the land area with planned harvest is 70,000 acres, the annual harvest is 1,000 acres. The range of tree ages present within a managed stand is constrained to be no more than 20-percent of the rotation age. In the example, this would be 20-percent of 70 or 14 years.

This system creates a mosaic of single age class stands across the forestlands designated as suitable for producing forest products. When a stand reaches the desired rotation age, harvesting is scheduled to remove all or most of the merchantable trees in the stand. In even-aged stands and considering only desired trees the greatest number of stems is in the average diameter then the numbers steadily decrease as diameters either increase or decrease. (Desired trees are those capable of forming a main, high canopy; that is, not including woody shrubs or small understory trees such as dogwood.) When graphed as points of the number of stems in each diameter class and the points connected by a line, the result is a line that first ascends steeply from left to right then flattens, gradually curves over and descends steeply to the right. The profile created is one of a 'bell-shaped curve'. In comparison to the desired stems within uneven-aged stands, within each of these stands there is a lower variety of stem density, tree heights, and continuity of the canopy at the scale of ten to fifty acres. At a landscape scale of a thousand to several

thousands of acres, these separate blocks with relatively low variation within them aggregate to great variation on the landscape. The numbers of stems over diameter classes graphed for even-aged stands at the scale of several thousands of acres once again produces the 'reverse J-shaped curve.' That is, even-aged management produces an uneven-aged landscape forest structure.

Paradoxically, as even-aged stands age they can develop an uneven-aged arrangement of stem sizes when all species are considered and not just the overstory canopy. This is the prevalent situation on both the Chattahoochee and the Oconee. While they have the classic uneven-aged structure of stems, they cannot be managed as uneven-aged stands. The smaller size classes are tolerant understory species, many of which are not capable of growing to a high canopy. If they are, such as with white pine understory in an oak stand, species conversion would result. The reader is referred to the 'Forest Cover' topic of the EIS for the numbers that substantiate this conclusion.

Shelterwood

The shelterwood system is one in which new regeneration develops underneath the shelter of trees from a previous forest. The final harvest; the 'shelterwood' part, is implemented in stages of from two to three operations. If two treatments are used; a seed cut followed by a removal, the system is called a 'two-stage shelterwood'. If three treatments are used; a prep cut, a seed cut, and then a removal, the system is called a 'three-stage shelterwood'. The prep (preparation) cut is for the purpose of developing the trees to provide seed. The seed cut is intended to create conditions to establish seedlings. The removal cut harvests the residual trees, leaving only the new stand. To complicate things a bit further, shelterwood can be 'regular' and 'irregular' in application. If the system is a 'regular' one, the residual trees from the previous stand are removed; that is, the removal cut occurs. If 'irregular', the removal cut does not occur and the old residual trees remain indefinitely along with the new stand.

In stands that have been undisturbed for long periods, the prep cut of a shelterwood may not be a commercial harvest at all. Rather it may be the treatment of midstory and understory stems to reduce competition. In other words, it is an 'advance site preparation'. This type of treatment has been used on the Bent Creek Experimental Forest to develop established northern red oak seedlings so that they are competitive with other species, particularly yellow poplar, when the stand is opened up further.

After the seed cut and when viewed from above, tree canopy covers approximately 20 to 30-percent of the area; that is, the large tree density is low. Tree density is typically in the range of from ten to forty trees per acre. Natural events that could create comparable conditions might include wildfire, blow down followed by fire, and selective tree mortality due to insects or disease.

The shelterwood system is most applicable with species characterized as intermediate in tolerance. Most, but not all, of the oaks fit this description. These species can develop well in less than full sunlight but need more light than is available under a continuous canopy.

Seed tree

In the seed tree system all trees are harvested except for approximately five to twenty per acre that are left to produce seed. Tree species adapted for this type of treatment are intolerant and typically require a mineral soil seedbed or at least a sparse cover of organic debris. Best examples are the various southern yellow pines; shortleaf, loblolly, pitch, and Table Mountain. Site preparation to prepare a seedbed may occur at very nearly the same time as the harvest or be delayed until a good seed crop occurs. Seed trees are typically removed within five to ten years.

Natural events that could create similar conditions would be tornados or southern pine beetle attacks followed by intense wildfire, catastrophic wildfire alone, or perhaps a frequent burning regime that created a sparse ground cover of grass, forbs, and scattered woody species. Particularly on the Chattahoochee, a prevalent historic condition at about the time of Forest Service land acquisition was a low-density overstory above a forest floor burned as frequently as every one to three years.

With the seedtree system, the timing of site preparation needs to coincide with a seed crop or the stand has to be maintained in a condition to ensure seedling establishment when seed production does occur. Seed crops vary considerably and sometimes too few seedlings become established and at other times there are too many. In good to excellent seed years, the very high number of seedlings that become established creates a need for pre-commercial and commercial thinning to maintain growth and reduce susceptibility to other problems such as southern pine beetle attack in the yellow pines.

Clearcut

Clearcutting involves near-complete removal of woody stems. In forestry usage, the ‘clearcut’ is the removal of all commercially valuable stems (merchantable stems) at one time. It is typically used with species that benefit further from the removal of the remaining non-merchantable stems by felling, mechanical equipment, herbicide, or prescribe burning. Clearcutting may be chosen when past practices have so limited the present options to use other systems that ‘starting over’ is the best choice. When it is used, regeneration is often by artificial means, sprouts of pre-existing vegetation, or from seed stored on the forest floor. For example, oaks are very reliable sprout producers and yellow poplar seed can remain viable in the leaf litter on the forest floor for years then respond to increased light by germinating. Particularly when planting is used, a high degree of control on numbers of seedlings per acre can be maintained.

SILVICULTURAL SYSTEMS CONSIDERED

Silvicultural systems, harvest methods, and other vegetation management practices are described and evaluated as they apply to eleven vegetation types or type groups that occur on the two National Forests in Georgia.

Woody vegetation types occupying a minor number of total forest acres, non-woody desired vegetation communities such as canebrakes, and/or vegetation types of very small acreages within management prescriptions that are suitable for timber production are not specifically addressed in this appendix. Instead, they are addressed by the Rare Communities management prescription, the botanic/zoologic management prescription, forestwide standards, or implementation guides to the Plan.

The system name is based on the number of age classes (even-aged, two-aged, uneven-aged), and the final harvest method used (clearcutting, shelterwood, seedtree, etc). The silvicultural systems evaluated in this appendix are as follows:

1. The even-aged silvicultural systems
   Three individual silvicultural systems in even-age silviculture are:

a. Clearcutting – This is the harvesting in one cut of all merchantable trees on an area for the purpose of creating a new, even-aged stand. Regeneration is obtained through natural seeding, through sprouting of trees, advance reproduction, or through planting or direct seeding.

b. Shelterwood – The mature stand is removed in a series of cuts. Regeneration of the new stand occurs under the cover of a partial forest canopy or shelterwood. A final harvest cut removes the shelterwood and permits the new stand to develop in the open as an even-aged stand. The shelterwood method is especially adapted to species or sites where shelter is needed for the new reproduction, where heavy seed of the desired species limits coverage of the seed fall over the entire area, or where the shelterwood can give the desired regeneration an advantage over undesired competing vegetation.

c. Seedtree – This method involves harvesting nearly all the trees on a selected area in one cut. A few of the better trees of the desired species are left well distributed over the area to reseed naturally. Seedtrees are removed after restocking standards for numbers, species, and distribution of stems has been met. This system applies mainly to conifers.

2. The two-age silvicultural systems are a variation of the pure even-aged systems and are a planned sequence of treatments for tending, harvesting and re-establishing a stand and maintaining trees of two distinct age classes. This system creates a mosaic of two-age class stands across the forestlands designated as suitable for producing forest products. The reserve trees left in this system would be expected to grow and survive to the end of the next harvest entry, so that two age classes could be present at all times. The length of time reserve trees are retained can be from 20-percent to 100-percent of the rotation age of their younger associates. The resulting stand may be two-aged or tend toward an uneven-aged condition as a consequence of both an extended period of regeneration and the retention of reserve trees that may represent one or more age classes. The term

'irregular' is often used as a modifier with classic even-aged system names to refer to two-aged systems; for example, irregular shelterwood. Three silvicultural systems are used with two-age silviculture are:

a. Clearcutting with reserves– This is the harvesting in one cut of most of the merchantable trees on an area for the purpose of creating a new, even-aged stand. Varying numbers of reserve trees are not harvested to attain goals other than regeneration. Regeneration is obtained through natural seeding, through sprouting of trees, advance reproduction, or through planting or direct seeding.

b. Shelterwood with reserves– This is a variant of the shelterwood method in which some or all of the shelter trees are retained, well beyond the normal period of retention, to attain goals other than regeneration. Regeneration of the new stand occurs under the cover of a partial forest canopy (shelterwood). This method is especially adapted to species or sites where shelter is needed for the new reproduction, where heavy seed of the desired species limits coverage of the seed fall over the entire area, or where the shelter trees give the desired regeneration an advantage over undesired competing vegetation.

c. Seedtree with reserves– A seedtree method in which some or all of the seedtrees are retained after regeneration has become established to attain goals other than regeneration. This system applies mainly to conifers.

3. The uneven-aged silvicultural systems. Two silvicultural systems used with uneven-aged silviculture are:

a. Group selection– A method of regenerating uneven-aged stands in which trees are removed, and new age classes are established, in small groups. The maximum width of groups is approximately twice the height of the mature trees, with small openings providing microenvironments suitable for shade-tolerant regeneration and the larger openings providing conditions suitable for more shade-intolerant regeneration. Although groups may resemble small clearcut patches, this method is distinguished from clearcutting in that the intent of group selection is to create a balance of age or size classes throughout the forest community. The forest community in which regeneration, growth, and yield are regulated consists of an aggregation of groups. Regeneration is established almost continuously.

b. Single tree selection – A method of creating new age classes in which individual trees of all size classes are removed more-or-less uniformly throughout the stand to achieve desired stand structural characteristics. The objective is maintenance of an uneven-age stand, with trees of different ages or sizes. Regeneration is established almost continuously. However, because the openings created by cutting scattered individual trees are usually small,

operational (non-research) use of the system has generally been limited to more shade-tolerant species.

Single tree selection has shown some success in shortleaf and loblolly pine forest types on the Ouachita National Forest and at the Crossett Experimental Forest in Arkansas. A few single-tree selection harvests have been implemented in the Southern Appalachians in white pine cover types during the 1990's but are still too young to be considered proven. .

