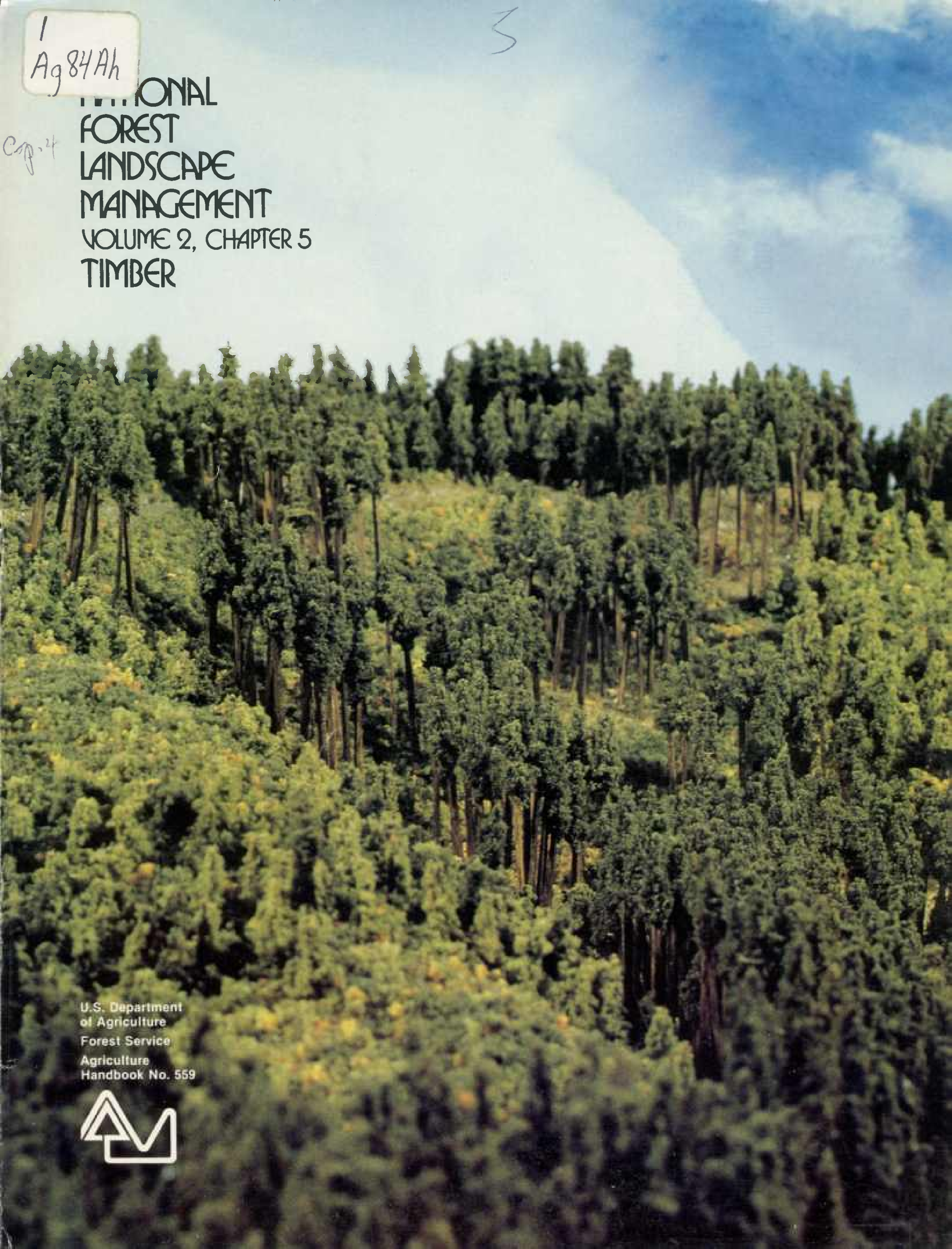
NATIONAL FOREST LANDSCAPE MANAGEMENT

VOLUME 2, CHAPTER 5

TIMBER



U.S. Department of Agriculture
Forest Service
Agriculture Handbook No. 559

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Foreword

Volume 1

National Forest Landscape Management, Volume 1, is a training document distributed throughout the National Forest System in April, 1973. It is used as a basic text to illustrate the concepts, elements, and principles of our landscape management program. This program seeks to identify the visual characteristics of the landscape and analyze, in advance, the visual effects of resource management actions. Volume 1 was prepared by landscape architects, land management specialists, and research scientists from throughout the Forest Service.

Volume 2

National Forest Landscape Management, Volume 2, will consist of several chapters (one of which you have before you), each dealing with the application of Volume 1 principles to a specific function or area of concern in the field of resource management. The effort to produce each chapter has been spearheaded by one Forest Service region, chosen for its experience and demonstrated expertise in the field, utilizing contributions from other regions, research scientists, industry, and universities. These chapters will be published separately, as they are completed, for the purpose of prompt dissemination of what is, hopefully, very useful information. All are available from the Superintendent of Documents, Washington, D.C. as Agriculture Handbooks (see page 223).

We hope you find this chapter thought provoking and useful. Comments and suggestions are always welcome.

R. Max Peterson
Chief

Acknowledgements:

The Scope of this book, involving treatment of six tree species throughout the United States and the techniques in several fields necessary for carrying out such management, would not have been possible without the work of many individuals.

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Contents

Introduction

Society and the Forest

The human has long been regarded as an integral part of nature and its complex processes. As such, it is believed that if one lives and works in harmony with nature, it not only produces a balance within the ecological systems, but also tends to maintain or upgrade one's psychological welfare. Since people's perceptions of their surroundings are based primarily on what is seen, the visual effects of human activities are of great importance in determining how a society feels about its relationship with the natural world.

"The landscape is not just a supply depot but is also the OIKOS—the home in which we must live." ODUM

In the National Forest System, public concern for the environment—including its esthetic values—has increased as more and more land has been visibly affected by management activities. Often foremost among these concerns has been the visual effect of timber harvesting.

Many timber harvest activities introduce harsh and incongruous visual elements into the landscape.

Concurrently, many of the more visually sensitive timber stands have remained unmanaged for want of a visually acceptable method of harvesting. Many such stands are reaching the end of their normal life cycle, and are becoming susceptible to nature's regeneration processes: wildfire, disease, insect infestation, or windthrow.

Nature's regeneration processes also often produce unpleasant visual elements in the landscape (such as this windstorm damage).

Timber harvest can cut short these natural catastrophies and in turn does not have to be accomplished with such obvious aesthetic impacts.

By applying the principles described in this handbook, processes can be developed by which the positive visual attributes of a managed forest can be enjoyed while minimizing the more negative visual aspects of timber harvesting.

A Managed Forest . . . full of visual diversity, subtle contrasts of human activities and enriched wildlife habitats.

Chapter Objectives

The objectives of the timber management chapter are to:

—develop and illustrate various silvicultural and landscape design treatments, which, when used as guides in the preparation of specific site prescriptions, should be capable of meeting visual quality objectives;

—illustrate the planning process necessary to achieve visual quality objectives over time and space;

—illustrate the logging systems that may be used to achieve the recommended silvicultural treatments;

—encourage innovation and creativity in preparing specific site prescriptions from these guidelines.

The treatments may also be useful in land management planning to determine the degree of visual quality afforded, effect on other resources, product yield cost, and the difficulty of accomplishment for a recommended Visual Quality Objective (VQO).

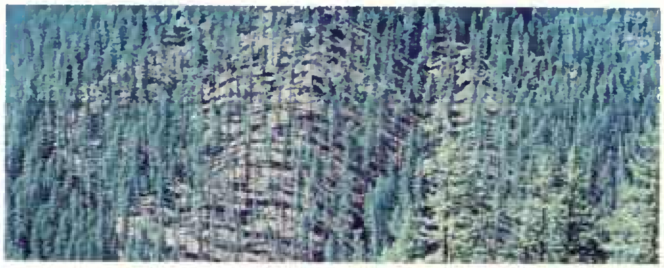
The silvicultural treatment concepts included in this text do not establish and are not intended to infer general Forest Service policy. They are suggested to stimulate new ideas for the preparation of treatments or prescriptions to meet local Visual Quality Objectives that have been adopted through the Land Management Planning process.

Visual Quality Objectives (VQOs)

There are five different Visual Quality Objectives and two short-term management alternatives.

The five VQOs are:

Preservation	P	Only ecological changes permitted
Retention	R	Management activities are not visually evident
Partial Retention	PR	Management activities remain visually subordinate
Modification	M	Management activities in foreground and middleground are dominant, but appear natural
Maximum Modification	MM	Management activities are dominant, but appear natural when seen as background



The two short-term management alternatives are:
Enhancement
Rehabilitation

The VQOs and the short-term alternatives are more completely defined for immediate visual effects in USDA Agriculture Handbook No. 462. When applied to the planning and design of timber harvesting over time and space, they require a more detailed definition, which this chapter provides.

The VQOs must be analyzed from three different perspectives:

1. The *"Desired Character"* to be retained or created.
2. The *"Negative Elements"* that create undesirable contrast such as activity residues, skid roads, skyline cable corridors.
3. The *"Positive Elements"* of water forms, rock forms, distinctive vegetation and spaces, which may be introduced or emphasized by removing, thinning, or planting surrounding vegetation.

Desired Character

The desired character is the appearance of the landscape to be retained or created over time. A description of desired character should include the appearance of the stand at regeneration, seedling-sapling stage as well as poles, small and large saw log sizes, the mature stand, and, where appropriate, old-growth stand characteristics. The desired-character description may set goals for featured species; scale of stand structure; tree diameters; bark characteristics; textural patterns; and contrasting tree species, shrubs, and ground covers. It should also include the distribution and proportion of different successional stages and size classes necessary in a managed state to achieve the mature character in some designed proportion of the viewed area over time.

Any design of the 'desired character' must recognize that a forest is a dynamic and constantly changing community of plants and animals. The manipulation of this dynamic situation to achieve a desired variety of conditions is the essence of a managed forest.

Before: This Douglas-fir stand is in an intermediate stage toward the desired character goal of 36-inch d.b.h. with deep furrowed bark. Since all of the foreground within the corridor is of this size class, only a portion should be thinned and allowed to grow on to the desired size. Other segments, as shown in the "after" photo, should start through the regeneration process.

After: Shelterwood harvest. The positive elements of vertical line, color, and texture of the ground vegetation and low-branched trees have been retained while moving this stand through regeneration methods toward replacement of these stand characteristics in this travel route segment. Dependent upon observer position and speed and on the extent of the activity, this would meet the *Retention* or *Partial Retention VQO*.

The desired character may not presently exist and must be created after analysis of the biological opportunities and constraints.

Early day logging and a series of fires have produced many miles of pole size trees in the foreground along this corridor. Planned treatments over the long term can reintroduce large yellow-bark pine, which existed before the fires, along with areas of young seedlings and saplings, and hardwood species in the wetter areas. This would introduce interesting variety while some of the pole size tree character is retained.

Negative Elements

Negative or unnatural appearing elements of timber harvest should meet VQO definitions.

The two pictures below illustrate the extremes of negative element contrast. Each harvest entry is moving its respective foreground landscape toward regeneration of a new stand of trees, but with vastly differing amounts of contrast, consequently meeting different VQOs.

In this shelterwood harvest, contrast is not evident. This entry meets the *Retention VQO* (see page 156 for further details).

This clearcut unit creates a dominant soil color contrast, and the unit is out of scale for a foreground activity. This activity would probably be acceptable only under the *Maximum Modifiction VQO.*

Positive Elements

Generally, considerable change can take place in the positive or natural appearing elements even under *Retention VQO* if the change achieves desirable variety and follows the principles of landscape design, such as proper scale and arrangement of these elements. An example of short-term *Enhancement* for a *Retention* landscape is shown below.

Before: This foreground stand is a combination of lodgepole and ponderosa pine. The lodgepole has formed a very dense dog-haired thicket near the road's edge. The visual effect lacks diversity of vegetative character and visual depth into the stand.

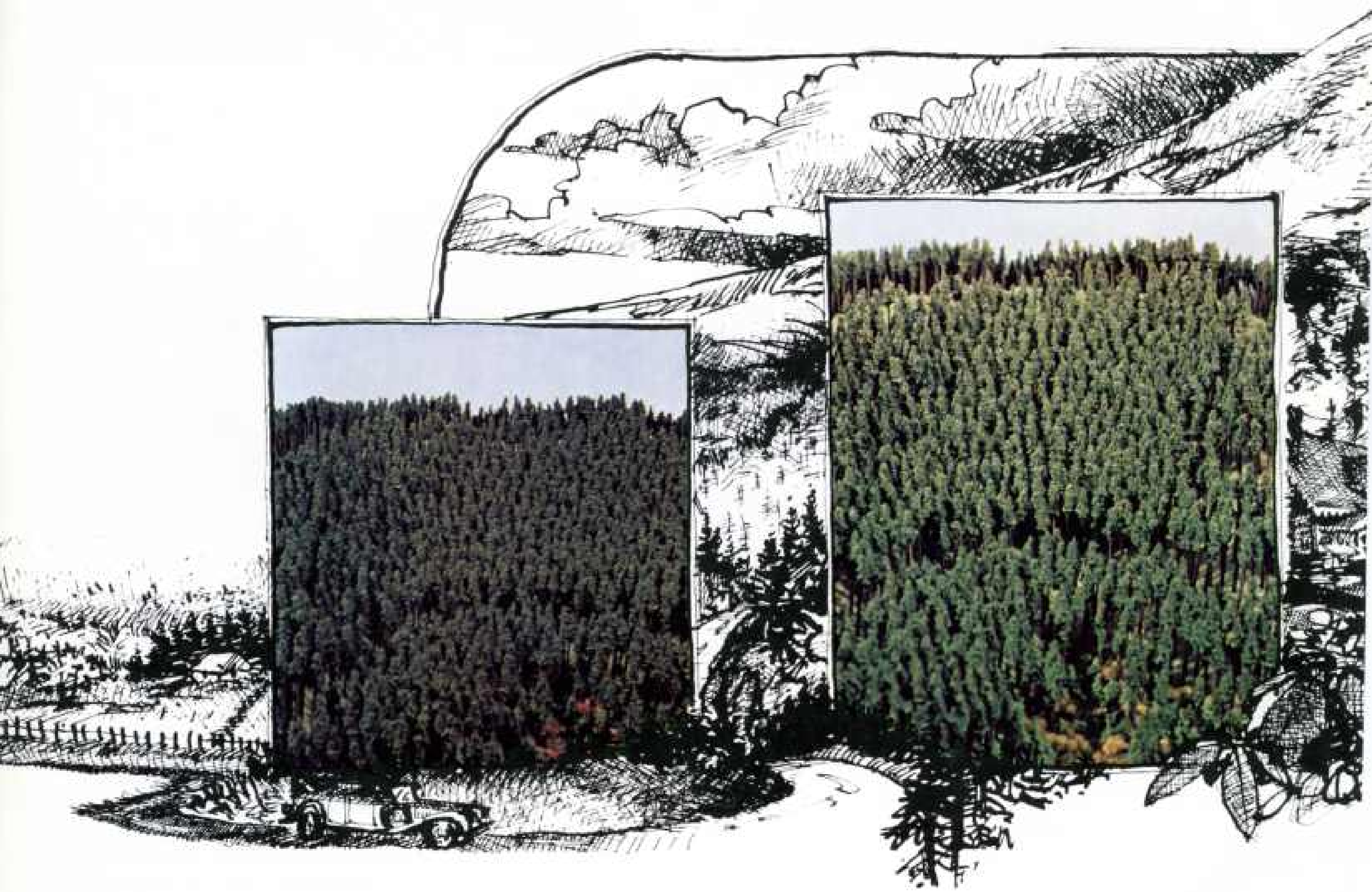
After: Removal of the stagnant lodgepole stand has added visual depth into the stand as well as releasing the more interesting ponderosa pine saplings to grow and develop to maturity. Stress has also been lessened on the few mature yellow bark trees adding their character to the scene for a longer period of time.

All timber harvest activity should move the stand toward the desired managed state which includes appropriate proportions of stand size classes. If the desired proportion of mature character and other size classes exists, management activity should act to maintain that *balance*. The segments of mature character should be retained until biologically ready for regeneration and sufficient amounts of the next younger size class exists to replace it. If the desired mature character and balance of other size classes does not exist, timber harvest activities should be used to create it.

Time and Space

Achieving long-term visual quality goals in a forest environment works in direct proportion to how well time and space are managed.

Involved is the amount of time it takes to grow certain vegetative characteristics such as seedling to large, mature trees or seedling to sufficient sapling and pole height and density to subdue an unnatural edge or soil color before further harvest. These time periods are but an instant in the forest, but seem like an eternity in human lifetimes.

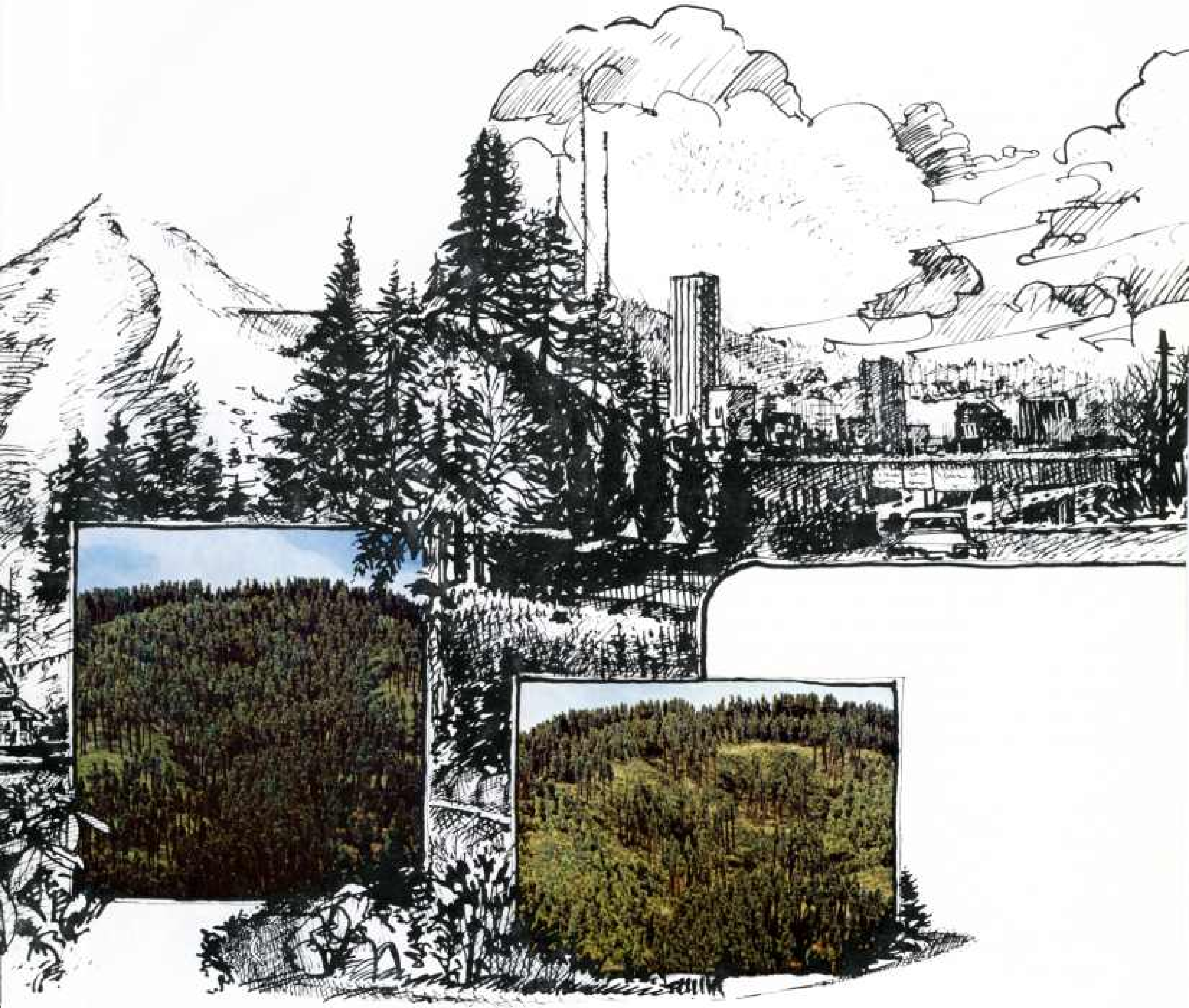


1931: For instance, 1931 saw the management of National Forests involved primarily with a "caretaker" conservation function, with relatively little timber being cut. This landscape was composed of forested hillside of old growth or mature Douglas-fir. A first entry clearcut was created on the ridgetop and planted with seedlings.

1946: After the great Depression and World War II, a second entry combination of shelterwood, clearcuts and uncut islands were created below the well-stocked clearcut and at both ends of the steep landform face (one end shown). Seedlings were planted underneath.

Space, in this context, refers to the total area viewed, both existing and potential, from a total travel route or logical segment thereof.

Involved in the time sequence below is a change in character from all old growth to a combination of old growth and younger age classes. All of the characteristics are important for visual variety but will shift in location as the trees are harvested and new ones grow to take their place. Planning of this dynamic situation throughout space to achieve an attractive sequence of views is important and will be addressed throughout this chapter.



1961: Shelter trees were removed leaving a well stocked stand underneath to grow peacefully during the turmoil of the decade. Leave islands were shelterwood cut but help maintain dominance of texture. Middle part of landform is given similar treatment to that described in 1946.

1976: Shelter trees in the leave islands were removed making the evolving changes in landscape character very apparent but natural in appearance. Trees planted in 1931 must grow another 45 years before being considered mature enough to harvest (year 2021). Large tree character would take considerably longer.

Silvicultural Terms and Concepts

*Silviculture is the art and science of establishing, growing, and tending stands of trees. *The basic objective of silviculture, in any given place, is to create a certain desirable kind of vegetational development in order to achieve the specific management objectives selected for that area. The varying vegetative characteristics appropriate to different resources (including visual) can, therefore, be achieved through applied silviculture.*

It is important to note at this point that many aspects of recent American silviculture practices are still very new as far as the long time scale of forestry is concerned. The whole idea of growing trees consciously really did not take hold to any significant extent in this country until the time of World War II. Most forestry on industrial holdings started about then. Before that time, most public forests were regarded as economically inaccessible so they were protected and little was harvested from them.

Successful silviculture practice is dependent on determining the processes that created a specific set of vegetative characteristics in nature and then simulating them directly or indirectly. Those practices that go against natural processes are often doomed to failure. The paradoxical point of this is that destroying or removing plants is the constructive guiding force in replacing old plants with new and also with steering the development of established vegetation.

Tree removal or killing is the main silvicultural tool because forest vegetation typically fills all of the available growing space. It cannot be changed or guided in its development without creating vacancies. Vegetation in general, and that of woody perennials in particular, hungrily expands its foliage and roots to fill all of the physiologically inhabitable space above and below ground. The occupancy soon becomes so complete that nothing new can be added unless some growing space is made vacant by removing something. In a more subtle way, the growth of one established plant can be enhanced by killing or removing a competing neighbor.

Pole-size class.

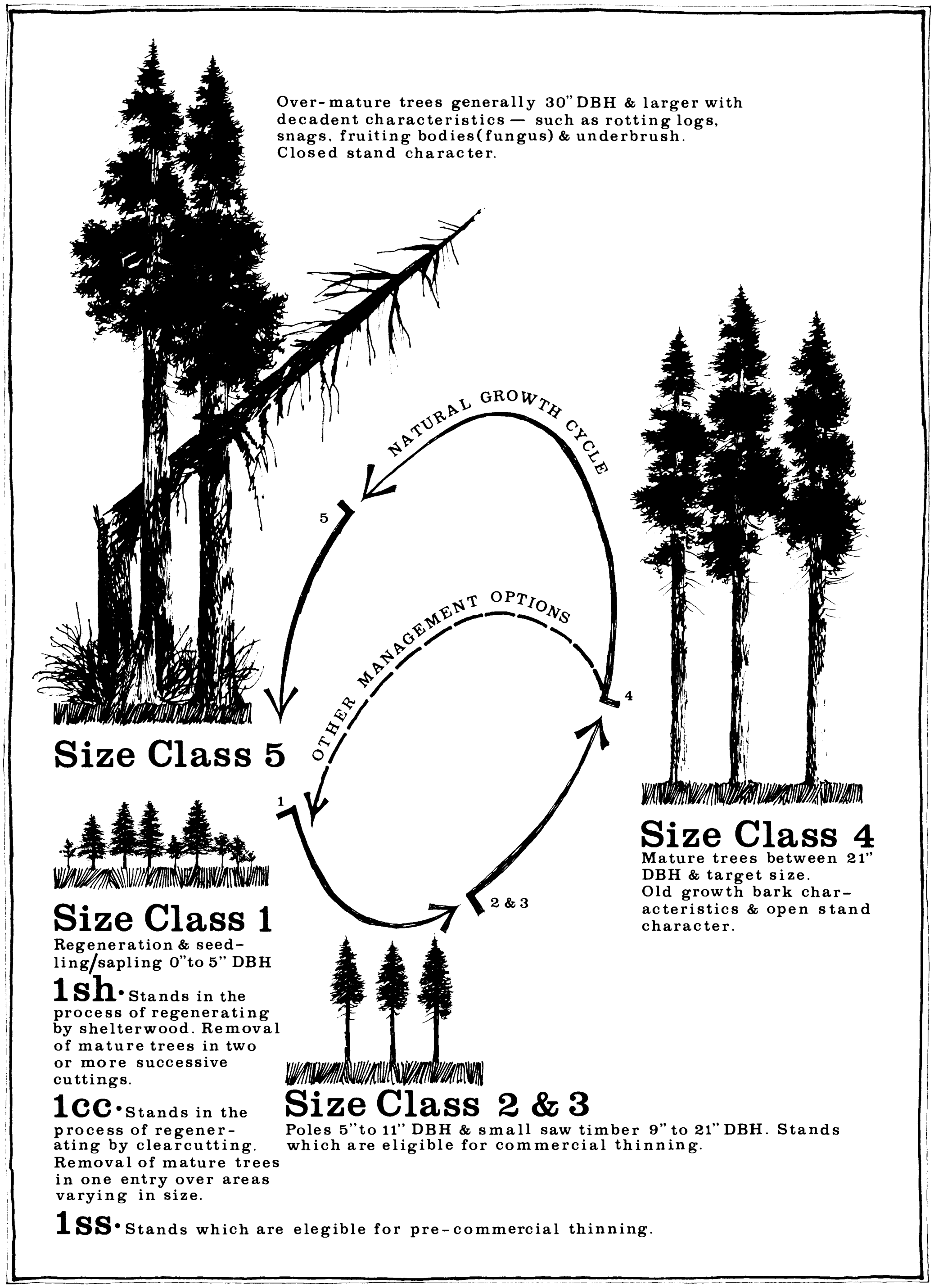
Mature or old-growth age class.

If the pole-size class is to reach a large mature or old-growth tree age class within a reasonable management time frame, a large number will need to be killed or removed. This provides space for the rest to grow. Above is such an activity being accomplished by commercial thinning. Clumpy appearance and, in general, irregular spacing provides a natural appearance.

*Adapted from a speech entitled, *The Scientific Basis for Timber Harvesting Practices* by Professor David M. Smith, School of Forestry and Environmental Studies, Yale University, New Haven, Conn.

Below is a general representation of the age-class situations of tree species. It represents both a visual and a silvicultural continuum. Stands may fall into one of the illustrated size class situations or somewhere in between. It is important to recognize that, depending on the species, site, and size class involved, 25 to 50 years are frequently required to move a timber stand from one recognizable size class to a larger one. Size classes 1 through 4 define the sequential stages of development of a timber stand through time from seedling to maturity. Stands at class 4 may be allowed to move into age class 5 before regeneration. However, age class 5 is generally considered to represent the decadent characteristics of an unmanaged life cycle, silviculturally speaking.

Depending on the successional stage of a particular tree species within a given plant community, the natural growth cycle from age class 5 may include other plant species before size class 1 will again be reached. Management options, however, may sometimes shortcut other subclimax pioneer or climax species.



Origin of Stands

Understanding the natural origin of various tree species can aid greatly in comprehending plant succession and age classes, as well as how and why various silviculture management systems are used. Some species are adapted to colonize severely exposed areas, especially those created by hot forest fires. These species, aptly termed pioneers, can endure wide extremes of temperature and grow fast enough to push their roots quickly through the inch or two of soil which has been severely desiccated by the fire. These species must grow fast if they are to survive and they require lots of light to support their rapid growth and high respiration rates. Among the natural fire-following species are jack and lodgepole pines, as well as the aspens, poplars, and certain birches. In silvicultural practice, the regeneration of such species usually requires the complete removal of the old forest.

Aspen colonizing after a severe fire.

At the other extreme are the so-called shade-tolerant species that not only endure shade but also tend to require it in their early stages of development. These species have characteristics such as low respiration rates, high chlorophyll content, and efficient leaf arrangement, which enable them to stay alive at low light intensity. Their seedlings do not grow rapidly in height simply because there has never been any survival value in doing so. They have also sacrified much of their ability to endure exposure and require very specific seedbed and minimal ground vegetation conditions for successful seedling establishment. These species include certain spruces, most true firs, hemlocks, and most maples and oaks. They are generally adapted to persist for many years beneath old stands of trees, but to retain the capacity for initiating rapid height growth when released by lethal disturbances that kill forests from the top downward. The natural disturbances to which they are adapted are windstorms, the lethal effects of defoliating insects, and fungi or other pests that weaken tree stems enough to cause them to break.

Shade-tolerant stand of predominantly maple.

As is usually the case in such matters, there are many species that represent adaptations to microenvironment that are intermediate between the extremes just described. Actually, there is a gradational series of adaptations from one end to the other. Many of our most important species fall into this broad intermediate category. *They may individually have some special ecological requirements that must be met, but they are generally flexible enough so that a variety of regeneration cutting patterns and silvicultural techniques can be applied.* Among the species in this group are Douglas-fir and such important pines as loblolly, slash, ponderosa, red, and the five-needled white pines.

Douglas-fir, intermediate in shade tolerance, but often limited in management regimes because of other factors such as windthrow, steep topography, and often being sub-climax in succession.

Ponderosa pine, also intermediate in shade tolerance, but generally very flexible in possible management regimes.

Management Concepts

In silviculture practices today there are two management concepts used to guide the manipulation of vegetation. They are:

Even Age

Uneven (All) Age.

Even-age Management

The even-age management process produces stands composed of trees having a relatively small difference in age and tending to look like the stand shown here.

Douglas-fir even-age stand 15 years after clearcut regeneration.

The regeneration processes in even-age management tend to produce the strongest and longest duration visual impacts of any timber management activity. The three different regeneration processes are:

Clearcut

Shelterwood

Seed Tree

Clearcut

Clearcutting is the removal of an entire standing crop of trees over a given area to assist renewal of a new tree crop already present, or to make renewal possible. Regeneration may be accomplished by either natural seed fall or by planted seedlings. Clearcuts which are 10 acres or larger in size are called "stand clearcuts" and generally either were or will be managed as a "stand" of trees uniform in age, height, and other characteristics. (Note page 7 for foreground view.)

Shelterwood

A shelterwood cut is also a regeneration harvest, but the standing crop of trees is removed in two or more entries. Trees are usually left to protect young seedlings from frost and heat and, sometimes, also to provide a seed source. The visual appearance of initial entry shelterwoods varies considerably with each timber type. The appearance after the final removal is often that of a clearcut because of the small size of the young trees, but is of a shorter duration since a new stand is already established. The shelterwood initial cut is illustrated below.

Seed tree

Seed tree regeneration is the removal in one entry of the mature timber from an area except for a small number of seed bearing trees. Its visual appearance is similar to a clearcut because so few trees are left (usually 6 to 8 trees per acre or less). This treatment is often used in southern pine stands but rarely in western softwoods.

Between the time of a young stand's formation and its harvest, intermediate cuttings are often necessary to increase growth, protect trees from insects and disease, and sometimes to salvage dead and dying trees. The three types of intermediate entries are:

Commercial Thinning
Precommercial Thinning
Sanitation Salvage

Commercial Thinning

Commercial thinning is the harvesting of immature but marketable trees, which concentrates growth in the remaining crop trees (leave trees).

Visually, impacts are usually only a problem in foregrounds as can be seen in the photograph. Leave trees are often evenly spaced. Slash resulting from commercial thinning entries often remains untreated. As markets and fiber utilization improve, there should be less untreated slash left on the ground and the visual impact will be reduced.

Precommercial Thinning

A cutting made in an immature stand primarily to concentrate diameter growth on the remaining crop trees, precommercial thinning generally does not produce merchantable material. Under standard operations some slash remains, including the main stem. Leave trees are often evenly spaced, producing an unnatural appearance. As in commercial thinning, this problem is usually evident only in foregrounds. An example of precommercial thinning is shown.

Sanitation Salvage

The removal of trees that are dead, damaged, or susceptible to disease and pests, sanitation salvage maintains the stand in a healthy condition. Such entries will be done in most stands to treat insect and disease infestations. Visual impacts of any significance are normally confined to foreground. The exact degree of visual impact will depend on the stand character, number and frequency of entries, and speed of the viewer. As seen here, visual objectives should generally be quite easy to achieve.

Uneven-aged Management

When applied to appropriate species, uneven-aged management produces forests that contain trees of many sizes and ages intermixed in the same stand. The forest canopy remains relatively continuous and unbroken. As a result, visual impacts of timber management activities may be kept to a minimum; the uneven-aged system is capable of achieving the Retention visual quality objective in all distance zones if it is properly applied.

There are two primary cutting methods applied to uneven-aged management. They are:

Single-Tree Selection Cutting
Group Selection Cutting

Single tree selection cutting in progress with little visual impact.

Single-Tree Selection Cutting

Single-tree selection cutting involves the periodic removal of trees in several or all size classes within a stand, in such a way as to achieve or maintain a balanced uneven-aged stand structure. This means that the stand is cut to leave a predetermined residual density, with predetermined numbers of trees in each of the various size classes up to some predetermined maximum size. The same goals are used for each successive cut over an indefinite period.

Trees are evaluated for cutting on an individual basis, and the stand is marked to improve spacing and favor the faster growing, more valuable stems within the limits imposed by the stand structure goals.

Every cut under single-tree selection is a combination regeneration cut, harvest, and thinning. Many of the trees removed will be large enough to make merchantable products, although some smaller trees may also be cut to achieve stand structure goals and provide more growing space for the residuals. The small canopy openings created by the removal of the individual trees provide vacant growing space in which regeneration of shade tolerant species may get started. Subsequent cuts

Small-scale diversity of all classes represented, resulting from single-tree selection cutting in 1927 and again in 1963.

maintain the open canopy so that continuous waves of regeneration will occur, some of which gradually move up into the main crown canopy to replenish the trees harvested.

Group Selection Cutting

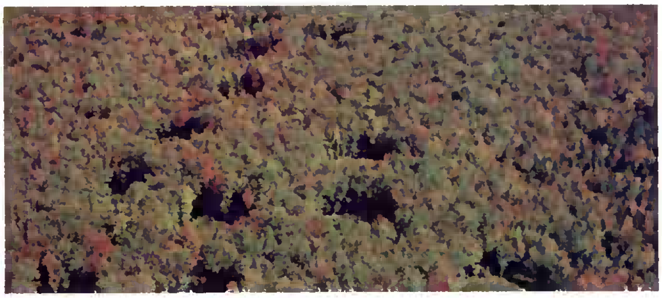
Group selection cutting involves the periodic removal of trees in much the same manner as single-tree selection, except that trees are cut in groups of from two or three up to many trees. This creates larger openings in the crown canopy than single-tree selection, thus providing conditions under which less tolerant regeneration may get started in mixture with the more tolerant species.

In group selection cutting, trees are still examined and marked individually, but the characteristics of the group as a whole are evaluated as well. Group selection openings are usually less than 1 acre in size. A typical stand cut under this system would include openings of many sizes in a random pattern, with single-tree selection cutting in the area between groups.

Group selection cutting is regulated by means of the same stand structure goals as described for single-tree selection. Stands are cut to retain predetermined

Group selection cutting 2 years after harvest.

numbers of trees in each of the various size classes, even though some parts of the stand are in openings at any one time.



Aerial view of group selection cutting.

The larger group selection openings grade into small clearcuttings, and there is no clear distinction between them in terms of size. But so long as the opening is not mapped and recorded as a separate stand, and so long as regulation of cutting is achieved through control over the distribution of trees by size class (rather than distribution of area by age class), the openings are considered group selection openings under uneven-aged management. However, it must be noted that group selection openings larger than 1/4 to 1/2 acre have the same visual effect as small clearcuttings, and their ability to meet the Retention visual quality objective may be questionable.

Adaptability to Uneven-aged Management

Some forest types are not well-adapted to uneven-aged management. Adaptability depends upon the species desired, their tolerance to shade, their place in the community's successional development toward the climax, and on the environmental or microclimatic conditions of the selected site.

Forest types which contain desirable or acceptable tolerant species can usually be handled under uneven-aged management. For example, northern hardwoods which include sugar maple and beech are generally adaptable to management with uneven-aged techniques. Eastern red spruce-balsam fir and Rocky Mountain Englemann spruce-subalpine fir types are also adaptable.

There are a few forest types dominated by intolerant species that can be handled under uneven-aged management simply because more tolerant species are absent or grow slowly. Many ponderosa pine forests are in this category, as are some lodgepole pine forests in the Rocky Mountains and eastern Oregon and some mountain hemlock forests in the southern Oregon Cascades.

Some tolerant species that seem well adapted to uneven-aged techniques cannot be managed that way because partial cutting makes them susceptible to damage from such agents as windthrow or insect and disease infestations. The western hemlock-sitka spruce type is such an example.

Forest types dominated by shade-intolerant species, or types in which the intolerants are to be favored over the tolerants, usually cannot be managed using uneven-aged techniques—at least not without great difficulty and expense. Typical examples include coastal Douglas-fir, the southern pines, aspen-birch, oak-hickory, and northern hardwoods that are dominated by cherry, ash, yellow poplar, and similar species.

Implications of Using Uneven-aged Management to Achieve Visual Quality Objectives

In general, the more adaptable a timber type is to uneven-aged management, the easier it is to meet the more difficult visual quality objectives. It may be

The design of vegetative treatments in pedestrian-oriented landscapes, such as developed use sites and trail foregrounds, should consider very small scale randomly spaced harvest activities. Single-tree and very small group selection, even in such species as Douglas-fir, should be considered.

possible to meet a Retention visual quality objective with uneven-aged management using single-tree selection cutting in situations where none of the traditional even-aged techniques would do so. Examples include: An observer wandering on foot through developed sites or along trails and looking at foreground landscapes from all angles; an observer with a long view duration scrutinizing a foreground landscape enclosed by landform; an observer viewing class A features in a middleground landscape for a long duration.

The advantage of uneven-aged management in these situations results because it is a small scale process—selective in nature and random in pattern—and because it leaves the natural appearing forest character intact when viewed from almost any angle. For these reasons, uneven-aged management should be considered in even the less adaptable types where visual quality objectives cannot be met by even-aged techniques. Other alternatives, such as no timber management at all or modified even-aged treatments outlined later in this book, should also be considered and, of course, the trade-offs of each alternative need to be evaluated carefully for each situation before a final decision is reached.

Landscape Design

The landscape design vocabulary to be used in this section includes elements, principles, and variables. The elements are:

Form

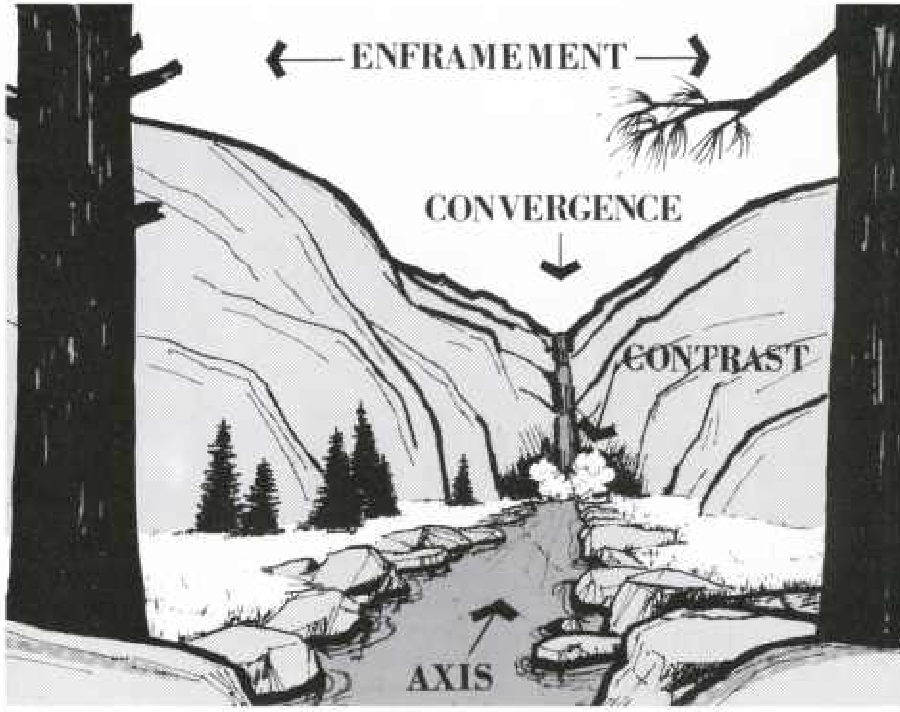
Color

Line

Texture

The principles include:

Contrast
Axis
Sequence
Convergence
Enframement



Variables involved are:

Motion	*Scale*
Light	*Distance*
Atmospheric Condition	*Time*
Observer Position	*Seasons*

The design elements, principles, and variables are used to help describe "desired character" and develop "landscape design techniques," both of which can then be applied for each "distance zone" and VQO combination.

Desired Character

As defined under Visual Quality Objectives, desired character is a statement about what is or could be attractive in a landscape. It is a combination of design attributes and opportunities, as well as biological opportunities and constraints. The description and purpose of a desired character can be defined in terms of the elements, principles, and variables. Examples include:

"Yellow plated old-growth ponderosa pine bark with deep, dark furrows or the white peeling bark with black spots of the white birch." The bark of old-growth trees is often a desired character which adds richness of color and texture to the forest.

"Mixture of various aspen stands with spruce and other conifers" provides a desired character of dramatic contrasts—fall color, summer greens, and winter textures.

"Irregularly spaced old-growth Douglas-fir and hemlock with an understory of ferns and shrubby hardwoods" creates a rich variety of textures and form. The large diameter trees are important because of their scale in contrast to the surrounding landscape.

"Enframed views of natural open spaces such as ponds or meadows and created natural-appearing openings" are often desirable because they bring a variety of forms and scale to the landscape.

A desired character description should be developed for each VQO, distance zone, and plant community combination. In planning the seen area of a total travel route, the desired character description is kept fairly broad as shown in the section on "planning." When applied to project design, desired character is more specific and is generally listed under design criteria.

Landscape Design Techniques

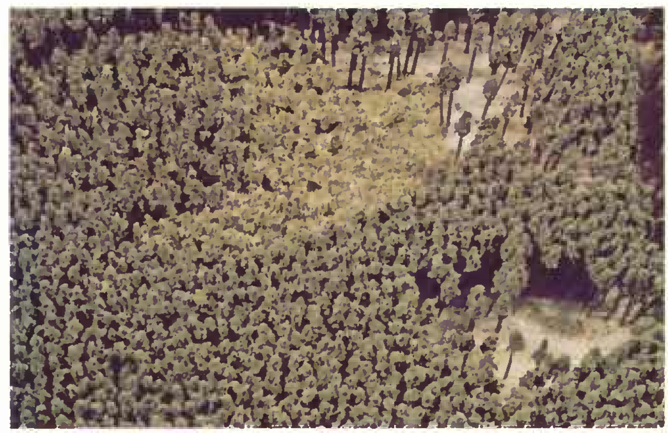
Manipulation of *edge*, *shape*, and *scale* of harvest units and *distribution* of activities over time and space are the techniques used in landscape design. These techniques can be used to produce desired character in the landscape by accentuating the positive elements and by minimizing or mitigating the negative elements of timber management activities.

