

**Forest Service Manual
National Headquarters - Washington Office
Washington, DC**

**Forest Service Manual 2400 – Timber Management
Chapter 2470 - Silvicultural Practices**

Amendment: 2400-2014-1

Effective date: March 06, 2014

Duration: This amendment is effective until superseded or removed.

Approved by: Tony Tooke, Associate Deputy Chief, NFS

Date approved: February 28, 2014

Responsible Staff:

Last Change: 2400-2009-2 to 2400_zero_code

Superseded Document(s): 2470, Amendment 2400-2004-6, August 13, 2004

Digest: Following is an explanation of the changes throughout the directive by section.

2470: Revises chapter in its entirety given specific edits to sections listed.

2470.1: Sets forth revised direction on the purpose of the Organic Administration Act of 1897 (30 Stat. 34, as supplemented and amended; 16 U.S.C. 473-478).

Adds Healthy Forest Restoration Act of 2003.

2470.3: Revises policy to capture ecological restoration, management at landscape scale and managing for climate change.

Provides alignment with FSM 2020.

2470.5: Revises definitions for harvest and regeneration terms to reflect refinements made for definitions in FACTS and adds eight new definitions.

Clarifies that Forest Service Activity Tracking System (FACTS) is now the official database of records for silvicultural activities.

2471.02: Revises objectives to include creation of resilient and healthy forests.

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

2472.02: Sets forth direction that clearly states reforestation required by law and revises objectives for reforestation.

2472.05: Adds four new definitions.

2472.1: Provides details of reforestation plans and reports.

2472.4: Delete obsolete statistical requirements.

2472.5: Moves 'Certification of Restocking and Treatment' section from FSM 2496.11c to FSM 2472.5 and sets forth direction.

2472.6: Adds new section called 'Natural Recovery' and sets forth direction.

2473: Changes title from 'Forest Tree Nurseries' to 'Forest Nurseries' to reflect production of native plants at the nurseries and sets forth direction. For the same reasons, changes 'tree/s' to 'nursery stock' throughout this chapter.

2473.03: Removes obsolete direction to reference on agreements with state agencies.

2473.12: Revises the financing of nursery stock, and sets forth direction that WCF funds will be used to finance capitalized nursery stock production costs.

2475: Changes title from "Forest Tree Improvement" to "Genetic Resource Management" and sets forth direction.

2475.03: Revises policy to emphasize not only the need to increase production of forest products, but to increase resistance to insects and pathogens and develop resiliency to climate change.

2475.05: Adds twenty new definitions.

2475.61: Revises reference to the 2002 National Genetics Strategic Plan and National Genetics Lab (NFGEL).

2476: Changes title from 'Timber Stand Improvement' to 'Stand Improvement'.

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

Table of Contents

2470.1 - Authority.....	7
2470.2 - Objectives	8
2470.3 - Policy	8
2470.4 - Responsibility	10
2470.41 - Regional Forester	10
2470.5 - Definitions.....	10
2471 - Harvest Cutting	18
2471.02 - Objective	18
2471.1 - Even-aged Stands	18
2471.11 - Considerations	18
2471.12 - Methods	18
2471.2 - Two-aged Stands	18
2471.21 - Considerations	18
2471.22 - Methods	19
2471.3 - Uneven-aged Stands.....	19
2471.31 - Considerations	19
2471.32 - Methods	19
2471.4 - Intermediate Cutting	19
2471.41 - Consideration	19
2471.42 - Methods	19
2472 - Reforestation	20
2472.02 - Objectives.....	20
2472.03 - Policy.....	20
2472.04 - Responsibility	21
2472.04a - Regional Forester	21
2472.04b - Forest Supervisor	21
2472.04c - District Ranger	21
2472.1 - Reforestation Plans and Reports.....	22
2472.2 - Setting and Tracking Priorities	22
2472.21 - Economic Analysis.....	22
2472.3 - Reforestation Process.....	23
2472.31 - Site Preparation	23
2472.32 - Regeneration Methods.....	23
2472.33 - Reforestation Protection	24
2472.4 - Regeneration Examinations	25
2472.5 - Certification of Restocking and Treatment	25
2472.6 - Natural Recovery.....	25
2472.7 - Forest Regeneration Committee	26
2473 - Forest Nurseries.....	26
2473.01 - Authority	26
2473.02 - Objectives.....	26

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

2473.03 - Policy.....	26
2473.04 - Responsibility	27
2473.04a - Chief	27
2473.04b - Regional Forester	27
2473.04c - Station Director	28
2473.1 - Financing.....	28
2473.11 - Construction and Development.....	28
2473.12 - Nursery Stock Production.....	28
2473.13 - Other Nursery Costs	29
2473.2 - Sale, Exchange, and Purchase of Nursery Stock	29
2473.21 - Purchasing Nursery Stock.....	29
2473.22 - Sale of Nursery Stock to National Forests	29
2473.23 - Exchange of Nursery Stock	30
2473.24 - Sale of Nursery Stock to Other Public Agencies.....	30
2473.25 - Disposal of Surplus Nursery Stock.....	31
2473.26 - Donation of Nursery Stock	31
2473.3 - Plans, Records, and Reports.....	31
2473.31 - Plans.....	31
2473.32 - Records.....	31
2473.33 - Reports	32
2474 - Seed.....	32
2474.01 - Authority	32
2474.02 - Objective	32
2474.03 - Policy.....	32
2474.04 - Responsibility	33
2474.04a - Chief	33
2474.04b - Regional Forester	33
2474.1 - Cone (Seed) Collection and Procurement	33
2474.11 - Designation of Harvest Areas	33
2474.12 - Cone (Seed) Collection or Purchase	33
2474.13 - Quality Specifications.....	34
2474.14 - Documentation and Records	34
2474.2 - Cone and Seed Processing, Storage, and Accountability	34
2474.21 - Cone and Seed Processing	34
2474.22 - Seed Storage.....	34
2474.23 - Accountability.....	34
2474.3 - Financing.....	35
2474.31 - Construction and Development.....	35
2474.32 - Seed Bank.....	35
2474.33 - Use of Knutson-Vandenberg Funds for Seed	35
2474.4 - Purchase and Disposal of Seed.....	36
2474.41 - Purchasing Seed.....	36
2474.42 - Sale of Seed to National Forests	36

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

2474.43 - Exchange of Seed	36
2474.44 - Sale of Seed to Other Public Agencies.....	36
2474.45 - Disposal of Surplus Seed	36
2474.46 - Donation of Seed	36
2474.5 - Plans, Records, and Reports.....	37
2474.51 - Plans.....	37
2474.52 - Records.....	37
2474.53 - Reports	37
2475 - Genetic Resources Management	37
2475.02 - Objectives.....	37
2475.03 - Policy.....	37
2475.04 - Responsibility	38
2475.04a - Regional Forester	38
2475.04b - Regional Geneticist	39
2475.04c - Forest Supervisor.....	39
2475.05 - Definitions	39
2475.1 - Administration of Genetic Resource Management Programs.....	41
2475.11 - Program Priorities.....	41
2475.2 - Program Prerequisites	41
2475.21 - Seed-Collection Zones	41
2475.22 - Breeding Zones	41
2475.23 - Identity-Control Systems.....	41
2475.3 - Program Intensity Levels.....	42
2475.31 - Level 1, Tree-Seed Zones	42
2475.32 - Level 2, Seed-Collection Stands	42
2475.33 - Level 3, Seed-Production Areas	43
2475.34 - Level 4, Seed Orchards (Not supported by evaluation plantations).....	43
2475.35 - Level 5, Selective Breeding and Rogued Seed Orchards.....	43
2475.4 - Selective Breeding Phases.....	43
2475.41 - Selection of Superior Trees.....	44
2475.42 - Breeding Strategies	44
2475.43 - Evaluation Plantations	44
2475.44 - Mass Production of Seed.....	44
2475.45 - Handling of Seed and/or Seedlings	44
2475.5 - Protection of Genetic Resource Material.....	44
2475.6 - Plans, Records, and Reports.....	45
2475.61 - Genetic Resource Management Plans.....	45
2475.62 - Records and Reports	46
2476 - Stand Improvement	46
2476.02 - Objectives.....	46
2476.03 - Policy.....	46
2476.04 - Responsibility	46
2476.04a - Regional Forester	46

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

2476.04b - Forest Supervisor	47
2476.04c - District Rangers	47
2476.1 - Stand Improvement Plans and Reports	47
2476.2 - Priorities and Economic Analysis.....	47
2476.3 - Stand Improvement Categories.....	48
2476.4 - Integrating Multiple Objectives	48
2476.5 - Stand Improvement Implementation Methods	48
2476.6 - Use of Pesticides	49
2476.7 - Validation.....	49
2476.8 - Monitoring	49
2477 - Collection and Use of Deposits for Sale Area Improvement.....	50
2478 - Silvicultural Examinations, Prescriptions, and Evaluations	50
2478.01 - Authority	50
2478.02 - Objectives.....	50
2478.03 - Policy.....	50
2478.04 - Responsibility	51
2478.04a - Regional Forester	51
2478.1 - Silvicultural Examinations.....	51
2478.2 - Diagnosis of Treatment Needs	52
2478.3 - Silvicultural Prescriptions	52
2478.4 - Forest Vegetation Monitoring.....	52
2478.5 - Training and Certification of Silviculturists	53
2478.51 - National Standards for Silviculturist Certification.....	53
2479 - Stocking Guides and Growth Projections	54
2479.01 - Authority	54
2479.02 - Objectives.....	54
2479.03 - Policy.....	54
2479.04 - Responsibility	54
2479.04a - Regional Forester	54

Forest Service Manual 2400 – Timber Management
Chapter 2470 - Silvicultural Practices
Amendment: 2400-2014-1
Effective date: March 06, 2014

2470.1 - Authority

Basic authority for silvicultural practices on National Forest System lands is contained in the following acts:

1. Organic Administration Act of 1897 (30 Stat. 34, as supplemented and amended; 16 U.S.C. 473-478), that states the purpose of the national forests, and directs its control and administration to be in accord with such purpose, that is, "No national forest shall be established, except to improve and protect the forest within the boundaries, or for the purpose of securing favorable conditions of water flows, and to furnish a continuous supply of timber for the use and necessities of citizens of the United States."
2. Knutson-Vandenberg Act of 1930 (46 Stat. 527, as amended; 16 U.S.C. 576 - 576b), authorizes the Secretary of Agriculture to "...establish forest tree nurseries and do all other things needful in preparation for planting on national forests..." and requires the "purchaser of national forest timber to make deposits of money ...to cover the cost ...of planting, sowing with tree seeds, cutting, destroying, or otherwise removing undesirable trees or other growth and protecting and improving the future productivity of renewable resources..."
3. Bankhead-Jones Farm Tenant Act of 1937 (50 Stat. 525, as amended; 7 U.S.C. 1010-1012), authorizes and directs the Secretary to "...develop a program of land conservation and land utilization, in order thereby to correct maladjustments in land use, and thus assist in controlling soil erosion, reforestation, preserving natural resources..."
4. Anderson-Mansfield Reforestation and Revegetation Act of 1949 (63 Stat. 762; 16 U.S.C. 581j-581k), states "...it is the declared policy of the Congress to accelerate and provide a continuing basis for the needed reforestation and revegetation of national forest lands and other lands under administration and control of the Forest Service of the Department of Agriculture in order to obtain the benefits hereinbefore enumerated..."
5. Granger-Thye Act of 1950 (64 Stat. 82, as amended; 16 U.S.C. 490), authorizes the Secretary of Agriculture "... where the public interest justifies, to cooperate or assist public and private agencies,...in performing work...within or near a national forest for which the administering agency, owner, or other interested party deposits...a sufficient sum to cover the total estimated cost of the work to be done for the benefit of the depositor, for administration, protection, improvement, reforestation, and such other kinds of work the Forest Service is authorized to do on lands of the United States. It also "authorizes the Secretary of Agriculture, subject to such conditions as he may prescribe, to sell forest-tree seed and nursery stock..."
6. Multiple-Use Sustained-Yield Act of 1960 (Pub. L. 86-517, 74 Stat. 215; 16 U.S.C. 528-531), authorizes and directs the Secretary of Agriculture "...to develop and administer the renewable surface resources of the national forests for multiple use and sustained yield of the several products and services obtained therefrom..."