Table F-12. Summary of Silvicultural Systems Recommendations for the Chattahoochee-Oconee National Forest

	Even-aged Mgmt.			Two-aged Mgmt.			Uneven-aged Mgmt.	
Forest Type Group	Clearcut (CC)	Seedtree (SDTR)	Shelterwood (SHWD)	Clearcut w/ Reserves (CCR)	Seedtree w/ Reserves (SDTRR)	Shelterwood w/ reserves (SHWR)	Single-tree Selec-tion (STS)	Group Selection (GS)
Oak-hickory	Rc	NR	Rc	Rc	NR	Rc	NR	Rc
Cove hardwood	Rc	NR	RC	RC	NR	Rc	NR	Rc
Bottomland hardwood	Rc	NR	Rc	Rc	NR	Rc	NR	Rc
Oak -yellow pine	Rc	Rc	Rc	Rc	Rc	Rc	NR	Rc
Oak-white pine	Rc	Rc	Rc	Rc	Rc	Rc	NR	Rc
Yellow pine-oak	Rc	Rc	Rc	Rc	Rc	Rc	NR	Rc
White pine-oak	Rc	NR	Rc	Rc	NR	Rc	NR	Rc
Loblolly pine	R	R	R	Rc	Rc	Rc	Rc	Rc
Shortleaf/pitch pine	R	Rc	Rc	Rc	Rc	Rc	NR	NR
Virginia pine	R	NR	NR	Rc	NR	NR	NR	NR
White pine	Rc	NR	R	Rc	NR	Rc	Rc	R

THE BASIS FOR ALLOCATION OF EVEN-AGED, TWO-AGED AND UNEVEN-AGED SILVICULTURAL SYSTEMS

The recommendation of a silvicultural system is based on the existing forest/stand's condition and the desired condition of the management area of which the stand is a part.

Uneven-aged systems will only be used where successful regeneration of the desired species is possible and where the long-term use of the system is economically viable. Three main considerations will be used to determine this:

1. A stand must be of sufficient size so that the harvested volume allows the purchaser to make a profit. A size of 100 acres will be used as a rule of thumb, although smaller sized stands can be used if other criteria are favorable.
2. Slopes must be gentle enough to permit adequate access through the forest community. Slopes of up to 20% are generally considered favorable, although slopes greater than this will be considered in combination with other criteria. Steeper slopes sometimes cause difficulty with ground-based tree felling and skidding equipment, which can cause uneconomical timber sales.
3. Existing system roads must be in place to limit the need for additional construction of roads for log removal.

The Chattahoochee-Oconee Forest Plan does not emphasize timber production. There is no quantitative objective for a timber output volume. Rather timber yield is as a result of providing desired conditions of wildlife habitat, visual quality, forest health or other vegetation-associated values. Provision of wildlife habitat is a major reason for vegetation management practices and will also be a primary factor in choosing a regeneration harvest method. Among wildlife habitats, the greatest attention will often focus on the provision of early successional habitat. For this reason, how it will be calculated is described in some detail here.

Successional forest objectives in prescriptions are stated in terms of percent of forested land desired in early-successional forest, mid- and late-successional forest combined, and late-successional forest alone. To be most meaningful for providing desired habitat conditions for wildlife, percentage objectives apply to blocks of over 1,000 acres of contiguous prescriptions with the same successional objectives. Prescription allocation blocks of less than 1,000 contiguous acres may be lumped with nearby prescriptions having the same successional forest objectives. Grouping of prescription blocks for analysis purposes should be stable over time to provide a consistent basis for project planning.

Because successional forest objectives describe a desired ecological condition, percentage objectives apply to all forested land, not just acreage classed as suitable for timber production. Non-forest, which includes roads, water, and permanent openings, such as pastures, permanent wildlife openings, old fields, maintained rights-of-way, and balds, are not included in calculations of early-successional forest percentages. Woodlands, savannas, and grasslands, which will be managed for a relatively open condition on a permanent basis, also are not included in these calculations. For both logistical and ecological reasons, patches smaller than 2 acres will not be tracked separately, but will be combined with the surrounding successional type. Successional forest conditions on surrounding private lands are not included in calculations, but should be considered when developing alternatives during project-level planning. For example, high amounts of quality early-successional

forest on surrounding private land might result in decisions to provide such habitats on national forest land at the low end of the objective range.

Early-successional forest for all forest types is generally defined as forest 0-10 years old. Within this general working definition, there will be the future need to refine its application when considering the effects of natural disturbance and the density and size of stems remaining to determine whether or not they are functional as early successional and will also sustain the desired forest cover. When these conditions are met, early-successional forest patches created by natural disturbances will be counted toward early-successional forest objectives. Because of their highly stochastic nature, no attempt was made in the FEIS effects analysis to predict amounts of early-successional forest likely to be created by natural events in the future. The salvage volume estimate shown in this Appendix is not equated with early successional habitat. Even-aged and two-aged regeneration cutting, prescribed burning, or other vegetation management treatments that create open canopy conditions and relatively uniform and dense regeneration of woody species across patches larger than 2 acres, may create early-successional forest.

Ages of mid- and late-successional forests are defined by forest community type Appendix B of the FEIS. To meet objectives for mid- and late-successional forest habitats, managers will ensure that planned forest regeneration does not result in percentages falling below objective levels. Management treatments to thin or create small canopy gaps are compatible with maintaining mid- and late-successional forest conditions. Areas managed under uneven-aged regeneration methods are not counted as either early- or late-successional forest, but as a separate successional category. Acreage of these areas would be included as part of the forested acreage base for the purpose of successional stage calculations.

Vegetation Management Practices in the Forest Types of the Chattahoochee-Oconee National Forests

The Forest Cover topic of the EIS has a brief summary of land use history and forest compositions by ecological units. That material is being incorporated here by reference.

As a result of past practices by European settlers the forest consists essentially of even-aged stands of timber. As of 1994, about half (53%) of the Chattahoochee National Forest was in cove and upland hardwoods. Approximately a quarter (24%) was forested by yellow pines and white pine. The remaining quarter was roughly split between mixed pine–hardwood (13%) and hardwood–pine (10%) communities.

On the Oconee National Forest in 1994, sixty-nine percent (69%) of the forest area was dominated by yellow pine, mostly loblolly. Bottomland hardwoods made up 4% of the area, upland hardwoods dominated on 24% of the land, and mixed stands made up the remaining 3% (hardwood - pine at 2% and pine – hardwood at 1%.)

Thinning timber harvests are recommended in all forest type groups whenever an operable volume would result and residual stocking does not fall into a ‘non-stocked’

or 'understocked' condition for the species, site, stem size, age, or other variables used in published stocking charts. These thins are needed to help prevent insect and disease problems by restoring or maintaining vigorous growth on the desired forest composition, to realize greater economic return by capturing natural mortality and focusing growth onto the best trees, to guide species composition to achieve multiple-use values such as wildlife habitat and visual quality, and to select and retain the best trees as regeneration sources in the future and thereby potentially widen the choice of silvicultural options. Priority in thinning should be given to; (a) those species that are at risk to 'stagnate' or greatly slow height and diameter growth, then not response to thinning later after the overly-dense situation has continued for too long; and (b) those stands which most exceed 'normal' stocking levels as these are at highest risk from insects and disease.

Salvage and sanitation cuts are recommended in all forest type groups whenever harvest volumes are sufficient to produce an operable cut. Salvage should be used to reduce extremely high fuel loadings, capture economic value, help support local wood industry, clear roads and trails, and avoid future safety problems. Sanitation cuts should be used to remove disease infection or insect brood centers that threaten to spread the problem. Written criteria for the selection of trees to be removed are recommended. Consult with the Forest liaison to the Forest Health Protection Unit in diagnosing the problem, prescribing treatments, and developing cut and/or leave guidelines.

The following tables display 1) the recommendation and reasons for recommending certain regeneration methods with certain forest types (communities), and 2) the recommendation for vegetation management practices that apply to those regeneration methods. Within these tables, entries are coded as follows:

Table F-13: Abbreviations Used in Silvicultural Systems and Vegetation Management Practices Tables in Plan Appendix F.

R	Recommended practice
Rc	Recommended with conditions
NR	Not recommended

Adequacy of regeneration means being able to meet or exceed the forestwide re-stocking standard of the Forest Plan. Assessing adequacy includes all regeneration sources including, as applicable, their probability of contributing competitive regeneration.

Recommendations shown, when applied, must meet the applicable standards of the Forest Plan for the management prescription in which they are being applied. These standards have been designed to ensure sustainability and protect visual quality, water quality, wildlife habitats, recreation opportunities, and other values. Standards are not being repeated here.

The forest vegetation types listed below are the major forest community type groups making up the Chattahoochee-Oconee National Forest.

Oak – hickory
Cove hardwood
Bottomland hardwood
Oak – yellow pine
Oak – white pine
Yellow pine – oak
White pine – oak
Loblolly pine
Shortleaf/pitch pine
Virginia pine
White pine

An effort was made to include forest types that will be the focus of timber production on lands determined to be suitable for timber production, and not to include all inventoried forest types. Some forest communities are not included here as vegetation types due to their patchy distribution. However, these species may be addressed elsewhere with standards (example: hemlock) or as rare communities (example: longleaf pine).

VEGETATION MANAGEMENT PRACTICES IN THE OAK-HICKORY COMMUNITY

The oaks and hickories are generally intermediate in tolerance of shade. (See Table F-10.) Many associated trees such as red maple, dogwood, and sourwood, and most shrubs are tolerant to very tolerant of shade. Consequently, if undisturbed, the successional trend of the oak-hickory type is toward the shade-tolerant species, particularly on the higher quality sites. Oaks and hickories are able to become established and persist on the drier sites where stands are usually more open and development of many of the more tolerant species is restricted.

Table F-14: Silvicultural Systems in Oak-Hickory Forest Type Group.

Silvicultural System	Applicability and Reasons for Silvicultural System
Even-aged Management	
Clearcut (CC)	Rc - when advance regeneration is adequate.
Seedtree (SDTR)	NR - heavy seed is poorly distributed and slow growing seedlings are not able to compete with other vegetation
Shelterwood (SHWD)	Rc - when advance regeneration is inadequate.
Two-aged Management	
Clearcut with reserves (CCR)	Rc - when advance regeneration and potential for stump sprouting exist, and other resource objectives must be met.
Seedtree with reserves (SDTRR)	NR - heavy seed is poorly distributed and slow growing seedlings are not able to compete with other vegetation
Shelterwood with reserves (SHWDR)	Rc - when advance regeneration is inadequate, and other resource objectives must be met.
Uneven-aged Management	
Single-tree Selection (STS)	NR - system will not perpetuate oaks and other shade intolerant species.
Group Selection (GS)	Rc - when advance regeneration and potential for stump sprouts exist, when it is desirable to minimize adverse visual impacts. Regulation of size classes and a sustained yield of products may be difficult.

Table F-15: Vegetation Management Practices in the Oak-Hickory Forest Type Group.

Vegetation Management Practices for Recommended Systems	CC	SDTR	SHWD	CCR	SDTRR	SHWDR	STS	GS
System Recommendation	Rc	NR	Rc	Rc	NR	Rc	NR	Rc
Site Preparation	R		R	R		R		R
Natural Regeneration	R		R	R		R		R
Artificial Regeneration	Rc		Rc	Rc		Rc		Rc
Release/Weeding	Rc		Rc	Rc		Rc		Rc
Pre-commercial Thinning	Rc		Rc	Rc		Rc		Rc
Pruning	Rc		Rc	Rc		Rc		Rc
Prescribed Fire	Rc		Rc	Rc		Rc		Rc
Mid-story Reduction	Rc		Rc	Rc		Rc		Rc

Where mid-story reduction and prescribed burning has not pre-conditioned stands, site preparation is recommended to: (a) temporarily reduce or remove the competition of tolerant understory stems, and (b) rejuvenate existing desired species by top killing them and thus stimulating competitive stump sprouts.