Edge

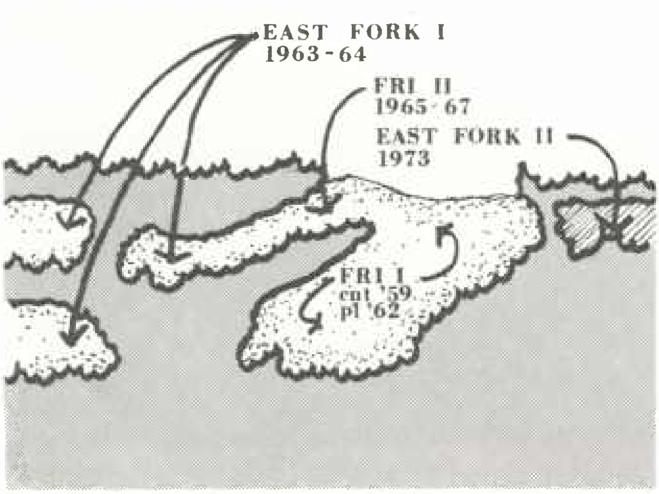
Achieving a natural-appearing edge in timber harvests is an important key to meeting desired character and Visual Quality Objectives. A natural-appearing edge is perceived mainly in terms of texture.

Harvest unit edges which are also biological edges have advantages for wildlife. In general, the greater the edge diversity, the greater the number and variety of animals which will use the area.

Natural-appearing edges can be achieved in vegetative manipulation by locating harvest boundaries at existing biological edges.



Natural-appearing edges can be accomplished by harvest scheduling—progressively cutting trees toward the observer over a considerable time (as shown in the Douglas-fir section on page 154-155).



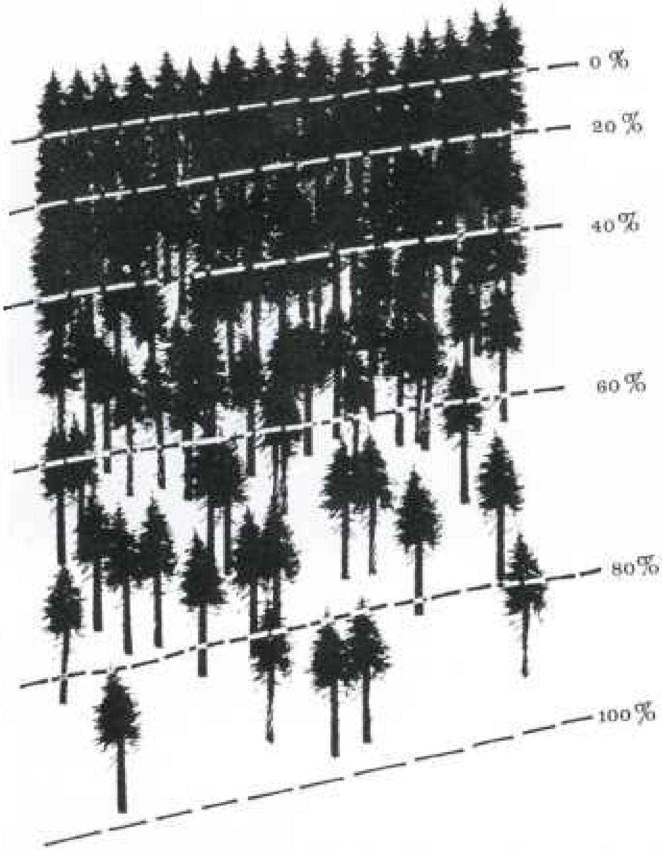
Tying several clearcuts together over time can result in fewer harsh edges as shown in the sketch and photo of the same area.

The desired effect can sometimes be achieved by leaving the existing understory just inside the harvest unit boundary or by progressively increasing the height of uncut vegetation away from the harvest unit.

The edges of clearcuts can be feathered and scalloped to create a near-natural appearance. When these designed edges are combined with islands of trees left standing in the clearcut, the result is very desirable. The feathering technique is valuable primarily where the remaining tree crowns are of sufficient density and height to soften a strong tree bole edge.

Combining the feathered edge with islands of leave trees which increase in density toward the uncut stand provides an additional ingredient for a mosaic appearance.

Locating the unit boundary so the viewer sees only vegetative crown can sometimes be effectively done by beginning at the top of opposing slopes. Side and top edges must cross contours and ridgetops at an angle. Successive entries should be cut downhill toward the observer, maintaining the textured edge.



Note:

—Depth of percentage removal zones varies with size of clearcut unit, species and size of trees, and observer distance. Generally, the larger the unit, the greater the depth of each percentage removal zone.
—Leaving a single species in a mixed stand along clearcut unit peripheries will often achieve the desired effect.

Shape

In addition to designing edges of harvest units, the shape of a clearcut is important.

Clearcuts with shapes that borrow from natural openings in the landscape are more visually pleasing.

The shape of a clearcut may be evident in the middleground or background, but it will probably be less distinguishable in the immediate foreground. Shaping of foreground units generally must be more pronounced to be effective.

Both a natural-appearing shape and edge can sometimes be accomplished in a middleground of multiple small-scale landforms by treating one of the landforms in total.

Achieving a natural-appearing shape is often the function of the logging system's capabilities. Here the natural appearance was achieved by changing the position of the high lead cable anchor point at the lower end of the harvest area. The upper edge could have been improved by removing the thin fringe of trees. Other techniques can be found in the logging system section and middleground application.

Scale

The third important design technique is scale.

Scale refers to the relative size of activities in relation to the surrounding landscape or to the human figure (as in pedestrian-oriented foregrounds).

It is an important variable to consider in any activity design so that activities do not appear too large or too small to accomplish particular site objectives.

The same size clearcuts can be in scale in one landscape and too large in another.

The large clearcut in the center of this photo, though irregularly shaped, is out of scale with this landscape's natural openings and other clearcut units, and therefore draws attention to itself.

Clearcuts on the left are in scale with the natural openings on the right.

Foreground harvest units must generally be quite small in scale to retain the characteristics of a mature forest without natural openings.

This small-scale clearcut totally retains the appearance of the mature forest character as it is seen while moving down the highway.

Detail of clearcut on the left.

This clearcut done in the same area is out of scale (too large) to even partially retain the mature forest character.

Clearcut is in scale.

Clearcut is out of scale.

Distribution (as part of the concept of variety)

The landscape design technique of distribution spreads out impacts of timber harvests over time and space to reduce the negative impacts and create variety in natural-appearing forms, color, and textures.

The landscape on the left has good distribution of harvests over time and space, while the landscape on the right has poor distribution.

Foreground Application

Foreground applications of the landscape design techniques include consideration of (1) observer position, (2) design diversity, (3) mitigating negative elements, and (4) enhancing positive elements. Desired character in the foreground landscape often includes:

—small-scale diversity of trees, shrubs, and ground covers, including those for fall and spring color;

—distinctive tree forms, including appropriate snags;

—small-scale, enclosed spaces;

—natural-appearing edges;

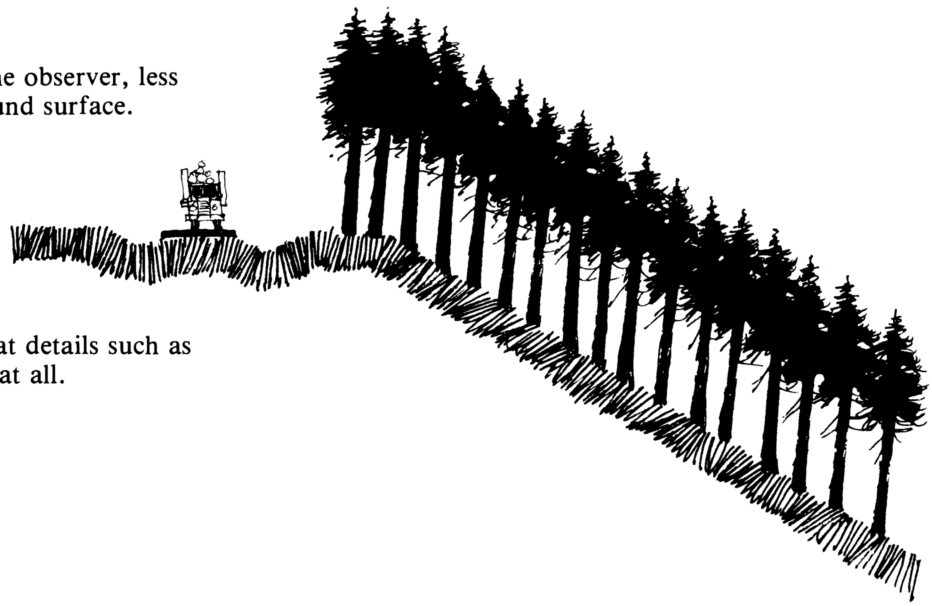
—and attractive bark characteristics

Observer Position

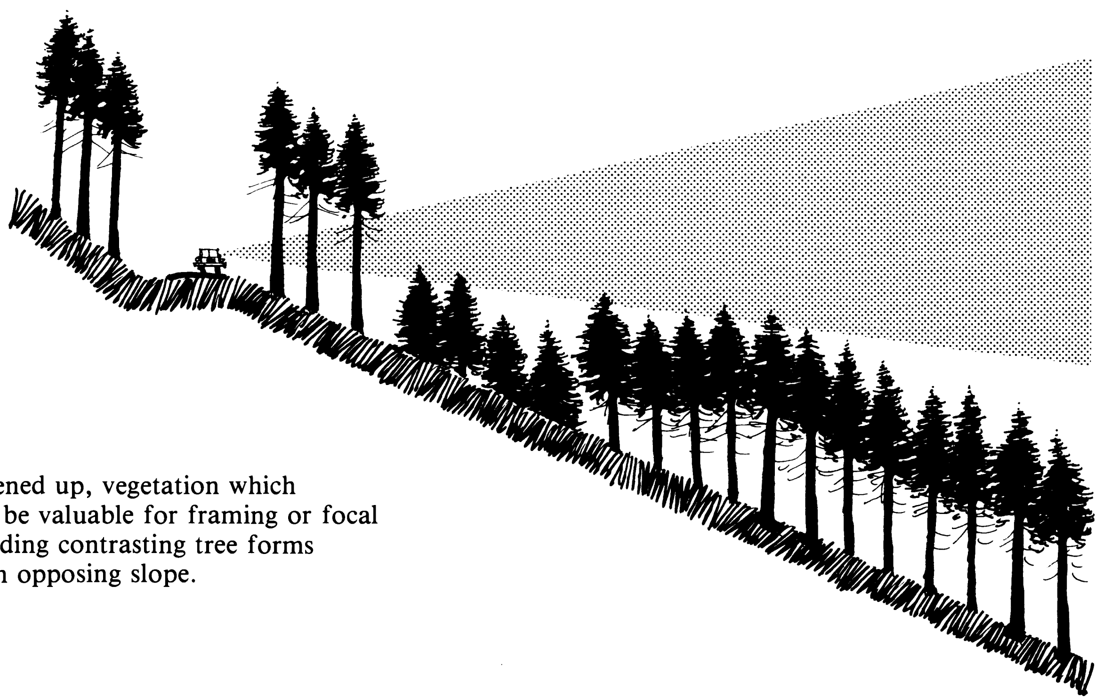
In foreground applications, observer position is one of the first things to consider in landscape design. The landscape may be above, level with, or below the observer. These changing observer positions can create interest in the foreground landscape as well as defining the ease or difficulty of reducing negative elements.

Above

As the slope becomes steeper below the observer, less attention is paid to details on the ground surface.



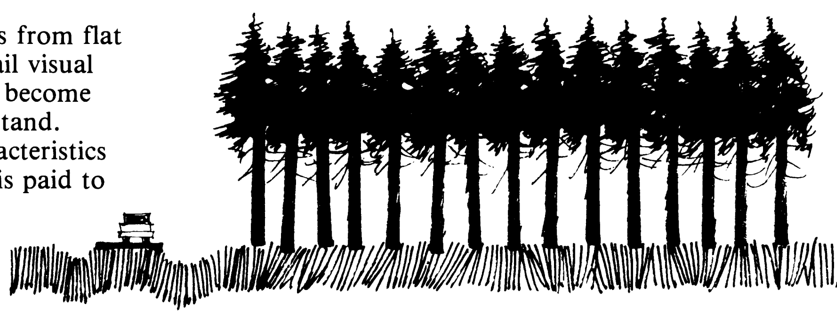
Finally, the slope becomes so steep that details such as debris and disturbed soil are not seen at all.



When the canopy is opened up, vegetation which protrudes into view can be valuable for framing or focal landscapes, or for providing contrasting tree forms against the texture of an opposing slope.

Level

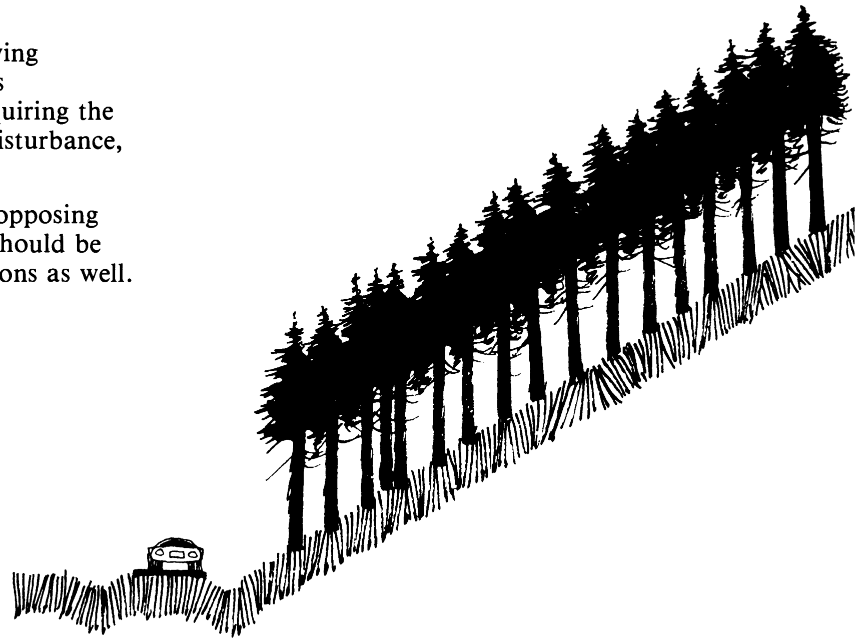
Where the slope adjacent to the viewer varies from flat to about 30 percent above or below, the detail visual characteristics outlined on the previous page become important to a much greater depth into the stand. Activities done to create or retain these characteristics also become more critical as more attention is paid to the ground surface.



Below

As the slope becomes steeper above the moving observer, the area of detail concern becomes foreshortened but more critcally viewed, requiring the most careful treatment of residue, ground disturbance, and similar factors.

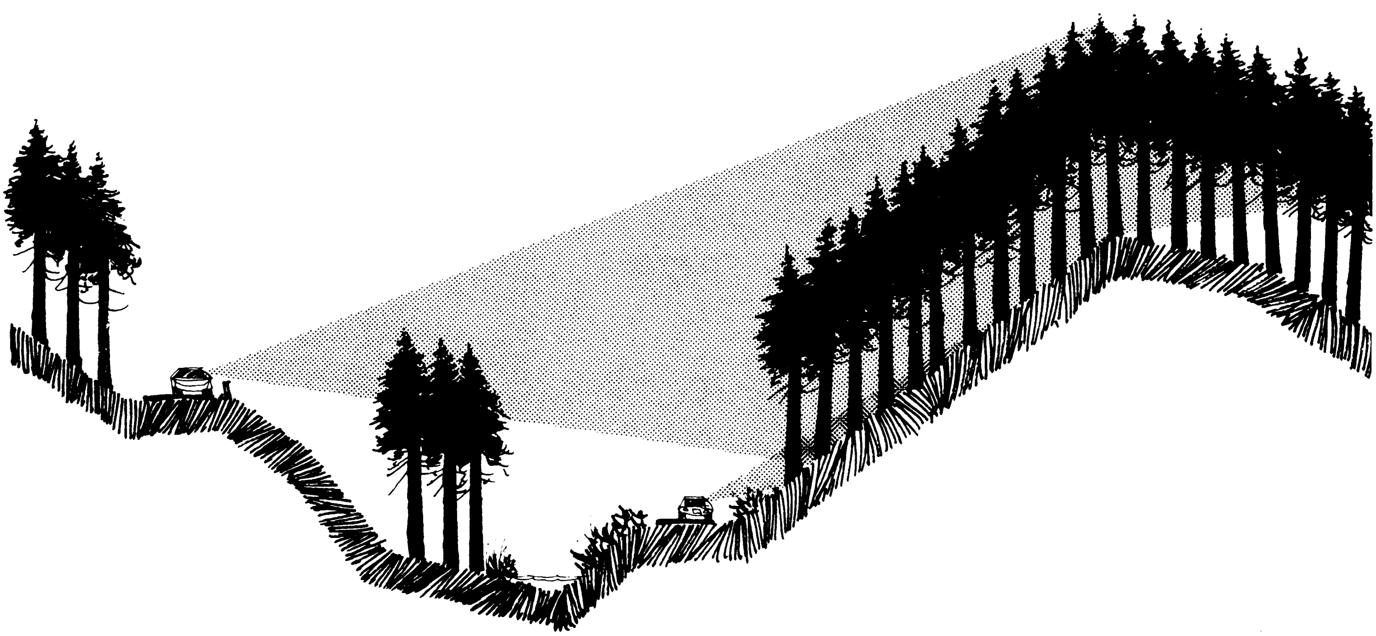
Many such slopes are also seen as enclosed opposing landscapes from other vantage points, and should be treated as viewed from those observer positions as well.



Distant Foreground

Many foregrounds in areas of steep topography are also seen from other vantage points as textured hillsides. Form of tree crowns and groupings of crowns become important. Large tree diameters and subtle bark characteristics are generally of less importance than in the previous three observer positions. Mitigation of debris and ground disturbance tends to be less of a problem because of the potential screening ability of the vegetation. However, roads, landings, and use of skyline cable corridors becomes much more difficult and will often require some of the techniques outlined on pages 204-214.

In such cases, similar treatment should be considered for the entire slope to the top of the ridge. For example, the quality objectives should not change at midslope from *Partial Retention* to *Modification*. If the majority of an opposing slope falls within foreground distances of one-half mile or less, the entire slope should be treated under the designated foreground objective. If the slope is so extensive that the majority is in middleground, it is suggested that middleground treatments be used from the base of the slope, providing there is adequate foreground to give a sense of separation between the observer and the base.



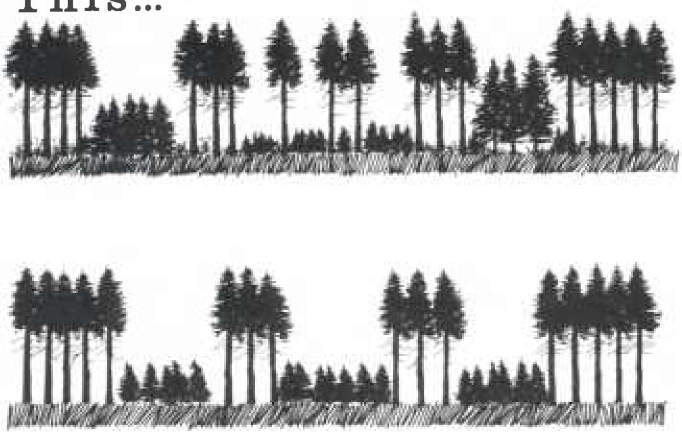
Example of distant foreground.

Design Diversity

Design diversity is the second consideration in foreground landscape design.

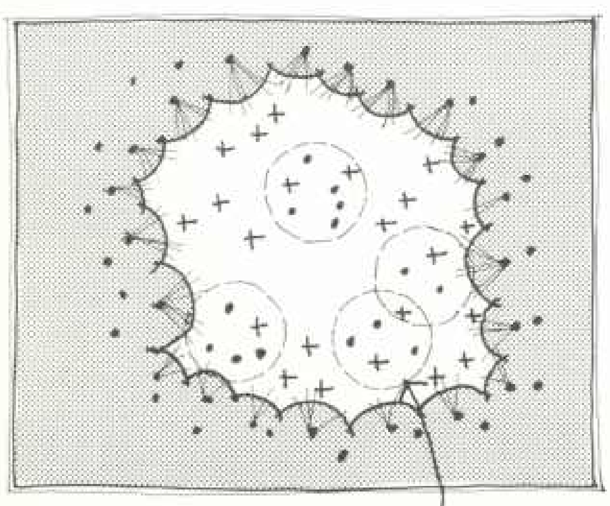
A pleasing diversity of age and size classes can be created by varying the road frontage length and distribution of different sized stands. Depending on the height of regeneration at the time of overstory removal, foreground shelterwoods can generally be larger than clearcuts. Evenly spaced clearcuts or shelterwoods of the same size should be avoided.

This...



but not This

Here diversity of tree species, size classes, small-scale openings, and natural-appearing edges create pleasing visual variety.



The appearance of open park-like stands can be created in shelterwoods and commercial thinnings by clumping some leave trees, creating small open spaces, and, in general, providing irregular or random spacing of remaining trees. Selecting random tree patterns by eye is only one method of achieving this concept. Two other, less difficult, techniques are:

Shelterwood Example (12-15 TPA)

Pick random 50-foot circles within the area to be harvested. Select the 3 to 5 trees within each circle that have the most desirable bark characteristics and that represent both the smallest and largest d.b.h. within the circle. Cut all other trees within the circles, along with all trees outside the circle (see the sketch left). The number of 50-foot circles in the harvest area depends upon the desired leave stand density.

Commercial Thinning Example (Diameter Selection)

Select an upper and lower tree diameter limit. Cut all trees between these limits, with the exception of 3 to 5 random singles per acre to provide middle range variety. These, plus the trees left because their d.b.h. was above or below the cut limits, will give approximately the desired stems per acre, *if* cut limits have been correctly set. The result in most stands is a clumpy irregular appearance. In many cases, the second thinning entry will be easier—merely cutting one or two trees out of each clump (see page 75 in Ponderosa Pine).

A sequence of small- to moderate-size clearcuts, randomly disbursed, could begin to add spacial and eventually size-class variety to this dense tunnel-like corridor of lodgepole pine. A small clearcut was made in the vicinity of the low-branched tree. The result is increased design diversity, plus increased biological diversity.

Here design diversity is still occurring as a result of the regenerated lodgepole pine clearcut in the immediate foreground of this road. Inclusions of spruce, fir, and larch were used as the edge, resulting in a natural-appearing space. It should be noted that the clearcut will in a few year's time no longer be a space but will add vegetative diversity.

In some visual character types where the landscape is viewed primarily as a flat foreground, a variety of natural-appearing open spaces, including large ones, may be in order. This should only be tried where site greenup is very rapid (within stated time periods of VQO).

This 1-year-old clearcut is natural-appearing in edge shape and ground surface.

Foreground precommercial thinnings can be done to create appearances of closed stands or a feeling of space. They may also be done in combination, using the closed stand appearance to emphasize the enclosed space. The single most important concept is that *they both must be done before the lower branches die*. This prevents the "leggy," "feathers on a stick" appearance.

Closed stand characteristics are often desired for the purposes of providing:

—a visual screen,

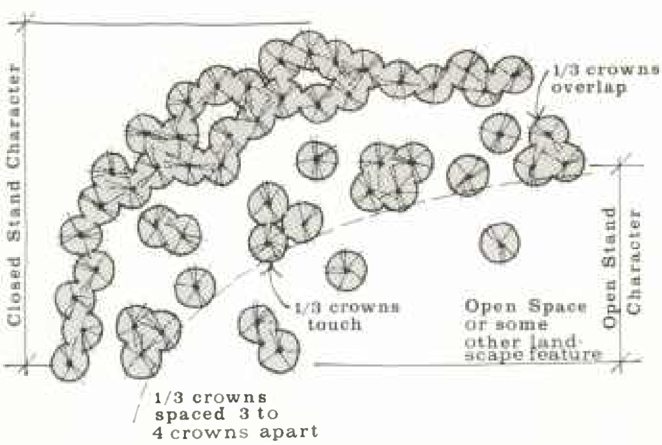
—a constricted feeling along a road corridor to contrast an open stand character further on,

—a foil against which to display a feature or define an open space,

—wildlife cover.

Open stand characteristics are normally used to provide the open part of an enclosed space or to display feature trees, rock outcrops, etc.

A closed stand appearance need not be so dense that growth is greatly restricted.



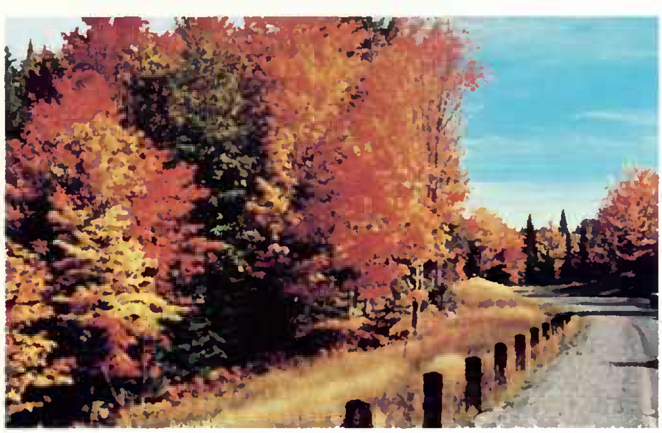
Leave trees should be in irregularly spaced clumps or groups plus singles approximately in proportion as shown here. Spaces between groups should be irregular in size and distribution but large enough to allow roots to grow on at least two sides of each tree.

Example

If the enclosed space created by the 1958 clearcut shown here was to be maintained, considerable thinning should have been done as shown in the previous sketch. In the 1976 photo, the spatial feeling is disappearing and saplings in the enclosed space are not growing well. Not only should this stand be thinned considerably but the more dense stands around it as well to act as a foil and to emphasize the space.

Buckboard Creek. June 1958.

Buckboard Creek. June 1976.

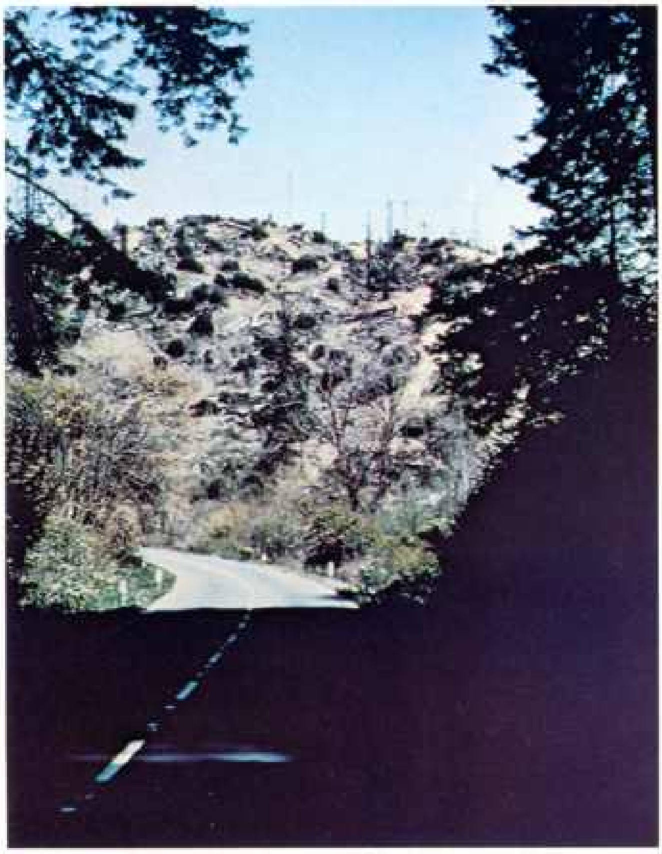


Visual diversity can also be achieved by managing timber stands for diversity of vegetative species.

Managing for both hardwoods and conifers results in desirable color contrast in the foreground.

Mitigating Negative Impacts

Mitigating negative elements is the third concept in foreground application of landscape design techniques.



This foreground clearcut is an example of doing almost everything wrong. It is out of scale, remains in full sunlight in contrast with a dark travel corridor, is at the focal point of the road, is on steep ground, and has visually unacceptable amounts of stumps, snags and gilpokes. These negative elements can be minimized or mitigated in timber management activities.

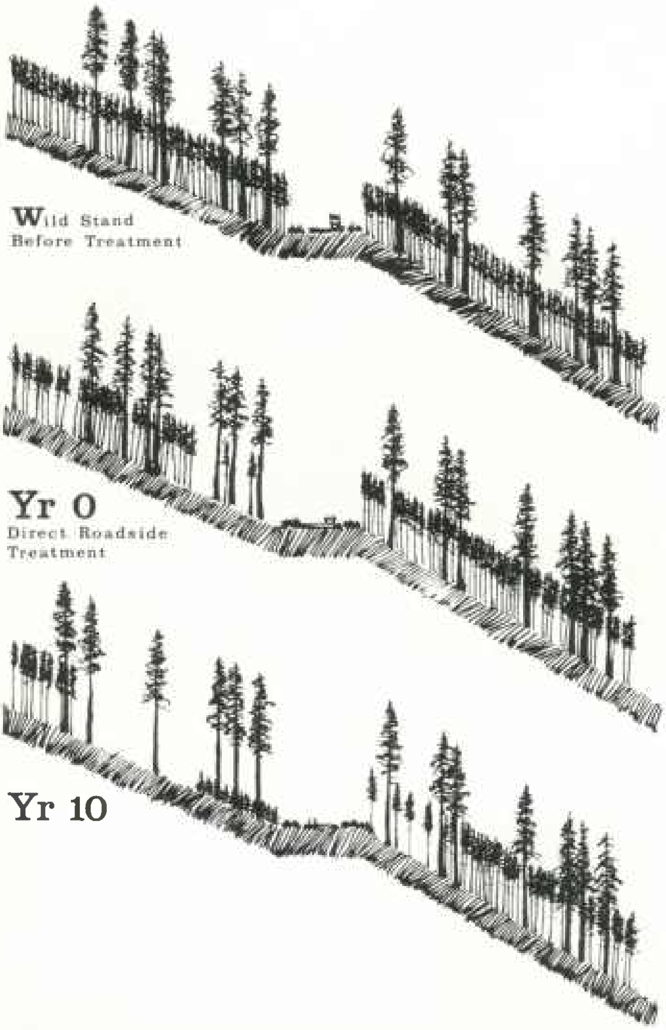
This clearcut achieves many of the characteristics desired for a natural-appearing, enclosed space. Enough sapling and young poles with low branches have been left to create a textured, natural edge effect. Topography is flat. The ground surface from the highway appears fairly natural because of the surface-cut stumps and removal of all identifiable harvest residues larger than very small branches.

Where a natural-appearing space is not desired or cannot be created, the negative elements of regeneration harvest can be made less apparent by placing the activities in areas screened from view. Where vegetative screening does not exist, it can often be grown before regeneration harvest is done.

This regenerated clearcut is below eye level and at such oblique angles to the lines of sight from the road that stumps, debris, soil disturbances, etc., would have little, if any, contrast.

The clearcut creating the small stand of saplings above is of low contrast because, from most *observer positions*, the ground surface is above eye level.

A small clearcut has been introduced behind this roadside vegetation. Negative elements are not evident.



These cross sections illustrate carefully done prelogging or partial cutting to stimulate a seedling/sapling screen before a clearcut is done behind. See lodgepole pine section for more detail. The results of such a cutting in Douglas-fir is shown below.

Stumps can be negative elements in the foreground. Low-cut stumps or a moss covering placed on stumps can reduce their visual impact. A shovel full of dirt thrown across the fresh cut, or stumps cut on a slant away from the road can also be effective.

Moss-covered stump.

Low-cut stump.

Slant-cut stumps.

Over frozen snow, log yarding and debris gathering can often be done with less disturbance to the site than during other seasons. This should be an important consideration in determining alternative treatment approaches.

Enhancement of Positive Elements

Enhancement of positive elements is the fourth technique for foreground application. The before and after photos shown here illustrate a good example of thinning out a foreground screen to display a rock feature. The trees behind were retained as a backdrop for the outcrop.

Before.

After.

Before. This stand has relatively few elements of visual interest or variety.

After. A majority of the large trees in poor biological health have been removed. A few have been retained to contrast agaist the visual elements of color and texture introduced by the young stand in the distance.

Middleground Application

Middleground applications of landscape design techniques can be categorized into one or more of the following areas: (1) observer position, (2) design diversity, and (3) mitigating negative elements.

Observer Position

Observer position is an extremely important factor in determining the impact that management activities will have in the middleground.

These clearcuts are low in visual impact because of relatively flat slopes and/or level observer position.

Although these clearcuts are on a similar scale and slope, they are highly noticeable because of the different observer position.

Design Diversity

Design diversity is important in landscapes viewed as middleground. Retaining or creating diversity of plant species is a function primarily of the silvicultural treatments. Depending on the biological situation, the following are some suggested methods:

Where a species such as this aspen stand is a distinctly separate plant community, it should be treated as a separate viewshed response unit to maintain the stand over time.

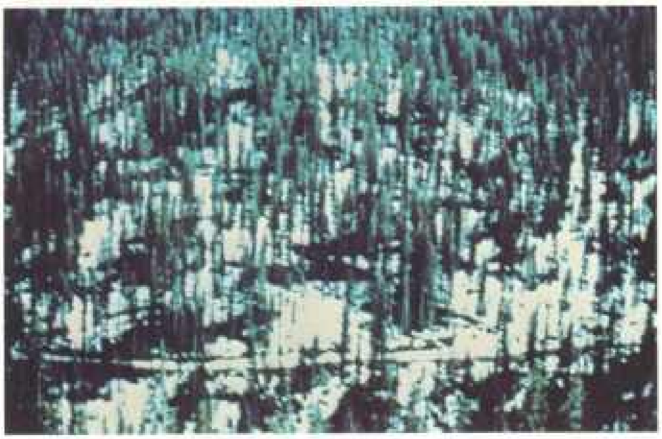
Where desired diversity such as these alders mixed with Douglas-fir are a persistent result of almost any regeneration activity, a sufficient amount of this species can often be achieved by controlling the Douglas-fir stocking at something less than 100 percent. Such diversity is important both from the standpoint of biological diversity and visual interest.

Mitigating Negative Impacts

Negative Impacts can be mitigated in the middleground by:

(1) Reducing texture contrasts of harvest areas,
(2) Reducing color contrast,
(3) Borrowing shape from natural openings,
(4) Borrowing shape from landform configuration,
(5) Including leave islands of untouched vegetation,
(6) Creating natural-appearing edges,
(7) Dispersing harvests over time and space, and
(8) Minimizing roads and landings and skyline corridors.

Clearcuts that repeat the forms and scale of natural openings in the characteristic landscape are desirable. Here clearcuts follow the shape and scale of natural bald knobs.



Texture is retained by the use of a shelterwood. This harvest is a shelterwood cut by groups, leaving openings for burning of debris. Such harvest units must be shaped and in scale with natural occurrences. The regenerated stand must be of sufficient density and height to subdue soil color contrast and tree bole edge before the overstory is removed.

This clearcut follows the directional emphasis of edge lines and is in scale with natural occurrences.

Sheltenwood harvests also reduce soil color contrast.

Leave islands and natural-appearing shape and edge effect help blend this clearcut, although it is still visually dominant. The edge is particularly effective because of the many different tree heights and random spacing. The access road and landings are located to remain partially screened.

Regeneration harvests must be distributed over time and space. Too much cutting in one viewshed without allowing time for healing or greening up between harvests results in a discordant landscape.

This landscape depicts a good example of distribution over time and space.

The results of not distributing harvests.

In this landscape, the timber stands at the top and bottom of the ridge are old growth. The timber in the lower-middle section is young growth, and the upper-middle section is a recently harvested area. This is good distribution over time.

All of these harvests occurred within a very short time.

Landings and roads can totally dominate the middleground landscape unless they are situated to minimize cuts and fills. Their size should be restricted to the minimum that allows for safety and efficient operation. Even with that, some special design techniques may be required to mitigate the negative visual elements. (See logging systems section.)

Roads and landings located and constructed to minimize cuts and fills.

Background Application

In background applications, landscape design techniques should consider:

(1) the adopted Visual Quality Objective,

(2) appropriate design diversity, and

(3) mitigating negative elements.

Background landscapes are generally panoramic landscapes. Where distance from the observer becomes greater than about 5 miles, clarity of detail in both the landscape and man's activities tends to decrease.

Adopted Visual Quality Objective

As a general rule, treatments designed to meet middleground Visual Quality Objectives will usually achieve a VQO which is one level higher when viewed as background.

Treatments designed to meet middleground:	R	PR	M	MM
should meet background:	R+	R	PR	M

However, this is not true for a background skyline, which is the one part of background landscapes still vulnerable to very high visual impacts from timber management activities.

Considerable care needs to be taken with activities that will be silhouetted against the skyline.

Design Diversity

In background, form is generally the most critical design element.

The shape and edge effect of this clearcut is an example of appropriate design diversity in the background.

Mitigating Negative Impacts

Color and texture are subordinate, generally, to form and line.

In the background, regeneration harvests must be dispersed over time and space. At greater distances the contrast of color and texture largely disappears, but the wider panorama allows the viewer to see greater areas.

In the landscape above, harvests have been distributed over time and space, while below they have not.

Planning the Corridor Viewshed

The palette of diversity within a viewshed is often quite extensive, limited only by the landscape designer's imagination.

A corridor viewshed is defined as the total landscape seen or potentially seen from all or a logical part of a travel route, use area, or water body. The purpose of corridor viewshed planning is to provide the management direction for retaining or creating the desired forest character in an attractive sequential arrangement over time and space. This planning should provide the necessary supporting size classes and successional stages to maintain that desired character indefinitely.

In land management planning, corridor viewsheds are those areas selected for intensive visual management.

Corridor viewsheds should include foreground, middleground, and background distance zones.

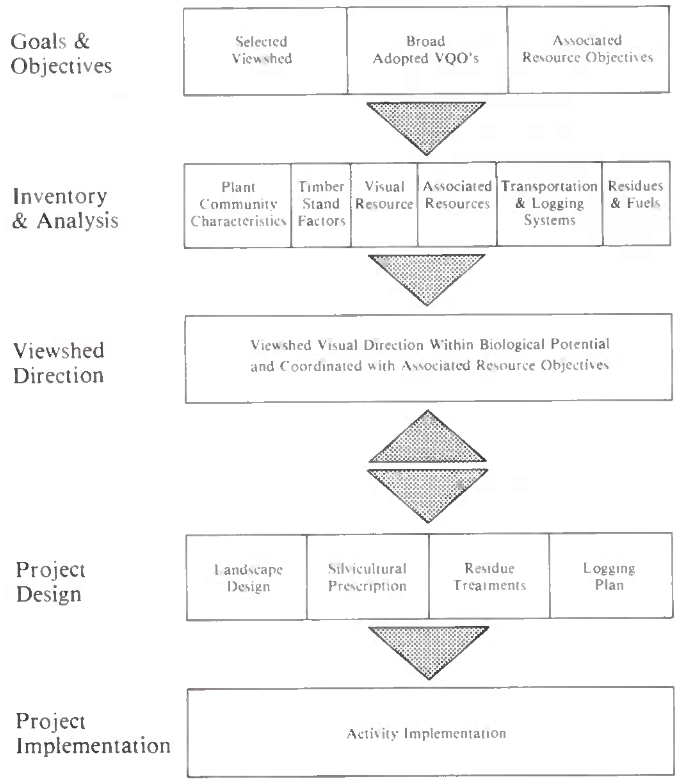
Process

Possible planning processes to establish management direction for corridor viewsheds are of necessity quite varied in both character and intensity. The flow diagram and procedural steps are intended to show the general relationship of inventory, analysis, and direction elements which are necessary in most cases.

Step 1. Identify land use allocation objectives established in land management plans as they relate to the viewshed.

In this example: (a) *Timber-Visual Allocation*—Optimize timber production while meeting adopted Visual Quality Objectives.

(b) *Roaded Recreation*—Timber harvest should be done primarily to enhance the visual resource.



Step 2. Identify Visual Quality Objectives adopted for the viewshed.

In this example: (a) *Retention* for foregrounds.

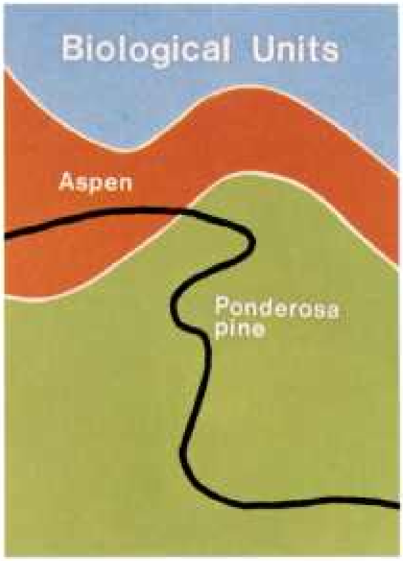
(b) *Partial Retention* for middleground, background, and unseen class A features.

Step 3. An interdisciplinary team should inventory and analyze the various factors as they affect establishment of viewshed direction. This list is not intended to be all inclusive as each viewshed will differ. Most of the data should be available from previous functional and land use studies.

- **Plant Community Characteristics**
- **Visual Information**
- **Stand Information**
- **Wildlife Resources**
- **Soil and Water Data**
- **Range Information**
- **Cultural Resources**
- **Transportation Systems**
- **Logging Systems**
- **Fuels Management**
- **Other**

This community of factors is extremely complex, since most of its parts are interdependent. It is necessary to inventory and analyze these parts so that changes initiated in one will not cause unwanted or harmful effects in another.

Step 4. From inventory and analysis of plant community characteristics, the interdisciplinary team should establish biological units which will react the same or nearly the same to vegetative manipulation. In this case a segment of the corridor viewshed was chosen which contained both climax ponderosa pine and aspen plant communities.



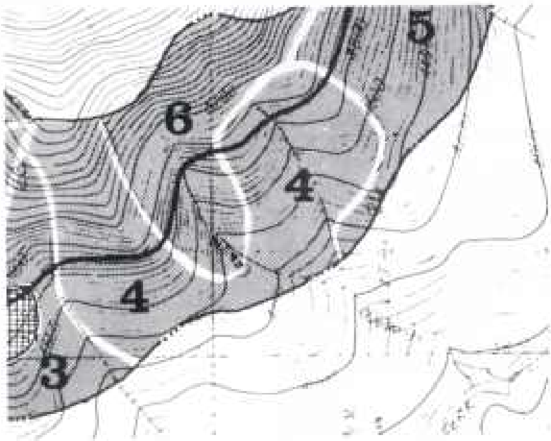
Step. 5. Identify and record areas where, for visual, recreation, or associated resource reasons, the vegetative management will be significantly different.

Step 6. The interdisciplinary team should then combine these two inventories to establish management response units. A management response unit is defined as a homogenous vegetative unit from biological, social, and management standpoints.

Other situations which might constitute separate management response units include such things as:

Calving areas
Winter sports areas
Cultural features
Utility corridors
Fuelbreaks
Watersheds (water supply)

Lodgepole Pine response units (see Lodgepole section).



Where stand sizes are large, such as in lodgepole pine and Douglas-fir, management response units may be further broken down into stands or size classes within a given plant community. This approach also allows a greater sensitivity to response characteristics of slope, aspect, micro-climate, etc.

Foreground

The climax ponderosa pine foreground management response unit will be used as the example throughout the rest of the process *illustrated in this section.*

Step 7. Analyze existing foreground stand character particularly if significantly different from that desired or that can be maintained over time. In this example, the foreground stand character is primarily "open park-like stands of old-growth, deep-furrowed, yellow-bark pine ranging in diameter from 24 to 48 inches."

Maintain open park-like stands of old-growth averaging 30 inches d.b.h., producible in 250 to 300 years, in approximately 20 percent of the foreground.

Small-scale open spaces scattered through about 25 percent of the regeneration treatment areas.

