DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE NAVY PUBLICATION

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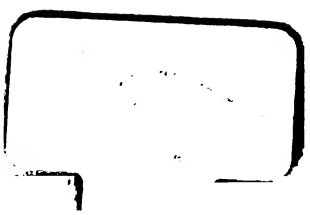
INSTALLATIONS—GENERAL

WOODLAND MANAGEMENT

DEPARTMENTS OF THE ARMY AND THE NAVY

APRIL 1963



TECHNICAL MANUAL
No. 5–631
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DEPARTMENTS OF THE ARMY
AND THE NAVY
WASHINGTON 25, D.C., *2 April 1963*

INSTALLATIONS—GENERAL

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*This manual supersedes TB ENG 253, 24 April 1957.

CHAPTER 1

GENERAL

1. Purpose

a. This manual provides guidance, standards, and technical aids to foresters, land managers, and others concerned with the protection and management of installation woodlands. Because of the wide variety of types and sites found in the forest regions of the United States, the practices set forth are general in nature.

b. The material contained in this manual has been developed by the Departments of the Army and Navy with the assistance of the Forest Service, U.S. Department of Agriculture. Protection is emphasized because of its importance to woodland management.

CHAPTER 2

WOODLAND MANAGEMENT

Section I. GENERAL

2. General

The management of military woodland is the application of technical forestry principles to the operation of the forested property. Management objectives (par. 3) must be accomplished without interfering with the assigned military missions of the installations.

3. Objectives

The objectives of woodland management are to—

a. Protect the real estate investment of the Government from depreciation, exploitation, and depletion.

b. Facilitate the military missions.

c. Produce the maximum of forest products needed.

d. Provide a mobilization reserve when determined to be feasible and desirable (par. 4*d*).

e. Contribute forest products to the local and national economy.

f. Protect downstream property from flood and erosion damage.

4. Basic Concepts of Military Woodland Management

a. The primary concern of military installations is the assigned mission; the production of timber is secondary. Good management conserves resources, improves grounds, and prevents waste. The necessities of military use may require unforeseeable changes in land use which will substantially and quickly increase or reduce the area of woodlands available for management.

b. Woodlands available for management are also available for troop training. Training requirements may alter desirable woodland management practices.

c. The installation has no obligation to provide equal annual yields of timber, since the primary purpose of woodland management is neither to supply a dependent industry nor to obtain an equalized annual income. It is, however, good public relations as well as good management to offer the timber at scheduled annual or regular periodic intervals.

d. Large dimension sawtimber of white oak, black walnut, bald cypress, and old-growth dense longleaf pine is of particular value in time of national emergency. Trees or groups of these species are retained as live storage mobilization reserve and paint-marked MR, when meeting the criteria of sound bole, healthy crown, straight stem over 16 inches diameter breast high (DBH) with a minimum of two clear logs, and in operable volume accessible for truck logging.

e. The hazards of fire and explosion, and metal in the timber on military installations are far greater than in commercial woodlands. Management and disposal operations must consider these hazards.

5. Guiding Principles

a. It is not necessary to determine rates of growth and volume of growing stock prior to prescribing initial management practices. Put the woodland in the best possible growing condition as rapidly as possible. Cut over the entire woodland for the first time within 10 years; or 5 to 8 years if area is small enough to permit it. In this operation all undesirable trees should be removed. This may result in lower sale value than would accrue if only better trees were removed, but removal will increase future values through better stands.

b. Timber made useless by imbedded metal should be deadened or felled to make way for better growing stock. Salvage for poles, piling, and posts, if usable. Metal detectors may be used on large logs. (If not too deeply embedded the metal may be chopped out before the log goes to the saw.) Always include metal-infested timber in

Figure 1. Projectile exploding in edge of an impact area.

the timber made available for disposal unless predetermined to be valueless.

c. Annual or semiannual reduction of vegetation on impact areas is necessary to lessen the danger of fires resulting from explosions of projectiles (fig. 1). Such fires may interfere with target spotting or may escape to adjacent areas and interfere with other types of training.

d. Maintain seed trees on impact areas whenever practical.

e. Determine the species to be favored. Military requirements are high for coniferous timber and negligible for all hardwoods except white oak and black walnut. Some conifers are relatively unimportant. Replace Virginia pine, for example, with loblolly, shortleaf, slash, or longleaf pine (whichever is locally adapted). White pine has limited military value; red (Norway) pine is the better crop species where both occur.

Section II. PERSONNEL

6. Requirements

The personnel requirements vary with the acreage of woodland involved, the volume of timber to harvest, the difficulties involved in maintaining adequate fire protection, the insect problems, and available funds. Figure 2 is a guide.

7. Training

a. The Workshop. The workshop method is an excellent procedure for training foresters. For best results it is desirable that counterpart personnel of all Department of Defense establishments participate. The workshop is not a substi-

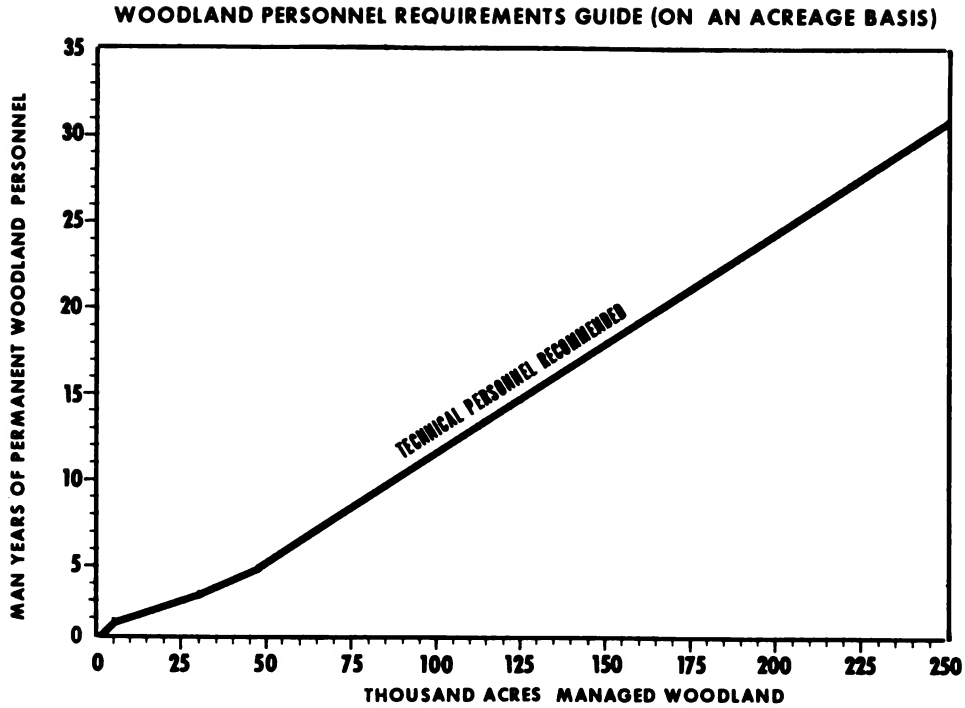


Figure 2. Personnel requirements guide on an acreage basis.

tute for on-the-job training, but serves as a means of improving overall techniques of protection and management, introducing new equipment, and demonstrating better methods of equipment use. The workshop should be conducted at an installation having an active woodland program and suitable quarters for visitors. A suggested agenda for a workshop is given in appendix V.

b. On-the-Job Training. Training by doing, supported by lectures, charts, and demonstrations, is essential at the installation level. Hold scheduled training programs prior to each fire season. In the South this means two a year; in most other forest areas, one a year. When feasible, invite specialists from State or Federal forest fire suppression agencies to assist with the lectures and demonstrations.

Section III. MANAGEMENT PLANNING

8. General

The first step in management is to develop the written plan (AR 420–74; and BUDOCKSINST 11015.9). The *outline* for the Woodland Management Plan is presented in appendix II.

a. Start with preparation of the fire protection portion of the overall plan (par. 21). When the Fire Protection Plan is completed and locally approved, develop remaining parts of the full plan.

b. Keep the approved management plan alive by revisions and amendments.

c. A pressboard binder which will hold the entire plan including the maps and charts offers a satisfactory means of presenting, protecting, and filing the completed plan.

9. Steps in Preparing the Management Plan

a. Base Map. Select a suitable base map. A map scale of 4 inches per mile is satisfactory for most purposes.

b. Aerial Photographs. Obtain the most recent 4-inch-per-mile aerial photographs of the installation. If the military photographs are old, procure more recent photographs through the nearest office of the Soil Conservation Service, Department of Agriculture.

c. Land Use Map. Prepare a basic land-use map of the reservation. On it outlined improved grounds, firing ranges, impact areas, antenna fields, ammunition storage areas, and other land areas not in the woodland category. The

remaining area is the woodland to be placed under management. Determine the overall woodland acreage by planimeter, modified acreage grid, or other suitable method.

d. Woodland Stand Map.

(1) *A stand map is justified when—*

(*a*) There are two or more easily recognized major forest type groups. *Example:* Upland pine and bottomland hardwood.

(*b*) Broad age classes of even-aged stands exist over extensive areas. For most localities, the following stand-size classes are sufficient: sawtimber stands, pole timber stands, seedling and sapling stands, and nonstocked areas. Age classes may be used to supplement the stand-size classification. The merchantability and volume in each stand-size class depends on timber type and site class.

(*c*) There are pronounced differences in conditions that have resulted from burning, cutting, thinning, or other practices.

(2) *The minimum stand to be recognized* is 10 acres of productive woodland. Prepare stand maps from aerial photos by photo interpretation techniques if trained personnel and special equipment are available. Request assistance from the nearest forest experiment station or regional office of the Forest Service, U.S. Department of Agriculture, or use ground reconnaissance and map sketching with the help of aerial photos.

(3) *In determining condition classes to be recognized*, it is better to have a few condition classes which are useful in locating and managing timber than to have too many.

e. The Cutting Cycle. Establish the cutting cycle. This is the planned period within which all compartments (*f* below) producing merchantable timber are cut over once, in orderly sequence.

(1) Different cutting cycles for different species are not necessary; adjust essential differences in treatment of various species by changing the marking rules (par. 14).

(2) Establish the cutting cycle as 10 years for the initial stages of management, when not determined by other methods. It will exceed 10 years only when the woodland area is too large to permit completion of marking within that period with the personnel and funds expected to be available.

f. Compartment Determination. Select compartments and define on a map (fig. 3). Compartments are subdivisions of the woodland, established for purposes of orientation, administration, protection, and silvicultural operations, and defined by permanent or semipermanent boundaries, either of natural features or manmade lines, which do not necessarily coincide with stand boundaries.

(1) *Number of compartments.* Establish one compartment for each year of the cutting cycle. The number of compartments established will be 5 to 10, depending on the growth rate. They should be approximately equal in area, if this is feasible. Use roads, streams, reservation boundaries, and other clearly defined physical lines as the compartment boundaries. Use legal subdivisions if convenient. Military subdivisions are useful in some instances.

(2) *Order of cutting.* After the compartments have been established, determine the order of cutting on the basis of worst first silvicultural need. Designate the compartment most in need of cutting as "Compartment I," the next as "Compartment II," and so on. If new construction or other developments eliminate from the woodland all or a large portion of a compartment, that compartment may be dropped. The woodland acreage remaining is added to the area of an adjacent compartment.

g. Cutting Units. Cutting units are subdivisions of the compartment, usually about 40 acres in area. Cutting units increase efficiency in timber marking and estimating, provide identifiable units to assign to logging crews, and are useful in describing fire locations, work assignments, and in recordkeeping. Delineate cutting units on the compartment map and on the ground and identify by numbers starting in the southwest corner, proceeding east, thence west, and so on. *Sale areas* are composed of one or more cutting units within a compartment. When described by cutting unit

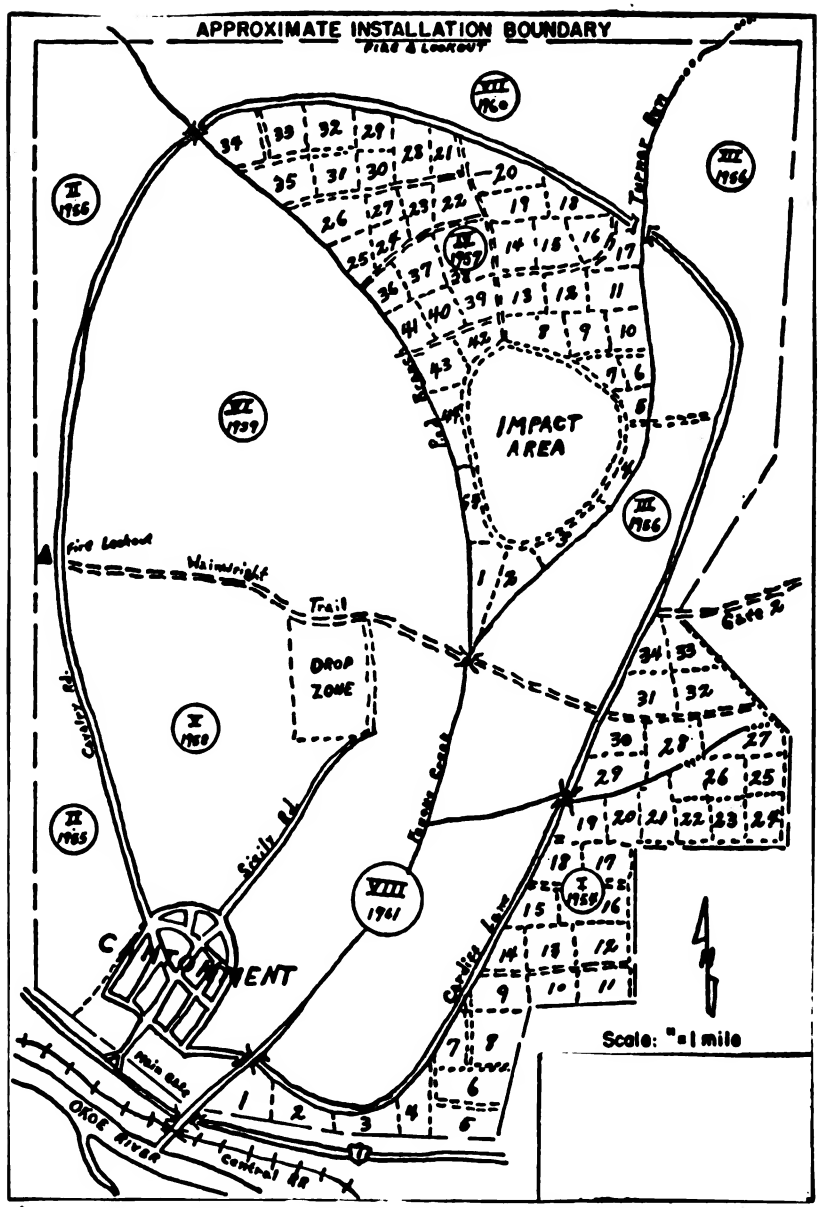


Figure 3. Compartments and cutting units.

numbers, the locations of a sale area is positive and the cutting record permanent.

h. Volume Inventory. An approximation of the volume is essential to long-range planning. It is important to know what is available in terms of products to be produced, where the volumes are located, priorities of harvest or cultural treatments, and the prospective productivity.

(1) *Estimating.* An estimate by a person with considerable experience in cutting local timber may be accurate within 25 percent and is usable for preliminary planning purposes. A harvest or cruise in a similar stand may be used.

(2) *Plot sampling.* If accuracy of 10 percent is necessary, use the following procedure:

(*a*) Define the areas in which plots are to be taken. Omit all areas of over 2½ acres of open land, brush land, and stands of trees under pulpwood size.

(*b*) The following cruising percents by area are appropriate for determining the number of plots to be used: 20 percent for 50 to 500 acres, 2 percent for 501 to 1,000 acres, 1 percent for 1,001 to 10,000 acres.

(*c*) Locate $\frac{1}{5}$-acre circular plots (radius: 52.66 feet or 0.797 chain) over the entire merchantable woodland, with each plot equidistant from adjoining plots. Use 4-inch-per-mile air photographs to locate plots.

(*d*) Tally on each plot all commercial species which are 5.0 inches DBH or larger. Use a separate tally sheet for each plot (this will permit statistical analysis later). Record the "cut" and "leave" tally by species or groups of species according to local utilization practice. For example, if shortleaf and loblolly pines are commonly sold without differentiation, tally for "pine" rather than for the separate species. Similarly, tally red, black, and scarlet oaks as "black oak"; white, post, burr, overcup, and swamp chestnut oaks as "white oak"; other broadleaf species as "mixed hardwoods."

(*e*) Measure each tree to be tallied with diameter take to 2-inch-diameter classes. Determine merchantable height in 16-foot logs and half logs with hypsometer or Abney level. Assure that "border trees" are in or out of the plot; use the tape.

(*f*) Obtain the total volume of the woodland by determining the total volume on the plots, then multiply the result by the factor of relation between total plot area and the total woodland area. Example: 150,000 acres total, 30 acres of plots: the factor is 5,000. Do not attempt any reduction for defect unless an accurate cull factor is available (par. 17).

i. The Cutting Budget. This is harvest planning to provide a flow of wood products having a similar annual value.

(1) Budget by area is established by determination of the cutting cycle, the establishment of compartments equal in number to the number of years in the cutting cycle, and the determination of the order in which the compartments will be cut over (*f* (2) above), to insure profit to the loggers and provide openings which will permit establishment of desirable reproduction. Ingrowth and increment accruing between cuts should normally exceed volume removed (until regulation is fully established). However, this may not occur nor be desirable where there is an excess of large, mature, decadent, or damaged timber which must be promptly removed or wasted. When such an overcut is necessary, it may be advisable to omit the next scheduled cut for the compartment, or affected areas within the compartment.

(2) Develop a copy of the compartment map as a *cutting budget map* and visual progress report (par. 16*b*). This map is the basic record of woodland management operations, and the primary guide to preparation of the second cutting cycle budget.

(3) The average annual cut per cutting cycle is budgeted but is not necessarily an accurate prediction of the volume to be cut from each compartment. This average figure is determined for the first cutting cycle as follows:

(*a*) Make cut-and-leave tally for the kind of cutting planned on plots in representative merchantable condition classes. Tallies of appropriate plots from among those used for the total volume inventory (*h* above) will serve this purpose.

(*b*) From the tally, obtain the average cut-percent figure and apply to total merchantable volume as previously determined (*h* above).

(*c*) Divide result by number of years in the cutting cycles. The answer represents the average annual yield expected, except for growth that may occur during the cutting cycle. The result is, therefore, conservative, but this is not objectionable.

(*d*) The actual volume to be removed annually is determined by a volume tally of trees marked for removal. The estimated average annual yield provides a guide to the amount of marking required, number of personnel necessary to do marking, and budgeting of funds.

(*e*) Annual volume estimates of growth and mortality are not essential knowledge in preparation of the initial plan.

These are more important in later cutting cycles. The major problem initially is to improve stand quality and vigor by removing all possible undesirable trees whether dead or alive. The operation of the short cutting cycle (10 years or less) tends to prevent large accumulation of dead timber.

10. Plans for Small Woodlands

The following modifications of the management practices outlined for larger installations may be made for small woodlands:

a. The woodland area should be divided into compartments and a 5- to 10-year cutting cycle used where practical. If the woodland occurs in several scattered blocks, they may be identified as compartments, for reference purposes.

b. Annual harvests can be planned if the area is large enough or it may be satisfactory and more profitable to prescribe periodic instead of annual harvests, except to fulfill local needs. After annual installation needs have been provided for, plan on harvesting the remaining allowable cut annually or at 5- to 10-year intervals as necessary to assure enough volume to interest buyers.

c. Neither the absence of an installation forester nor the use of periodic harvests need lessen the quality of marking and other woodland care. Obtain professional services from higher levels, or request assistance from State or Federal foresters, or use professional consultant forester services contracts. Teach marking rules to nonprofessional personnel, and prepare a work program covering a period of several years.

d. On smaller installations, wildfire occurrence is at a lower frequency than on larger installations. Modifications of protection practices are discussed in chapter 3.

11. Annual Work Plan

In advance of each fiscal year prepare a written work plan which describes for the forester's superior officer the types and magnitude of work to be performed during the ensuing year. A copy of the annual work plan should be made a part of the woodland management plan and forwarded with annual revisions (par. 12*a*) to appropriate headquarters. The following format is suggested (Navy personnel refer to FY Annual Increment Plan in accordance with BUDOCKS Instruction 11015.9, 9 Apr 62):

a. Narrative. Describe the major activities planned for the year and brief summary of progress made in previous year.

b. Personnel Requirements. Furnish the following data:

	Man-days
Timber management:	
Marking	
Cruising	
Planting	
Poisoning and thinning	
Inspection	
Fire protection:	
Firebreaks	
Prescribed burning	
Fire suppression	
Lookout towers	
Miscellaneous:	
Leave	
Officework	
Training	
Travel	
Total	

12. Revising the Woodland Management Plan

a. Annual Revisions. The purpose of annual revisions is to furnish revised data to support actions proposed in the plan, and to correct information furnished originally. Page revisions normally are adequate for corrections; changes in personnel requirements; and record of fires, and estimated damage (acres and value) resulting thereform. Sample chart follows for submitting data on volumes, receipts, personnel requirements, and costs (Department of Navy personnel, see BUDOCKS Instruction 11015.9, 9 Apr 62).

b. Complete Revisions. An active woodland program on an installation normally requires periodic complete revision of the plan. Five-year intervals are usually desirable. These revisions should summarize the data furnished in the original plan and subsequent complete and annual revisions. Other items may include: revised compartmentation and cutting units, and changes in marking rules and cutting budgets. Complete revision may require fieldwork, especially when new rates of growth and volume determinations and stand mapping are needed. It may be desirable to program stand mapping in one year and volume inventory the next. Plan revisions when other work is least demanding. Put program cost estimates and personnel requirements in writ-

	Unit	FY ---\- (previous yr)		Estimated for FY ----[1]
		Amount	Receipts	
Woodland managed	Acres	----------	XXX	
Conifer sawtimber harvest	BF			
Hardwood timber harvest	BF			
Conifer pulpwood harvest	Cords			
Hardwood pulpwood harvest	Cords			
Miscellaneous products harvest [2]	As applicable			
Management costs	Dollars	----------	XXX	
Total	Dollars	XXX	----------	XXX
Personnel	Each	----------	XXX	
(List by grades)				

[1] Estimated work program and planned harvest for ensuing fiscal year.
[2] List miscellaneous products separately, such as poles and piling, fenceposts, stumps, etc.

ten form for review and approval by the installation commander before completing the revised plan for final submission.

c. Record Copies. Retain copy of each superseded plan or page in the installation file for reference. Superseded copies normally are destroyed in higher headquarters and are not available for reference.

Section IV. TIMBER DISPOSAL PROCEDURES

13. General

Remove from the stand those trees which would otherwise be wasted by death and decay, or will interfere with the growth rate or survival of more desirable trees. There are three primary methods for eliminating such trees:

a. Timber Stand Improvement, by cutting or deadening undesirable trees and species. No utilization is attempted, unless there is a local demand for firewood.

b. Installation Utilization, by cutting and removing marked trees in the course of training or by use of grounds maintenance crews.

c. Commercial Sale or Lumber Procurement Harvest. This is the principal method of preventing waste and improving the stand.

14. Timber-Marking Rules

In any type of partial cutting, select in advance and mark each tree which is to be removed (par. 15*a*(3)). Develop marking rules in writing for each type of intermediate and harvest cutting that is planned.

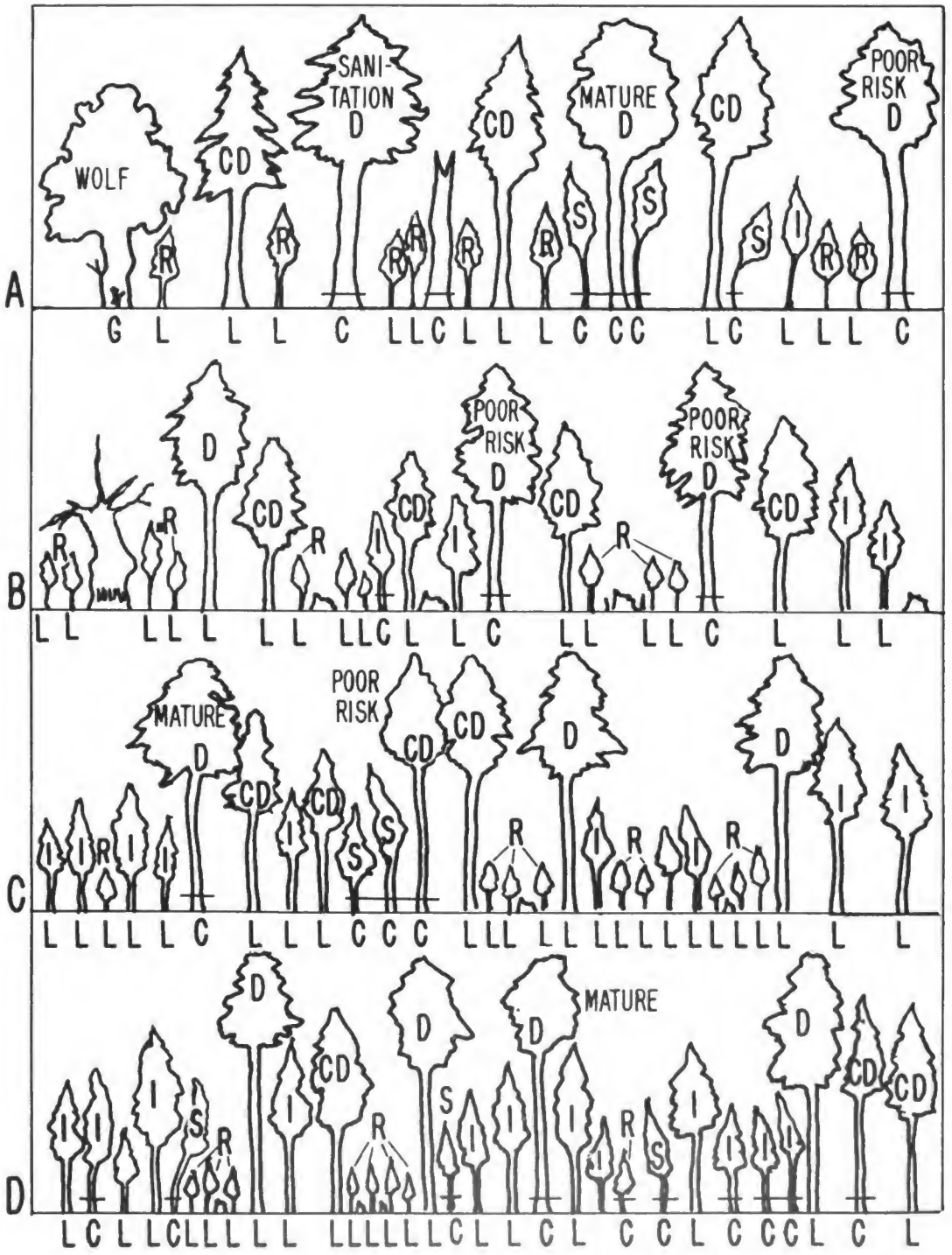
a. Guidelines. Mark for removal the following classes of trees (fig. 4):

(1) *Sanitation trees.* Those trees in which the presence of wood-destroying fungi (par. 25) are unmistakably evident. Sanitation trees will be retained only when better trees are not available and seed trees are essential.