Natural regeneration is recommended because: (a) it is reliable with management, (b) seedlings to plant are difficult to obtain in quantity, (c) the science for knowing

how far hardwood seedlings can be moved from their origin is not well-established, (d) seedlings are very expensive to buy and cost from $200 to $300/acre to plant because – unlike yellow pine seedlings – they require a small excavation, and (d) one or more release treatments are needed because planted seedlings do not have the established root system of their competition.

Regeneration of the oak-hickory type by planting or direct seeding has limited application. Artificial regeneration should be used to restore the oak-hickory type to lands ecologically suited for the species but natural regeneration from sprouts of existing oak and hickory is inadequate to establish an oak-hickory stand. In these situations, using seed originating from as near the planting site as possible is recommended. Planted oaks usually grow very slowly and vegetation control is needed for several years for planted oaks to become part of the new stand. Direct seeded acorns are susceptible to pilferage by squirrels and other wildlife. Recent successes with red oak and white oak plantings on the Forest demonstrate the feasibility of regenerating oaks by planting using recently-developed seedling grading techniques to ensure planting only 'the best of the best'.

Release and weeding treatments are not recommended in this type group with natural regeneration since stump sprouts – the primary regeneration source – have established root systems and are already competitive. Release is recommended for planted seedlings until they develop a strong root system.

Pre-commercial thinning is recommended after crown closure, or approximately age 10, to reduce multiple stump sprout clumps to the one or two best trees. Avoid cutting only one of clumps where the angle between two adjacent stems is a "V" rather than a "U".

Pruning is recommended only for select trees that have the potential for producing exceptional quality and/or value.

Prescribed fire is recommended to control small stems of tolerant understory up to 4" dbh. Fire probably has an important role in the development of existing oak-hickory stands, where frequent fires reduced the numbers of less fire-resistant species, and oaks and hickories survived because of their ability to sprout repeatedly and the ability of these sprouts to grow rapidly. Current research shows prescribed fire to be beneficial to oak seedling establishment as well as growth by reducing the numbers of competing trees as well as their use of growth resources.

Mid-story reduction is recommended as an intermediate treatment a minimum of ten years prior to stand regeneration for stems greater than 4" dbh up to approximately 8" dbh; that is, those too large to be managed with fire, to free growth resources for other desired plants such as herbaceous forest floor cover, provide wildlife habitat, and condition stands for establishment of reproduction of desired species. A guideline for the residual basal area of all woody stems equal to or greater than 1" dbh is that it equal the site index for oak on that site.

Vegetation Management Practices in Cove Hardwood (Appalachian Mixed Hardwood) Communities

Cove hardwoods, characteristic of productive, moist, and sheltered sites in the Blue Ridge Mountains, and to a much lesser extent in the Ridge and Valley, make up approximately 14-percent of the Chattahoochee National Forest. Species composition is typically diverse and stands average approximately twenty species, including understory. Species typically vary rather widely in their tolerance. For example, sugar maple, white ash and hemlock are very tolerant. Basswood, elm, and buckeye are tolerant. Northern red oak and cucumbertree are intermediate. Yellow poplar is intolerant. The numbers of the various species in the stands is influenced by the manner in which regeneration occurred. Even-aged silvicultural practices result in a greater variety of species and a higher ratio of shade-intolerant to tolerant species than do uneven-aged practices. These stands typically have relatively high volumes and can have the most highly valued species as well. A significant proportion of the type group occurs on slopes greater than or equal to 40-percent.

Sources of reproduction in these hardwood stands include buried seed, stump sprouts, root suckers, and advance regeneration. Reproduction of intermediate tolerant species usually follows a moderate opening in the canopy on these mixed hardwood sites. Yellow poplar in particular has seed that remains viable in leaf litter for many years. Basswood is a prolific sprouter. Northern red oak also sprouts.

Table F-16: Silvicultural Systems in the Cove Hardwood Forest Type Group.

Silvicultural System	Applicability and Reasons for Silvicultural System
Even-aged Management	
Clearcut (CC)	Rc - both shade tolerant and intolerant tree species are reproduced by this method.
Seedtree (SDTR)	NR - under most circumstances regeneration is already established or will become established in the 1st growing season after cutting. Seedtrees are subject to windthrow and loss of bole quality.
Shelterwood (SHWD)	Rc - where there is no desirable advance regeneration. Promising for reproducing species of intermediate shade tolerance such as oaks.
Two-aged Management	
Clearcut with reserves (CCR)	Rc - when other resource objectives must be met. Favors both tolerant and intolerant tree species.
Seedtree with reserves (SDTRR)	NR - seedtrees are subject to windthrow and loss of boll quality.
Shelterwood with reserves (SHWR)	Rc - where there is no desirable advance regeneration and other resource objectives must be met.
Uneven-aged Management	
Single-tree Selection (STS)	NR - unless a continuous forest canopy is preferred, or the objective is to minimize stand and site disturbance, such as where aesthetic values are high.
Group Selection	Rc - when it is desirable to minimize adverse visual impacts. Both tolerant and intolerant tree species are reproduced. Regulation of size classes and a sustained yield of products may be difficult.

Clearcutting generally is recommended to regenerate cove hardwood stands. Both intolerant and tolerant species are reproduced by this method. Shelterwood cutting may be promising for reproducing species of intermediate tolerance such as oaks. The shelterwood method is recommended where there is no desirable advance regeneration. However, the shelterwood system has not consistently resulted in the establishment of new oak advance oak regeneration, though it will allow development of pre-existing regeneration. Some recent research has shown success in using prescribed burning before and after partial cutting to increase the competitive vigor of oaks and reduce the competition. Regeneration by seedtree is seldom used or needed in these cove hardwood stands.

Using the uneven-aged method of single tree selection in the cove hardwood type will not perpetuate a high proportion of the shade-intolerant species. Eventually the mixed character of the cove hardwood stands will be reduced by the single tree selection method to a few commercial tolerant species. Group selection provides a mixture of desirable tolerant and intolerant species in the cove hardwood stands.

Table F-17: Vegetation Management Practices in the Cove Hardwood Forest Type Group.

Vegetation Management Practices for Recommended Systems	CC	SDTR	SHWD	CCR	SDTRR	SHWDR	STS	GS
System Recommendation	Rc	NR	Rc	Rc	NR	Rc	NR	Rc
Site Preparation	R		R	R		R		R
Natural Regeneration	R		R	R		R		R
Artificial Regeneration	NR		NR	NR		NR		NR
Release/Weeding	NR		NR	NR		NR		NR
Pre-commercial Thinning	R		R	R		R		R
Pruning	Rc		Rc	Rc		Rc		Rc
Prescribed Fire	Rc		Rc	Rc		Rc		Rc
Mid-story Reduction	Rc		Rc	Rc		Rc		Rc

Where mid-story reduction has not pre-conditioned stands, site preparation is recommended in situations where understory species and residual un-merchantable stems make up more than 10 basal areas. Thoroughness of site preparation will be moderated by compliance with Forest standards for dens, snags, soft mast, and other retention objectives.

Natural regeneration is recommended as it is consistently reliable and abundant. Where it is desirable to increase the proportion of northern red oak in the regenerated stand from that present at the time of regeneration, develop large advance reproduction using the guidelines developed by David Loftis at the Bent Creek Experimental Forest before conducting the regeneration harvest.

Artificial regeneration is not recommended as it is not cost effective and seedlings are even less competitive on these moderate to high productivity sites than they are in the oak-hickory type.

Release and weeding is not recommended - except in the rare case where artificial regeneration is being used – because it is not effective at shaping stand composition in the highly competitive environment on these sites.

Pre-commercial thinning is recommended following crown closure; primarily to reduce multiple-sprout clumps to the one or two best ones, shape species composition, and begin to improve spacing.

Pruning is recommended only for the highest value species such as walnut, northern red oak, and white oak and then only when disturbance has provided light levels such that natural pruning is not occurring.

Prescribed fire has potential as a stand composition management tool by top-killing yellow poplar seedlings (which has limited re-sprouting from small seedlings) and favoring re-sprouting of northern red oak, basswood, and other species. It should not be used unless and until a pre-burn inventory of species composition has been completed and a projection of fire effects on species composition can be made.

Mid-story reduction is recommended to reduce the level of forest floor shade by removing stems in the 2" to approximately 8" dbh range. A guideline for total residual basal area of all stems equal to or greater than 1" dbh is that it should equal the site index for yellow poplar on each sites.

Vegetation Management Practices in the Bottomland Hardwood Community

The Bottomland Hardwood Community is located on the Oconee National Forest. A broad range of silviculture is possible, but constraints associated primarily with the riparian/wetland location have historically limited active management. In addition, wildlife habitat concerns have tended to result in leaving it untouched.

Typical species include American beech, green ash, boxelder, American hornbeam, Florida maple, American holly, red maple, blackgum, elm, mulberry, dogwood, hickory, white oak, hackberry, birch, sweetgum, black cherry and water oak. Loblolly pine also does well on these sites; its natural habitat. Japanese privet is a common non-native invasive species on these sites. It forms very dense thickets and – because it is semi-evergreen – shades the forest floor at all seasons. These stands may be flooded, or partially flooded, at times or they may retain runoff as surface water during periods of heavy rain. Soils are deep and moist and can be very productive unless limited by a water table near the surface, reducing rooting volume.

As with the Appalachian cove hardwood, the component species vary in their tolerance. Beech, hornbeam, and holly are very tolerant. Florida maple, red maple, green ash, blackgum, boxelder, mulberry, dogwood, and elm are tolerant. White oak and hackberry are intermediate. The birches, sweetgum, black cherry and water oak

are intolerant. Vegetation management practices can thus range from favoring very tolerant species all the way to favoring intolerant species. Typically disturbance could favor both with varying degrees; depending on the type, timing, and intensity of that disturbance.

As with other hardwood communities, natural regeneration is the primary method of establishing new stands. The presence of advance regeneration – particularly of the very tolerant, tolerant, and intermediate species - under the existing stand, combined with the probable stump sprouting from the cutting of desired species, are key to successful natural regeneration of bottomland hardwoods. Artificial regeneration can be viable and effective for some species in this community due to ongoing research and experimental planting and seeding, but application of this practice in this community typically involves higher costs associated with site preparation, acquisition of seed or seedlings, planting, and the need for intensive control of competing vegetation. Prescribed fire is not considered to be a viable practice for use in this community. Some of the most productive and valuable fish and wildlife habitats are found in the Bottomland Hardwood Community.

Table F-18: Silvicultural Systems in the Bottomland Hardwood Forest Type Group

Silvicultural System	Applicability and Reasons for Silvicultural System
Even-aged Management	
Clearcut (CC)	R – best results when used in combination with adequate advance regeneration and probable stump sprouting. Favors shade intolerant species.
Seedtree (SDTR)	NR – seldom successful because of the conditions required to establish and maintain desired regeneration, including control of competing vegetation.
Shelterwood (SHWD)	Rc – more feasible when stand does not have adequate advance regeneration. Removal of shelterwood trees should take place within 5 years after adequate regeneration is established.
Two-aged Management	
Clearcut with reserves (CCR)	R – when advance regeneration and potential for stump sprouting exist, and other resource objectives (visual, wildlife) must be met.
Seedtree with reserves (SDTRR	NR – poor distribution of heavy seeds from some species, and slow growing seedlings are not able to compete with other vegetation without intensive control.
Shelterwood with reserves (SHWR)	Rc - when advance regeneration is inadequate, and other resource objectives must be met.
Uneven-aged Management	
Single-tree Selection (STS)	NR - this system will favor more shade tolerant (and usually less desirable) species unless small openings are enlarged within 10 years of initial cut.
Group Selection (GS)	Rc – considered a suitable compromise system when it is desirable to address other resource objectives. The interior of openings will favor regeneration of more shade intolerant species. This system constrained by acreage needed and road system required for repeated entries.