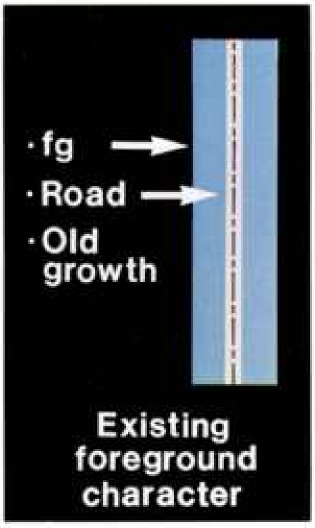
Step 8. Determine the desired visual character from conditions that currently exist, that historically are known to have existed, or that are known to be biologically possible. Adjust desired character to reasonable biological constraints and management limitations. If we are to always have old-growth open park-like stands somewhere within the foreground, we must have a balance of all size classes; each class will predictably move into the next larger size class until old-growth tree character is reached. Then these trees, in turn, either die naturally or are harvested. An identified range of desired characteristics offer the opportunity to create both biological and design diversity in an attractive sequence as one moves down the corridor.

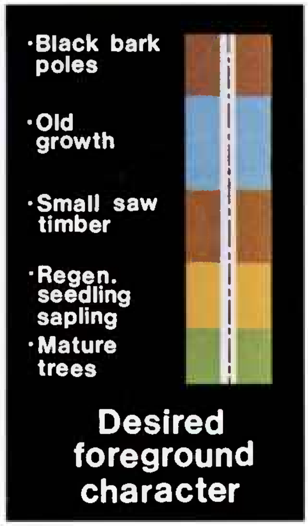
The stages or progression of this concept are illustrated by the photos on this page.

Areas of seedling-sapling texture with a few old-growth accents to grow on to become extra large trees and wildlife snags.

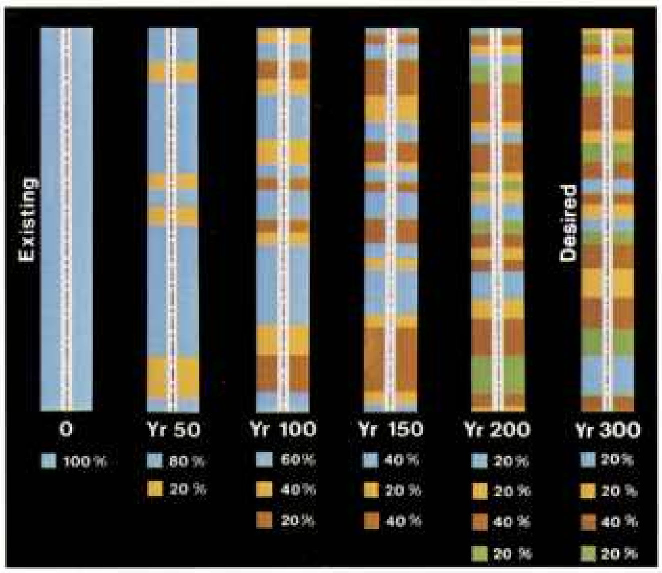
An area approaching maturity—it will eventually replace old-growth stands above.

Areas of "black bark" with a few old-growth trees and wildlife snags.





These diagrams illustrate, schematically, existing foreground vegetative characteristics and biological capabilities as the basis for determining desired visual character. The desired quantity of each size class is based on the proportion of each that is necessary to maintain 20 percent of the foreground in old-growth character indefinitely. The exact quantities will vary on a case-by-case basis.



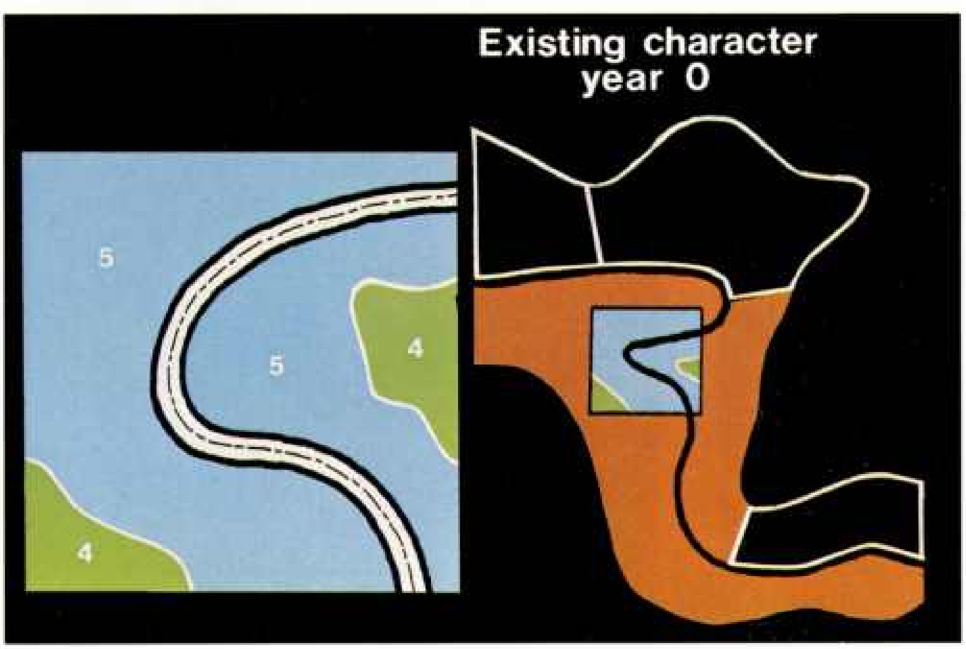
This diagram shows not only existing character (year 0) and desired character (year 200 and year 300) but also the intermediate steps and time periods needed to achieve the balance of size and age class over time.

The conversion of a viewshed foreground to a managed state may start with a total old-growth stand situation, as illustrated, or a mixture of any of the other combinations.

Corridor viewshed planning may end at this point if scale of planning is broad. More detailed and site-specific planning could use the following steps 9 through 11.

Step 9. Map the existing stands by size class.

The drawing below is a plan view showing a segment of existing character at year 0. This same segment appears in the right side drawing to show its relationship to a management response unit.



Step 10. Divide the stands into cells of 10 to 30 acres. Select the cells to be moved to their next size class. The map at year 50 shows 20 percent of the foreground moved through regeneration seedling-sapling stage in the 10- to 30-acre size cells shown as 1 shelterwood and clearcut. The cells are distributed throughout the foreground by design, but collectively represent the 20 percent shown in the diagram.

The 10-acre size minimum was chosen since it is generally the smallest cell size which can be easily recorded. The 30-acre maximum size was chosen to keep the treatment areas outlined in Step 11 within foreground scale. However, it may be acceptable to adjoin several units of varying sizes and move them through situations simultaneously, if that effect is desired.

In order to achieve small-scale diversity and reduce activity impacts to meet *Retention* in foregrounds, it is often necessary to further break up the 10- to 30-acre cells into treatment areas or subunits.

Character at year 50

Step 11. Treatment to accomplish the year 50 regeneration seedling-sapling character is done each decade in small increments that make up 20 percent of a cell. An example of one of these increments is shown in white. At year 50, treatment of the total cell will be complete. Management control of the small treatment areas is done by desired percentages of each cell. The 10- to 30-acre cells, however, are mapped and monitored over time.

Development of such a conceptual silvicultural and visual process is usually about where corridor viewshed planning ends for foreground ponderosa pine and project design begins. The section on ponderosa pine describes development of landscape design criteria and silvicultural treatment concepts to achieve corridor viewshed direction.

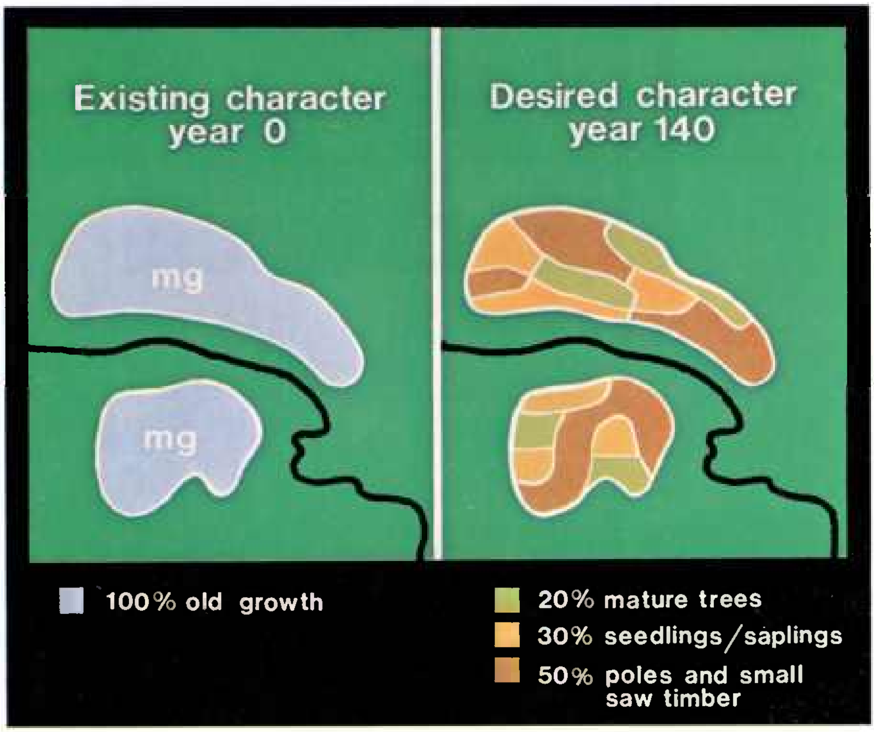
Example increment within a cell

Middleground

The planning process to set middleground direction is essentially the same except that the desired character elements tend to be different. Large tree character and bark characteristics are of less importance. Texture diversity with some scattered groups of mature pine are critical. Size, shape, and dispersement of harvest units, plus attention to minimizing impact of roads and landings, are important.

The change of character from old-growth stands to a balance of size classes might look as diagrammed here. Details of how to achieve this balance for various species can be found in the section on landscape design and in the individual silvicultural sections.

Discussion of inventory factors as they affect planning of the corridor viewshed can be found on the following pages.



Inventory and Analysis of Plant Communities (Including Fire)

Identification of plant communities and analysis of their ecological characteristics is a major factor in successful planning of the viewshed. It is the key to determining the intermediate and mature character diversity possible in each community, and the relative ease or difficulty in achieving that diversity under the adopted VQO. It is important to be able to predict the community's reaction to silvicultural treatment and to prescribe specific treatments to attain a desired combination of trees, shrubs, and herbaceous plants. Plant community characteristics that should be considered in planning include:

—Typical successional stages;
—Productivity of various components such as trees, shrubs, and herbs;
—Kinds of plant species typifying the community;
—Regeneration characteristics of the dominant species (including shrubs and herbs in addition to trees);
—Interaction of the plant community with expected wild animals and domestic livestock.

Typical Successional Stages are important indicators for separating relatively stable (near climax) vegetative components of the landscape from those capable of rapid change (early to mid-successional stages). For example, in the West, ponderosa pine occurs as a climax dominant on some sites where it can be considered stable. However, it is successional to fir on other areas where it has been maintained by lightning fires. If left to the natural process, a situation in which fir reproduction is abundant, any reduction in pine will accelerate a type conversion from pine to fir—at a rapid rate of change.

Productivity Characteristics may be used to evaluate the size, form, color, and texture possibilities of the plants and combinations of plants within a community. For example, large diameter trees may be quite difficult to grow within a reasonable time on sites of low productivity, while on high or moderate sites such elements are quite feasible. The added color and texture of shrubs and herbaceous plants may not be feasible on very dry sites, but quite possible on wetter ones. In the ponderosa pine communities, for example, shrub species are only feasible in those communities that have more moisture than the ponderosa pine-pinegrass community.

Regeneration Requirements are good indicators of the relative ease or difficulty in meeting the contrast element of the Visual Quality Objectives. Natural regeneration of Douglas-fir, for example, often requires both removal of much of the dark, dense upper canopy to provide adequate light and considerable disturbance of the forest floor to allow seeds to reach mineral soil. In this situation, more restrictive VQOs are difficult to meet, particularly in foregrounds, and often require such variations in treatment as hand planting desired

In the top photo, the plant community is mixed conifer-pinegrass. White fir has regenerated under a heavy shelterwood of ponderosa pine. Surface fires formerly prevented fir regeneration.

The middle photo illustrates the same stand 10 years later, with the fir growing and the suppressed ponderosa pine dying (note dead top on ground). Pine will be replaced naturally by fir if fires are kept out of the stand. Fir grows faster in height and diameter than pine; therefore, pine cannot compete under "natural" conditions without fire. Pine could be maintained by thinning out the fir and through stocking level control, so that the pine could grow in height and diameter.

In the lower photo, the suppressed pine has died and been removed. Note stump and dead top from middle picture still on the ground.

species and preplanting more shade-tolerant species near the road.

A myriad of interrelationships exists between the natural system components which comprise a plant community. Managers who wish to manipulate particular strata or species for a particular desired character must recognize and anticipate the relative ease or difficulty of changing or accepting the natural progression of plant communities. If they choose to alter the natural progression, they must consciously plan a level of activity to control change, while achieving the desired visual characteristics, rather than accepting natural change. Managers should consider the following when prescribing treatments:

1. Recognize the inherent potential of the stand for improved diversity by observing similar stands under different degrees of disturbance.
2. Consider what type of diversity will be affected by management.
3. Identify those species from which a response is desirable.
4. Evaluate the successional stages and the relative time periods through which a disturbed stand will progress.
5. Gear management techniques to the kind of diversity being manipulated and the type of vegetation response desired.

Stand Situation is the term used to describe the inventory of plant community characteristics and other stand condition factors necessary to write viewshed direction and prescribe treatments. The inventory should include:

—Species mix of tree, shrub, and ground layers;

—Age of timber stands in terms of situations or growth stages outlined on page 11;

—Volume or number of trees per acre and diameters;

—Thriftiness of the stand, including insect and disease problems;

—Desired species typifying the community but not existing at present, plus an indication of the treatment necessary to cause them to occur.

Most of this information can be gathered in what is commonly known in the Forest Service as a stand or compartment examination. For viewshed planning, this examination may involve only a quick analysis of aerial photos. For project planning, however, it should be of sufficient intensity to develop specific site prescriptions. Ideally, it would be based on intensive, on-the-ground plot samples.

Visual Rehabilitation

Within many viewsheds past management activities, secondary effects (windthrow, mass soil slumps) or natural occurrences of fire, insects, or disease have created alterations to the characteristic landscape that do not meet adopted Visual Quality Objectives. In addition, they also may be so located that a logical progression of harvesting to meet the adopted VQO is very difficult.

As part of corridor viewshed planning, the boundaries of these activities and secondary effects should be mapped. A suggested process by which the negative effects of such activities can be mitigated and the activity areas worked into the long-range progression of vegetative treatments can be found in the section on *Rehabilitation.*

Visual Sequence

The term visual sequence refers to the series of viewed or potentially viewed spaces as an observer might experience them from a road, trail, waterway, or other travel route. Within this sequence of views, the visitor may have a chance to stop and examine a scene in great detail from one point such as an overlook. Occasionally, particularly in use sites such as a campground, the visitor may wander through the landscape examining all segments from many angles.

In viewshed planning, the inventory and analysis of this sequence combined with the biological inventory often forms much of the basis for establishing management response units. Pedestrian foregrounds should generally be considered as separate response units from those which are primarily vehicle oriented. The following procedural steps are suggested:

Canopied and Focal.

Step 1. Categorize the viewshed into broad compositional types using the following categories as a guide: *Canopied, Enclosed, Panoramic.*

Step 2. Within these broad categories inventory the more detailed compositional types, both existing and potential, such as *Feature, Focal or Enclosed Space* (small scale). Such an inventory in plan form might look as shown in the abstraction on the next page.

Detail feature.

Enclosed narrow river valleys.

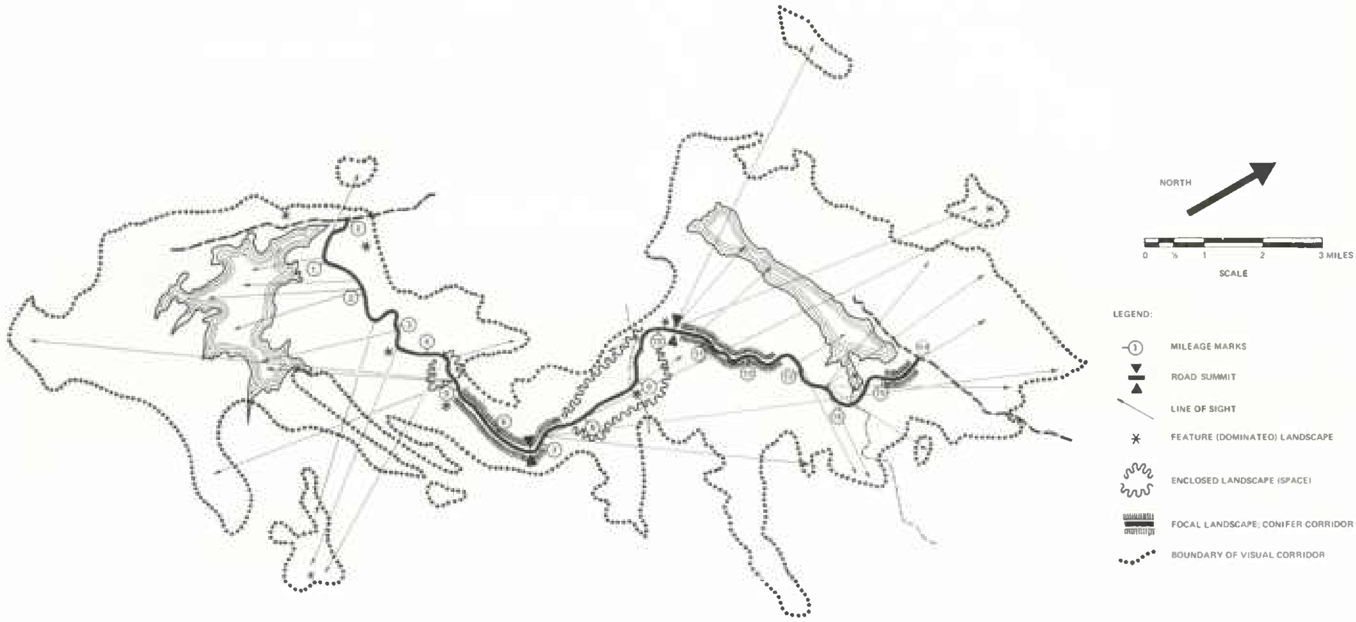
Panoramic.

Step 3. Analyze the proportion, arrangement, and detail elements of all these compositional types as they relate to the *total* viewshed sequence.

Step 4. Where it is desirable to retain certain compositional types, including vegetative and other elements within them, determine from biological studies what direction is necessary for accomplishing this.

Step 5. Where an overabundance of one broad compositional type, such as canopied landscapes, exists, variety within it (such as detail features, focal points, and in general increased diversity of plant species and size

Enclosed broad-valley pastoral landscape.



From R. Burton Litton, Jr., *Forest Landscape Description and Inventories*, PSW-49.

classes) often can be accomplished. This is done after identifying biological and visual opportunities and constraints. Such an enhancement was accomplished in the half-mile sequence illustrated to the right and below with treatments similar to those outlined on pages 154-155. State the viewshed direction needed to accomplish such treatment. It might read as follows:

—Maintain a dominance of mature forest character with an average tree diameter of 36 inches in areas of size class 4.

—Introduce small-scale variety of different age class, shrubs, accent trees, etc.

—Open views to distant features where feasible.

Step 6. Coordinate with other resource and management objectives. Revise as necessary.

26.1 mi

26.7 mi

26.5 mi

Visual Absorption Capability (VAC)

A VAC analysis (see FSM 2382.2) provides an objective basis for predicting whether management manipulations of the landscape will meet predetermined visual quality objectives, or how difficult it will be to meet such objectives.

An analysis of the landscape above would show that most of the factors that affect visual absorption capability are the same on both sides of the photo (slope, vegetation type, observer position, and viewing distance). The one significantly different factor is vegetative patterns. The portion of the landscape to the right has a continuous canopy of trees with no pattern, while the left portion has an interesting natural pattern of closed-canopied forest, grassy glades, and scattered clumps of trees. The left portion of this landscape has higher absorption capability for vegetative manipulation than the right portion.

Because the diversified vegetative pattern is not visible from the lake to the right, it would be difficult to initiate clearcut activities in the continuous canopy without creating significant visual contrasts. However, if the landscape is viewed from the point from which this photo was taken, then the continuous canopy has a higher potential to accept harvest activities because of the higher VAC of the overall scene. Small openings could be created which would repeat the forms, colors, and textures of the grassy glades.

It should be noted that although the landscape to the left can absorb vegetative manipulation relatively easily, developing a transportation system to meet the adopted VQO may present significant problems. Another observer-oriented VAC factor may be necessary to help locate and design such systems as well as aiding harvest unit design. It is termed "visual magnitude" and involves not only distance and the observer's position above or below the activity slope, but also the landscape's vertical and horizontal aspect in relation to viewer position.

This can best be explained by using a computer perspective (not the same area as in the photo) of a combination of opposing slopes.

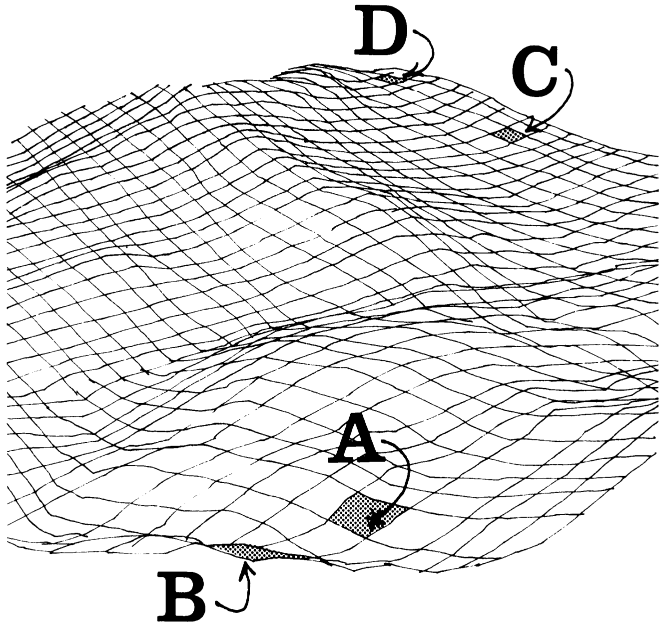
Cell A has a very low absorption capability because of its close proximity and its tilt toward the observer.

Cell B, although closer, has a very high absorption capability since it is tilted nearly on edge to the observer.

Cell C has a lower absorption capability than cell B, despite its greater distance, because it is tilted toward the observer.

Cell D has the highest absorption capability, because of its distance and its tilt away from the observer. However, Cell D also appears to be on the ridge line. Care must be taken not to silhouette a harvest unit against the sky.

In addition to distance and aspect toward the observer, absorption capability is also affected by stand density



and live crown screening ability. Changes in treatment dictated by these factors are outlined in the treatment section.

In viewshed planning, it is important to identify areas of high, moderate, and low visual absorption capability so that costs of various management activities and priorities for landscape architect's involvement can be determined.

Wildlife

Bighorn sheep, for example, should be discouraged along high-speed roads. However, they are edge effect creatures whose habitat is enhanced by both the road edge and vegetative diversity created along the road. Animal use may be discouraged by introducing plant species low in palatability. In the West, pubescent wheatgrass is the least palatable domestic grass available. It is also useable for vegetating cut and fill slopes and other disturbed areas.

Wildlife can add the exciting dimension of movement and sound to the observer's landscape. Although wildlife exists to some degree in almost any landscape, the variety and number of species can often be enriched and better displayed to the viewer, or protected from view if need be, by purposeful manipulation of the vegetation.

The abundance of edge, small-scale openings, and variety in plant community species and successional stages resulting from the silvicultural treatments outlined in this book have direct wildlife implications. See also page 169. However, they must be purposely arranged and scheduled with wildlife objectives in mind, to achieve beneficial results and avoid undesirable or harmful effects.

At the viewshed analysis stage, it is important to identify the:

—Wildlife species typifying the plant communities that may be visually displayed to the viewer, and

—Wildlife species that need to be retained or introduced in the plant communities, but protected from view of observers.

The habitat requirements of each animal species desired should be identified at project level treatment. Guidance can be found in the Landscape Management Handbook on Wildlife.

Beaver activity such as shown in this photo adds considerable interest to this pedestrian observer's landscape. Perpetuating the Aspen stands are a major key to retaining this feature. In many regions they, along with willows, are the primary source of food and home building materials for the beaver.

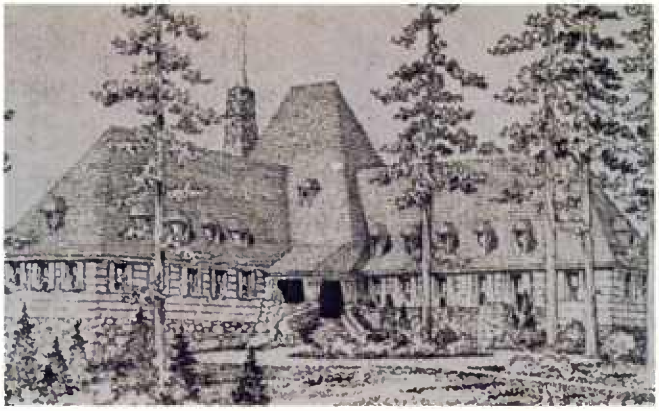
Range

Domestic range animals such as cattle and sheep have historically been an established component of some National Forest landscapes. Where they are an appropriate element of a pastoral landscape, their existence can be encouraged by adequate provision of forage and water. Silvicultural treatments can be scheduled to provide views into some areas of forage and water, for the enjoyment of the observer, if these areas are designed as part of the visual sequence.

Cultural Resources

Cultural Resources consist of historical and archaeological sites found within National Forest lands. Historic sites such as cabins, homesteads, and railroad trestles can add a nostalgic dimension to the visual landscape if adequately highlighted to the viewer. On the other hand, archaeological sites generally should be hidden from view, to discourage illegal surface hunting or digging for artifacts.

Either of these objectives, highlighting an historical feature or screening an archaeological site from view, can be accomplished depending upon the manner in which vegetative treatments are located and scheduled for entry. Details for achieving these objectives can be found in the silvicultural treatment sections.



Historic building to be featured.

At the viewshed-analysis stage, it is only necessary to identify those sites that should be highlighted for public viewing or screened from public view.

Larger scale cultural images such as pastoral landscapes may be handled as part of the desired visual character direction. Separate direction should be given in the viewshed plan, as a *cultural resource goal,* for features or landscapes that are primarily other than visual images. (Example: Indian hunting grounds, which tend to be spiritual rather than visual.)

Burial cairn to be screened from public view.

Grass came back in on this site quickly after harvest, reducing the visual impact. However, these 10-year-old trees established at that time are not doing well because of soil compaction (note shallow root depth in soil pit). A subtle, but long term, visual impact is created.

Soil and Water

The primary emphasis of soil and water concerns in the viewshed should be the protection of those resources regardless of whether visual impacts are created or not. Some soil and water resource impacts are visually spectacular, such as surface erosion, mass failures, sedimentation, and turbid waters. However, others are subtle and less visible, such as soil compaction, loss in productivity, or increased water temperatures.

The latter impacts, though visually subtle in immediate results, can be far-reaching and quite devastating in the long term. Soil compaction and loss in productivity can create unrevegetated site impacts of very long duration. In addition, reaching a specific desired mature character may be greatly hampered. Increased water temperatures can be very detrimental to the fisheries resource and, in turn, affect recreational and visual experiences.

Soil and water resource factors that should be used in writing viewshed direction and on-site treatments include:

—Soil displacement potential,
—Soil erosion potential,
—Soil compaction potential,
—Soil productivity potential (see page 53 and FSM 2382.2), and
—Soil color contrasts of both surface and subsurface soils (see VAC FSM 2382.2).

In addition to guiding viewshed direction and prescription writing, the soil and water resource inventory factors must be used to measure the potential environmental effects of any proposed action, both short and long term.

Tree removal and problems with log yarding systems on this unstable slope created both a strong visual and a soil impact. The slide will continue to ravel for a considerable period of time, leaving a long-term visual impact of high contrast.

Residues

Residue management will almost always be an important consideration in any forested ecosystem where one or a series of silvicultural treatments are planned to achieve visual and other objectives. There will be residues created, and these residues have both positive and negative aspects on many resource values such as:

—Fuel accumulations and fire hazard,
—Reforestation,
—Access for future management activities,
—Wildlife,
—Watershed,
—Aesthetics or visual quality,
—Nutrient balance of site (short- and long-term role in maintaining productivity).

There will normally be natural residues in addition to those that are activity created. In few cases will it be possible to judge residues as simply "good" or "bad," even with regard to a single resource. For example, the variety provided by snags and down logs may have positive visual benefits in moderation, whereas large residue accumulations may be extremely unsightly. Moderate numbers of naturally created debris dams may assist in maintaining physical stability and biological diversity of streams, while large accumulations of fresh logging slash would be detrimental. The proportion of a site's nutrient capital tied up in various residue components is often an important consideration, along with the residue's short- and long-term role in providing a continuous nutrient supply for forest growth. It is increasingly apparent that woody debris plays a more important role in some forest types than has been previously recognized with regard to wildlife, watershed (erosion), nutrient cycling, and even as a substrate for new trees and shrubs. There will be wide variation in the residues and resource values from forest type to forest type (geographically) as well as locally. Fuel reduction will be less important in less fire-susceptible types such as spruce-hemlock in Alaska.

There are many types of treatment to be considered, including no treatment. But it is critical that the manager specifically address the residue problem in viewshed planning. The nature of the expected residues, their relationship to various resource values, and costs and benefits of various alternatives should be considered. Finally, a conscious decision must be made for management of the residues.

Residue treatments are discussed in detail in the Landscape Management Handbook on "Fire"; the purpose of this discussion is to ensure that (1) residues are not ignored in planning (management by default), and (2) the positive as well as negative aspects of residues are considered.

Achieving Desired Character

A desired sequence of visual character should be established and described through the process of corridor viewshed planning. Creating and/or maintaining this desired character on the ground requires development of silvicultural prescriptions and application of landscape design techniques. The following sections of the book illustrate possible silvicultural treatments for six major timber types in the Nation.

Each example represents a different silvicultural process designed to create or maintain certain visual characteristics in a given biological situation:

Ponderosa Pine	—Maintain old-growth characteristics in a climax semi-tolerant species.
Lodgepole Pine	—Convert an intolerant seral species (lodgepole) to a more manageable and visually attractive climax situation (Englemann spruce–subalpine fir, with some larch and lodgepole).
Southern Pine	—Recreate nonexistent, mature tree character; size and species diversity; and small-scale variety in loblolly pine.
Northern Hardwoods	—Maintain old-growth climax forest with areas of subclimax intolerant species for color and texture contrasts.
Douglas-fir	—Maintain a dominance of mature forest character and vegetative texture in a semi-tolerant, but difficult to manage visually, *sub-climax* species.
Sitka Spruce–Western Hemlock	—Maintain a dominance of mature forest character and vegetative texture in a semi-tolerant climax species.

In most cases, the illustrated process is only one of many approaches; but it may be useable also for other species when biological, physical, and desired visual characteristics are similar. The methods presented for the northern hardwoods timber type, for instance, may have some application to the ponderosa pine type, or even to hardwood stands in the Douglas-fir zone.

Each silvicultural process illustrates a series of stand treatments, which, when molded to fit a given site, should provide the scale for regeneration activities, the timing of their entries, and the progression of harvesting within the site. This planning provides the basic parameters within which meeting VQOs should be possible. Landscape design treatments, which are discussed in a previous section, not only influence the silvicultural alternatives but also provide the additional mitigation and enhancement techniques necessary to meet VQOs.

Criteria for the treatment examples are:

—Must be biologically sound as well as technically feasible;

—Must illustrate treatments and variations necessary to meet visual quality objectives of Retention, Partial Retention, and Modification;

—Must design treatments and scheduling so that long-range predictions of harvest yields can be made;

—Must provide treatments capable of being measured, recorded, and monitored over time;

—Must provide opportunities for the most economical logging system and residue disposal techniques that will meet VQOs and other resource goals. Note: In some cases, silvicultural treatments necessary to meet VQOs may considerably increase harvest unit layout costs, as well as time, materials handling, and costs required for residue reduction. Any silviculture treatment design should anticipate the need for treatment of residues.

The reader should be aware that the ecological state of the art at present is such that a long history of plant community observations does not exist. The illustrated character resulting from treatments for each species represents an average of what is expected to happen over time and for a given management response unit. Variation, particularly because of microsite conditions, is expected and will generally add to the visual character. However, in some cases, it may not meet desired character goals.

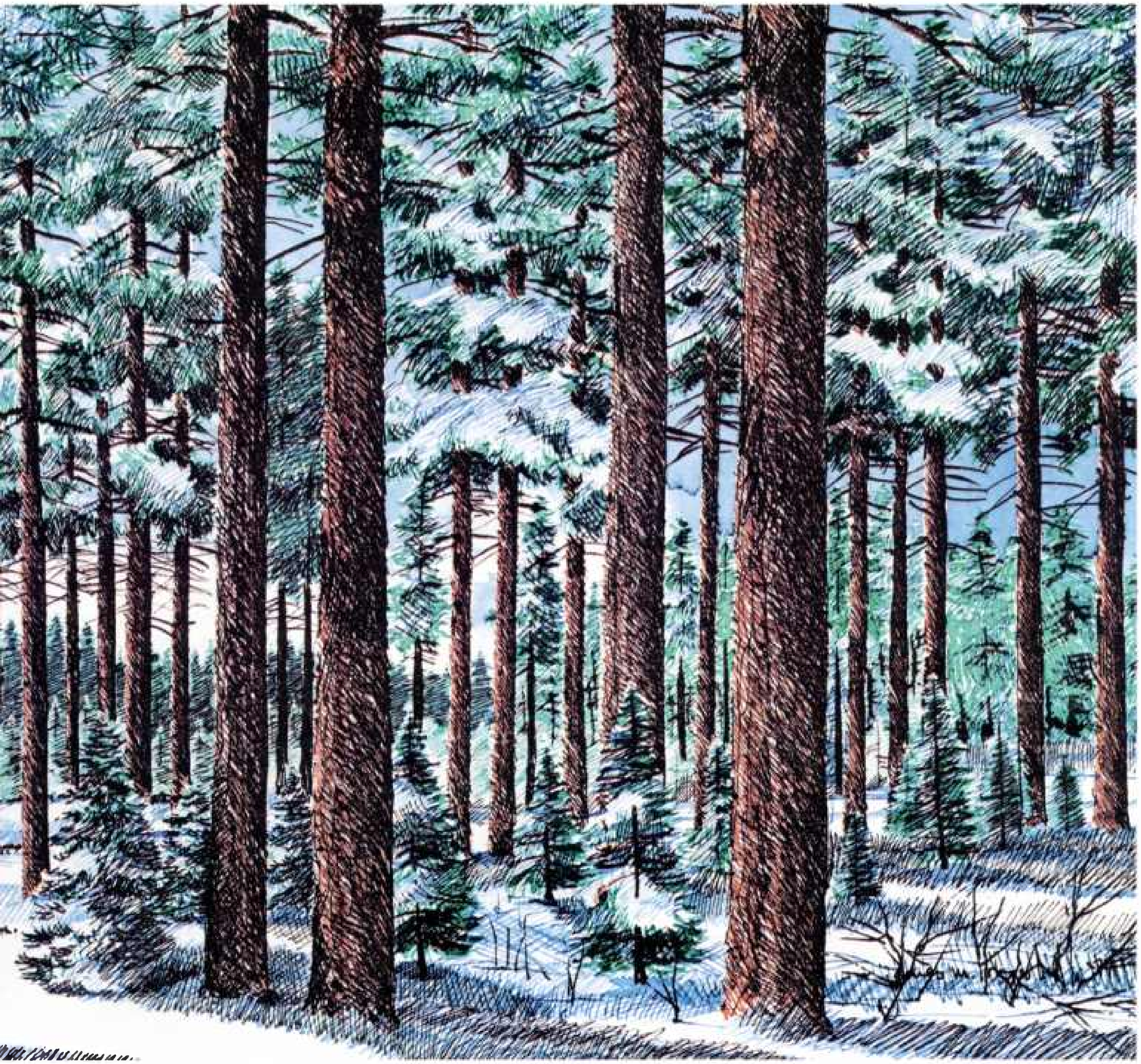
It is also possible that the overall average character within a response unit will not evolve as predicted. Vegetative manipulation can lead to unpredicted changes in plant communities and in plant succession. Monitoring the results of treatments over time and measuring against the character desired then becomes essential. Planning must be flexible enough to permit adjustment in proposed activities that will compensate for natural and perhaps unplanned changes in the particular species growing on the site being managed.

Finally, the proposed treatments under each timber type should not be used as final prescriptions but rather serve as illustrations of an array of acceptable stand treatments. They must be altered and molded to accommodate each specific project condition and constraint.

Ponderosa Pine

The primary visual characteristic associated with ponderosa pine is a concept of relatively large, yellow-bark trees in an open, park-like stand.

It is frequently pictured with a grassy ground cover, growing on relatively flat ground. This condition is historically accurate where ponderosa pine is a climax species and fires are permitted to ignite and burn. These low intensity, frequent fires eliminate most of



the brush and young trees that inevitably become established under the low stand densities associated with mature pine stands.

Ponderosa pine and the species normally associated with it in the Pacific Northwest are capable of growing to large (30- to 40-inch d.b.h.) diameters when density is controlled at a relatively low level.

Individual trees tend to be full crowned, often with 50 to 70 percent of the total tree height in live crown. However, large numbers of small trees will survive for a long period of time at extremely slow growth rates.

In fact, ponderosa pine and the more tolerant species usually growing with it frequently are excessively dense—to the point of stagnation. This condition may retard height and diameter growth for decades, resulting in thickets, which are nonproductive for wood fiber and of little value as a visual resource.

Younger pine trees of merchantable size (9-inch + diameter), like the mature trees, maintain their full crown if grown at low stand densities, but they have dark bark, a characteristic of rapid growth rates.

Open park-like stand with grass understory.

Low-intensity fire used to maintain the open stand characteristic.

It is only when the tree diameter growth rate slows and the older bark is exposed to the weather that the anticipated yellow-bark characteristic begins to appear.

Other species normally growing with ponderosa pine also respond to density control with full crowns and relatively fast growth to the larger tree diameters.

Often hardwood species exist in certain areas of a ponderosa pine foreground corridor and add considerable variety to the pine character.

Individual trees in open-grown stands are deeply rooted and quite windfirm. This characteristic permits a wide latitude in management of harvest techniques, without significant danger of loss to windthrow.

Because of the full crowns, usual abundance of mid-level vegetation, very open stand character, and relatively flat terrain, many standard timber management activities can be practiced with less modification for visual purposes than in other timber types. In the foreground, small clearcuts, up to 2 or 3 acres in size, can often be introduced and achieve the characteristics of a natural opening.

Black bark stage.

Hardwood inclusion within ponderosa pine foreground corridor.

Foreground clearcut.

Initial entries of foreground shelterwoods are often of low impact if the trees are clumpy and unevenly spaced and if ground disturbance and debris disposal are adequately handled. The overstory removal, however, requires that the foreground units to be relatively small in scale or the canopy height, over a large area, will drop excessively.

Middleground shelterwood

Middleground shelterwoods often meet Partial Retention or better on initial entries because of full crowns and open stand character.

Overstory removal requires careful attention to harvest unit boundaries and to location and design of roads and landings. Large clearcuts are not as frequently applied to ponderosa pine as to some other species.

Diversity in mid-level vegetation of many different canopy heights is often characteristic of these stands; particularly in foregrounds, this should be considered one of the desirable elements to retain or create. If properly thinned, the mid-level canopy should provide a valuable visual asset. Some modification of even-aged systems, which provides the appearance of uneven-aged management, is often feasible in ponderosa pine, and should be considered as a management alternative, particularly in foregrounds.

Assumptions

—Full *Retention* of mature ponderosa pine character in both a foreground corridor and middleground landform is possible while moving a stand toward replacement and perpetuation of that character.

—Negative elements arising from slash, skid roads, and disturbed soil can be mitigated to meet VQOs.

—An even-age management system can be applied to achieve VQOs in ponderosa pine and present the appearance of all-age character. The system should be applicable to meeting VQOs of all observer situations, including trail foregrounds and occupancy sites.

Design Criteria

—Design the management process to retain or create irregular appearance, small-scale diversity, and large yellow-bark trees commonly associated with ponderosa pine.

—Control spacing and density in planting, precommercial thinning, and commercial thinning to achieve the highest timber production possible while creating the visual diversity described.

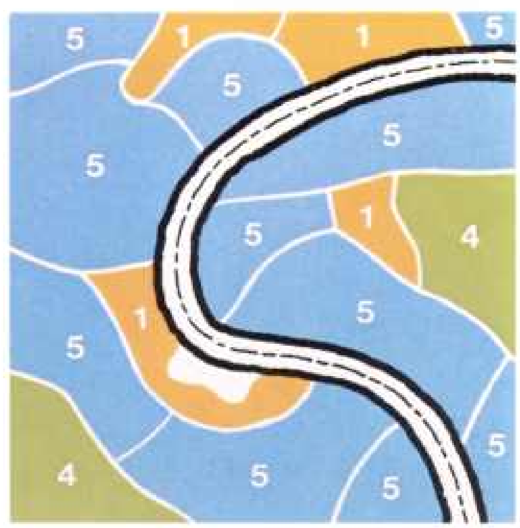
—Design commercial and precommercial thinning entries to accentuate desired characteristics such as large trees, irregular edge, openings, and special vegetation (hardwoods, etc.).

—Accomplish a regeneration harvest in specific areas where animal and vegetative competition will be controlled until regeneration is established.

—Design entry intervals to minimize site impact.

—Provide for residue reduction sufficient to meet fuel abatement needs, the VQOs reforestation requirements, and, where necessary, other resource goals.

A management process designed to achieve this criteria was described in the previous section on planning. Detailed concepts to further carry out the planning direction follow, beginning with an enlarged plan of the treatment area shown in white.



Plan view.

Treatment Concepts

Retain Size Class 4 (Mature Stand) or 5 (Old Growth)

The goal may also be to create it.

The objective is to retain the desired mature or over-mature character until the cell is ready to be regenerated. If a ponderosa pine stand were treated to meet this objective under the following direction, it might look like this:

Actual scene.

Example Treatment—Retention

Maintain *large* (26- to 36-inch diameter) *trees with a stand density* (160- to 200-ft^2 basal area) *adequate to maintain an open park-like appearance* and restrict the growth of understory trees. Old growth characteristics, such as yellow, deep-fissured bark, will occur as a result of additional aging time and restricted growth.

Example Treatment—Partial Rentention

Cells should again vary between 10 and 30 acres. Less emphasis is placed on large tree diameters; desired diameter ranges from 18- to 26-inches. Stand density should still maintain an open, park-like appearance; this would be similar to the level called for in Rentention—about 160- to 200-square foot basal area. The two to five shelter trees per acre left from shelterwood cuts will provide adequate large-tree character.

Create Size Class 1 Shelterwood (sh) (Stand in the process of being regenerated by shelterwood) from size class 4 or 5.

The *objective* is to alter the density of the mature stand sufficiently to start regeneration, yet retain or create special enhancement effects, such as increased visual penetration into the stand at the time of the seed cut. As regeneration becomes established, either naturally or by planting, the open character will be replaced by rather dense but clumpy stands of reproduction. Small clearings sufficient to enframe or feature large trees will be created or retained. See page 34. Varying densities in the clumps will provide screens to avoid continuous deep visual penetration.

This is a progression from the mature stand characteristic; if a ponderosa pine stand were treated to meet the above objective under the following direction, it might look, several years later, as shown in the photo to the right.

Create Size Class 1 Clearcut (cc) (Stands in process of being regenerated by patch clearcut) from size class 4 or 5.