(2) *Poor risk trees.* Included are those in which the loss of marketable wood currently exceeds the annual growth of new wood; those which are overmature and suppressed, unthrifty due to insect or fungus attack, or weakened mechanically and subject to windthrow; and those damaged by fire, turpentining, lightning, logging, or insects. Poor risk trees may be left as seed trees when no better trees are available.

(3) *Mature trees.* Trees which have just passed the peak of annual growth and natural vigor as shown by crown appearance. Do not remove all mature trees in a single harvest. Select those least likely to survive through the next cutting cycle. A basis of one per wooded acre for each year of the cutting cycle is a practical guide. Any others selected from this class should be on a need for thinning basis or when only seed trees are to remain.

(4) *Thinnings.* Those trees of marketable size that are least desirable and should be removed to give proper growing space to better trees.



A. FIRST CUT, UNDERSTOCKED, UNMANAGED, DECADENT STAND
B. SECOND CUT, END OF FIRST CUTTING CYCLE, LIGHT
C. THIRD CUTTING, END OF SECOND CUTTING CYCLE, VERY LIGHT
D. FOURTH CUT, END OF THIRD CUTTING CYCLE, MOSTLY PULPWOOD

LEGEND

C-CUT	CD-CODOM.
G-GIRDLE	I-INTER.
L-LEAVE	S-SUPPR.
D-DOM.	R-REPRO.

Figure 4. Types of cuttings.

(5) *Culls and undesirable species.* Those trees of merchantable size which are considered to be unmerchantable or are of undesirable species. As an exception, individuals of undesirable species if thrifty, of high quality, and not in competition with better trees may be retained for possible future demand.

(6) *Metal infested timber.* See paragraph 5*b*.

b. Wildlife and Timber Marking. Good forest management is also good game management. *Deer* require some open land and some hardwood growth. Removal of undesirable hardwoods from pine stands will cause the deer to move from the area treated to the areas where good hardwood growth is maintained. *Wild turkey* require areas of seedbearing hardwood growth, such as oak, beech, black gum, and dogwood, and interspersed openings, such as old fields, woods roads, and firebreaks. *Squirrels* feed on mast (seed) of hickory, oaks, beech, and pine. In marking timber, give consideration to wildlife factors whenever it is practicable.

15. Timber Harvesting

See AR 420–74 and BUDOCKSINST 11015.9.

a. Commercial Sales.

(1) *Written release.* For leased lands, the real estate officer must secure written approval of the lessor unless specifically permitted by the lease.

(2) *Map.* Prepare a reproducible map to delineate the cutting area. Show all economically operable areas, danger areas, main roads, woods roads, firebreaks, streams, available mill sites (if any), compartment and cutting unit identification, and any other features important in logging, hauling, and milling operations.

(3) *Marking.* Mark the trees to be removed. The use of tree paint for marking (fig. 5) is now almost universal, although the marking ax it still used occasionally.

(*a*) *In selective cutting* every tree to be removed is marked at breast height (4½ to 5 feet above gound) and on the stump at ground line. Use only one color of paint (yellow as a rule), and face all marks in the same direction (fig. 6).

(*b*) *When an area is to be clear cut* to remove all merchantable timber, mark only the boundary trees. Place the marks 5 feet high facing into the tract and also away from the tract. Do not cut boundary trees.

(4) *Volume estimates.*

(*a*) Obtain the volume estimate as the trees are marked. If the stand is to be clear cut, marking is unnecessary, *but* the volume of merchantable timber must be estimated by 5 or 10 percent strip or plot sampling.

(*b*) Compute volume separately for major species. Where "peeler" logs are important, determine separately the "peeler" volume.

(*c*) For species of lesser importance, combine volumes into "mixed conifers" or "mixed harwoods."

(*d*) If dead timber comprises more than 5 percent of the total volume offered, list separately by species; if less than 5 percent, include in the green timber estimate.

(*e*) The estimate should be sufficiently accurate to permit lump-sum sale of volumes of less than 1 million board feet of sawtimber of 2,000 cords of pulpwood.

(*f*) See also paragraph 17, "Volume Tables."

(5) *Estimating procedure.* Estimating procedure depends on the expected method of payment.

(*a*) *If payment is based on volumes measured after cutting:*

1. Tally, by species and diameter, all marked trees.

2. Measure 1 tree in 20 selected by random sampling and classify by products, tree diameters, tree species, or other groups. Measure each sample tree to 1-inch DBH class and 8-foot logs for sawtimber, full bolts for pulpwood, linear feet for poles. Use a crew of three or four men to select and paint-mark the trees to be cut, and a crew chief to tally the "calls" and determine the trees to be measured. If men work in pairs, one man

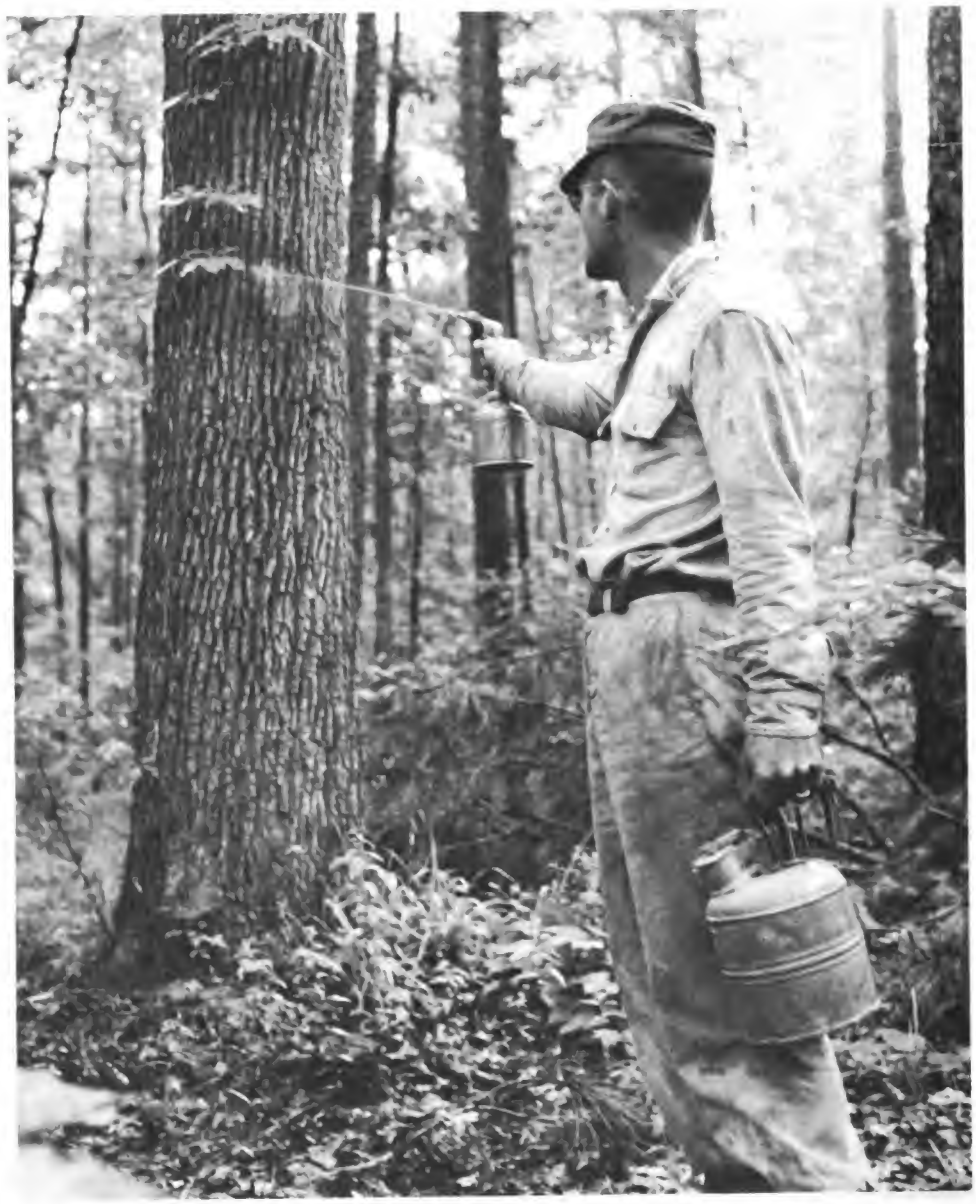


Figure 5. Paint marking trees for cutting.

will select the sample trees and tally each tree marked.

(*b*) *If payment is based on volumes measured prior to sale* (*lump-sum payment*), measure one tree selected by random sampling from every five marked, classifying them by species, and diameters.

(6) *Statements of availability.* Prepare a declaration of availability (app. XII) for submission to the designated approval authority.

(7) *Merchantability.* Clearly define all terms for use in the specifications. The following are examples.

(*a*) *Logs. A merchantable pine sawlog* is defined as being not less than 8 feet long and 8 inches inside bark at the small end. *A hardwood log* is at least 10 feet long and no less than 12 inches in diameter inside bark at small end.

Note: Logs are generally considered unmerchantable if net scale is less than one-third of gross scale.

(*b*) *Trees.*

1. A merchantable sawtimber tree is defined as containing at least one merchantable sawlog.

2. A merchantable pulpwood tree must produce in the stem no less than two pulpwood bolts 5 feet long and no less than 4 inches inside bark at the small end.

Note: Local practices may require consideration of other specifications.

(8) *Other conditions.* Other conditions of sale to be included in the declaration of availability are—

(*a*) How slash and tops are to be disposed of and expected standards of performance.

(*b*) The month and year in which cutting must be completed. This is especially important for "crash" programs necessary to clear land, stop insect attacks, or salvage storm damaged timber. When there is no hurry, the completion date should be ample to permit completion in a reasonable time, as determined by local practices without conflict with anticipated military training.

(*c*) Explain if loggers will be permitted to operate only on specified days of the week.

(*d*) Some trees in a stand may be of doubtful merchantability. Mark these with an X, or other symbol, to indicate buyers choice to cut or leave without penalty. In the availability data, show the number so marked, with the statement that their volume is not included in the estimate.

(*e*) Provision for reimbursement for logging damage to other standing trees, drainage systems, and the like.

1—Pine stand marked for cutting.

Figure 6. Selective cutting.

2—Same area after cutting.

Figure 6—Continued.

b. Installation Utilization. This may provide the opportunity to make needed improvement cuttings in stands that are unattractive for commercial sale.

(1) Mark the trees to be removed (*a*(3) above) and instruct responsible officers on the importance of cutting marked trees only and maintaining the same standards as required in sale areas.
(2) When special timbers are required and are not available in the designated area, they may be cut wherever found in the woodland.
(3) Keep a record of all volumes removed to to provide annual production records.

Section V. MANAGEMENT RECORDS

16. Record System

Adopt a system of management records adequate to provide a useful, easy-to-understand, and economical-to-maintain record of the annual accomplishments. Include—

a. A written record on 5- by 8-inch cards or typed letter-size pages, according to preference. The following information should be compiled:

(1) For each compartment:
  (*a*) Installation identification and locations.
  (*b*) The fiscal years covered by the record.
  (*c*) The name or number of compartment and cutting unit to which the record pertains.
  (*d*) The gross and managed woodland acreage in the unit.

(*e*) Products removed, by name and volume.

(*f*) Contract numbers, if removed by sale or harvest.

(*g*) Dollar returns to U.S. Treasury.

(*h*) Reforestation record in acres, number of trees planted, percent surviving, acres remaining to be planted.

(2) Summary for installation (total annual cost by years).

b. Management Map. (The fire record is maintained on a separate map, as described in paragraph 20.) The management map should show—

(1) The compartments and planned year for cutting.

(2) The areas marked (northeast-southwest lines).

(3) The areas reported available for disposal (northwest-southeast lines).

(4) The areas assigned for installation cutting, including troop training and other post needs (horizontal lines).

(5) Progress of cutting (north-south lines).

(6) Reforestation planned (light green-solid).

(7) Reforestation completed (dark green-solid).

(8) Record (on the map margin) for each operation:

(*a*) The identity and number assigned.

(*b*) Date cutting or planting began.

(*c*) Date cutting or planting completed.

(*d*) Contract number if applicable.

(*e*) Volume removed, or number of trees and acres planted (by species).

Navy personnel refer to BUDOCKS Instruction 11015.9.

17. Volume Tables

a. Girard form class tables (app. I, Nos. 1 and 39) based on the Schribner Decimal C log rule for merchantable height are recommended because of accuracy and the ease with which adapted to local use. The Girard form class is the percentile relationship between diameter inside bark at the top of the first 16-foot log (above 12-inch stump) and the diameter outside bark at breast height (4½ feet above ground). To select the form class volume tables applicable to an installation, make taper measurements by diameter classes on 100 to 150 trees from all parts of the area covering the species, range of diameters, and merchantable lengths. Average the form class by diameter classes for each species and smooth off by plotting the values and drawing a curve.

b. Since neither woodland volume inventory nor volume estimates for timber offerings to be sold by log scale require net volume (gross volume minus defect), local volume tables are not necessary. However, if tree measurement or sample tree measurement is used as the basis of payment for timber, accuracy would require that local net volume tables by species be prepared to allow for defect. Make additional measurements and defect deductions to obtain accurate local data.

c. In the application of merchantable length volume tables, care must be taken that heights be estimated or measured as tables stipulate, and that lengths are not reduced by estimators as allowance for limbiness or quality of the top log. To do so causes error in the application of the tables.

d. Volume tables may be obtained through forest experiment stations or regional offices of the Forest Service, U.S. Department of Agriculture (app. VI).

CHAPTER 3

PROTECTION

Section I. GENERAL

18. General

Adequate protection against fire, insects, disease, and other enemies is the first major accomplishment to be sought in developing woodland management. Nationwide, insects and diseases are the most destructive enemies of timber. Fire is, however, the most common and most spectacular enemy, and the most destructive of human life, property, and wildlife.

Section II. FIRE PROTECTION

19. Fire Prevention

a. Objectives. The purpose of fire prevention is to reduce the number of man-caused fires to the lowest practical minimum. In planning and action, prevention efforts should be on a parity with other phases of fire control.

b. Military Requirements. Fires in military woodlands are especially hazardous because of stored equipment, ammunition and supplies; and the multiple use of these lands for training, military operations, timber production, and recreation.

c. Analysis of the Problem. An analysis of the problem with which prevention must deal requires that localized risk and hazard surveys be made to determine when, where, and why fires occur.

d. Action. A program of action directed at fire prevention includes—

(1) *Control of causitive agents* (e.g., debris burners, hunters, fishermen, campers, lumbering and logging operations, railroads, incendiarists).

(2) *Publicity*, including press releases, daily bulletins, posters, and the like, for informing both military and local residents of the value of fire prevention.

(3) *An efficient organization* capable of acting quickly and efficiently at a fire.

(4) *Review of past fires* and recurrent evaluation of procedures used.

(5) *Prescribed burning.* This is a planned fire restricted intensity applied to a predetermined area for the purpose of fuel reductions, and in some instances, improved silvicultural practices. Annual burning may be necessary on impact areas, firebreaks around danger areas such as those used for ammunition and equipment storage and structures. Three- to seven-year intervals may be necessary for fuel reduction, control of undesirable understory in pine stands, removal of undersirable vegetation prior to natural seeding or reforestation, and control of brownspot disease in longleaf pine. The following criteria for prescribed (controlled) burning are essential:

(*a*) *Plan.* Do not proceed with prescribed burning until the Fire Protection Plan for the installation is approved (par. 6, app. II). Include in the Fire Protection Plan procedures to be used for the control of prescribed fires. Coordinate the plan with appropriate training officers, the fire department, and local forestry and fire protection agencies.

(*b*) *Firebreaks.* Where practical construct firebreaks at ⅛-mile intervals and at right angles to prevailing wind direction. Crossbreaks may be necessary in some locations.

(*c*) *Burning blocks.* Provide burning blocks no larger than can be burned and made safe in 1 day (an area that may vary from 300 to 1,000 acres depending on vegetation and terrain).

(*d*) *Use experienced personnel* to supervise burning operations to insure that essential safeguards are observed.

(*e*) *Brief the burning crews* the day before burning and provide each formen with a detail map of his assigned area.

(*f*) *Notify lookouts, range officers*, military police, local forestry officers, and adjacent land occupants of intention to burn. Provide lookouts with map coordinates of areas to be burned.

(*g*) *Make final check* with U.S. Weather Bureau. Defer burning if weather predictions are unfavorable for the next 12 hours (table I).

Table I. Fire Weather Forecast Service, U.S. Weather Bureau

State	City	State	City
Alabama	Montgomery.	Missouri	Kansas City.
Alaska	Anchorage.	Montana	Billings.
Arizona	Phoenix.		Missoula.
Arkansas	Little Rock.	Nevada	Reno.
	Fort Smith.	New Mexico	Albuquerque.
California	Los Angeles.	New York	Albany.
	Fresno.	North Carolina	Asheville (covers also Virginia, Kentucky, Tennessee, and South Carolina).
	San Francisco.		
	Redding.		
Colorado	Denver.	Pennsylvania	Philadelphia.
Connecticut	Hartford.	Oregon	Pendleton.
Florida	Tallahassee.		Portland.
Georgia	Macon.		Salem.
Idaho	Boise.	South Dakota	Rapid City.
Illinois	Chicago.	Utah	Salt Lake City.
Louisiana	Shreveport.	Texas	Houston.
Maryland	Baltimore.	Washington	Olympia.
Massachusetts	Boston.		Seattle.
Mississippi	Jackson.	Wyoming	Cheyenne.

(*h*) *Proceed to burn* if wind is steady from the north or northwest at not over 10 miles per hour, the temperature is under 60°, and the ground moisture is high or the fire danger reading is not higher than class 2 (par. 22*d*). Do not burn hilly or rolling land except during periods of low wind velocity (3 to 5 miles per hour).

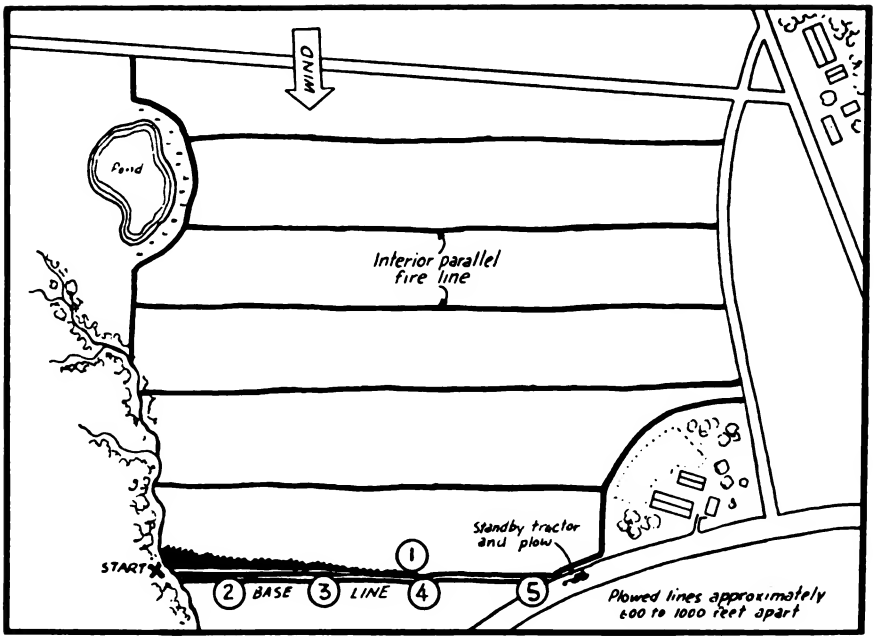
(*i*) *Set fires to burn against the wind.* Figures 7, 8, and 9 illustrate the method. Circled numerals in these figures show placement of men and their movements. Flames should move at the rate of 100 feet per hour. Faster burns will cause more destruction to trees that should be saved. With firebreaks one-eighth mile apart, the burn should be completed in 6 to 8 hours.

(*j*) *Discontinue burning* if unforeseen wind changes occur.

(*k*) *Maintain a patrol* until fire is out.

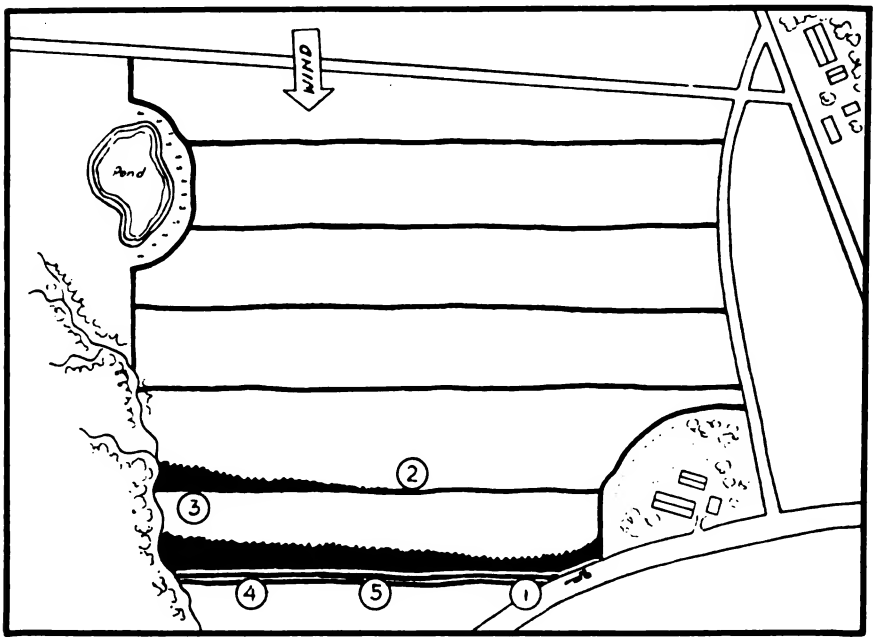
(*l*) *Evaluate the result.* When burning to control understory in pine stands, inspect sapling pines for damage. For sapling longleaf and slash pine, one-third or less of the lower live needles should show scorch. Greater injury necessitates revision of procedures used. Consult professional foresters before continuing the burn if young trees show a high scorch on much of the tree population.

(*m*) *Hot fire technique.* The hottest possible fire will at times be required. An example is where hardwood undergrowth is too large or dense to control with a ground fire. Identify these areas in the woodland management plan. Set backfires around the perimeter of the block to be burned with the windward side last. In the southern or eastern United States, choose a class 3 or 4 danger reading day (par. 22*e*) when fuel conditions will insure the greatest amount of heat (fig. 10).



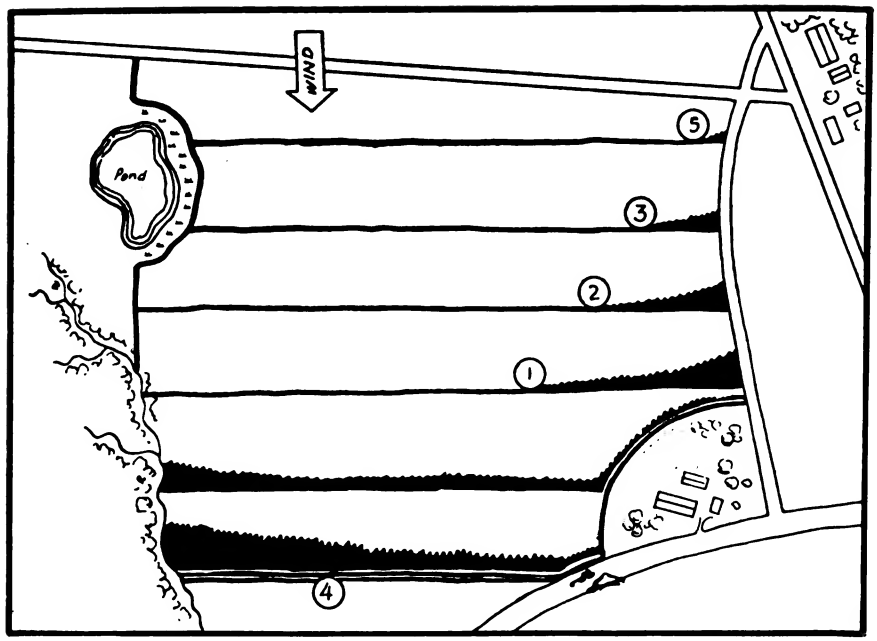
(1) Torchman; (2), (3), and (4), Security patrol.

Figure 7. Beginning controlled burn.



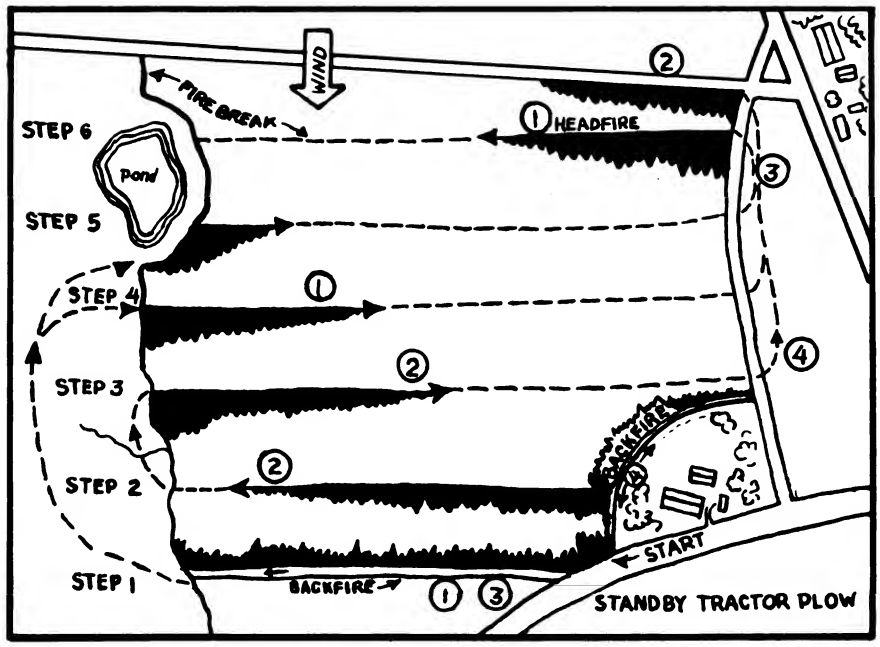
(1) Security man; (2) Torchman; (3), (4), and (5), Security patrol.

Figure 8. Progression to second line.



(1), (2), (3), and (5), Torchmen; (3) and (4), Security patrol.

Figure 9. All lines fired.