Table F-19: Vegetation Management Practices for the Bottomland Hardwood Forest Type Group.

Vegetation Management Practices for Recommended Systems	CC	SDTR	SHWD	CCR	SDTRR	SHWDR	STS	GS
System Recommendation	R	NR	Rc	R	NR	Rc	NR	Rc
Site Preparation	R		R	R		R		R
Natural Regeneration	R		R	R		R		R
Artificial Regeneration	NR		NR	NR		NR		NR
Release/Weeding	Rc		Rc	Rc		Rc		Rc
Pre-commercial Thinning	R		R	R		R		R
Pruning	Rc		Rc	Rc		Rc		Rc
Prescribed Fire	NR		NR	NR		NR		NR

Where mid-story reduction has not pre-conditioned stands, site preparation is recommended in situations where understory species and residual un-merchantable stems equal to or greater than 1" dbh make up more than 10 basal areas. In particular, privet thickets will need to be controlled to allow regeneration to establish. Thoroughness of site preparation will be moderated by compliance with Forest standards for dens, snags, soft mast, and other retention objectives.

Natural regeneration is recommended as it is consistently reliable and abundant. Where it is desirable to increase the proportion of the very tolerant, tolerant, or intermediate tolerant species in the regenerated stand from that present at the time of regeneration, develop large advance reproduction using the guidelines developed by David Loftis at the Bent Creek Experimental Forest several years before conducting the regeneration harvest.

Artificial regeneration is not recommended as it is not cost effective and seedlings are even less competitive on these generally high productivity sites than they are in the oak-hickory type.

Release and weeding is recommended between age 5 and crown closure to shape the species composition at the time of crown closure. In the rare case where artificial regeneration is being used, release must be early and repeated to ensure seedlings survive their competition.

Pre-commercial thinning is recommended following crown closure; primarily to reduce multiple-sprout clumps to the one or two best ones, shape species composition, and begin to improve spacing. Pruning is recommended only for the highest value species and then only when disturbance has provided light levels such that natural pruning is not occurring or new stem sprouts (epicormic branching) has been stimulated. .

Prescribed fire is not recommended as a management tool for native tree species but should be used in canebrake management on these sites and to reduce the re-establishment of privet once it has been controlled.

Mid-story reduction is recommended to reduce the level of forest floor shade by removing stems in the 2" to approximately 8" dbh range. A guideline for total residual basal area of all stems equal to or greater than 1" dbh is that it should equal the site index for water oak on each site.

Vegetation Management Practices in the Oak–Yellow Pine Community

These mixed communities typically occur on low productivity sites for oak and moderate productivity sites for pine. Included pine species on the Chattahoochee are shortleaf, Virginia, pitch, loblolly and Table Mountain pine. On the Oconee, included pine species are primarily loblolly with much less shortleaf. Included oak species on the Chattahoochee are white oak, black oak, southern red oak, chestnut oak, and scarlet oak. On the Oconee, oak species include white oak and southern red oak. Typical understory species on both Forests include dogwood, sourwood, and red maple. On the Oconee, persimmon is frequent. On the Chattahoochee, these communities often have a dense understory of advance reproduction of white pine that can response readily to reduced overhead shade with rapid height growth.

The species involved include both intolerants and intermediate in tolerance types. Yellow pines are intolerant. Oaks, except for scarlet oak, are intermediate. Pines establish from seed, usually within one season of a heavy disturbance. Oaks are only competitive as sprouts from stems present in the stands when they are harvested. Seedlings are non-competitive in the first year and slowly become increasingly more likely to be able to grow into the main canopy following a disturbance. This likelihood has been related by research to the root collar diameter. The relationship is that, as root collar diameter increases, the probability of a sprout from that root stock reaching the main canopy of a new stand increases. However, the increase is not indefinite. At diameters above approximately sixteen inches, the probability begins to decrease because larger stumps are less likely to produce sprouts.

Table F-20: Silvicultural Systems in the Oak-Yellow Pine Forest Type Group

Silvicultural System	Applicability and Reasons for Silvicultural System
Even-aged Management	
Clearcut (CC)	Rc – must have adequate advance regeneration and probable stump sprouting of oaks along with probable seed producing pines along edges or reliance on fill-in planting of yellow pines. Intensive competition control typically necessary to maintain pine component.
Seedtree (SDTR)	Rc - pine seed trees reserved when probable seed sources on edges are not present. May result in patchy stand due to poorly distributed heavy seed of oaks combined with slow growing seedlings. Adequate advance regeneration and probable stump sprouts of oaks distributed across area may fill in regeneration. Intensive competition control methods typically necessary to maintain both pine and oak components. Size of cutting area will control proportion of shade tolerant and intolerant species that regenerate.

Table continued next page.

Silvicultural System	Applicability and Reasons for Silvicultural System
Shelterwood (SHWD)	Rc - when advance regeneration is absent or inadequate. Intensive competition control methods typically necessary to maintain pine component. Size of cutting area will control proportion of shade tolerant and intolerant species that regenerate.
Two-aged Management	
Clearcut with reserves (CCR)	Rc – same as even-aged clearcut management. Use when other resource objectives (visual, wildlife) must be met.
Seedtree with reserves (SDTRR)	Rc – same as even-aged seedtree management. Reserves can be a mixture of oaks and pines as well as others. Use to meet other resource objectives.
Shelterwood with reserves (SHWR)	Rc – same as even-aged shelterwood management. Reserves can be a mixture of species, however grouping of reserve trees may be necessary for intolerant oaks and pines to be competitive. Use to meet other resource objectives.
Uneven-aged Management	
Single-tree Selection (STS)	NR – openings in crown canopy are too small to ensure adequate reproduction of yellow pines, yellow poplar and most upland oaks.
Group Selection (GS)	Rc – openings of at least ½-acre in combination with improvement, sanitation, salvage or thinning cuts between groups are needed. Stand will transition to shade tolerant hardwoods unless intensive competition control is employed.

Table F-21: Vegetation Management Practices for the Oak-Yellow pine Forest Type Group

Vegetation Management Practices for Recommended Systems	CC	SDTR	SHWD	CCR	SDTRR	SHWDR	STS	GS
System Recommendation	Rc	Rc	Rc	Rc	Rc	Rc	NR	Rc
Site Preparation	R	R	R	R	R	R		R
Natural Regeneration	Rc	Rc	Rc	Rc	Rc	Rc		Rc
Artificial Regeneration	Rc	Rc	Rc	Rc	Rc	Rc		Rc
Release/Weeding	R	R	R	R	R	R		R
Pre-commercial Thinning	Rc	Rc	Rc	Rc	Rc	Rc		Rc
Pruning	NR	NR	NR	NR	NR	NR		NR
Prescribed Fire	R	R	R	R	R	R		R
Mid-story Reduction	R	R	R	R	R	R		R

Where mid-story reduction and prescribed burning has not pre-conditioned stands, site preparation is recommended to: (a) temporarily reduce or remove the competition of tolerant understory stems, (b) rejuvenate existing oak species by top killing them and thus stimulating competitive stump sprouts, and (c) reduce leaf litter and provide a seedbed for pines in natural regeneration prescriptions. When using

natural regeneration, site preparation should be timed to coincide with a seed crop predicted to be sufficient to reach re-stocking standards.

Natural regeneration of the pine component is recommended only on the conditions that: (a) a reliable seed source is present and well-distributed, (b) seedlings to plant are difficult to obtain in quantity, (c) the site has been well-prepared to provide a seedbed and reduce competition sufficiently that pine seedlings are competitive..

Regeneration of the oak-pine type by planting or direct seeding has limited application. It is recommended only for restoration efforts and then only to the extent that any existing reliable regeneration is inadequate to meet re-stocking standards. In these situations, use acorns originating from as near the planting site as possible. Planted oaks usually grow very slowly and vegetation control is needed for several years for planted oaks to become part of the new stand. Direct seeded acorns are susceptible to pilferage by numerous wildlife species or being eaten by acorn weevils. Damaged acorns, if they produce a seedling, produce a weaker one that cannot be counted on to survive. Successes with red oak and white oak plantings within the last ten years on the Forest demonstrate the feasibility of regenerating oaks by planting using recently-developed seedling grading techniques to ensure planting only 'the best of the best. In extensive operational use, artificial regeneration is recommended for the planting of bare root shortleaf, pitch, or Table Mountain pine and containerized longleaf. In the oak-pine type, planting of yellow pine would be used to supplement the oak and meet re-stocking standards.

Pre-commercial thinning is recommended just at the time of crown closure, or approximately age 10, to reduce multiple stump sprout clumps of oak to the one or two best trees and to maintain the pine component in the stand. Avoid cutting only one stem of oak clumps where the angle between two adjacent stems is a "V" rather than a "U." Because site quality is only moderate or low and initial stand density is not high, the need for PCT is not expected to be as high as in cove or bottomland hardwood.

Pruning is not recommended for the species that would grow in this mixture because; (a) they prune well naturally, or (b) pruning would not re-pay the costs of doing it

Prescribed fire of low to moderate intensity is recommended on a three to seven year cycle to control small stems of tolerant understory up to 4" dbh.

Mid-story reduction is recommended as an intermediate treatment a minimum of ten years prior to stand regeneration for stems greater than 4" dbh up to approximately 8" dbh; that is, those too large to be managed with fire, to free growth resources for other desired plants such as herbaceous forest floor cover, provide wildlife habitat, develop future seed or shelterwood trees, and condition the forest floor for establishment of reproduction of desired species. A guideline for the residual basal area of all woody stems equal to or greater than 1" dbh is that it equal the site index for oak on that site.

Vegetation Management Practices in the Oak – White Pine Community

These mixed communities occur only on the Chattahoochee and almost exclusively within the Blue Ridge Mountains portion above approximately eighteen hundred feet elevation. They typically occur on low to moderate productivity sites for oak but high productivity sites for white pine. This forest type group is likely to include a minority component of shortleaf, Virginia, pitch, loblolly or Table Mountain pine. Included oak species on the Chattahoochee are white oak, black oak, chestnut oak, and scarlet oak. Typical understory species include dogwood, sourwood, rhododendron, and red maple. Due to fire exclusion, these communities often have a dense understory of advance reproduction of white pine that can response readily to reduced overhead shade with rapid height growth.