The objective is to create and maintain natural appearing open spaces. Creating such spaces is accomplished as described below in each Visual Quality Objective. Maintaining open space quality is accomplished by controlling the density of planted or natural regeneration to 50 to 70 trees per acre. If this is maintained, commercial thinning should be unnecessary or, at least, much reduced. The open spaces are most effective when displayed against areas of reproduction occurring a decade or two after the shelterwood seed cut.

This is also a progression from the mature stand characteristics; if a ponderosa pine stand were treated to meet the above objective under the following direction, it might look, several years later, as shown in the photo below.

Example Treatment—Retention (class 1 sh)

Retain 12 to 15 shelter trees per acre, in clusters of 3 to 5 trees within a 50-foot diameter circle (see page 32). Trees with the yellowest bark should be selected for shelter trees. The area influenced by these clusters should cover 75 percent of the subunit (see sketch) that is being regenerated and achieve a density of 300+ seedlings per acre within a decade.

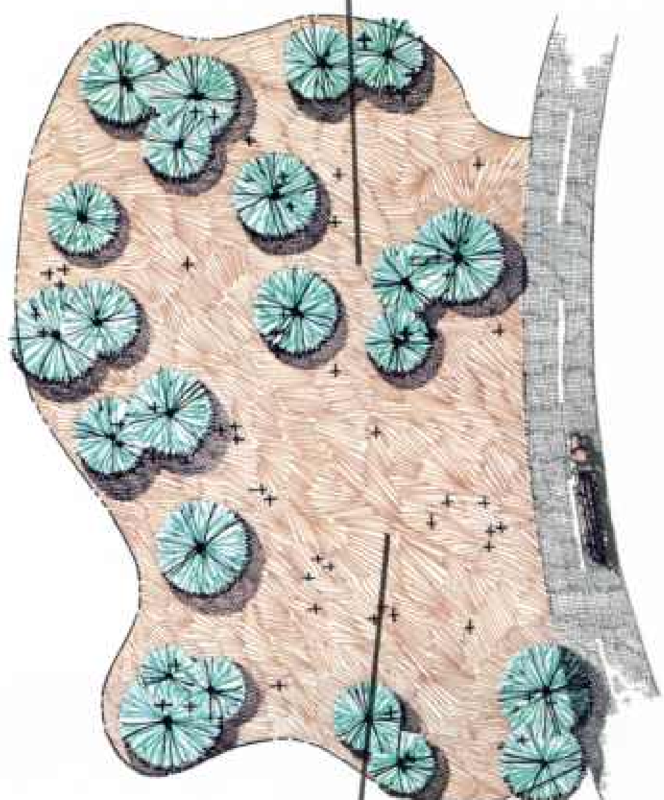
Example Treatment—Retention (class 1 cc)

The treatment area or subunit should consist of openings ranging in size from about 1/4 acre to about 1 acre, with natural or planted stock of 50 to 70 trees per acre. Areas with this stocking level should make up the remaining 25 percent of the selected original mature stand.

Example Treatment—Partial Retention (Regenerating stands)

To meet the *Partial Retention VQO* in this size class, patch clearcut areas could range from 1/2 acre to 3 acres in size, with similar dispersement.

Size class 1 sh.

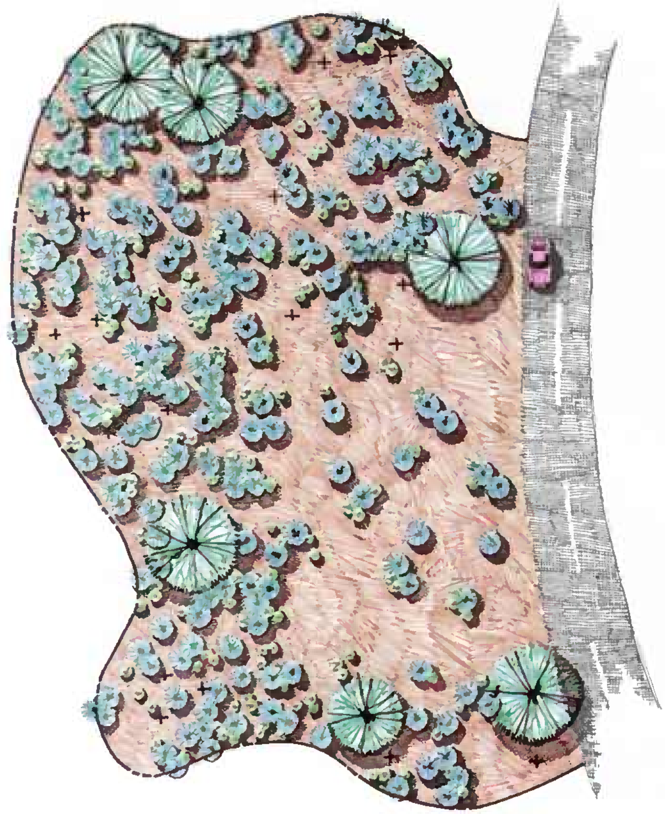


Plan view.

Size class 1 cc.

Create Size Class 1 Seedling-Sapling (ss) (Stands in need of precommercial thinning derived from the shelterwood regeneration harvest.)

The objective is to thin the stands that result from both the shelterwood and clearcut harvest activities, before the trees' lower branches die. Thinning spacing should vary considerably, as illustrated on page 34, to give a natural appearance and add visual depth into the treated area. Precommercial and initial thinning entries may be completed, for the most part, during the same 50-year conversion period as the regeneration cutting, and will probably occur in approximately the same order of entry.



Example Treatment—Retention

Precommercial thinning will be required when the live crown ratio of crop trees falls below 85 percent, or the average stand diameter reaches 4 inches d.b.h.

The initial precommercial thinning entry should reduce the average stand density to 300 stems per acre (note: interplant up to 180 trees per acre (TPA)). When the stand reaches a crop tree average of 6 inches d.b.h., density should be reduced to 180 stems per acre, if a market does not exist for 6-inch d.b.h. material. The remaining shelter trees should appear as scattered singles. Of the five remaining shelter trees, three may be converted to snags during the following 150 years, both for aesthetics and wildlife needs. This conversion would be unnecessary if adequate snags are already present. The two remaining shelter trees may be left to die a natural death after filling the need for a few very large trees with old-growth character.

Example Treatment—Partial Retention

Because of treatment area size, detailed thinning and planting techniques are effective and necessary for only 150 to 200 feet back from the road. The balance of the cell should have some irregularity of thinning for future appearances.

Retaining five shelter trees per acre is still necessary in *Partial Retention,* because these trees provide the only visual link to the old-growth characteristics normally associated with ponderosa pine stands.

A ponderosa pine stand in need of thinning to meet the above objective. Density of shelter trees has been reduced as indicated in the direction.

Create Size Class 1ss (Stands in need of precommercial thinning derived from small clearcuts.)

By design, the stocking established in small clearcuts should be much sparser to retain the open feeling of the unit; spacing should be widely varied to appear natural. This tends to produce additional contrast with the surrounding, more heavily stocked areas. Such contrast is desirable.

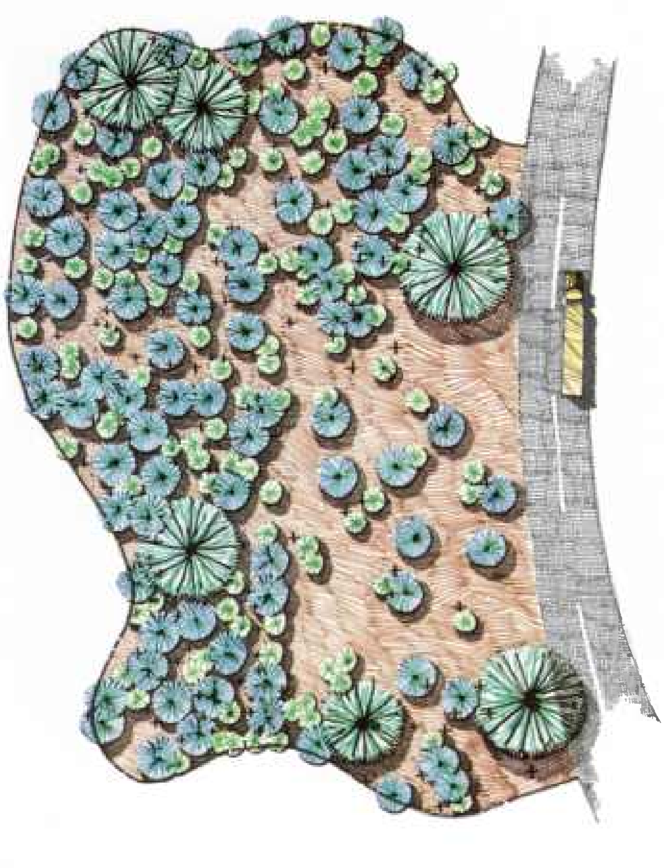
To meet this objective in the same ponderosa pine stand, the techniques described below might be prescribed:

Example Treatment—Retention

Areas created by the small clearcut situation should be precommercial-thinned at 2-inch d.b.h. crop-tree size or fill-in planted, as necessary, to provide an approximate density of 50 to 70 trees per acre. Areas treated in this manner will reach conditions described in the mature situation (open and park-like) earlier than those treated by shelterwood. The use of fire or powersaws may be necessary to create and continue the mature stand (open and park-like) characteristics.

Necessary planting or thinning should be done to retain the open feeling of these small units. This would be achieved if crowns range from 3 to 12 feet apart in a random pattern.

Widely spaced trees after thinning retain a feeling of enclosed space.



Create Size Class 2 and 3 (Stand eligible for commercial thinning.)

As treatment areas within a stand approach this size class, their appearance tends to become more uniform, with a resulting decrease in contrast and diversity. In ponderosa pine, the predominant visual effect of such a stand is the appearance of vertical line (black bark trees). Visual diversity is caused primarily by the varying densities and diameters of trees. The objective should be to maintain this diversity as much as possible.

Example Treatment—Retention

These are stands exceeding an average 6-inch d.b.h., with a density greater than the recommended stocking level. Three or four commercial thinning entries are anticipated to reach a crop tree average size of 16 inches d.b.h. An additional thinning entry will be needed near maturity. Commercial thinning should be accomplished in all portions of the stand before the stand density reaches a level where diameter and height growth are badly restricted.

Commercial thinning should reduce stand density to within ± 10 percent of the recommended stocking. It should also maintain a diversity of spacing and diameter size. Diameter-size diversity can be achieved by varying leave tree diameters to ± 25 percent of the average stand diameter. Variety of tree size will be achieved by the natural growth rate differences of individual trees. Commercial thinning should be accomplished in varying densities, creating contrast with the nearest similar portion. The last commercial thinning entry will be scheduled at approximately 26 inches average d.b.h., as the stand enters (attains) Group 4 characteristics.

Spacing should vary between from 15 to 50 feet. Trees with minimum spacing should have maximum open spaces on at least two sides.

Example Treatment—Partial Retention

The objective and treatments are again essentially the same as those for *Retention,* except that the final commercial thinning entry will be scheduled at a smaller average d.b.h. as the stand enters mature stand characteristics.

This scene illustrates a need for commercial thinning of a few stems from the foreground clumps. Unoccupied space surrounding the groups provides root occupancy room so that clumpy effect can remain. Note remaining old-growth providing accents of color, texture, and form in a predominantly black-bark stage. Tree on left has become a wildlife snag.

A stand after the last commercial thinning as it enters size class 4 characteristics (see page 72). Note remaining old growth at close right filling the need for a few, very large trees.

Predicting Timber Yields

The treatment examples for ponderosa pine illustrate several elements that influence or affect potential yields. These elements include size-of-tree objective, entry cycle, regeneration harvest practice, and the proposition of a given area to which different harvest practices are applied.

Pertinent items that influence foreground Retention scheduling yields are:

1. Entry cycle—20 years.
2. Size of tree—30 inches d.b.h.
3. Harvest practice—25 percent cc and 75 percent sh.
4. Stand age at replacement—250 years.

Foreground Partial Retention yield:

1. Entry cycle—20 years.
2. Size of tree—26 inches d.b.h.
3. Harvest practice—25 percent cc and 75 percent sh.
4. Stand age at replacement—180 years.

Foreground Table
Shelterwood

Age (years)	Height (feet)	Trees per acre (number)	Average tree diameter (inches)	Mean annual increment (cubic feet)
20	20	300	2.0	—
50	48	118	10.0	25.9
110	82	47	18.4	41.3
130	94	43	20.8	43.5
180	110	38	26.4	43.3
250	119	32	30.6	36.9
300	121	29	32.2	31.9

Clearcut

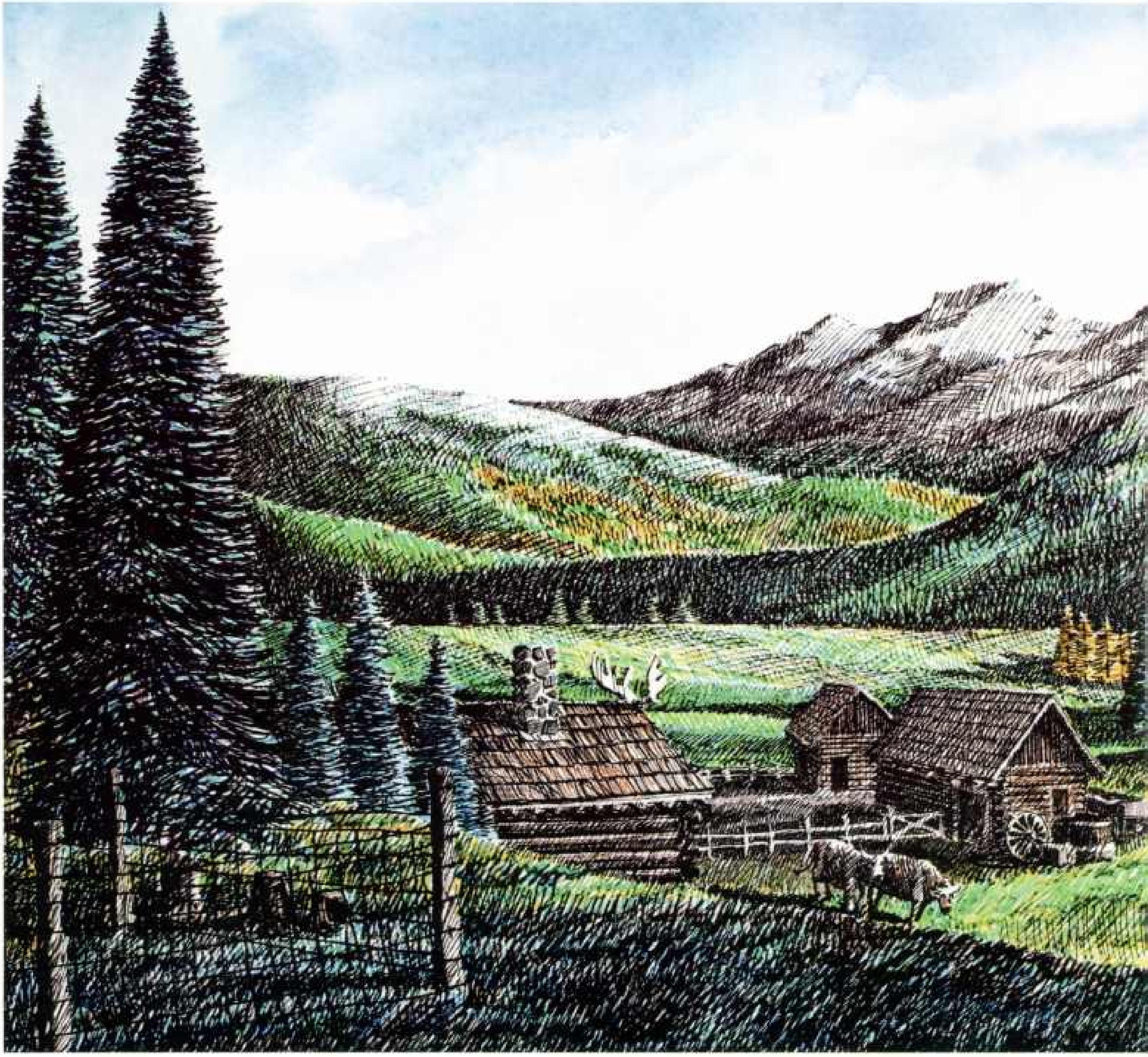
Age (years)	Height (feet)	Trees per acre (number)	Average tree diameter (inches)	Mean annual increment (cubic feet)
20	21	65	3.5	—
50	50	61	11.5	15.5
110	83	42	21.5	33.8
130	94	36	23.5	36.2
180	110	31	28.3	35.7
250	119	27	31.8	29.7
300	121	26	33.4	26.4

Combined Table

Age	Clearcut volumes (25%) (cubic feet)	Shelterwood volumes (75%) (cubic feet)	Total production	Mean annual increment (percent)	Potential yield (percent)
130	—	—	Standard = 54.39	—	100
180	6,441	7,808	—	—	—
Fg PR[1]	(1,610)	5,856	7,444	41.5	76
300	7,421	9,222	—	—	—
300 year *Fg R*[2]	(1,855)	(6,919)	8,774	35.1	65

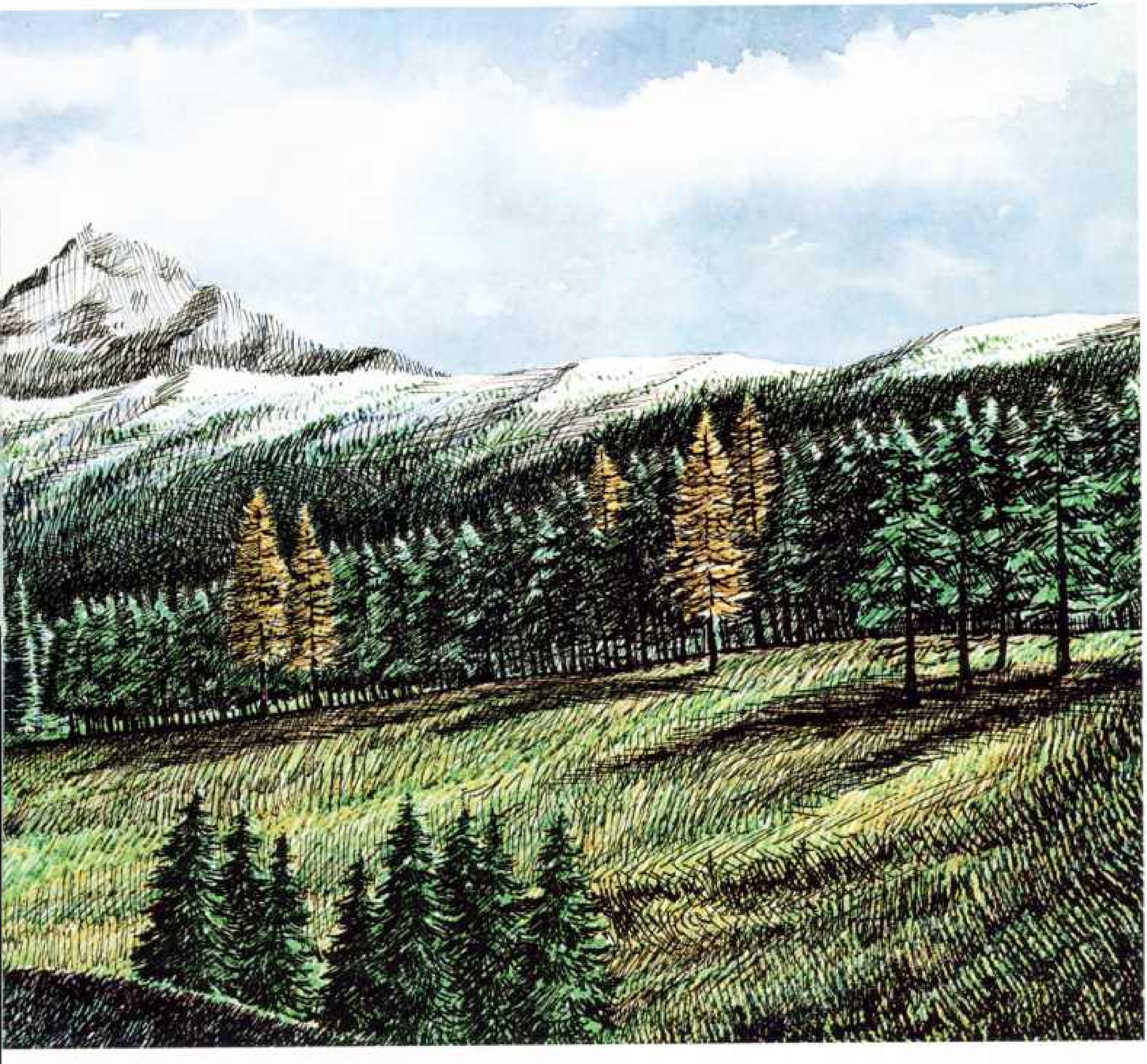
[1]Foreground Partial Retention.
[2]Foreground Retention.

Lodgepole Pine



Silvical Characteristics

Lodgepole pine can dominate stands originating from wildfire or logging on many habitat types as described by the Daubenmires (1968) in northern Idaho and by Pfister et al. (1977) in western Montana. The short-lived nature of these lodgepole stands limits the treatments that a manager, concerned with the visual resource, can use to manipulate the stand over time. On habitat types where lodgepole pine is a dominant seral species, stand decline is underway by age 100 and mortality is usually complete within 200 years (Pfister and Daubenmire 1973).



Lodgepole pine can establish itself so rapidly on disturbed areas that manageable numbers of other species are excluded. Seedling densities which exceed 100,000 trees per acre are common, creating stands that stagnate soon after they become established. Stagnated stands leave the manager little choice but to seek relief with some regeneration method.

Stands that are free to grow face dwarf mistletoe infection beginning at the seedling stage and continuing throughout the life of the stand. Infection can proceed very rapidly in fast growing trees and heavy infection greatly increases mortality.

By the time a free-growing stand reaches 80 years of age, it has attained high susceptibility to the Mountain Pine Beetle. Present at endemic levels in most lodgepole stands, this insect can build to epidemic numbers when stand diameters exceed 7 inches. Almost all lodgepole trees in such stands can be killed within several years.

Fuel accumulations from disease and insect mortality make treatment for Retention and Partial Retention objectives difficult, if not impossible, throughout the entire rotation.

For lodgepole stands in northern Idaho and western Montana, habitat types provide a useful basis for categorizing forest areas. Habitat types describe land of similar biotic potential and help the manager to visualize the vegetative development through stages of plant succession.

On most habitat types where lodgepole is a dominant seral species, lodgepole stands can be converted to other forest types that offer greater treatment flexibility. Culturing lodgepole stands to meet visual quality objectives involves the manager in dealing *first with the lodgepole-dominated stand to a logical regeneration age and next with manipulating the new stand over time.*

Options to manage lodgepole stands for long periods of time are limited. If the stand is not stagnant, thinning can continue growth. By the time the stand reaches about 80 years of age, however, increasing susceptibility to damaging agents prompts a decision to begin the regeneration process.

Some lodgepole stands have an understory of tolerant species like subalpine fir and Engelmann spruce. In most situations it would be difficult to manage for this understory. Partial cuttings to release the understory would increase the susceptibility of the stand to windthrow. This, together with logging debris from the trees removed, constitutes a fire hazard that cannot be reduced without damaging the understory. Complete removal of the overstory would also produce considerable damage to tolerant understories, which are susceptible to the effects of logging. Finally, there is doubt that a suppressed understory can be developed into a manageable stand over the long run. Subalpine fir and Engelmann spruce which have been suppressed for long periods of time will exhibit initial release, but it is difficult to sustain their growth to develop visually acceptable stands. These problems point to the importance of regenerating lodgepole-dominated stands to new stands supporting more manageable species compositions.

Fuel accumulations.

Unmanageable understories.

Visual Characteristics

The visual characteristics of lodgepole pine in dominant seral situations range from stands with outstanding variety to those with extreme sameness. The last situation can create visually monotonous landscapes when viewed extensively from off-site.

Lodgepole pine trees generally are not considered as individual "specimen" trees; their role is usually supportive in larger visual compositions. Individual trees usually do not offer striking visual opportunities in their form, texture, or color. When viewed collectively they present very strong, line-dominated foreground viewing.

The even growth and branching patterns are usually considered visually undesirable when viewed in the early growth stages; in this growth stage they are commonly referred to as "dog hair" stands.

Strong line character for foreground viewers.

Lodgepole pine mixed with larch.

As the stands are thinned and viewed with other contrasting seral species, such as larch, their visual contribution supports better visual conditions. In situations that allow more shade tolerant species, such as Engelmann spruce and alpine fir, to intermingle with stands of lodgepole pine and western larch, a rich diversity of color, form, and texture develops. The stand also begins to offer more vertical diversity.

On some habitat types, pure mature stands that lack strong species diversity can offer outstanding foreground landscapes, with strong line and shading elements. The forest floor is open and park-like, sometimes with bear grass and occasional clumps of shade-tolerant species.

When lodgepole pine is viewed in the middleground, it is most visually desirable when there are a variety of natural openings, which develop into strong compositional landscapes of landform, rock form, and vegetative patterns. Continuous landscapes of lodgepole pine mixed with larch offer striking short-term fall and subtle spring contrast situations.

Assumptions

In displaying an example of lodgepole stand treatment in western Montana and northern Idaho, certain assumptions are made.

1. Lodgepole pine stands can be converted to more manageable species compositions.
2. Suppressed understories of tolerant species generally cannot be developed to meet all visual quality objectives over the long term.
3. Accumulations of forest fuels must be reduced to tolerable levels at some stage in the treatment process.
4. Seral stands dominated by lodgepole will not be able to continually meet foreground VQOs of Retention and Partial Retention during all phases of the treatment process.

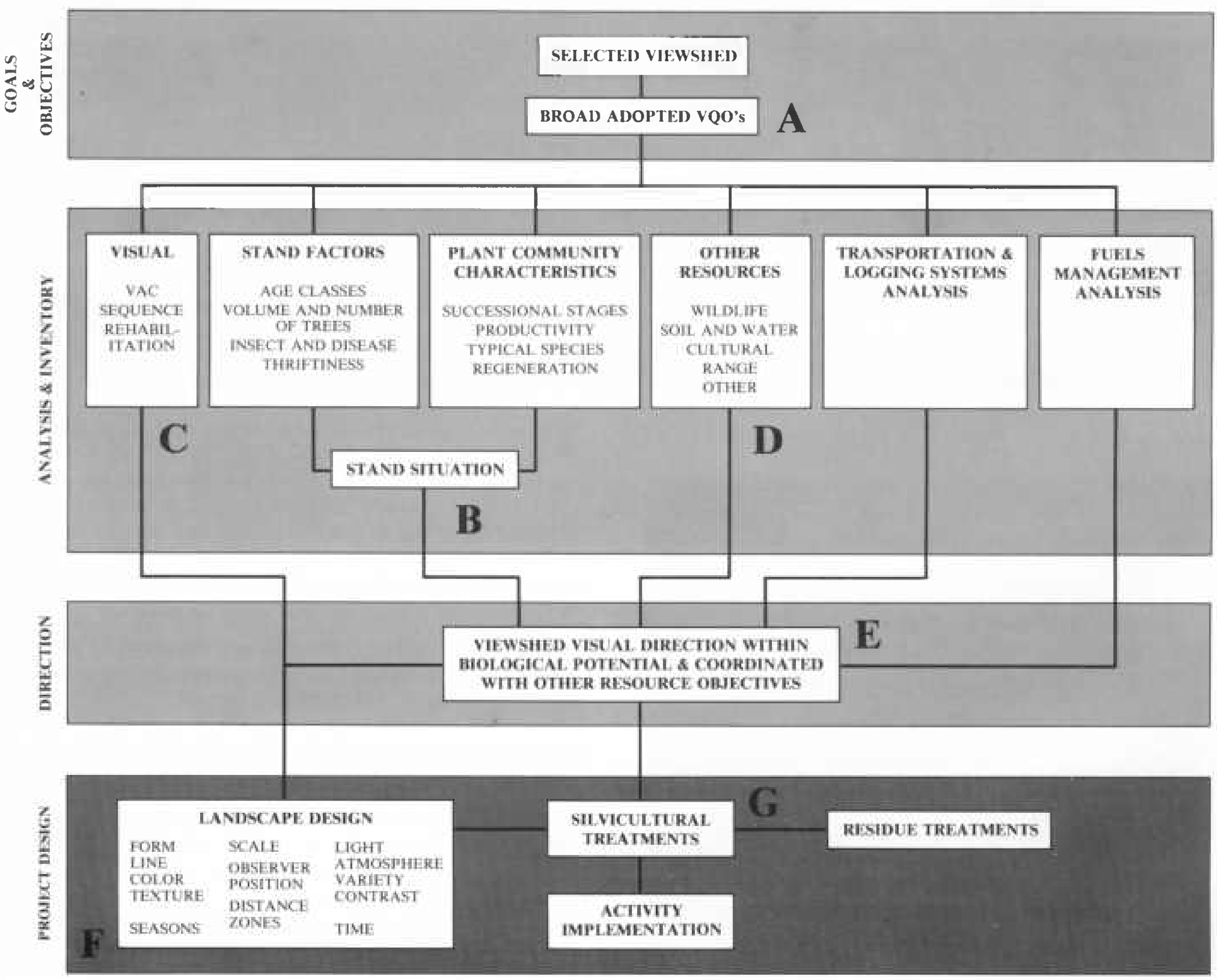
Planning Process

The treatment examples displayed for lodgepole pine are generated within the framework of the *Corridor Viewshed Planning Process* described in the planning section of this handbook. The use of a definable process is important in project design, to coordinate disciplines, and to provide a common basis for change if greater flexibility is required. The process chart shown here gives details of the process with notation references to the steps (A-G) treated on the following pages. Lodgepole pine is used as the example.

Broad Adopted VQOs (A)

Treatments designed to meet visual quality objectives must depend on the specific combination of habitat type, stand situation, and landform encountered by the manager. Rather than trying to describe all treatment

Planning process chart.



possibilities, an example has been chosen to illustrate a technique for developing treatments with one stand situation on one habitat type. Using the broad concept illustrated in the example, managers can respond to their individual needs on their own sites.

The VQOs of Retention, Partial Retention, and Modification have been assigned to the selected treatment area. The middleground has VQOs of Partial Retention and Modification for the same treatment area as used in the foreground.

Visual criteria and guidance are applied to the broad VQO allocations during the inventory and analysis of the visual corridor.

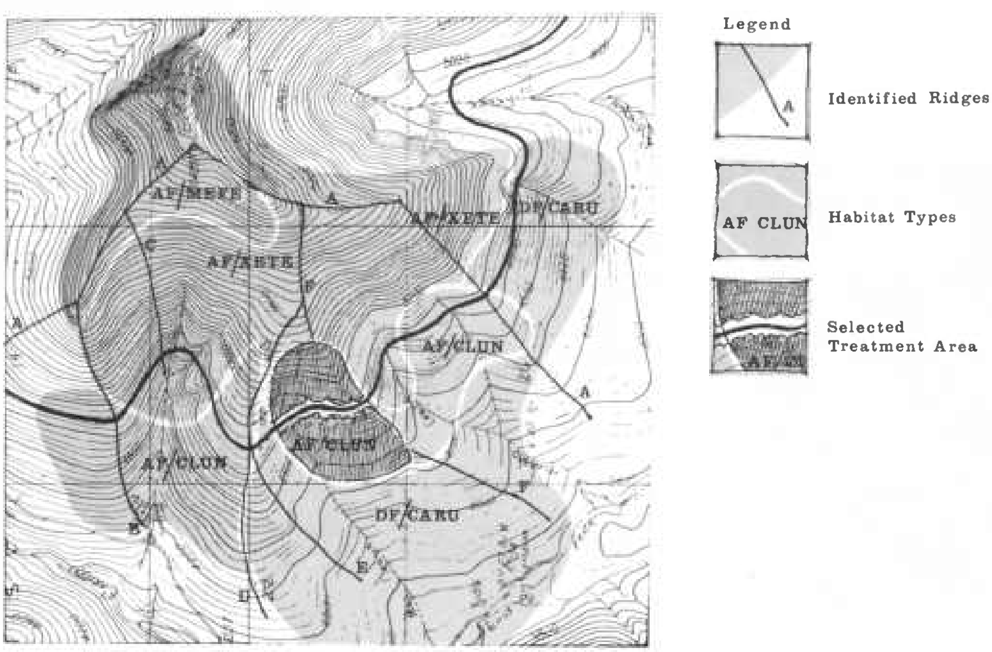
Stand Situation (B)

The stand situation should be a summarization of inventory data needed to develop treatments. The stand chosen for this example is representative of many lodgepole types encountered in western Montana. The following description displays some of the information used in making a treatment decision.

Sixty-one acres in size, this stand is located at an average elevation of 5,200 feet on a west exposure. The stand is bisected by a road whose standard will vary in this example, depending upon whether foreground or middleground viewing is contemplated. Slopes below the road average 50 percent; above the road, 30 percent. The *habitat type* is assumed to be subalpine fir-queen cup bead lily (*Abies lasiocarpa-Clintonia uniflora*), (AF/CLUN as described for Montana in Phister et al. 1973). This habitat type represents the most mesic situation within the subalpine fir series. Undergrowth is abundant but presents no serious competition for seedling development. Subalpine fir, Engelmann spruce, Douglas-fir, western larch, and lodgepole pine are the tree species commonly associated with this type. Productivity is good, and an average site index of 60 (western larch) is used for this example.

The stand to be treated is two-storied with western larch overtopping lodgepole pine. Age of the larch exceeds 150 years and stocking of the overstory trees averages 10 per acre. Lodgepole stocking is 675 trees per acre with diameters from 2 to 11 inches. Included with the lodgepole component are 15 trees per acre of western larch in the 2 to 11 diameter class. The age of the lodgepole component varies, but the majority of codominant crowns belong to trees in the 40-year class. Seedlings of subalpine fir and Engelmann spruce are found throughout the stand wherever ground cover is light. Total basal area for the stand is 140 square feet, and growth based on just the lodgepole component is slightly lower than stand potential. Crown ratios of codominant lodgepole average 30 percent. Total stand volume is 11 million board feet Scribner per acre; 5 million board feet is the overstory larch.

Study Area Base Map



Visual (C)

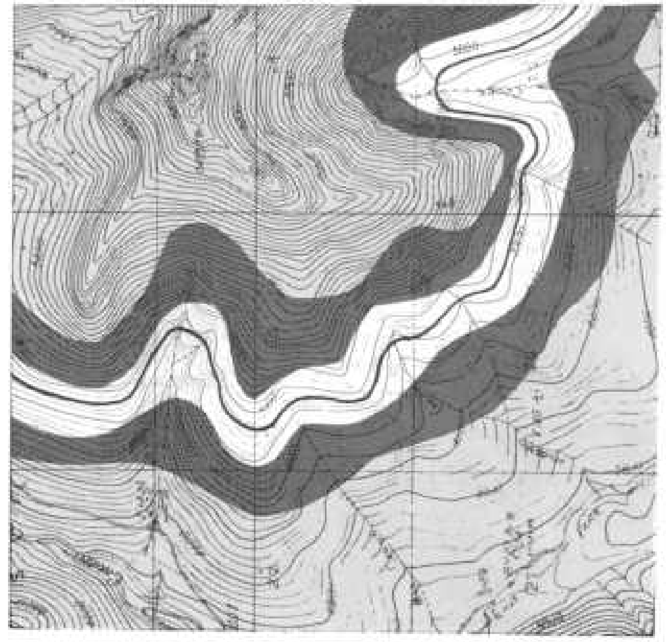
Foreground Inventory and Analysis

Step 1. A major road was identified within the study area corridor. Using the road and the study area landforms, a seen foreground was developed using the distance zone criteria. The immediate foreground in this example was established as 300 to 400 feet on the uphill site and 150 to 200 feet on the downhill side.

Step 2. The landscape compositional types were inventoried as described on pages 55-57. The foreground was not mapped for its visual absorption capability (VAC) but was stratified into two areas within the foreground zone.

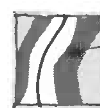
The foreground map, with analysis, was used to interface with stand situations in the cell delineation process of Section E.

step 1
Visual Inventory & Analysis



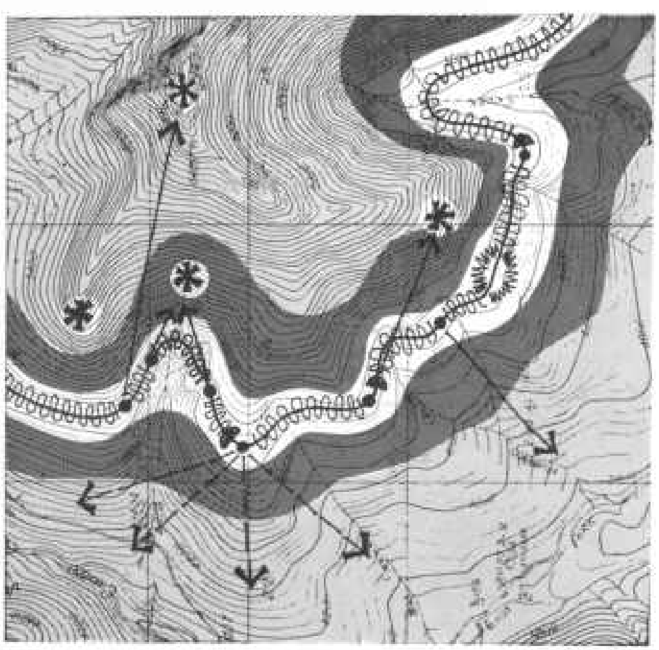
Legend

Defining the Immediate Foreground

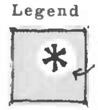


Remaining Foreground

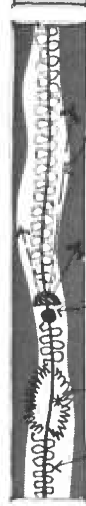
step 2
Visual Inventory & Analysis



Legend



Feature



Potential Views

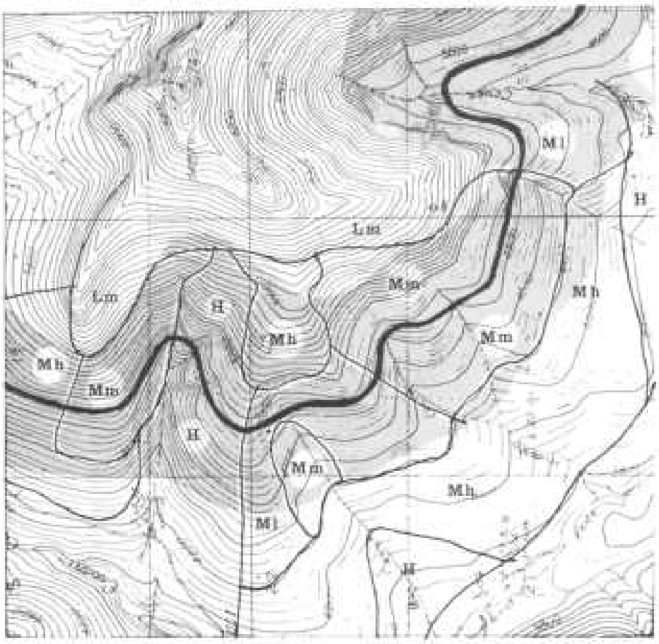
Existing Views

Focal Landscape

Enclosed Landscape

Canopied Landscape

VISUAL ABSORPTION CAPABILITY MAP



Ll • Least able to absorb
Lm •
Ml •
Mm •
Mh •
H • High ability to absorb

Middleground Inventory and Analysis

An observer position was selected with middleground viewing distances of the study area. The maximum distance ranged from 3/4 mile to 3 miles. The observer position is at 3,700 feet and the study area is at 4,600 to 5,400 feet. The area was assumed to have only minor landscape features as viewed off-site but there are strong feature landscapes in the background.

The land planning process usually provides the manager with rather broad allocations of visual quality objectives. The Visual Absorption Capability (VAC) mapping process provides more project emphasis in predicting the visual consequences of the proposed activity.

The VAC process was used in this example to further stratify the study area into units with the same relative ability to absorb clearcut logging and associated roading. It should be noted that there presently are numerous approaches to VAC mapping; VAC mapping is included in this chapter to show how it can logically relate to the landscape management process.

The basic criteria used to develop the initial VAC map were:

—Landform, waterform, and vegetative complexity;
—Distance from significant observer positions;
—Land aspect relative to observer;
—Soil color;
—Slope relative to observer; and
—Vegetative recoverability.

This initial stratification mapping was developed using the above criteria. Computer perspectives were developed, using a desktop computer, plotter, and digitizer to draw conceptual 10- and 20-acre clearcuts. The results of the projections and the use of a screening distance process were used to further adjust VAC units (see map, left).

The visual screening process shows the various steps required to determine view slope. To convert view slope with tree height into the distance screened, the matrix on the following page.

The following specific screening data relate to the selected treatment area:

30 percent ground slope (top portion of treatment area) at elevation 5,200 feet and 11,000 feet from the observer, who is at elevation 3,700 feet.

Tree height (feet)	*Ground slope (percent)*	*Distance screened (feet)*
30	30	190
60	30	380
90	30	600

50 percent ground slope (bottom portion of treatment area) at elevation 4,800 feet and 10,000 feet from the observer, who is at elevation 3,700 feet.

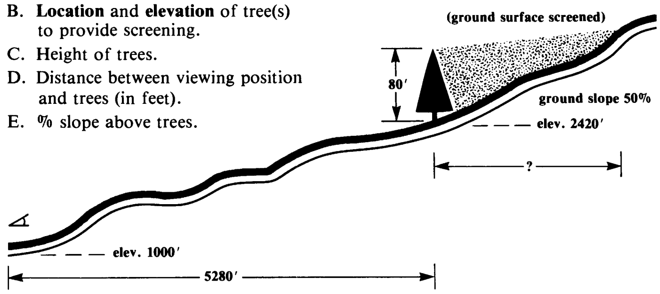
Tree height (feet)	*Ground slope (percent)*	*Distance screened (feet)*
30	50	77
60	50	158
90	50	237

VISUAL SCREENING DISTANCE DETERMINATION

(See Forest Landscape Management Vol. 1, R-1)

To use the tables the following criteria must be determined:

A. **Location** and **elevation** of viewing position.
B. **Location** and **elevation** of tree(s) to provide screening.
C. Height of trees.
D. Distance between viewing position and trees (in feet).
E. % slope above trees.



Step 1—determine the difference in elevation:

elev. & tree ht. (2420' + 80') = 2500'
− 1000'
1500'

Step 2—divide the elevation difference by distance: 5280)1500.00 = .28 or 28%

Step 3—substract the 28% (elevation difference ÷ distance) from the ground slope difference

50%
− 28%
22%

Step 4—use the slope table (back of card) to determine screening
— if necessary the exact slope can be computed.
22% slope would require the 20% slope table with the tree height (80')

20% with an 80' tree equals 400' of screening.

The difference between the 20% table and 25% table for a tree height of 80 feet is:

400'
− 320'
80'

5)80 = 16 + ft./1% slope difference

2 x 16' = 32'

The total screening would be:
(Note steeper slope = less screening)

400'
— 32'
368' ft. of screening

An 80' tree which is 1500' above the viewer at a distance of one mile and on a 50% slope will screen (or visually shadow) 368' of the ground surface.