(1), (2), and (3), Torchmen; (4) Security patrol.

Figure 10. Hot fire technique—heavy fuel.

20. Fire Records and Damage Appraisal

An accurate record and damage appraisal of fires is essential to a planning and management program. Include in the record the time fire was first observed and by whom, the time control operations were completed, method used in suppression, number of firefighters used, type of vegetation burned, acreage burned, and estimated value of damage. Compute damage from tables available from local Federal agencies, but not less than $1 per acre. For damage on private land where damage suits may result, assign a professional forester familiar with local conditions. Prepare fire reports as required by applicable military instructions and directives (see BUDOCKS Instruction 11320.2C Change 1, and 11320.3A Change 4; and Army Regulation 385–12). For large installations, locate fire damage on maps. Use a ¼-inch circle for marking fire origin, then delineate the fire damage to scale. Number the fires chronologically and show by legend the fire number, date, cause, acres burned, and fuel type. Cover a 5-year period on each map. Compute separately damage to marketable timber and to young trees not ready to harvest. Estimate cost of reestablishment where the stand must be regenerated artificially. Base appraisal of damage on a cruise of 2 to 15 percent of the damaged area (e.g., 2 percent of 10,000 acres, 10 percent of 1,000 acres, and 15 percent of 100 acres).

21. Fire Protection Plan

An outline for the fire protection plan is provided in appendix II. Review the plan annually and revise where necessary on the basis of experience gained, changes in risk and hazard conditions, and new techniques and equipment. Distribute copies of the approved plan to all individuals concerned with woodland fire-suppression activities.

22. Preparedness

a. Organization.

(1) Develop well-organized trained crews. The fire marshall will select the fire boss after careful screening of available personnel. This may be the structural department chief, the installation forester, the land management supervisor, or the grounds foreman. Train strawbosses to assume duties on large fires. Use land management and forestry civilian personnel to the extent available. It is not advisable to weaken protection of built-up areas by committing structural firefighters to suppress woods fires if it can be avoided. Enlisted personnel are of most value as manpower pools to be called upon when large or prolonged fires exhaust the regularly available civilian crews.

(2) Detecting and reporting personnel are essential to prompt action. The key personnel are lookouts (in towers), ground patrols, air patrols, and dispatchers. On larger installations all may be required; on smaller installations these duties may be combined as appropriate. The dispatcher assigns the first task force in the absence of the fire boss and notifies higher authority.

(3) In planning schedules, provide for availability of suppression forces during periods of the year when hazards are high.

b. Training. Hold an annual fire training session for fire crews of at least 1-day duration. Discuss fire behavior, equipment, tactics, safety, and related information. Send key personnel to training sessions held by Federal, State, or private industry fire suppression forces. Use training films to the extent available. The U.S. Forest Service catalog of film may be obtained from: Forest Service, U.S. Department of Agriculture, Washington 25, D.C.

c. Safety. Emphasize the following safety measures:

(1) Send physically fit men to fight fires.

(2) Require sturdy clothing, hardhats, and heavy shoes (preferably safety shoes).

(3) Transport tools in toolboxes, or otherwise secure them to protect personnel from injury in transit.

(4) Provide built-in seats in trucks and require personnel to ride sitting down.

(5) Teach the safe way to carry and use handtools.

(6) Do not work men to exhaustion. On fires of more than 8 hours' duration, arrange for 8-hour shifts with periodic rest periods.

(7) When cutting snags or trees, assign one man to watch for heavy detached limbs and to warn fallers and others nearby.

(8) Qualify at least one member of each fire crew for first aid. Carry one first-aid kit per crew.

(9) Teach personnel never to try to outrun a fire, but to move to the flanks (or inside the burned area, if that area has cooled and can be reached safely).

(10) Provide an escape route for each crew.

(11) Teach crew men to stay with and under the direction of their crew boss.

(12) Locate on maps heavy flammable growths that represent special hazards.

d. Fire Danger Prediction. Fire danger predictions are provided by some Federal and State fire danger stations (fig. 11) at any hour of the day. Fire danger stations provide scientific equipment for recording and predicting weather conditions. On larger installations fire danger stations may be justified. One fire danger station per 100,000 acres is a standard guide. Consult the State forester or U.S. Forest Service for pro-

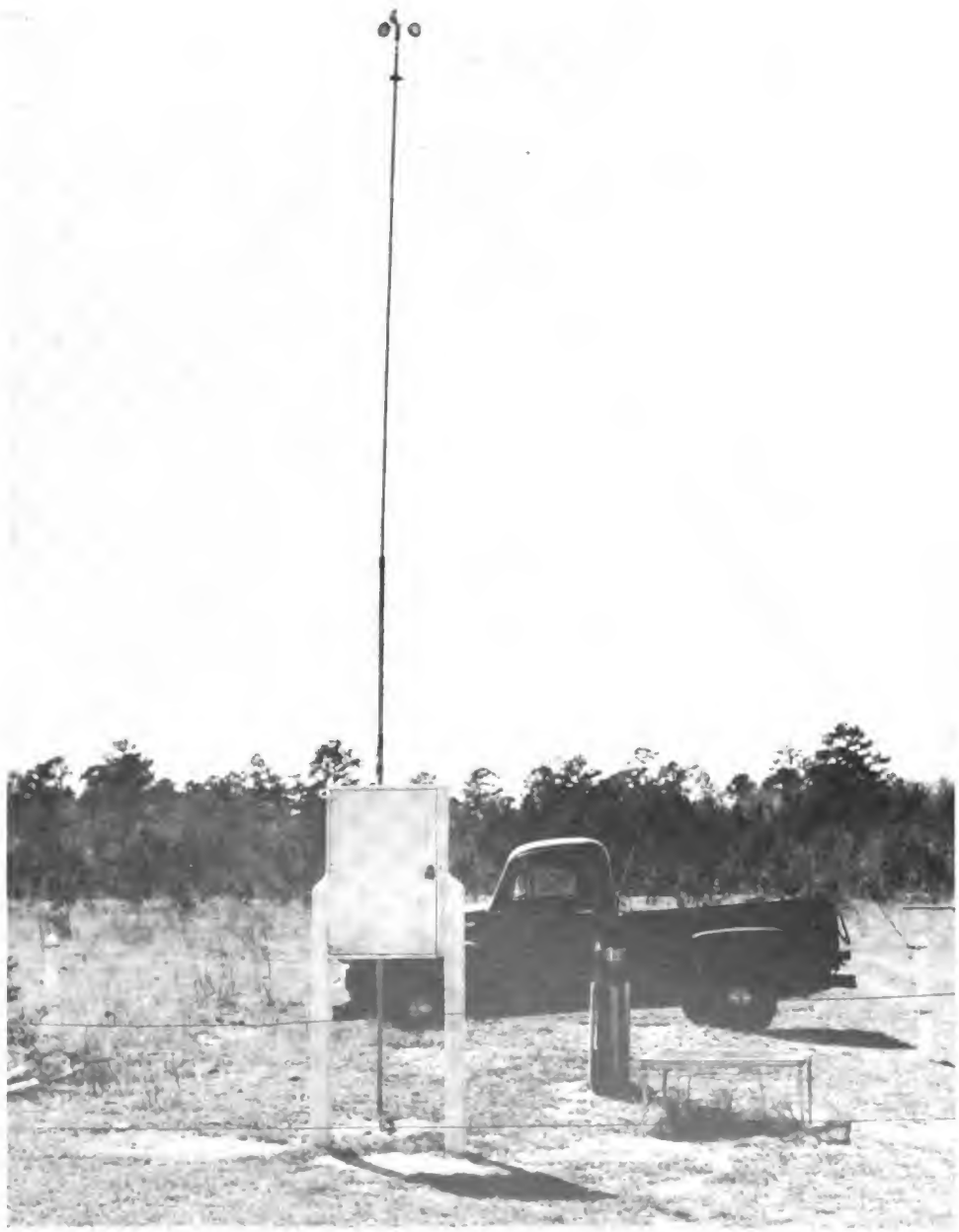


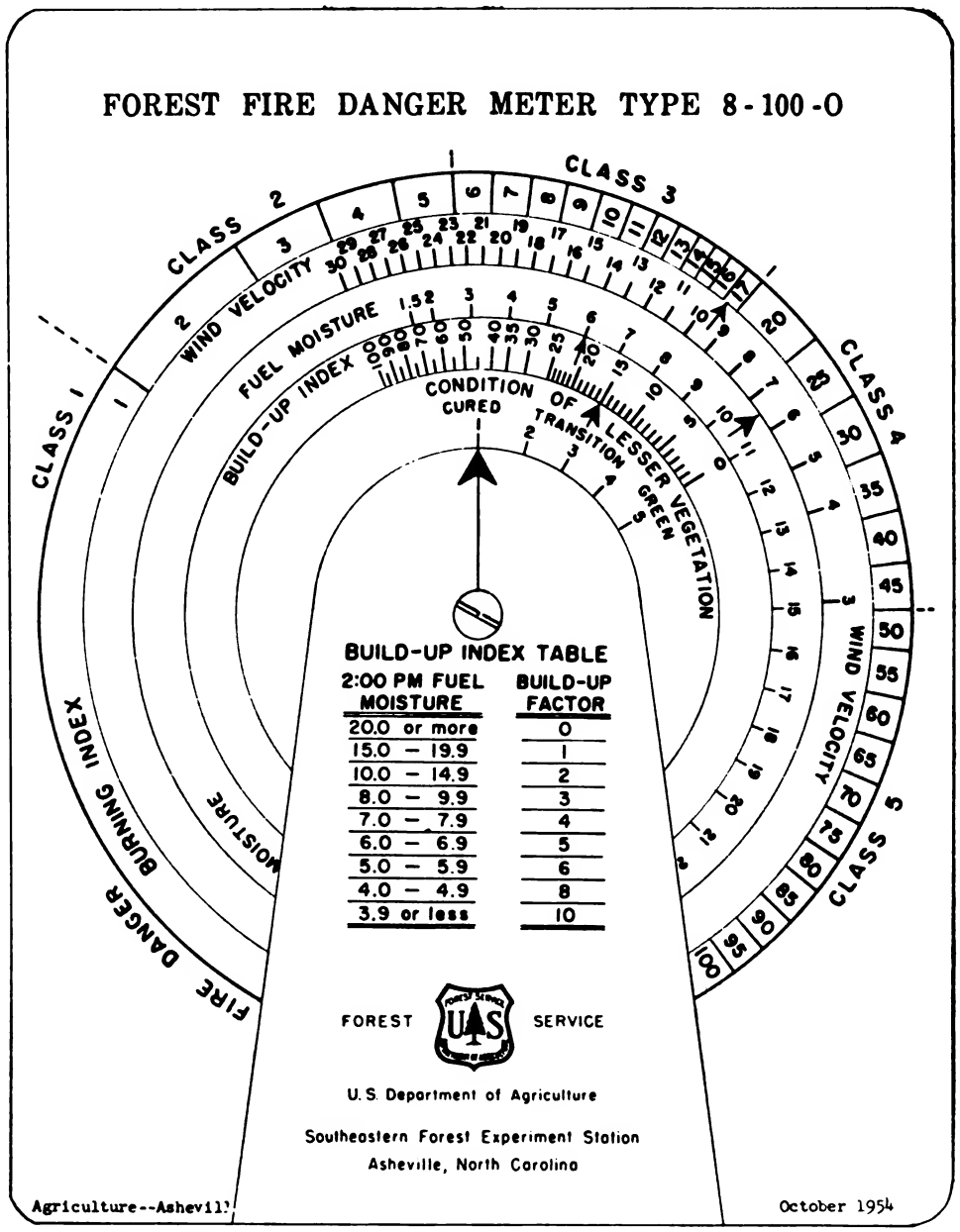
Figure 11. Fire danger station.

cedures and equipment required. The following requirements normally are observed:

(1) Keep daily record during fire danger periods of rainfall (standard rain gage reading), condition of understory vegetation (color and dryness), fuel moisture percent (calibrated sticks), temperature (high and low thermometer), wind direction and velocity (anemometer readings), and relative humidity (psychrometer readings).

(2) Evaluate records made ((1) above) by using an appropriate formula or meter for classifying flammability of woodland vegetation. Figure 12 illustrates one type of meter used in the Southeastern States. The areas of use for fire danger meters are shown in figure 13.

(3) Recalibrate or replace calibrated indication sticks every 6 months. These are even-weighted sticks designed to compute fuel moisture.



More than 500 fire danger stations in the South are using meters of this kind.

Figure 12. Forest fire danger meter type 8–100–O.

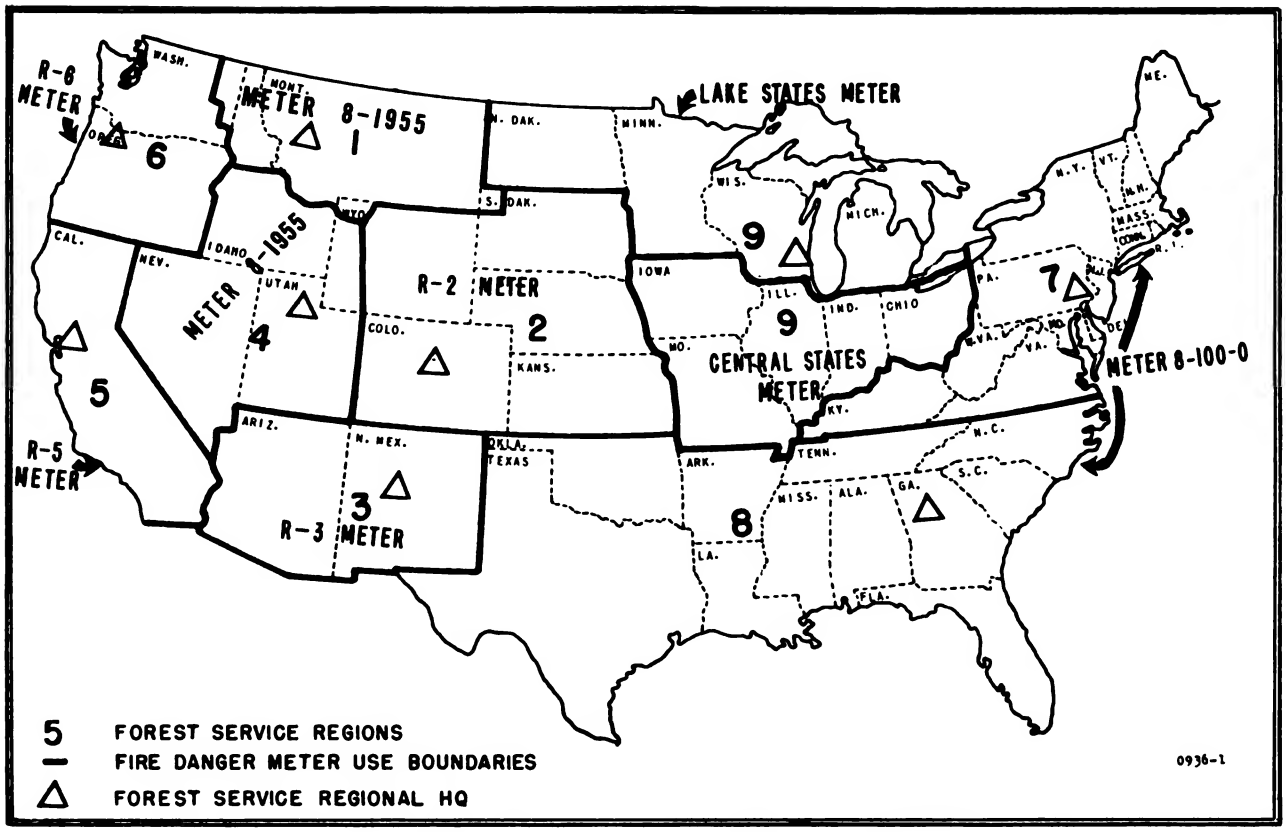


Figure 13. Areas of use for fire danger meters.

e. Fire Danger Classes. The following five danger classes indicate the behavior pattern of fire in woodlands and grasslands and correspond in general to the classification illustrated in figure 12.

(1) *Class 1.* Fire will spread slowly and tend to die out.

(2) *Class 2.* Fire will spread in grass and leaves until extinguished.

(3) *Class 3.* Fire will burn briskly and spread rapidly. Short-distance spotting may occur.

(4) *Class 4.* Fire spreads rapidly and tend to crown in young conifer stands. Long-distance spotting is common. Intense convection activity may develop.

(5) *Class 5.* Fires burn fiercely and spread rapidly. Where vegetation occurs in quantities, fires may be unmanageable.

f. Application of Ratings. Class 3 or over, hold crews assigned to land and woodland management close to fire equipment and in contact with the dispatcher. For class 4 or 5, crews may need to be held idle if local work assignments are not available. Issue fire warnings when fire danger reaches class 3 or equivalent (table II). Alert fire crews for instant action. Send fire danger warning to range officers, military personnel in training, fire department installation commanders, and supervisory personnel directing crews in ammunition storage and other danger areas. Guidelines for dispatch of personnel and equipment are contained in table III. For large forested areas or where important flammable material (e.g., ammunition, and fuel) is stored, display a prominent signboard indicating the fire danger rating on the installation (fig. 14).

g. Detecting and Locating Fires.

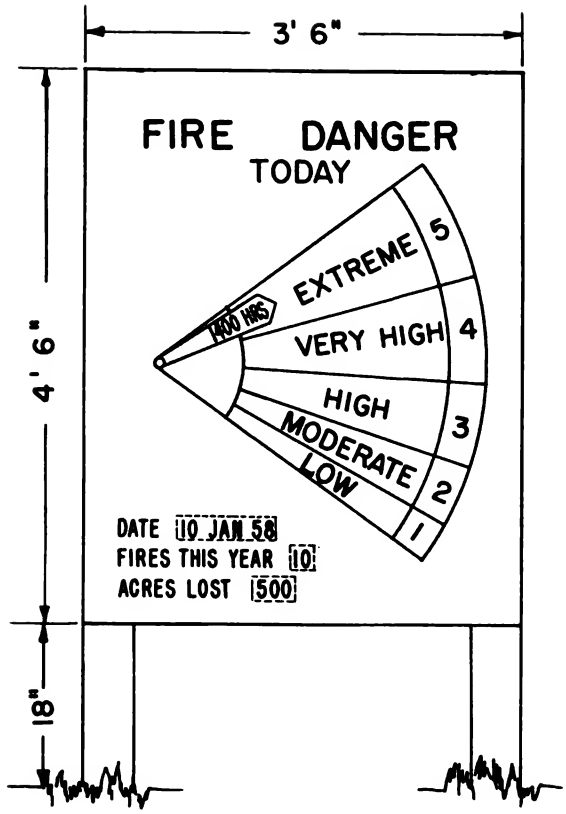
(1) *The fire lookout tower.* Erection of lookout towers is justified when the protection of the timber is in the national interest, and other means of detection (towers and observation aircraft of other agencies) are not available. The tower is usually a steel structure with an inclosed cab (fig. 15) high enough to enable the lookout to see for 15 miles on all sides. Topography and weather will influence

Table II. Correlated Fire Danger Ratings for Continental United States

	Basic Fire Danger Classes				
	1	2	3	4	5
1. Locality		Adjective Ratings			
a. Central and Lake States	Safe to very low.	Low	Moderate	High	Very high to extreme.
b. U.S. Forest Service Regions 1 and 4	Low	Moderate	Average	High	Extreme.
c. Region 2	Dormant	Low	Moderate	High	Extreme.
d. Region 5	Low	Moderate	High	Very high	Extreme.
e. Region 6	Low	Low	Moderate	High	Extreme.
2. Meter Model		Burning Index			
a. 8–0	1–2	3–11	12–35	36–99	100–200.
b. 8–100–0	1	2–5	6–17	18–47	48–100.
c. 8–1955	1–20	21–35	36–50	51–70	71–100.
d. Lake and Central States	0–3	4–6	7–12	13–24	25–100.
e. R–2 and R–3	0–15	16–40	41–65	66–85	86–100.
f. R–5	0–5	6–11	12–18	19–26	27–100.
g. R–6	1b	1a	2–15	16–35	36–100.
This area, Pacific Northwest, has 10 danger classes.	1	1	2, 3, 4	5, 6	7, 8, 9, 10.

Table III. Minimum Dispatch Requirements (Southeastern United States)

Off season (June, July, August)	Early and late seasons (January, February, September, December)	Peak season (March, April, May, October, November)
Class 1, 2, and 3 days	*Class 1 and 2 days*	*Class 1 and 2 days*
1 equipment operator 3 firefighters 1 tractor plow 1 pickup w/handtools	1 fire boss 1 tractor plow 1 equipment operator 3 firefighters 1 pickup w/handtools	1 fire boss 1 tractor plow 1 equipment operator 6 firefighters transp. w/handtools
Class 4 and 5 days	*Class 3 day*	*Class 3 day*
As for peak season	1 fire boss 1 crew boss 12 firefighters 1 tractor plow 1 equipment operator	1 fire boss 2 crew bosses 12 firefighters 1 tractor plow 1 equipment operator transp. w/handtools alert 2 support crews
	Class 4 and 5 days	*Class 4 and 5 days*
	As for peak season	1 fire boss 2 crew bosses 12 firefighters 2 tractor plows 2 equipment operators 1 support crew transp. w/handtools alert 2 additional support crews



SPECS
YELLOW BACKGROUND; BLACK LETTERS
HOURS, DATE, FIRES, ACRES IN EXCHANGEABLE UNITS

Figure 14. Daily fire danger board.

the range of vision. One for 30,000 acres is normally the minimum. Rugged topography may make a tower necessary for an area as small as 10,000 acres. Consult the State forester for design, spacing (with relation to existing towers), and operation.

(2) *Firefinder.* This is the instrument used by the lookout to determine location of fires. Most standard types consist of an alidade mounted to swing over a circle that is divided into 360°, oriented with zero at true north (fig. 16). Consult the State forester on the appropriate type for local conditions.

(3) *Aircraft.* Use aircraft, including helicopters, to the extent feasible to locate fires, transport materials, and direct suppression. Direct two-way air-ground radio communication is essential.

(4) *Ground patrols.* Ground patrols are most valuable at small installations without lookout or aircraft coverage, or when smoke prevents tower or aerial observation. Use of two-way radios is essential.

(5) *Fire protection grid map.* This is a map of the installation and its environs on which are shown military grid lines, or latitude and longitude at 0°05′ intervals (fig. 17). Each block formed by these lines is identified by a number in the upper left-hand corner. A lookout or patrol with the maps before him may report the location of a fire to the dispatcher who has identical maps. A transparent overlay fire location grid (fig. 18) is convenient to more accurately identify the location of a fire. This location grid is identical in size to a block on the grid map and should be placed over the appropriate block. The report to the dispatcher is, for example, in block 666 G3.

Figure 15. Fire lookout tower.

Figure 16. The firefinder.

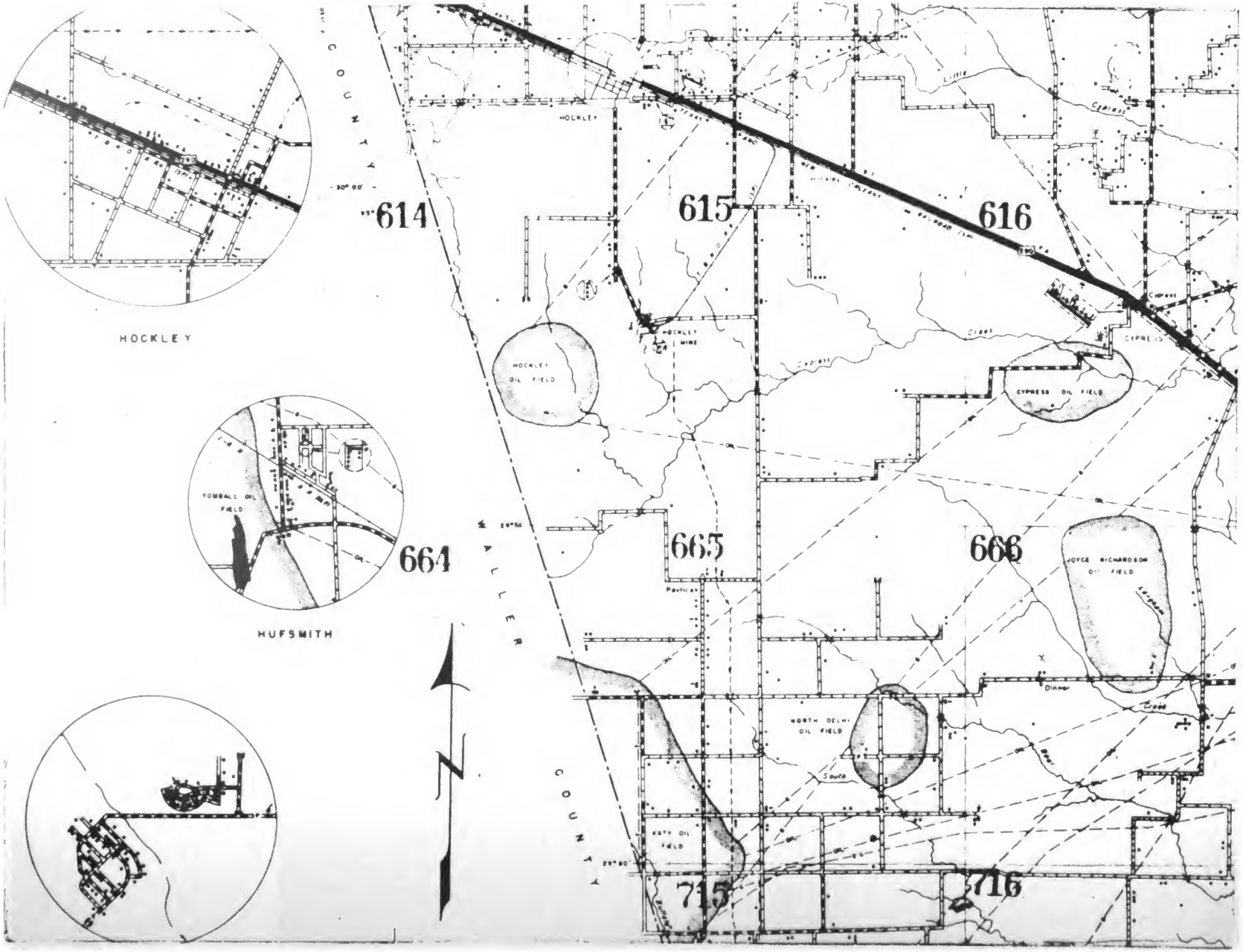


Figure 17. Fire protection grid map.