The species involved, except for scarlet oak, are intermediate in tolerance. White pine is the only pine on the Forests so classified. An adage about white pine is that it is 'tolerant in youth and intolerant in old age'. It will readily establish on the forest floor under a closed canopy, persist for long periods in the absence of fire, then response to increased light with rapid growth. It is fire intolerant, especially as a seedling and sapling, and can be killed with low intensity fire and does not re-sprout. Oaks are only competitive as sprouts from stems present in the stands when they are harvested. Oak seedlings are non-competitive in the first year and slowly become increasingly more likely to be able to grow into the main canopy following a disturbance. This likelihood has been related by research to the root collar diameter. The relationship is that, as root collar diameter increases, the probability of a sprout from that root stock reaching the main canopy of a new stand increases. However, the increase is not indefinite. At diameters above approximately sixteen inches, the probability begins to decrease because larger stumps are less likely to produce sprouts.

Table F-22: Silvicultural Systems in the Oak-White Pine Forest Type Group

Silvicultural System	Applicability and Reasons for Silvicultural System
Even-aged Management	
Clearcut (CC)	Rc – must have adequate advance regeneration of white pine and probable stump sprouting of oaks or use fill-in planting of white pines. Competition control of white pine may be necessary to maintain oak component.
Seedtree (SDTR)	Rc – Seed regeneration after harvest generally not competitive; adequate advance white pine regeneration and probable stump sprouts of oaks distributed across area are needed White pine seedtrees reserved must be probable seed producers at time of harvest. White pine seedtrees are subject to windfall; oak seed is heavy and will not disperse across site.
Shelterwood (SHWD)	R – When advance regeneration is absent or inadequate; provides adequate seed source and shade is beneficial during the establishment of seedlings. White pine trees reserved as shelter trees have high incidence of windthrow.

Table continued next page.

Silvicultural System	Applicability and Reasons for Silvicultural System
Two-aged Management	
Clearcut with reserves (CCR)	Rc - sufficient oak advance regeneration and stump sprouts must be present. Advance regeneration, probable seed-producing reserves or edge trees, and/or artificial methods (planting, seeding) can be used to establish the white pine component. Reserves must meet visual and wildlife habitat requirements.
Seedtree with reserves (SDTRR)	Rc – Same as Seedtree.
Shelterwood with reserves (SHWDR)	R – Same as Shelterwood.
Uneven-aged Management	
Single-tree Selection (STS)	NR – Light regime provided inadequate to ensure maintaining the oak component.
Group Selection	Rc – Adequate advance regeneration must be present before harvest, release oak from white pine and other competition as needed to maintain, openings must be ½ - acre or larger to avoid significant diameter and height growth reductions in oaks. Guideline for minimum opening size is two tree heights of oldest white pine component.

Table F-23: Vegetation Management Practices for the Oak-White pine Forest Type Group.

Vegetation Management Practices for Recommended Systems	CC	SDTR	SHWD	CCR	SDTRR	SHWDR	STS	GS
System Recommendation	Rc	Rc	R	Rc	Rc	R	NR	Rc
Site Preparation	R	R	R	R	R	R		R
Natural Regeneration	R	R	R	R	R	R		R
Artificial Regeneration	Rc	Rc	Rc	Rc	Rc	Rc		Rc
Release/Weeding	Rc	Rc	Rc	Rc	Rc	Rc		Rc
Pre-commercial Thinning	Rc	Rc	Rc	Rc	Rc	Rc		Rc
Pruning	Rc	Rc	Rc	Rc	Rc	Rc		Rc
Prescribed Fire	Rc	Rc	Rc	Rc	Rc	Rc		Rc
Mid-story Reduction	Rc	Rc	Rc	Rc	Rc	Rc		Rc

Where mid-story reduction has not pre-conditioned stands, site preparation by felling is recommended to rejuvenate existing oak reproduction sources with vigorous stump sprouting.

Natural regeneration is recommended as the primary reproduction method relying on advance regeneration of both oak and white pine.

Artificial regeneration is recommended only for the white pine component and then only if pre-harvest inventory has determined that the number and distribution of any existing white pine seedlings will not result in meeting an oak-white pine stand

composition. Planting should be limited to only that needed as fill-in to meet that objective.

Release is recommended when it is needed to ensure that the oak component remains in a competitive position with the white pine (will involve releasing oak from white pine) and with a lesser priority objective of releasing white pine concurrently. Pre-commercial thinning **is** recommended for the purpose of maintaining the oak but not primarily for the sake of white pine growth. If loss of oak is not at least a moderate risk, defer treatment to a commercial thinning.

Pruning is recommended only for the white pine component because leaf-off season light penetration through the oaks will encourage lower limb retention. Pruning should not be done to improve wood quality unless an economic analysis shows that it will at least recover costs.

Prescribed fire is recommended only if advance white pine regeneration is either absence or is not being relied on to ensure full stocking. In these cases, prescribed fire begun some years prior to planned regeneration *may* provide a habitat niche suitable for white pine seedling establishment. In cases of super-abundant (> 300/acre) white pine advance regeneration, it may be cost-effective and biologically necessary to prescribed burn to remove it and fill-in plant after harvest to reach oak-white pine composition objectives.

Mid-story reduction is recommended in the 4" dbh to approximately 8" dbh in existing stands to reduce total woody stem basal area. A guideline for total woody stem basal area is no more than the site index for white pine. This will reduce basal areas somewhat below published stocking chart values.

Vegetation Management Practices in the Yellow Pine - Oak Community

These mixed communities typically occur on moderately productive sites for pine and low productivity sites for oak. Included oak species on the Chattahoochee are white oak, black oak, southern red oak, post oak, chestnut oak, and scarlet oak. Of these, chestnut oak and scarlet oak are the most common associates. On the Oconee, oak species include white oak, chestnut oak, blackjack oak, and southern red oak. Included pine species on the Chattahoochee are shortleaf, Virginia, pitch, loblolly and Table Mountain pine. On the Oconee, included pine species are primarily loblolly with much less shortleaf. Typical understory species on both Forests include dogwood, sourwood, and red maple. On the Oconee, persimmon is frequent. On the Chattahoochee, these communities often have either a dense understory of advance reproduction of white pine or a patchy shrub layer of mountain laurel. On the Oconee, sweetgum is a common species in the understory.

The species involved include both intolerants and intermediate in tolerance types. Scarlet oak is very intolerant. Yellow pines are intolerant. Oaks, except for scarlet oak, are intermediate. Pines establish from seed, usually within one season of a heavy disturbance. Oaks are only competitive as sprouts from stems present in the stands when they are harvested. Seedlings are non-competitive in the first year and

slowly become increasingly more likely to be able to grow into the main canopy following a disturbance. This likelihood has been related by research to the root collar diameter. The relationship is that, as root collar diameter increases, the probability of a sprout from that root stock reaching the main canopy of a new stand increases. However, the increase is not indefinite. At diameters above approximately sixteen inches, the probability begins to decrease because larger stumps are less likely to produce sprouts.

Table F-24: Silvicultural Systems in the Yellow Pine-Oak Forest Type Group

Silvicultural System	Applicability and Reasons for Silvicultural System
Even-aged Management	
Clearcut (CC)	Rc – must have reliable seed producing pines in adjacent stands or use fill-in planting of yellow pines. Also, must have adequate advance regeneration and/or probable stump sprouting of oaks to maintain minor component. Intensive competition control may be necessary to maintain dominant pine and oak components proportionate to former overstory. *Exceptions:* o Longleaf pine seedlings must be planted due to heavy seed and an inadequate number of existing seed trees; o Pitch and Table Mountain pine sites may need prescribed burning in adjacent stands or seedlings planted due to serotinous nature of cones on some trees.
Seedtree (SDTR)	Rc - pine seed trees must be probable seed producers and must have adequate advance regeneration and probable stump sprouts of oaks. Intensive competition control methods may be necessary to maintain pine and oak components. Size of cutting area will control proportion of shade tolerant and intolerant species that regenerate. *Exceptions:* o Longleaf pine seedlings must be planed because the number and distribution of seed trees is inadequate; o Pitch and Table Mountain pine stands may need prescribed burning or seedlings planted due to serotinous nature of cones in some trees. o Not recommended for stands where Virginia pine is the only overstory pine species. Virginia pine seedtrees subject to extensive mortality due to wind, ice and snow; regeneration may not develop in partial shade.
Shelterwood (SHWD)	Rc – same as seedtree with modified exceptions. *Exceptions:* o Pitch and Table Mountain pine stands may need prescribed burning or seedlings planted due to serotinous nature of most cones. o Not recommended for stands where Virginia pine is the only overstory pine species. Virginia pine residuals subject to extensive mortality due to wind, ice and snow; regeneration may not develop in partial shade.
Two-aged Management	
Clearcut with reserves (CCR)	Rc – same as even-aged clearcut management except: 1) longleaf pine may regenerate with an adequate number of seed-producing reserves; and 2) Virginia pine is not recommended for use as a reserve tree. Use when other resource objectives (visual, wildlife) must be met.

Silvicultural System	Applicability and Reasons for Silvicultural System
Seedtree with reserves (SDTRR)	Rc – same as even-aged seedtree management with additional exceptions under clearcut with reserves. Reserves can be a mixture of pines and oaks as well as others. Use to meet other resource objectives.
Shelterwood with reserves (SHWR)	Rc – same as even-aged shelterwood management except that Virginia pine is not recommended for use as a reserve tree. Reserves can be a mixture of species, however adequate light requirements for shade intolerant species may limit retention of additional reserve trees, especially hardwoods. Use to meet other resource objectives.
Uneven-aged Management	
Single-tree Selection (STS)	NR – ○ Not recommended for longleaf and Virginia pine stands due to highly shade intolerant growth requirements. Mature Virginia pine adjacent to gaps are subject to mortality from wind, ice and snow. ○ Unproven in pitch and Table Mountain pine stands as well as mixed pine-oak forest communities. Openings of at least one acre may be necessary to obtain reproduction and juvenile growth.
Group Selection (GS)	Rc – pine trees not harvested must be probable seed producers and must have adequate advance regeneration and probable stump sprouts of oaks in and around openings. Intensive competition control methods may be necessary to maintain pine and oak components. Openings of at least ½-acre in combination with improvement, sanitation, salvage or thinning cuts between openings are recommended. *Exceptions:* ○ Not recommended for Virginia pine stands due to highly shade intolerant growth requirements. Mature Virginia pine adjacent to openings are subject to mortality from wind, ice and snow. ○ Unproven in pitch and Table Mountain pine stands.

Table F-25: Vegetation Management Practices for the Yellow pine-Oak Forest Type Group.

Vegetation Management Practices for Recommended Systems	CC	SDTR	SHWD	CCR	SDTRR	SHWDR	STS	GS
Systems Recommended	Rc	Rc	Rc	Rc	Rc	Rc	NR	Rc
Site Preparation	R	R	R	R	R	R		R
Natural Regeneration	Rc	Rc	Rc	Rc	Rc	Rc		Rc
Artificial Regeneration	Rc	Rc	Rc	Rc	Rc	Rc		Rc
Release/Weeding	R	R	R	R	R	R		R
Pre-commercial Thinning	Rc	Rc	Rc	Rc	Rc	Rc		Rc
Pruning	NR	NR	NR	NR	NR	NR		NR
Prescribed Fire	R	R	R	R	R	R		R
Mid-story Reduction	R	R	R	R	R	R		R

Where mid-story reduction and prescribed burning has not pre-conditioned stands, site preparation is recommended to: (a) temporarily reduce or remove the competition of tolerant understory stems, (b) rejuvenate existing oak species by top killing them and thus stimulating competitive stump sprouts, and (c) reduce leaf litter and provide a seedbed for pines in natural regeneration prescriptions. When using natural regeneration, site preparation should be timed to coincide with a seed crop predicted to be sufficient to reach re-stocking standards.