VISUAL SCREENING DISTANCE

Tree Height	Distance @ 5%	Distance @ 10%	Distance @ 15%	Distance @ 20%	Distance @ 25%	Distance @ 30%	Distance @ 35%	Distance @ 40%	Distance @ 45%	Distance @ 50%	Distance @ 60%	Distance @ 70%	Distance @ 80%	Distance @ 90%	Distance @ 100%
10′	200′	100′	67′	50′	40′	33′	29′	25′	22′	20′	17′	14′	13′	11′	10′
20′	400′	200′	133′	100′	80′	67′	57′	50′	44′	40′	33′	29′	25′	22′	20′
30′	600′	300′	200′	150′	120′	100′	86′	75′	67′	60′	50′	43′	38′	33′	30′
40′	800′	400′	267′	200′	160′	133′	114′	100′	89′	80′	67′	57′	50′	44′	40′
50′	1000′	500′	333′	250′	200′	167′	143′	125′	111′	100′	83′	71′	63′	56′	50′
60′	1200′	600′	400′	300′	240′	200′	171′	150′	133′	120′	100′	86′	75′	67′	60′
70′	1400′	700′	467′	350′	280′	233′	200′	175′	156′	140′	117′	100′	88′	78′	70′
80′	1600′	800′	533′	400′	320′	267′	229′	200′	178′	160′	133′	114′	100′	89′	80′
90′	1800′	900′	600′	450′	360′	300′	257′	225′	200′	180′	150′	129′	113′	100′	90′
100′	2000′	1000′	667′	500′	400′	333′	286′	250′	222′	200′	167′	143′	125′	111′	100′
110′	2200′	1100′	733′	550′	440′	367′	314′	275′	244′	220′	183′	157′	138′	122′	110′
120′	2400′	1200′	800′	600′	480′	400′	349′	300′	267′	240′	200′	171′	150′	133′	120′
130′	2600′	1300′	868′	650′	520′	433′	371′	325′	288′	260′	217′	186′	163′	144′	130′
140′	2800′	1400′	933′	700′	560′	467′	400′	350′	311′	280′	233′	200′	175′	156′	140′
150′	3000′	1500′	1000′	750′	600′	500′	429′	375′	333′	300′	250′	214′	188′	167′	150′
160′	3200′	1600′	1067′	800′	640′	533′	457′	400′	356′	320′	267′	229′	200′	178′	160′
170′	3400′	1700′	1133′	850′	680′	567′	486′	425′	378′	340′	283′	243′	213′	189′	170′
180′	3600′	1800′	1200′	900′	720′	600′	514′	450′	400′	360′	300′	257′	225′	200′	180′
190′	3800′	1900′	1267′	950′	760′	633′	543′	475′	422′	380′	317′	271′	238′	211′	190′
200′	4000′	2000′	1333′	1000′	800′	667′	571′	500′	444′	400′	333′	286′	250′	222′	200′

NOTE: **1**

"View Slope"
Observer Dist. $\sqrt{\text{Difference in elv.}}$

2

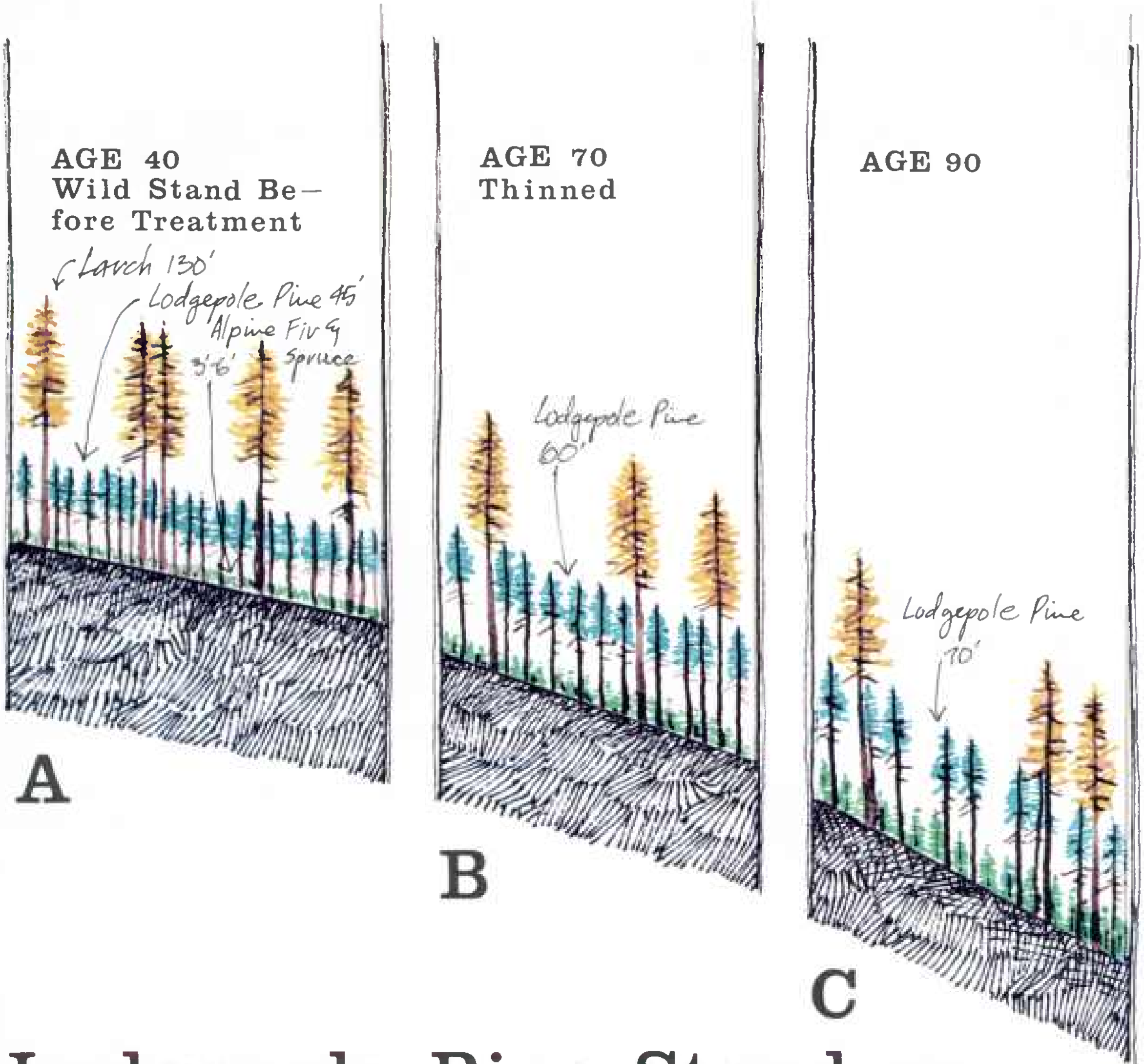
Ground Slope
− "Viewed Slope"
Slope Difference

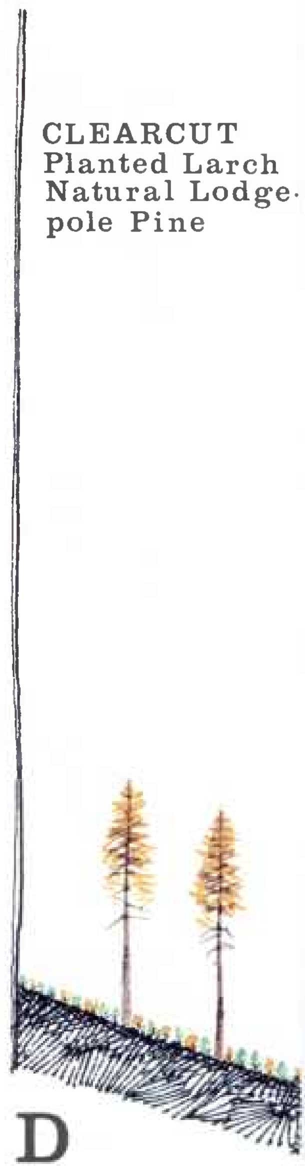
3

Slope Difference/Tree Height = Visual Screening Distance (above table)

Other Resources (D)

No attempt will be made to interface resources other than Timber and Visual in this treatment example. What is significant is recognizing the opportunities and constraints the resources not mentioned can have on land management within the corridor. The resources not included in the example would normally receive management direction through the Forest/Unit Planning process and would be inventoried and evaluated in a manner similar to that displayed for the Timber and Visual resource.





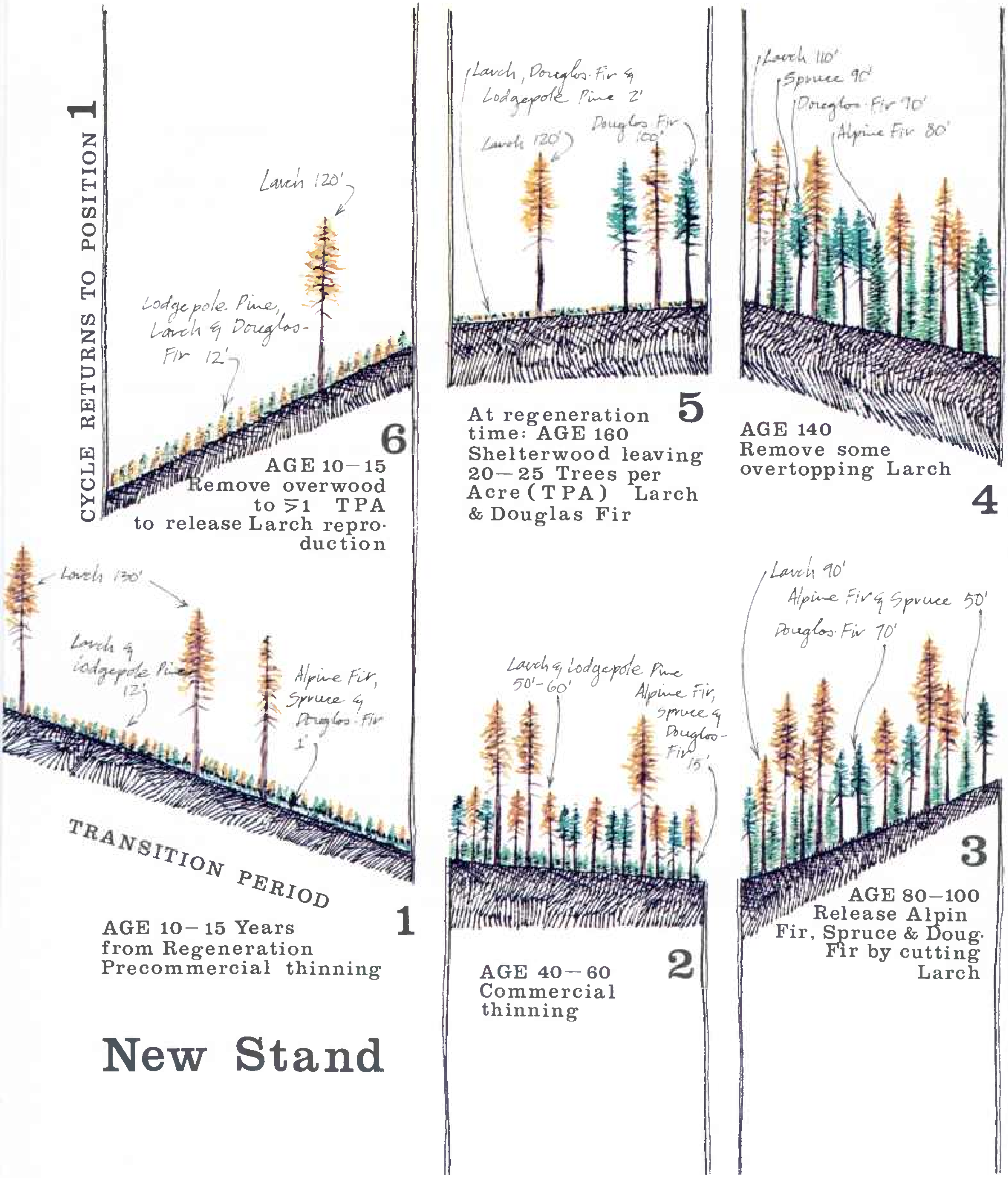
Lodgepole Pine Stand on Selected Treatment Area

Silvicultural Direction (E)

As described in the introductory section, *Lodgepole Pine Characteristics,* treatment of lodgepole pine stands generally involves three steps.

1. Management of the lodgepole stand to regeneration age. Sections B and C.
2. Regeneration to a stand with more diversity. Section D.
3. Management of the new stand. Sections 1 thru 6.

These steps are portrayed here as part of a total plant successional sequence. On the following pages, they are explained in more detail for both foreground and middleground Visual Quality Objectives. Treatments suggested are only one of several alternatives and can vary considerably for different habitat types and stand conditions.


CYCLE RETURNS TO POSITION 1
Larch 120'
Lodgepole Pine, Larch & Douglas-Fir 12'
6
AGE 10—15
Remove overwood to ⩾1 TPA to release Larch reproduction
Larch, Douglas-Fir & Lodgepole Pine 2'
Larch 120'
Douglas Fir 100'
5
At regeneration time: AGE 160
Shelterwood leaving 20—25 Trees per Acre (TPA) Larch & Douglas Fir
Larch 110'
Spruce 90'
Douglas-Fir 70'
Alpine Fir 80'
AGE 140
Remove some overtopping Larch
4
Larch 130'
Larch & Lodgepole Pine 12'
Alpine Fir, Spruce & Douglas-Fir 1'
TRANSITION PERIOD
1
AGE 10— 15 Years from Regeneration
Precommercial thinning
New Stand
Larch & Lodgepole Pine 50'-60'
Alpine Fir, Spruce & Douglas-Fir 15'
2
AGE 40— 60
Commercial thinning
Larch 90'
Alpine Fir & Spruce 50'
Douglas-Fir 70'
3
AGE 80—100
Release Alpin Fir, Spruce & Doug. Fir by cutting Larch

Landscape Design Criteria (F)

After the inventory, analysis, and direction have been established, the next step is to develop desired visual character criteria and landscape design techniques. The desired visual character criteria are needed to give the necessary specific visual direction. It is during this phase that initial creative concepts are further tested as to feasibility with other project and biological constraints.

Meaningful design techniques and desired visual character, which can be described in narrative format, should be established to communicate, as much as possible, the design intent to the various disciplines involved. The following suggested landscape design techniques and desired character for the selected treatment area should *not* be considered all inclusive.

Design elements, principles, and variable factors[1] cannot be defined for all site specific conditions. After the silvicultural prescriptions have been written, the less tangible design factors are developed into conceptual layout and final unit layout. It is not the intent of the lodgepole pine chapter to show a final design solution for the many possible design options within the selected habitat.

There may be few, or only one, biological options, to meet an adopted VQO, but the design opportunities are usually quite extensive and limited only by the designer's imagination. Factors such as policy, economics, and biological limitations are usually more constraining.

Foreground—Retention

Using the broad visual goals, adopted VQOs and resource inventories, the following specific landscape design techniques and desired visual character concepts were developed:

Immediate foreground	*Remaining foreground*
a. Surface-cut stumps.	
b. Complete activity debris treatment. Clean up so as to not be evident from the road.	Standard fuels management.
c. No evident visible ground disturbance after 1 year, as viewed from the road.	
d. Natural-appearing tree spacing (irregular-spacing concepts).	
e. No strong "tree bole effect" on viewed stand edges.	Same as immediate foreground.
f. Contrasting and diversified species.	Same as immediate foreground.
g. Large-tree character—130 feet high and 20-inch + diameter (hold larch as long as possible if crowns are good).	Same as immediate foreground, but less in number.
h. Activities relate to small-scale design.	Same as immediate foreground.
i. Hold the optimum desired character (New stand, p. 91, fig. 3 and New stand, p. 91, fig. 4) for as long as biologically possible—140+ years.	Same as immediate foreground.
j. A forested landscape character[2] is required in the foreground to meet the VQO.	Same as immediate foreground.
k. The foreground will require five harvest entries, with 7 to 8 acres harvested each entry. Clearcut size will average about 2 acres in size.	

[1]Agriculture Handbook No. 434, "National Forest Landscape Management."

[2]Definition: A situation in which the dominant vegetation is trees. Humans feel subordinate to the vegetation.

Foreground—Partial Retention

a. Surface cut stumps.
b. Activity debris will remain visually subordinate in the immediate foreground.
c. Ground disturbance will remain visually subordinate in the immediate foreground.
d. Natural-appearing tree spacing in immediate foreground.
e. Contrasting and diversified tree species.
f. Large-tree character (hold larch as long as possible if crowns are good), 3 to 5 trees per acre in the immediate foreground.
g. Activities relate to small-scale design.
h. Hold the "optimum" desired character[2] (New stand, p. 91, figs. 2, 3, and 4) to 20 to 30 years beyond normal rotation.
i. A forested landscape character[2] is required in the immediate foreground to meet the VQO.

Foreground—Modification

a. Contrasting tree species are desirable.
b. Relate activities to small-scale size and intensive use of landscape management design concepts (pages 19-42).
c. Four entries will be required, with a unit size of 4 to 5 acres or less.

Middleground—Partial Retention

a. Screen the road as viewed from the off-site observer position until complete visual recovery of cuts and fills.
b. Include larch trees for fall color.
c. Hold the initial shelterwood situation of 20 to 25 trees about 10 years, then reduce the overstory to 10 trees per acre. This will allow maximum visual recovery and still favor western larch over lodgepole pine.
d. Relate activities to small-scale size and intensive use of landscape management design concepts (pages 19-42).
e. During any one entry, limit the amount of ground surface viewed to 20 percent or less of the area as viewed from selected offsite observer positions.

Middleground—Modification

a. Harvest units may visually dominate the textured slopes of the characteristic landscape; however, units will repeat natural appearing edge and shape conditions.
b. Roads, landings, and unnatural appearing edges may be evident but must remain subordinate to the shape and pattern of harvest units.
c. Natural openings and the VAC map (page 87) will be used to guide clearing size and distribution. The Mh (moderately high ability to absorb) areas can absorb larger clearcut harvest units and will require only two entries with two units harvested each entry of about 15 acres each. The Ml (moderate to low ability to absorb clearcuts) areas may require three harvest entries with two units per entry of about 10 to 12 acres each.

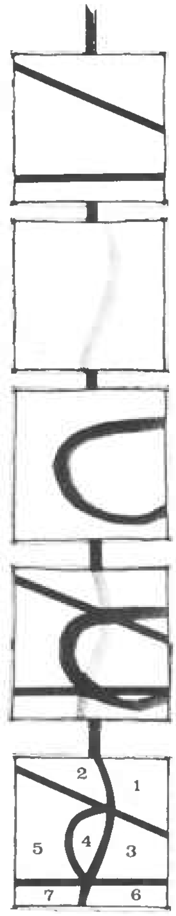
Habitat Map
And/Or
Stand Map

Landscape Feature Inventory (Fg)
or VAC Map

Other Resources

Response Unit Map

Adjusted Response Unit Map



Silvicultural Treatment (G)

Response Unit Delineation

Prior to writing silvicultural prescriptions, logical land units need to be identified. The various mapped resources are combined into similar management situations. These units can then be used to write silvicultural prescriptions. This is best accomplished by using a basic overlay process to determine both the initial and the adjusted unit configuration.

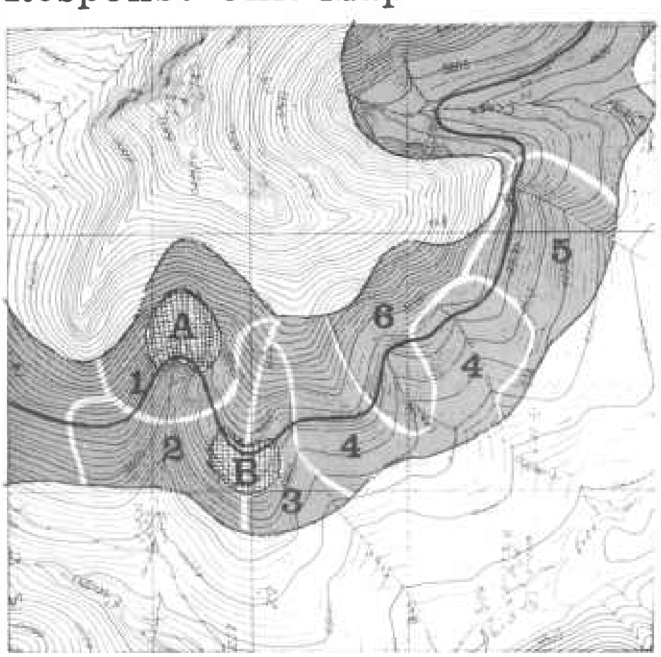
The conceptual diagram to the left shows how units are generated. These are the smallest homogeneous cells for prescribing treatments.

Response Unit Delineation for the Selected Study Area

1. Initial Response Unit

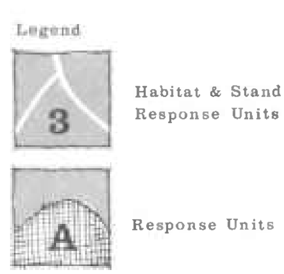
A response unit map was developed using the stand situations and visual inventory/analysis for the study area. Response unit configuration would generally be influenced by incorporating resource inventories in addition to the visual and timber resources as diagrammed below.

Response Unit Map



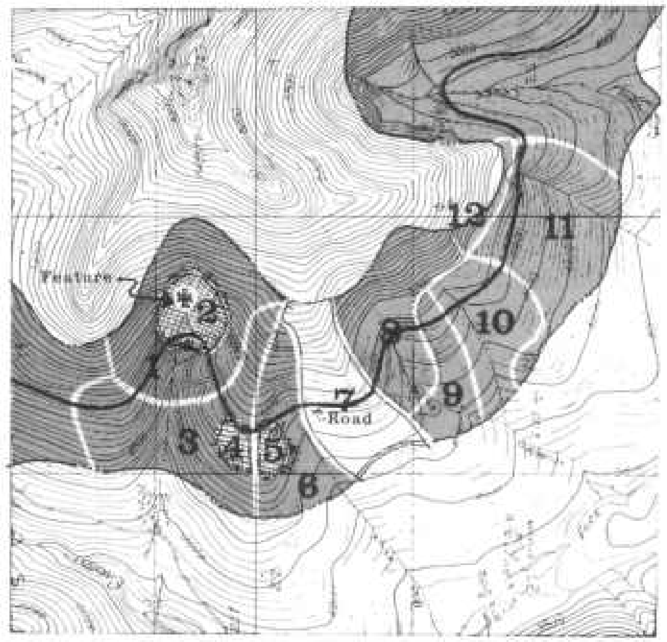
2. Evaluation of Response Unit Map

The response unit delineation map was used to make an initial determination of those units that could be managed to meet the adopted VQO from the start and those units that would require long-term enhancement. The map also showed a first approximation of units that required stand replacement (regeneration) and units that could be modified and managed for the assigned VQO.



3. Adjusted Response Unit

The initial response unit map was adjusted to reflect unit size considerations and visual feature needs. These units are then given a number designation. These small homogeneous units are then used for treatment prescriptions.



Legend

Selected Treatment Area for Study Purposes

Adjusted Response Unit Map

R/PR/and M – Foreground

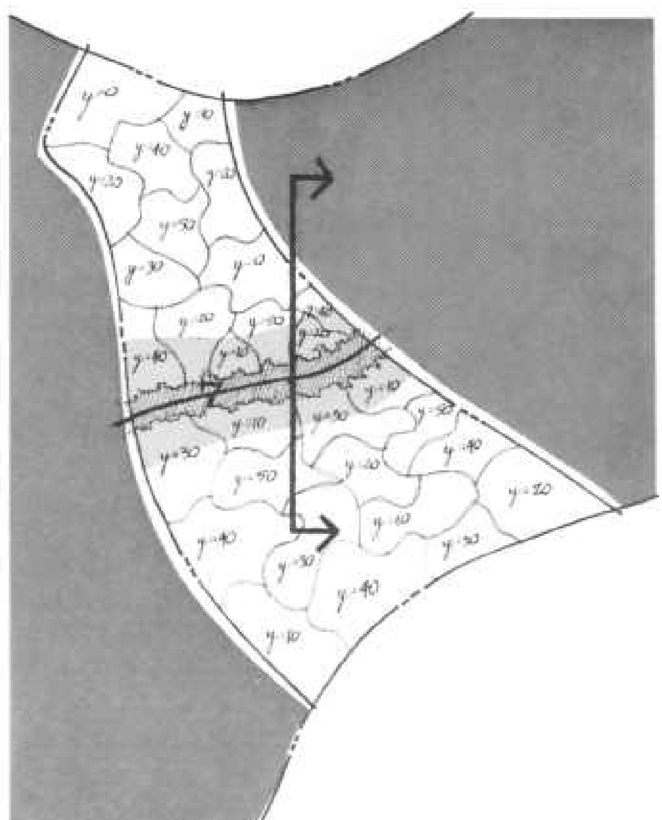
Foreground—Retention

LP Stand/Foreground Retention

Page 90, fig. A. The age and growth rate of the example lodgepole stand indicated that it can be managed for some time before it is regenerated. Based upon silvicultural characteristics, a thinning now, and again in 30 years (stand age 70) will maintain growth and desirable stand features (page 90, fig. B). The overstory larch should be retained for the visual impressions it provides. In 50 years the lodgepole stand will be 90 years old and should be regenerated (page 90, fig. C). To handle fuel accumulations, a clearcut method must be used.

At this point, an important step in defining treatments is to compare the total area to be cut over with a smaller visually acceptable treatment area. In this case, an acceptable treatment area is judged to be about 2 acres. The total foreground area is 38 acres. Not all of the area should be treated in one or two entries. To meet the VQO of Retention, a treatment interval of 10 years is chosen, based upon the vegetative recovery expected. This treatment interval indicates that if all the foreground is to be regenerated in 50 years, five entries are needed, starting in 10 years.

To treat the 38 acres will require that 7 to 8 acres be clearcut each entry for five entries. If average clearcut size is 2 acres, 3 to 4 clearcuts will be required at each entry. Based on the size and timing of entries, a treatment schedule and mosaic layout can be devised for the foreground lodgepole stand.



Selected treatment area (see sketch above). Explanation of nomenclature on following page.

Year 0: commercially and precommercially thin 31 acres (7 acres is not thinned because it will be clearcut in 10 years.

Year 10: clearcut 7 acres—broadcast burn—plant.

Year 20: clearcut 8 acres—broadcast burn—plant.

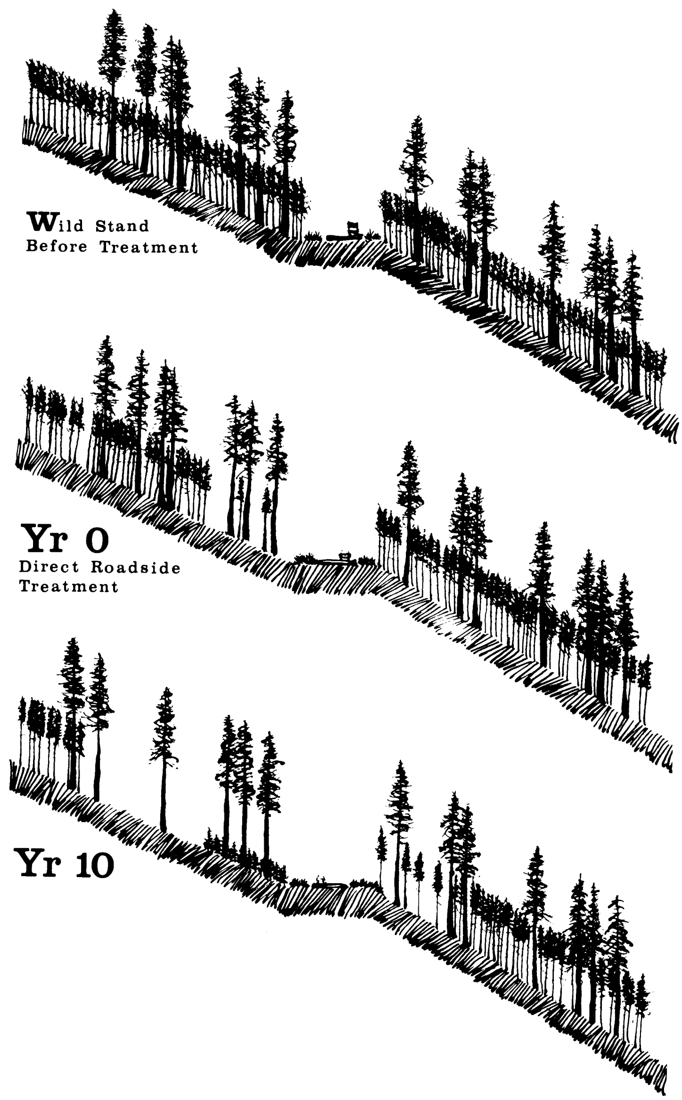
Year 30: clearcut 8 acres—broadcast burn—plant, commercially thin 8 acres (7 acres remain unthinned because they will be held only 10 more years).

Year 40: clearcut 7 acres—broadcast burn—plant.

Year 50: clearcut 8 acres—broadcast burn—plant.

Before clearcut entries next to the road are started, seral species on the road cut/fill slope, augmented by tolerant understory trees in the stand edge should be encouraged. This can be done by some judicious partial cutting for a very short distance into the stand at least 10 years before the clearcut is to be made. Clearcut edges viewed from the road will require feathering.

At each clearcut entry, planting should be western larch at a density of at least 500 trees per acre in order to occupy the site with this species. Natural lodgepole pine reproduction will rapidly fill in with the larch, but will offer serious competition to the juvenile trees for about 10 years.



Cross section sketches of area indicated in plan on previous page.

New Stand/Foreground—Retention

Once any portion of the lodgepole stand has been regenerated, the silvicultural treatment will be aimed at:

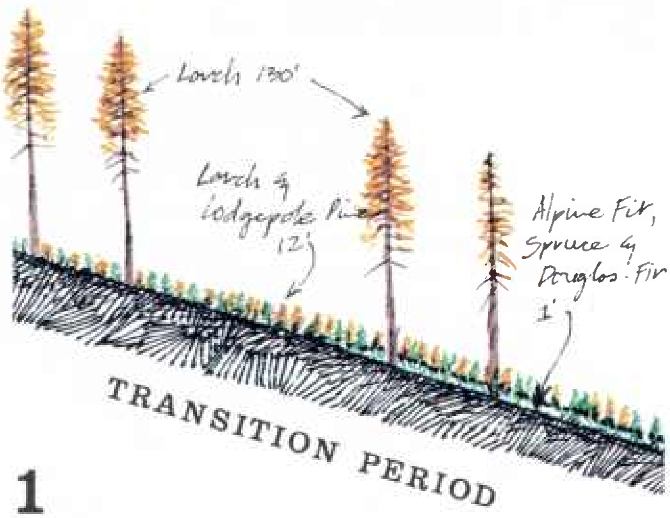
—Growing and retaining large larch trees.

—Cutting lodgepole trees by 60 years of age.

—Developing subalpine fir, Engelmann spruce, and Douglas-fir understories to full-sized trees as part of the codominant and intermediate crown canopy.

—Structuring the species composition early in the life of the stand so that western larch, with light crown residues, will constitute the bulk of partial cuttings necessary for stand development.

—Feathering clearcut edges viewed from the road.



1

Age 10-15: Precommercially thin to reduce lodgepole pine, maintain larch crowns, and start the subalpine fir–Engelmann spruce–Douglas-fir understory. Slash disposal will be lop and scatter.

2

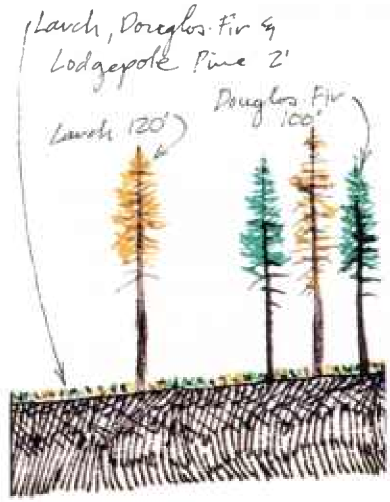
Age 40-60: Commercially thin to reduce lodgepole pine, maintain larch crowns, and release subalpine fir–Engelmann spruce–Douglas-fir. Remove highest risk, old-growth larch. Slash disposal will be lop and scatter.

3

Age 80-100: Continue to release subalpine fir–Engelmann spruce–Douglas-fir by cutting larch. Slash disposal will be lop and scatter.

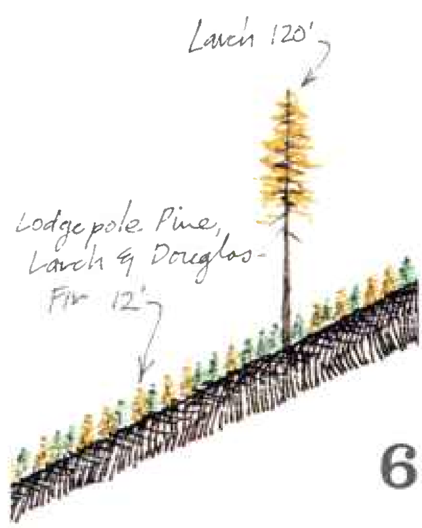
4

Age 140: Remove any larch crowding more tolerant species. Leave more than 25 larch and Douglas-fir trees per acre to constitute a shelterwood at regeneration time. Slash disposal will be by lop and scatter. Treatment at this and subsequent entries should be based on stand condition.



5

Regeneration Age Year 160: The intention is to hold this stand as long as biologically possible. Regeneration may be at about 160 years of age depending upon condition of the subalpine fir and Engelmann spruce. It is anticipated that with minimum entries over a long period of time, there will be some unsalvaged mortality as well as debris from cuttings that will contribute to an increasing fuel accumulation. It would be very difficult to deal with the fuel accumulation and, at the same time, perpetuate the stand by regenerating tolerant species in the understory and then releasing them. Regeneration will, therefore, be by a shelterwood, leaving 20 to 25 fire resistant larch and Douglas-fir per acre. Hazard reduction and site preparation will be by underburning followed by underplanting larch and Douglas-fir to stay ahead of the lodgepole pine that will almost certainly fill in naturally.

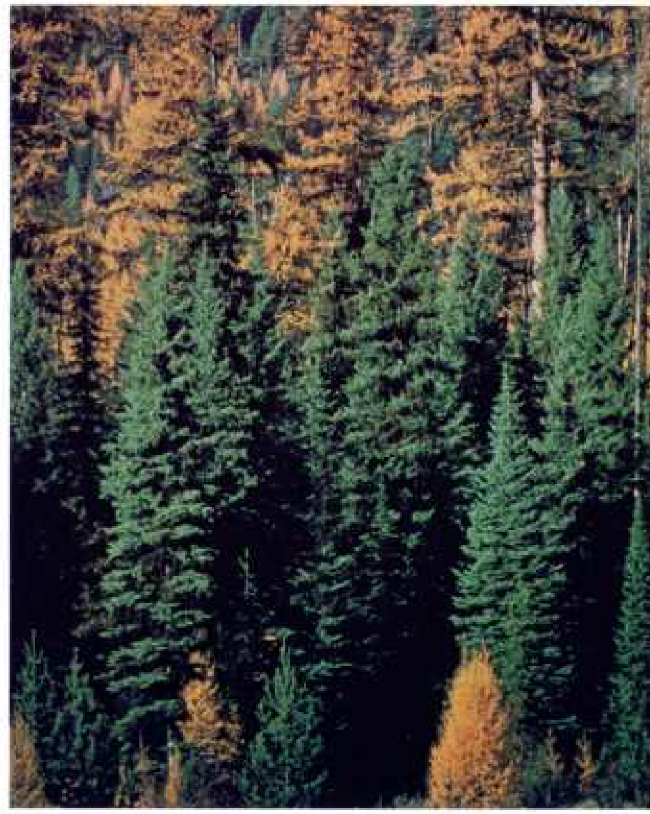


6

Age 10-15: The overstory should be reduced to about 10 larch per acre to avoid holding the larch regeneration under further shading. At this time, the stand should be precommercially thinned and the cycle repeated (page 91, fig. 6).

Yields from this treatment are expected to be reduced from full potential.


Approximate conditions suggested in New stand, page 91, figures 2 and 3 at 80 to 100 years.


Approximate conditions suggested in New stand, page 91, figures 3 and 4 at 140 years.

The three photographs show the desired vegetative diversity, which is considered the optimum visual situation in the new stand cycle for the selected study area.


Approximate conditions suggested in New stand, page 91, figure 4 at 160+ years.

Logging systems will differ, depending upon slope and skidding direction in relation to the road. Below the road on steep ground, a conventional cable skidding system that can lift the log would probably be employed. Above, on gentle slopes, tractor skidding could yard logs to the road for loading.

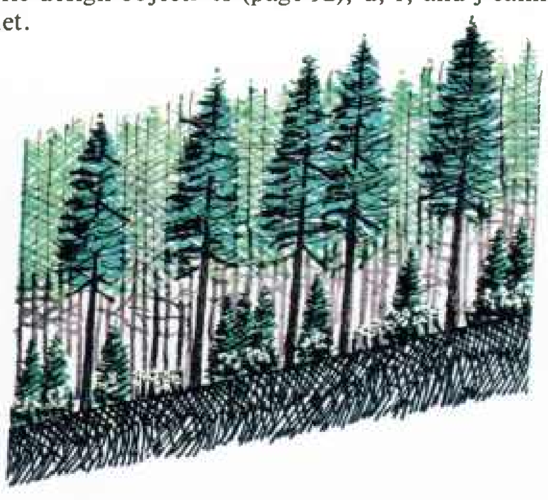
Relationship between Treatment and VQO

The treatment has been developed to meet an adopted VQO. It can be evaluated using the landscape design techniques and desired visual character concepts developed for foreground Retention as displayed on page 92. This evaluation is a critical step in the overall process, because it defines the response possible in a given biological situation.

		Average Age (years)	Retention
Lodgepole stand	page 90-A	40	—
	page 90-B	70	—
	page 90-C	90	—
	page 90-D	90	—
New stand	page 91-1	10-15	—
	page 91-2	40-60	X*
	page 91-3	80-100	X
	page 91-4	140	X
	page 91-5	160+	—
	page 91-6	10-15	—

*X = VQO can be met

Figures 3 and 4 (age 80-140) display the optimum visual situations as described in the visual goals and specific design objectives. Page 91, 1, 5, and 6 present situations which do not meet the adopted VQO because specific design objectives (page 92), d, f, and j cannot be met.



Example of Habitat Differences for Foreground Retention

In contrast to the diversity of species, sizes, and shapes attainable on a subalpine fir–clintonia habitat type, this illustration shows a stand developed on a subalpine fir–beargrass habitat type. On this habitat type, lodgepole pine persists in the regenerated stand with Douglas-fir, so the regeneration cycle must be shorter and stand age at maximum development is younger. Undergrowth is low and creates a park-like appearance. Understory subalpine fir would not occupy the whole site even if released, so it remains an associated species in the stand. Beargrass blossoms in early summer and adds to the visual appeal of stands managed in this habitat type.

Foreground—Partial Retention

I. LP Stand/Foreground Partial Retention

The treatment of the lodgepole stand (page 90-A) will not vary from the treatment for Retention.

II. New Stand/Foreground Partial Retention

Treatment of the regenerated stand (page 91-1) will be similar to that described for Retention. After age 60, however, the next entry might occur at age 79 to 90 to harvest anticipated mortality; regeneration can occur at age 120 to 130. An attempt will still be made to develop subalpine fir and Engelmann spruce in the main stand canopy. Regeneration will be by the shelterwood method, with underplanting and a removal cut carried out in the same manner. Yields will still be reduced with this treatment; but with quicker entries and earlier regeneration, yields are expected to increase from the treatment suggested for Retention.

Relationship between Treatment and VQO

		Average Age (years)	Partial Retention
LP Stand	page 90-A	40	X*
	page 90-B	70	X
	page 90-C	90	X
	page 90-D	90	—
New Stand	page 91-1	10-15	—
	page 91-2	40-60	X
	page 91-3	80-100	X
	page 91-4	120-130	X
	page 91-5	120-130	—
	page 91-6	10-15	—

*X = VQO can be met.

The following specific visual objectives (page 93) for foreground Partial Retention cannot be met:

—Lodgepole stand: objectives c, d, and i, with objectives e and h not applicable.

—New stand: objective i at 10 to 15 years and after 140 years.

Foreground—Modification

I. Lodgepole Pine Stand/Foreground Modification

Treating the lodgepole stand (page 90-A) for a modification VQO can vary in some detail from treatments applied in the Retention and Partial Retention alternatives. The maximum area to be treated at each entry would remain the same, but each regeneration area could increase from 2 acres to an average of 4 to 5 acres. Two of these units could be entered at each treatment interval. Rather than 5 entries, the whole area could be covered in 4 entries which would allow 20 years until the first regeneration cut. Overstory western larch would be retained. The entire 38-acre foreground could be thinned at year 0. Yields should increase from those obtained with the suggested Retention and Partial Retention treatments.

II. New Stand/Foreground Modification

The modification VQO will allow favoring fast growing seral species over tolerant understory species. Entries will be earlier and regeneration can take place at rotation age.

Age 10-15: Precommercially thin to retain larch and lodgepole crop trees. Lop and scatter slash.

Age 40-50: Commercially thin to favor lodgepole, larch, and faster growing Douglas-fir and Engelmann spruce. Lop and scatter slash.

Age 70-80: Commercially thin to remove lodgepole. Favor larch and Douglas-fir over less windfirm spruce. Lop and scatter slash.

Age 110: Regenerate with a shelterwood composed of larch and Douglas-fir seed trees. Underburn and underplant larch and Douglas-fir to insure species diversity against lodgepole fill-in. Overwood should be removed in 10 to 15 years. Yields from this treatment should not be reduced from potential.

Relationship between Treatment and VQO

		Average Age (years)	Modification
LP Stand	page 90-A	40	X*
	page 90-B	70	X
	page 90-C	90	X
	page 90-D	90	X
New Stand	page 91-1	10-15	X
	page 91-2	80-100	X
	page 91-3	120-130	X
	page 91-4	120-130	X
	page 91-5	120-130	X
	page 91-6	10-15	X

*X = VQO can be met.

The VQO of foreground modification (page 93) can be met during all entries.

Middleground—Partial Retention

I. Lodgepole Pine Stand/Middleground Partial Retention

A process similar to that which delineated foreground response units was used to define specific middleground cells. One significant difference was the use of the VAC map (page 87) to define units and evaluate the visual affect that activities would have on the visual resource.

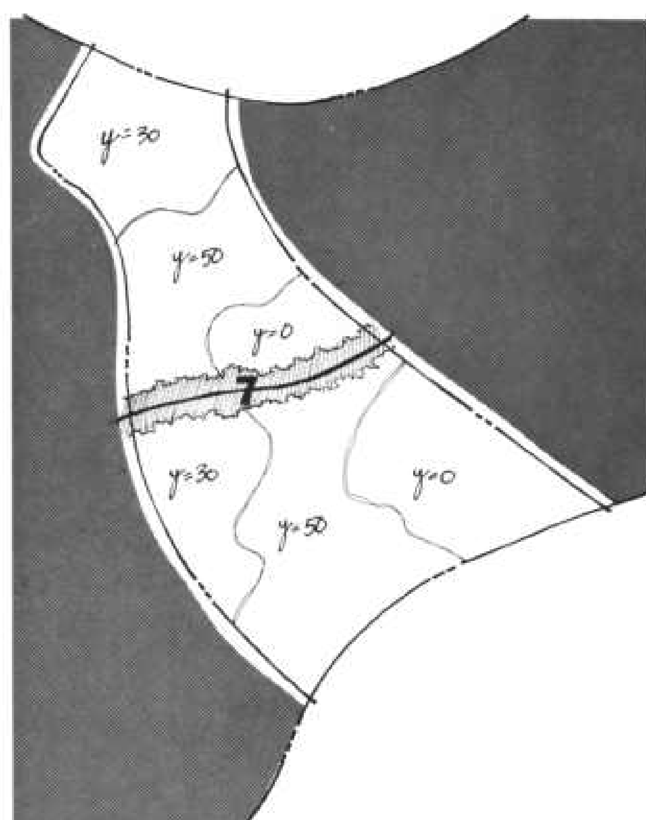
As with the foreground example, the 40-year-old lodgepole stand (page 90-A) can be managed to an age compatible with regenerating the whole area in the biological time limits of the stand—in this case, 50 years. Silvicultural needs remain the same. The stand should be thinned now, again in 30 years, and regenerated in 20 years after the second thinning. However, to cover the area with a mosaic that will meet visual requirements, early regeneration of part of the stand must take place.