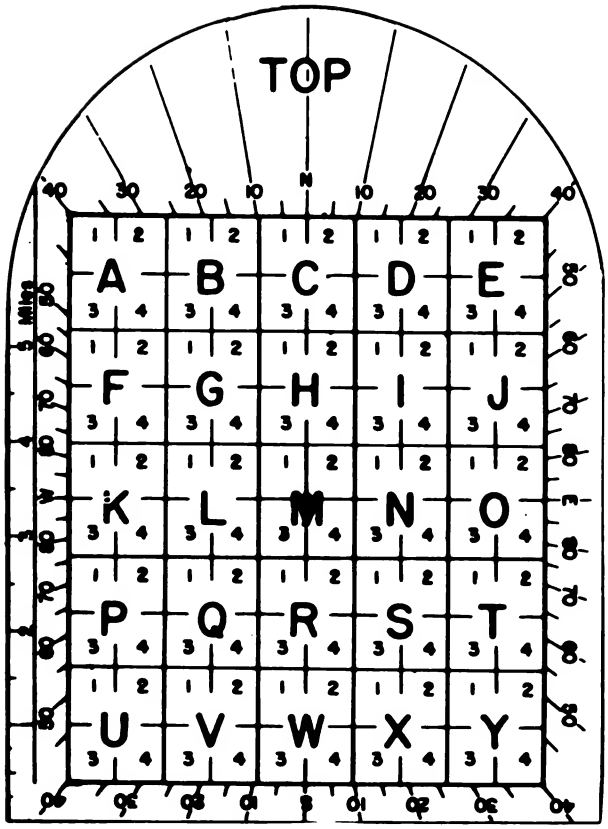


Figure 18. Fire locator grid.

(6) *Plotting map.* Azimuth readings are necessary to locate fires in large areas of forested land. Two or more lookout towers are required.

(*a*) *Preparation of map.* Use a grid map ((5) above) with 1″=mile scale. Mount the map on fiberboard and place vertically. Place a paper 360° azimuth circle at each tower point centered on true north. Make a small hole with a metal sleeve at each tower point and thread a fine cord through each hole. The cord should retract with a weight or spring behind the map. The other end (map side of the cord) has a glass-headed tack fastened to the map.

(*b*) *Use of map.* Stretch each cord in the direction and beyond the fire, as reported by telephone or two-way radio from each tower. The intersection of the readings of two or more towers will show the location of the fire (fig. 19). Use the grid ((5) above) to report the location to the fire boss, or higher authority. Operation of the plotting map is normally by the dispatcher. Where a number of smokes are visible at the same time from the towers, be sure that the lookouts are observing the same smokes.

h. Firebreaks and Trails. Assure that all parts of a military installation are accessible to firefighting equipment and personnel. Firebreaks not only slow up fires but may be used as trails to reach inaccessible areas. A system of trails and firebreaks provides greater military use of the installation (fig. 20).

(1) *Construction.* Firebreaks are not normally effective in stopping fires, especially during period of high danger hazards. A 20-foot width permits use of most firefighting techniques including backfiring and may be considered a minimum width for permanent fireguards. Greater widths may be necessary adjacent to highways and other hazardous areas. A patrol road may be adequate as firebreak; in some areas both may be required (fig. 21). Figure 22 illustrates a V-type pusher, and figure 23 illustrates fireguard construction. Burning a firebreak may be more economical than plowing in some woodlands. When burning is used, follow the procedure described for prescribed burning (19*d* (5)).

(2) *Maintenance.* Disk harrows with two or four 3-disk sections are suitable for use as fire-line maintenance. Alternate plowing with the disks set to throw the soil toward and then away from the centerline is necessary. Selective herbicides can be used also in firebreak maintenance.

(3) *Erosion control.* Plowed or burned fireguards and those treated with soil sterilants are not practicable in some areas because of hazards from soil erosion. On plowed or burned areas, maintain low-growing, succulent, erosion-resisting vegetation. (See NAVDOCKS Design Manual 5 and TM 5–630.) Vegetated firebreaks require grazing or mowing. One or two annual mowings normally are adequate.

Figure 19. Locating fire at intersection of readings.

Figure 20. Fire-line construction using heavy fire-line plow.

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Figure 21. Boundary-type firebreak, including patrol road and tilled ground.

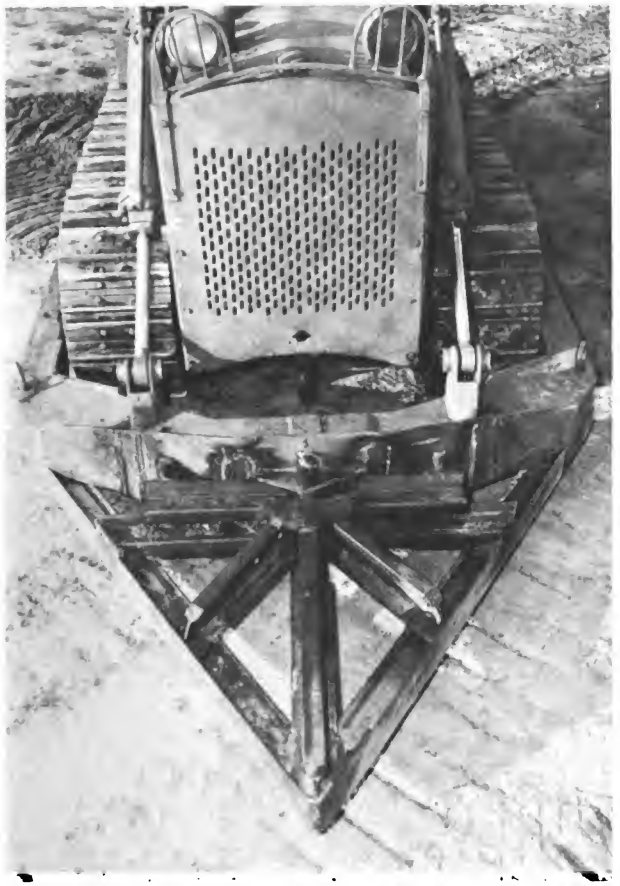

Figure 22. V-bar tree pusher for opening fire lines through dense sapling and small pole stands.

i. Equipment and Vehicles (*see also* app. III).

(1) *Transportation of personnel.* Provide adequate transportation for equipment and personnel to the fires. Use ½-ton, four-wheel drive pickups or "jeeps" for fire boss, crew bosses, scouts, and messengers. Use ¾-ton pickups to haul three- to six-man crews with handtools. Provide a protective canopy to guard against tree branches. Use 1½-ton trucks, with protective canopy for hauling up to 20 men with handtools.

(2) *Transportation of equipment.* For light tractor-plow units, use stake and platform trucks (2½-ton, 6 x 4). For medium weight tractor-plow units and bulldozers, use cargo trucks (5-ton, 6 x 6) with special loading skids. For heavy tractor-plow units and bulldozers, use tractor trucks (2½-ton, 6 x 6; or 4–5-ton, 4 x 4) with special high-low semitrailers or lowboys.

(3) *Tank trucks.* Use small trucks (either fixed or slip-on tankers) with four-wheel drive to permit travel on unimproved roads and trails. They are used chiefly for holding backfires and mopping up. About 180-gallon tanks may be used by securing them to flat-bed trucks. Crawler tankers may be improvised for difficult terrain by mounting two 50-gallon rectangular tanks on carriers over the tracks of light crawler tractors. Equip tractors with pumps, bumpers, radiator guards, lights; and protective brush guards for the operator, tanks, and hose connections. Provide 50 feet of discharge hose in hose racks on tank trucks.

(4) *Fire-line plows.* Use tractor-plows for firebreaks rather than handtools wherever the terrain and soil depth permits. These plows are mobile, efficient, and economical. The two-disk plow, with coulter and plow point mounted on wheels for towing behind a tractor, is the most common type (figs. 24 and 25). Equip tractors with heavy bumpers, radiator guards, rear winches, protective armor underneath, brush guards for the operators and lights (front and rear). Design bumpers to prevent saplings and poles from fouling the tracks. Use wide-track shoes on soft ground.

(*a*) On sandy soil, grass cover, light brush, and the like, use light plows (350 pounds) pulled by crawler tractors with 4,000 pounds drawbar pull. Wheeled tractors with or without auxiliary tracks (fig. 24) may be substituted where light ground cover exists. Transport with 1½-ton trucks equipped with loading skids.

(*b*) On loam soils especially in longleaf-slash pine, loblolly-shortleaf and ponderosa pine types, and in average pine reproduction areas, use middle weight plows (500 pounds) pulled by crawler tractors with 8,000 pounds drawbar pull. Transport with semitrailers.

Figure 23. **V-bar tree pusher at work.** *(This tractor is also pulling a fire plow. A brush guard for the driver is lacking.)*

Figure 24. Loading light tractor with fire plow attached. (Note supplemental track.)

(*c*) On clay or muck soils, dense pine undergrowth, and heavy underbrush, use heavy plows (1,000 pounds) pulled by crawler tractors with 10,000 or 15,000 pounds drawbar pull. A V-bar may be substituted for bulldozer blades on these units (fig. 22). Transport in low-bed trailers.

(5) *Bulldozers.* Since bulldozers are generally available at military installations, they form a valuable reserve of fireline building equipment. The angledozer is better than the straight bulldozer for most sites. Equip units, where practicable, with lights (front and back), protective armor underneath, winches, and shields for the operators. Powered road graders may also be used in light soils and light brush.

(6) *Pumping equipment.* Portable pumps are used for filling tank trucks when a source of water is close to the fire, or on the fire if water supplies are nearby. Power is supplied by two-cycle or four-cycle engines. The four-cycle requires less repair and is easier to start under difficult conditions. Both gear and centrifugal pumps may be used. Use strainers on the intake suction hoses operated in reservoirs and ponds where foreign material is present. See reference 13, appendix I, for discussion of portable power-pumping equipment.

(7) *Handtools.* Keep fire tools sharp, handles tight, and store them in accessible dry places. Inspect and recondition them after each use. Treat tool handles to protect them against powder-post beetles. Mark handtools distinctly, store them in clearly designated locations, and use only for fires (fig. 26).

(*a*) *Ready tools* may be stored in a central place from which attack forces start, or placed in toolboxes at key points on the installation. Provide toolboxes with tools for 6, 12, or 24 men, and so label. Use boxes which are weather tight and mounted on truck-bed height platforms for ready loading. Seal boxes with car seals; never lock them.

Figure 25. Loading a D–4 unit with two-disk plow attached. (Note 20-inch shoes on tractor.)

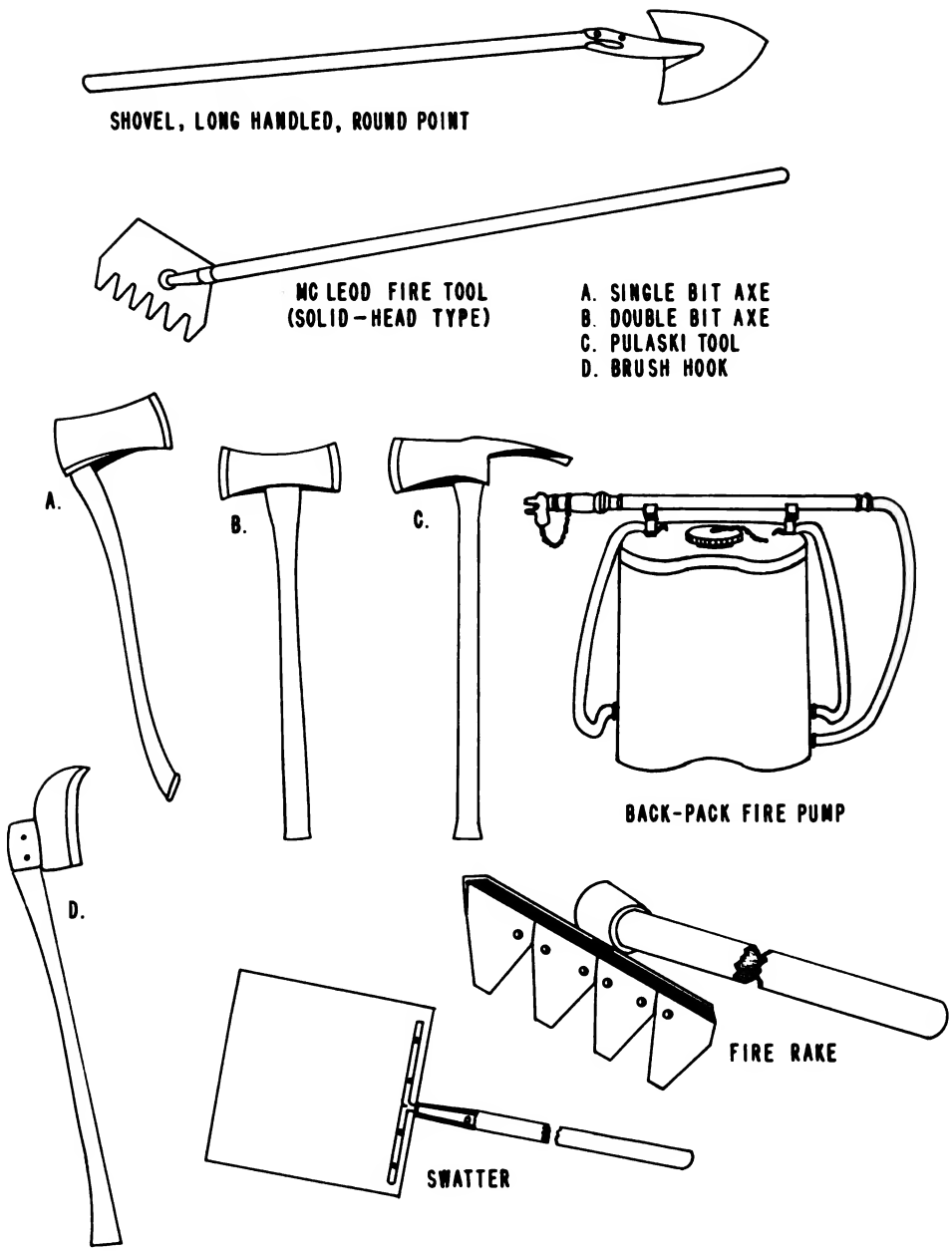

Figure 26. Handtools in general use for forest and grass-fire suppression.

Show location and quantities of tools stored in the fire protection plan.

(*b*) *Reserve tools* may be stored in central location.

(*c*) *Selection of tools.* See tables IV and V for guides in selection of handtools. See reference 13, appendix I, for descriptions of typical handtools.

Table IV. List of Fire Tools for Use With Tractor—Plow Units

	Crew size		
	6 men	12 men	25 men
Axes, double or single bit	1	2	4
Hooks, brush	1	1	3
Saws, crosscut or power	1	1	1
Shovels, LHRP	1	2	6
Pumps, backpack	2	4	8
Rakes, fire	2	4	8
Torch, drip	1	1	2
Hats, hard	6	12	25
Lights, electric	6	12	25

Table V. List of Fire Tools for Use by Handline Crews

	Crew size		
	6 men	12 men	25 men
Axes, double or single bit	1	2	4
Hooks, brush	1	2	4
Saw, crosscut or power	1	1	1
Shovels, LHRP	2	4	8
Rakes, fire	4	8	16
Swatters [1]	4	6	12
Pumps, backpack	2	4	8
Torch, drip	1	1	2
Hats, hard	6	12	25
Lights, electric	6	12	25

[1] For use only where grass fuels predominate.

23. Suppression

Fire suppression includes locating and reporting the fire, transportation of personnel and equipment, extinguishing and containing the fire, and mopping up to make certain the fire is out. Fire is rapid chemical combination of fuel, heat, and oxygen (fig. 27). Suppression is accomplished by altering or revising one or more of these elements (fig. 28). To cut off oxygen, smother or beat out the flames. To reduce temperature, cool by applying water or soil, and by separating the burning fuel from the unburned fuel. To remove or cut off the fuel supply, make a barrier around the fire. Stop the fastest moving part of the fire first.

Figure 27. The fire triangle.

Figure 28. Breaking the fire triangle.

a. Characteristics of Forest Fires. Forest fires have characteristics which materially influence their suppression.

(1) *Variety of fuels.* Vegetative fuels include dry grass, standing timber, dense brush, needles, leaves, deep duff, dead roots, and stumps (fig. 29). These fuels may burn for many days, some underground, and break out later to start new fires.

Figure 29. Surface fire burning in brush protecting a watershed.

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(2) *Convection columns.* Vertical air columns develop where extensive areas of heavy fuel exist. Whirlwinds, blowup, crowning (fig. 30) and long-distance spotting occur under these conditions. It is important that all fires be extinguished before they cover large areas.

Figure 30. Typical crown fire.

b. Safety Precautions.

(1) *Stay alert.* Plan the attack and know where the fire is. Continually plan escape routes to assure personnel safety. Remember the suppressed quiet-appearing fire may be dangerous. For escape, use burned-over areas and streams or gravel bars where available. Fires tend to move uphill in daylight and downhill at night. Do not move men ahead of a fire. If necessary to jump through a fire, be sure the men cover faces with hats or coats. After reaching the escape spot, dig foxholes if necessary and post a lookout for rolling logs or falling snags. Make men stay close to earth and keep damp cloths over faces to prevent suffocation. Watch for rolling embers on hillsides (fig. 31).

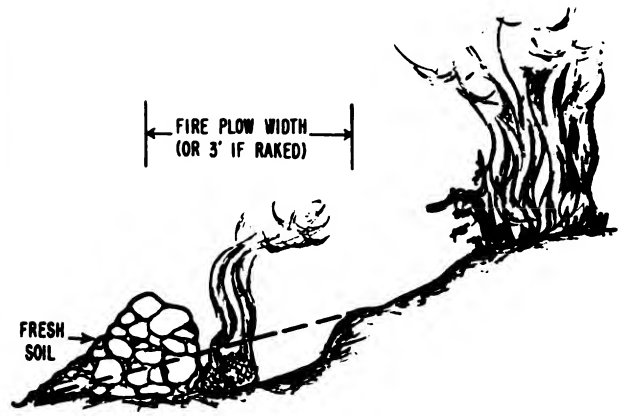


Figure 31. Hillside fireline construction designed to stop rolling embers.

(2) *Work as a team.* Keep the crew together. When making an escape, retain all handtools and move as a unit.

c. Fire Tactics. Vary the details of fire tactics according to fuel, topography, wind, humidity, and availability of personnel and equipment. The following basic tactics are normally applicable.

(1) *Small fires (5 acres or less).* If fuel is light and water is available from tankers or backpacks, attack the head of the fire from inside the burn (fig. 32). On stronger fires, start at the heel of the fire, knock down the flank or one side, cross the head with a fire line, then knock down the opposite flank. In making the line, use the most efficient tools available (handtools, fire plow, bulldozer). Make the shortest line possible; avoid sharp angles and pronounced crooks. Develop line 2 to 6 feet wide. Chop out and remove all logs, snags, or roots. A mixture of water and fire retardant such as bentonite cascaded by Navy torpedo bombers converted to carry special 400-gallon tanks has been successful in holding, cooling, knocking down spot fires, and for laying a line in advance of a

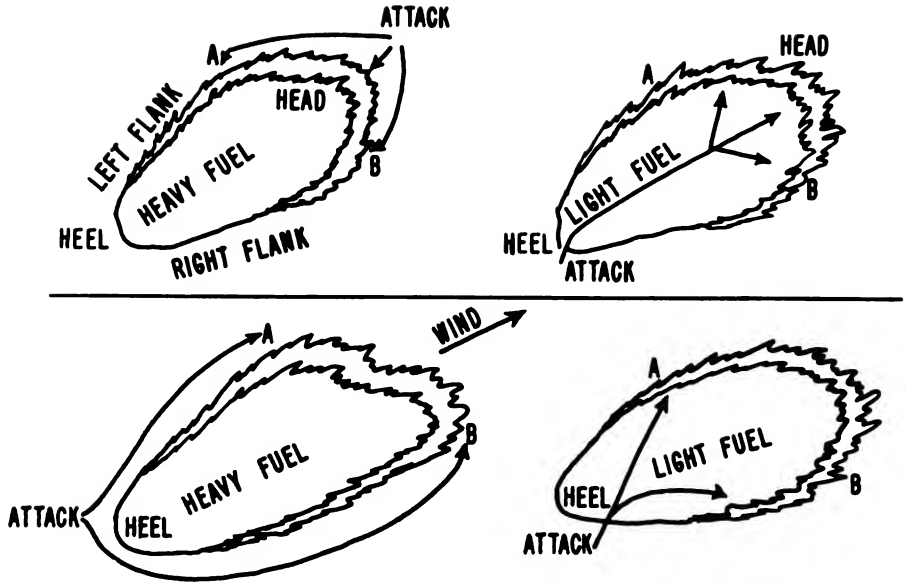


Figure 32. Small-fire tactics.

fire. Lightweight bags with fire retardant and water mixtures may be used from helicopters. Coordinate use of tankers and heilcopters with suppression ground crews.

(2) *Large fires (over 5 acres).* Use tractor plow or bulldozer units as illustrated in figures 33, 34, and 35.

(*a*) *One tractor-plow or bulldozer unit* (fig. 33). Plow from road or unloading point to anchor point *A*. Do not attempt to hold this line but move men to head of fire. Plow a control line (anchor points *A* to *B*) far enough ahead of fire to permit backfiring to burn an area of 50 or more feet, more under severe burning conditions. Hold plow at anchor point *B* until backfires have successfully held the line. Plow new fire line if first is unsuccessful. When head fire is controlled, plow flank *B* to *C* and backfire, then backfire *C* to *A*. A three-man crew is satisfactory for this operation; tractor driver is fire boss; second man follows the plow and sets the backfire; third man uses backpack pump and shovel or rake to control the backfire. Mop up after the fire is controlled.

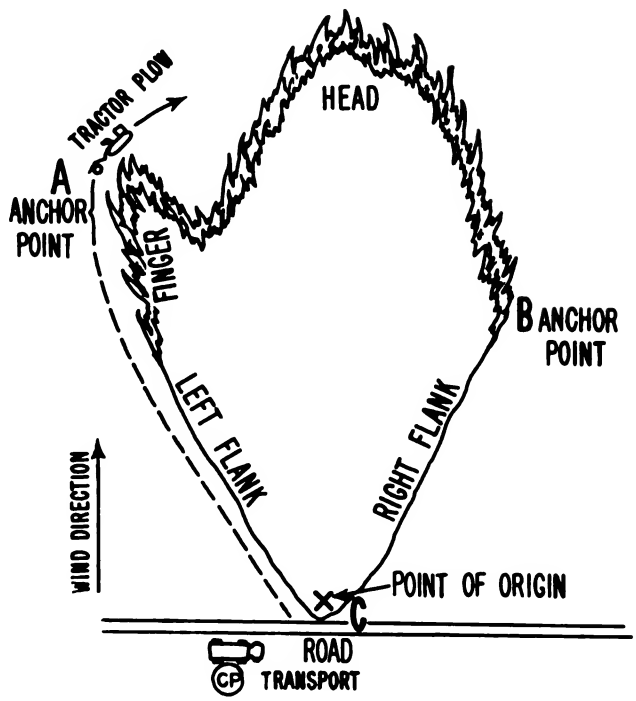


Figure 33. Tactics when only one tractor-plow unit is available.

(*b*) *Two tractor-plow units.* The tactics are similar as in (*a*) above. Use plows and crews as illustrated in figures 34 and 35. The second tractor plow is used to plow a safety line from an-

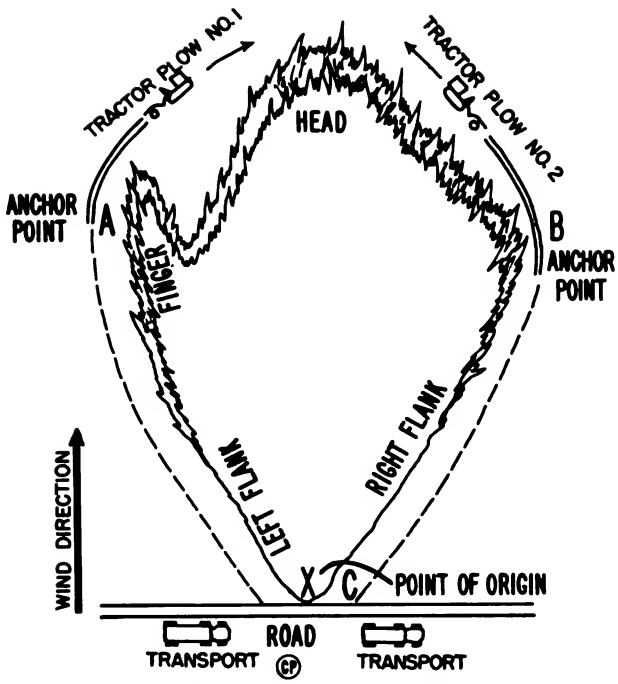


Figure 34. Tactics when two tractor-plow units are available.

chor point *A* to *B*, or to move in from the right flank, depending upon the terrain or size of fire. Use a three-man crew with each plow as shown for the one tractor-plow.

(*c*) *Handtools without tractor-plows.* See figure 36 for procedure to use. The line locator, line cutters with axes, brush hooks, power saws; line rakers with rakes, Pulaski tools, hoes and mattocks; backfiring man; and line holding unit with backpack pumps, rakes and shovels; follow each other in sequence ahead of the fire from anchor point *A* to *B*. The line-cutting unit normally clears an area 6 to 8 feet in width of brush, tall grass, logs, and other debris. The line raking unit develops a line about 2 feet in width. Locate the line far enough ahead of the fire to protect the crews from heat and smoke. Good linemaking requires coordination of each function. Each man removes only a part of the material on the ground with one or two strokes, then moves forward. The last man in the line preceding the backfiring man thus reaches mineral soil. The crew boss stays just behind the backfiring man to inspect the line and to control the rate of line firing. The line-holding unit protects the backfire and controls spot fires. A tank truck is useful to the line holding unit. When the head fire is under control, attack the flanks in the same way.

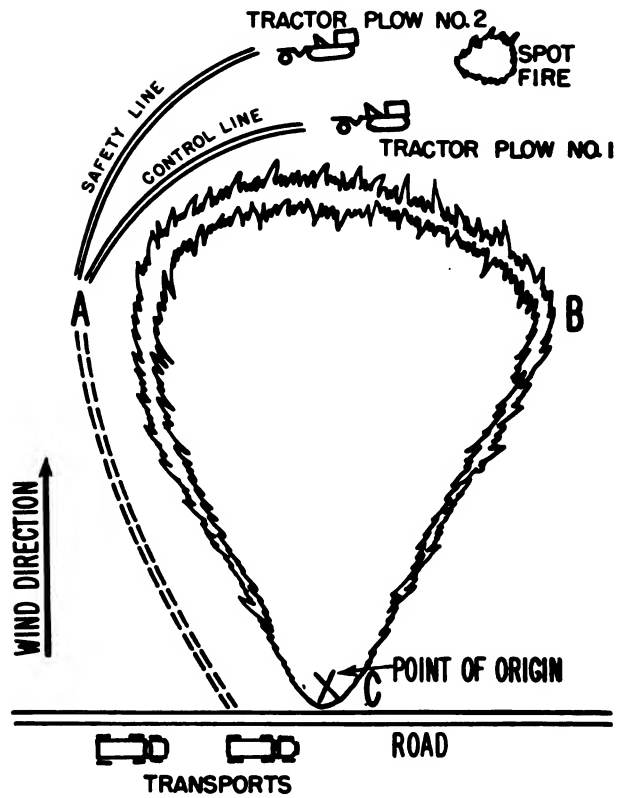


Figure 35. Alternate tactics for use of two tractor-plow units.