Natural regeneration of the pine component is recommended only on the conditions that; (a) a reliable seed source is present and well-distributed, (b) seedlings to plant are difficult to obtain in quantity, (c) the site has been well-prepared to provide a seedbed and reduce competition sufficiently that pine seedlings are competitive..

Regeneration of the yellow pine-oak type by planting or direct seeding of the oak component has limited application to restoration efforts and then only to the extent that any existing reliable regeneration is inadequate to meet re-stocking standards. In these situations, use acorns originating from as near the planting site as possible for seed or to produce seedlings. Planted oaks usually grow very slowly and vegetation control is needed for several years for planted oaks to become part of the new stand. Direct seeded acorns are susceptible to pilferage by numerous wildlife species or being eaten by acorn weevils. Damaged acorns, if they produce a seedling, produce a weaker one that cannot be counted on to survive. In extensive operational use, artificial regeneration is recommended for the planting of bare root shortleaf, pitch, or Table Mountain pine and containerized longleaf. In the yellow pine-oak type, planting of yellow pine would be used to supplement the oak and meet re-stocking standards where natural regeneration is infeasible.

Release and weeding treatments are recommended to maintain both the oak and the pine component in a competitive position and to reduce any super-abundance of Virginia pine or white pine that puts at risk the ability to reach the desired composition.

Pre-commercial thinning is recommended at the time of crown closure or very soon thereafter, or approximately age 10, to; (a) reduce multiple stump sprout clumps of oak to the one or two best trees, (b) to maintain the oak component in the stand, and (c) to shape the species composition because it will tend to be maintained thereafter. Avoid cutting only one stem of oak clumps where the angle between two adjacent stems is a “V” rather than a “U”. Because site quality is only moderate or low and initial stand density is not high, the need for PCT is not expected to be as high as in cove or bottomland hardwood.

Pruning is not recommended for the species that would grow in this mixture because; (a) they prune well naturally, or (b) pruning would not re-pay the costs of doing it

Prescribed fire of low to moderate intensity is recommended on a three to seven year cycle to control small stems of tolerant understory up to 4” dbh and to create and maintain a habitat niche for herbaceous or small woody species that are non-

competitive in a closed forest environment. Examples are the various species of bluestem grass and the panic grasses.

Mid-story reduction is recommended as an intermediate treatment between crown closure and final harvest; particularly in existing stands, to restore historic conditions. Stems greater than 4" dbh up to approximately 8" dbh; that is, those too large to be managed with fire, will require an alternative form of treatment. A guideline for the residual basal area of all woody stems equal to or greater than 1" dbh is that it equal the site index for oak on that site. This will be lower than stocking tables would show for pine but the lower basal area would contribute to meeting other objectives, such as managing southern pine beetle risk.

Vegetation Management Practices in the White Pine - Oak Community

These mixed communities occur only on the Chattahoochee and almost exclusively within the Blue Ridge Mountains portion above approximately eighteen hundred feet elevation. White pine abundance is in part a function of historic land use and especially fire exclusion that began about seventy to eighty years ago. This forest type group typically occurs on low to moderate productivity sites for oak but high productivity sites for white pine. It is likely to include scattered individuals of shortleaf, Virginia, pitch, or Table Mountain pine. Included oak species on the Chattahoochee are white oak, black oak, chestnut oak, and scarlet oak. Typical understory species include dogwood, sourwood, rhododendron, mountain laurel, and red maple. Unlike oak stands, white pine advance regeneration is not as prevalent and is usually almost absence underneath large white pines. However, it is often abundant in small openings created by lightening or root disease.

The species involved, except for scarlet oak, are intermediate in tolerance. White pine is the only pine on the Forests so classified. An adage about white pine is that it is 'tolerant in youth and intolerant in old age'. It will readily establish on the forest floor under a closed hardwood canopy, persist for long periods in the absence of fire, then response to increased light with rapid growth. It is fire intolerant, especially as a seedling and sapling, and can be killed with low intensity fire and does not re-sprout. Oaks are only competitive as sprouts from stems present in the stands when they are harvested. Oak seedlings are non-competitive in the first year and slowly become increasingly more likely to be able to grow into the main canopy following a disturbance. This likelihood has been related by research to the root collar diameter. The relationship is that, as root collar diameter increases, the probability of a sprout from that root stock reaching the main canopy of a new stand increases. However, the increase is not indefinite. At diameters above approximately sixteen inches, the probability begins to decrease because larger stumps are less likely to produce sprouts.

Table F-26: Silvicultural Systems in the White Pine-Oak Forest Type Group

Silvicultural System	Applicability and Reasons for Silvicultural System
Even-aged Management	
Clearcut (CC)	Rc – sufficient white pine and oak advance reproduction or probable sprouting trees exist well distributed to regenerate stand; or artificial regeneration (planting, seeding) will be used to supplement..
Seedtree (SDTR)	NR – good white pine and oak seed crops occur infrequently; white pine seedtrees are subject to windfall; oak seed is heavy and will not disperse across site; oak seedlings usually cannot compete with others.
Shelterwood (SHWD)	R – when advance regeneration is absent or inadequate; provides adequate seed source and shade is beneficial during the establishment of seedlings.
Two-aged Management	
Clearcut with reserves (CCR)	Rc - sufficient white pine and hardwood advance reproduction exist well distributed in the understory. Reserves must meet visual and wildlife habitat requirements.
Seedtree with reserves (SDTRR)	NR – same as Seedtree. Reserve white pine trees subject to windthrow.
Shelterwood with reserves (SDWR)	R – same as Shelterwood. Reserve white pine trees subject to windthrow.
Uneven-aged Management	
Single-tree Selection (STS)	NR – Light regime provided inadequate to ensure maintaining the oak component.
Group Selection (GS)	Rc – Adequate advance regeneration must be present before harvest, release oak from white pine and other competition as needed to maintain, openings must be ½ - acre or larger to avoid significant diameter and height growth reductions in oaks. Guideline for minimum opening size is two tree heights of oldest white pine component.

Table F-27: Vegetation Management Practices in the White pine-Oak Forest Type Group.

Vegetation Management Practices for Recommended Systems	CC	SDTR	SHWD	CCR	SDTRR	SHWDR	STS	GS
Systems Recommended	Rc	NR	R	Rc	NR	R	NR	Rc
Site Preparation	R		R	R		R		R
Natural Regeneration	R		R	R		R		R
Artificial Regeneration	Rc		Rc	Rc		Rc		Rc
Release/Weeding	Rc		Rc	Rc		Rc		Rc
Pre-commercial Thinning	Rc		Rc	Rc		Rc		Rc
Pruning	Rc		Rc	Rc		Rc		Rc
Prescribed Fire	Rc		Rc	Rc		Rc		Rc
Mid-story Reduction	Rc		Rc	Rc		Rc		Rc

Where mid-story reduction has not pre-conditioned stands, site preparation by felling is recommended to rejuvenate existing oak reproduction sources with vigorous stump sprouting. Where white pine advance reproduction is not established, reduce dense low shade, such as that cast by mountain laurel, to improve white pine seedling establishment.

Natural regeneration is recommended as the primary reproduction method relying on advance regeneration of both oak and white pine.

Artificial regeneration is recommended only for the white pine component and then only if pre-harvest inventory has determined that the number and distribution of any existing white pine seedlings will not result in meeting a white pine-oak stand composition. Planting should be limited to only that needed as fill-in to meet that objective.

Release is recommended when it is needed to ensure that the minority oak component remains in a competitive position with the white pine (will involve releasing oak from white pine) and with a lesser priority objective of releasing white pine concurrently.

Pre-commercial thinning **is** recommended for the purpose of maintaining the oak but not primarily for the sake of white pine growth response. If loss of oak is not at least a moderate risk, defer treatment to a commercial thinning.

Pruning is recommended only for the white pine component because leaf-off season light penetration through the oaks will encourage lower limb retention in white pine. Pruning should not be done to improve wood quality unless an economic analysis shows that it will at least recover costs.

Prescribed fire is recommended only if advance white pine regeneration is either absence or is not being relied on to ensure full stocking. In these cases, prescribed fire begun some years prior to planned regeneration *may* provide a habitat niche suitable for white pine seedling establishment. In cases of super-abundant (> 500/acre) white pine advance regeneration, it may be cost-effective and biologically necessary to prescribed burn to remove it and fill-in plant after harvest to reach white pine-oak composition objectives.

Mid-story reduction is recommended to create and maintain a niche for advance oak regeneration establishment where it is inadequate to meet re-stocking standards. Mid-story reduction for the sake of white pine is a low priority and a limited amount of mid-story can be retained for visual quality or wildlife habitat mitigation without compromising stocking standards.

Vegetation Management Practices in the Loblolly Pine Community

The native loblolly pine community is most closely associated with the Southern Appalachian Piedmont and Southern Ridge and Valley ecological sections. Each of these is in the Humid Subtropic climatic division. Loblolly extends into the Blue Ridge

Mountains ecological section generally in mixture with other species and at elevations of 1000 to about 1600 feet. In the Blue Ridge, it is usually associated with riparian areas. In the Piedmont and Ridge and Valley, it typically forms stands in which loblolly is the primary species on old agricultural fields, most of which were cleared prior to 1850. Agricultural clearing removed any existing hardwood root stocks and subsequent erosion lowered the site productivity, rendering old field sites less hospitable to the pre-clearing hardwood species.

Loblolly, like the other yellow pines, is intolerant of overhead shade. Loblolly, like white pine, red maple, and yellow poplar, is a 'generalist' and occurs on a variety of sites. Species associated with a loblolly community include persimmon, scattered understory American beech, American hornbeam and American holly in minor amounts, red maple, blackgum, elm, eastern redbud, sourwood, dogwood, hickory, white oak, southern red oak, black oak, eastern red cedar, sweetgum, post oak, shortleaf pine, yellow poplar, black cherry, water oak, and sassafrass. Sweetgum, dogwood, and red maple are the most common understory species.

Loblolly is a reliable seed producer and understory seedlings are common following a canopy reduction. Seed are relatively large and heavy compared to other yellow pines on the Forests and have a higher energy to establish seedlings. However, these seedlings fade over time if light levels are not maintained. Loblolly is rated highly tolerant of fire. Seedlings readily survive low intensity fire in cool weather. Saplings can survive total crown consumption, though diameter and height grown is reduced for several years afterwards.

Within the Red-Cockaded Woodpecker Habitat Management Area on the Oconee (all National Forest south of Interstate 20) loblolly pine management must be consistent with the USDI Fish and Wildlife Service recovery plan for that species. Silviculturally, that plan calls for thinning to reduce loblolly pine basal area to approximately 60 and for the regeneration method to be a shelterwood with reserves system. Reserve trees are not to be removed. The purpose in leaving them indefinitely is to furnish future opportunities to the bird to excavate roosting and nesting cavities.