Steeper slopes on the 36 acres below the road will require treatment in smaller units, not exceeding twice the area visually screened (as determined from the process described in the illustrations on pages 88-89). To meet the Partial Retention VQO, care must be taken to screen the cut and fill slopes from off-site viewing until they are adequately revegetated.

Year 0: Clearcut, broadcast burn, and plant larch on one-third of the area in two units (year 0), with the unit next to the road cut approximately 200 feet wide with an irregular edge. About one half of each of the units may be screened from view. Remove the larch overstory on the remaining two-thirds of the area and commercially thin this portion (units designated as year 30 and year 50).

Year 30: Clearcut one-third of the area (year 30) and treat as at year 0. Commercially thin the remaining one-third (year 50).

Year 50: Clearcut the remaining one-third of the stand (year 50) and treat as at years 0 and 30.



Selected treatment area (see sketch page 95).

II. New Stand/Middleground Partial Retention

Regeneration of the lodgepole stand (see sketch above) in a mosaic has defined the treatment areas for dealing with the regenerated stand. The treatment described for modification in the foreground may now be applied as each area develops.

Relationship between Treatment and VQO

		Average Age (years)	Partial Retention
Lodgepole stand—	page 90-A	40	X*
	page 90-B	70	X
	page 90-C	90	X
	page 90-D	90	X
New stand	page 91-1	10-15	X
	page 91-2	40-50	X
		70-80	X
	page 91-5	100	X

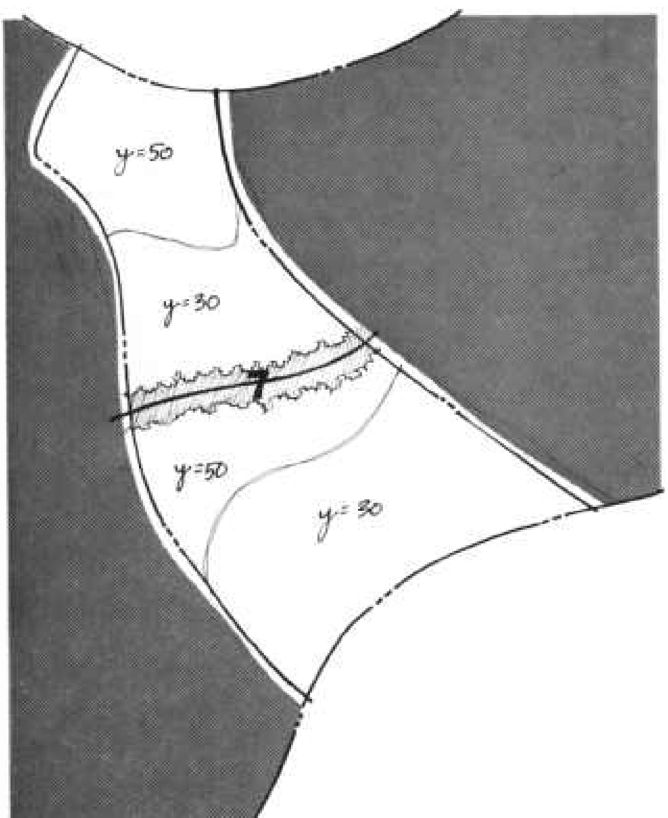
*X = VQO can be met.

The specific visual objectives (page 93) can be met throughout the management rotation.

Middleground—Modification

1. LP Stand/Middleground Modification

Treatment of the stand for this VQO increases the size of clearcut units over previous objectives.



Selected treatment area (see sketch page 95).

Year 0: Remove overstory larch. Commercially thin the entire area.

Year 30: Clearcut 30 acres in at least two units locating one above the road and one below. Broadcast burn and plant as in previous examples. Commercially thin the balance of the area.

Year 50: Clearcut the balance of the area in two units as for year 30. Yields would be reduced by early regeneration of half the stand at year 30.

2. New Stand/Middleground Modification

Once the lodgepole stand is regenerated, the treatment applied would be that described for the regenerated stand in the foreground modification example. Yields from management of this phase of the stand would not be reduced.

Relationship between Treatment and VQO

		Average Age (years)	Modification
Lodgepole stand—	page 90-A	40	X*
	page 90-B	70	X
	page 90-C	90	X
New stand	page 91-1	10-15	X
	page 91-2	40-50	X
		70-80	X
	page 91-5	110	X

*X = VQO can be met.

The specific visual objectives (page 93) can be met throughout the management rotation.

Southern Pine

Most National Forest land in the southeast was acquired by the Forest Service in the late 1920's and the 1930's. Much of this land had either been cut over and burned annually, or had been farmed. The upper Coastal Plains, in particular, possessed slope and soil

characteristics suitable to early farming practices. These lands were cleared and row-cropped until severe erosion depleted soil nutrients and large ditches made the land untenable.

Historic photos of abused land.

Fire played an historical role in creating the southern pine forest. This role predates the early settlers who used fire to "open" woodland and provide better access. Through the early 1900's, fire developed into a sociocultural pattern. This cultural pattern, "open range," refers to the belief that anyone has customary "rights" to range or graze livestock on land that is not fenced. "Open range" came to be considered an almost inalienable right because of its traditional association. This cultural pattern, concerning livestock grazing, included the practice of using fire. Such fires usually ran uncontrolled and killed most young trees in their path; consequently, the traditional, unrestricted use of fire was incompatible with reforestation.

Due to the past agricultural and burning practices on these lands, most of the oak and hardwood understory associated with southern pine was destroyed, leaving only stumps, grass, weeds, and other early plant invaders.

With the advent of fire protection and other conservation programs that were active during the depression years, vast acreages of pine became established.

Since hardwoods had practically been eliminated in many areas, the new stands, whether established naturally or by planting, were pure pine. To develop a hardwood component naturally in such stands requires going through the many stages of plant succession, and cannot be accomplished in a short period of time.

Over 60 percent of the pine stands in the southeast are in the 40- to 60-year age class. In order to achieve much needed diversity and age class distribution, some stands will have to be regenerated before their prescribed rotation, while others will have to be carried beyond rotation age.

The four major pine species found in the southeast are longleaf, slash, shortleaf, and loblolly. Silvicultural treatments are similar for all of these, even though they have different site and climatic requirements. Loblolly pine, because of its wide range and abundance, is the principal commercial species.

Typical foreground.

The characteristic landscape of the Southern Coastal Plain is one of flat or gently rolling, sandy land interspersed with low, wet areas. While best known for its softwood timber-producing capability, the area also provides outdoor recreation, wildlife, and grazing. The topographic and vegetative characteristics of the landscape are such that the total landscape is predominantly perceived as a foreground zone. This foreground is dominated by stands of pine arranged in strict geometric rows. This mechanical appearance is further enhanced by the absence of other tree species. Such stands may be reasonably large, encompassing from ten to several hundred acres in one uniform age class.

Large tracts regenerated or converted to pine plantations created a sense of uniformity.

Adjoining stands may also be composed of large acreages within one age class. The average stand rotation is about 60 years, with a target d.b.h. of 18 to 24 inches for loblolly. This visual affect may be perpetuated throughout an entire travel route. Travel route edges normally reflect the same management process. Edges are uniform and parallel with the roadway, with little variation in tree spacing. Trees are normally planted on a grid or row system, which is easily detected from the road. Pine canopies are of uniform height in each size class, with no layering where associated species are absent.

Visual penetration into young stands ranges from very limited to good, based upon cultural treatment and the presence of associated species. Mature pine stands derived from row planting also have a visual depth based upon cultural treatment. Fire is used in these stands as a silvicultural treatment to suppress understory growth. It is also a management tool to enhance

Large area of a mechanically prepared site.

wildlife habitat, improve forage, and reduce wildfire hazard; it may be applied to several stands or compartments in one treatment. Such prescribed treatments provide visual depth, but may disrupt the visual sequence by exposing the even-sized character of stands.

Two types of naturally regenerated loblolly stands can be found in the characteristic landscape: natural stands with standard intensive cultural treatments and natural stands that are relatively unmanaged.

Immature pine stand which still retains row or plantation appearance.

Stands derived from natural regeneration and managed under intensive management have some of the same visual characteristics as planted areas, because of their size and cultural treatments. Cultural treatments, throughout the rotation age, attempt to achieve a more uniform stem spacing, eliminate open spaces and tree clumps, develop a uniform canopy height, and narrow the d.b.h. range into a similar size. Stand improvement treatments are intended to provide adequate growing space for the managed species by removing excessive numbers of competing stems, both pine and hardwood. However, in many cases this treatment has been used to eliminate hardwood as a codominate species in pine stands. Edges tend to be more uneven, with small openings, even though the overall edge may appear straight. However, even the most intensively managed naturally regenerated stands do not take on the completely mechanical appearance found in the row plantations.

Naturally regenerated stands, which have not experienced the mechanical application of cultural treatments, present a pleasing blend of diversity indigenous to the natural ecosystem. As these stands move toward maturity, they are typified by large-boled trees with a mixture of smaller diameter trees, spaced in a very random pattern.

Clustering of stems is more pronounced, with small openings that control visual sequence and depth. Hardwoods may occupy codominant positions in the forest canopy and dominate the mid-level canopy. A third canopy layer may consist of dogwood, redbud, and other smaller hardwoods. The forest floor is the fourth layer, and may consist of a wide range of vines, wildflowers, and shrubs.

A naturally regenerated loblolly stand shows diversity of plant communities, spacing, and canopies.

Modern forestry adopted controlled fire as a management tool to promote range and wildlife, reduce wildfire, and promote maximum fiber production. These applications of fire, coupled with other modern forestry practices, have created large "open" stands with essentially a single canopy layer. Associated species are eliminated or suppressed to reduce competition with the chosen crop trees, grasses, and legumes. These treatments provide visual depth, but may disrupt visual sequence by exposing both large areas and the even-sized character of the stands. The frequency of prescribed burning within these foreground areas tends to perpetuate their intensive management characteristics.

Longleaf stand shows character established by continuous fire management. Understory is retained at forest floor level.

The present characteristic landscape of southeastern National Forests is the direct result of early land use practices. When these lands came under National Forest ownership, the primary goal was to establish thrifty stands of crop trees that could be managed in

Before: Stand with diversity of species and viewing sequence.

During: Prescribed burn.

After: Prescribed fire has altered plant succession or severly suppressed growth. Visual variety is removed.

an efficient manner while controlling soil movement. Mechanical planting and hand "row" planting were employed to establish most stands. These practices were directed toward effective reforestation; visual goals were not an important factor in silvicultural practices during this era. Management of these landscapes is complicated by the mixed ownership patterns common to many Forests. National Forest lands are typically interspersed with agricultural cropland, rangelands, or industrial forest lands managed for timber production. These patterns of ownership and land use affect the classification of landscape management distance zones, sensitivity levels, visual quality objectives, and visual absorption capabilities of adjacent National Forest lands. For example, an agricultural foreground may expose middleground forest land, increase the VAC for the adjoining forest, and may affect VQOs for that portion of the travelway.

While it is desirable to maintain the overall productivity of these valuable National Forest timberlands, in visually sensitive zones the establishment of species and age class diversity should be recognized as another important objective. Various methods for achieving this objective are discussed in the Loblolly Pine section, which follows. These treatments may generally be adapted to other species of southern pine.

Characteristics—Loblolly Pine

Individually, loblolly pine character is reflective of its forest environment. This tree is capable of growing to a relatively large (22- to 28-inch d.b.h.) diameter and to a height of 100 feet in 80 years when density is controlled throughout the rotation. Full crowned trees, in well managed stands, exhibit foliage on 25 to 35 percent of the total bole length. Loblolly will grow in dense stands but it becomes suppressed, appearing as "leggy," small diameter trees with short crowns. Development of the fast growing, high quality full crowned tree should begin with cultural treatment during the sapling stage, and continue throughout the rotation. Stands that are not treated for several decades will not respond to treatment and thereafter develop a full crown character.

Some modification of the even-age system to provide the appearance of uneven-aged management is often feasible in the foreground, and should be considered as a management alternative.

Design Criteria

a. Design silvicultural treatments that will achieve VQOs and enhance areas that have little or no variety as a result of past practices.

b. Design a management process to retain or create stands with irregular shape and small scale diversity of stand ages, sizes, and mature tree character.

c. Schedule treatments during a season that will meet VQO contrast requirements and minimize site impact.

Retention and Partial Retention

The primary short-range goal of the Retention and Partial Retention VQOs is to enhance and restructure visually sensitive areas of the southern pine forest into a diverse, natural appearing landscape. Associated goals are: To create or retain natural appearing stands throughout a foreground, provide small-scale diversity, exhibit variety in sizes and species, and develop a mature tree character.

When a mature tree character has been developed, it will also become a goal to maintain an element of this character throughout a travel corridor. Additional variety can be provided by areas developed with:

—Full crown, rapid growing pine;
—Undergrowth communities;
—Hardwood components;
—Visual depth;
—Visual sequence;
—Serrated edge; and
—Layered canopies.

Young stand of slash pine, properly thinned to maintain rapid growth and provide visual depth.

The mature tree character for loblolly pine is further defined as:

Retention — 22 to 28 inches d.b.h.
Partial Retention — 20 to 26 inches d.b.h.
Modification — 18 to 24 inches d.b.h.

The objective is to apply a process of cultural treatments, throughout the stand's life, with a goal of "enhancement" and development toward small scale (10 to 20 acres) diversity and a natural appearing stand. It is anticipated that limited success will be achieved by cultural treatments during early stages. However, each treatment is a progression toward the next entry and the goal can be achieved by stand maturity.

This stand of longleaf pine is an example of a poorly managed stand.

Treatment Concepts

The following treatment (pages 111 to 113) is for a foreground loblolly pine plantation, derived from a mechanically prepared site with row planting. Assume that the terrain is flat to gently rolling and the stand is 100 acres in size. It is important to note that the example treatments are presented on a conceptual basis to meet established VQOs, and that all stand conditions will not require the same treatments. A site-specific analysis will be required to apply landscape management principles to each stand condition.

[3]Size Class 1—Precommercial Thin

The objective at this age is to soften the mechanical appearance, maintain rapid growth, encourage tree form development, and promote associated species within the stand. When the average height is 3 feet to 6 feet and before lower crowns begin to die, thinning should be done. Thinning in the immediate foreground (up to 200 feet) should be by hand, reducing the number of stems to no more than 300 per acre and creating an irregular pattern of spacing or grouping. Edges along roadways should be treated to reduce the straight line effect, allow visual depth, and provide viewing sequence with small spaces. Here selected hardwood or associated species found within the young stand should be retained and allowed to develop. Establishment of random tree spacing will allow for a wider range of tree diameters, from sapling through maturity.

Size Class 2 and 3

The objective is to create further enhancement by expansion of previous treatments to diversify stand characteristics. When the average tree diameter reaches a merchantable size and stocking is above the recommended level, commercial thinning can be used to achieve the VQO. Thinning should occur before density reaches a level at which crown and diameter growth is restricted. Three or four commercial thinning entries

Immature stand has developed a poor character and species diversity by inadequate treatment.

[3]See page 11 for definition of size class.

are anticipated before the mature character size is reached. Each entry should be used to further the diversity of spacing and variety begun by precommercial thinning. Tree groupings, feature trees, small openings, and serrated edges should become more pronounced as each entry is completed.

Associated species should be promoted and retained in patterns throughout the stand. Hardwoods within the mid-level canopy will provide variety in canopy layering, texture, and color.

While still in these size classes, the 100-acre foreground stand should be broken into smaller stands to achieve diversity of size class and small scale. Assuming the stand was broken into seven stands ranging from 10 to 20 acres, three could be regenerated (natural method) at different times before the mature class is reached. A fourth stand may be regenerated as it reaches a mature character with a d.b.h. of 24 inches.

In some cases, the 10- to 20-acre stands may not fully achieve the small-scale foreground objective. In such cases, inclusions may be used to diversify size. Inclusions or groups (1 to 4 acres) can be a management tool to diversify stands with poor tree character where associated species are absent, or where more diversity is needed for future regeneration of the stand.

Size Class 4

As the stands move into the mature class, the foreground areas should exhibit diversity in distribution, small scale, canopy layering, depth, and species. The 100-acre stand has been broken into smaller stands of 10 to 20 acres. Four of the smaller stands have reached the mature character d.b.h. Regeneration of these mature stands should depend upon the total corridor condition and needs. It may be necessary to retain mature stands beyond the maximum character d.b.h., in order to bring the overall corridor into the desired character condition. In some cases, it may be desirable to retain a specimen mature stand as long as biologically possible before beginning the natural regeneration process.

Stands that are to be retained for longer periods may require cultural treatments to further enhance edge and opening appearances, or may need a preparatory cut (thinning) as a step toward future regeneration. The cut should maintain a basal area of 80 to 120 square feet and large (22- to 28-inch d.b.h.) trees. The mature tree character should be emphasized with feature trees and groups. Canopies within the immediate foreground would be more open to create space relationships.

Naturally regenerated stand.

Maturing stand shows a well balanced plant community and diversity.

The mature stand character within this foreground has diversity of visual elements. Space is defined by the enclosed landscape, but is softened by the serrated forest edge and further complimented by the uneven form of tree canopies. Trees are randomly spaced or in groups, which add new dimension to the space relationship. The canopy is well structured with pine and hardwood species. Silviculturally, the stand is well stocked and producing high-quality timber.

Retention VQO—Regeneration by Natural Method

Regeneration within a *Retention VQO* area should be accomplished by natural regeneration using the shelterwood method.

Retain 18 to 24 shelter trees per acre in random patterns with some groups to maintain stand character but give full seed coverage. Design treatments to soften the edge transition to adjacent stands and to eliminate the wall effect when overstory is removed. Retain selected hardwood groups and understory communities within the stand to control visual distribution and insure early diversity in the young stand. Select residue treatment and site preparation methods which meet the VQO by providing adequate disposal and minimizing site impact. Also, a method of site treatment should be selected to promote recovery of the site's total ecosystem. Chemical treatment should not be used.

The removal cut has the potential of interrupting the established visual sequence. Normally, the final cut will be made 3 to 5 years after the shelterwood. Removing the overstory canopy from a large acreage destroys the small-scale diversity. In the Retention VQO, an average of 4 to 8 trees per acre should be retained until the first commercial thinning occurs. These trees should be located mostly within the near and medium foreground, in random or group patterns.

Partial Retention VQO—Regeneration by Natural Method

Regeneration within a *Partial Retention VQO* should be by either the shelterwood or seed tree method, with 10 to 14 trees per acre. Choice of the regeneration method will depend upon stand condition and individual tree characteristics. Stands with "leggy" stems and short crowns should be regenerated by the shelterwood method.

Less emphasis is on large trees, with desired diameters ranging from 20 to 26 inches. Otherwise, treatment objectives are essentially the same as for Retention.

Modification

Under the *Modification VQO*, areas could be regenerated by shelterwood or seed tree, with the normal number of stems per acre. Clearcuts may also be used as an acceptable method. However, the designer should remain concerned with stand scale and shape, as well as with the number and arrangement of the harvest units. Harvest units should be in the 10- to 30-acre range, or adjusted to blend with openings found within the characteristic landscape. Less emphasis is placed on large trees and a standard rotation d.b.h. of 18 to 24 inches is anticipated.

Example Treatment

A 20-acre clearcut is planned with superior stock to be hand planted as the regeneration method. The stand is designed in an irregular shape, with inclusions to control visual distribution of variety. Transitions with adjacent stands are planned to avoid a solid wall effect. Site preparation methods should be selected to dispose of residue, minimize site impact, and aid the recovery of associated species.

Example of seed tree regeneration which could only meet the Modification or Maximum Modification objective.

Vegetative alterations dominate foreground. Residue and roads should be subordinate to the opening.

Hardwood Stand To Be Converted to Loblolly Pine

Some forest types presently occupying a particular site cannot be commercially productive, because of severe growth limitations or disease, and should be converted to a species more suited to the conditions on that site. Such short-term objectives may convince a manager that a *Partial Retention* area should be temporarily managed to the *Modification* objective. In such cases, the long-term objectives of the total corridor would still influence mitigation measures and eventual stand size.

The objective is to convert a low-quality hardwood stand to a rapid growing loblolly stand, yet retain such special enhancement effects as directing the visual sequence and retention of hardwood elements.

Hardwood groups or inclusions can be maintained in sensitive areas to maintain visual and wildlife needs while converting a substantial part of a stand to pine.

Example Treatment

A 50-acre hardwood stand is selected for conversion to loblolly pine within a Partial Retention area. The VRM corridor management plan indicates a long-term need for diversity of age class and small scale. Also, wildlife requirements indicate the need for retention of 18 percent (10 acres) of the stand as a hardwood inclusion. On this basis, 10 acres are selected in the roadside area and 20 acres in the rear foreground. The 20-acre site is not easily viewed, so a clearcut is prescribed.

The 10-acre foreground is designed to retain hardwood groups and islands as hardwood components. Areas to be planted are treated by injection or girdled by chain saw and then hand planted to a random pattern with varying densities. Planting along the roadway is carried out to make a serrated edge.

Fire-Fuel Management

Prescribed fire is a valuable silviculture tool in the southern pine type. Controlled fire is an integral part of multiple use forest management and is used to:

— Reduce fire fuels,
—Increase grass production for livestock,
—Encourage sprouting of some understory species for wildlife benefit,
—Increase legumes in the understory,
—Accomplish site preparation,
—Reduce timber sale marking cost, and
—Control undesirable species

In some areas the above management objectives require the continuous application of fire on a 3- to 4-year cycle, which indicates the rapid recovery ability of the lush green southern forest. Normally, prescribed burning is done during the fall and winter months. By early spring (April), understory vegetation is sprouting and by summer the forest floor is a green carpet.

The application and method of application of fire can enhance or disrupt visual diversity. Preburn planning should be designed to meet the established VQO within a burn area. This preplanning should identify areas or plant communities that create visual diversity in the roadway sequence, such as canopy layering, or open park-like effect. These selected understory communities should be "plowed out"[4] or otherwise protected from fire. The remaining foreground area may be burned to accomplish resource objectives.

Within a loblolly treatment area with a VQO of Retention, one-third of the foreground area should be designed in an irregular pattern to create variations in depth, open space, and visual sequence and should be protected from fire treatment. With a VQO of Partial Retention, one-fourth of the total treatment area should be designed and protected. A VQO of Modification would require identification and protection of key plant communities in the foreground.

[4] "Plowed out"—a firebreak made with a fire plow to control burn area.

The following chart shows the recommended techniques for treating residue for different VQOs.

Residue Fuel Treatment System

Method of treatment	Visual quality objective[1]				
	P	R	PR	M	MM
Off-Site Disposal					
1. Chip and haul		•	•	•	•
2. Exportation		•	•	•	•
3. Pile and advertise		•[2]	•[2]	•	•
On-Site Disposal with Fire					
1. Broadcast burn	NO CULTURAL TREATMENT	•	•	•	•
2. Underburn		•	•	•	•
3. Hand pile and burn		•	•	•	•
4. Tractor pile and burn				•	•
5. Swamper burning		•	•	•	•
6. Crush and burn				•	•
7. Spray and burn					•
8. Open pit burning					•
9. Incinerator burning		•	•	•	•
On-Site Disposal Without Fire					
1. Chip		•	•	•	•
2. Crush/chop/disc/plow (use one key word)					•
3. Windrow					•
4. Bury					•
5. Mastication				•	•
6. Lop with scatter		•	•	•	•
7. Lop without scatter				•	•

[1]P = preservation, R = retention, PR = partial retention, M = modification, MM = maximum modification.

[2]Acceptable technique but must be removed as planned or otherwise disposed of.

Northern Hardwoods

Northern hardwood (beech-birch-maple) forests occur throughout the northeastern United States, from the Lake States across the northern Appalachians and into New England.

The original northern hardwood forest was a climax association dominated by American beech, sugar maple, and yellow birch, with minor amounts of other hardwood and softwood species. These stands contained trees of many sizes, with several age classes intermixed.

Many of the current northern hardwood stands are the result of heavy commercial logging that took place near the turn of the century. These second-growth stands represent an intermediate stage in the succession to the climax situation. They are often dominated by the less tolerant species such as black cherry, white ash, yellow-poplar, red ash, red maple, basswood, paper birch, black birch, aspen, and similar species. Although they are predominately even-aged, these second-growth stands contain trees of many sizes because of the widely differing growth rates and tolerance levels of the species in the mixture.


Second-growth stand.


Trees of many sizes and several age classes.

Management of the northern hardwood forest may be directed toward either retention of the intolerant even-aged stands now prevalent, or toward hastening the succession toward the climax, uneven-aged structure of the original forest.

Even-aged management for intolerant species tends to be favored for timber production, because of the more rapid growth rates and higher commercial values of these species. Cutting techniques involved also tend to create stands of varying ages and sizes with a wide mixture of tree species and wildlife habitats. Some of the intolerants perpetuated by even-aged management have special appeal in foreground landscapes because of their unusual tree form, bark characteristics, fall foliage color, or attractive flowers.

On the other hand, uneven-aged forests of tolerant species maintain unbroken expanses of forest that contain some large trees on all areas. Although there may be less total variety in such forests, the visual appearance more closely resembles the virgin condition than can be achieved by other management schemes. The effects of man's activities can be kept subordinate in spite of moderately intensive timber culture.

Topography in the northern hardwood region varies from extremely flat to rolling in the Lake States to mountainous in the Northern Appalachian and New England areas. In the comparatively flat land of the Lake States, middleground and background portions of the landscape are seldom visible and present few visual management problems. In the more mountainous parts of the northern hardwood range, middleground and even some background areas are highly visible, and present difficult visual problems.

Use of forested areas in the northern hardwood region spans all seasons of the year, and the seasonally changing appearance of the deciduous trees adds complexity to the problem of reducing the visual impact of management activities. A revegetated clearcut that is virtually unseen in summer, for example, may contrast vividly with adjacent uncut areas when the ground is snow-covered and the trees are leafless; especially when observed in the middleground.

Logging residue (slash) creates a major visual impact in northern hardwood stands. Because northern hardwood stands often contain large numbers of small trees, logging leaves large amounts of branches, limbs, unmerchantable boles, and similar residue that creates an unsightly appearance. The residue left behind is often much more objectionable than the harvesting of the tree itself. This logging residue is especially critical in the foreground areas.

Climate throughout the northern hardwood region is continental, but is also influenced in many areas by the large water surfaces of the Great Lakes. Precipitation averages 25 to 50 inches, well distributed throughout the year. During winter months, much of the precipitation falls as snow, and snow cover is continuous for 2 to 5 months during most years. Seasonal changes are distinct, with warm summers and cold winters.

Because of the adequate rainfall through the growing season, and the variety of species present, exposed soil and harvested areas heal quickly. Clearcuts normally blend with surrounding uncut areas in 5 to 10 years after cutting.

Ten-year-old clearcut.

New clearcut.

The northern hardwood region is heavily populated. Private ownerships are intermingled with National Forest lands in many places, creating many inclusions over which the land manager has no control. Few forested areas in the northern hardwood region are more than 3 to 5 hours driving time from large metropolitan centers, and these forests receive recreation use as heavy as any in the United States.

Planning

Corridor viewshed planning as described on pages 43-64 is necessary in the northern hardwoods in order to:

—Identify specific visual opportunities and constraints within selected corridor viewshed(s),

—Identify biological opportunities and constraints relative to achieving desired visual character over time and space,

—Identify other resource objectives which will affect setting corridor viewshed(s) direction,

—Set corridor viewshed(s) direction within biological potential and coordinated with other resource objectives.

Corridor viewshed direction should establish the general description, amount, scale, and disbursement of such visual character elements as: Featured tree species, number and target diameters for each species, contrasting species variety, desired bark characteristic, shrubs and ground covers, seasonal color, stand structure (i.e., small scale grouped or single tree), enframed views, enclosed spaces, etc. Selection of one, or as in most cases a combination of several, of the management regimes (goals) described on the following pages should be based on *achieving the visual direction set forth in the viewshed plan.* Application of the guides following the goal descriptions should be used in the same manner.

Visual Goals

In the northern hardwood region, it is possible to manage for either of two types of characteristic landscape. The land manager may choose to manage an area to achieve or maintain one, or a combination of both landscape types. These types are:

1. *An unbroken forest with a high percentage of larger trees (18 to 30 inches) in mixture with other smaller sized trees* (primarily a foreground goal).

   The uneven-aged cutting methods used to achieve this goal will tend to perpetuate forests dominated by shade tolerant species, although some intolerant species can be obtained through use of special techniques. These cutting methods also tend to maintain even-textured canopies and uniform stand heights.

   The cutting methods described under this goal are capable of meeting the broad visual quality objectives of Retention for pedestrian as well as vehicle-oriented observers.

2a. *A forest containing an attractive mixture of stands with a variety of sizes, ages, heights, and species composition compatible with the existing characteristic landscape.*

   The even-aged cutting methods used to achieve this goal tend to perpetuate forests containing a mixture of tolerant and intolerant species, with stands that vary in tree size, canopy height, and texture.

   The cutting methods used under this goal are capable of meeting the broad visual quality objective of foreground Partial Retention for vehicle-oriented observers, and *may* be capable of meeting the visual quality objective of Partial Retention for both pedestrian and vehicle-oriented observers.

2b. *An attractive mixture of stands of intolerant species but at a much smaller scale than in goal #2a.* This even-age process with smaller scale variety of sizes, ages, heights, and species composition should allow meeting foreground Retention for the vehicle-oriented observer. It should provide some areas of similar visual character to goal #1, but with much greater potential for visual diversity and ease of management. This goal is not displayed in the following guides but is rather an adaptation of the management process (and is similar in scale) to that shown under ponderosa pine.

Other site specific visual goals, such as retaining or enhancing views of meadows, waterbodies, rock outcrops, or distant views are possible under either of the above goals. These are best identified in a preliminary planning process, the components of which are outlined on pages 43-64. Treatments listed in the following guides can then be designed to accomplish these and other visual goals, as well as to achieve the chosen vegetative character.

Retention of fall color character.

Treatment Guide

The development of a management plan to achieve visual goals that are coordinated with other resources follows normal planning procedures. The tract of land may be a travel corridor, a compartment, or a unit.

Compromise often is required to accommodate several resource uses. In making these compromises, the land manager needs to have an array of treatments available, and needs to know how well each treatment meets the various land use objectives. The guides that follow provide a concise summary of silvicultural treatments available for northern hardwood stands, and the ability of those treatments to meet various VQOs and various site-specific visual goals.

Standard silvicultural treatments have been listed in the guide under the VQOs that they are capable of meeting. In some cases, variations of standard treatments may be needed to meet visual objectives. For example, certain sizes or shapes of clearcuts or special handling of logging residue may be required to meet those VQOs involving retention of natural appearances. These variations, limitations, and special requirements are all listed in the guides.

In a few cases, special silvicultural treatments are listed in the guide. These are treatments that are not currently part of standard silvicultural practice, but that appear to be biologically sound and technically feasible. They are suggested as additional means of achieving visual quality objectives in situations where standard practices may not suffice. These special treatments are described more completely in the section that follows the guide.

None of the treatments listed in the guide are intended to be fixed requirements. Rather, they are intended as general guides to the kinds of treatments that will usually meet the stated objectives. They cannot be substituted for professional judgment. They are a first step in arriving at a prescription—landscape architects, silviculturists, and other resource professionals should always make the final recommendation based upon consideration of the specific circumstances involved.

Use of the even-aged management treatments listed in the guide should automatically produce a variety of vegetative characteristics. Even so, consideration should be given to landscape design concepts, including variations in the size, shape, number, and arrangement of various elements into a pleasing sequence of views to avoid large scale monotony. See pages 13-17, Agriculture Handbook No. 434.

Use of the uneven-aged treatments listed in the guide will tend to produce only small scale variety. *Its use for vehicle-oriented travel routes should be limited to fairly short segments to eliminate the almost-certain, large-scale monotony.*

The guides are designed for vehicle-oriented observers. The section of the guide involving uneven-aged cutting methods in foregrounds to achieve goal #1 may be used for pedestrian observers. *The section of the guide involving even-aged cutting methods to achieve goal #2 is for vehicle-oriented observers only. To use this section of the guide for a pedestrian observer, the visual quality objective achieved will be one objective lower than shown.* For example, if an even-aged cutting technique that is listed under Retention is used in a pedestrian area, the VQO actually achieved will probably be closer to Partial Retention.

Variety of vegetative characteristics.

TREATMENT GUIDE
for
NORTHERN HARDWOODS

FOREGROUND **VISUAL GOAL #1**

TREATMENT	P	R	PR	M	MM
SINGLE TREE SELECTION CUTTING	No ↓	Yes	→	→	→
		Special "q"	→	Normal "q"	→
		Favor attractive trees	→		
		Requires seasonal restrictions	→	Normal seasonal restrictions	→
		Special residue management	→	Normal residue management	→
		Special road and landing design	→	Normal road and landing design	→
		Additional logging equipment restrictions	→	Normal logging equipment restrictions	→
GROUP SELECTION CUTTING	No ↓	Yes	→	→	→
		Openings up to 1/10 acre	Openings up to 1/2 acre	Openings up to 2 acres	→
		Shaping and/or edge feathering - no geometric shapes	→	No geometric shapes	→
		Favor attractive trees	→		
		Consider seasonal restrictions	→	Normal seasonal restrictions	→
		Special residue management	→	→	Normal residue management
		Special road and landing design	→	Normal road and landing design	→
		Additional logging equipment restrictions	→	Normal logging equipment restrictions	→

TREATMENT GUIDE
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MIDDLE GROUND **VISUAL GOAL #1**

TREATMENT	P	R	PR	M	MM
SINGLE TREE SELECTION CUTTING	No ↓	Yes	→	→	→
		Consider favoring attractive trees	→	Normal selection practices	→
		Normal residue management	→	→	→
		Special road and landing design	→	Normal road and landing design	→
GROUP SELECTION CUTTING	No ↓	Yes	→	→	→
		Openings up to 1/4* acre	Openings up to 1* acre	Openings up to 2* acres	→
		OPENING DENSITY No more than 20% of the stand in opening	→		
		Opening oriented to the contours and existing land-scape characteristic	→	→	
		Shaping and/or edge feathering — no geometric shapes	→	No geometric shapes	→
		Consider favoring attractive trees	→	Normal selection practices	→
		Normal residue management	→	→	→
		Special road and landing design	→	Normal road and landing design	→

* The apparent size may vary considerably from the actual size indications in these guidelines. The apparent size, acceptable to meet the adopted VQO will depend on the landscapes visual capability to absorb the specific impact, inclusions left, orientation to the viewer and desired character to be created or retained. Openings necessary for visual enhancement are for the most part not addressed here.

TREATMENT GUIDE
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BACKGROUND **VISUAL GOAL #1**

TREATMENT	P	R	PR	M	MM
SINGLE TREE SELECTION CUTTING	No ↓	Yes	→	→	→
		Normal residue management	→	→	→
		Normal road and landing design	→	→	→
GROUP SELECTION CUTTING	No ↓	Yes	→	→	→
		Normal residue management	→	→	→
		Normal road and landing design	→	→	→

TREATMENT GUIDE
for
NORTHERN HARDWOODS

FOREGROUND **VISUAL GOAL #2**

TREATMENT	P	R	PR	M	MM
CLEARCUTTING	No ↓	No EXCEPT THAT OPENINGS UP TO 2 ACRES MAY BE USED FOR ENHANCE-MENT ALONG ROAD EDGES (see page 33)	Yes	→	→
	↓		Openings up to 5 acres with inclusions and shaping.	Openings up to 25* acres with inclusions and shaping	Opening up to 40* acres without inclusions
	↓		No geometric shapes consider extended rotation	→ Normal rotation	→ →
	↓		Visible edges feathered	→	No edge feathering required — road-side opening unlimited
	↓		Roadside opening up to 200'	Roadside opening up to 400'	
	↓		Spacing of openings 1000'	→	Normal spacing of openings
	↓		No adjacent regeneration cutting for a minimum of 20 years	No adjacent regeneration cutting minimum 10 years	→
	↓		Seasonal restrictions	→	Normal seasonal restrictions
	↓		Special residue management	→	Normal residue management
	↓		Special road and landing design	Normal road and landing design	→
	↓		Additional logging equipment restrictions	→	Normal logging equipment restrictions

*See page 127.

TREATMENT GUIDE
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FOREGROUND **VISUAL GOAL #2**

TREATMENT	P	R	PR	M	MM
SHELTERWOOD CUTTING	No	Yes	→	→	→
	↓	"Esthetic" shelter-wood up to 3* acre removal cut	"Esthetic" shelter-wood up to 10* acre removal cut	Standard or "Esthetic" shelter-wood up to 30* acre removal cut	→ Up to 50* acre removal cut
	↓	Shaping and/or edge feathering — no geometric shapes	→	No geometric shapes	→
	↓	Roadside opening up to 200'	Roadside opening up to 400'	→	Unlimited roadside opening
	↓	Spacing of opening 1000'	→	→	Normal spacing of openings
	↓	No adjacent removal cutting — minimum 20 years	→	No adjacent removal cutting — minimum 10 years	No restrictions
	↓	Consider extended rotation	→	Normal rotation	→
	↓	Special residue management	→	→	Normal residue management
	↓	Special road and landing design	→	Normal road and landing design	→
	↓	Additional logging equipment restrictions	→	Normal logging equipment restrictions	→

*See page 127.

TREATMENT GUIDE
for
NORTHERN HARDWOODS

FOREGROUND **VISUAL GOAL #2**

TREATMENT	P	R	PR	M	MM
TWO-AGE MANAGEMENT CUTTING	No ↓	Yes	→	→	→
		Roadside cutting limited to 200′	Roadside cutting limited to 400′	Roadside cutting unlimited	→
		No adjacent regeneration cutting - minimum 20 years	→	No adjacent regeneration cutting - minimum 10 years	Normal adjacent regeneration cutting
		Extended rotation	→	Normal rotation	→
		Special residue management	→	Normal residue management	→
		Special road and landing design	→	Normal road and landing design	→
	↓	Additional logging equipment restrictions	→	Normal logging equipment restrictions	→
THINNING	No ↓	Yes	→	→	→
		Favor attractive trees	→	→	Normal selection
		Special residue management	→	Normal residue management	→
		Special road and landing design	→	Normal road and landing design	→
	↓	Additional logging equipment restrictions	→	Normal logging equipment restrictions	→

TREATMENT GUIDE
for
NORTHERN HARDWOODS

MIDDLE GROUND **VISUAL GOAL #2**

TREATMENT	P	R	PR	M	MM
CLEARCUTTING	No	Yes	→	→	→
	↓	Only if the opening with inclusions cannot be observed from the observer position	Variable size up to 40* acres with inclusions. No geometric shapes. Openings oriented to contours and existing landscape characteristic Consider sequence cutting	Normal practices	→
	↓	Normal residue management	→	→	→
	↓	Special road and landing design	→	Normal road and landing design	→
SHELTERWOOD CUTTING	No	Yes	→	→	→
	↓	2 cut shelterwood only if the opening cannot be observed	''Esthetic'' shelterwood	2 cut or ''Esthetic'' shelterwood	→
	↓	No geometric shapes and/or edge feathering	→	Normal practices	→
	↓		Consider sequence cutting with inclusions and residuals		
	↓	Normal residue management	→	→	→
	↓	Special road and landing design	→	Normal road and landing design	→

*See page 127.

TREATMENT GUIDE
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NORTHERN HARDWOODS

MIDDLE GROUND **VISUAL GOAL #2**

TREATMENT	P	R	PR	M	MM
TWO-AGED MANAGEMENT CUTTING	No ↓	Yes	→	→	→
		Normal residue management	→	→	→
		Special road and landing design	→	Normal road and landing design	→
THINNING	No ↓	Yes	→	→	→
		Favor attractive trees	→	Normal selection practices	→
		Normal residue management	→	→	→
		Special road and landing design	→	Normal road and landing design	→

TREATMENT GUIDE
for
NORTHERN HARDWOODS

BACKGROUND **VISUAL GOAL #2**

TREATMENT	P	R	PR	M	MM
CLEARCUTTING	No	Yes	→	→	→
	↓	Variable size up to 25* acres. No geometric shapes. Opening oriented to contours and existing landscape characteristic	→	Variable size up to *40 acres. No geometric shapes	→
	↓	Normal residue management	→	→	→
	↓	Normal road and landing design	→	→	→
SHELTERWOOD CUTTING	No	Yes	→	→	→
	↓	2 cut or "Esthetic"	→	→	→
	↓	Variable size and shape up to 50* acres. Fit to existing landscape characteristic	→	Variable size and shape up to 100 acres*	Unlimited size
	↓	Normal residue management	→	→	→
	↓	Normal road and landing design	→	→	→
TWO-AGED MANAGEMENT CUTTING	No	Yes	→	→	→
	↓	Normal residue management	→	→	→
	↓	Normal road and landing design	→	→	→
THINNING	No	Yes	→	→	→
	↓	Normal silvicultural practices	→	→	→
	↓	Normal residue management	→	→	→
	↓	Normal road and landing design	→	→	→

*See page 127.

Treatment Guide Explanations

Terms	Sources and Explanations
Single tree and group selection	See U.S. Forest Service 1976.
Clearcutting	See Marquis et al. 1975; Leak et al. 1969; and U.S. Forest Service 1965.
Two-cut shelterwood	See Godman and Tubbs 1973; Marquis et al. 1975.
"Two-age" management cutting	See Special Northern Hardwood Treatment section, "Two-age" Management Cutting on page 139.
"Esthetic" shelterwood cutting	See Special Northern Hardwood Treatment section, "Esthetic" Shelterwood cutting on page 138.
Sequence cutting	See Douglas-fir section on pages 153-154.
Inclusions and residuals	See Special Northern Hardwood Treatment section, Retention of Residuals on page 140.
Special "q"	See Special Northern Hardwood Treatment section, Single Tree Selection Cutting on page 142.
Extended rotation	Extending the normal rotation age so as to grow trees to larger size before the stands are harvested. A minimum of 20 years extension is normally required to achieve any significant increase in tree size.
Shaping	Configuration of openings are free-form with undulating edges. Also see section on Shape, page 25 and section on Scale, page 26.
Edge feathering	Partial cutting of trees along the border to create a transition in heights between areas and/or a transition in stand density between stands of different densities; i.e., between 0 and full stocking. See section on Edge, page 23.

Extending rotation for large trees.

Orientation	Direction of the long axis of an opening or treatment area. Openings with one axis longer than the other are less noticeable if the long axis is perpendicular to the point of observation. Also, openings with the long axis in relation to natural contours and observer position will be less noticeable.
Opening density	The relation of the number of openings to the treatment area. A relatively small treatment area with a large number of openings will create a "measles" or "pock-marked" appearance when viewed in middleground. Size of the openings will be a contributing factor; i.e., there generally can be more small-sized openings in a given treatment area and fewer large openings. As a general guide, no more than 20 percent of the area should be in group selection openings that are 40 years of age or less at any one time.
Roadside opening	The width of the opening measured along the edge of the road. This does not limit the depth or length of the other edges of the opening, nor does it mean the width of the opening should not be varied. Variety can be created by varying the width of openings. See National Forest Landscape Management, Volume 1, pages 13-17.
Spacing of openings	The minimum distance between openings measured along the edge of the road. This does not mean the spacing between openings should not be varied in order to create variety. See National Forest Landscape Management, Volume 1, pages 13-17.
Favoring attractive trees	In foregrounds, it is often possible to favor existing and potential specimen trees, groups of trees, flowering trees and shrubs, and conifers by cutting around and under them. This will enhance the roadside landscape characteristics by creating and enhancing variety and detail focal points. In middleground areas, it is possible to cut so as to favor groups or clumps of the above kinds of trees.