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

7. Supplemental National Forest Reforestation Fund Act of 1972 (87 Stat. 242, 245, as amended; 16 U.S.C. 576c-576e), directs the Secretary of Agriculture to establish a "Supplemental National Forest Reforestation Fund."

8. Forest and Rangeland Renewable Resources Planning Act of 1974, as amended by the National Forest Management Act (NFMA) of 1976 (16 U.S.C. 1600-1614), states "it is the policy of the Congress that all forested lands in the National Forest System be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans" and directs the Secretary of Agriculture to ensure that timber will be harvested from National Forest System lands only where there is assurance that such lands can be adequately restocked within five years after harvest. It provides for logging while recognizing "the fundamental need to protect and where appropriate, improve the quality of soil, water, and air resources." It ensures that timber will be harvested from national forest lands "only where soil, slope or other watershed conditions will not be irreversibly damaged." It also specifies that "protection is provided for streams, stream-banks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of water courses, and deposits of sediment, where harvest are likely to seriously and adversely affect water conditions or fish habitat."

9. Reforestation Trust Fund, Title III - Reforestation, Recreation Boating Safety and Facilities Improvement Act of 1980 (16 U.S.C. 1606a, as amended), establishes "...in the Treasury of the United States a trust fund, to be known as the Reforestation Trust Fund..., consisting of such amounts as are transferred to the Trust Fund under Subsection (b) (1)..."

10. Healthy Forests Restoration Act (HFRA) of 2003 (16 U.S.C. at 1611-6591), provides processes for developing and implementing hazardous fuel reduction projects on certain types of "at-risk" National Forest System and Bureau of Land Management (BLM) lands, and also provides other authorities and direction to help reduce hazardous fuel and restore healthy forest and rangeland conditions on lands of all ownerships.

2470.2 - Objectives

To prescribe, implement, and monitor silvicultural practices that develop and sustain desired forest stand conditions which meet land management objectives designated in regional guides and/or land and resource management plans.

2470.3 - Policy

Policy for prescribing, using, and monitoring silvicultural practices that are used in the restoration and sustainable management of National Forest System lands at stand and landscape scales is as follows:

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

1. Use only those silvicultural practices that are best suited to the land management objectives for the area.
2. Ensure practices are applied so as to sustainably manage forest vegetation resources, as directed in the land management plan.
3. Prescribe treatments that are practical in terms of the cost of preparation, administration, transportation systems, and logging methods.
4. Monitor practices using procedures specified in land management plans to ensure that the objectives are met.
5. Before scheduling stands for regeneration harvest, ensure, based on literature, research, or local experience, that stands to be managed using even-aged management methods can be adequately restocked within five years of final harvest. Five years after final harvest means five years after:
 - a. Clearcutting.
 - b. Final overstory removal in shelter woodcutting.
 - c. Seed tree removal cut in seed tree cutting.

Where stands are to be managed using uneven-aged management methods (group or individual tree selection) ensure that they can be adequately restocked within five years after every entry harvest.

6. Inform minorities and women about the opportunities in contracting for silvicultural activities.
7. Perform silvicultural activities in a cost-effective manner consistent with resource management objectives. Ensure work performed by force account and by contract meet the same quality standards.
8. Include the verification of acreages reported for reforestation and stand improvement attainment as a standard item on appropriate timber program or activity reviews.
9. FACTS (Forest Service Activity Tracking System) is the database of record for reporting silvicultural accomplishments. Enter planned and accomplished activities into FACTS tabular. Accomplished activities must also have an associated geospatial feature entered into FACTS Spatial.

2470.4 - Responsibility

2470.41 - Regional Forester

It is the responsibility of the Regional Forester to ensure practices are consistent with laws, regulations and policies.

2470.5 - Definitions

In addition FSM 2475.05, use the following terms and definitions. Many of these definitions are taken from the Society of American Foresters' The Dictionary of Forestry (Helms 1998), the recognized source for silvicultural terminology and definitions. Departure occurred only where further clarification or precision was imperative.

Activity Unit. A piece of ground on which one or more activities occurs. The activity unit is used in the Forest Service Activity Tracking System (FACTS). It may be split into subunits if the activity occurs on only a portion of the activity unit. Activity units may be analogous to stand or timber sale harvest unit (polygon). An activity unit can be a polygon (acres), line (miles) or point (each) geospatial feature.

Advance Regeneration (also called advance reproduction or advance growth). Seedlings or saplings that develop or are present in the understory.

Age Class (cohort). One of the intervals into which the age range of trees is divided for classification or use. A distinct aggregation of trees originating from a single natural event or regeneration activity, or a grouping of trees, such as a 10-year age class, as used in inventory or management.

Appropriate Forest Cover. The species composition of tree cover, degree of stocking, rate of growth, and condition of the stand consistent with the land management objectives.

Artificial Regeneration (reproduction). A group or stand of young trees created by direct seeding or by planting seedlings or cuttings.

Clearcut.

1. A stand in which essentially all trees have been removed in one operation to produce an even-aged stand. Depending on management objectives, a clearcut may or may not have reserve trees left to attain goals other than regeneration (see regeneration method two-aged methods).
2. A regeneration or harvest method that removes essentially all trees in a stand. A minor live component of the stand may be retained for purposes other than regeneration. The retained trees, referred to as leave trees, should generally comprise less than 10% of the growing space of the stand.

Clearcutting Regeneration Method. An even-aged regeneration method that removes essentially all trees, producing a fully exposed microclimate for the development of a new age class. Regeneration can be from natural seeding, direct seeding, coppice or planted seedlings (may include minor portions of advance reproduction). When the primary source of regeneration is advance reproduction, the preferred term is overstory removal. A minor live component of the stand may be retained for purposes other than regeneration. The retained trees, referred to as leave trees, should generally comprise less than 10% of full stocking of the stand. The management unit or stand in which regeneration, growth, and yield are regulated consists of the individual clearcut stand.

There are three variations of the clearcutting regeneration method:

1. Patch clearcut - A harvest that removes essentially all trees in patches at a sub-stand level in two or more entries to produce an even-aged stand where the range of tree ages is less than 20% of the rotation age after harvest of all patches.
2. Stand clearcut - A harvest that essentially removes all the trees in a stand in one operation.
3. Strip clearcut - A harvest that removes essentially all trees in strips at a sub-stand level in two or more entries to produce an even-aged stand where the range of tree ages is less than 20% of the rotation age after harvest of all strips.

Clearcutting Regeneration Method with Reserves. A variation of the clearcutting regeneration method to produce a two-aged stand in which varying numbers of reserve trees are retained to achieve goals other than regeneration. The reserve trees should generally compromise at least 10% of the growing space of the stand. There are three variations of the clearcutting regeneration method with reserves:

1. Patch clearcut with reserves - A harvest that removes essentially most trees in patches at a sub-stand level in two or more entries to produce a two-aged stand where the range of tree ages is less than 20% of the rotation age after harvest of all patches.
2. Stand clearcut with reserves - A harvest that essentially removes most trees in a stand while retaining reserve trees to create a two-aged stand.
3. Strip clearcut with reserves - A harvest that removes essentially most trees in strips at a sub-stand level in two or more entries to produce a two-aged stand where the range of tree ages is less than 20% of the rotation age after harvest of all strips.

Coppice Regeneration Method. An even-aged method of regenerating a stand in which the trees in the previous stand are cut and the majority of regeneration is from sprouts or root suckers. A minor live component of the stand may be retained for purposes other than regeneration. The retained trees, referred to as leave trees, should generally comprise less than 10% of the growing space of the stand.

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

Coppice Regeneration Method with Reserves. A coppice regeneration method to produce a two-aged stand in which varying numbers of reserve trees are retained to achieve goals other than regeneration. The majority of regeneration is from sprouts or root suckers. The reserve trees should generally compromise at least 10% of the growing space.

Culmination of mean annual increment of growth. See mean annual increment of growth.

Ecosystem. A spatially explicit, relatively homogeneous unit of the earth that includes all interacting organisms and elements of the abiotic environment within its boundaries. An ecosystem is commonly described in terms of its: composition, structure, function and connectivity (FSM 2020).

Even-aged Methods. A planned sequence of treatments designed to maintain and regenerate a stand with predominately one age class. The range of tree ages is usually less than 20 percent of the rotation (see clearcutting, seed-tree, shelterwood, and coppice regeneration methods).

Even-aged Stand. A stand of trees composed of a predominately single age class in which the range of tree ages is usually less than 20 percent of rotation (see clearcutting, seed-tree, shelterwood, and coppice regeneration).

Final harvest. The removal of the remaining crop trees in an even-aged stand (such as clearcutting, final overstory removal in a shelterwood cut, seed tree removal in a seed tree cut).

Forest. An ecosystem characterized by more or less dense and extensive tree cover, often consisting of stands varying in characteristics such as species composition, structure, age class, and associated processes, and commonly including meadows, streams, fish and wildlife.

Forest Land. Land at least 10 percent stocked 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 clearings of any width (FSM 1905).

Group Selection Regeneration Method. A method of regenerating uneven-aged stands in which trees are cut, in small groups, and new age classes are established. The width of groups is commonly approximately twice the height of the mature trees, with small openings providing microenvironments suitable for tolerant regeneration, and the larger openings providing conditions suitable for more intolerant regeneration. In the group selection regeneration method, the management unit or stand in which regeneration growth and yield are regulated consists of a landscape containing an aggregation of groups.

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

Improvement Cut. An intermediate treatment made in a stand, pole-sized or larger, primarily to improve composition and quality by removing less desirable trees of any species.

Intermediate Treatment. A collective term for any treatment or tending designed to enhance growth, quality, vigor, and composition of the stand after establishment or regeneration and prior to final harvest.

Leave Tree. A tree retained after even-aged harvest (same as reserve tree). In a stand, the residual trees are for purposes other than regeneration, such as green tree snag replacements, and comprise of a minor component of the stand, generally less than 10% of full stocking. When residual trees comprise at least 10% of full stocking, consider the trees reserve trees in a two-aged system.

Liberation Cut. An intermediate harvest treatment made in a stand with an established understory but it is not past the sapling stage, in order to free the favored trees from competition of older, overtopping trees.

Mean annual increment of growth and culmination of mean annual increment of growth. Mean annual increment of growth is the total increment of increase of volume of a stand (standing crop plus thinnings) up to a given age divided by that age. Culmination of mean annual increment of growth is the age in the growth cycle of an even-aged stand at which the average annual rate of increase of volume is at a maximum. In land management plans, mean annual increment is expressed in cubic measure and is based on the expected growth of stands, according to intensities and utilization guidelines in the plan.

Natural Recovery. The use of natural processes to revegetate an area after a natural disturbance (such as fire) and the acceptance of resulting conditions, even though it may take many years to attain stocked forested conditions.

Natural Regeneration. The establishment of a plant or plant age class from natural seeding, sprouting, or suckering.

Nursery Stock. All plants, whether field grown, container grown, or collected native plants; trees, shrubs, vines; turf grass sod, seedlings, perennials, biennials; and buds, cuttings grafts and scions thereof, grown or collected or kept for propagation, sale or distribution.

Overstory Removal. The cutting of trees comprising an upper canopy layer in order to release advance regeneration in an understory which is not fully established. Overstory removal is only applicable to the clearcutting regeneration method and only when the primary source of regeneration is advance reproduction.

Reforestation Treatment. A reference to a specific reforestation activity used to establish reproduction in a stand. Treatments include planting, direct seeding, coppice or root

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

suckers, site preparation for natural reproduction (regeneration), or natural regeneration without site preparation. These treatments typically start at the beginning phases of a regeneration method just subsequent to the harvest, such as: clearcutting, clearcutting with reserves, seed-tree, seed-tree with reserves, shelterwood, shelterwood with reserves, coppice, coppice with reserves, single-tree selection, and group selection.