Table F-28: Silvicultural Systems in the Loblolly Pine Forest Type

Silvicultural System	Applicability and Reasons for Silvicultural System
Even-aged Management	
Clearcut (CC)	R – Allows cultural operations to be concentrated in time and space. Provides for rapid and timely spacing and stocking control of regeneration.
Seedtree (SDTR)	R – Allows cultural operations to be concentrated in time and space. Success of reproduction depends on proper mix or population of seed supply and seedbed conditions.
Shelterwood (SHWD)	R – Allows cultural operations to be concentrated in time and space. Success or reproduction depends on proper mix or population of seed supply and seedbed conditions.

Table continued next page.

Two-aged Management	
Clearcut with reserves (CCR)	Rc – must provide for desirable diversity for aesthetic value and wildlife habitat. Must provide sufficient light for seedling development and growth.
Seedtree with reserves (SDTRR)	Rc – must provide for desirable diversity for esthetic value and wildlife habitat. Must provide sufficient light for seedling development and growth.
Shelterwood with reserves (SHWR)	Rc – must provide for desirable diversity for esthetic value and wildlife habitat. Must provide sufficient light for seedling development and growth. Required for RCW HMA
Uneven-aged Management	
Single-tree Selection (STS)	Rc – must involve periodic cuttings at 5-10 year intervals of group or single trees where regeneration is needed. Hardwood competition must be controlled.
Group Selection (Gs)	Rc – must involve periodic cuttings at 5-10 year intervals of group or single trees where regeneration is needed. Hardwood competition must be controlled.

Table F-29: Vegetation Management Practices in the Loblolly Pine Forest Type.

Vegetation Management Practices for Recommended Systems	CC	SDTR	SHWD	CCR	SDTRR	SHWDR	STS	GS
System Recommended	R	R	R	Rc	Rc	Rc	Rc	Rc
Site Preparation	R	R	R	R	R	R	R	R
Natural Regeneration	R	R	R	R	R	R	R	R
Artificial Regeneration	Rc	Rc	Rc	Rc	Rc	Rc	Rc	Rc
Release/Weeding	R	R	R	R	R	R	R	R
Pre-commercial Thinning	R	R	R	R	R	R	R	R
Pruning	Rc	Rc	Rc	Rc	Rc	Rc	NR	NR
Prescribed Fire	R	R	R	R	R	R	R	R
Midstory Reduction	R	R	R	R	R	R	R	R

Where mid-story reduction and prescribed burning has not pre-conditioned stands, site preparation is recommended to; (a) temporarily reduce or remove the competition of tolerant understory stems, and (b) reduce leaf litter and provide a seedbed for pines in natural regeneration prescriptions. When using natural regeneration, timing of site preparation is not likely to be critical in loblolly pine.

Natural regeneration of the pine component is recommended provided that the site has been well-prepared to provide a seedbed and reduce competition sufficiently that pine seedlings are competitive..

Artificial regeneration is recommended for the purposes of significantly improving insect or disease resistance, to better meet RCW habitat objectives, to restore loblolly to ecologically appropriate sites where no natural regeneration source is available, or to provide greater control over the numbers of seedlings established.

Release and weeding treatments are recommended to maintain the pine component in a competitive position and to reduce any super-abundance of loblolly regeneration that puts at risk the ability to reach specific Plan objectives.

Pre-commercial thinning is recommended at approximately the time of crown closure, especially in naturally-regenerated stands that have a number of seedlings per acre that equals or exceeds the re-stocking standard maximum.

Pruning is recommended for loblolly only where specific product objectives have been set for specific locations that pruning would help achieve.

Prescribed fire, both dormant and growing season, is recommended on an approximate three to seven year cycle to: (a) control small stems of tolerant understory up to 4" dbh, (b) create and maintain a habitat niche for herbaceous or small woody species that are non-competitive in a closed forest environment, and (c) maintain the open stand conditions favored by the red-cockaded woodpecker.

Mid-story reduction is recommended as an intermediate treatment between crown closure and final harvest; particularly in existing stands, to restore historic conditions. Stems greater than 4" dbh up to approximately 8" dbh; that is, those too large to be managed with fire, will require an alternative form of treatment. Follow RCW recovery plan for residual basal area and what is included in calculating it. Priority for mid-story reduction is; (1) in the RCW sub-HMA, (2) in the oldest loblolly stands, and (3) in those oldest stands with the greatest density of mid-story.

Vegetation Management Practices in the Shortleaf and Pitch Pine Communities

Shortleaf and pitch pine are separate communities for the most part, though they may also occur in association with each other. Pitch pine reaches an edge of its range in northeastern Georgia. Shortleaf occurs through both the Chattahoochee and the Oconee. In the Blue Ridge Mountains of the Chattahoochee, shortleaf is 5.6-percent and pitch is 1.7-percent of forest cover on all forest acres. In the Southern Ridge and Valley shortleaf is 4-percent of all forested acres and pitch is essentially absence. On the Oconee, shortleaf is 2-percent of all forested acres and pitch is absent.

Shortleaf pine reaches its best development in dry-mesic moisture conditions rather than drier, more exposed sites. Pitch pine does well in sandy soils with a dry-mesic moisture regime. Associated overstory species are Virginia pine, chestnut oak, scarlet oak, white oak, and hickory. Associated understory is primarily dogwood, sourwood, red maple, and may also have extensive coverage of mountain laurel.

Both shortleaf and pitch pine are intolerant and do not establish seedlings in an undisturbed forest. Seedlings die soon after germination when seed energy has been expended and light levels do not support the switch to independent photosynthesis. It has been suggested that shortleaf will be the next tree species to be in decline, like Table Mountain pine now is, by mortality of the mature trees without replacement by new seedlings.

Both shortleaf and pitch pine are fire-tolerant, and can survive complete defoliation from fire, though their growth is reduced while the crown regenerates. Shortleaf is a fire-adapted species. One of its adaptations is early development of a thick, fissured bark that insulates against heat. Another is the formation of a 'basal crook' at the ground line for seedlings. Root collar buds protected on the underneath of this crook re-sprout when a seedling is top-killed by fire.

Table F-30: Silvicultural Systems for the Shortleaf and Pitch Pine Communities

Silvicultural System	Applicability and Reasons for Silvicultural System
Even-aged Management	
Clearcut (CC)	R – Provides abundant light and is most compatible with use of fire and equipment to control competing competition while preparing a suitable seedbed.
Seedtree (SDTR)	Rc – Provides abundant light and can be compatible with use of fire and equipment to control competing competition while preparing a suitable seedbed; requires survey for seed crop and timed site prep.
Shelterwood (SHWD)	Rc – Rainfall must be sufficient for good first year survival and only when < about 50 BA/Acre is allowed to remain.
Two-aged Management	
Clearcut with reserves (CCR)	Rc – must provide for desirable diversity for aesthetic value and wildlife habitat. Shading by reserves must provide sufficient light for seedling development and growth.
Seedtree with reserves (SDTRR)	Rc – must provide for desirable diversity for aesthetic value and wildlife habitat. Shading by reserves must provide sufficient light for seedling development and growth.
Shelterwood with reserves (SWHR)	Rc – Shading by reserves must be low enough to provide sufficient sunlight to forest floor for seed germination and seedling development.
Uneven-aged Management	
Single-tree Selection (STS)	NR – contiguous blocks of types not available, difficult to use, requires more care and is economically less efficient than alternative methods.
Group Selection (GS)	NR – contiguous blocks of type not available, difficult to use, requires more care and is economically less efficient than alternative methods.

Table F-31: Vegetation Management Practices for Shortleaf and Pitch Pine Communities

Vegetation Management Practices for Recommended Systems	CC	SDTR	SHWD	CCR	SDTRR	SHWDR	STS	GS
System Recommendation	R	Rc	Rc	Rc	Rc	Rc	NR	NR
Site Preparation	R	R	R	R	R	R		
Natural Regeneration	Rc	Rc	Rc	Rc	Rc	Rc		
Artificial Regeneration	R	R	R	R	R	R		
Release/Weeding	R	R	R	R	R	R		
Pre-commercial Thinning	Rc	Rc	Rc	Rc	Rc	Rc		
Pruning	NR	NR	NR	NR	NR	NR		
Prescribed Fire	R	R	R	R	R	R		
Mid-story Reduction	R	R	R	R	R	R		

Where mid-story reduction and prescribed burning has not pre-conditioned stands, site preparation is recommended to: (a) temporarily reduce or remove the competition of tolerant understory stems, and (b) reduce leaf litter and provide a seedbed for pines in natural regeneration prescriptions. When using natural regeneration, site preparation should be timed to coincide with a seed crop predicted to be sufficient to reach re-stocking standards for the type.

A total reliance on natural regeneration of the pine component is recommended only on the conditions that: (a) a reliable seed source is present and well-distributed, (b) seedlings to plant are difficult to obtain in quantity, (c) the site has been, or will be prior to seed fall, well-prepared to provide a seedbed and reduce competition sufficiently that pine seedlings are competitive. When reserve trees are left for other purposes, the appearance of a seed tree is not an effective seedtree. When first year surveys do not show adequate seedlings from natural regeneration, plant the following spring and release as needed to maintain pine.

In extensive operational use, artificial regeneration is recommended with planting of bare root shortleaf or pitch. Many of the shortleaf on the Forests in particular were suppressed early in their life and do not have full crowns or a reliable cone crop.

Release and weeding treatments are recommended to maintain both the pine component in a competitive position and to reduce any super-abundance of Virginia pine or white pine that puts at risk the ability to reach the desired composition. Release is even more critical when natural regeneration is being pitted against long-established hardwood.

Pre-commercial thinning is recommended at approximately the time of crown closure in situations where there is a super-abundance of regeneration (meets or exceeds maximum stems/acre for the type) and especially if competing species such as Virginia pine or white pine equal or exceed the number of shortleaf or pitch pine.

Pruning is not recommended for the species that would grow in this mixture because; (a) they prune well naturally, or (b) pruning would not re-pay the costs of doing it

Prescribed fire of low to moderate intensity is recommended on a three to seven year cycle to control small stems of tolerant understory up to 4” dbh and to create and maintain a habitat niche for herbaceous or small woody species that are non-competitive in a closed forest environment. Examples are the various species of bluestem grass and the panic grasses. These types are appropriate ones for a pine woodland restoration also, which will require fire use, especially growing season fire, to convert to predominantly herbaceous forest floor cover. Fire is a potentially valuable tool to remove Virginia pine seedlings and saplings and allowing shortleaf and pitch to re-sprout. Fire can also extend the period of time that seedling and sapling stands provide high-quality early-successional habitat.

Mid-story reduction is recommended as an intermediate treatment particularly in existing stands, and in newly-established stands between crown closure and final

harvest, to restore historic conditions. Stems greater than 4" dbh up to approximately 8" dbh; that is, those too large to be managed with fire, will require an alternative form of treatment. A guideline for the residual basal area of all woody stems equal to or greater than 1" dbh is that it equal the site index for shortleaf or pitch respectively on that site. This will be lower than stocking tables would show for pine but the lower basal area would contribute to meeting other objectives, such as managing southern pine beetle risk.

Vegetation Management Practices in the Virginia Pine Community

Virginia pine is limited to the Chattahoochee and, within the Chattahoochee; it is most abundant along the mountain-piedmont transitional area. This location coincides with the ecological classification division, province, and section boundaries. It is also a location where extensive disturbances; farming, woods grazing, burning, and logging created conditions suitable for rapid and widespread colonization by Virginia pine. Once effective fire control began, Virginia pine reclaimed extensive areas.