Seasonal restrictions	This includes limiting management activities to a specific season of the year. This is important in foreground areas to avoid conflict with high recreation user periods. In addition, it might be important to consider seasons of the year when logging equipment may create unwanted soil disturbance.
Special residue management 	This is especially important in foreground areas. Special treatments to reduce visual impacts of logging residue include: Complete removal from the site by chip and haul, exportation, and pile and advertise. In addition, this could be accomplished with on-site disposal methods including: Chipping, lopping with or without scattering, incinerator burning, and yarding unmerchantable material (YUM). Special rcsidue management also includes the felling of dead, dying, broken, and leaning trees in the foreground areas.
Special road and landing design 	In foreground and middleground areas, proper design and location of access roads is especially important. Reverse curves on access roads in foreground areas should be used to block the view into the landing from the road. Landings should be located a minimum of 400 feet from the road, so that they will be screened from observation. Complete removal or burying of boulders, stumps and other residue from the clearing operation is necessary in foreground areas. Consideration should be given to planting the access roads and landings immediately after construction in foreground and middleground areas. Use native grasses, crown vetch, or other plants to soften the contrast of exposed soil. The special road and landing designs outlined here are often necessary to meet Retention and Partial Retention visual quality objectives. See Logging Systems section, page 195, for additional design criteria. The special road and landing designs outlined above are usually necessary to meet Retention and Partial Retention visual quality objectives.
Additional logging equipment restrictions	This includes limiting the use and type of logging equipment within foreground zones where the VQO is Retention or Partial Retention. For example, avoid using rubber-tired skidders on compactible soils or in seasons when deep rutting can occur. Also consider skidding *away* from the road. See Logging Systems section for additional description, pages 196-211.

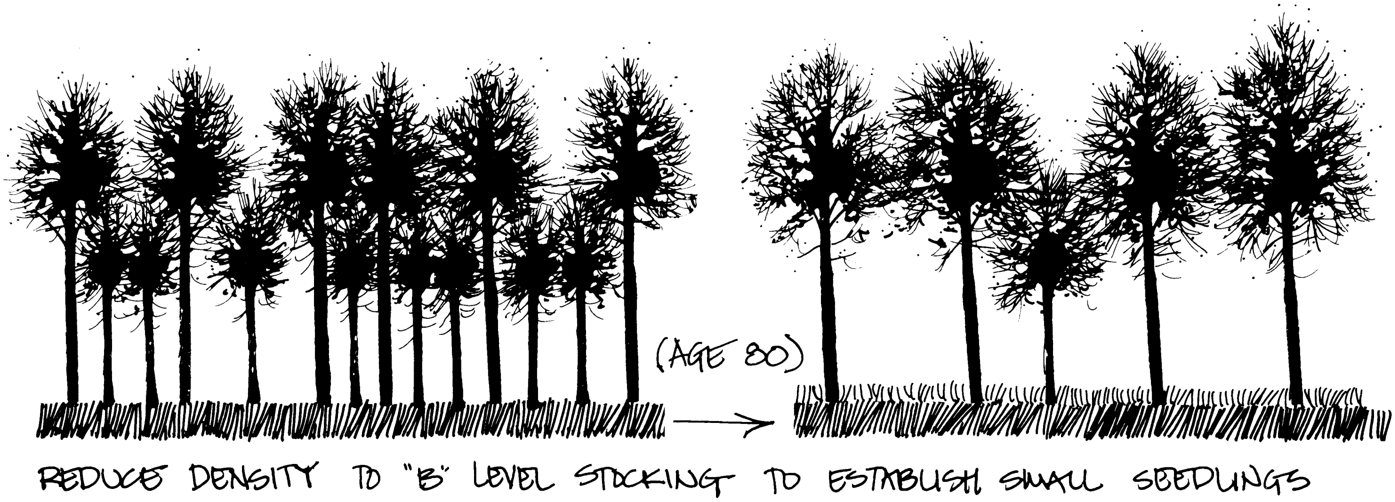
Special Northern Hardwood Treatment Descriptions

The following are definitions and descriptions of the special treatments listed in the Treatment Guide.

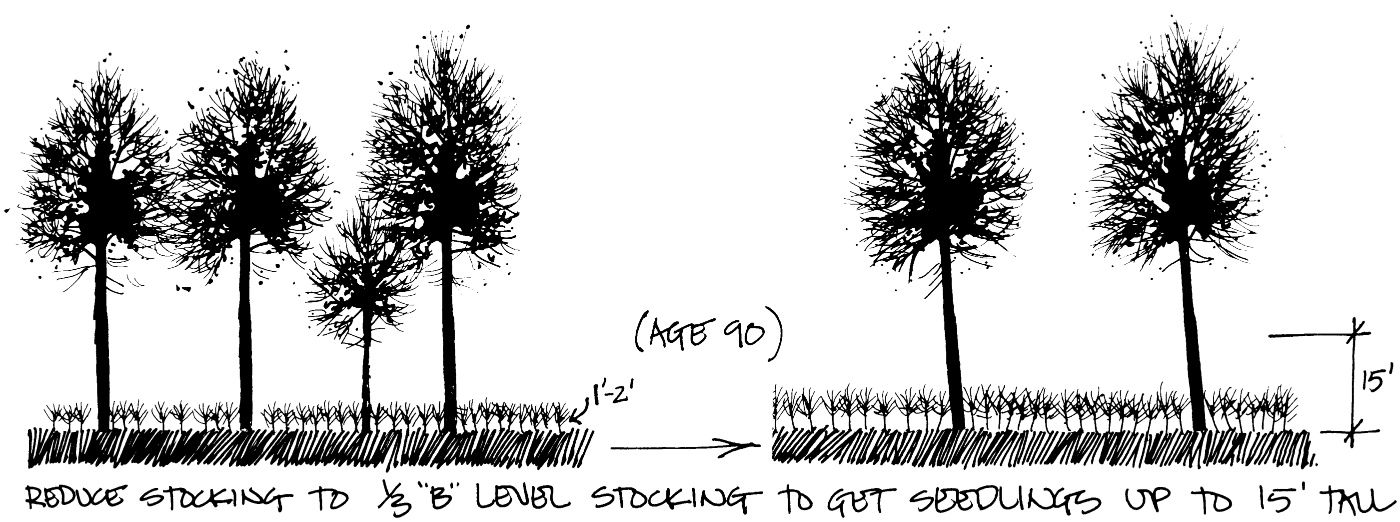
Esthetic Shelterwood

''Esthetic'' shelterwood is a modification of standard shelterwood techniques that requires one additional entry, the purpose of which is to develop the advance reproduction to 10 feet or 15 feet in height before the final overstory removal. This large reproduction conceals soil disturbance and logging residue, leaves an opening that has already been partially healed, and conceals the unsightly appearance of a fresh clearcut or ordinary shelterwood. However, an opening similar to a 10- to 20-year old clearcut does remain, and the edge of the cutting will be visible for an additional 20 to 40 years. Consequently, ''esthetic'' shelterwood cutting may not meet Retention or Partial Retention objectives under all circumstances.

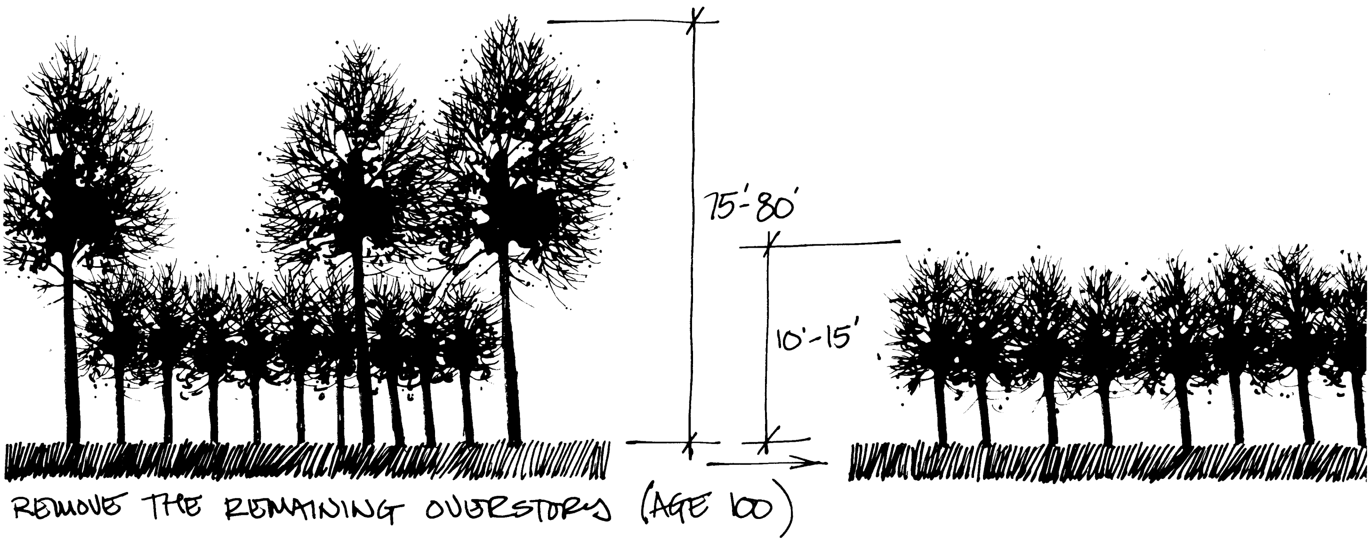
''Esthetic'' shelterwood cutting might be handled as follows in an even-aged stand approaching rotation age (100 years):



Year 0: Make the seed cut of a normal shelterwood sequence, reducing stand density to B level or slightly below (Leak et al. 1969, Roach 1977). This will open the canopy moderately to encourage the establishment of seedling regeneration, or to augment any advance regeneration already present.



Year 10: Make the first of two removal cuts, reducing stand density to one-half of B level stocking. This maintains adequate canopy density so that the visual effect of a stand remains, but provides adequate light for the advanced seedlings to make moderately fast height growth.



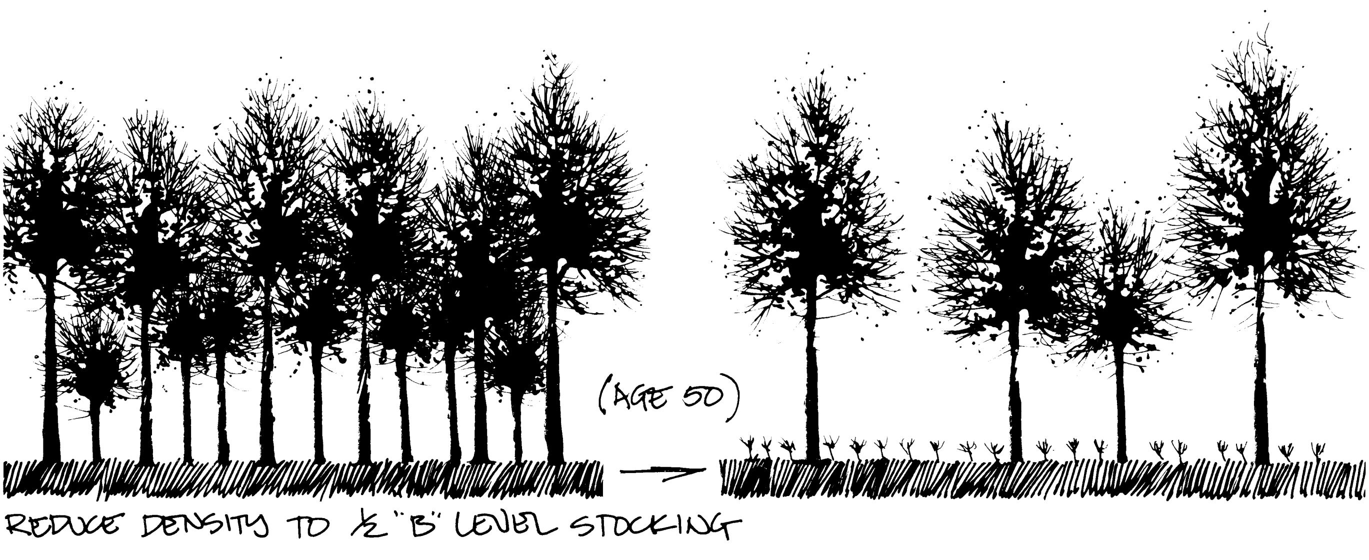
Year 20 or 25: Make the final overstory removal when advance reproduction has reached a height of 10 feet to 15 feet over most of the area. This will usually require 10 to 15 years additional growth after the previous cut.

The final overstory removal will leave a seedling-sapling stand that can be managed in the same manner as any other even-aged stand.

"Two-Age Management" Cutting

"Two-age management" cutting (as defined and used here) is a cutting technique and management scheme that falls somewhere between traditional even-aged and uneven-aged schemes. It is intended to permit maintenance of intolerant species while avoiding complete overstory removal at any time.

"Two-age management" cutting involves the maintenance of two distinct age classes on all areas at all times. For example, a second-growth, even-aged stand about halfway to rotation age (100 years) might be handled as follows:



Year 0: Harvest about half of the existing 50-year-old stand, reducing density to one-half of B level stocking (Leak et al. 1969, Roach 1977). This leaves a residual stand about half as dense as that left after a normal thinning, and creates an open canopy under which intolerant species will regenerate. The resulting stand will consist of 50-year-old trees and new regeneration in about equal numbers.

AGE 100 CANOPY IS REMOVED, LEAVING AGE 50 TREES & ESTABLISHING SEEDLINGS

Year 50: After 50 years growth, the two age classes will be 50 and 100 years old. At this time, all of the 100-year-old trees are cut, and the 50-year-old trees are thinned back to one-half of B level stocking as before. A new crop of regeneration is again obtained to replace the 100-year age class that was removed.

Year 100 and beyond: After year 50 repeat cuttings at half-rotation intervals.

Thinnings may be applied in both age classes at intermediate times in the above schedule. For example, thinnings at year 35 and again at year 85 will often be desirable to maintain density control and insure that the intolerants will not be shaded out. Such a thinning could be a combination precommercial operation in the younger age class and commercial thinning in the older age class.

Special Practices for Openings

The visual impact of clearcut openings, group selection openings, and openings created after the final removal cut of a shelterwood sequence can be softened considerably by a variety of techniques. These include: (a) Retention of some residual trees in the openings, either in groups or uniformly across the area; (b) progressive cutting from the back toward the observer so that the new edge is hidden from view (see pages 154 and 155 under Douglas-fir); (c) selection of size, shapes, and orientation of openings, and treatment of border trees to reduce the visibility of the openings and help them to blend with surrounding stands. Also see pages 45-47.

Retention of residuals.—The standard practice during final harvest cutting in northern hardwoods is to cut all trees down to some minimum size, such as 2 inches d.b.h. However, it may sometimes be desirable to retain a small number of residual stems in harvest areas for timber, wildlife, or visual purposes. The procedures are similar for clearcuts or final removal cuts of a shelterwood sequence.

Inclusion.—Clumps or islands of trees may be retained in final harvest areas to break up the opening and reduce its apparent size. This is especially effective when viewed from an oblique angle in middleground landscapes. (see Douglas-fir section, page 163.) Such inclusions can also benefit wildlife if mast-producing,

Clumps or islands of trees left to visually reduce apparent size of clearcut.

den, or perch trees are retained, or if the trees are retained along streamsides to avoid stream temperature increase or siltation.

Uniform residuals.—Residual trees may be retained throughout the harvest areas for both visual and timber purposes. The residual trees should be restricted to tolerant species, such as sugar maple and beech, which will withstand the sudden exposure without severe epicormic branching or mortality, and will recover and grow under such conditions. The trees retained should be between 3 and 8 inches d.b.h., with clear, straight boles. The goal should be to retain between 60 and 100 such trees per acre, uniformly distributed.

This small number of residual trees may serve timber purposes also. Fast growing, intolerant regeneration will catch up to the residuals by about age 40 to 50, and join with them to form a single crown layer. This is often the only feasible way to grow species of markedly different shade tolerance so that all species mature at the same time. These residuals also make it possible to perform the first commercial thinning at an earlier age than otherwise possible. However, care must be exercised in the selection of trees to retain, and in their number and distribution, so that the desired effects are obtained without interfering with intolerant regeneration.

Residual trees left after harvesting.

Single-Tree Selection Cutting with Low "Q"

Single-tree selection procedures make it possible to achieve Retention VQOs in northern hardwoods in areas viewed from all observer positions and for pedestrian as well as vehicle-oriented observers. The fact that cutting has taken place will not be evident to most observers.

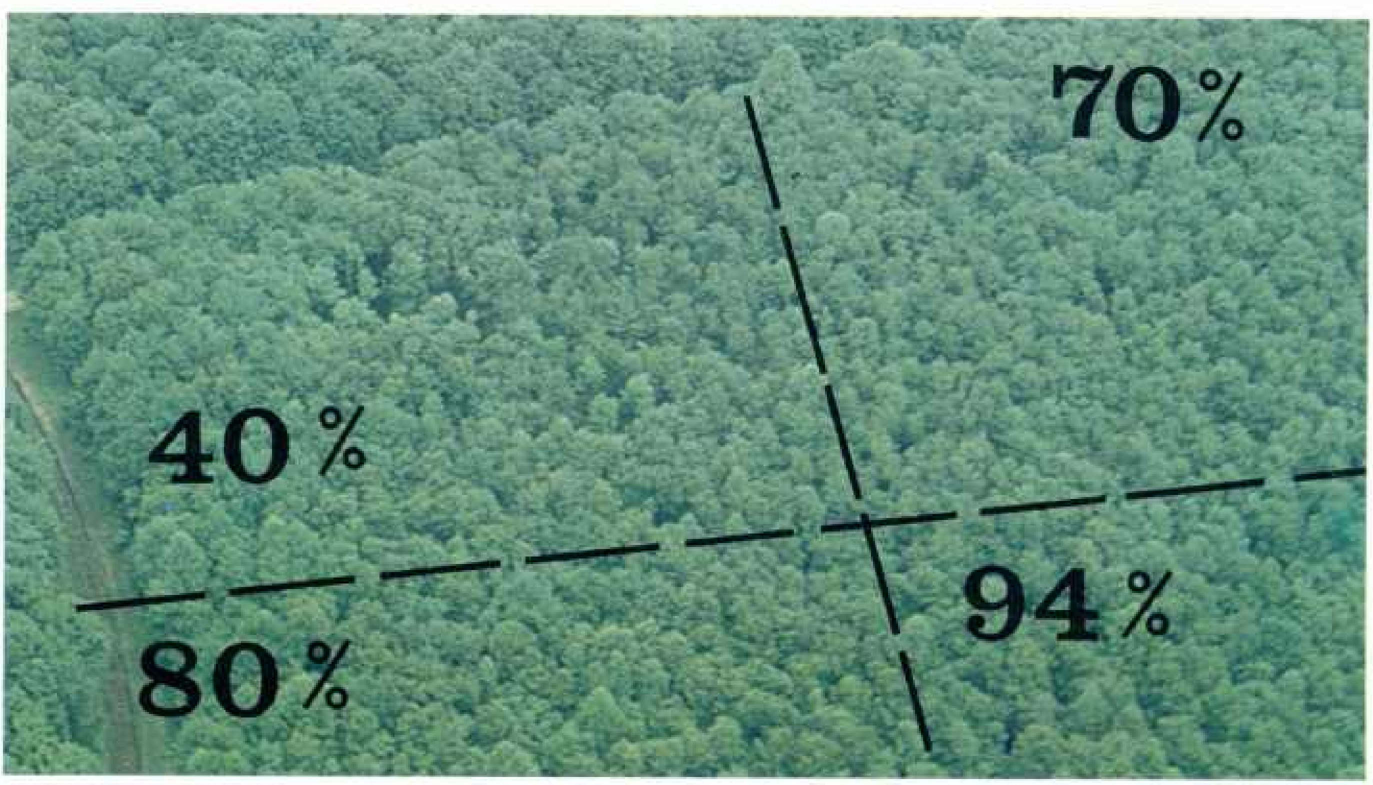
This is not achieved without some cost—mainly restriction of species to those more tolerant, like sugar maple and beech, with their somewhat lower growth rates and reduced timber yields. Nevertheless, acceptable timber yields are possible.

Standard single-tree selection procedures provide considerable latitude in residual stand densities, maximum tree sizes, and proportions of small to large trees. No special techniques are required to achieve visual quality objectives, but variations that provide for relatively high proportions of large trees will come closest to achieving the stand appearance outlined for goal #1. This control is exercised in the choice of the stand structure to be maintained, as follows:

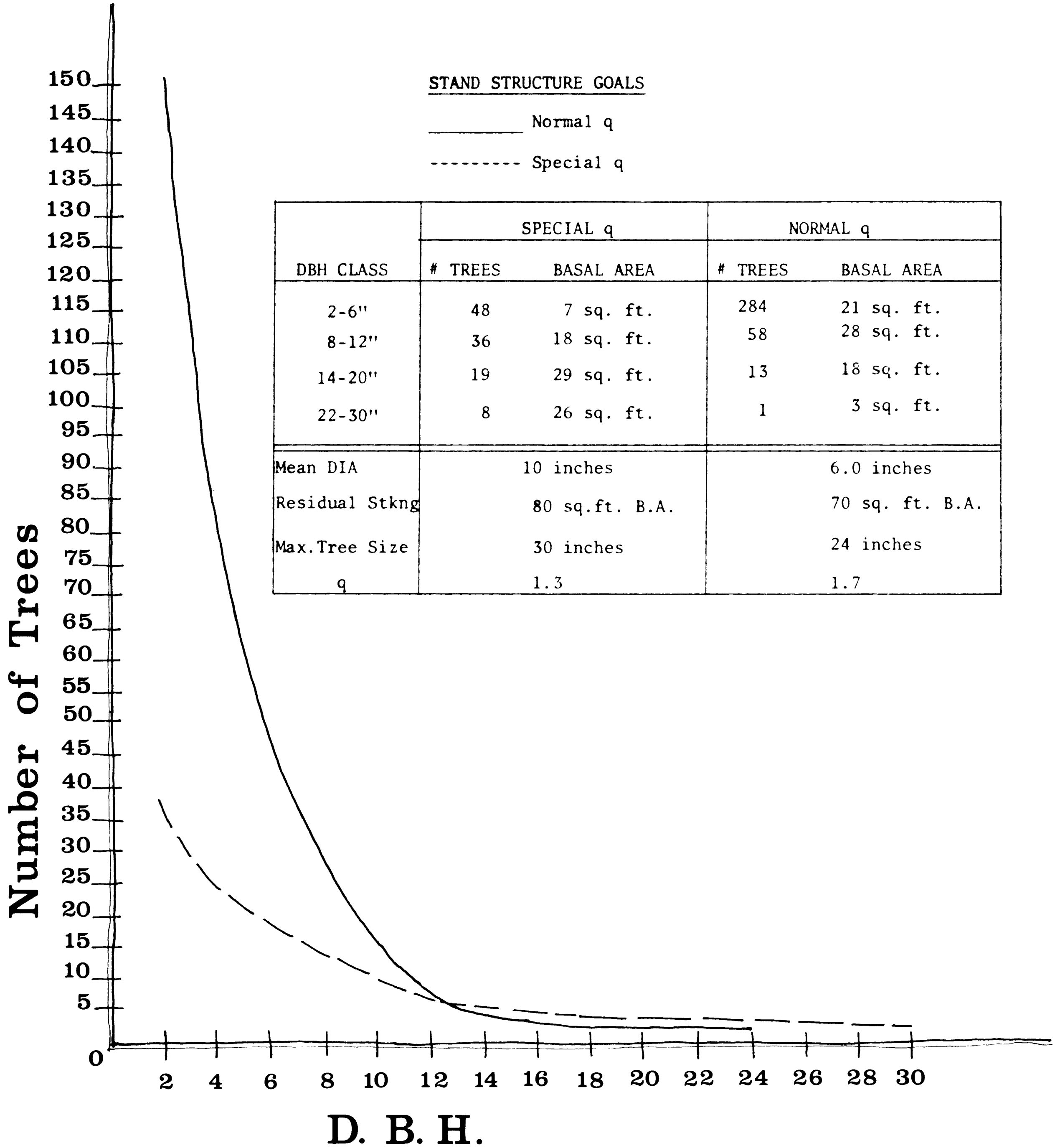
In selecting a stand structure goal, three parameters must be set: (a) the residual stocking level, (b) the maximum tree size, and (c) the distribution of size classes. Residual stocking levels should be set at B level, or at some other basal area goal already used for timber production purposes (Leak et al. 1969, Roach 1977). The maximum size of tree to be retained for timber production normally falls in the range of 18 to 24 inches d.b.h., depending upon species, site quality, and economic objectives. In foreground areas, where there is a Retention or Partial Retention visual quality objective, the maximum size of tree to be grown may be set at a somewhat higher level. A range of 18 to 30 inches d.b.h. seems appropriate.

The third alternative, distribution of size classes, is commonly expressed in terms of the ratio "q" between numbers of trees in successive 2-inch diameter classes. For example, a "q" of 1.5 means that there are 1.5 times as many 10-inch trees as there are 12-inch trees; 1.5 times as many 12-inch trees as there are 14-inch trees, etc. The lower the "q" ratio, the more large trees there are in proportion to small trees. Ratios of 1.5 to 2.0 are often recommended for timber production in northern hardwoods, but somewhat lower ratios (1.3 to 1.5) would be better where the objective is to provide large trees for visual purposes. This will normally entail additional expenditures for timber stand improvement, to remove small trees to achieve the diameter distribution goal. A sample of stand structure goals, based on the above normal and special criteria, is illustrated in the following graph.

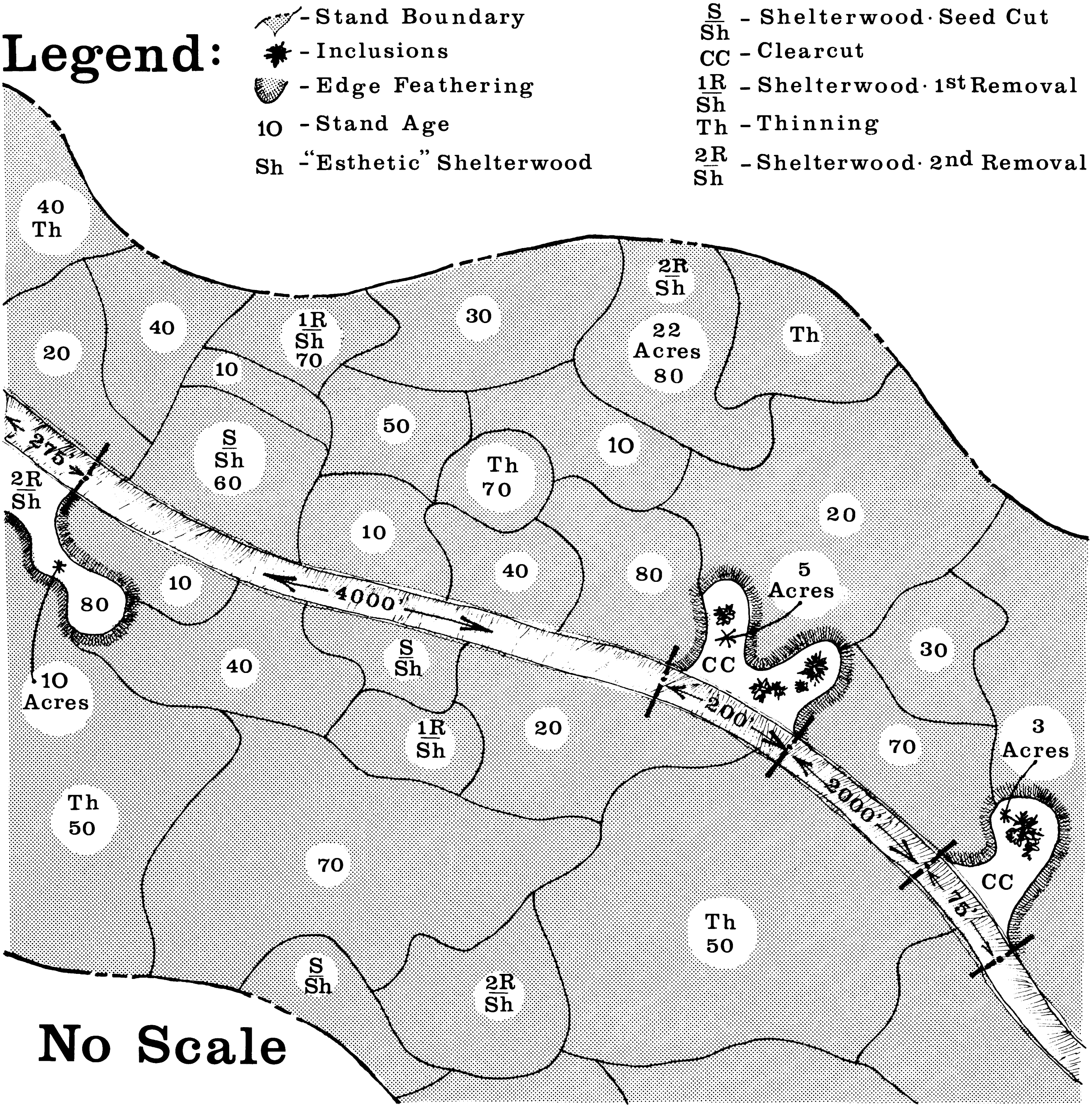
If second-growth stands are to be handled under single-tree selection cutting with the above parameters, there will be a considerable adjustment period required before there are any trees in the large diameter classes and before a balanced stand structure is achieved. This long-term enhancement may require 40 to 100 years or more, depending upon initial stand conditions. For a more complete description of single-tree selection procedures, see Marquis (1976).



Overlay figures on photo illustrate percent of trees left in four different harvest plots.



DBH CLASS	SPECIAL q # TREES	SPECIAL q BASAL AREA	NORMAL q # TREES	NORMAL q BASAL AREA
2-6"	48	7 sq. ft.	284	21 sq. ft.
8-12"	36	18 sq. ft.	58	28 sq. ft.
14-20"	19	29 sq. ft.	13	18 sq. ft.
22-30"	8	26 sq. ft.	1	3 sq. ft.
Mean DIA	10 inches		6.0 inches	
Residual Stkng	80 sq.ft. B.A.		70 sq. ft. B.A.	
Max.Tree Size	30 inches		24 inches	
q	1.3		1.7	


Legend:
- Stand Boundary
- Inclusions
- Edge Feathering
10 - Stand Age
Sh - "Esthetic" Shelterwood
S/Sh - Shelterwood · Seed Cut
CC - Clearcut
1R/Sh - Shelterwood · 1st Removal
Th - Thinning
2R/Sh - Shelterwood · 2nd Removal
40 Th
20
40
1R Sh 70
30
2R Sh
22 Acres 80
Th
10
S Sh 60
50
Th 70
10
20
275'
2R Sh
10
40
80
5 Acres
10
80
4000'
30
40
S Sh
CC
200'
10 Acres
1R Sh
20
70
3 Acres
2000'
Th 50
70
CC
75'
Th 50
S Sh
2R Sh
No Scale

Application of the Treatment Guides

The treatment guides provide some options available for a tract of land or section of a corridor where land management planning has defined the selected Visual Resource Management Objective. Guides, especially, can be easily misconstrued as direction; thus, it is appropriate at this point to reemphasize the statement made at the initial introduction. This portion, as well as all of the material in this Timber Chapter of the Visual Resource Management Handbook, is illustrative of concepts and provides examples to stimulate innovative designs. None of the material provides direction nor policy for the National Forest System. The use of visual resource management concepts that would constrain the output of other resources in conflict with Land Management Planning direction would be inappropriate.

The guides may be used as a planning tool as follows:

a. Refer to the visual quality objective map to determine the distance zone and visual quality objective recommended or adopted for the area in question;

b. Decide which of the two characteristic landscape goals (#1 and #2) will be achieved;

c. In the guide, find the appropriate characteristic landscape goal, distance zone, and visual quality objective, and determine the silvicultural treatments that can be used under that set of conditions, and the special measures or variations of standard practices that are required;

d. Ascertain whether the treatment options determined above can be prescribed to meet the sequence of visual goals and other resource goals for the area. If not, some compromise may be required in the management objectives adopted.

For example, consider a foreground zone inventoried as being appropriate for Partial Retention. If a characteristic landscape containing an attractive variety of stands (Goal #2) is selected, then the guides indicate three options for regeneration cuttings:

1. Clearcuts up to 5 acres in size may be used, if they are carefully shaped, if the edges are feathered, and if they contain inclusions.
2. "Esthetic" shelterwood cutting may be used on areas up to 25 acres in size, if edges are either shaped or feathered.
3. "Two-age management" cutting may be used on areas up to normal maximum stand sizes.

The land manager may choose any combination of these cutting methods to best meet overall goals, keeping in mind the need to insure acceptable visual variety. For all cutting methods there are restrictions on the maximum length of cutting along the road edge and minimum distances between openings along the road. The guide also indicates that thinning may be used in this zone, and that there are special requirements for residue treatment, road and landing design, and logging equipment for any cutting that is done.

Normal even-aged sustained yield scheduling practices, combined with the restrictions listed in the guide for Goal #2, will tend to create considerable variety in stand age, size of trees, height, and species composition.

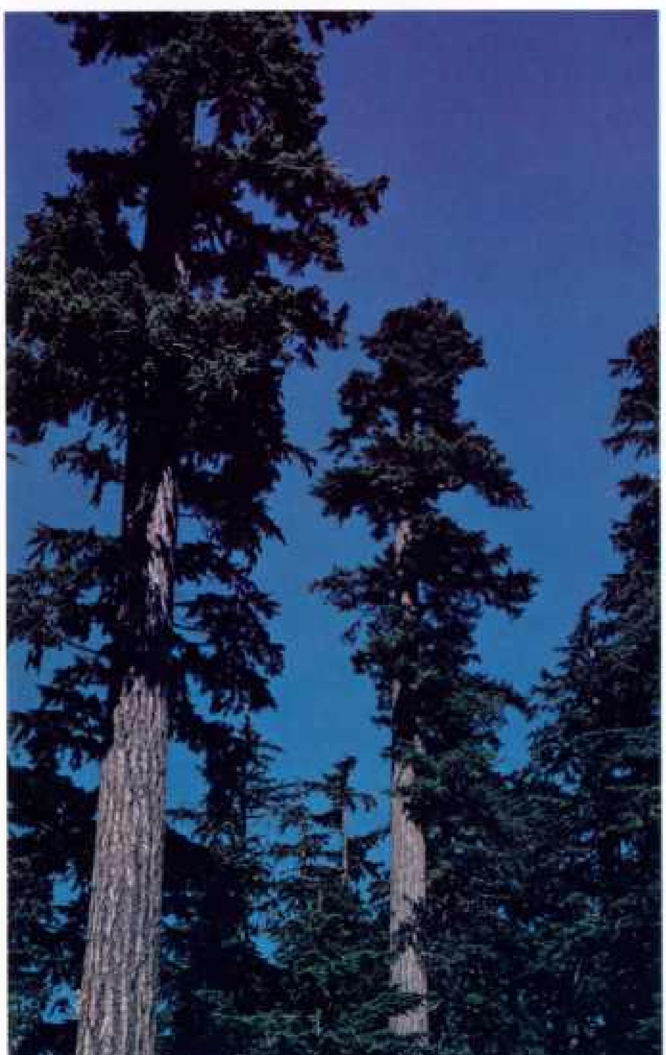
Douglas-Fir

Douglas-fir, as found in the Cascade Range of Washington and Oregon, consists of the westside Douglas-fir type and was chosen to represent tree species of a certain set of silvical, visual, climatic, and other characteristics. Douglas-fir is the predominant species of the type, but western hemlock, cedar, and true firs are also frequent stand constituents. Treatments illustrated in this section may often be adapted to other species having similar characteristics.

Climatically, the area is dominated by maritime weather patterns, causing a moist and relatively mild climate with long growing seasons. Severe winds often cause windthrow problems in the shallow rooted old-growth stands. Soils are generally well drained, deep, and fertile. The combination of favorable climatic and soil conditions results in almost ideal conditions for timber growth.

The first impression of an old-growth Douglas-fir stand is one of continuous texture. Careful examination of any area of significant size, such as this drainage on the Mt. Hood National Forest, shows subtle differences in the canopy level. These are generally caused by higher or lower site productivity levels or natural variation in seedling density as a result of seed source. There may be an actual difference in age as a result of small fires that killed part of the stand, as well as age differences that reflect difficulty of natural regeneration establishment after the catastrophy that eliminated the previous stand. Close examination of the photo reveals considerable diversity in what first appears to be a continuous stand of old-growth Douglas-fir.

The present old-growth of Douglas-fir originated over 200 years ago, following naturally occurring events such as windthrow, fire, and other phenomena. Where the species has grown beside long established openings (such as roads) or, because of soil and climatic conditions, has grown in fairly open stands, the crowns are often quite long and full. This provides visually desirable tree forms in foreground and has a good screening capability for shelterwoods in middleground. It also creates natural appearing edge effects for clearcuts.



In most situations, Douglas-fir is typified by tall trees grown in dense stands. Severe light reduction in these stands causes the live crowns to be very sparse, occurring only in the top 30 percent of trees 180- to 200-feet tall. These short sparse crowns result in the visual screening ability of a single tree to be very low when viewed on opposing slopes.

Long unbranched tree boles produce a very strong, unnatural edge effect in clearcuts and shelterwood overstory removals. This emphasizes the harvest opening and makes any sort of natural appearance more difficult to attain.

The management of Douglas-fir is limited by the species' silvical characteristics, particularly its susceptibility to windthrow and its intolerance to shade. These, together with the difficulty of logging very large trees on the steep topography found over much of the species range, limit the treatment opportunities. Younger stands of timber that will replace the existing stands of old growth, if managed by commercial thinning throughout their life, will be more windfirm. New stands will also provide greater flexibility in treatment opportunities for regeneration activity during the second harvest cycle.

A significant element in achieving success in these treatments is long-range planning for harvest on a total landform face or in a foreground segment of a mile or longer. This planning should be done prior to the first entry, even though only a small percentage of the area is harvested at each entry.

Several treatments are described for both the foreground and middleground distance zones. Within these zones, treatments are structured according to the *Retention* and *Partial Retention VQOs* and include descriptions of enhancement treatments.

The *Modification VQO* is also discussed. The task of meeting a stated VQO depends upon a site-specific prescription to account for all of the variables of the site and observer position.

Most treatments are described under an even-age management system, with treatment areas kept as small as necessary to meet visual and other resource objectives. A variety of silvicultural treatments can be used. These include shelterwood and clearcut regeneration systems, precommercial thinning, and commercial thinning. Stocking will be controlled at levels necessary to optimize timber production, within the constraints of other resource objectives. Artificial regeneration will be practiced promptly in all units undergoing regeneration harvest.

Soil disturbed to prepare the site for seed germination often produces a strong color contrast with surrounding untreated stands.

Assumptions

Full retention of old-growth stand characteristics over a long period of time is not possible because of shade intolerance and other stand management problems. Character of the stands in both foreground and middleground under proposed treatments will, therefore, change subtly over time.

Under the VQO of Retention in foreground, enhancement techniques may be necessary because the changes introduced will generally add increased variety of vegetative color and texture. Negative elements arising from slash, skidroads, and disturbed soil can be mitigated to meet VQOs.

Treatments are designed primarily for the vehicle-oriented observer and, in general, will not meet the more restrictive VQOs in pedestrian occupancy sites and critical trail foregrounds. These areas should be handled as outlined under the section entitled Implications of the Uneven-age Concept and VQOs, page 17.

Design Criteria—Foreground

Treatments must:

—Provide sufficient light for growth of planted fir seedlings;

—Minimize windthrow potential;

—Allow for salvage of blowdown concurrent with other harvest operations;

—Allow for commercial thinning operations concurrent with other harvest operations;

—Soften unnatural edges to meet VQOs;

—Design size of entries to provide human scale in foregrounds, blend with landforms and natural openings in middleground, and provide capability of mitigating negative elements to meet the visual quality objective;

—Design entry intervals to minimize site impact;

—Provide for residue reduction sufficient to meet fuel abatement needs, VQOs, reforestation requirements, and, where necessary, other resource goals.

To illustrate foreground treatments in a Douglas-fir stand, a segment of road foreground with uniform stand characteristics was selected from a corridor plan. A variety of appropriate visual goals was assigned to achieve, within biological potential, a specific group of visual characteristics in the total sequence of experiences. This permitted the following design and illustration of an array of visually and silviculturally acceptable treatments.

The specific characteristics of the timber stand and area selected were:

1. A Douglas-fir stand with a relatively unbroken canopy.
2. An age that exceeds 250 years, but without serious insect or disease problems; stable.
3. Site index of approximately 145 (100-year base).
4. Topography is flat or gently rolling.

These characterisitcs provided information from which certain predictions could be made. The productivity permitted an estimate that a 36-inch diameter target could be achieved in 185 years with careful stocking control. Gently rolling ground, combined with productivity, indicated that negative elements such as slash, skidroads, and other disturbance could be abated with proper treatment to achieve VQOs.

These and other predictions were used in designing silvicultural treatments to achieve the following goals that relate to VQOs:

1. Maintain dominance of texture as found in a dense mature timber stand.
2. Introduce small-scale diversity as enhancement, with negative elements falling within contrast limitations.
3. Maintain a representation of large tree diameters as specified for Retention and Partial Retention.

These goals were further refined and made specific as follows:

—Target mature tree diameter: 36-inch average for *Retention*; 30-inch average for *Partial Retention.* Normal diameter at standard rotation for *Modification.*

—Unnatural edges should remain subordinate or not evident for *Retention* or *Partial Retention* objective.

—Allow colorful shrub and ground cover species to intermix with the seedling and sapling age classes.

—Small-scale areas of different age classes can be created to provide variety while maintaining a dominant mature stand characteristic.

Finally, it was assumed that the observer in the foreground is vehicle oriented, traveling at a rate of 35 to 50 mph. The middleground observer is above and about 1 mile distant from the observed area.

Treatment Concepts

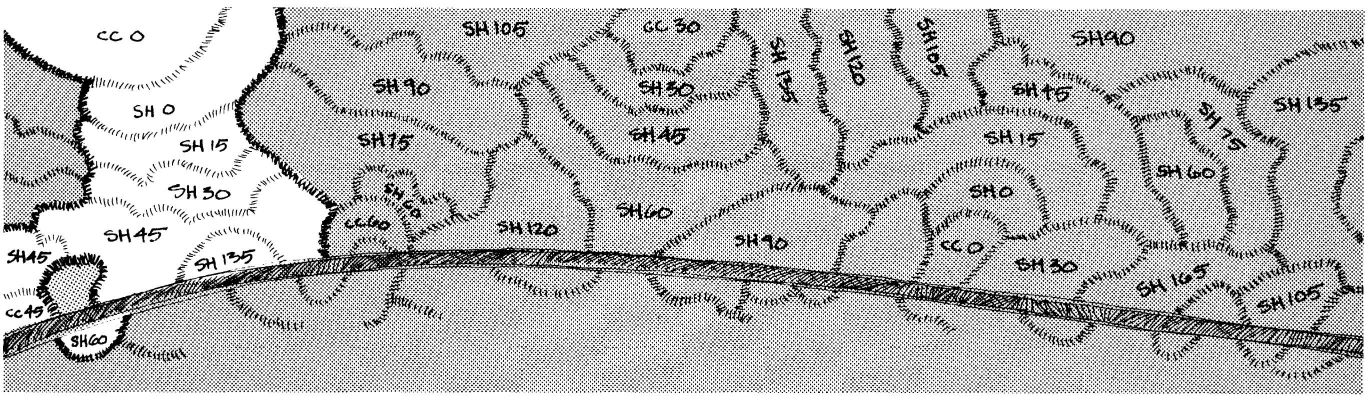
Progressive small-scale entries are suggested to achieve the various VRM objectives. The designer of clearcut and shelterwood units must be concerned with scale and shape, as well as number and arrangements of harvest units.

Initial entries should begin both at the road edge and along the back of the treatment area. Subsequent regeneration harvest entries should progress toward or away from the observer and be carried out sequentially (see sketch). The timing of entries should be controlled by the Visual Quality Objective, the site productivity, and the ability of the previously regenerated stand to provide sufficient height and color differences in age classes to meet the small-scale variety objectives. The fire hazard and conditions requiring disposal of debris created by commercial or precommercial thinning should be physically treated or abated naturally prior to new entires.