Regeneration Method. A cutting procedure by which a new age class is created. The major methods are clearcutting, seed-tree, shelterwood, selection, and coppice. Regeneration methods are grouped into four categories: coppice, even-aged, two-aged, and uneven-aged.

Release. An intermediate treatment designed to free young trees from undesirable, usually overtopping, competing vegetation.

Reserve Trees. Live trees, pole-sized or larger, retained in either a dispersed or aggregated manner to create a two-aged stand after the regeneration period under the clearcutting with reserves, seed-tree with reserves, shelterwood with reserves, group selection with reserves, or coppice with reserves regeneration methods. Trees are retained for resource purposes other than regeneration. Generally the reserve trees comprise at least approximately 10% of the growing space of the stand. If fewer trees are retained, consider them leave trees in an even-aged regeneration system.

Resilience. The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change (FSM 2020).

Restoration. The process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. Ecological restoration focuses on reestablishing the composition, structure, pattern, and ecological processes necessary to facilitate terrestrial and aquatic ecosystems sustainability, resilience, and health under current and future conditions (36 CFR 219, FSM 2020).

Salvage Cut. The removal of dead trees or trees being damaged or dying due to injurious agents other than competition, to recover value that would otherwise be lost. A salvage prescription should only be used for intermediate harvests where an adequately stocked stand will remain. If the salvage cutting is heavy enough to require regeneration, it is considered a regeneration harvest and a different prescription is required.

Sanitation Cut. The removal of trees to improve stand health by stopping or reducing actual or anticipated spread of insects and disease. A sanitation prescription should only be used for intermediate harvests where an adequately stocked stand will remain. If the sanitation cutting is heavy enough to require regeneration, it is considered a regeneration harvest and a different prescription is required.

Seed Tree Regeneration Method. An even-aged regeneration method in which a new age class develops from seeds that germinate in fully-exposed micro-environments after

removal of the previous stand, except for a small number of trees left to provide seed. Any retained trees, referred to as leave trees, should generally comprise less than 10% of the growing space of the stand. When the Seed Tree method is employed, the sequence of treatments can include three distinct types of cuttings:

1. Seed Tree Preparatory Cut - An optional cut that enhances conditions for seed production and/or develop wind firmness for a future seed cut.
2. Seed Cut - A cut to prepare the seed bed and create a new age class under full sun while retaining trees needed to provide seed needed for regeneration.
3. Seed Tree Removal Cut - An optional final removal cut that releases established regeneration from competition with seed trees after they are no longer needed for seed or as leave trees.

Seed Tree Regeneration Method with Reserves. A seed tree regeneration method that produces a two-aged stand in which some or all of the seed trees are retained as reserve trees after regeneration has become established to attain goals other than regeneration. Reserve trees may also include those trees that are not expected to provide seed for desirable regeneration. The reserve trees should generally comprise at least 10% of the full stand stocking. Similar to the seed-tree regeneration method, seed tree regeneration method with reserves two or more cutting treatments:

1. Seed Tree Preparatory Cut - An optional cut that enhances conditions for seed production and/or develop wind firmness for a future seed cut.
2. Seed Cut - A cut to prepare the seed bed and create a new age class under full sun while retaining trees needed to provide seed.
3. Seed Tree Removal Cut with Reserves - An optional cut that releases established regeneration from competition with seed trees after they are no longer needed for seed while retaining reserve trees to create a two-aged stand.

Shelterwood Regeneration Method. A method of regenerating an even-aged stand in which a new age class develops beneath the moderated micro-environment provided by the residual trees. Any retained trees, referred to as leave trees, should generally comprise less than 10% of the growing space of the stand. When the shelterwood regeneration method is employed, the sequence of treatments can include three distinct types of cuttings:

1. Shelterwood Preparatory Cut - An optional cut that enhances conditions for seed production and/or develop wind firmness for a future shelterwood establishment cut.
2. Shelterwood Establishment Cut - A cut to establish a moderated micro-environment, prepare the seed bed, and create a new age class.

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

3. **Shelterwood Removal Cut** - A final removal cut that releases established regeneration from competition with shelter trees after they are no longer needed for shelter under the shelterwood regeneration method.

Shelterwood Regeneration Method with Reserves. A regeneration method that creates a two-aged stand in which some or all of the shelter trees are retained to attain goals other than regeneration. The reserve trees generally comprise at least 10% of full stocking after the last harvest. Similarly, when the shelterwood regeneration method with reserves is used, there may be one or more harvest entries:

1. **Shelterwood Preparatory Cut** - An optional cut that enhances conditions for seed production and/or develop wind firmness for a future shelterwood establishment cut.

2. **Shelterwood Establishment Cut** - A cut to establish a moderated micro-environment, prepare the seed bed, and create a new age class.

3. **Shelterwood Removal with Reserves Cut** - An optional removal cut that releases established regeneration from competition with shelter trees after they are no longer needed for shelter while retaining reserve trees to create a two-aged stand.

Silviculture. 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.

Silvicultural Prescription. A document written or approved by a certified silviculturist that describes management activities needed to implement silvicultural treatment or treatment sequence. The prescription documents the results of an analysis of present and anticipated site conditions and management direction. It also describes the desired future vegetation conditions in measurable terms (FSM 2478.03). It documents a planned series of treatments designed to change current stand structure and composition to one that meets management goals. The prescription normally considers ecological, economic, and societal objectives and constraints.

Silvicultural Treatment. A forest management activity such as thinning, harvesting, planting, pruning, prescribed burning and site preparation that is designed to alter 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

Single Tree Selection Regeneration Method. An uneven-aged method where individual trees of all size classes are removed more or less uniformly throughout the stand, to promote growth of remaining trees and to provide space for regeneration.

Stand. A contiguous group of trees sufficiently uniform in age class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit, such as mixed, pure, even-aged, and uneven-aged stands. A stand is

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

the fundamental unit of silviculture reporting and record-keeping. Stand may be analogous to Activity Unit.

Stand Composition. The proportion of each tree species in a stand expressed as a percentage of the total number, basal area, or volume of all tree species in the stand.

Stand Improvement (previously Timber Stand Improvement). An intermediate treatment of trees not past the sapling stage made to improve the composition, structure, condition, health, and growth of even- or uneven-aged stands.

Stocking Level. The degree to which trees occupy the land, measured by basal area or trees per acre, compared with stocking standards for full utilization of the lands growth potential

Thinning. An intermediate treatment made to reduce stand density of trees primarily to improve growth, enhance forest health, or to recover potential mortality. Includes crown thinning (thinning from above, high thinning), free thinning, low thinning (thinning from below), mechanical thinning (geometric thinning), and selection thinning (dominant thinning).

Timber Harvest. The removal of trees for wood fiber use and other multiple-use purposes.

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.

Two-Aged Method. Regeneration and maintenance of stands with two age classes. The resulting stand may be two-aged or tend towards an uneven-aged condition as a consequence of both an extended period of regeneration establishment and the retention of reserve trees (green trees) that may represent one or more age classes.

Two-Aged Silvicultural System. A planned sequence of treatments designed to regenerate or maintain a stand with two age classes. Cuts in two-aged systems are a form of even-aged management.

Two-Aged Stand. A growing area with trees of two distinct age classes separated in age by more than plus or minus 20 percent of rotation.

Uneven-aged Methods. Regeneration and maintenance of stands with a multi-aged structure by removing some trees in all size classes either singly or in groups or in strips.

Uneven-aged Silvicultural System. A planned sequence of treatments designed to regenerate or maintain a stand with three or more age classes. Includes single-tree selection, and group selection regeneration methods.

Uneven-aged Stand. A stand of trees of three or more distinct age classes, either intimately mixed or in groups.

Unstocked. The percent of a forested land area that does not meet forest plan stocking levels due to disturbances such as fire, harvest, wind, insects or diseases.

Weeding. A release treatment in stands not past the sapling stage that eliminates or suppresses undesirable vegetation regardless of crown position.

2471 - Harvest Cutting

2471.02 - Objective

The objectives of harvesting trees include, but not limited to improving the health and resilience of the forest; fuel reduction; improving wildlife habitat; timber production; and enhancing the recreation setting.

2471.1 - Even-aged Stands

2471.11 - Considerations

Before applying any even-aged regeneration cutting method to a stand, consider the standards and guidelines in the forest plan concerning the culmination of mean annual increment along with the size, shape, dispersal, and duration of openings. Apply clearcutting only where it has been found to be the optimum method of regeneration to meet multiple-use objectives. Ensure the land can be adequately restocked within five years after final harvest.

2471.12 - Methods

Even-aged stands are created through the use of the following regeneration harvest cutting methods:

1. Clearcutting
2. Coppice
3. Seed tree
4. Shelterwood

2471.2 - Two-aged Stands

2471.21 - Considerations

Ensure the land can be adequately restocked within five years after the regeneration cut (clearcut with reserves, seed-tree cut with reserves, shelterwood cut with reserves).

2471.22 - Methods

Two-aged stands are created through the use of the following regeneration harvest cutting methods:

1. Clearcutting with Reserves
2. Coppice with Reserves
3. Seed tree with Reserves
4. Shelterwood with Reserves

2471.3 - Uneven-aged Stands

2471.31 - Considerations

Consider the effects of frequent entries; generally higher sale layout costs, logging complexities, and relatively low removal volumes per entry when applying uneven-aged cutting methods. The residual stand must be protected from logging damage. Desired species for regeneration must be capable of establishing and developing in relative small openings created under selection harvest methods. Ensure the land can be adequately restocked within five years after each harvest entry.

Control the stocking density in uneven-aged stands by setting the residual stocking level, maximum tree size and residual diameter distribution.

2471.32 - Methods

Uneven-aged stands are produced by the following regeneration harvest cutting methods:

1. Individual-tree selection.
2. Group selection.

2471.4 - Intermediate Cutting

2471.41 - Consideration

Salvage and sanitation cuts are considered an intermediate harvest where intermediate cutting is required. However, if salvage or sanitation cutting is heavy enough to require regeneration, it is considered a regeneration harvest rather than intermediate cutting, and steps should be taken to adequately restock the stand within five years of final harvest.

2471.42 - Methods

Intermediate cutting includes the following types of treatments or cutting:

1. Commercial thinning.
2. Sanitation.
3. Salvage.
4. Improvement cutting.
5. Liberation cutting.

2472 - Reforestation

2472.02 - Objectives

The Forest Service seeks to:

1. Maintain all forest lands within the National Forest System in appropriate forest cover as directed by NFMA.
2. Improve the quality and yield of new timber stands.
3. Restore forested conditions to provide ecosystem services such as recreational experience, fish and wildlife habitat, watershed protection, and carbon sequestration.
4. Achieve desired stocking level goals in a timely and cost-efficient manner.
5. Accelerate the establishment of desired species composition.
6. Develop and demonstrate successful reforestation methods and techniques.

2472.03 - Policy

1. Base reforestation treatments, including site preparation, on silvicultural prescriptions written to meet site-specific resource requirements.
2. When harvest or a disturbance event reduces forest cover to an unstocked or understocked condition, make an initial assessment and diagnosis to identify the acres in need of reforestation treatment or natural recovery in order to meet management objectives. Report planned and accomplished reforestation treatments and natural recovery in Forest Service Activity Tracking System (FACTS).
3. Use genetically improved seed and planting stock to the full extent consistent with tree improvement plans. Do not use seed and seedlings of exotic tree species or native species from an offsite source, except where:
 - a. Scientific studies have proven they are adaptable to the area in question.

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

- b. Administrative studies or evaluation tests are being carefully planned and monitored with the advice, cooperation, or assistance from knowledgeable Research scientists.
4. Use Knutson-Vandenberg Act funding as the primary means of financing reforestation on timber sale areas (FSM 2477 & FSM 6513) when possible.
5. Examine all reforestation areas for certification as meeting specific reforestation standards approved by the Regional Forester for timber production and other resource objectives. Make regeneration examinations, at a minimum, after the first and third growing seasons following treatment.