(3) *Grass fuels.* In tall grass use procedures described in (2) above. More leadtime is required for grass fires since rate of spread is high. In low or sparse grass, backfiring may not be necessary. Use swatters and water on the fire.

(4) *Backfiring.* Backfiring is one of the most useful tools available, but is dangerous if used by untrained personnel (fig. 37). The procedure consists of setting fire along the inner edge of a control line to burn into the wind and toward the head fire (fig. 38). Foresters fusees and drip torches are available for this purpose. A

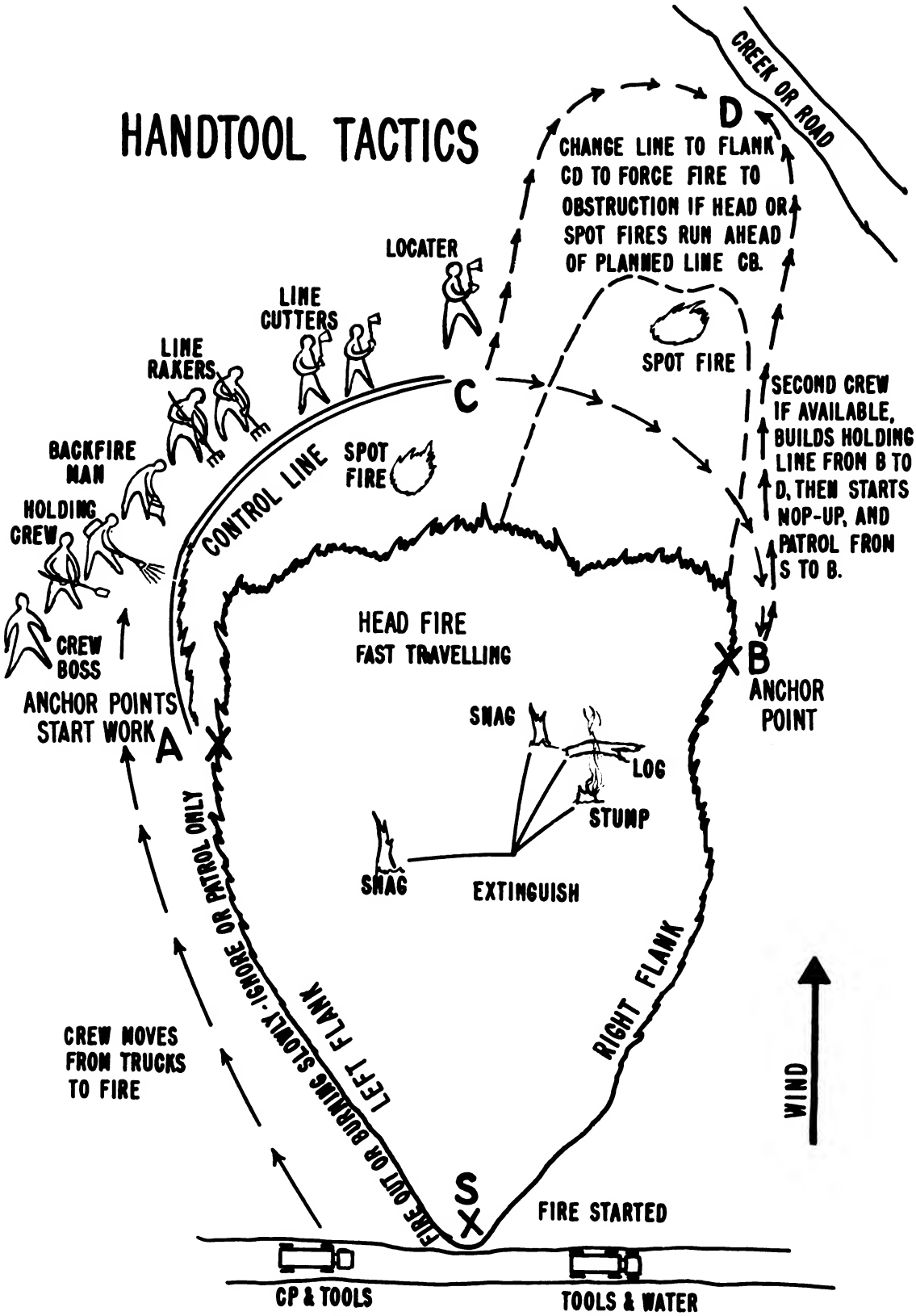


Figure 36. Handtool tactics.

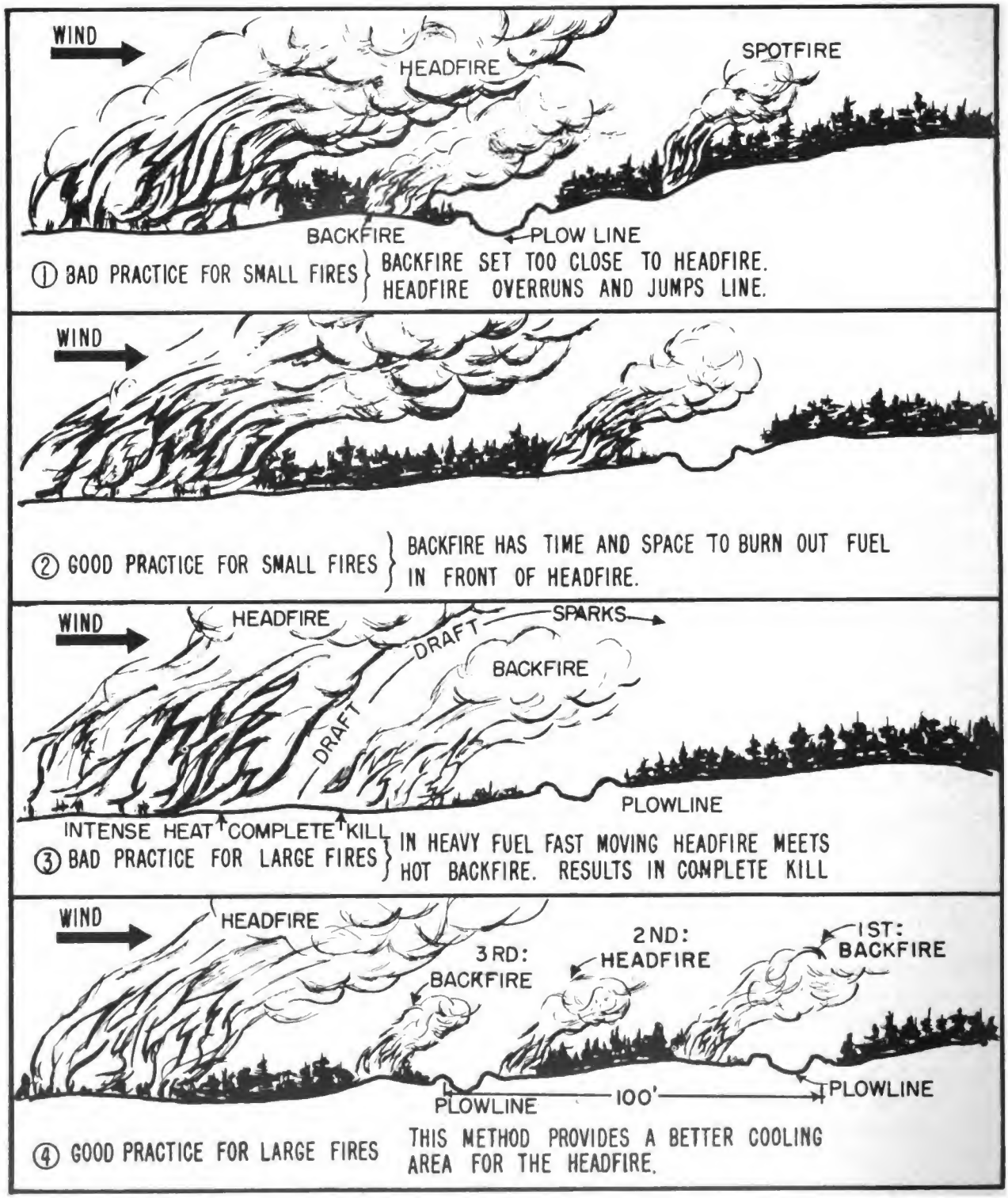


Figure 37. Good and bad backfiring.

Figure 38. Backfiring against headfire in an indirect attack maneuver supported by freshly plowed firebreak.

good backfire burns out the fuel in front of the head fire in time to prevent sparks from being thrown across the prepared line where the two fires meet. Patrol areas burned by backfiring to insure against breakout if the wind changes.

Section III. PROTECTION AGAINST INSECTS, DISEASE, AND OTHER ENEMIES

24. Insects

a. Preventive Measures. Use varieties of trees which are resistant to insect attack.

b. General Control Measures. Insect control methods do not, as a rule, exterminate the species. In order to plan for the most effective and economical control measures and to obtain authorization to use controlled and nonstandard insecticides, insect control programs should be planned with the assistance of the Army Command or Navy District entomologist. Control measures include—

(1) Cleanup practices and disposal of refuse products to reduce insect populations.
(2) Control by insecticides, and dipping nursery stock as described in TM 5-632 and NAVDOCKS—TP-PU-2.

c. Specific Control Measures. Department of Defense Standards require that insect and rodent control measures be performed only under the supervision of trained and certified personnel. Effective control of forest insects requires careful scheduling and often involves the use of insecticides not carried in local stock. Therefore, expected requirements for insect control measures should be brought to the attention of the trained and certified supervisor as early as possible.

25. Diseases

a. Diseases. Some diseases have wide distribution and are continuing to increase their range. Other diseases, such as brown spot needle disease, seem to be sectional. Typical wood-destroying fungi are redheart (*Trametes pini*) and stump rot

(*Polyporos schweinitzii*). If the disease is not recognized, send specimens to the nearest Forest Experiment Station for identification and control recommendations.

b. Control Measures. Remove diseased trees by thinning or sanitation cutting. Other control measures follow:

(1) *Fusiform rust of southern pines.*
- (*a*) Restrict use of native pines to favorable sites.
- (*b*) Maintain high stand density.
- (*c*) Avoid cultivating and fertilizing.
- (*d*) Remove branches that have live galls within 15 inches of the main stem.
- (*e*) Remove trees with stem galls unless to do so would open the stand too much.

(2) *White pine blister rust.* Destroy the alternate hosts (currants and gooseberries) for at least 900 feet from white pines, and eradicate European black currant for at least 1 mile in every direction. Destroy infected nursery stock.

(3) *Brownspot needle blight* (Scirrhia acicola) *on longleaf pine seedlings, and occasionally on other southern pines.*
- (*a*) Use a prescribed burn during the winter when the plants are 3 years old. Try to scorch each seedling to total height, or a maximum of 4 feet. Repeat at 2-year intervals until height growth is well started.
- (*b*) In planted stands, and other areas where burning is not possible, spray with Bordeaux mixture at 2-week intervals, May to October. Mix a fresh batch for each spraying and use the 4–4–50 formula:

  4 pounds copper sulfate
  4 pounds hydrated lime
  50 gallons water
  2 pounds fishoil soap

(4) *Littleleaf disease.* This serious local enemy of shortleaf pine is most common in Alabama, Georgia, and South Carolina.
- (*a*) Cutting may reduce losses.
  1. Remove all diseased trees each 10 years if infection is light.
  2. Remove all diseased trees each 6 years when the infection is heavy (over 10 percent of the stand).
  3. Remove all infected trees as they become merchantable if the infection is noted in more than 25 percent of the stand.
- (*b*) In high value stands where infection is light, fertilize each acre at 4-year intervals with 1,000 pounds of 10–6–4, plus 1,000 pounds of ammonium sulphate. This expensive treatment is rarely justified.

(5) *Dutch elm disease and phloem necrosis.* These are diseases of the American elm and other native elm species. Since the elms are of minor importance as timber crop trees, they should be removed from the timber stand as rapidly as possible whether or not infected or mature. Such action will destroy possible sources of infection for nearby ornamental trees of the same species.

26. Livestock

a. Where hardwoods are the predominant crop, exclude livestock completely. Livestock prevent regeneration of desirable timber species, damage good trees by browsing, and their trampling may inhibit reproduction.

b. In the longleaf-pine type, exclude hogs if possible. Range hogs eat the pine seedlings and prevent reproduction. Hogs are difficult to control partly because of long-established local custom. Success will depend on developing agreements with hog owners.

c. In other conifer types, light grazing by cattle (only) may be justified. Maximum stocking in any case should not exceed 1 head to 40 acres.

27. Destructive Animals

Damage to woodlands by most forms of wildlife is minor and may be ignored.

Exceptions:

a. Deer. Deer cause damage where their protection has permitted excessive populations to develop.

(1) *Damage* results from the deer browsing on the growing trees, eating seedlings of desirable species, and trampling seedlings.

(2) *Control* requires reduction in herd population, either by regulated hunting or by trapping and removal. Close cooperation and coordination with, and approval by, the appropriate State game agency is necessary for all hunting and trapping practices aimed at herd reduction.

b. Porcupine. Eliminate, or at least reduce, the population by yearlong hunting.

c. Beaver. Beaver are destructive on some reservations and are a growing threat on others. Recurrent removal of the beaver by trapping is the only control and must be done by, or with permission of, State and Federal game agencies. Destroy their dens if the State law permits.

d. Other Destructive Animals. Control measures for the control of other destructive animals is described in TM 5–632 and NAVDOCKS TP–Pu–2.

28. Trespass

On military installations unauthorized cutting of timber is minor in occurrence and extent. Some thefts occur where the timber is good and the property line is not well marked.

a. The best preventive is to clearly identify the property lines. Patrols at irregular intervals further discourage theft. Investigate signs of recent log skidding and truck or wagon tracks entering the installation. Require all wagons and trucks moving forest products across or out of the installation to carry a permit, or other evidence of authorization to be on the installation, together with proof of legal title to the products being hauled.

b. When legal action becomes necessary in case of timber trespass, prepare evidence which will stand up in court. Include estimates of the volume removed, the stumpage and sale values of the stolen timber, and the dollar and volume losses of growth projected to planned year of harvest. Such evidence must be obtained by a professional forester.

CHAPTER 4

SILVICULTURE

Section I. OBJECTIVES

29. General

a. Silviculture is the science of producing and tending a forest, and the theory and practice of controlling forest establishment, composition, and growth.

b. In an unmanaged forest, there is a continuous loss of valuable wood in trees that die of old age, trees killed by fire and disease, and trees unable to survive the competition for food and moisture. By applying silviculture, the volume otherwise wasted is reduced by utilization, and more trees of greater volume and better quality reach maturity. The goal of silviculture is to raise net production until it coincides with total volume growth.

Section II. FOREST REGIONS

30. Northern Region

a. In the Northern Region (fig. 39), the once widespread white- and red-pine forests have been reduced by severe cutting and fire to extensive areas of aspen and jack pine.

b. The desirable crop species for military installations of this region are hemlock, red pine, white oak, black walnut, sugar maple, and black cherry. White pine will be considered a crop tree only where growing on top-quality sites, reseeding abundantly, and not in competition with red pine. It is good practice to replace aspen with pine (spruce on poor sites) by release cutting and by planting.

c. Fire occurrence is low, although the region at one time suffered many disastrous fires. Mopping up is more difficult and costly than in the South.

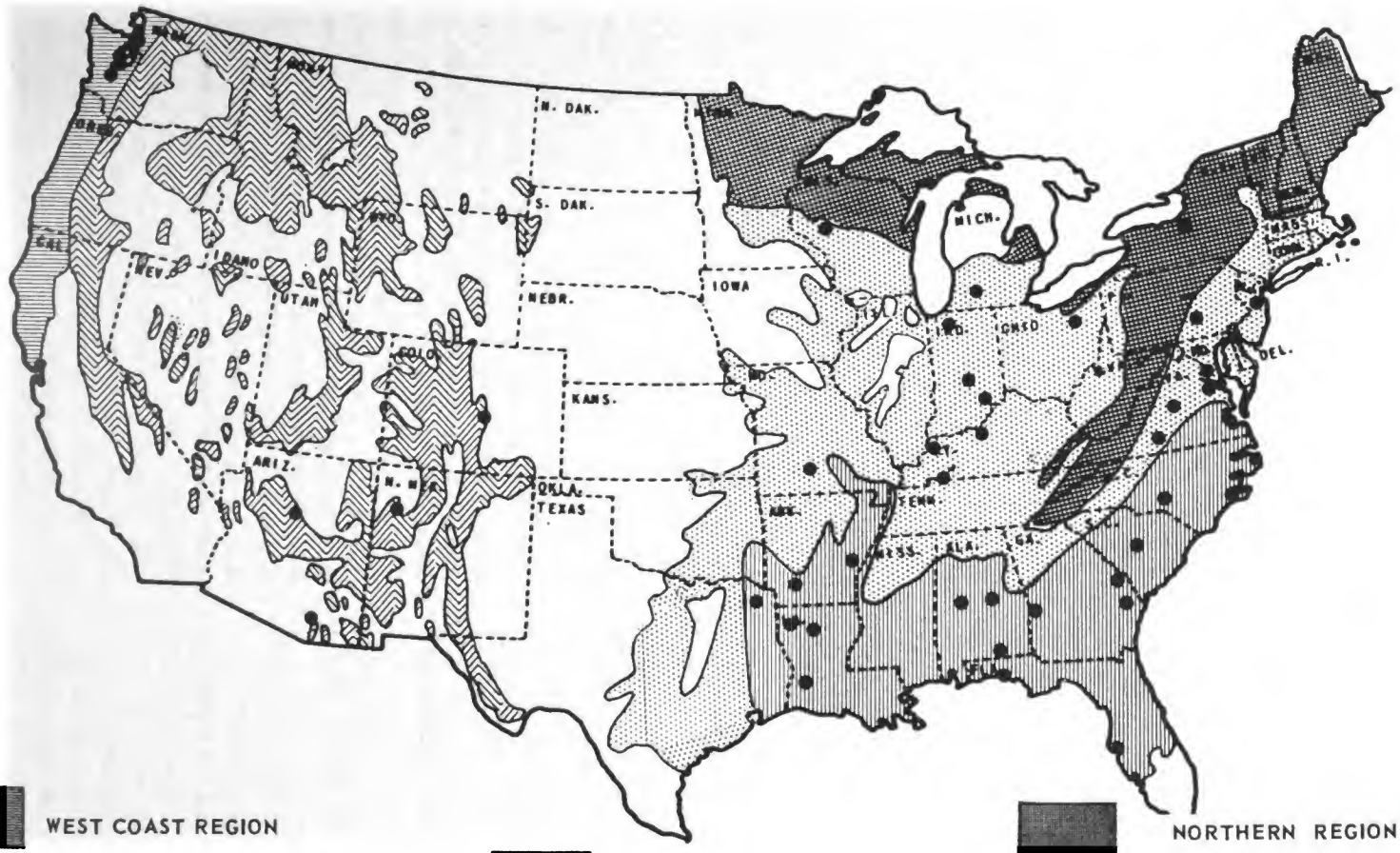
d. The principal forest cover-type groups of the Northern Region are—

Type groups and forest cover types	Principal associated species
White-red-jack pine	White, red, jack pine; hemlock; quaking and bigtooth aspen; paper, yellow, and gray birch; red maple; and northern red, white, and chestnut oaks.
Spruce fir	Red, black, and white spruce; balsam fir; hemlock; northern white-cedar; and red maple.
Aspen birch	Quaking and bigtooth aspen; paper birch; pin cherry; red maple; and gray birch.
Maple-beech-birch	Sugar maple; beech; yellow birch; elm; basswood; ash; northern red oak; black cherry; paper and sweet birch; and hemlock.

31. Central Region

a. In the forests of the Central Region (fig. 39) there are two major type groups for management purposes: the oak-hickory and the oak-pine. Red oaks are the principal oak species, although white oak occurs. The principal conifers are shortleaf, pitch, white, and Virginia pines and eastern red cedar. On the better sites, white oak, cherry, black walnut, and yellow poplar may be grown. The principal type group of the bottom lands is elm-ash-cottonwood. The stands are in a period of recovery from past cutting and neglect. Considerable stand improvement work to remove cull trees and trees of undesirable species is necessary. Cuttings to improve composition and quality are standard practice. Regeneration is usually by selection system, either single tree or group.

b. Fire occurrence is low, fortunately, since the hardwood forests are easily damaged by fires.



WEST COAST REGION

Douglas fir; western hemlock; redwood; western red cedar; Sitka spruce; sugar pine; lodgepole pine; incense cedar; white fir; Port Orford cedar; and others.

WESTERN REGION

Ponderosa pine; Idaho white pine; western larch; Engelmann spruce; Douglas fir; lodgepole pine; sugar pine; western red cedar; western hemlock; white fir; and others.

CENTRAL REGION

Northern portion - oaks; hickories; ashes; elms; maples; beech; black walnut; pitch; shortleaf and Virginia pines, cottonwood; and others.

NORTHERN REGION

Red, black and white spruces; balsam fir; white, red, jack and pitch pines; eastern hemlock; maples, oaks, beech birches, aspen.

SOUTHERN REGION

Longleaf, shortleaf, loblolly and slash pines; southern oaks; red gum; hickories; southern cypress; eastern and southern red cedars; and others.

Figure 39. Forest regions of continental United States.

c. Forest insects and diseases are of minor importance and usually damage individual trees rather than whole stands or species.

d. The principal forest cover-type groups of the Central Region are—

Type groups and forest cover types	Principal associated species
Oak-hickory	Black, post, scarlet, chestnut, northern red and white oaks; hickories; black locust; maples; sweet gum; yellow poplar; and beech.
Oak-pine	In addition to the above, shortleaf, pitch, white and Virginia pines; and eastern red cedar.

32. Southern Region

a. In the Southern Region, the longleaf-slash pine of the coastal plain and the shortleaf-loblolly pine of the Piedmont are the principal type groups for management purposes (fig. 39). Many hardwood types occur along the streams and in the swamps.

b. The principal crop species are the pines—longleaf, slash, loblolly, shortleaf. In some areas, Virginia pine, pitch pine, and pond pine form stands of such extent as to require crop tree management. In the bottom lands, cypress, sweet gum, Shumard oak, cherrybark oak, and swamp white oak are desirable species.

c. Three inhibiting factors characterize the region and have led to widespread use of prescribed burning as a corrective.

(1) *Brownspot needle disease* of longleaf pine.
(2) *The dense understory* of undesirable hardwood species unfavorable to development of pine species.
(3) *The high incidence of wildfire* which is reduced by periodic fuel reduction.

d. Selection management and timber stand improvement (par. 36) are used where prescribed burning is ineffective or hazardous to the crop species. Herbicides are used to eliminate the unmerchantable, undesirable trees, *except* when density of the undesired understory requires removal by mechanical eradication (bulldozers and special brush-cutting equipment).

e. The principal insect enemies are the turpentine beetles Dendroctonus and Ips which damage merchantable pine timber.

f. Markets are good for sawtimber and pulpwood. Thinning of young even-aged stands for pulpwood is a common practice. Planting techniques are well established; old fields and similar open areas are usually machine planted. Naval stores operations, once widespread, are now confined largely to the longleaf-slash pine areas of southeast Georgia, north Florida, and the gulf coast.

g. The principal forest cover types of the Southern Region are—

Type groups and forest cover types	Principal associated species
Longleaf-slash	Longleaf, slash, loblolly pines; bluejack, blackjack, southern red, laurel, willow and water oaks; sweetgum; hickories; black and tupelo gums; magnolia; red maple; and bay.
Loblolly-shortleaf pine	Loblolly, shortleaf, Virginia pines; southern red, black, scarlet, white oaks; sweetgum; hickories; red maple; and blackgum.

33. Western Region

a. The variable elevations of the Western Region (fig. 39) result in many vegetation types extending from the desert areas to timberline. The area is characterized by low rainfall.

b. The principal silvicultural practices are directed toward the extension of old-growth timber by partial cuttings and the regeneration of overmature stands.

c. The region has only a summer fire season, usually June through September. Most fires are caused by lightning. The area, in general, is relatively inaccessible, making fire control difficult.

d. Disease problems are minor, consisting principally of Cronartium rust on lodgepole pine, white pine blister rust, and mistletoe on ponderosa pine.

e. The principal cover types are—
Engelman spruce—subalpine fir
Interior Douglas-fir
Ponderosa pine
Western White pine
Lodgepole pine
Pinyon pine—juniper

34. West Coast Region

a. The timber of the West Coast Region (fig. 39) consists chiefly of old-growth Douglas-fir, redwood, and associated species.

b. The main problems are fire, the regeneration of old-growth stands, and the development of practices for intermediate cuttings in the second-growth stands.

c. The only important disease is white pine blister rust in the sugar pine stands in southern Oregon.

d. Fire hazard is high. Logging increases the hazard by adding quantities of flammable slash. Regeneration of Douglas-fir requires removal of this slash by burning. July and August are the most dangerous fire months. Fires may occur in other months, but rains lower the hazard and permit slash disposal under competent direction and State approval.

e. The principal cover types are Sitka spruce, Western hemlock, Western red cedar, Pacific Douglas-fir—Western hemlock, Redwood, and Ponderosa pine—sugarpine—fir.

35. Alaskan Region

The forests of Alaska (fig. 40) are divided into the coastal forest of southeast Alaska and the interior forest.

a. The coastal forest is similar to that of the West Coast Region. It occupies a mountainous belt of high rainfall about 50 miles wide from the coast to the Alaska Coast Range. The timber consists mostly of western hemlock and Sitka spruce. Fire occurrence is low. Regeneration is by clear cutting in blocks, leaving blocks of seed trees, without slash burning. Current harvests are of virgin timber; there are no young or middle-aged stands and partial cutting is impractical. The principal cover types are Sitka spruce, Western hemlock, Sitka spruce—western hemlock, and Western redcedar—western hemlock.

b. The interior forest is similar to that which extends across Canada. It is composed mostly of white spruce and Alaska white birch with black spruce and cottonwoods in areas of low rainfall and permafrost. There are scattered bodies of merchantable timber, but much of the forest is classed as unmerchantable due to the extensive destruction by uncontrolled fires. Markets for local use are developing slowly. Methods of management are not yet established. Principal cover types are White spruce, White spruce—birch, Poplar—birch, and Black spruce.

Section III. SILVICULTURAL PRACTICES

36. General

Each forest region must receive specific silvicultural treatment. Lack of markets for some products, or high logging costs, or large proportions of low value species, will restrict management practices. Thinning young hardwood stands for pulpwood is impractical in some regions because of poor markets, excessive costs, or unsuitable species, but thinning young pine stands, is a profitable practice where pulpwood is in demand as in the Southern Region. Because of these differences, it is necessary to prescribe silvicultural practices in general terms. Develop locally in each woodland management plan modifications suitable to the region. The principal practices applicable to military woodlands are intermediate cuttings, harvest or regeneration cuttings, timber stand improvement, and reproduction.