In nature, Virginia pine is most competitive on the most adverse lower elevations sites; rocky, thin-soiled, droughty, and infertile. It has thin bark, even beyond the sapling stage and is not fire tolerant. It is easily killed by fire as a seedling and sapling and does not re-sprout. Virginia pine is intolerant and though it produces abundant seed and seedlings each year, these do not survive in shade but aggressively occupy bare mineral soil especially.

Ecologically Virginia pine is valuable as a rapid forest cover but it is short-lived and begins to decline beyond approximately age sixty. It is very susceptible to developing 'red heart rot' caused by the fungus *Fomes pini* with advanced age. The interior rot that results accelerates the decline of stands. Virginia pine also is very prone to windthrow or breakage if not supported by near neighbors. When gaps appear in a stand they tend to expand outward over time.

Table F-32: Silvicultural Systems in the Virginia Pine Forest Type

Silvicultural System	Applicability and Reasons for Silvicultural System
Even-aged Management	
Clearcut (CC)	R – Provides sufficient light for seedling development and growth. No damage caused to retained trees, provides for economical means for seed bed preparation and hardwood control.
Seedtree (SDTR)	NR – seed source not needed, intolerance to shade hampers seedling development, susceptibility to wind, ice and snow damage causes loss of residual trees, negating their use for natural regeneration.
Shelterwood (SHWD)	NR – seed source not needed, intolerance to shade prevent seedling development, susceptibility to wind, ice and snow damage causing loss of residual trees, negating their use for natural regeneration.

Table continued next page

Two-aged Management	
Clearcut with reserves (CCR)	Rc – provides sufficient light for seedling development and growth and provides for desirable diversity for esthetic value and wildlife habitat but reserve trees need to be other species.
Seedtree with reserves (SDTRR)	NR – seed source not needed, intolerance to shade retards seedling development, susceptibility to wind, ice and snow damage causes loss of residual trees, negating their use for regeneration, esthetic value and wildlife habitat.
Shelterwood with reserves (SHWR)	NR – seed source not needed, shelterwood shade too heavy - intolerance to shade prevents seedling development, susceptibility to wind, ice and snow damage causing loss of residual trees, negating their use for regeneration, esthetic value and wildlife habitat.
Uneven-aged Management	
Single-tree Selection (STS)	NR – shade too dense to establish and develop seedlings, uneven aged structure of stand would deteriorate to a transition to a transition to hardwood. Virginia pine is intolerant of shade.
Group Selection (GS)	NR – uneven aged structure of stand would deteriorate to a transition to a transition to hardwood. Virginia pine is intolerant of shade.

Table F-33: Vegetation Management Practices for the Virginia Pine Community Type.

Vegetation Management Practices for Recommended Systems	CC	SDTR	SHWD	CCR	SDTRR	SHWDR	STS	GS
System Recommended	R	NR	NR	Rc	NR	NR	NR	NR
Site Preparation	Rc			Rc				
Natural Regeneration	R			R				
Artificial Regeneration	NR			NR				
Release/Weeding	NR			NR				
Pre-commercial Thinning	Rc			Rc				
Pruning	NR			NR				
Prescribed Fire	Rc			Rc				

In dense Virginia pine stands being replaced with Virginia pine, competition is typically low. Due to the typical over-abundance regeneration, allowing regeneration to occur without site preparation could help hold down stem density and cost-effectively help achieve other objectives. When residual basal area equals or exceeds approximately 20, site preparation will be needed.

Natural regeneration will be ample in almost all cases to replace this species. Artificial regeneration should only be used to restore the community on appropriate sites where no seed source exists.

Release and weeding is generally un-necessary because Virginia pine overwhelms its associated competition if site prep was adequate.

Pre-commercial thinning is recommended provided it is low cost. Virginia pine can stagnate and virtually cease growth when overly-dense. Because natural regeneration in this species will predictably produce several thousand seedlings per acre, some method of density control is needed. A backing or flanking fire through a seedling stand that has a wide range in root collar diameters would kill the smallest stems and leave many of the larger ones.

Pruning is not recommended because it will not recover the cost of doing it. Virginia pine is marketed as a low-grade softwood as a species and has no means of receiving a quality premium price.

Prescribed burning is incompatible with this type in most cases, except as previously noted. However, it is recommended for use as a site preparation tool because; (a) adequate seed will either survive the fire or blow in from surrounding stands, and (b) the number of seedlings establishing will be greatly reduced, thus providing greater wildlife habitat benefits, alleviating the need for later density control, and improving resistance to southern pine beetle.

Vegetation Management Practices in the White Pine Community

White pine is essentially limited to the Blue Ridge portion of the Chattahoochee above approximately eighteen hundred feet elevation, though a few hundred acres are in the Piedmont portion of the Chattooga Ranger District. The current abundance and distribution is a disturbance related effect and – as with Virginia pine – has been heavily influenced by effective fire control that gave protection to its seedlings beginning about seventy years ago.

White pine is a 'generalist' species and grows well on a wide variety of sites. This forest type typically occurs on low to moderate productivity sites for oak but high productivity sites for white pine. It is likely to include scattered individuals of shortleaf, Virginia, pitch, or Table Mountain pine. Included oak species are white oak, black oak, chestnut oak, and scarlet oak. Typical understory species include dogwood, sourwood, rhododendron, mountain laurel, and red maple. Unlike oak stands, white pine advance regeneration is not as prevalent and is usually almost absence underneath large white pines. However, it is often abundant in small openings created by lightening or root disease.

White pine is the only pine on the Chattahoochee classified as intermediate in tolerance. An adage about white pine is that it is 'tolerant in youth and intolerant in old age'. It will readily establish on the forest floor under a closed hardwood canopy, persist for long periods in the absence of fire, then response to increased light with rapid growth. It is fire intolerant, especially as a seedling and sapling, and can be killed with low intensity fire and does not re-sprout.

Table F-34: Silviculture Systems in the White Pine Forest Type.

Silvicultural System	Applicability and Reasons for Silvicultural System
Even-aged Management	
Clearcut (CC)	Rc – when sufficient white pine advance reproduction exist well distributed in the understory or artificial regeneration is planned.
Seedtree (SDTR)	NR – good seed crops occur infrequently, seedtrees are subject to windfall, and new seedlings are not competitive
Shelterwood (SHWD)	R – provided adequate seed source and shade is beneficial during the establishment of seedlings
Two-aged Management	
Clearcut with reserves (CCR)	Rc – when sufficient white pine advance reproduction exist well distributed in the understory. Reserves must meet visual and wildlife habitat requirements.
Seedtree with reserves (SDTRR)	NR – seed crop occurs infrequently and retainer trees subject to windfall and new seedlings are not competitive.
Shelterwood with reserves (SDWR)	Rc – sufficient advanced reproduction exist. Well distributed in the understory and light intensity is adequate for survival and growth of the reproduction.
Uneven-aged Management	
Single-tree Selection (STS)	Rc – light intensity is critical to the survival and growth of WP seedling, stand structure would deteriorate to a transition of hardwood, dense low shade must be reduced or eliminated before white pine can germinate and become established. In addition, white pine retained must be probable seed producers or planted throughout gaps.
Group Selection (GS)	R – constraints imposed by periodicity of seed crop or sufficient advanced reproduction exist. Future release requirements must be considered.

Table F-35: Vegetation Management Practices in the White Pine Forest Type.

Vegetation Management Practices for Recommended Systems	CC	SDTR	SHWD	CCR	SDTRR	SHWDR	STS	GS
System Recommendation	Rc	NR	R	Rc	NR	Rc	Rc	R
Site Preparation	R		R	R		R	R	R
Natural Regeneration	R		R	R		R	R	R
Artificial Regeneration	Rc		Rc	Rc		Rc	NR	NR
Release/Weeding	NR		NR	NR		NR	NR	NR
Pre-commercial Thinning	NR		NR	NR		NR	NR	NR
Pruning	NR		NR	NR		NR	NR	NR
Prescribed Fire	NR		NR	NR		NR	NR	NR
Mid-story Reduction	Rc		Rc	Rc		Rc	Rc	Rc

Where mid-story reduction has not pre-conditioned stands and white pine advance reproduction is not established, reduce dense low shade, such as that cast by mountain laurel, to improve white pine seedling establishment.

Natural regeneration is recommended as the primary reproduction method relying on advance regeneration of white pine primarily but when it does not exist, using the shelterwood method to establish it. .

Artificial regeneration is recommended only if pre-harvest inventory has determined that the number and distribution of any existing white pine seedlings will not result in meeting a white pine stand composition. Planting should be limited to only that needed as fill-in to meet that objective.

Release is not recommended as white pine will tolerate shading and is variable enough in height growth not to stagnate through overly-dense conditions.

Pre-commercial thinning is not recommended for the purpose of maintaining the white pine growth response as it is un0necessary, also frequent thinning in white pine are likely to cause problems with root disease.

Pruning is not recommended as white pine will prune naturally, especially in a predominantly white pine stand.

Prescribed fire is not recommended as even mature white pine is not very tolerant of fire.

Mid-story reduction is recommended only if needed to achieve objectives other than sustaining a white pine community

REFERENCES

Analysis of Management Situation, Forest Cover Chapter. USDA Forest Service, Chattahoochee – Oconee National Forests, Gainesville, GA. 2000.

The Scientific Basis for Silvicultural and Management Decisions in the National Forest System. Russell M. Burns. General Technical Report WO-55. September, 1989.

Silvicultural Systems for the Major Forest Types of the United States. Russell M. Burns. Agriculture Handbook 445.

Silvics of North America, Volumes 1 (Conifers) and 2 (Hardwoods). Agriculture Handbook 654. December, 1990.

Regional Silviculture of the United States. John W. Barrett. Third Edition, 1995. John Wiley and Sons, Inc. 643 pp.

Forest Cover Types of the United States and Canada. F.H. Eyre. Society of American Foresters. 1980. 148 pp.

Guidance for Conserving and Restoring Old-Growth Communities on National Forests in the Southern Region. Report of the Region 8 Old-Growth Team. Forestry Report R8-FR-62. June, 1997.

Seeds of Woody Plants in North America. James A. Young and Cheryl G. Young. Dioscorides Press, 1992.

"Understory Vegetation 3 Years after Implementing Uneven-Aged Silviculture in a Shortleaf Pine – Oak Stand." Michael G. Shelton and Paul A. Murphy. Research Paper SO-296, September, 1997.

"Managing Longleaf Pine under the Selection System – Promises and Promises." Robert M. Farrar, Jr. and William D. Boyer. In Proceedings of the Sixth Biennial Southern Silvicultural Research Conference, Memphis, Tennessee, 1990, Volume 1. General Technical Report SE-70, published by Southeastern Forest Experiment Station, Asheville, North Carolina, September, 1991.

"Pine-Hardwood Regeneration in Small Openings for Uneven-Aged Management." Thomas A. Waldrop. In Proceedings of the Sixth Biennial Southern Silvicultural Research Conference, Memphis, Tennessee, 1990, Volume 1. General Technical Report SE-70, published by Southeastern Forest Experiment Station, Asheville, North Carolina, September, 1991.