2472.04 - Responsibility

2472.04a - Regional Forester

The Regional Forester shall:

1. Certify to the Chief that reforestation work has been accomplished according to approved plans and prescriptions. This may be delegated to Forest Supervisors (FSM 2496).
2. Report to the Chief the annual reforestation needs and accomplishments (FSM 2496).
3. Set general priorities for reforestation. Approve specific reforestation priorities in forest plans.
4. Utilize FACTS to ensure each area which is understocked due to natural causes, fire, or harvest is planned for reforestation treatment or natural recovery. Account for lands that are planned for reforestation treatment until they are certified as stocked.

2472.04b - Forest Supervisor

1. The Forest Supervisors shall plan and program reforestation to meet the objectives of the forest plan. Determine the appropriate successional pathway for all areas needing restocking. Schedule reforestation treatments or natural recovery as appropriate. Ensure areas planned for reforestation treatment are tracked until certified as stocked.
2. Report annually the Reforestation Needs balance for the national forest and validate that the report has been reviewed for accuracy and complies with the requirements of FSM 2496.

2472.04c - District Ranger

1. Accomplish reforestation in accordance with approved plans, except on experimental areas where a memorandum of understanding between a Station Director and a Regional Forester or Forest Supervisor specifies otherwise (FSM 2403).

2. Maintain a program of work which assures the highest priority work is accomplished.
3. Ensure that reforestation personnel have the training and experience necessary to properly execute the reforestation activities under their control.

2472.1 - Reforestation Plans and Reports

Assess and account for all lands that are in an understocked condition as a result of harvest, fire, and other natural causes (sec. 2472.03).

A post disturbance assessment shall address objectives from the land management plan and apply sound stewardship principles. When artificial or natural regeneration is the diagnosis, consider the entire sequence of activities including seed availability, growing of planting stock, harvesting dead material, control of competing vegetation and other reforestation treatments. Identify lands where natural recovery is appropriate following fire or other natural disturbances.

Plan reforestation treatments to meet the prescribed stocking levels and timeframes consistent with land management objectives. Determine reasonable assurance of adequate restocking within five years of harvest as required by sec. 2471.1, sec. 2471.2, and sec. 2471.3. Current research findings and experience should be used as part of the basis for determining reasonable assurance of restocking (FSH 1909.12, sec. 61.2).

Assess the area and report planned activities in FACTS. Modify FACTS records as decisions for when treatments are made, or if decisions or treatments are made that deviate from the original diagnosis.

2472.2 - Setting and Tracking Priorities

The Regional Forester establishes general priorities for reforestation within the Region (FSM 2472.04).

Use FACTS to track the sequence of all activities needed for reforesting each area. Prioritize and schedule the necessary activities as prescribed in the silvicultural prescription until reforestation is assured and certified.

2472.21 - Economic Analysis

The forest plan provides the overall framework for economic analysis to determine the types of reforestation investments (treatments) needed. Further economic analysis should be done only to determine the least costly manner of executing a treatment or of determining priorities when funding prevents treatment of all acres.

District Rangers shall not program reforestation for timber management purposes on those low-productivity areas understocked due to natural causes or human-caused fires which have received previous proper but unsuccessful treatment, if an economic analysis indicates a negative present net value. Exceptions are those areas where reforestation is specifically required to meet

components of the land management plan, such as desired conditions, objectives, standards, and guidelines.

2472.3 - Reforestation Process

Reforestation is a series of events, like the links of a chain, in which each event is dependent on the previous event to achieve a successful project. Utilize the most cost effective methods to achieve the desired results in terms of species composition, distribution, density and timeframes. Consider reforestation objectives relative to climate change, however, do not compromise current survival and success for predicted long-term species shifts. Young trees are vulnerable to microsite and macroclimatic conditions, and these should be incorporated into objectives and treatment methods.

Certify reforestation treatments as stocked when stocking meets the prescription and land management objectives (FSM 2472.5). Consider species composition, density and distribution and future management in the determination. Certification concludes the reforestation period and no additional reforestation treatments are expected.

2472.31 - Site Preparation

Schedule reforestation treatment after harvest to take full advantage of the favorable conditions of exposed mineral soil and reduced vegetation competition resulting from logging and slash burning. Accomplish adequate site preparation by application of one or more of the following methods:

1. Mechanical
2. Chemical
3. Fire

Where site preparation methods or timing will conflict with other resource needs, coordinate with other Resource Specialists. Do not attempt reforestation without adequate site preparation.

2472.32 - Regeneration Methods

The forest plan provides overall direction on the regeneration methods to use. Regeneration methods include the following categories:

1. Natural Regeneration
 - a. Natural seeding
 - b. Sprouting
 - c. Suckering

When the forest plan management guidelines and objectives indicate that natural regeneration is a viable alternative to meet economic, silvicultural, and other resource concerns, regeneration prescriptions must consider this alternative.

2. Artificial Regeneration

- a. Direct seeding
- b. Planting (seedlings or cuttings)

Regional Foresters shall specify in regional manuals or handbooks planting practices and standards, and provide training for Supervisors or Inspectors to ensure high quality planting and maximum success.

2472.33 - Reforestation Protection

Include adequate protection measures in the reforestation prescription and implementation. Where conditions are such that unacceptable damage is predicted and adequate protection measures are either unknown or cannot be implemented, prescribe a different series of treatments or defer harvest.

Personnel responsible for pesticide use shall be knowledgeable about safety precautions, laws, and regulations that apply to its use (FSM 2150) and trained in proper methods of application (FSM 3400) before using pesticides.

1. Animal Damage Control

- a. Wildlife. Control in accordance with instructions in FSM 2650. Evaluate the proposed treatment in terms of its effect on all wildlife, especially threatened and endangered species, as well as the target species.
- b. Domestic Animals. Control livestock grazing to achieve successful reforestation. Mitigate or otherwise protect reforestation areas from livestock until seedlings are capable of withstanding any permitted grazing.

2. Insect and Disease Control. Control insects and diseases in accordance with FSM 3400, 6510, and 2150.

3. Vegetation Control. Treat competing vegetation, which threatens the establishment of reforestation projects by the appropriate method. Vegetation control conducted prior to certification of adequate stocking is considered part of the reforestation process. Carefully consider benefits to all resources before taking action. Treatment done to improve the growth of trees that are already established is considered a stand improvement treatment (FSM 2476).

2472.4 - Regeneration Examinations

1. Stocking Surveys. As a minimum, conduct stocking surveys or examinations after the first and third growing seasons following reforestation treatment. Continue to survey each stand until adequate stocking is achieved and the stand can be certified as satisfactorily stocked. The intent of the survey is to determine density, species composition and distribution of seedlings. Follow Regional guidelines for survey design. After examination, areas which fail to meet stocking standards shall be scheduled for further stocking surveys or retreatment as prescribed in the silvicultural prescription. Consider the financial feasibility (FSM 2472.21) as well as land management objectives and reforestation requirements (FSM 2470.3).

Regional Foresters shall establish additional types, frequencies, and quality standards for stocking surveys as necessary for program monitoring.

2. Plantation Survival. Use a row of staked sample trees to determine mortality causes and to estimate seedling survival after planting. Sample at least 100 trees of each major species planted on a national forest as required by FSM 2496. Return after the first and third growing seasons to determine survival and causes of mortality.

Take more intensive samples, as necessary, for specific problem units or mortality cause determinations. Determine reason(s) for plantation failure and take corrective action before retreating an unsuccessful area.

2472.5 - Certification of Restocking and Treatment

The Line Officer at each reporting level must certify that the area is satisfactorily stocked. For reporting purposes, a satisfactorily reforested area is an area with acceptable levels of live seedlings at the time of survey as set forth in the prescription for the area, and which the silviculturist has determined requires no additional work to meet the minimum stocking level established in the prescription (FSM 2478). Any areas that have previously been certified and have subsequently become unsatisfactorily stocked should be evaluated for restocking and certification. Refer to FSM 2470.3 for time requirements for ensuring adequate restocking for varying silvicultural systems.

2472.6 - Natural Recovery

Not all National Forest System lands require prompt regeneration following a natural disturbance. Natural recovery represents a silvicultural diagnosis that follows land management plan guidelines to count on natural processes for reestablishment of forest vegetation. The selection of natural recovery depends on conditions such as slope, soil productivity, and economic analysis of the cost/benefits associated with investments on these sites, the local knowledge of the site conditions, successional pathways, and management objectives. The recommendation must address monitoring and assessment of the recovery process. Effectiveness of desired vegetation establishment of all life forms (grass, forbs, shrub, trees), and soil erosion prevention are among the ecosystem conditions that may be evaluated. The timeframe and

sample design is dependent on the resource value at risk. When expected results are not achieved, follow-up treatments should be prescribed as deemed appropriate. Areas designated for natural recovery due to low site productivity, erosion potential, slopes, and other physical or ecological barriers need to be considered for land suitability re-classification in the forest plan monitoring reports.

When harvest is applied, natural recovery is not an appropriate prescription. These areas should receive a prescription that calls for artificial or natural regeneration treatments.

2472.7 - Forest Regeneration Committee

See FSM 1355.24.

2473 - Forest Nurseries

2473.01 - Authority

In addition to the principle laws and regulations in FSM 2470.1, and FSM 6301.2, see FSH 6409.31, Federal Property Management Regulations concerning the disposal and sale of surplus nursery stock and FSH 6509.11f, chapter 60 Working Capital Fund. Specific authorities relating to the exchange, sale, and disposal of nursery stock follow:

1. Granger-Thye Act of 1950, Section 9, (16 U.S.C. 504a) provides the authority for the sale and/or exchange of nursery stock of the same or different species with states or political subdivisions thereof, and public agencies of other countries.
2. The Economy Act of 1932 (31 U.S.C. 686) authorizes the sale of property (nursery stock) to other Federal agencies.
3. The Federal Property and Administrative Services Act of 1949 (40 U.S.C. 471) authorizes the disposal of nursery stock as a perishable agricultural supply through sale or donation.

2473.02 - Objectives

1. Produce quality nursery stock of the proper seed source and elevation on schedule, economically, and in quantities needed for national forest reforestation programs.
2. Develop and demonstrate improved methods and procedures for nursery operation.

2473.03 - Policy

1. Production for National Forests. Forest Service nurseries must produce quality nursery stock in requested quantities for use on national forests located within an area of similar physiographical and biological characteristics.

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

2. Production for States and Other Agencies. Forest Service nurseries may produce nursery stock for states, or other agencies if requested provided there is some public benefit (see Granger-Thye Act section 9).
3. Purchases from State Nurseries. The Forest Service will cooperate with state nurseries by acquiring nursery stock from them within procurement regulations. Stock must meet source, quality and quantity standards.
4. Purchases from Private Nurseries. Nursery stock may be purchased from private nurseries under current procurement regulations when they can supply source identified quality stock in sufficient quantity to meet contract specifications.
5. Establishing New Nurseries and Changing Status of Existing Nurseries. Consider availability of stock and capacity from Forest Service Nurseries in other Regions and from state or private nurseries in all proposals to expand existing nurseries or to establish new nurseries.

2473.04 - Responsibility

2473.04a - Chief

The Chief shall:

1. Approve the following actions:
 - a. Establishing a new nursery.
 - b. Expanding capacity at an existing nursery.
 - c. Temporary or permanent closure of an existing nursery.
2. Approve the sales of nursery stock to public agencies in other countries.
3. Charter a forest national nursery steering committee to standardize the Forest Service nursery and seed extractory operations and program delivery.

2473.04b - Regional Forester

The Regional Forester shall:

1. Approve establishing or abandoning the following:
 - a. Temporary transplants beds.
 - b. Temporary or movable containerized nursery stock production facilities.
2. Specify the responsibilities for administration and management of each nursery.

3. Approve sales of nursery stock to states and political subdivisions.

2473.04c - Station Director

Station Directors shall approve sales of nursery stocks grown in research facilities to domestic public agencies.