37. Intermediate Cuttings

Cuttings aimed at improving the existing stand are known as intermediate cuttings. It is sufficient here to recognize three types:

a. Thinning. A thinning is a cutting in an immature stand to increase its rate of growth, to foster quality growth, to improve composition, to promote sanitation, and to aid in litter decomposition (fig. 41). Begin thinning when the dominant trees reach the minimum diameter of 4 inches if a fencepost market exists, or 5 or 6 inches if no stem smaller than pulpwood is to be utilized.

(1) *Crown thinning.* Remove the least promising dominants and codominants that are competing with more promising individuals of these classes. Few, if any, trees in the lower crown classes are merchantable, but the stand will stagnate or have a high mortality if not thinned.

Figure 40. Forest regions of Alaska.

Figure 41. Young longleaf pine woodland thinned by its first timber crop (pulpwood). Area is now suitable for maneuvers and bivouac.

(2) *Low thinning.* This type anticipates natural thinning by marking from below. Remove overtopped trees having merchantable value as well as unpromising intermediates, lower grades of codominants, and others the removal of which will provide better growing space for the remaining dominants and codominants.

(3) *Quality thinning.* Select for retention crop trees in the sapling and small pole stands and cut the competing trees. Frequently a band of blue paint or other distinctive mark is placed on the crop trees to be retained throughout the rotation. This intensive practice is not justified for military woodlands except for mobilization reserve species (par. 4*d*).

(4) *Selection thinning (also known as the Borggreve method).* Remove dominants which show wolf-tree tendencies and overtopped trees which have a conversion value. Do not remove choice clean, slender-stemmed trees that retain sufficient crown to continue into the dominant class (fig. 41).

(5) Use the following guides to select "cut" and "leave" trees.

(*a*) *Basal area guide.* Basal area is an expression of area in square feet of breast-high cross section for individual trees or for all trees above a designated minimum diameter in one acre. Sound judgment and experience are the best marking guides. Keep the trees of good quality in the dominant position and utilize the growing space to its full potential. Either reduce basal area to 70 or 80 square feet per acre, or maintain the basal area of the dominant and codominant trees at approximately the same figure as the site quality index; for example, 100 square feet of basal area on site index 100. Timber markers may not readily visualize the basal area they are leaving and must check from time to time

by use of the angle gage or other device for plotless cruising.

(*b*) *Diameter guide.*

1. In young stands, the spacing and number of stems may progress from the spacing used in planting seedlings to the spacing and number of stems indicated when the basal area goal is first applicable (when the stems average 8 inches in diameter). If average area allotted per tree in planting is a mil-acre and if the basal area per acre goal is 75 square feet when the stems average 8 inches or more in diameter, then the radius of the circular area occupied per tree would be as follows:

Size of tree	*Radius of area occupied (feet)*
Seedling	3.7
2 inches DBH	4.3
4	5.5
6	6.7
8	8.0
10	10.0
12	12.0
14	14.0
16	16.1
18	18.1
20	20.1

2. For trees from 7.0 inches DBH up, a wedge prism or angle gage with a basal area factor (BAF) of 75 would be used; for smaller trees the the distance can be readily measured. Distribution of stocking areawise is important. This is done by classifying points as either stocked or not stocked. The points may be distributed systematically over the area in question. Only points stocked with dominant or codominant trees of suitable quality are considered satisfactorily stocked. Other stems within the stocking radius are tallied by number to provide the estimate of excess basal area. The goal is one dominant or codominant tree per point, using a BAF 75 prism. If an appreciable proportion of points are stocked with two or more equally dominant trees, overstocking is indicated and thinning is prescribed. If the average diameter increase of dominants and codominants is known approximately, the prospective stocking in 5 or 10 years can be estimated by use of the wedge prism and the cutting cycle determined. If, in a fast-growing stand that is is satisfactorily stocked currently, the expected diameter growth is such that more than a third of the sample points will be occupied by two or more dominant trees in 5 years, thinning should be done in 5 years.

Note. **When distribution of stems is taken into account, the goal of 75 square feet of basal area may correspond to at least 100 square feet of total basal area on a plot tally when distribution is not taken into account.**

b. Improvement Cutting. Improvement cutting is made in a stand older than the sapling stage, usually to start improvement of wild stands being placed under management. It involves the removal of only those unwanted trees which are of sufficient size to provide the material for merchantable products. Types of trees removed in addition to undesired species include: diseased trees, those mechanically injured, unthrifty trees likely to die during the first cutting cycle, insect infested trees, and those of poor form (forked, crooked). Improvement cuttings and thinnings in a compartment are usually concurrent operations.

c. Salvage Cutting. These cuttings remove dead or injured trees to utilize them before they become worthless. Salvage timber promptly following tornado blowdowns, severe fires, or attacks of insects or diseases. If extensive areas are damaged, keep as seed trees those deemed most likely to live. It is often difficult to judge whether or not fire damaged trees will die, but in the South particularly, make the decision immediately after the fire. Fire-damaged individual trees are likely to die if—

(1) The fire occurred in late spring or summer rather than winter.

(2) The intensity of the fire was great enough to create a "gray ash" appearance rather than a blackened appearance of the ground.

(3) More than half of the crown was scorched.

(4) More than half of the bole was charred to a height of 10 feet or more.

38. Harvest Cuttings

This is any cutting designed to remove the mature and overmature trees in the stand and facilitate regeneration of desired species. There are four primary types of harvest cuttings:

a. Clear Cutting.

(1) *General.* Clear cut where trees are overmature or diseased or dying, or to change the species composition of the forest, or to rearrange the age classes. (New construction requires clear cutting, but this is not a silvicultural practice.) Clearcut areas are reseeded either by natural reseeding from adjacent uncleared areas, from tops of trees cut, or by artificial reseeding. Extensive clearcut areas are usually seeded or planted artificially. It is best to run a hot fire over the area to remove grass and debris, then seed or plant as soon as the ashes are cold. Schedule plantings during the most desirable planting season. If harvesting is finished too late to plant during the first season, defer burning until late the following summer. Fire will usually aid germination of seed from natural regeneration. However, if it will destroy the seed, omit the fire.

(2) *Shape of cut.*

(*a*) *Clear cutting in strips.* The strips should be not less than 1½ times wider than the height of adjacent dominant trees nor more than 2 times wider. Regeneration is from windblown seed. The strips left in standing timber should be equal in width to the clear-cut strip. Cut strips up the slope in hilly country to make logging easier, and at right angles to major wind direction on the flat lands. The standing trees on the uncut strips should be windfirm, else the loss from windfalls may exceed the economies gained in this practice.

(*b*) *Clear cutting in patches.* Patches or blocks are generally preferred in big timber country, such as Douglas-fir stands in the Northwest. This method is of particular value in protecting mountainous areas against erosion and mass denudation, and for salvage cutting to remove trees damaged or killed by fire or insects.

b. Seed Tree Method. Seed tree silviculture is of value on military installations when areas of woodland must be cleared for use as new firing ranges and impact areas, motor parks, and bivouacs and the period of use may be for 10 years or less. Seed trees left during that period may produce seedlings of desired species which will result in a new timber crop after the period of destructive use is over. Seed tree value is indicated by the number of seedlings around a tree (fig. 42). The seed trees may be left standing singly, or in groups of 6 to 10 if soils or species favor windthrow. If groups are used, leave 4 to 8 groups per acre in trees 8 to 12 inches in diameter. When seed trees are left singly, base the number to leave per acre on:

DBH class	Desired number per acre	Point value for mixed diameters
10″ (9–11)	30	3⅓
12″ (11.1–13)	10	10
16″ (13.1–18)	7	14¼
18.1″ and over	4	25

Any combination of number of trees per acre times the point value totaling 100 points provides a satisfactory number of seed trees.

c. Shelterwood. The basic principle of the shelterwood system is the gradual removal of the timber crop by a series of partial cuttings over a period which is a fraction of the rotation, but long enough to obtain the desired reproduction. It is a modification of the seed tree method, using large numbers of seed trees rather than a few. Shelterwood is one of the more complex methods of silviculture, best applied to even-aged stands and begets even-aged groups. It is best adapted to heavy-seeded, particularly the broadleaf, species which benefit from light shade during and immediately following the germination period. Southern pine species require full exposure to sun for seed germination and initial growth; the true shelterwood system cannot be applied. Ponderosa pine reproduces abundantly under partial or complete shade.

(1) There are three stages to shelterwood management:

(*a*) *Preparatory cutting.* To prepare for reproduction, cut below the dominant and codominant stand and remove 25 to 40 percent of the trees. The remain-

Figure 42. Longleaf pine seed tree.

ing trees grow better crowns and become more windfirm and decomposition of the litter is hastened. If cutting is too heavy, grasses and weeds may move in. The preparatory cutting (one or more) is unnecessary if thinning is practiced at regular intervals.

(*b*) *Seed cutting.* Make only one seed cutting to provide reproduction and remove 25 to 50 percent of the remaining stand. This cutting is made just after the seeds mature in a good seed year. Logging serves to work the seeds into the humus and mineral soil. Remove smaller trees, those of relatively low vigor, and those of very large size which would destroy too much reproduction if allowed to remain until the "removal cutting."

(*c*) *The removal cutting* harvests the remaining old trees in one or several operations, the last of which is the "final cutting" which may not be made for many years.

(2) Pure shelterwood does not provide the most economical processes of forest management. As the situation requires, combine the various steps each time a scheduled cutting cycle is marked.

d. Selection. This method calls for the removal, annually or periodically, of the trees which have reached rotation age. It is particularly suitable for military woodlands. The theoretical selection forest is all-aged with proportions of each age class from 1 year old to rotation age. Actually, this condition seldom exists, but practical application of this type of cutting may be modified to fit local conditions. For best results, harvest cutting, thinning, and improvement cutting are combined in one operation. Each area is cut over once every cutting cycle (which may be any period from 5 to 12 years as local growth rate dictates). The openings made by removal of the mature trees permit reproduction but the removal of the mature tree may not provide sufficient open space. If removal of surrounding trees does not provide at least ¼-acre open area, remove sufficient additional trees to obtain it.

39. Timber Stand Improvement

This is, broadly, the release of young trees of desirable species, generally under 4 inches DBH, from the competition of brush and overtopping by undesirable tree species. It differs from the other described types of silviculture in that the trees removed are unmerchantable for one reason or another.

a. Timing. Accomplish the work before the overstory destroys the ability of the desirable trees to recover.

b. Procedure. Use the following procedures to kill low value hardwoods.

(1) *Chopping* is useful when the tree can be removed by less than four blows of a sharp ax. Include trees and shrubs of larger diameter when motor-powered circular saws are available. Followup

treatment of the stumps with poison is desirable.

(2) *Girdling* is usually confined to trees over 10 inches DBH. Trees of that size seldom sprout after girdling and, therefore, do not require poisoning. Completely sever the bark and cambium layer and cut into the sapwood at least one-half inch preferably in mid-April through June. Some species, particularly sweet and black gums, may not die for several years following girdling.

(*a*) *Ax girdling.* At a labor wage of $1 per hour, girdling will cost at least 7 cents per tree of 10-inch diameter, and more for larger trees.

(*b*) *Machine girdling.* One man with a machine is about twice as fast as a man with an ax. A complete unit weighs about 35 pounds and is carried on the operator's back. Labor, travel, maintenance, supervision, and equipment depreciation costs will be about 3 cents per tree. Machinemade girdles, being narrow, are more easily bridged by new growth than are ax girdles. The treated area of all girdled trees under 12 inches DBH should receive an application of ammonium sulfamate or 2,4,5-T as discussed under "Poisoning."

(3) *Poisoning.* Tree poisons are more effective than girdling. Observe strict safety precautions and clean equipment carefully after each use. Once equipment has been used to mix or dispense any of the poisons, do not use it for any other purpose as even the best washing may not remove the poison. Containers will be adequately labeled, giving the composition of the contained material and manufacturer's instructions for handling and storage. Supervisory personnel should be familiar with the precautionary measures recommended by the manufacturer and should consult the responsible medical officer for more detailed information on the safe use of specific poisons. Only authorized personnel will have access to herbicides. For additional information, see TM 5–630. Use a red fruit dye in all liquid silvicides to mark the trees that have been treated.

(*a*) *Ammonium sulfamate* is best known by the trade name "Ammate." Normally considered to be relatively nontoxic to humans, wildlife, or livestock, prolong contact may cause minor skin irritation. It is dangerous when heated to decomposition or on contact with acid or acid fumes, it emits highly toxic fumes of oxides of sulfur. It is used either as purchased in the dry crystalline form or as a solution in mixture with water. To prepare the solution use 2 pounds of crystals to 1 gallon of water. Always use stainless steel or protectively coated equipment. Principal use is for control of beech and hickory.

1. Crystalline form. Use one heaping tablespoon per notch, in notches cut 6 inches apart at the root collar. On small trees that were cut with two or three ax strokes, place one heaping tablespoon of crystals per tree.

2. Liquid form. Apply to larger trees in frills made by overlapping ax cuts which cut through the bark into the sapwood; on small stumps, wet the top of the stump thoroughly.

(*b*) *2,4,5-Trichlorophenoxyacetic acid (2,4,5-T)* is used alone or in combination with 2,4-Dichlorophenoxyacetic acid (2,4-D). This herbicide is relatively nontoxic to men and animals, but is dangerous when heated to decomposition. Prolonged contact may cause skin irritation. Both are noncorrosive, giving them some advantages over ammonium sulfamate. Both are marketed as concentrates, to be diluted for use with water, kerosene, fuel oil, or diesel oil. Select the proper diluent based on proposed use. Poisoning is most effective if done during the months of April through June in most woodland areas. Eighty percent kills within 2 years are considered successful. The following three methods are in common use:

1. Dilute 16 pounds of acid equivalent (usually 4 gallons of commercial concentrate) in 100 gallons of diesel fuel oil when applying in frills.

2. For a basal spray, dilute 12 to 16 pounds of acid equivalent in 96 gallons of diesel fuel oil or kerosene.
3. For an aerial spray use 1 to 2 pounds, acid equivalent 2,4,5-T ester in 2½ to 8 gallons diesel oil per acre to hardwoods which overtop pines or spruces. Evergreens must be hardened off before applying spray. August is usually the best period.

(4) *Prescribed burning.* This is an economical procedure for reducing or eliminating (in some cases) undesirable broadleaved brush and tree species. Do not use it where hardwood species are the principal crop. The method assists in the control of brownspot on longleaf pine, and in the germination and establishment of new pine seedlings (by seedbed preparation, and by opening seed bearing burrs on the ground). Instructions are given in paragraph 19*d*(5).

(5) *Pruning.* Trees in understocked stands and in plantations do not prune themselves as a rule. Those in dense stands prune naturally while the tree diameters are small. Pruning of small trees, whether naturally or by mechanical means, will improve the quality of timber produced. However, the expense is not justified for all species. Conifers that will produce high-quality products and a limited number of special product hardwoods may benefit from pruning. Hardwood limbs over 2 inches in diameter should not be pruned. Good sites are a prerequisite for pruning. High value in such species is usually associated with large size and clear wood (no knots). Such trees may require wide spacing and several prunings. Pruning directions follow:

(*a*) *Do not prune all the trees.* Select not to exceed 150 to 200 per acre of the most promising trees that can be expected to survive to become crop trees. All others are to be removed in early thinnings or will die by suppression.

(*b*) *Make first pruning* to a height of 10 to 16 feet, retaining 50 percent of total tree height in crown.

(*c*) *Make second pruning* 3 years later to a height of not over 20 feet, retaining at least 40 percent of total tree height in crown.

(*d*) *Prune in one operation*, if delayed until the selected trees are 35 to 40 feet tall.

(*e*) *Prune* during winter months.

(*f*) *Cut all branches*, whether dead or alive, flush with the trunk when pruning.

(*g*) *Do not injure the trunk.*

(*h*) *Do not leave stubs, or ragged edges to wounds.*

(*i*) *Use a special pruning saw* (curved blade) with pull stroke.

40. Reproduction

a. Natural Seeding. This is the most economical method of reproducing the woodland if seed of the desired species is or will be abundant within a year or two of the time scheduled for reproduction. Many of the conifers valuable to national defense, including the southern pines, ponderosa pine, and Douglas-fir, will reproduce readily on mineral soil seedbeds. Just prior to the ripening of the seed of these species, prepare a suitable seedbed that will expose mineral soil. Possible procedures include—

(1) Logging with tractors when their operation will expose enough mineral soil to serve as a seedbed.

(2) Burning the area just prior to logging to remove all excess fuel, litter, and debris. The winter prior to logging is the most practical time for a prescribed burn.

(3) If the processes in (1) and (2) above are not feasible, disk the area with a tractor-drawn bush-and-bog harrow just prior to logging, or bulldoze strips to mineral soil after logging is finished.

b. Coppice. Although many of the present forests in the Central Region are of sprout origin (coppice) and many of the hardwoods are reproduced by sprouting, the size and quality of the products grown by this method do not meet the objectives of military woodland management. Except in unusual circumstances do not use the coppice system. In hardwood forests of coppice origin, effort should be directed to changing to a shelter wood or selection system.

c. Planting. Restrict reforestation to land that needs artificial regeneration, and sites that are po-

tentially suitable for commercial timber and not required solely for military use.

(1) *Selection of sites.* Do not plant areas which are needed for purposes incompatible with tree growing (tank parks, bivouac areas, wildlife food plots, etc.). Typical areas for planting are open fields, areas dominated by undesirable species and capable of growing better species, understocked areas, and former impact areas. (Decontamination must be complete to insure safety of planters.) Soil-site factors should be carefully evaluated before planning an area for planting.

(2) *Species.* Selection of species to plant depends on the forest region, the adapted species most needed for defense purposes, and the species available. Do not plant if proper stock is not available. Place orders a year or more in advance to assure the species desired.

41. Planting Methods

a. Planting Young Trees.

(1) *Stock.* Use the kind, size, and age of stock best adapted to local soils and climate. One-year-old seedlings, identified as 1–0 stock and ranging from 9 to 12 months in actual age, normally are used in the Southeastern States. In other areas seedlings 2 or more years of age (2–0, 3–0, etc.) may be used or transplants (1–2, 2–1, 2–2, etc.) may be necessary. The older the stock, the higher the initial cost. Wildlings dug from nearby woodland may be used, but the practice is costly and results are usually unsatisfactory.

(2) *Care of planting stock.*

(*a*) Protect planting stock in transit against overheating and breakage. This normally is the responsibility of the producer. If the installation provides the transportation from nursery to planting site, follow the nurseryman's advice on necessary care in transit.

(*b*) After the trees are delivered, take every practical precaution until they are planted, to prevent loss from overheating, drying out, or other causes. *If they will be held only 2 or 3 days,* leave in the bundles, soak well, and stack in a shady, cool, well-ventilated space. Keep bundles moist. *If necessary to hold more than 3 days,* place the bundles in cold storage at 35° constant temperature with not more than 35 percent relative humidity. If this is not possible, open the bundles and heel the stock in a V-trench that is deep enough to permit covering the roots well without curling them. When planting starts, place the trees in buckets or planting trays for transportation. Keep the roots continuously moist with wet moss, water, burlap, canvas, or other suitable material until planted.

(3) *Site preparation.*

(*a*) Little or no preparation is required before planting abandoned fields and pastures, unless underbrush or tall grasses are present to interfere with growth and survival or with planting equipment. Remove interfering material by scalping or by burning over the area with a hot fire not less than 30 days prior to planting. Take precautions as for any prescribed burn.

(*b*) Scalping the planting surface is most economically done by means of a fire plow, making a cut not over 5 inches in depth. Follow the contour as closely as possible to reduce the erosion hazard. Do not scalp by hand unless the area is too rough or steep to permit use of motorized equipment.

(*c*) Mulching is often desirable or essential before planting badly eroded or erosive sites such as new cuts, fills, or dunes. *If the area is small,* scatter by hand a mulch cover of pine straw, leaf litter, or grain straw to a depth of 1 to 2 inches. Where wind will remove mulch, use a suitable disk or packer to anchor it to the soil. The seedlings or seeds are then planted in this mulch. *If the area is large enough* to permit use of grain drills, prepare the soil as for a field crop and sow small grain (e.g., oats) in the fall, at the rate of 2 bushels per acre. Fertilize at the rate of 50 pounds of nitrogen per acre. Al-

low the crop to die unharvested; it should provide about 1 ton of mulch material. Plant in the mulch the following spring.

(4) *When to plant.* Plant while the stock is dormant, or not later than when just starting new growth. Soil conditions must be favorable, not wet or frozen. This season varies with various sections of the country.

(*a*) *In the West*, plant in the spring and and continue as long as soil moisture and condition of the stock permits.

(*b*) *In the Central and Northern Regions*, plant from 1 March to 1 May.

(*c*) *In the Southern Region* plant from 1 December to 15 March whenever the ground is not frozen. In some years, planting may extend into April if condition of stock and soil moisture will permit.

(5) *Planting procedure.*

(*a*) *Machine planting* is fast and economical, and is usually done by contractors specializing in this type of work (fig. 43).

(*b*) *Use hand planting with the planting bar and slit method* if machines are not available or if topography is too rough or rocky for machines. In some areas of the North and West, the mattock or grub hoe, and hole method is preferred.

(*c*) *When planting a tree:*

1. Dig the hole deep enough to prevent bent or doubled roots.
2. Set at the same depth, or slightly higher than it grew in the nursery.
3. Firm the soil about the roots.
4. Set upright with respect to the surrounding ground level, and never in a pit or on a mound.

(6) *Rate of planting.* As a basis for calculating labor and machine requirements, estimate 300 trees per man-day (8 hours) in holes in clay soils and on rough or rocky land, 800 trees per man-day (8 hours) on sandy soils and smooth land with planting bar and slit method, and 1,200 trees per machine-hour using tractor-drawn planters and 2 men.

(7) *Spacing.* Planting should allow each seedling a growing space of 60 to 70 square feet, with space enough between the planted rows to drive a log truck or fire equipment. Such spacings will require the following number of plants:

Space of plants	Trees per acre		Square feet per tree
	Required	To order[1]	
8 ft. in rows 8 ft. apart	680	700	64
7 ft. in rows 10 ft. apart	622	650	70
7 ft. in rows 9 ft. apart	691	700	63
6 ft. in rows 11 ft. apart	660	700	66
6 ft. in rows 10 ft. apart	726	750	60

[1] When ordering: Add 1 percent to indicated need, and round off to the next highest unit of 50.

b. Planting Seed.

(1) *Obtain seed of desired species* with the specification that it will have been treated to repel rodents, birds, and insects. Request the nearest Forest Experiment Station to provide their latest recommendations on which to develop contract specifications. Seeds subject to delayed germination (more than 14 days) should be soaked, stratified, or scarified, if such treatment will not affect the planting method.

(2) *Site preparation* is the same as for seedlings.

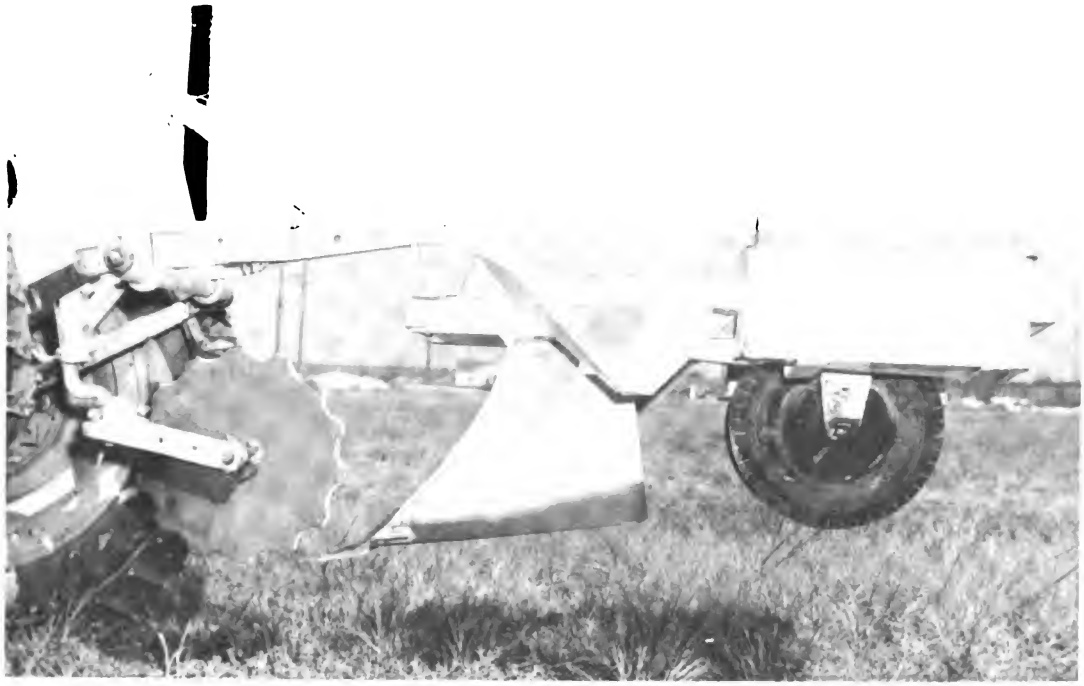
(3) *Distribute the seed* over the area by one of four methods:

(*a*) *Hand broadcasting* is suitable for small areas only, and is the most expensive since distribution is uneven and more seed than necessary is used.

(*b*) *Knapsack seeders* (*Cyclone*) are economical for areas of 10 acres or less. Speed of travel and spacing are predetermined by calibration trials in order to place the desired number of seed evenly over the open ground.

(*c*) *Aircraft* equipped for seeding are available by contract from agricultural flying services (crop dusters). For large areas this method is usually the cheapest. Apply at the rate of 30,000 viable seeds per acre.

(*d*) *Farm or garden drills* are practical where soil types and terrain permit and the area has been prepared in advance.



(1) Side view
(2) Back view

Figure 43. A tree-planting machine, tractor towed, for reforestation use.

With garden drills the seed is planted in plowed furrows at the rate of 20,000 viable seeds per acre in furrows spaced 8 feet apart. When using a farm drill on prepared land, set the planter to drop 3 seeds per linear foot in rows 8 feet apart, or 16,100 viable seeds per acre.

(4) *Plant* during the proper season for the climatic zone and according to the tree species used.

(5) *Correct depths* to plant are—

(*a*) For pine and seed of similar size, one-eighth inch;

(*b*) For acorns and walnuts, depth equal to width of seed being planted.