2473.1 - Financing

2473.11 - Construction and Development

Finance construction and development of new nurseries, construction of new facilities at existing nurseries, and expansion of the cultivated area or physical plant at existing nurseries with appropriated funds. Allow time for appropriate Regional Office and Washington Office approval and for the necessary appropriation and allocation of funds (FSM 1930, 2473.03, 7310, and 7400). Construction and Land Acquisition, Finance Administration & Operations funds are available to construct or expand nurseries, including the construction of service, storage, dwelling, office, greenhouse, and other buildings; and equipment which is an integral part of buildings, such as sewer, electrical, and water systems, including underground irrigation systems. Items specifically excluded are seedbed development (including land preparation), surface and subsurface drainage, above-ground irrigation, perimeter fences, and personal property equipment within buildings.

2473.12 - Nursery Stock Production

Nursery activities may be capitalized as an activity in the Working Capital Fund (WCF) (FSH 6509.11f, ch. 60) or activities may be authorized under other Forest Service fund as appropriate.

1. WCF stock production:

- a. Finance capitalized nursery stock production costs at new nurseries with appropriated funds up to the fiscal year stock are to be sold. Donate the stock into WCF at the time of lifting the stock, prior to shipment. Thereafter, finance capitalized stock production costs with WCF funds.
- b. Finance increases in capitalized stock production at operating WCF nurseries with appropriated funds requested and allocated for that purpose.
- c. Establish nursery stock prices so that income from the sale of nursery stock will equal the total WCF cost of stock production. A small profit may be allowed to provide additional working capital to finance minor increases in production or future increases in production costs. Do not allow deficits to accumulate.
- d. When the current price of capitalized nursery stock shipped is reduced, the price reductions may be spread over the next two years of stock sales. This

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

situation could develop when high income is earned one year, and production is reduced in future years.

2. Non- WCF stock production:

- a. Nursery stock may be produced outside the Capitalized WCF. This is an appropriate procedure for production of non-capitalized products during the development of new product and species, or infrequently produced species.
- b. Non-capitalized nursery products shall be billed on an annual basis and not carried in inventory to the next fiscal year.
- c. Negotiate prices with client based on actual costs on a project basis.

2473.13 - Other Nursery Costs

1. Public relations work related to the nursery program is part of the nursery operation and is chargeable to the current cost of nursery stock production. Finance public relations work not directly related to nursery operations, even though it is carried on at the nursery, with appropriated funds.
2. Charge the cost of administrative studies directly related to nursery operations to the cost of stock production.
3. Finance other nursery work not directly related to nursery stock production and costs for constructing equipment and machinery that are investments for long-term benefits to nursery stock production with appropriated funds.
4. Purchase reasonable stockpiles of fertilizers, packing materials, chemicals, and other materials necessary for nursery stock production from WCF, and charge the total amount to the cost of nursery stock production in year purchased. The cost of unused materials will be carried forward as a portion of future of future fiscal year's inventory value.

2473.2 - Sale, Exchange, and Purchase of Nursery Stock

2473.21 - Purchasing Nursery Stock

Negotiating small purchases of nursery stock from other than Forest Service Nurseries is subject to limitations in FSH 6309.12, chapter 40.

2473.22 - Sale of Nursery Stock to National Forests

Forests will reimburse the nursery for capitalized WCF nursery stock in the same fiscal year that the stock is delivered to them, or shorter accounting period as necessary. Regional Foresters may require Forests failing to take delivery of nursery stock to pay all or a portion of the costs of that stock, or they may recover the costs from future nursery stock sales.

Non-capitalized nursery products are billed on an annual basis and payable in the fiscal year in which the expense occurs.

2473.23 - Exchange of Nursery Stock

Before agreeing to exchange nursery stock for seed or nursery stock of the same or different species with States or political subdivisions, and public agencies of other countries (FSM 2473.01, item 1) determine whether the exchange is in the interest of the United States, and that the value of the property given in exchange does not exceed the value of the property received. Such exchanges are considered to be in the public interest when the Forest Service receives nursery stock needed for current reforestation, revegetation, or research programs in exchange for unneeded planting stock of no greater value.

The Forest Service will not exchange nursery stock as ornamentals or for other landscape use.

2473.24 - Sale of Nursery Stock to Other Public Agencies

Rates must be no less than the actual or estimated production costs including appropriate depreciation expense. Credit proceeds from the sale of capitalized WCF nursery stock to other Federal agencies or to states and political subdivisions thereof, and public agencies of other countries to the WCF. Handle proceeds from the sale of nursery stock produced in nurseries that have not been capitalized into the WCF as a reimbursement to the appropriation available for the production of nursery stock at the time such moneys are deposited.

Generally the nursery stock sold to other public agencies should be excess to the needs of the national forests or cooperators for whom it was grown. The Forest Service will not become a major source of supply for planting stock needed by the states, and their political subdivisions, or foreign public agencies. The Forest Service should encourage states, to grow in their own nurseries, all the stock needed for planting on private and non-Federal public lands. The primary purpose of the authorization (FSM 2473.01, items 1 and 2) is to aid public reforestation programs, in a limited way, by sale, at cost, of any available nursery stock to eligible agencies that find themselves unable to procure or produce sufficient stock to meet their requirements.

Regions may, when circumstances warrant, enter into agreement with states and other Federal agencies to produce planting stock for them in Forest Service nurseries (FSM 2473.03).

Do not encourage direct sales to political subdivisions of a state. Long established Forest Service policy is to handle sale of nursery stock to soil conservation districts, counties, cities, and similar political units of State government, through the State Forester or other appropriate official.

Nursery stock produced by the Forest Service will not be sold as ornamentals or for other landscape use.

2473.25 - Disposal of Surplus Nursery Stock

Nursery stock not exchanged or sold as prescribed in FSM 2473.22, .23, or .24 must be disposed of (FSM 2473.01). Nursery stock is a perishable agricultural supply. As such, it is not reportable to GSA (FSH 6409.31, Federal Property Management Regulations, sec.101-43.4801) or to the Department (FSH 6409.31, sec. 104-43.311-1) and can be declared surplus by the holding agency (FSH 6409.31, sec.104-43.318). After notification of the appropriate GSA regional office, the holding-activity Property Management Officers may sell the nursery stock, regardless of the estimated proceeds from the sale (FSH 6409.31, sec.104-45.105). Sales of surplus nursery stock are not under any prohibition from selling for ornamental or other landscape purposes. However, the surplus nursery stock must be sold for no less than the actual or estimated production costs including depreciation. Regions are encouraged to establish minimum quantities to promote bulk purchases.

Credit proceeds from sales of surplus capitalized WCF nursery planting stock to the WCF. Deposit proceeds from sales of surplus planting stock, from nurseries, which have not been capitalized into the WCF, to an appropriate general fund receipt account (FSH 6509.11k, sec. 37.24).

Surplus nursery stock that cannot be sold will be used in the nursery as mulch after suitable composting, or disposed of in an acceptable manner.

2473.26 - Donation of Nursery Stock

Nursery stock may be donated to appropriate parties as interpreted by GSA (FSH 6409.31, Federal Property Management Regulations, sec. 101-44).

2473.3 - Plans, Records, and Reports

2473.31 - Plans

1. Develop a long-term plan for soil treatments and crop rotations to maintain the required level of soil fertility and to prevent buildup of harmful insects and disease.
2. Develop sowing and shipping schedules annually based on requests submitted by Forests and other agencies being served.
3. Develop other plans for nursery operations in accordance with Regional or Forest procedures and requirements.

2473.32 - Records

Maintain records using the Nursery Management Information System (NMIS).

2473.33 - Reports

Instructions for nursery reports are in FSM 2496.13 and FSH 6509.11f, section 68 (WCF accounting).

2474 - Seed

2474.01 - Authority

In addition to the principal laws and regulations cited in FSM 2470.1, see FSH 6409.31, Federal Property Management Regulations concerning the disposal and sale of surplus seed. Specific authorities relating to the exchange, sale, and disposal of seed follow:

1. Granger-Thye Act of 1950, Section 9, (U.S.C. 504a) provides the authority to exchange or sell forest tree seed for forest tree seed or nursery stock of the same or different species with states or political subdivisions thereof, and with public agencies of other countries.
2. The Economy Act of 1932 (31 U.S.C. 686) authorizes the sale of property (forest tree seed) to other Federal Agencies.
3. The Federal Property and Administrative Services Act of 1949 (40 U.S.C. 471) authorizes the disposal of forest tree seed as a perishable agricultural supply through sale or donation.

2474.02 - Objective

Have enough high quality and genetically appropriate seed available to meet the reforestation and revegetation needs of national forests and to respond to large-scale disturbances, restoration and conservation initiatives, and climate change.

2474.03 - Policy

1. Seed Inventory. Maintain an adequate seed inventory by species, seed/breeding zones, and elevation bands (if appropriate) (FSM 2475.05) in accordance with the planned reforestation programs, seed procurement plans, frequency of seed crops, and storage life of seed. The seed inventory may include any types or species of seeds.
2. Verification and Labeling. Verify origin of all seed purchased or harvested. Maintain the identity of cones and seed in a manner that makes it possible to identify seed origin from time and place of harvest to time and place of use on reforestation areas. Maintain a database of records for this material and activities.
3. Seed Testing. Develop procedures and arrangements with accredited seed-testing laboratories to test seed for purity, viability, and moisture content and to supply standard laboratory reports of tests suitable for use in settlement of commercial seed transactions.

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

Periodically test seed in storage to determine its quality. Use these records to monitor seed handling and storage procedures and to make adjustments to collection schedules for replenishing the seed.

4. Seed Storage. Store seed under temperature, humidity conditions and seed moisture content that are conducive to maintaining viability and vigor without deterioration.

5. Disposal of Low Quality and Surplus Seed. Annually review seed inventory by species and seed/breeding zones and elevation bands. Dispose of low-quality seed or excess/surplus seed promptly and in accordance with Federal Property Regulations (FSH 6409.31, sec. 104-45.105).

6. Construction and Closure of Seed Extractories. Obtain the necessary approvals before constructing or closing seed extractories.

2474.04 - Responsibility

2474.04a - Chief

The Chief shall:

1. Approve construction or closure of permanent seed extractories.
2. Approve sales of forest tree seed to public agencies of other countries.

2474.04b - Regional Forester

The Regional Forester:

1. May approve the establishment or closure of temporary or portable facilities for cone drying, seed extraction, and seed storage.
2. Shall specify the responsibilities for administering and managing the seed program.
3. Approval sales of forest tree seed to domestic public agencies.

2474.1 - Cone (Seed) Collection and Procurement

2474.11 - Designation of Harvest Areas

Harvest seed or cones from areas that have been designated and approved as sources of seed for use on areas to be revegetated (FSM 2475.3). Take appropriate measures to ensure seed is harvested in designated areas.

2474.12 - Cone (Seed) Collection or Purchase

Labor sources for cone (seed) collection are:

1. Forest Service crews.
2. General public--open market purchase of cones collected in designated areas.
3. Contract collection in designated areas.

Clean seed or cones may be purchased if it meets standards (FSM 2474.13) and it is from the appropriate seed/breeding zones, and elevation bands.

2474.13 - Quality Specifications

Regions must develop quality standards for seed and cone collection and handling. Coordinating standards with adjacent Regions is encouraged.

1. Cone standards must include a measure of cone ripeness, a minimum crop size, a minimum number of crop trees (for genetic diversity), a minimum average number of sound seeds per cone that is acceptable for each species and geographic seed source documentation. Cones that do not meet the minimum standards will not be purchased.
2. Seed standards must include minimum germination and purity percentages, viability, range of pure live seed per unit of measure, and acceptable range of moisture content.

2474.14 - Documentation and Records

Regions should maintain a database of record for all activities associated with tree seed.

2474.2 - Cone and Seed Processing, Storage, and Accountability

2474.21 - Cone and Seed Processing

Trained personnel shall perform all seed extraction, cleaning, and other seed handling using equipment designed for the purpose. Processing of Forest Service cones and seed may be contracted where suitable commercial facilities are available. Trained personnel shall closely administer these contracts to ensure seedlot integrity.

2474.22 - Seed Storage

Regions must provide adequate facilities to store the quantities of seed necessary to support the reforestation program. Coordination with silviculturists and/or vegetation Managers is advisable.

2474.23 - Accountability

Maintain an inventory of all seedlots (FSM 2474.52), including additions, subtractions, and test data. A physical inventory must be done every five years. Regions will develop a schedule for retesting seedlots that have not been used for a period of five years. This period should be shortened for species that are difficult to store. Manage the inventory to prevent accumulations of old seed or of seedlots that are no longer needed, viable or used. (FSM 2474.51).

2474.3 - Financing

2474.31 - Construction and Development

Finance buildings associated with the seed bank according to instructions in FSM 2473.11.

2474.32 - Seed Bank

Seed activities of all species may be capitalized as an activity in the Working Capital Fund (WCF) (FSH 6509.11f, ch. 60) or with other Forest Service funds as authorized.

1. WCF Seed Activities

- a. Finance initial seed collection or purchase, transportation to extractory, extraction, cleaning, testing, and storage with appropriated funds and donate to WCF. Subsequent seed collections of the same species may be funded using WCF.
- b. Seed procurement with WCF funds may begin at seed collection. Use the income from seed sales to replenish the seed inventory and WCF seed account.
- c. Finance increases in seed inventory with appropriated funds requested and allocated for that purpose. Increases in seed inventory include adding new species or at increased levels than the amount initially capitalized.
- d. Establish seed prices annually so that income from seed sales will equal the total WCF cost of operating the seed bank. A small profit may be allowed to provide additional working capital to finance minor increases in the inventory. Albuquerque Service Center recommends a 30% WCF account surplus. Do not allow deficits to accumulate.

2. Non-WCF Seed

- a. Forests or Regions may elect to obtain or use seed outside of the WCF system.
- b. Seed collected with non-WCF may be donated to the WCF system.
- c. Seed collected with non-WCF may be stored and managed in the Regions seed bank with annual costs for storage, testing and other services billed to the owning unit.

2474.33 - Use of Knutson-Vandenberg Funds for Seed

Knutson-Vandenberg (K-V) funds generally should not be used to finance increases in the seed inventory. In emergency situations, K-V funds may be used to finance part of the increase equal to the ratio between the K-V acres planted and the total acres planted averaged over the last three years.

2474.4 - Purchase and Disposal of Seed

2474.41 - Purchasing Seed

Purchasing seed from other than Forest Service seed inventories is subject to limitations in FSM 6310.4 in support of an established reforestation and restoration need.

2474.42 - Sale of Seed to National Forests

Forests must reimburse the WCF seed account in the same fiscal year the seed is removed from storage.

2474.43 - Exchange of Seed

Before exchanging seed for seed or nursery stock of the same or different species with states or political subdivisions thereof, and with public agencies of other countries, (FSM 2474.01) determine whether the exchange is in the interest of the United States, and that the value of property given in exchange does not exceed the value of the property received.

Such exchanges are considered to be in the public interest, when the Forest Service receives tree seed or planting stock needed for current reforestation, revegetation, or research programs in exchange for unneeded seed of no greater value.

2474.44 - Sale of Seed to Other Public Agencies

Rates for the sale of seed must be no less than the actual or estimated production costs. Credit proceeds from the sale of WCF seed under these authorities to the WCF. Handle proceeds from the sale of seed not capitalized into WCF seed as a reimbursement to the appropriation available for the seed bank at the time such moneys are deposited. Coordinate with the Albuquerque Service Center on rate settings.

Generally, the seed sold should be excess to the needs of the national forests.

2474.45 - Disposal of Surplus Seed

Seed not exchanged or sold as prescribed in FSM 2474.42, .43, or .44 must be disposed of (FSM 2474.01, item 3). Credit proceeds from sales of surplus WCF seed to the WCF. Deposit proceeds from sales of surplus seed not capitalized into WCF to an appropriate general fund receipt account (FSH 6509.11k, sec. 37.24).

2474.46 - Donation of Seed

Seed may be donated to appropriate parties as interpreted by GSA in the Federal Property Management Regulations (FSH 6409.31, sec.101-44).

2474.5 - Plans, Records, and Reports

2474.51 - Plans

Develop long-term seed procurement and inventory plans for each species seed or breeding zone in accordance with the planned reforestation and restoration (large-scale disturbance and climate change) and conservation programs.

2474.52 - Records

Maintain seed bank records using the Nursery Management Information System (NMIS).

2474.53 - Reports

Instructions for seed reports are included under nursery reports in FSM 2496.13 and FSH 6509.11f, ch. 60 (WCF accounting).

2475 - Genetic Resources Management

2475.02 - Objectives

1. To provide genetically diverse, well-adapted plant materials for vegetation management activities, and restoration of sites disturbed by natural processes, climate change, or human activities. Planted material should be healthy, vigorous, self-perpetuating and adapted to their environment.
2. To provide genetically diverse plant material with increased resistance and resilience to especially damaging exotic insects, pathogens and projected changes in climate.
3. To develop management tools to conserve species threatened by pathogens, insects, or changes in climate.
4. To produce increased biomass per unit area of higher quality forest products.

2475.03 - Policy

1. All reforestation projects must be done with reproductive material resulting from a level 1 or higher program (FSM 2475.3).
2. Apply genetic principles to all silvicultural prescriptions. Design silvicultural operations to upgrade the genetic quality of stands by leaving the best phenotypes. Design regeneration practices that maintain climatically adapted and genetically diverse plant material.
3. Design species programs to produce only enough reproductive material for reforesting National Forest System lands while maintaining reserves for large-scale disturbance or

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

projected changes in climate. Retain a broad genetic base in ex situ and in situ archives so restoration activities can sustain ecological resilience.

4. Maintain communication with Forest Service State and Private Forestry, Forest Service Research and Development, other Federal agencies, state agencies, tribes, universities and private landowners conducting genetics programs. When appropriate and mutually beneficial:

- a. Exchange reproductive material from trees growing on intermingled or reasonably close ownerships, thereby broadening the genetic variation sampled.
- b. Establish uniform standards for selecting superior trees.
- c. Share data to evaluate the breeding potential and adaptability of selected trees.
- d. Share knowledge gained during the implementation of these programs.

5. Work with national and international organizations in efforts to manage and conserve forest genetic resources. Identify opportunities to sustain ecological refugia that may serve as in situ conservation areas.

6. Maintain a broad genetic base in the reproductive material used to restock National Forest System lands to ensure genetic diversity, minimize inbreeding or outbreeding depression, and increase ecological resilience.

7. Maintain flexibility in selection and breeding programs to accommodate changes in management direction and changes in climate and adaptive capacity.

8. Maintain identity of reproductive material through all stages of collection, processing, storage, nursery production, distribution, and other activities, including final use in reforestation or genetics projects.

9. Use seedlings that are adapted to local climatic conditions. Use seedlings from distant sources only after successful performance in evaluation trials. Seedlings from distant sources may be used to accommodate projected changes in climate. Monitoring protocols should be established to track survival and performance of seedlings from distant sources.

10. Develop all phases of genetic resource management through close cooperation of Research, State and Private Forestry, and National Forest System Staffs.

2475.04 - Responsibility

2475.04a - Regional Forester

The Regional Forester shall:

1. Appoint a Regional Geneticist.
2. Establish priorities by species, important traits and program intensity of genetic resources management.

2475.04b - Regional Geneticist

The Regional Geneticist shall:

1. Develop guidelines for the use of reproductive materials including:
2. Develop plans for genetic resource management including tree improvement, resistance to especially damaging exotic insects or diseases and adaptability to changing environments.

2475.04c - Forest Supervisor

Accomplish genetic resource management objectives in accordance with plans approved by the Regional Forester (FSM 1233.7 and FSM 2472.04b).

2475.05 - Definitions

Genetic terms used are defined herein and in:

1972 "Glossary for Forest Tree Improvement Workers," E.B. Snyder, Southern Forest Experiment Station, United States Department of Agriculture, Forest Service, New Orleans, Louisiana. www.esf.edu/for/maynard/GENE_Glossery.html

1998 "Dictionary of Forestry", Helms, John A. Society of American Foresters Publishing, Bethesda, MD. www.dictionaryofforestry.org

Assisted migration trial. A test designed specifically to determine what sources of seed or other propagules will be most appropriate for projected future climates.

Breeding. The science and art of changing the genetic constitution of a population, out-crossing of individuals to improve a desired trait(s).

Breeding zone. A geographic area based on anticipated adaptability of an improved population of trees.

Evaluation plantation. Progeny test.

Ex situ. Conservation of a species under artificial or non-native conditions, "off-site" conservation.

Gene conservation. Activities related to preventing loss of gene pools, gene complexes, genotypes and/or species.

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

Gene conservation bank. Field planting or cryopreservation of a species at risk.

Genetic diversity. Total number of genetic characteristics in the genetic makeup, a measure of heterogeneity.

Genetic variability. The tendency of genetic characteristics to vary.

Genetic gain. Increase in specific traits (for example, productivity, disease or pest resistance) following a change in gene frequency.

Genetic resource management. Management and oversight of the genetic resources (for example, seed orchards, seed production areas, evaluation plantations, assisted migration trials, conservation plantings, seed banks, and so forth), and related management activities (such as tree breeding, tree improvement, establishing and monitoring evaluation plantations, assisted migration trials, collecting data, and so forth).

Genetically appropriate plants. Plants adapted to target site conditions (for example, has good establishment, vigor, and reproductive capabilities); sufficiently, genetically diverse to respond and adapt to changing climates and environment conditions; unlikely to cause genetic contamination and undermine local adaptations, community interactions and function of resident native species within the ecosystem; not likely to become (not natural or inappropriate) invasive and displace other native species; and not likely to be a source of non-native invasive pathogens; likely to maintain critical connections with pollinators (FSM 2070).

In situ. On-site conservation of a species in their native forest.

Progeny test. Evaluation plantation.

Rogue. Removal of less desirable families or clones from a seed orchard or seed production area.

Seed collection stand. A phenotypically superior stand or plantation from which seed is collected.

Seed collection zone. An area within which seed can be collected and moved with minimal risk of maladaptation.

Seed production area. A phenotypically superior stand or plantation rogues and managed to produce large quantities of seed.

Seed orchard. A planting established where superior phenotypes and/or genotypes are managed for the production of seed.

Superior tree. A tree selected for its phenotypic superiority, which has then been tested and proven for its genetic superiority.

Tree seed zone. An area within which seed can be collected and moved with minimal risk of maladaptation.

2475.1 - Administration of Genetic Resource Management Programs

2475.11 - Program Priorities

The plan developed by the Regional Geneticist and approved by the Regional Forester should establish priorities by species, traits of importance, and intensity of genetic resource management efforts (FSM 2475.3). Five genetic resource management program intensity levels are described in FSM 2475.3. Usually, increasing the intensity level will result in greater potential genetic gains in return for increased investment in time, money, and expertise. Therefore, balance benefit-cost ratios, gain per unit of time, and available resources against expected gain when program levels are selected.

2475.2 - Program Prerequisites

Each Region must develop seed-collection zones, breeding zones, elevation bands (where appropriate) and identity-control systems prior to implementing a program level from FSM 2475.3 to ensure that seed is used where it is expected to be adapted.

Revise zone boundaries as necessary based on information and analysis collected in evaluation plantations, common garden studies and assisted migration trials.

Develop, model or revise as necessary the seed transfer guidelines and protocols to assure a high probability of adaptation within both the current climatic conditions and those predicted for the future.

2475.21 - Seed-Collection Zones

Delineate seed collection zones using the best physiographical and biological data available. If variability among species is great, it may be necessary to delineate unique seed-collection zones for certain species.

Develop, model or revise as necessary the seed transfer guidelines and protocols to assure a high probability of adaptation within both the current climatic conditions and those predicted for the future.