42. Tree Classification

a. Hardwoods are native trees that have broad leaves and, except in tropical regions, shed their leaves prior to each growing season. *Examples:* oak, ash, maple, magnolia, elm, hickory, and aspen. The term has nothing to do with the physical hardness or softness of the wood.

b. Softwoods are known also as conifers. All native species of softwoods have needlelike or scalelike leaves and bear their seed in cones. With the exception of two genera, *Larix* (larch) and *Taxodium* (baldcypress), softwoods are "evergreen."

c. Old growth refers to trees and stands that have reached or passed maturity. In addition to age and size, the principal characteristic is relatively slow growth due to intense competition for sunlight and moisture.

d. Second-growth trees and stands are those which follow, by natural processes, the original heavy cutting or a devastating fire. The term may be applied to timber stands which are in reality "third" or "fourth" growth, having developed after the removal of two or more previous tree crops. "New growth" is a more accurate description.

e. Crown classification is valuable as a gage of silvicultural behavior and the current position of trees in the stand. The following system distinguishes the eight classes which are standard for all Department of Defense military reservation timber:

(1) *Dominant* trees extend above the general level of the canopy.

(2) *Codominant* trees are not as tall as the dominants, but receive excellent overhead light, have full crowns, vigorous growth, and show no danger of being crowded out by the dominants.

(3) *Wolf* trees are distinguished by a wide-spreading crown that occupies more than its fair share of the growing space, and limbs that are relatively larger and often more numerous. The lumber quality of the stem is poor to unmerchantable because of the large knots resulting from the many oversized limbs.

(4) *Intermediate* trees have slender crowns that occupy smaller openings in the canopy, receive only a limited amount of direct sunlight, and will probably be crowded out by the dominants or codominants before reaching maturity unless released by death or removal of the dominating trees.

(5) *Suppressed* trees are definitely below the general level of the canopy and receive no free overhead light. These trees will die before the end of the rotation, or will remain stagnated making no appreciable height or volume growth.

(6) *Isolated* trees stand at a distance from other trees, have a greater height than the average dominant, and are not properly classified as *wolf* or *reproduction.*

(7) *Reproduction* is a naturally established tree seedling or sprout having a diameter of less than 2 inches DBH and an age of less than 30 years.

f. Age classification is useful in type mapping (pure stands are frequently types by age classes), volume table construction, and reports. Examples of age classification classes are—

Inclusive ages	Age classification
0–10	5
10–20	10
20–30	20
30–40	30

g. Diameter classification is useful for volume table construction, development of fire damage tables, stand descriptions, and other purposes. For example, volume tables are usually developed by 1- or 2-inch-diameter classes. The 1-inch classes are generally 4, 5, 6, and up, with each group including all trees having diameters, inclusive, of 3.6 through 4.5, 4.6 through 5.5, and so on. The 2-inch classes are generally 6, 8, 10, 12, and up, with each group including all trees having diameters, inclusive, of 5.1 through 7.0, 7.1 through 9.0, 9.1 through 11.0, and so on.

h. Form class is based on DBH, total height, and taper of bole. It is desirable to classify trees according to form in order to develop greater accuracy in volume tables. Theoretically, all trees of like form class should contain the same volume, regardless of species or locality. In practice this is not quite true due to differences in volume resulting from the kind and degree of utilization (sawtimber or pulpwood, and varying top utilization diameter) and type of volume table desired (board foot, cubic foot, peeled cord, or rough cord). Volume tables based on form class are in widespread use.

(1) *Computation.* Form class is expressed as the percentage ratio between the diameter, inside bark, at the top of the first 16-foot log; and the diameter, outside bark, at breast height (DBH). For example: a tree whose first 16-foot log has a scaling diameter (inside bark) of 15 inches and a DBH of 18 inches has a form class of $(15 \div 18) \times 100$, or 83.3 percent, which in practice is referred to as "form class 83."

(2) *Minimum form class.* Form class 65 is the smallest generally recognized in practice. Swell-butted species, such as cypress and tupelo, will have a very low form class based on DBH. To avoid this, the diameter of swell-butted trees should be measured high enough on the tree to provide a realistic form class.

i. Botanical Classification. Trees may have more than one common name, varying with locality. "Pitch pine" may be coulter pine in California, slash pine in South Carolina, or longleaf pine in Louisiana. To avoid confusion and insure accurate identification of trees and other vegetation, scientific names have been assigned to each species and variety together with standardized common names for everyday use.

(1) *The scientific name* has two or more parts: First, the generic name; second, the specific name. Sometimes it is necessary to add a varietal name. The generic name is always written first and is capitalized. The specific and varietal names usually begin with small letters. For example: all true maples have the generic name "Acer." The specific name for sugar maple is "saccharum." These two words, *Acer saccharum*, identifies it as sugar maple.

(2) *The Check List of Native and Naturalized Trees of the United States* (including Alaska), issued by the Forest Service, U.S. Department of Agriculture, as Agricultural Handbook No. 41, 1953, is a useful manual for forest tree names.

43. Wildlife Management

a. Coordination With Woodland Management. Woodland management directly affects the habitat of birds and mammals. A successful wildlife program is dependent upon close coordination of the two activities. Manage woodlands wherever practicable to provide a completely integrated program. Include description of food sources, habitat cover, and other wildlife requirements, in appropriate land or woodland management plans.

b. Food and Cover. Where clear cutting is practiced, leave small blocks of timber for cover and food. Reserve adequate forest cover near streams to moderate stream temperatures for fish, especially the cold water species. Where possible, leave den trees for such animals as raccoons and squirrels. Proper woodland marking (par. 14*b*) assures that food and nesting trees remain. In a mixed forest stand, a greater variety of food items are made available than in pure stands. Leave nut trees such as hickory, walnut, and pecan. Cultivated food plots may be provided in woodland areas for clover and other legumes, and cereal crops. Such areas are of special value for small game.

c. Water Sources. Develop small ponds and seeps to provide water holes. This is of special importance where large streams or lakes are not present. Stock spring-fed ponds with desirable fish. Keep water sources free from moss and aquatic weeds. Remove silt where necessary to maintain a year-round water source.

d. Cooperation With Other Agencies. Coordinate fish and wildlife practices with local State and Federal agencies. Obtain manuals, and other printed matter relating to the type of wildlife under management. Develop a workable public relations program to permit, where possible, hunting and fishing by residents living near the military installation (AR 210–221; and SECNAV INSTRUCTION 11015.10 of November 1962).

APPENDIX I

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APPENDIX II

OUTLINE FOR WOODLAND MANAGEMENT PLAN

1. Title

Use the title "Woodland Management Plan" followed by the name of the installation, and date forwarded for approval.

2. Contents (Center Heading)

Include a contents page listing all headings and locating them by page number.

3. Introduction (Center Heading)

a. Purpose of Plan. Prepare a statement of the purpose and objectives.

b. Location. Identify the State or territory, county or parish, important nearby towns and cities, main roads and railroads adjacent to and traversing the installation, and any wood-using industries offering potential markets for the forest products to be grown.

c. History of the Woodland. Briefly state—

(1) When and how acquired for military use.

(2) Land treatment since acquisition, including history of fires, logging, and military use.

(3) Timber harvests (since acquisition) by years, products, and volume removed; disposal method (e.g., lumber procurement harvest, sale or installation and training requirements); income from sales and harvests; and sales made to clear areas for new construction.

d. Summary. (Prepare in tabular form.) Include—

(1) Total woodland under management, in acres.

(2) Total estimated merchantable volume of sawtimber, pulpwood, and other forest products.

(3) Acres planned to be reforested.

(4) Calculated annual allowable harvest, first cutting cycle, by products.

(5) Year in cutting cycle.

(6) Estimated operating cost (protection included) for the first cutting cycle.

(7) Estimated value of products to be harvested during first cutting cycle.

(8) Acres burned by wildfire, by years (as far back as records permit).

(9) Personnel by titles and grades, available and needed.

4. Description of Woodland (Center Heading)

a. Physical and Vegetative Characteristics. Include—

(1) *Principal tree and shrub, grass, legumes, and weed species in the woodland,* listed by common and scientific name. Discuss as to relative abundance of each in relation to timber production.

(2) *Topography.*

(3) *Soils.* Discuss as to erosiveness and general fertility. (Refer to the discussion of soils in the Land Management Plan.)

(4) *Climate.* Brief written description:

(*a*) Average precipitation by month and year.

(*b*) Average dates of last killing frost in spring and first killing frost in fall.

b. Area Classification. Name and describe the distinct forest types common to the managed woodland. Show the acreage in the following manner:

Forest type (name)	Acres within type			Total
	Danger area [a]	Nondanger area [b]	Area to reforest [c]	

[a] *Danger area* is forested acreage valuable for timber production but dangerous to operate because of duds or current use as impact areas, bombing range, and the like. Include target areas cleared of all but seed trees, or with only scattered reproduction remaining. (Exclude wooded areas designated as unimproved grounds.)

[b] *Nondanger area* is that acreage which presents no current or anticipated risk from explosions, duds, bullets, and like items. Usually, such acreage may be logged at any time except during maneuvers without interfering with the mission of the installation. (Exclude wooded areas maintained primarily as landscape and windbreak plantings.)

[c] *Area to reforest* is that open area which will be reforested according to plan. Hazardous areas may be included. (Exclude open areas maintained as improved grounds.)

5. Management (Center Heading)

a. General. Explain briefly the types of timber crops to be grown and the anticipated intensity of management with resources available. Outline the duties of each individual responsible for guiding and directing a phase of the work. Tie in with item (9) of the summary.

b. Species To Be Grown. Designate by common and scientific names the species which are to be grown and managed for production. Give the reason for the selection of each. Estimate for each species sawtimber and pulpwood volume currently available.

c. Rotation. (Approximate age of species when ready to harvest as sawtimber.) Designate the rotation to be used for each timber species.

d. Cutting Cycle. (Interval planned between harvests.) State the number of years selected and give reasons.

e. Compartment and Cutting Units. Establish the administrative and regulatory subdivisions as follows:

(1) One compartment for each year of the cutting cycle when practical, considering species, rotation, acreage, yield, and topography. If the acreage and yield are small, use fewer compartments or blocks and adopt a periodic cutting cycle.

(2) Where the total woodland is less than 100 acres and the maximum possible sustained annual yield is less than 10,000 board feet, enter the entire woodland as one compartment.

(3) Within each compartment, establish cutting units of 40 to 80 acres each with easily identifiable boundaries; mark first on a contour map and then on the ground.

(4) Schedule the planned year of harvest for each compartment for the first cutting cycle.

f. Special Areas and Species, and Treatments Required.

(1) *Special areas.* Those portions of woodland requiring special treatment (bivouac and truck park areas used during maneuvers when the overhead camouflage of tree foilage is essential). These areas are never opened up in a manner which would destroy the concealment value of the cover. Designate these areas on suitable maps and prescribe their management.

(2) *Special species.* Those designated for specific purposes and management. Included are species for mobilization reserve such as white oak, black walnut, and baldcypress. Describe the management for these species.

g. Silviculture System. Define the practices to be used in growing and reproducing timber crop species.

(1) *The harvest schedule.* Specify whether annual or periodic harvests are to be made and state reasons. Indicate, by products, the approximate volume to be cut during the first cutting cycle and the basis for the estimate. Where more than one product is to be harvested, schedule the order of cutting according to type of product. *Example:* poles, lumber, ties, posts, and pulpwood.

(2) *Marking rules.* Make these rules clear and concise.

(*a*) Include size of crew, duties of each crewmember, the use of paint for marking and colors to use, where to place the marks, and how to proceed in the woods to prevent missing trees which should be marked. Define areas which should not be marked, and give other details deemed necessary.

(*b*) Name and describe trees to mark and to leave.

(*c*) Establish and explain, where applicable, the operation of a guide formula to assist inexperienced markers in thinning young pulpwood stands and immature timber.

(3) *Other silvicultural treatment.* Describe the use of prescribed burning, the removal of undesirable tree species by herbicides, girdling, and combinations of these when their use is applicable. Designate the species to be removed. Define procedures for the formulation and application of chemicals, and rules for safety. Include in schedules for applying the designated treatment, the time of year, time of day, and kind of day. Locate and schedule each type of treatment on a map. Include instructions deemed essential to proper correlation of silviculture and game management. Correlate prescribed burning for silvicultural

treatment with burning for fuel reduction (protection).

(4) *Planting.* Describe fully the planting planned for each year, identifying location, species and spacings to be used, acres to be planted, and number and age of planting stock required. Specify the time of year to plant and how to plant hand or machine and type of tool preferred). Explain reasons for planting (as opposed to natural revegetation) and for the species selected to plant. List sources of planting stock. Explain how and when to prepare and place orders. Provide an estimate of costs.

(5) *Annual work plan.* To insure proper sequence of woodland management work, prepare an annual work plan which will guide day-by-day activities during the year so far as foreseeable (par. 11).

h. Management Record System.

(1) List and describe essential maps and records.

(2) Prepare maps showing compartment and cutting unit locations, areas cut over, areas planted, and location and dates of each reported fire.

(3) Prepare file cards showing unit identification, unit area in acres, calculated allowable cut per cutting cycle, products and volume actually cut, cash returns from sales and procurement harvest, and the reforestation record.

6. Fire Protection (Center Heading)

This section is the detailed fire protection plan. *Prepare it first.* This is a separate section (or plan) for distribution to those directly responsible for fire protection.

a. General. Describe the overall approach to fire protection. Include a summary of fire protection activities and definite assignments of responsibility for each phase of the activity.

b. Categories. Fire protection is divided into three categories.

(1) *Preventiton.*

(*a*) *Annual analysis.* Include a schedule of annual inspection and analysis of fire reports for each fire season with names of board members making the analysis. State how woodland fire protection is to be improved.

(*b*) *Education.* Describe how posted signs, installation newspaper, daily orders, movies, and other devices are used to keep personnel fire-prevention-and-protection conscious.

(*c*) *Prescribed burning.* Provide burning schedules by location and time of year, describe methods and equipment to be used, and indicate relationship of prescribed burning to silvicultural treatments.

(2) *Preparedness.*

(*a*) *Organization.*

1. List personnel by responsibilities, assigned fire duties, and name, with telephone number or other means of reaching them in an emergency. This may be in narrative form or shown on an organization chart. Include the names of leaders (and alternates) and all experienced personnel considered qualified to serve as line and sector bosses and an organization chart for multiple sector fire.

2. Place in the appendix a copy of each current cooperative agreement and instructions for requesting, through higher authority, additional aid as necessary.

(*b*) *Training.* Outline training plans for both civilian and military firefighters.

(*c*) *Detection system.*

1. Describe procedure for accurately locating fires.

2. List available and required detection facilities, including—

(a) *Lookout stations*, by designation, location, ownership, height, area of usefulness, how equipped, and available communications system. When located on military lands, list available storage facilities for tools and equipment.

(b) *Helicopters and light planes*, by types, number, and ownership. Indicate whether radio equipped, and explain procedure to follow when service is required.

(c) *Ground patrols*, by type of organization (military police, etc.), type of transportation, and devices for locating fires. Describe how to use.

(*d*) *Communications systems.*

1. Describe the existing system and list additional proposed facilities.

2. Name office to first receive reports of fires (fire department, forestry section, or military police).

3. In appendix, include a map of the communications systems, present and proposed.

(*e*) *Transportation system.*

1. Firebreak, road, and trail system. List separately mileage of firebreaks, roads, and trails. Classify them on the basis of types of equipment for which each is passable. Justify where necessary additional firebreak requirements. Locate both existing and proposed firebreaks on a map in the appendix.

2. Transportation equipment. List kinds and numbers of motor vehicles available, personnel capacity of each, and firefighting equipment each one carries. Where necessary, describe additional requirements and estimate cost.

(*f*) *Water supplies.* Identify sources of available water for fire camps, backpack pumps, and pumpers, and show location on map in the appendix. List needed additional facilities and estimated cost.

(*g*) *Tools, supplies, and equipment.* List items not included in (*d*) and (*f*) above, both existing and required. Give estimated cost for items to be purchased.

(3) *Suppression.*

(*a*) *Action following report of fire.* Explain the procedure to be followed after the report is received ((2)(*e*) above). Describe procedure to be followed for fires originating off the installation.

(*b*) *Methods of attack.* Describe methods of attack and kinds of equipment to be used for fires in the one or several topographic and vegetative type area(s). Define safety requirements for personnel and equipment. Prescribe crew and equipment requirements for fires in each problem area.

(*c*) *Mopping up.* Describe mopping-up procedures for fires of various types.

(4) *Fire reports.* Describe procedures used by the nearest State or U.S. Forest Service office or, in Alaska, by the Bureau of Land Management, Department of the Interior, for estimating damage, and use these procedures for statistical reporting unless accurate factual data are available. In the appendix, include a model for the report and appropriate instructions.

7. Insects, Diseases, and Rodent Control (Center Heading)

Prepare this section as a separate detailed protection plan for furnishing to those assigned this responsibility.

a. General. Describe assignments of responsibility for insect and rodent control.

b. Forest Tree Insects and Tree-Destroying Rodents. List by common and scientific names and indicate kind and importance of damage currently being done by each. Describe control measures, personnel, equipment, and supplies on hand and required. Include deer and beaver control in this section, where those animals are present in destructive abundance.

c. Diseases. Cover to the extent considered essential to insure adequate protection to the woodland.

8. Wildlife Management (Center Heading)

If there are desirable wildlife species to be encouraged on the installation, give the following information:

a. Types of desirable wildlife present. Include yields of game species harvested during last three years by kinds.

b. Types of vegetative cover, food crops required, and procedure proposed to furnish them.

c. Restocking schedules.

d. Installation regulations, law enforcement requirements, and related details for coordination with the land and woodland management plans.

e. Status of cooperative agreements or plans (if any) with Federal or State agencies.

f. Degree of access granted to the public for hunting and fishing, including number of visitors normally granted access.

9. Revision of Plan (Center Heading)

Provide for general amendment and revision of the Woodland management plan every 5 years after date of first approval. Also provide for interim page revisions if conditions justify. The area of woodland may be materially enlarged by acquisition, or reduced by construction of military facilities or changing missions. Any such change will affect the annual allowable cut. Revised volume data may be accumulated which will require changes in marking rules. Include a copy of the annual work plan and prior years data on costs, volumes, and receipts.

10. Appendix (Center Heading or Separate Folders)

Include essential maps, photographs, samples of record forms and fire reports with data filled in, charts and tables for computing statistical fire damage, local growth data by species and sites, and other pertinent information not included in the body of the plan.

APPENDIX III

TABLE OF BASIC REQUIREMENTS IN EQUIPMENT AND PERSONNEL FOR GUIDANCE OF MILITARY INSTALLATIONS ACCOMPLISHING WOODLAND MANAGEMENT

Line No.	Type	Units required for stated acreage						
		1,000 or less	5,000	10,000	20,000	50,000	125M	250M
1	Personnel [1]—Professional	¼	1	1	1	2	3	3
1a	Personnel [1]—Other	¼	------	1	2	4	12	28
2	Ax, DB or SB, 4-lb	1	2	4	8	12	24	48
3	Backfire torch	2	2	3	4	6	8	12
4	Backpack pump, 4-gal	4	6	10	12	24	30	36
5	Biltmore stick	2	2	3	4	5	9	12
6	Brush hook	2	2	3	4	6	12	24
7	Compass, forester	------	1	1	1	2	3	4
8	Diameter tape	1	1	2	2	3	4	6
9	Fire danger station [2]	------	------	1	1	1	2	3
10	Firefinder, lookout [4]	------	1	1	1	1	2	3
11	Fireplow, heavy	------	------	------	1	1	2	4
12	Fireplow, light	------	1	1	1	2	4	8
13	Fire rake	4	8	16	32	48	80	120
14	Fuel can, kerosene, 5-gal	1	1	1	1	2	4	6
15	Fusee, forester or railroad	24	36	48	48	60	120	120
16	Hats, hard	12	15	20	30	40	80	144
17	Increment borer, 12-inch	1	1	1	1	2	3	4
18	Lights, electric	6	12	25	30	36	48	48
19	Lookout tower [4]	------	1	1	1	1	2	3
20	Paint gun, tree marking	1	1	2	3	4	6	7
21	Pulaski tool	2	4	6	8	12	24	36
22	Radios, 2-way, vehicles	------	2	3	3	5	8	10
23	Saw, cross cut, 2-man [5]	1	1	2	2	4	6	10
24	Saw, power, 1- or 2-man [5]	------	1	2	2	3	4	6
25	Shovel, LH, RP	8	12	16	20	24	30	40
26	Snakebite kits [4]	1	2	3	4	8	12	24
27	Surveyor tape, steel, 100-foot	1	1	1	2	2	4	6
28	Tally book, 8 by 11 inches, metal	1	1	1	2	2	4	6
29	Tractor, crawl, 34–45 hp	------	1	1	2	3	5	8
30	Tractor, crawl, D–6 or D–7	------	------	------	1	1	2	4
31	Tractor, w/transport trailer [3]	------	------	------	1	1	2	3
32	Truck, pickup, 4–WD	------	1	1	1	2	3	5
33	Truck, stake body, 2½-ton, 6 by 4	------	1	1	1	2	4	6
34	Truck, 1-ton, 4 by 4, w/250-gal. slipon tank	------	1	1	1	2	3	4

[1] Man-years, permanent.
[2] When other stations cannot provide the data.
[3] Truck-tractor 2½-ton, 6 by 6, or 4-5-ton, 4 by 4.
[4] If justified by local conditions.
[5] Size will vary, depending on size of local timber.

Note. This list is a guide to local basic equipment requirements. Consult local State and Federal foresters concerning actual needs.

APPENDIX IV

PAINT-MARKING INFORMATION

1. A good grade of tree-marking paint will leave a clear mark for at least 2 years.

2. The forester, marking in average pulpwood stands in the South, is estimated to mark 1,000 trees daily and to use 5 quarts of paint.

3. Paint guns range from small hand types to pressure-operated backpack types.

a. The *hand-pressure gun* is lighter and less expensive to buy and to repair.

b. The *backpack pressure gun* eliminates much hand fatigue and time lost in reloading.

4. Give paint gun frequent cleaning to keep nozzle and plunger in good working order. Clean with kerosene before storing.

5. Plunger and nozzle wear out in use. Never continue to use worn parts.

6. Use a distinctive color of paint for each of the various purposes.

7. The usual boundary mark comprises three parallel lines near breast height, crossed by one vertical line which faces the actual boundary line.

APPENDIX V

SAMPLE AGENDA—3-DAY WORKSHOP PROGRAM

Day and hour	Woodland management plan
Monday	
0800–1000	Registration, quarters and assignments.
1000–1015	Welcome by installation commander.
1015–1030	Workshop objectives.
1030–1045	Break.
1045–1100	The place of woodland management in the Army.
1100–1115	The place of woodland management in the Navy.
1115–1130	The place of woodland management in the Air Force.
1130–1145	The place of woodland management in the Marine Corps.
1145–1200	Discussion.
1200–1330	Lunch.
1330–1700	Tour of woodlands at host installation.
Tuesday	
0800–0815	The fire problem at the host installation.
0815–0830	Fire prevention and troop training.
0830–0900	Fire protection cooperation with other agencies.
0900–0930	Developing the fire plan and forest fire organization.
0930–1130	Fire problems at each service.
1130–1200	Discussion.
1200–1330	Lunch.
1330–1700	Field demonstrations of fire fighting techniques and equipment.
1800–2100	Dinner, slides or films afterwards.
Wednesday	
0800–0900	Writing and assembling the woodland management plan, speakers from each service.
0900–1000	Implementing woodland management plans, speakers from each service.
1000–1015	Break.
1015–1045	Reforestation problems.
1045–1130	Insect and disease problems.
1130–1200	Discussion.
1200–1330	Lunch.
1330–1430	Making timber available for disposal, speakers from each service.
1430–1500	Coordination of the wildlife program.
1500–1515	Break.
1515–1545	Control of weed trees and brush by chemicals.
1545–1700	Discussion and summary.

APPENDIX VI

FOREST AND RANGE EXPERIMENT STATIONS OF THE FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE

1. Alaska Forest Research Center
   Post Office Box 740, Juneau, Alaska
2. Pacific Southwest Forest and Range Experiment Station Headquarters
   1960 Addison St.
   Berkley, Calif.
3. Central States Forest Experiment Station Headquarters
   111 Old Federal Building, Columbus 15, Ohio
4. Intermountain Forest Range Experiment Station Headquarters
   Forest Service Building
   25th St. and Adams Ave., Ogden, Utah
5. Lake States Forest Experiment Station Headquarters
   St. Paul Campus, University of Minnesota
   St. Paul 1, Minn.
6. Northeastern Forest Experiment Station Headquarters
   102 Motors Ave., Upper Darby, Pa.
7. Pacific Northwest Forest and Range Experiment Station Headquarters
   809 NE 6th Ave., Portland 12, Oreg.
8. Rocky Mountain Forest and Range Experiment Station Headquarters
   Forestry Building, Colorado State University
   Fort Collins, Colo.
9. Southeastern Forest Experiment Station Headquarters
   223 Federal Building, Ashville, N.C.
10. Southern Forest Experiment Station Headquarters
    704 Lowich Building, 2026 St. Charles Ave., New Orleans 13, La.
11. Forest Products Laboratory
    North Walnut Street, Madison 5, Wis.

APPENDIX VII

DIMENSIONS AND AREA OF SQUARE AND ROUND PLOTS

Area		Linear feet	
Acres	Square feet	Square plot, 1 side	Circular plot, radius
1.0	43, 560	208. 7103	117. 7522
3/4	32, 670	180. 8000	101. 8000
1/2	21, 780	147. 5805	83. 2634
1/3	14, 520	120. 4990	67. 9843
1/4	10, 890	104. 3552	58. 8761
1/5	8, 712	93. 3381	52. 6604
1/6	7, 260	85. 2056	48. 0721
1/7	6, 223	78. 8851	44. 5061
1/8	5, 445	73. 7902	41. 6317
1/9	4, 840	69. 5701	39. 2507
1/10	4, 356	66. 0000	37. 2365
1/50	871	29. 5161	16. 6527
1/100	436	20. 8710	11. 7752
1/1000	43. 6	6. 6000	3. 7237
10. 0	435, 600	660. 0000	372. 3651
100. 0	4, 356, 000	2, 087. 1033	1, 177. 5219

APPENDIX VIII

MEASUREMENT EQUIVALENTS

LINEAL MEASUREMENT EQUIVALENTS

Units	Mile	Feet	Inches	Chains	Meters	Kilometers	Varas [1]
1.0 mile	------	5, 280	63, 360	80	1, 609. 3	1. 6093	1, 900. 8
1.0 chain	0. 0125	66	792	--------	20. 12	. 0201	23. 76
1.0 meter	. 0006	3. 281	39. 37	. 0497	----------	. 001	1. 18
1.0 kilometer	. 6214	3, 280. 800	39, 369. 6	49. 7	1, 000. 0	------	1, 181. 13
1.0 vara [1]	. 0005	2. 778	33⅓	. 04	. 8	. 0008	--------
1.0 foot	. 0002	---------	12	. 015	. 3048	. 0003	. 36
1.0 rod, perch or pole	. 0031	16½	198	. 25	5. 0292	. 0050	5. 94
1.0 furlong	. 1250	660	7, 920	10	201. 16	. 2011	237. 6
1.0 arpent [2] (linear)	. 0364	192½	2, 310	2. 91667	58. 67	. 0586	69. 29

AREA MEASUREMENT EQUIVALENTS

Units	Square mile	Square feet	Square chains	Acres	Square varas [1]
1.0 square mile	--------	27, 878, 400	6, 400	640	3, 613, 040
1.0 square foot	--------	----------	. 00023	0. 00002	. 1296
1.0 square chain	0. 000156	4, 356	----------	. 1	. 00177
1.0 acre	. 00156	43, 560	10	----------	5, 645. 4
1.0 square vara	--------	7. 7173	. 16	. 00017	----------
1.0 league [3]	6. 92	192, 896, 748	44, 288. 00	4, 428. 8	25, 000, 000
1.0 hectare	. 0037	107, 638. 7	24. 710	2. 471	13, 949. 78

[1] Texas vara. California vara is 33.0 inches.
[2] The arpent as a unit of land (French) approximates 0.85 acre.
[3] Spanish and Texan.

APPENDIX IX

STANDARD CONVERTING FACTORS FOR STATISTICAL USE

Number of units	Product	Assumed unit dimensions	Equivalent
			Board feet
2	Cord, standard	4 x 4 x 8 feet	1, 000
1	Cord, long	4 x 5 x 8 feet	625
1	Cord, shinglebolts	4 x 4 x 8 feet	600
3	Cord, small (under 5-inch averaged)	4 x 4 x 8 feet	1, 000
1	Cord, short	4 x 3 x 8 feet	375
1	Cord, short (under 5-inch averaged)	4 x 3 x 8 feet	250
10	Cubic feet	13.6 inches x 1 foot	60
6	Lagging	3 inches x 6 feet	10
1	Pole, converter or fence	4 inches x 20 feet	10
5	Pole, (phone) or piling	8 inches x 45 feet	1, 000
10	Pole, (phone) or piling	8 inches x 35 feet	1, 000
1	Pole, (phone) or piling	7 inches x 60 feet	280
5	Pole, (phone) or piling	7 inches x 50 feet	1, 000
10	Pole, (phone) or piling	7 inches x 40 feet	1, 000
20	Pole, (phone) or piling	7 inches x 25 feet	1, 000
1	Pole, (phone) or piling	5 inches x 25 feet	30
10	Post, fence	5 inches x 7 feet	50
175	Post, fence, mixed size	(Mixed) x 7 feet	1, 000
70	Post, fence, mixed size	Mixed dimensions	[1] 1
10	Post, split	18 inches circumference x 7 feet	60
1	Prop	6 inches x 10 feet	10
1	Tie, 8 feet standard	7 x 9 inches	42
1	Tie, 8 feet standard	7 x 8 inches	37
1	Tie, 8 feet standard	6 x 6 inches	24
1	Tie, 6½ feet narrow gage	7 x 8 inches	30
1	Tie, 6½ feet narrow gage	6 x 6 inches	20

[1] Cord.

Note. Local conversion tables should be developed if above data are not considered appropriate for local conditions.

APPENDIX X

APPROXIMATE WEIGHTS OF COMMERCIALLY IMPORTANT WOODS

Species	Pounds per cubic foot		Pounds [1]	
	Green	Airdry [1]	Per cord 4' x 4' x 8'	Per M board feet lumber [2]
Ash, commercial white	48	41	3,700	3,420
Aspen	43	26	2,300	2,260
Bald cypress	51	32	3,200	2,670
Birch (average sweet, yellow)	57	44	------	3,750
Cedar, eastern red	37	33	3,000	2,790
Cedar, northern white	28	21	------	1,830
Cedar, southern white	26	23	1,950	1,980
Cedar, western red	27	23	2,100	1,920
Cherry, black	45	35	3,250	3,010
Douglas-fir (Rocky Mountain)	35	30	2,900	2,540
Douglas-fir (coastal)	38	34	3,250	2,860
Fir, white (averaged 2 species)	46	27	------	2,250
Hemlock, eastern	50	28	------	2,420
Hemlock, western	41	29	------	2,470
Oak, red (averaged)	64	44	------	3,670
Oak, white (averaged)	63	47	------	3,920
Pine, loblolly	53	36	------	3,020
Pine, longleaf	55	41	------	3,470
Pine, shortleaf	52	36	------	2,970
Pine, ponderosa	45	28	------	2,380
Pine, Norway	42	31	------	2,620
Redwood (old-growth)	50	28	------	2,330

[1] Airdry, 12 percent moisture assumed, plus or minus 10 percent allowed.
[2] Rough.

APPENDIX XI

WIND SPEEDS DEFINED FOR OCULAR MEASUREMENT

Miles per hour (statute)	Weather Bureau description	Beaufort scale	Description	General description for use on land
Under 1	Calm	0	Calm	Smoke rises vertically.
1–3	Very light	1	Slight	Smoke shows wind direction but weather vane will not move.
4–7	Light	2	Slight breeze	Leaves rustle. Feel wind on face. Wind vane moves.
8–12	Gentle	3	Gentle breeze	Leaves and small twigs move. Wind extends light flag.
13–18	Moderate	4	Moderate breeze	Dust, loose paper, branches, move.
19–24	Fresh	5	Fresh breeze	Small trees in leaf sway. Crested wavelets form on inland waters.
25–31	Strong	6	Strong breeze	Large branches move. Telegraph wires "sing." Umbrellas hard to hold.
32–38	Strong	7	High wind	Whole trees sway. Walking against wind is effort.
39–46	Gale	8	Gale	Twigs break off trees. Foot progress impeded.
47–54	Gale	9	Strong gale	Chimney pots and roof slate removed.
55–63	Whole gale	10	Whole gale	Considerable structural damage occurs.
64–75	Whole gale	11	Storm	Widespread damage.
Above 75	Hurricane	12	Hurricane	Extensive damage.

APPENDIX XII

SAMPLE DECLARATION OF TIMBER AVAILABILITY

Subject: Timber Available for Disposal at _____.
(installation)

To: (*Appropriate Authority prescribed by regulations*)

1. The following estimated volume of timber has been marked for disposal at _____ in accordance with _____ and the approved
(installation) (appropriate regulation or instruction)
Woodland Management Plan for _____.
(installation)

a. *Sawtimber* (basis, Scribner Decimal C log rule to 8-inch top).

2,100,000 board feet of mixed southern pine (or named species), 10–36 inches DBH, average 14 inches DBH, totaling 17,569 trees, with 25 percent probably most valuable as poles or piling.

18,000 board feet of mixed hardwoods (or named species), 12–50 inches DBH, averaging 16 inches DBH, totaling 134 trees. These trees are scattered in 10 of the cutting units.

b. *Pulpwood* (basis standard cords).

1,500 cords of mixed conifer stems, 5–9 inches DBH, plus a few larger trees not suitable for other products.

400 cords of pine topwood to be cut after loggers have finished.

2. This timber is located in 30 cutting units of Compartment IV within an operable area of approximately 3,004 acres. (See Inclosure No. 1 for volume and number of trees marked by cutting units.) Title to land and timber is fee simple. See locality map, Inclosure No. 2, for general location of the area and its relation to roads, railroads, and shipping points.

3. Circumstances prompting removal are —

a. Sawtimber is mature to decadent and will be wasted by decay and death if allowed to remain longer in the stand.

b. Younger stands must be thinned due to overcrowded conditions.

4. The estimate is (is not) considered sufficiently accurate to permit disposal by lump-sum sale without monetary loss to the Government.

5. The following specifications should be included in any contract awarded, or modified only after complete concurrence by the installation commander.

a. Cut all trees marked with _____ paint at ground level and
(color)
breast height.

b. Cut stumps as low as possible, and in no case more than 10 inches above ground on the highest side, except when ingrown stones or metal, or excessive rootswell make the low height impracticable.

c. Limb all severed pine tops to a maximum of 4 feet above ground and leave no tops or slash within 3 feet of any residual living tree.

d. Remove all logs and bolts within 24 hours after they have been cut, unless authorized by the resident inspector to allow them to remain.

e. Marked trees overlooked by cutters must be cut as soon as contractor is notified. The cutting of any unmarked tree will be penalized on the basis of $_____ per inch in diameter measured at the stump.

f. Cutting must proceed in an orderly manner and only in the location designated by the resident inspector.

g. Sawmills will (will not) be permitted on the installation (subject to the following restrictions).

h. The location of all logging roads, landings, and skid roads must be approved by _____. All firelanes, streams, and trails must be kept free of tops, slash, structures, and unused equipment.

i. The contractor will be held liable for all damage to Government property and for all Government expenditures resulting from fires caused by his negligence or the negligence of his employees, agents, and subcontractors.

j. The contractor will comply with all pertinent provisions of the General Safety Regulations, _____.
(cite reference applicable to Department involved)

6. Cutting must be completed no later than _____.

APPENDIX XIII

SAMPLE AGREEMENT FOR FIRE SUPPRESSION SERVICE AND EQUIPMENT

THIS AGREEMENT, made and entered into this __ day of _____ 19__ at _____ (name of installation), by and between the Installation Commander, _____ (name of installation), hereinafter referred to as the Installation Commander, and the Forestry Commission (or Board) of the State of _____, hereinafter referred to as the Commission, witnesseth:

WHEREAS, the Installation Commander is responsible for the suppression of forest fires on _____ acres of Federally owned lands within the boundaries of _____ (name of installation); and

WHEREAS, the Commission is responsible for the suppression of forest fires on privately owned lands located within the counties surrounding _____ (name of installation); and

WHEREAS, in view of the live and moving characteristics of forest fires, it is the desire of the Installation Commander and of the Commission to create more effective protection for both Federally owned and privately owned lands within the areas of mutual interest adjacent to the boundaries of _____ (name of installation);

NOW, THEREFORE, in consideration of the mutual promises hereinafter made, the Installation Commander and the Commission agree as follows:

1. The Installation Commander shall have the right to take necessary action to suppress any fire which shall be deemed by him or his authorized representative to be immediately endangering the installation of _____ (name of installation), or any part thereof, and which shall exist within an area designated as follows:

"That portion of land adjacent to _____ (name of installation), and bounded on the west side by _____. Highway _____ from _____, to State Road _____ on the south side by State Roads _____ and _____ to the _____ Railroad and thence along said railroad to the _____ River; on the east side by the _____ River to the _____ Railroad; and on the north side by the _____ Railroad to _____."

2. The Commission shall have the right to take any action necessary to suppress any fire which shall be deemed by the duly authorized officials of the Commission to be immediately endangering any lands beyond the boundaries of _____, and which shall exist within an area
(name of installation)
designated as follows:

"That portion of land within _____,
(name of installation)
which is immediately adjacent and contiguous to the outer boundary of the installation and which extends at a width of one quarter of a mile around the entire installation."

The inner boundary of such area shall not be marked or otherwise indicated on the ground, but shall consist of an imaginary line existing only in the contemplation of the parties hereto.

3. The Installation Commander shall render assistance to the Commission whenever such assistance is requested, in the suppression of any fire which in the judgment of the Installation Commander or of his duly authorized representative is potentially dangerous to the installation of _____ or any part thereof, provided that personnel
(name of installation)
and equipment of _____, are reasonably available
(name of installation)
for such service.

4. The Commission shall render assistance to the Installation Commander whenever such assistance is requested, in the suppression of any fire which in the judgment of the duly authorized officials of the Commission is potentially dangerous to any private land of the State of _____, provided that personnel and equipment employed by or for the Commission can be spared for such service.

5. Whenever any personnel or equipment of _____,
(name of installation)
are engaged in the suppression of fire outside of the installation boundary, such personnel and equipment shall remain under the direction and supervision of the Installation Commander or his duly authorized representatives. However, the Installation Commander or his duly authorized representatives shall employ such personnel and equipment as to render full cooperation with duly authorized representatives of the Commission. Whatever rights and authority the Commission shall at the time possess for entry into private lands in the pursuance and suppression of fire shall be and the same are hereby delegated to the Installation Commander and his duly authorized representatives.

6. Whenever any personnel or equipment employed by or for the Commission are engaged in the suppression of fire inside the installation of _____, they shall act under the direction and supervision of the Installation Commander and such of his authorized representatives as shall be present.
(name of installation)

7. A report shall be made of any fire suppressed by either of the parties hereto in the area of land for which the other party is responsible.

8. No liability or responsibility is assumed by either of the parties hereto for any damage to property, or for any damage to equipment used by the other party, or for any personal injury to personnel employed by the other party which may result from fire suppression activities conducted by one party at the request of the other party as provided in paragraphs 3 and 4 above. Each party to this agreement waives all claims against every other party for compensation for any loss, damage, personal injury, or death occurring in consequence of the performance of this agreement.

9. No warranty is made by either of the parties hereto as to the quality or continuity of services which may be furnished under this agreement. Each of the parties reserves the right to withdraw its personnel and equipment from the scene of a fire whenever circumstances may require that such personnel or equipment be employed elsewhere, and such withdrawal is not to be considered a breach of this agreement.

10. Each of the parties hereto shall prepare a written plan for coordinating in detail the operations under this agreement and shall submit a copy of such plan to the other party.

11. The services provided in this agreement shall be furnished by both parties without monetary charge.

12. This agreement shall remain in full force and effect until it is terminated. Either party may terminate this agreement at any time, with or without cause, provided that the party so desiring to terminate the same shall give unto the other, at least 30 days prior to the proposed date of termination, a written notice of such intention.

IN WITNESS WHEREOF, we have hereunto set our hands the place, day, and year first above written.

(Name and rank)
(Name of installation)

Installation Commander
FORESTRY COMMISSION OF THE STATE OF

By ---
(Name and title)

APPENDIX XIV

EXAMPLE OF COOPERATIVE AGREEMENT

COOPERATIVE AGREEMENT

Between
The United States of America, Department of the _____,
_____
(installation name)
And
The _____ Department of Conservation, Division of Forestry,
(State)
_____ _____

Effective this __ day of _____ 196__, for the purpose of providing mutual assistance in forest-fire detection and suppresion when forest fires are burning on, or adjacent to and threatening, the lands of the _____ (installation name) _____ located in _____ County, _____ (State), approximately __ miles west of _____ (town or city), _____ (State), and hereinafter referred to as the Installation.

WHEREAS the Commander of the Installation has jurisdiction over, and is responsible for the security, proper maintenance, and protection of the forested and other lands of the Installation, and

WHEREAS the _____ (State) Department of Conservation, Division of Forestry, hereinafter referred to as the Division of Forestry, is the official agency of the sovereign state of _____ (State) for the protection from and suppression of forest fires on State and private lands within said State, and is authorized by law to provide assistance to, and cooperate with, Federal and other public and private organizations and agencies owning or operating forest lands within said State,

NOW, THEREFORE, it is mutually agreed as follows, subject to cancellation or modification by either party hereto on 60 days' written notice to the other:

1. The Division of Forestry will use facilities at its command to locate and report to the Installation any and all fires on and in the vicinity of the Installation, and will provide any available manpower and equipment to suppress, or aid in suppressing, such fires as may be on or endangering the Installation.

2. The Installation Commander will provide such personnel and equipment as he may deem available and necessary to assist the Division of Forestry in suppressing fires off the Installation that are threatening or endangering the security of the Installation.

3. Technical direction of suppression efforts on off-post fires will be the responsibility of the designated Division of Forestry officer; technical direction

of suppression efforts of fires burning on the Installation will be the responsibility of the official designated by the Installation Commander.

4. When Division of Forestry personnel are not available to take suppression action on fires threatening or endangering the Installation, the Installation Commander will take prompt action as becomes necessary.

5. In the event that a fire on the Installation reaches disaster proportions beyond the experience and ability of the Installation Fire Boss to control, the Division of Forestry will, on request, provide a man of the necessary qualifications to take full charge of the suppression activities.

6. Each party to this agreement waives all claims against every other party for compensation for any loss, damage, personal injury, or death occurring in consequence of the performance of this agreement.

7. Representatives of the Division of Forestry and of the Installation Commander will meet at the call of either party hereto to discuss and recommend amendments, changes, and additions to this agreement that are determined to be essential to keep the agreement current and effective.

APPROVED AND ACCEPTED as of this __ day of _____ 19__.

For the State of _____
Division of Forestry.

_____
(Name)

_____
(Title)

For the Department of the _____

_____
(Installation name)

_____
(Name)

_____
(Title)

GLOSSARY

Abney level—An instrument used to measure heights of trees, elevations, and slopes.

Afforestation—Establishment of a forest on an area not previously forested. (*See* Reforestation.)

Age, rotation—The age at which the timber stand is considered ready for harvesting under the approved plan of management.

Age, stand—The average age of the trees which compose a stand, or a "story" within a stand.

Age, tree—The number of years elapsed since germination of the seed or the budding of the sprout or root sucker.

All-aged—A stand of trees theoretically including all ages from seedling to overmature (*see also* Even-aged and Uneven-aged).

Angle gage—*See* Prism.

Arboriculture—The care, protection, and cultivation of trees primarily for shade or landscape effects.

At the base—A term used in timber contracts, when referring to the diameter of standing timber, meaning at the ground level.

At the stump—In timber contracts, the point at which the bole is severed from the stump. Local custom governs in case of litigation.

Backfire—

(1) Fire set along the inner edge of a fire control line to stop wildfire by reducing the fuel or changing the direction of force of the fire's convection-column.

(2) A prescribed fire set to burn against wind; also called "backburn."

(3) To set a backfire.

BAF (basal area factor)—A factor computed for a wedge prism or angle gage that when multiplied by the number of trees at a point gives basal area per acre.

BAF 75—A wedge prism or angle gage having a factor of 75.

Bank—Logging term: to assemble or bunch logs for transport. (*See* Landing.)

Basal area—In forestry, the area, usually expressed in square feet, of the cross section at breast height inside bark (unless otherwise stated), of either a single tree or of all the trees in a stand.

Blowdown—An area on which the trees have been thrown by wind. Syn.—*windfall.*

Board foot—A unit of tree and lumber measure 1 foot long, 1 foot wide, and 1 inch thick, Abbr.—Ft. b.m., FB.M., bd.-ft. In practice the unit is 1,000 board feet measure. M b.m.

Bole—The trunk (main stem) of a tree.

Borer, increment—An augerlike instrument with a hollow bit, used to extract cores from a tree, pole, or sawed timber, for growth rate and age determination, or preservative penetration.

Brush—Shrubs, and stands of scrubby trees that do not reach merchantable size on the growing site.

Bunch—To skid logs together to form a load for subsequent haulage by other equipment.

Butt cut—The first log (butt log) above the stump.

Canopy—Leaves and branches formed by the crowns of all trees in a forest.

Climax forest—The final stage of a succession of forest tree species which continues to occupy an area as long as climatic or soil conditions remain unchanged.

Contain—To effect control within a given area; to suppress or confine a fire by attack; to stop the spread.

Control time—Elapsed time from start of first work on a fire (discovery) until holding of control line is assured.

Coppice—A cutover area regenerated by sprouts.

Crown—The upper portion of a tree, comprising branches and foliage.

Crown fire—A fire which runs through the tops of living trees, brush, or chaparral; sometimes classed as running or independent, to distinguish the degree of independence from the surface fire.

Cruise—A survey of forest land to locate timber and estimate quantity by species, products, or other characteristics; the estimate obtained in such a survey.

Cruiser—One who cruises timber.

Cunit—A volume measure of 100 cubic feet.

Cut—The volume output of logs, lumber, pulpwood, or other forest products, in a stated period of time.

DBH—Symbol for "diameter breast high," 4½ feet above average ground level.

Dead-and-down—All down timber and dead timber either standing or down.

Diameter breast high—The outside bark diameter of a tree at 4.5 feet above average ground level (or on slopes, highest ground level). Customarily abbreviated as d.b.h. or DBH. When necessary the additional abbreviations, o.b. and i.b., are used to designate measurement outside bark and inside bark, respectively. (The abbreviation D.B.N. indicates diameter above "bottle neck"—usually 10 feet above ground for turpentined trees, and above the swelling of swell-butted trees.)

Duff—Forest litter and other organic debris (in various stages of decomposition) on top of mineral soil.

Even aged—A stand of trees in which relatively small age differences exist between individuals. Maximum difference normally permitted is 10 to 20 years, although when stand exceeds 100 years in age differences up to 25 percent of rotation age are permissible.

Faller—One who fells timber. Syns—*chopper; sawyer; cutter.*

Felling—The process of felling trees. Syn—*cutting.*

Fire, actionable—Any fire that requires suppression, as a fire started or allowed to spread in violation of law, ordinance, or regulation.

Fire, crown—A fire which runs through the tops of living trees, brush or chaparral.

Fire, ground—Fire that consumes the organic material beneath the surface litter of the forest floor; a peat fire.

Fire, marshal—Army: Post Engineer; Navy: Fire Chief.

Fire, surface—Fire that burns surface litter, other loose debris on the forest floor, and small vegetation.

Forester—A person who has been professionally educated in forestry, or who possesses qualifications to practice forestry which are essentially equivalent to graduation from a recognized forestry school.

Forestry—The scientific management of forests for the continuous production of goods and services.

Gross scale—Scale of a log in which there is no deduction for defect.

Growing stock—The sum, by number or volume, of all trees in a forest or a specified part thereof.

High-grading—Removing only the best trees from the woodland.

Hoedag—Grubhoe with short (16-inch) handle, used for tree planting on steep slopes.

Hotspot—A particularly active part of a fire.

Hotspotting—Checking the spread of fire at points of special threat or most rapid spread as the initial step in suppression.

Hypsometer—An instrument used to measure heights of trees, based either on geometric or trigometric principles.

Ingrowth—The volume or number of trees which have grown past an adopted lower limit of measurement during a specified period. Syn.—*recruits.*

Intolerance—The inability of a tree to develop and grow in the shade of and in competition with other trees.

Kill (noun)—Collectively, the trees killed by attack of fire, insects, or diseases; e.g., "the kill exceeded 90 percent."

Landing—A place where logs are assembled for transportation in loads or rafts. Syns—*bank; banking ground; log dump; rollway; yard.*

Limb—To cut the limbs from a felled tree. Syn.—*lop.*

Log—To cut and deliver logs; a tree segment suitable for manufacture into lumber.

Net scale—The scale of a log after deduction for defect.

Overstory—That portion of the trees in a forest forming the upper crown.

Prism (wedgeprism, BAF prism)—A glass prism or angle gage used to compute volumes in timber cruising. BAF is Basal Area Factor. (*See* BAF.)

Procurement harvest—A contracted cutting made to help fill Department of Defense lumber requirements.

Pulaski—A combination ax and hoe used for fire control.

Pulpwood—Wood cut or prepared primarily for manufacture into woodpulp. May be from tree bole (stemwood) or large limbs (topwood). Minimum diameter and length as specified by local practice (in the Southeast, usually 4 inches inside bark and 5 feet 3 inches in length).

Reforestation—The natural or artificial restocking of a previously forested area with forest trees. (*See Afforestation.*)

Regeneration—The natural processes by which a forest is renewed.

Right day—An expression used in connection with controlled burning designating the right kind of day to safely accomplish such burning. A "right day" generally follows a rain and rarely occurs more than 3 days after rain.

Rough—The accumulation of all living and dead ground and understory vegetation, especially grasses, forest litter, and draped dead needles. Usually qualified as 1-year rough, 5-year rough, etc.

Sawlog—A log large enough to permit production of lumber or other products by sawing. Size and cull percent permitted must be specified in any contract; it varies with local practice or regulations.

Sawtimber—Trees, of commercial species, which contain at least one merchantable sawlog.

Scribner decimal C log rule—An official log rule of the U.S. Forest Service and of the Department of Defense. Basically, it is the Scribner log rule modified by rounding off the last digit to the nearest 10 and dropping the cypher. *Example:* Scribner 213 bd. ft., Decimal C 21.0.

Shelterwood—A system of management requiring the removal of the mature timber in a series of cuttings which extends over a period of years to permit natural reproduction.

Site quality index—An index of the crop-producing capability of forest land as determined by the average height of dominant and codominant trees of stated species at a given age (usually 50 years). Syn.—*site class index.*

Slash—Debris remaining after logging, pruning, thinning, or brush cutting; large accumulations of debris after wind or fire. Included are logs, chunks, bark, branches, stumps, brush, broken and uprooted trees.

Snag—A standing dead tree from which most leaves and branches have fallen, or a standing section of bole broken off at a height of 20 feet or more. If broken off less than 20 feet above ground, it is properly termed a *stub.*

Spotting—A fire spreading as a result of sparks or embers carried ahead by the wind to start a new fire.

Stand, commercial—A specific forest stand or area producing commercially valuable crops of wood and not withdrawn from timber utilization.

Stand, noncommercial—

(1) Forest land withdrawn for any reason from timber utilization; or
(2) Incapable of yielding usable wood products because of inaccessibility or adverse site; or
(3) Unproductive land or water areas such as chaparral land, grassy parks and swamps, and open water; or
(4) Stands of trees under pulpwood size.

Sweep—A gradual bend in a log, pole, or piling, considered a defect.

Understory—That portion of the trees in a forest below the overstory.

Uneven-aged—Term applied to a stand in which there are considerable differences in age of trees and three or more age classes are represented.

Wet-water—Water with added chemicals, called wetting agents, which increase its spreading and penetrating properties.

Wedge prism—*See* Prism, BAF 75.

Wildfire—An unplanned fire requiring suppression action.

Wildlings—Seedlings naturally reproduced outside a nursery and used in reforestation.

Woodland management—As used herein, is the application of sound forestry principles and practices, including proper protection, to the operation of the woodlands of the installation within the limitations of military missions and regulations and the local growing conditions.

Woodland, potentially productive—Natural stands of young trees of commercially valuable species not yet of commercial size; areas reforested or to be reforested; old burns, cutover

land, gravel pits, and similar areas capable of growing valuable timber if reforested.

Woodland, productive—Those stands of hardwood and coniferous timber containing trees of commercial size, suitable for use by the installation or in demand by industry; normally trees over 5 inches DBH.

Note: For other terms and definitions, see "Forestry Terminology," third edition, revised, Society of American Foresters, 1958.

BY ORDER OF THE SECRETARIES OF THE ARMY AND THE NAVY:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:
J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

P. CORRADI,
Rear Admiral, CEC,
United States Navy,
Chief, Bureau of Yards and Docks.

Distribution:
Army:
Active Army:
DASA (4)
USASA (3)
CsigO (2)
CofEngrs (20)
OSD (I&L) (4)
TAG (5)
TSG (2)
USCDC (5)
DSA (H–ODI) (3)
USCONARC (4)
MDW (5)
Armies (CONUS) (5)
Instl (10)
OS Maj Comd (5)
OS Base Comd (5)
USMA (2)
USAES (100)
Div Engrs (5)
Engr Dist (5)
Engr Fld Maint Shops (2)
NG: None.
USAR: None.
For explanation of abbreviations used, see AR 320–50.
Navy: Major installations of the Naval Shore Establishment.

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