2475.22 - Breeding Zones

Delineate breeding zones for those species included in a level 4 or higher program (FSM 2475.3).

2475.23 - Identity-Control Systems

Develop control systems, including supporting records, to:

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

1. Maintain identity, including source and origin of seed and vegetative reproductive material, from collection through stand establishment and enter on each plantation-location record.
2. Confirm identity of seed labeled under a program administered by a State or other certifying agency. State agency certification is encouraged when available.
3. Identify pedigree of improved material.
4. Maintain high standards of documentation in the collection, analysis and reporting of data from evaluation plantations or other sources.
5. Ensure proper use of plant materials, such as matching the genotype as well as the species (FSM 2475.35) with site, and afterwards, monitor and describe its performance.

2475.3 - Program Intensity Levels

The five genetic resources management program intensity levels are ranked by increasing complexity based on workloads and potential genetic gain that can be realized. Increasing the intensity level will result in greater potential genetic gains in return for increased investment in time, money, and expertise. Low-level programs, which can be implemented quickly, may be designed to grade into higher-level programs (FSM 2475.11).

2475.31 - Level 1, Tree-Seed Zones

Level 1 requires that:

1. Seedlots should be collected from a single seed collection zone (FSM 2475.21).
2. If seed is collected from a plantation, the origin and source of the plantation should be identified.
3. The identity of the seed and/or seedlings must be maintained.

For each seedlot, harvest seeds from a sufficient number of parents to ensure a broad genetic base. Spatial separation among parents should reflect the species mating system. Each tree should show above average growth characteristics and appear healthy.

2475.32 - Level 2, Seed-Collection Stands

It is possible to take advantage of valuable natural selection by locating several trees or stands within a seed-collection zone that are above average in performance and designating them for intermittent collection of reproductive material while maintaining broad genetic diversity. These trees or stands can be managed to increase seed production.

2475.33 - Level 3, Seed-Production Areas

Seed-production areas are usually developed in natural stands that have demonstrated better-than-average performance in growth, quality, and seed production and are free of insect and disease problems. The poorer phenotypes and species that may hybridize are removed, and the stand is usually protected from insects and disease. Cultural techniques may be applied to increase seed production and harvest ability of seed crops. The area should be reserved from timber harvesting until unsuitable or no longer needed for seed production. Seed collected from individual select trees located in natural stands or plantations and included in level 4 or 5 programs, must be included in this level for reporting purposes. Seed production areas established through artificial regeneration or conversion of progeny tests to seed production areas fall under these guidelines as well.

2475.34 - Level 4, Seed Orchards (Not supported by evaluation plantations)

Establish seed orchards for specific breeding zone/species combinations where potential gains justify the investments. The selected trees included in the orchards may or may not have been evaluated for their genetic worth in progeny or family comparison tests, but the seed orchards will not have been rogued based on the results of these tests. Seed orchards may also serve as breeding arboreta or gene conservation collections.

2475.35 - Level 5, Selective Breeding and Rogued Seed Orchards

Selective breeding involves the production of seed of known parentage to provide an improved base from which to select materials for advanced generation seed orchards. Trees may be selected for: apparent resistance to insects or diseases, rapid growth, and/or quality of forest products that can be produced from them. Parents included in initial breeding programs may have been selected only because of their excellent appearance (phenotype).

As programs advance, base selections on either the performance of a tree, its relatives, or its ability to produce progeny of proven genetic superiority (genotype). Seed produced in seed orchards that have been rogued on the basis of genetic tests should be included in this level.

2475.4 - Selective Breeding Phases

Selective breeding is a long-term process that requires a substantial agency commitment. The costs and benefits of each program should be evaluated carefully before starting a program and periodically as it continues. Selective breeding involves the following steps:

1. Selection of trees with a superior appearance and subsequent use of reproductive material from these trees to establish evaluation plantations, seed orchards, and general plantations (FSM 2475.41).
2. Breeding of the selected trees in the forest, seed orchard, or clone banks (FSM 2475.42).

3. Evaluation of progeny (FSM 2475.43).
4. Mass production of seed with superior genetic potential for general reforestation and restoration (FSM 2475.44).
5. Efficient handling of this seed or vegetative propagules from forest through to entering plantation establishment in the records (FSM 2475.45).

2475.41 - Selection of Superior Trees

Each Region should develop criteria for selecting individuals or populations based on the objectives of the breeding program and the intensity level of planned programs (FSM 2475.31-.35).

2475.42 - Breeding Strategies

Breeding strategies should be designed to advance the goals of the program without compromising the principles of the genetic resources management program.

2475.43 - Evaluation Plantations

Establish evaluation plantations to determine the genetic worth of particular families and trees within families, and to create a base population where selections can be made for future breeding programs.

2475.44 - Mass Production of Seed

Design and manage seed orchards to mass-produce seed with proven genetic potential for reforestation and restoration. Seed orchards should be dynamic. Plans should include provisions for introducing additional reproductive material as it becomes available.

This cycle of selection, breeding, evaluation, and establishment of improved seed orchards can be repeated as soon as juvenile-mature correlations and commencement of flowering by a new generation permit. Additional increments or genetic gain can be expected for each cycle of selection, if a broad genetic base is maintained.

2475.45 - Handling of Seed and/or Seedlings

Seed extractory personnel, Nursery Managers, and reforestation crews should take extra precautions to ensure that the identity of all reproductive material is maintained, and that vigorous seedlings are planted properly on appropriate sites and at the appropriate time of the year to promote survival and growth.

2475.5 - Protection of Genetic Resource Material

Selected genetically improved material in seed orchards, clone banks and seed production areas represent a substantial long-term investment. Protect this material from fire, mining activities,

timber harvest, cone and seed insects, other pests and diseases or damaging agents. It may also be desirable to protect high-value selected trees in the forest until the genotype can be preserved by propagation.

Seed orchards may also contain conservation banks of tree species that may be considered threatened, endangered, sensitive or of concern. These conservation banks need to be preserved, propagated and protected as well. A plan should be developed to incorporate any additional species into conservation banks on the seed orchards.

2475.6 - Plans, Records, and Reports

Develop and maintain plans and records to provide for the protection, monitoring, and identity of selected genetic resource material; for program continuity; and for the integration of improved material into silvicultural systems and ecological restoration.

2475.61 - Genetic Resource Management Plans

Include a discussion of genetic resources management in land management plans when identified as an issue or concern (FSM 2412.31) or in other situations where appropriate.

Each Region shall develop a genetic resource management plan and/or handbook for the genetic resources program based on the total amount and kinds of reproductive material that will be needed for each species and program intensity level (FSM 2475.3). It must provide for orderly accomplishment of genetic resources objectives. The plan will include a discussion of coordination with Forest Service State and Private Forestry and research programs.

The genetic resource management plan must also contain a discussion of gene resource management on National Forest System lands. Include the following information:

1. Inventory of commercial and noncommercial forest tree species, especially for species of concern or considered sensitive.
2. Inventory of "set-aside" areas, including research natural areas, wilderness areas, National Parks and Monuments, modified management areas (for example, roadside strips, scenic areas, gene-conservation areas); and ex situ areas established with representative samples of the natural population(s). Evaluate the distribution of species growing on the areas listed in item 2 to ensure the commercial and noncommercial forest tree species in jeopardy are represented. The likelihood that the species of concern will be maintained in "set-aside" areas should also be addressed.
3. The probable influence of genetic resource programs on genetic diversity and climatic suitability should be addressed.
4. An analysis of seed needs for forest trees and other native species and a discussion of whether existing sources of seed are adequate to meet needs.

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

5. Collaborative projects, to assist land management decisions, ongoing with the National Genetics Lab (NFGEL), Placerville, CA.

2475.62 - Records and Reports

See FSM 2496.15.

2476 - Stand Improvement

2476.02 - Objectives

1. Maintain or increase the growth rate, resilience, species composition, and/or improve the quality of stands for timber or other resource uses according to direction in the land management plan.
2. Develop and demonstrate the benefit of improved methods and techniques of stand improvement for all resource uses as an encouragement for private landowners to apply stand improvement practices on their own land.
3. Accomplish the stand improvement treatments in a cost-effective manner.

2476.03 - Policy

1. Base stand improvement treatments on silvicultural prescriptions written to meet specific site and resource requirements.
2. Examine all areas receiving a stand improvement treatment and report that the treatment objective has been accomplished.
3. Accomplish stand improvement objectives to the extent possible by commercial sale, stewardship contract, or permitted use of timber and other forest products which promote improved biomass utilization consistent with other resource needs and objectives.
4. Do not prune for quality improvement of timber products unless required by the land management plan. Pruning may be done to meet other management objectives.
5. Consider forest fertilization on an operational basis only where research indicates a reasonable assurance of the desired response, economic analysis reveals an acceptable return, and the treatment meets multiple-use direction for the site.

2476.04 - Responsibility

2476.04a - Regional Forester

Regional Foresters shall:

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

1. Report annual stand improvement accomplishments, treatment needs, schedules for completion of treatments, and funding needed to implement those treatments (FSM 2496).
2. Establish standards and procedures for stand improvement work.
3. Validate that stand improvement has been accomplished according to approved plans and prescriptions.

2476.04b - Forest Supervisor

Forest Supervisors shall:

1. Plan stand improvement projects to accomplish the objectives in the Forest plan.
2. Issue more specific stand improvement guidelines based upon the analysis done to meet the objectives of the forest plan.

2476.04c - District Rangers

District Rangers shall:

1. Administer and accomplish planned stand improvement treatments, except on experimental areas where a memorandum of understanding between a Station Director and a Regional Forester or Forest Supervisor specifies otherwise (FSM 2403).
2. Maintain a program of work which assures high priority work is accomplished.

2476.1 - Stand Improvement Plans and Reports

See FSM 2496.

2476.2 - Priorities and Economic Analysis

Within the framework of general regional stand improvement guidelines, establish specific stand improvement guidelines based on forest level analysis. Examine all projects in light of forest level guidelines to determine whether or not stand improvement treatment is needed. Diagnose and schedule priority areas for stand improvement treatments. Schedule treatments in FACTS.

Although the economic analysis within the framework of the forest plan provides information on the types and amounts of stand improvement needed, further economic analysis may be necessary to determine the most cost effective method to carry out a treatment or to set priorities between projects when all of them cannot be financed. When using economic analysis to help set priorities, do not analyze each stand individually. Analyze representative types of stands and treatments, then apply the analysis results to similar types of stands. Follow regional direction for economic analysis and its application.

2476.3 - Stand Improvement Categories

See FSM 2496. The following are the categories of stand improvement recognized for work planning and reporting:

1. Release and weeding.
2. Precommercial thinning.
3. Pruning.
4. Fertilization.

In addition, stand improvement may include these types of activities:

1. Control of understory vegetation, including but not limited to mechanical mastication, herbicides, and prescribed burning.
2. Animal damage control.

2476.4 - Integrating Multiple Objectives

Stand improvement should be designed to integrate multiple resource objectives. Mitigation of some stand improvement activities may be necessary to accommodate specific needs in specific areas.

Perform forest pest management and stand improvement treatments concurrently where effective and economical. Use pest management funds to finance the extra cost of accomplishing the desired suppression or control (FSM 6150). If insect or disease control is a major consideration in a proposed stand improvement project, an entomologist or pathologist may need to make a detailed biological evaluation of the situation (FSM 3400). Exercise care to prevent stand improvement operations from creating insect or disease problems.

Prescriptions for stand improvement shall provide for slash treatment through coordination with Fire Management (FSM 5150). Since these treatments can be a major cost item in some stand improvement projects, keep the slash treatment to the minimum necessary for practical and economical protection of the treated areas, or explore options for woody biomass utilization.

2476.5 - Stand Improvement Implementation Methods

Stand improvement projects typically are non-commercial; however, sometimes commercial elements are present. Timber sale contracts, integrated resource timber contracts, integrated resource service contracts, service contracts, administrative use permits, and force accounts are all methods for implementation of stand improvement projects.

Material to be cut or killed in a stand improvement project which can be sold as stumpage or other product should be included in timber sale contracts where practical. Green timber and

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

salvage sales are a part of the timber management program and targets; do not use stand improvement funds to mark or administer such sales.

Stand improvement work can be incorporated into integrated resource timber contracts and integrated resource service contracts. Stand improvement funds can be used in stewardship contracting when stand improvement criteria are specified.

Administrative use permits can also be used to accomplish stand improvement. Stand improvement funds can be used to mark or administer the use, subject to FSM 6513. The cost of accomplishing stand improvement through administrative use permits must not exceed the total anticipated costs associated with a similar, but otherwise funded stand improvement projects.

Stand improvement projects are primarily accomplished through service contracts or force account crews. Service contracts may not authorize cut or killed trees to become the property of the contractor (salvage rights). Utilize free-use and firewood permits where the material cannot be sold.

2476.6 - Use of Pesticides

See FSM 2150.

2476.7 - Validation

Regional Foresters or Forest Supervisors, when authority has been delegated, shall validate that areas programmed for stand improvement during the fiscal year where accomplished in accordance with Regional standards and reported as required. A stand may have several stand improvement treatments during a rotation or as part of uneven-aged management. Validate each treatment individually as it is accomplished.

2476.8 - Monitoring

Forest plans include various types and amounts of stand improvement treatments to achieve their goals. These treatments are simulated in models and yield estimations are projected based upon research information on growth increases. Although research provides the basic data for yield simulation and growth model development, it is important to monitor the actual operational response of stands to these treatments, so that the actual rates can be compared to predicted growth rates.

Regions must establish guidelines for the establishment of benchmark stands to provide a basis for evaluation of operational growth responses due to stand improvement treatments. Measurements of benchmark (typical) stands over time provide a means to validate predicted yield estimations and provide a method to make local adjustments to yield models. The frequency of benchmark stand establishment should be in relationship to the various types of regeneration techniques (artificial or natural), stock types (improved or unimproved), the importance of the particular type of stand improvement treatment, and the value of the timber type. Consider funding of benchmark stand establishment, periodic measurement, and recordkeeping an integral part of the normal stand improvement program.

2477 - Collection and Use of Deposits for Sale Area Improvement

See FSH 2409.19, Renewable Resource Handbook, contains direction for performing renewable resource protection and improvement under approved timber sale area improvement plans using Knutson-Vandenberg (K-V) funds. It also contains direction concerning collection and reporting of the uses of K-V funds.

2478 - Silvicultural Examinations, Prescriptions, and Evaluations

2478.01 - Authority

Authority to make silvicultural examinations, diagnose treatment needs, prescribe for silvicultural treatment, and evaluate treatment results is inherently implied in the basic authorizations to harvest timber and carry out reforestation and stand improvement projects on national forest land (FSM 2401).

2478.02 - Objectives

The silvicultural examination, prescription, and evaluation process is undertaken to:

1. Secure adequate and accurate biotic and abiotic data for specific areas (usually stands).
2. Analyze and diagnose treatment needs to meet management objectives.
3. Predict consequences and determine relative effectiveness of feasible alternative treatments.
4. Prescribe specific methods, techniques, and timing of activities necessary to accomplish the silvicultural treatments to meet land management objectives.
5. Develop an orderly program of land treatments.
6. Determine the effectiveness (after implementation), need for remedial treatments, and improvements for future prescriptions.

2478.03 - Policy

1. Silvicultural examinations, diagnosis, and evaluations must be accomplished in order to maintain an orderly program of work.
2. Silvicultural examinations, diagnosis of treatment needs, and the preparation of prescriptions detailing the methods, techniques, and timing of the silvicultural activities necessary to achieve established objectives are required prior to initiating any silvicultural treatment on national forest lands. This includes all management actions affecting the establishment, growth, composition, health, and quality of forests and woodlands. On National Forest System lands, all silvicultural activities that cut, burn,

Forest Service Manual 2400 – Timber Management

Chapter 2470 - Silvicultural Practices

Amendment: 2400-2014-1

Effective date: March 06, 2014

establish, or otherwise modify forest vegetation, must have a silvicultural diagnosis and prescription prepared or reviewed by a certified silviculturist prior to implementing the project or treatment.

3. Monitor the results of each treatment and file the evaluation results with the prescription in stand, compartment, or similar files.
4. Base detailed prescriptions, considering interdisciplinary input, upon stand or market conditions that are not likely to change sufficiently prior to implementation of the treatment to cause a change in the prescription.
5. Diagnosis of treatment needs and detailed prescriptions for all silvicultural treatments must be prepared, or approved after field review of each prescription, by a certified Silviculturist. Regional Foresters may establish guidelines for exceptions to the field review requirement (for example, for simple or repetitive prescriptions for areas about which the certified Silviculturist has sufficient knowledge). Silvicultural treatments include all management activities that control the establishment, growth, composition, health, and quality of forested lands to achieve stated land management objectives. The use of prescribed fire and mechanical treatments such as mastication on forest and/or woodlands qualifies as a silvicultural treatment.
6. Regional Foresters shall establish procedures and guidelines for training and certifying Silviculturists. Regional certification programs must meet minimum national standards (FSM 2478.51).
7. Generally use appropriated funds for examinations, diagnosing treatment needs, preparing detailed prescriptions, and making evaluations. Finance examinations, diagnoses, prescriptions, and evaluations for projects using primary purpose objectives.

2478.04 - Responsibility

2478.04a - Regional Forester

The Regional Forester shall:

1. Ensure that silviculturists are trained, certified, and recertified every four years. Issue supplement to FSH 2409.17 to establish Regional Certification standards. Also ensure that a Region-wide list of certified silviculturists is maintained.
2. Provide guidelines for silvicultural examinations, diagnosis formats and contents, prescription formats and contents, and for sampling techniques.

2478.1 - Silvicultural Examinations

The silvicultural examination collects and records site and stand characteristics needed to identify existing stand conditions, capabilities, and trends. The examination includes the metrics needed for the diagnosis and silvicultural prescription. The metrics typically include site quality

and limitations, forest composition and structure, wildlife habitat components, and fuel characteristics. The examination design and intensity are based on support information needed to ensure that proper treatment can be prescribed to meet management objectives. Follow Regional guidelines for silvicultural examinations. Ensure data is entered in the appropriate database (for example, Field Sample Vegetation (FSVeg) and its ArcMap extension (FSVeg Spatial)).

2478.2 - Diagnosis of Treatment Needs

The diagnosis considers and evaluates the site capability, management direction, and landscape context relative to desired stand conditions. The diagnosis compares the existing conditions to the desired conditions to determine treatment options to achieve the management objectives. The diagnosis process first considers whether deferring action would be expected to achieve the management objectives. An intermediate treatment such as thinning, salvage, or sanitation is considered next if the current stand development would be unlikely to achieve the management objectives. Regeneration methods (both even-aged and uneven-aged) are analyzed if neither deferring action nor intermediate measures would achieve the desired condition. Consider stabilizing the stand if the objectives cannot be achieved with no action or an intermediate treatment and regeneration methods are not currently possible.

The diagnosis supports the proposed action as well as the purpose and need for action for silvicultural projects. The diagnosis ensures the objectives and requirements of the land management plan would be met and determines if clearcutting is the optimum method. The diagnosis provides information for alternative development and evaluation of the effects on the forest vegetation. Follow Regional guidelines for diagnosis format and contents.

2478.3 - Silvicultural Prescriptions

The prescription is the documented description of activities required to implement any silvicultural treatment on National Forest System lands. The prescription includes site preparation and regeneration, natural and activity fuel management, and the long-term treatment sequence needed to achieve the desired condition. Most fuel treatments in forest vegetation are considered silvicultural treatments and require a silvicultural prescription. Ensure burn plans in forest vegetation settings are reviewed by a certified silviculturist and are consistent with silvicultural objectives. Follow Regional guidelines concerning prescription format and content.

2478.4 - Forest Vegetation Monitoring

Monitor and evaluate treatments to determine if implementation was consistent with the silvicultural prescription and if prescribed future treatment sequence needs to be modified. Post-treatment silvicultural examinations may be needed to obtain necessary information for the evaluation and update of FSVeg and FSVeg Spatial. Monitoring may be accomplished on a sample basis. The project interdisciplinary team should review the monitoring results as a feedback mechanism to improve future similar projects. Follow Regional standards concerning valid sampling techniques support monitoring and evaluation requirements in land management plans.

2478.5 - Training and Certification of Silviculturists

Regional Foresters shall establish programs, procedures, and guidelines for training and certifying personnel authorized to make or approve silvicultural prescriptions.

The training must include prescription development, with all of its related knowledge, skills and abilities, duties related to implementation of plans and prescriptions, and monitoring and feedback of results. Required skills include preparing technical specifications for silvicultural contracts, implementing silvicultural projects, training professional and nonprofessional personnel in all aspects of silviculture, evaluating prescription results against objectives and expectations, and using this knowledge to make necessary modifications in future prescriptions or to improve future training. The program should also contain refresher training and education programs to maintain high levels of silvicultural expertise. Silviculturists shall be reviewed and re-evaluated for certification at intervals not to exceed four years.

Regional Foresters shall sign and issue certificates attesting that the named individual has demonstrated the necessary competence to prescribe for silvicultural treatment. Regional Foresters shall also ensure that a Region-wide list is maintained of certified Silviculturists. Regional Foresters should also encourage self-development among Silviculturists by recommending publications for reading.

2478.51 - National Standards for Silviculturist Certification

The standards for certification are the professional knowledge, skills, and abilities needed to perform each element as described in FSH 2409.17, sec. 8.5, exhibit 01. Each Regional Forester shall ensure certified Silviculturists meet the national standards. A regional test for certification shall include candidates preparing and defending a detailed silvicultural prescription.

These attributes are considered necessary to meet resource management responsibilities and to meet laws, policies, and basic resource stewardship requirements. Inherent in the standards is a need for practical skills developed through experience. Regional Foresters may establish experience standards.

FSH 2409.17, chapter 8, defines the minimum national standards for Silviculturist certification. Regional Foresters shall supplement FSH 2409.17 to establish regional certification standards.

Supplements will include the following:

1. Management of particular pests.
2. Particular growth and yield models.
3. Logging engineering, transportation planning, and other sale layout skills.
4. Silvics and silvicultural systems for particular tree species.

5. The Regional standard for each tool for which the national standard is "variable level."

2479 - Stocking Guides and Growth Projections

2479.01 - Authority

The Forest and Rangeland Renewable Resources Planning Act of 1974 as amended by the National Forest Management Act of 1976 states that "it is the policy of the Congress that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with land management plans." One relevant aspect of this law is the maintenance of a planned and controlled degree of stocking in managed forests. This requires the development, on a national level, of a standardized concept of stocking and a consistent interpretation, display, and application of stocking standards, or use of relevant silvicultural prescriptions prepared by certified silviculturists.

A second relevant aspect of the NFMA of 1976 is the development and use of growth projections from growth and yield system for Forest Planning and management purposes. The growth and yield systems are normally computerized to simulate the effects of various stand density levels.

2479.02 - Objectives

Develop a standardized format for timber stocking level charts, or use of relevant silvicultural prescriptions to increase the understanding and application of stand density management.

2479.03 - Policy

The following policy will guide the development and use of stocking charts for even-aged stands.

1. The stocking chart format described in chapter 9, FSH 2409.17, or relevant silvicultural prescription shall be the basis for stocking level guides developed for use on the national forests.
2. Stocking charts, or relevant silvicultural prescriptions will serve as the basis for determining appropriate stocking levels for forest stands within the National Forest System.

2479.04 - Responsibility

2479.04a - Regional Forester

Regional Foresters shall annually review the quality of existing stocking charts or use of relevant silvicultural prescriptions and ensure that information for new chart development has had appropriate Research review. Regional Foresters with Research assistance shall identify forest cover types where information is lacking for development of stocking level guides.