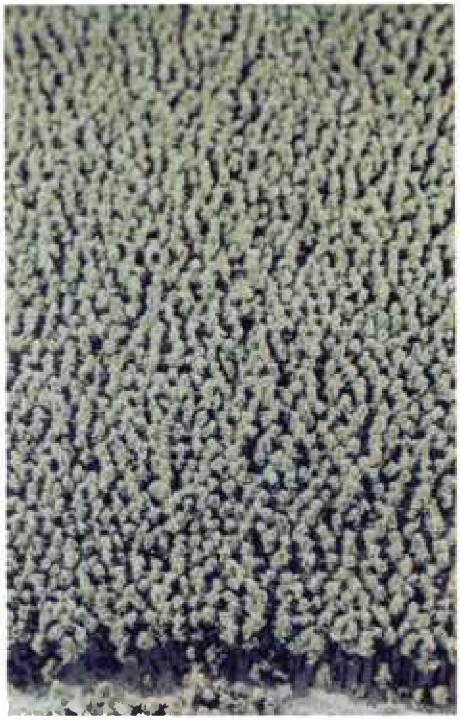
While the depth of the treatment area will vary, depending upon topography and the position of the observer, 800 to 1,200 feet should generally be sufficient to meet all VQOs.

Units in the immediate foreground will logically be a combination of shelterwood and very small clearcuts. New units may be larger than the initial unit size, as long as only a small portion of new cutting is opened up to the observer.

Only the first 3 or 4 entry periods should be planned and recorded. This will set the pattern conceptually, but will allow future designers the flexibility needed to incorporate necessary changes as the landscape character evolves, technology advances, and the physical condition of the timber stand develops.



Legend
\# = year of entry
cc = clearcut
sh = shelterwood
Dark outlined entries depicted in model photos next two pages.



Before entry

First

Second

The fourth entry as seen from a normal high observer position.

The selected example visualizes a harvest schedule designed to meet VQOs while systematically converting existing old-growth stands to thrifty, rapidly growing, even-aged small substands. These stands continue to grow until target size, bark characteristics, and other conditions are achieved.

The photos above show this progression. To adequately illustrate the concept, the model is photographed from directly overhead rather than as an observer would see it.

First Entry

A clearcut and shelterwood are made at the backside of the treatment area, with the shelterwood toward the observer. Sufficient uncut area must remain between initial entries to permit progressive cuttings described in later entries.

After slash disposal, both the clearcut and shelterwood sites are planted to assure prompt regeneration. This will begin to set up a transition zone to soften the visually harsh edge of Douglas-fir trunks.

Third

Fourth

Fifth

The model photos above illustrate this conceptual treatment along a short segment of road frontage. The actual visual effect of this treatment could be as shown in the sequence of photos on the next page.

Second Entry

The initial-entry shelter trees are removed and any blowdown is salvaged. A new shelterwood is made toward the observer. After slash disposal, the second entry cutting areas are planted while the first entry stands are precommercially thinned. Careful attention to density control should further soften unit edges, create diversity, and permit growth of the young stand at an acceptable rate.

Third, Fourth, and Fifth Entries

Third and fourth entries essentially repeat the previous treatments except that commercial thinning is carried out in the earliest regenerated stands which contain merchantable excess trees. The shelterwood unit will open out onto the road front in full view of the observer during the fourth entry. Fifth entry removes the shelter trees at the road's edge. Primary guidance for this and the fourth entry can be found under each Visual Quality Objective on pages 167-168 and Landscape Design on pages 35-36.

The small-scale treatments that are illustrated in the models help retain a dominance of mature forest character, while introducing a variety of other age classes and shrub character.

26.1 mi.

At a focal point down the road, an attractive grouping of different age classes and shrubs is made possible by the small-scale treatments.

26.5 mi.

Around a bend in the road, what used to be a closed foreground view is now opened so a distant feature can be observed. Foreground trees now are used primarily to enframe the feature after having screened more distant regeneration activities in the scheduling sequence.

26.7 mi.

Purpose of Treatment Design

Properly designed shelterwoods maintain canopy height and permit establishment of regeneration and other vegetation prior to the final removal of existing stands. They may be larger in size than a clearcut under a given set of conditions and will, therefore, make it easier to achieve scale and proportion of area to be harvested per entry period for any quality objective.

Clearcuts bordered by shelterwoods that are designed to have increasing density toward uncut stands provide space for debris disposal, as well as adequate light and space to establish regeneration and other desirable vegetation. The application of variable shelter density will provide a more natural appearance, particularly as seen from higher, more distant observer positions.

Ten- to 15-year entry periods are suggested to minimize site impact and to approximate periods of time during the growth cycle when the majority of previously entered areas are ready for further treatment.

Higher or lower site indexes may require some adjustment in entry time; usually a longer interval is necessary for lower site indexes. Such progressive harvesting should also facilitate a more economic logging operation to accomplish the treatments and salvage blowdown. The natural pattern of winter storms with strong winds virtually guarantees the loss of some standing shelter trees, although the high proportion of the initial operating area remaining *uncut* should provide adequate support in most cases. Some flexibility in timing and location of cutting units provides an opportunity to consider establishing priority for the harvest of timber stands that are deteriorating in individual tree vigor.

Variations Necessary To Meet Specific VQOs

Retention

The treatment area should be harvested by a combination of shelterwood and clearcut units, at an average rate of 10 percent of the area's commercial forest land per 15-year period with units of appropriate size. One hundred fifty years will complete the harvest of the treatment area, but an additional 35 years will be necessary to meet the target mature tree diameter.

The initial entries at the back of the treatment area should consist of 3- to 5-acre clearcuts. Exact size of the clearcuts and accompanying shelterwood units will depend on landform configuration and how the site is seen from higher viewing points.

Clearcuts and shelterwoods at the road's edge should be located at nonfocal points: The length of road frontage should be approximately 150 to 300 feet, with shelterwoods utilizing the greater distance. Both shelterwood and clearcuts should be used, where acceptable, to add variety.

The limitation on length of roadside frontage is due primarily to the contrast in canopy height that occurs after harvest. Slightly longer frontage is permitted for shelterwoods, since this impact is a little less at the time of overstory removal. A greater amount of cutting along the roadside frontage is permitted if it can be broken up by uncut segments.

The first cutting in a roadside frontage is most critical. Later entries may be more flexible because of the established openings.

Harvest along a road frontage should not exceed 400 feet per mile on each side of a road during the first 15-year period. This distance can be slowly increased to 600 feet per mile during the last 15-year period of the 150-year conversion.

New cutting units should be located behind vegetative screens, above observer eye level, along high cut banks, or on the slope below observer eye level. Occasionally, they may be opened up to full observer view when they meet requirements of "enhancement."

Vegetative screens may be used in several different ways. If ground vegetation exists along the roadside, it should be preserved. If there is no roadside vegetation, it may be created by planting semi-tolerant tree species 10 or 15 years in advance of the planned shelterwood. Shelterwoods can also be planned so that the greatest density of leave trees is located along the road.

Maximum attention must be paid to debris disposal and protection of established regeneration when the overstory shelter trees are finally removed along the road.

Partial Retention

Plan to harvest approximately 15 percent of the commercial forest land in the treatment area every 15 years. This should complete the treatment area in approximately 105 years. Allow trees to grow for another 30 years to reach the target diameter objective.

Clearcuts at the back of the treatment area should range from 5 to 8 acres in size. Exact size will vary as in *Retention*. Roadside harvest units should again be about 1 to 1-1/2 acres for initial entries and be limited to 150 feet of road frontage or less. They need not be screened if at nonfocal points. Clearcuts with larger than 150 feet of road frontage should be placed behind a screen, or above or below eye level, to meet VQOs. Road frontage should not exceed 300 feet for any one opening, even though screened.

Special emphasis, as in *Retention,* should be placed on protecting or establishing advanced regeneration and other vegetation prior to the final removal of the existing stand on any harvest area.

Modification

Initial entries of approximately 15 acres along the backside of the treatment area may be either clearcut or shelterwood harvested, depending upon which method will most efficiently regenerate a new crop of seedlings and blend with other treatments in the middleground. If shelterwood is used, the timing of overstory removal is related to silvicultural needs. Three- to 5-acre units should meet acceptable scale for initial entries along the road frontage. It should be possible to use either shelterwood or clearcut, depending upon location and the amount of ground vegetation or screening that will remain after logging. If adequate ground cover cannot be protected, shelterwood should be used.

The time interval between entries will relate to vegetative development. Approximately 15 percent of the commercial forest land in the treatment area should be entered per decade. Tree size is not a specified objective and longer-than-normal rotations are unnecessary.

It will be important to make initial entries along about 600 feet of road frontage. Cutting along the road should increase proportionately until nearly 1,000 feet of road frontage will be harvested by the seventh entry. Several harvest segments may be more desirable than one continuous strip when units are designed to take advantage of existing topography and vegetation.

Case Example: Gifford Pinchot National Forest.
Before Fifth Entry as depicted on page 155.
The view from the road shows regeneration resulting from road clearing and prelogging to be of sufficient height and density to remove the segments of overstory shelter trees as shown in fifth entry. Negative elements should not be evident. Mature forest character should remain dominant while introducing increasing size class diversity.

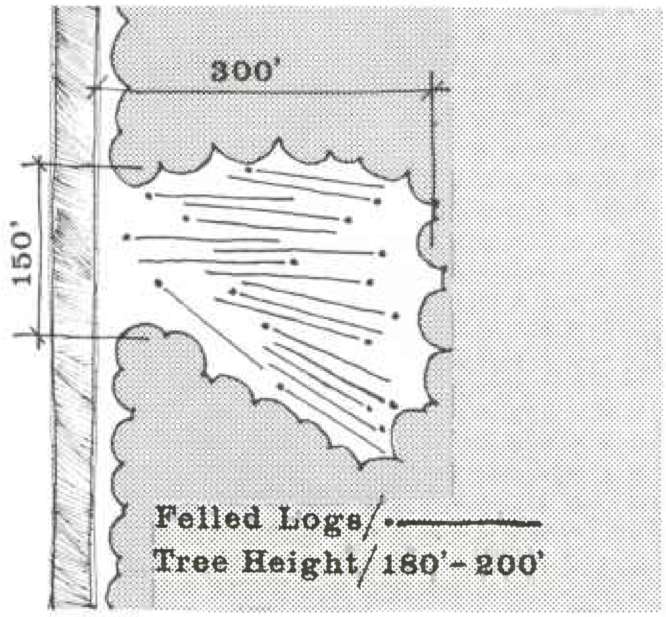
The view within the shelterwood (unseen by the observer) illustrates the increasing density of shelter trees as the activity approaches the highway (observer position) on the left.

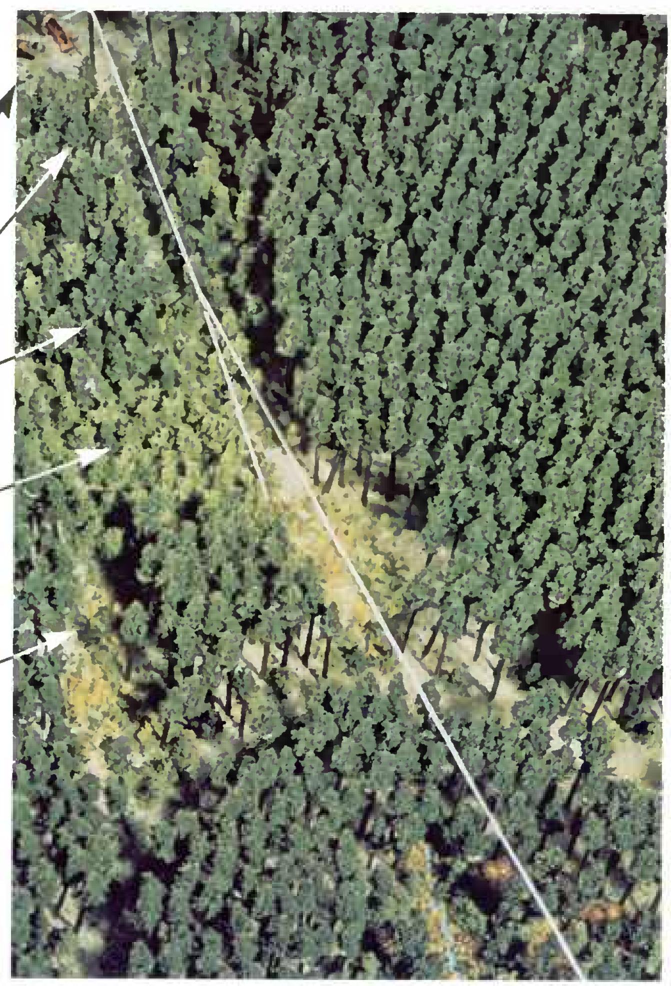
Logging Systems

Shelterwoods should be a minimum of one tree length in depth, to facilitate felling and yarding. Clearcuts must also be large enough to facilitate felling and yarding of the large trees. Clearings must not be less than 1-1/2 tree heights in at least one direction. This required dimension, however, can be used in depth away from the road as shown in the sketch.

The latitude then remains to make the clearing as narrow as needed to reduce impact. The exact shape and orientation to the road may vary, depending on necessary falling patterns across the topography.

The treatment described in this section has been for flat-to-rolling or benchy ground. Logging system alternatives would include ground lead systems such as tractor, soft track skidder, rubber tired skidder, or horse. The treatment is also applicable on fairly steep foregrounds, by use of cable suspension systems or helicopters. Steep foreground treatments usually must also meet VQOs from more distant observer positions, such as observer normal and above in middleground or more distant foreground. Below is a photo of the fifth-year entry period for a steep 60 percent + foreground (note main U-shaped road at bottom of photo) that also can be observed from a distant middleground vista point.





Limited road frontage in the early corridor entries helps maintain dominance of mature forest character while subtly introducing color and texture variety of younger age classes and shrub species. Island of mature trees will be removed at a much later entry. Meanwhile it provides an interesting visual feature at the end of the main road tangents and blocks direct view into the cable corridors that are evident in this aerial view.

Ridgetop spur road leading to the main haul road, which is out of the photo.

Initial entry clearcut now stocked with 60-year-old trees.

Second entry area now stocked with 45-year-old trees.

Third entry area now stocked with 30-year-old trees.

Fourth entry was on both sides of uncut island, adjacent to the main road. Area is now stocked with 15-year-old saplings and shrub species as removal of shelter trees is completed.

Fuels Management

Disposal of activity fuels in unseen foreground *Retention* areas, such as initial and second year entries[5] described on page 154 and 156, should be accomplished with the most economical fuels management solution possible. Year 30[5] disposal may be included in *Partial Retention* areas. Emphasis should be on meeting fuel disposal standards. Possible fuel disposal treatments in these entries may include broadcast burning in the clearcut entries, and machine piling and burning in the shelterwood entries.

As harvest entries approach the road, less impactful (usually) disposal techniques should be considered. Possible fuel treatments in these areas are hand piling and burning, chipping with removal or on-site dispersal, truck hauling, and pile and advertise for public firewood consumption. See Fire Chapter for more detail.

[5]These are general guidelines. Each site and observer situation must be examined for the effect of its own variables.

Middleground Criteria

A middleground landscape as shown above was selected to illustrate possible treatments on all slopes. Detailed treatments will be described for steep slopes, nearly perpendicular to the observer.

The specific characteristics of this middleground area are steep slopes of 45 to 65 percent with some gentler slopes ranging from 10 to 30 percent. The species is Douglas-fir, generally over 250 years of age, relatively healthy, and growing on site index 145 land. Close examination shows considerable variation in canopy height, but the textural dominance of an essentially unbroken canopy still prevails. The total distance of the steep slopes from ridgetop to bottom is about 2,000 feet.

Since the area is middleground, individual tree characteristics such as diameter and bark color are unimportant. The visual goals are;

—To maintain the appearance of a continuous, textured landscape in varying degrees, depending on the adopted VQO. The purpose is to provide a positive visual contrast against the distinctive landscape feature (the mountain).

—To reduce contrast of negative elements such as truck roads and landings, unnatural edges, skyline corridors, skidroads, and soil color to meet specific VQOs.

—To introduce the positive elements of color and texture from added vegetation, where they follow the principles and concepts of landscape design (shape, scale, and distribution of variety elements). The degree of change at each entry should meet VQO.

The visual goal involving negative elements can be further refined.

In this example, negative elements should comply with the following:

—In *Retention,* be nonevident.

—In *Partial Retention,* be subordinate to the continuous textured slopes of the characteristic landscape.

—In *Modification,* harvest units may be dominant over the textured slopes of the characteristic landscape. However, they should remain subordinate to the overpowering dominance of the volcanic cone. The units should follow the scale, shape, and distribution relationships often found in groups of natural openings and outlined in landscape design. Edges should appear primarily as texture. Together with residues, roads, and landings, they should remain subordinate to the composition of harvest units as a pattern of shapes.

The characteristics of a stand become the controlling elements in achieving specific goals. Some small clearcuts or very light density shelterwoods are essential to achieve an acceptable level of debris disposal.

Harvest techniques and schedules should be arranged to permit the introduction of flowering vegetation. Such vegetation adds color, yet subordinates unnatural edges to maintain the dominance of texture.

The observer position is moving, but with occasional pullout vista points. The observer distance from the slopes in this landscape stays about the same as portrayed.

Treatment Concepts

Progressive entries are as appropriate for middleground as for foreground; however, they can logically be scheduled differently. The design of harvest units should anticipate the use of clearcut, shelterwood, and no-cut areas to meet specific purposes.

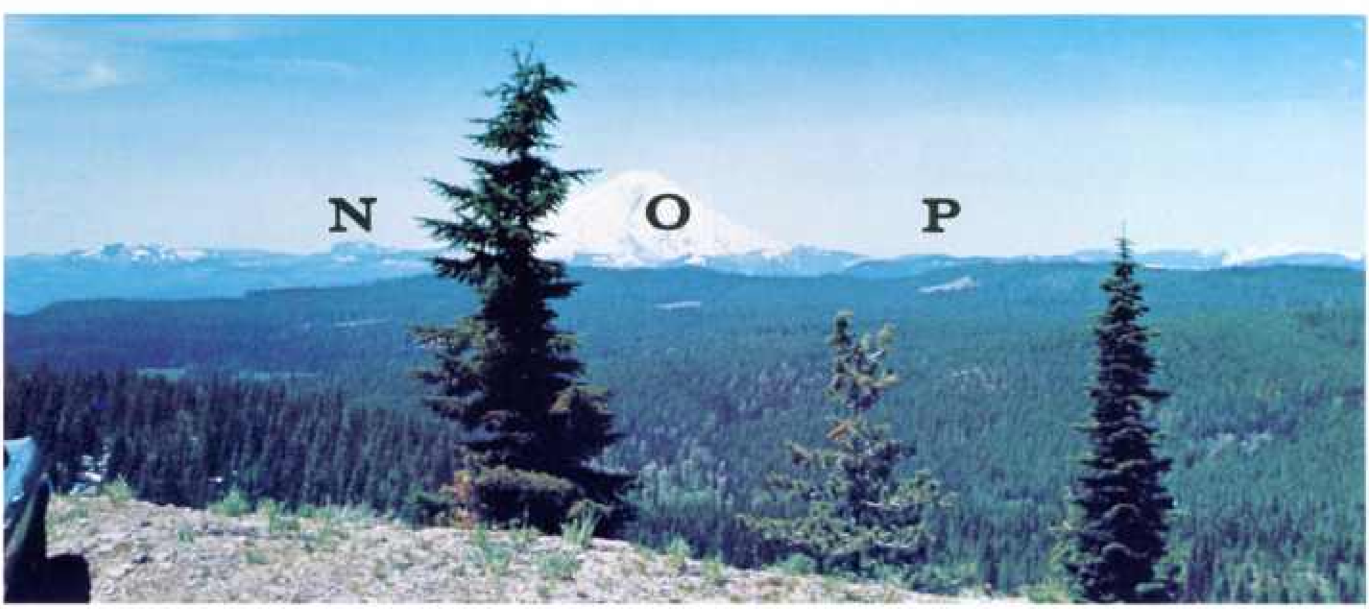
Units may be arranged starting at the top and sides of a landform, progressing downward and inward toward the observer. Units may also start at the back of more gentle slopes, or even at the center of a rather large area and progress toward the observer. *The key is to progress toward the observer from wherever harvesting begins.* Factors that are important in each case are the total tree height, amount of crown, slope of the ground, and observer position. The depth of both clearcut units and final shelterwood removal should be limited along the observer's line of sight. The degree of limitation will depend on the adopted VQO, and is described under each objective.

Treatment must now be divided into two categories: slopes obliquely oriented toward the observer with *high* Visual Absorption Capability (VAC), such as slope A; and those more perpendicularly oriented toward the observer with *low* Visual Absorption Capability (VAC), such as slope B.

High VAC Areas

Harvesting on slopes obliquely oriented toward the observer (high absorption capability) can usually be done with rather traditional shelterwood and clearcut treatments, so long as the limitations on edge and soil color are met. Shelterwoods, clearcuts, and uncut areas should be used in a random pattern, to allow apparent variety in size and shapes of treated areas as the landscape unfolds over time. The ability of variable density shelterwoods to maintain texture dominance while an understory is being established permits the desirable variation in size between units.

The 40- to 70-acre clearcuts done to begin this middleground concept vary in their success to meet *Partial Retention* VQO from this vista point. Unit N meets *Partial Retention.* Unit O and P need some reduction in depth or undulation of front edge to meet this same objective.



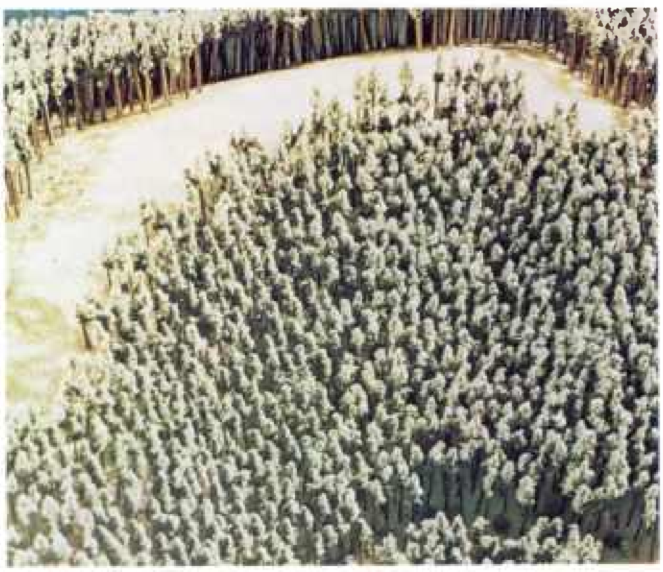
Low VAC Areas.

First Entry.

The treatment should begin with clearcuts covering as much of the top and sides of the treatment area as will meet VQO requirements from the viewing points.

The purpose of the initial entry is to set the stage for future silvicultural treatment in the area. After slash disposal, the clearcut is planted and prior to the second entry will provide a transition of young trees along the boundary of the treatment area. The young trees will "soften" the effect of future adjacent treatment.

Before Entry.



First Entry (aerial view).

First Entry (observer's view).

Second Entry (at year 15).

The second entry is a combination of shelterwoods, clearcuts, and uncut islands. This treatment is extended toward the observer from the initial entry clearcuts at the top of the landform.

Such a treatment is shown on both sides of the plan view. Photo below depicts what one side might look like from a ground observer's viewpoint. The visual quality objective to be achieved determines the proportion of area to be left uncut, treated by shelterwood, or treated by small clearcuts placed behind the uncut islands.

Clearcut from first entry now stocked with 15-year-old saplings.

Second Entry (plan view).

Second Entry (observer's view).

Case Example

Shown below is an example of what such a treatment looks like in an actual field situation. This unit is found in Pansy Basin on the Mt. Hood National Forest in Oregon.

A combination of clearcut, shelterwood, and no-cut units should be arranged to cause the no-cut areas to appear visually connected, even though separate. This arrangement maintains textural quality at early entries, while permitting the establishment of new stands that will grow and maintain texture dominance as uncut stands are harvested. Careful alignment of units along anticipated cable system corridors will add to yarding feasibility.

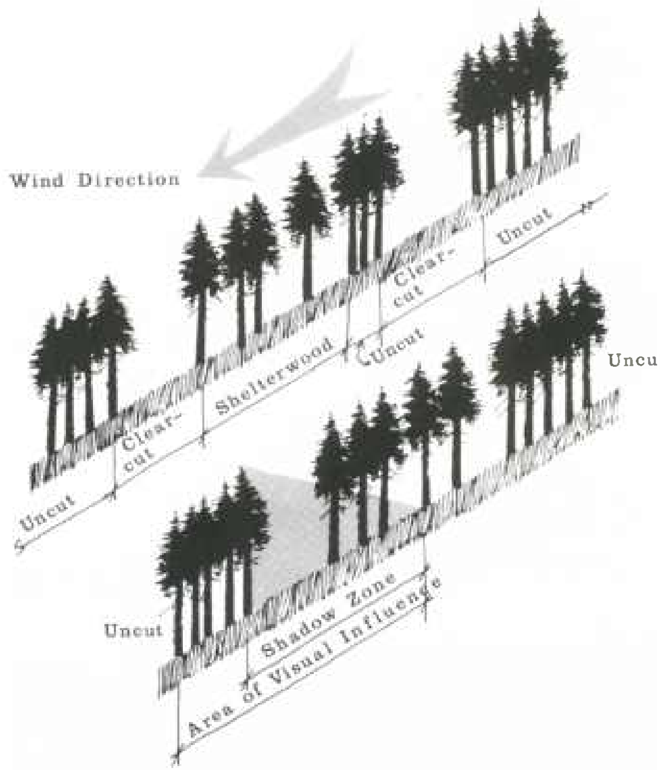
The selection of uncut areas should take advantage of ground vegetation and midcanopy density from existing tolerant and semi-tolerant species. Midcanopy vegetation will provide a visual link from the ground to the upper canopy, and a more wind resistant stand.

A well designed layout and schedule of harvest units will permit the coordinated activities of precommercial thinning, commercial thinning, shelterwood, overstory removal, and clearcut harvest where appropriate. It is conceivable that each of these activities, in addition to yarding through no-cut areas, could be carried out under a 2,000-foot cable corridor in one logging operation.

There is further benefit in timing the entries and progressing them toward the observer position. It allows for the growth of regeneration to sufficient height to screen out the wall effect along the back edge of the first unit, before it is exposed to full view from an observer position. This establishes an increasing canopy height from the most recent harvest unit to the oldest.

The transportation system for this area includes a road on the more gentle topography near the top of the ridge.

All of the harvested areas are planted. Some of the clearcutting is for the purpose described for the initial entry, while the remainder provides small units for safely disposing of logging residue. The uncut islands provide several benefits. They reduce windthrow by causing wind currents to flow above the general level of the tree canopy. They screen much of the ground disturbance and residue disposal impacts from observers. They also provide a softening effect by maintaining a more dense canopy appearance, in combination with the shelterwood harvests, while regeneration is being established.



As more of the total area becomes reforested with young trees, the need for upper canopy density to maintain the dominance of texture is reduced. Clearcuts from the initial entry will have attained a height and condition that qualifies these stands for precommercial thinning.

Third Entry (plan view).

Third Entry (at year 30)

This entry extends harvest activities from the second entry toward the center of the landform. In some cases, it may cover all the area left between the previous entries. **Note:** the model at left shows only a small segment of this entry, which is to the right of the earlier harvest area.

In other cases, the treatment area may be small enough to treat the total critical area during the second entry, making this area a part of a third entry unnecessary.

The second entry shelterwood is removed. Recently established saplings should be precommercially thinned if necessary. Uncut islands left from previous entries are treated with a shelterwood seed cut and planted. A small portion of the islands are clearcut for debris disposal purposes.

The first area clearcut should now contain trees approximately 60 feet tall. Edges of the total treatment area are softened, and diversity is increased.

Third Entry (observer's view).

Fourth, Fifth, and Subsequent Entries

Subsequent entries repeat treatments similar to those described in the third entry. These entries should complete the harvest indicated for the second entry area, with the removal of the overwood islands. Trees in the first area harvested should be commercially thinned. The middleground treatment permits greater flexibility in shape, arrangement, and amount of area harvested at each entry than in the foreground.

Fourth Entry (observer's view).

Fourth Entry (plan view).

Logging Systems

Logging system techniques involved in accomplishing this treatment are primarily reducing the impact of cable corridors as well as roads and landings. Such technique can be found in the Logging System section, pages 204-215. Photo at right illustrates ridgetop road and landing with cable and resulting corridors down slope.

Variations Necessary to Meet Specific VQOs

Retention

Totally meeting the *Retention* objective in middleground of this example is going to be extremely difficult. It will require maintenance of the high canopy to retain textural character dominance with soil color not evident. One option that may prove possible would be to harvest a large, identifiable landform area, all in one shelterwood unit, that maintains sufficient overstory density to retain textural dominance without evident contrast from soil color or cable corridors. This will require the planting of hemlock as well as Douglas-fir under this heavy overstory, and may well lead to a species conversion to primarily hemlock. The heavy density overstory can be removed in two entries. However, removal cannot occur until the newly established stand reaches a height of about 25 feet and a density that will accept some logging damage while still fully retaining texture dominance, with soil color not evident.

A portion of the area adjacent to the road can probably be logged during the first entry with an under-the-canopy skyline. The portion further from the road may require some other system. The overstory removal entries will be difficult, and will probably require helicopters. This operation will be successful only through the use of expert logging system design.

Another alternative may be the use of many very small clearcuts (1/10 to 1/4 acre), which approach group selection uneven-age management. The number of units and total area covered by this system will require specific design by the landscape architect and logging system specialist. The silvicultural affect of both concepts should be similar.

The result will probably be at least a partial species conversion, and a significant loss in yield. The lack of experience with this technique simply prevents the prediction of yields at this time.

There is another situation in middleground *Retention* in which the treatment area is viewed only from an oblique angle. This provides some flexibility in that initial clearcut or shelterwood units of 5 to 10 acres will quite easily meet the VQO. Later entries which enlarge these first units will become more evident. Carefully located and designed units, which subtly begin to impose undulations in the crown canopy, can be drawn upon for character in future entries and will be a key to maintaining the *Retention* objective. More flexibility will also occur as regenerated timber begins to influence the canopy texture. It is difficult to visualize the amount of area to be operated per decade, though the conversion of a treatment area to regenerate timber will probably require long time frames.

Partial Retention

Under the *Partial Retention VQO,* cutting unit size and location is controlled by landform and topography in the middleground. Timing of entries must be planned to visually subordinate soil color and unit boundary edges. This requires adequate time to grow regenerated timber to about 10 to 15 feet in height. These factors combine to indicate a 15-year interval between entries, and limit the proportion of the treatment area being entered during the interval to 15 to 18 percent of commercial forest land. A total treatment area should be cut over within about 90 years, to provide a high level of timber production while meeting the *Partial Retention* objective.

Helicopter Clearcuts: 5 to 14 acres in size; aerial view.

The initial entry, since it will be hidden from view for a period of 15 or 30 years, logically permits either clearcut or shelterwood harvest. The method which is most appropriate for all resources, including regeneration, should be used.

Later entries designed to meet the middleground *Partial Retention* objective will generally require variable density shelterwoods with very small clearcuts for debris disposal. The clearcuts will remain screened from the observer by no-cut areas, or by the more dense portion of shelterwoods.

The location of all units must recognize the limitations of logging systems appropriate to the topography of the area being harvested.

Modification

Harvest activities in middleground *Modification* readily permit the use of either clearcut or shelterwood. The harvest method selected depends upon which is best suited to the establishment of reproduction and is also acceptable to other resource objectives.

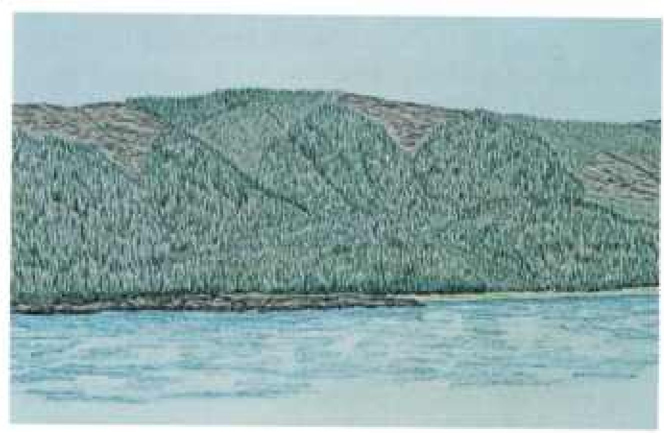
Shape, arrangement, and proportion of the area cut over per decade have the greatest influence on meeting the middleground *Modification* objective. Nearly as important are the size and density of regeneration in older units when new units are cut. Old units should have enough vegetation to mask soil color and hide roads and landings that would otherwise dominate the visual character of the treatment area.

The necessary vegetative condition can be achieved by a combination of unit location and timing, correlated with site productivity. Careful planning and execution of harvest activities should permit the production of full yields from *Modification* areas.

The clearcut entries summarized in these photos illustrate one approach to achieving the *Modification* objective. It is illustrated in more detail as it is applied to Spruce Hemlock on pages 173-186.

First Entry.

Second Entry.



Third Entry.

Fruiting bodies, conks, rotting logs, and other decadent characteristics plus resulting wildlife are elements of high visual interest to most forest visitors.

Effects of Treatments on the Wildlife Resource

Retention and *Partial Retention* foregrounds—Clearcuts 2 or more years old provide nesting and foraging habitat for many forest-zone birds. At second entry optimum deer and elk habitat are approached. The new shelterwood provides a "rejuvinated" forage area and the 15-year-old clearcut is now providing hiding cover. The new forage area is less than 1,200 feet across, making all of it usable by deer and elk. Uncut stands furnish thermal cover for elk and deer though the visual treatments provide considerably more than the ideal deer and elk percentages (20 percent of a land area in thermal cover). Nevertheless, the increasing areas of clearcut and shelterwood regeneration also increase elk and deer numbers considerably over total old-growth stands. In addition, diversity in the forest stand structure increases, thus creating more niches for different wildlife species.

By year 45, the first clearcut is capable of producing thermal cover several years after light to moderate commercial thinning. It is considered to be a forage area for a few years following thinning.

Middleground (*Partial Retention*)

Shelterwood and clearcut treatments in the second entry create habitat diversity and thus enhance an area for diversity in animals. For deer and elk forage, areas are created that tend to attract animals.

The third entry is an excellent example of a treatment that optimizes wildlife habitat by: Breaking up monotonous old growth, providing maximum edge per acre of cut, providing different kinds of edge (clearcut to uncut, shelterwood to clearcut or uncut), keeping distance across openings to less than 1,200 feet, and combining old-growth and shrub-forb habitats in close proximity to each other.

Third, fourth, and subsequent treatments tend to favor those wildlife species not dependent upon old-growth stands. As old growth is converted to managed stands, species such as the pileated woodpecker would become rare.

It is for this latter reason that in both foreground and middleground some stands should be held in old growth while others are moved towards maturity and then allowed to stagnate into a replacement old-growth stage, primarily for wildlife purposes. When such wildlife old-growth stands can be located in foregrounds of trails, slow speed roads, and occupancy areas, they become a decided visual resource asset.

Predicting Timber Yields

In the Timber Management Plan for a National Forest, the *Potential Yield* from those lands that may be used for timber production is determined. Since this plan recognizes the constraints imposed by such land allocations as wilderness, streamside management, recreation, and visual resource management, potential yield is determined for three different components: Standard, Special, and Marginal. Lands on which timber production is constrained by visual resource considerations are placed in the "Special (VRM)" component of the timber management plan.

While the process of determining potential yield may vary from Region to Region, it is universally necessary to be able to predict the volume that may be harvested annually or periodically from each component. The "Special (VRM)" component is no exception. To date, this component has proved to be one of the most difficult for which to predict potential yield.

To aid timber management planners in the assessment of potential yield for the "Special (VRM)" component, the following process has been developed. To present a concrete example, from which variations or major innovations may be based, the harvest regime outlined on pages 153 to 166 of this section was selected. The discussion that follows illustrates one method of determining the potential yield for this sample "Special (VRM)" area.

Yield tables have been prepard for Douglas-fir, site index 145, showing projected yield from treatments designed to meet VRM foreground *Retention* and *Partial Retention,* as well as the middleground *Partial Retention* objective. The yield tables indicate the percentage of the *Biological Potential* of the sample area that can be programmed for harvest, based on the treatments proposed. This percentage may be directly applied to yield tables for other site indexes to determine potential yield.

The accuracy of this system falls within the limits of current ability to predict yields for specific treatments.

The yield from the "Special (VRM)" component may be further reduced in areas where a timber type is all one class, such as all mature or all overmature. This reduction would be caused by the need to limit regeneration entries to a specified acreage per decade within each seen area. (Reference pages 156-157.)

Foreground Scheduling

In the treatment examples illustrated at the beginning of this section, several elements of design and treatment have an effect on the potential yield of the management area. These elements include arrangement, location, shape, size-of-tree objective, entry cycle, and harvest practice.

The size-of-tree objective establishes the age of the stand at the time it can be regenerated. The portion of the area that can be impacted at any one time and the degree of recovery necessary before another harvest can be made control the entry cycle.

The pertinent elements that influenced yield prediction in the foreground Retention sample illustrated are:

1. 15-year entry cycle,
2. 36-inch average diameter tree size,
3. 12 percent of the area impacted per decade, and
4. Regeneration by shelterwood.

The Partial Retention elements are:

1. 15-year entry cycle,
2. 30-inch average diameter tree size,
3. 15 percent of the area impacted per decade, and
4. Regeneration by shelterwood.

The combination of these elements on the site index 145 land selected for illustration permits the preparation of the following yield predictions.

Foreground Table (Showing influence of age or time restrictions on production).

	Age (years)	Height (feet)	Trees (number)	Average tree diameter (inches)	Mean annual increment (cubic feet)	Percent of potential yield
Land Management Classification	30	52	300	6.2	—	
Standard	75	116	88	19.8	166	
Special PR	120	142	44	28.6	155	(73% potential)
	135	148	40	30.6	147	
Special R	180	158	35	34.8	121	(57% potential)
	195	160	13	36.3	113	

Middleground Scheduling

In middleground, a logical progression for the project planner would be to first select the clearcut areas. These areas are critical because they must include the recognized high windfall potential areas, provide a space for debris disposal, and facilitate the logging operation. Next, areas of shelterwood with approximately 18 to 25 suitable shelter trees would be selected to provide transition from clearcuts to no-cut areas. Shelterwood units become the priority elements for overstory removal and guide the selection of harvest units for the next cycle of logging.

The special arrangements of units and the scheduling necessary to achieve VRM objectives require 90-year rotations to meet *Partial Retention,* plus an overstory removal 15 years later for the shelterwood portion.

The middleground treatment examples shown on pages 162 to 166 of this section include various sizes of clearcuts and shelterwoods that will regenerate new stands. The size and arrangement of these units influence tree growth rates.

Those elements that may affect predicted yield are:

1. 15-year entry cycle,
2. 20 percent of area in small units,
3. 45 percent of area in shelterwood,
4. Shelter density of 18 to 25 trees per acre,
5. 35 percent in clearcuts, restricted only by schedule, and
6. 90 years to regenerate for middleground Partial Retention.

Shelterwood

Age (years)	Height (feet)	Trees per acre (number)	Average tree diameter (inches)	Mean annual increment (cubic feet)
30	52	307	6.2	—
75	116	103	18.5	164
90	128	80	21.4	169
105	136	66	23.7	163
120	142	57	25.6	154
135	147	56	27.3	147
150	150	23	28.8	136

Clearcut (reflects effect of unit size and 15-year entry)

Age (years)	Height (feet)	Trees per acre (number)	Average tree diameter (inches)	Mean annual increment (cubic feet)
30	62	341	8.0	—
75	123	86	20.8	193
90	135	68	23.6	188
105	143	59	25.9	179
120	150	52	28.0	170
135	153	48	29.8	162

Clearcut (reflects 15-year entry)

Age (years)	Height (feet)	Trees per acre (number)	Average tree diameter (inches)	Mean annual increment (cubic feet)
30	66	341	8.2	—
75	127	86	20.9	202
90	139	68	23.7	196
105	147	59	26.0	186
120	154	52	28.1	177
135	157	48	29.9	168

Potential Volume Available with management illustrated.

Middleground Table (showing influence of age or time restrictions on production)

Land management classification	Age (years)	Volume in cubic feet: sh (45%)	cc with size and schedule limitations (20%)	cc with schedule limitations (35%)	Total production (cubic feet)	Mean annual increment (cubic feet)	Potential (percent)
	75	15,546	16,919	17,654			
Special PR	90	(6,996)+	(3,384)+	(6,179)=	16,559	184	86

Sitka Spruce—Western Hemlock

The Sitka spruce-western hemlock timber type occurs in the coastal regions from northern California to Cook Inlet in Alaska. The treatments referred to in this section refer specifically to the Tongass National Forest, from just north of Juneau to south of Ketchikan. Sitka spruce and western hemlock comprise about 95 percent of the commercial volume, with western red cedar, Alaska yellow cedar, and other minor species making up the balance. The old-growth forest commonly has a

ragged appearance because of its uneven-sized trees and numerous snags. Heights of 100 to 150 feet and diameters of 24 to 60 inches are common. Crowns of hemlock and spruce are relatively deep and dense when compared to other Pacific Northwest trees, such as Douglas-fir. The specific treatments illustrated can be adapted to other species in similar physiographic areas, or expanded upon to apply to other regions of the spruce-hemlock timber type.

"Ragged" appearance caused by uneven-sized trees and numerous snags.

The cool, moist, maritime climate is the major ecological factor in the archipelago of southeast Alaska, with annual precipitation as high as 200 inches in some areas and, generally, no dry season. Topography varies from relatively flat river bottoms to rolling hilly areas, to steep mountainous areas incised by numerous fiords. Soils are typically shallow and overlain with a thick, moist, organic duff layer.

Windthrow, caused by hurricane force winds, is the major silvicultural problem with these relatively shallow-rooted tree species. The crown ratio and shade tolerance of the hemlock-spruce type would appear to make these stands well suited to partial cutting, but the frequent occurrence of devastating winds cause extensive losses even within natural stands. Therefore, heavy partial cuttings or shelterwoods are susceptible to damage from wind.

Area of heavy natural windthrow.

The landforms of southeast Alaska are most commonly seen from boats and ferries 1/2 to 3 miles away. Spruce-hemlock forests often entirely cover these landforms without breaks in the old-growth canopy. They often extend from the water's edge to mountain tops 1,500 to 2,500 feet in elevation. In many locations, the forests grade into scrub, rock, alpine meadows, or snow and icefields above timberline. In any case, logic suggests that the entire landform faces be treated, as opposed to smaller areas within these faces, which might produce discontinuous contrasts in form, line, color, and texture. Although substantial areas of muskegs do occur, these are not normally viewed by the water-borne observer. From the air, however, muskegs appear as breaks in the forest cover.

The tree boles that are exposed along the edge of clearcuts produce a definite line contrast in the landscape. The normal brown and grey color of clearcuts will take a minimum of 10 years to change to a more or less uniformly textured green. Green-up time depends on distance from the observer, slope and aspect relative to the observer, and on-site conditions. Concurrent with the maintenance of visually acceptible views along the waterways, there are other important factors to consider. They are the habitats needed for winter feeding Sitka black-tailed deer and for feeding and rearing of the bald eagle. These habitats are dependent on elevation and distance from salt water.

Natural regeneration is relied upon as the major means of restocking cutover lands. However, the opportunities for treatment of the existing old-growth spruce-hemlock stands are limited not only by the silvical characteristics of the species and by topography, but also by logging systems and soil conditions. Western hemlock is a very shade tolerant species and can regenerate well even under heavy shade. Sitka spruce usually requires more nitrate nitrogen, a mixture of exposed mineral soil and organic matter, and higher temperatures. All these conditions are usually associated with a more open canopy condition. Therefore, if a first stage shelterwood cut is light, hemlock is encouraged at the expense of the spruce.

Because of the high percentage of steep slopes and the shallow, permeable, and unstable thixotrophic soils (breaking down of the soil structure under stress), cable logging systems are used almost exclusively. Downhill logging predominates. It is assumed that long-span skyline systems will be used more frequently in the future. *Although physically possible, partial cutting on a commercial basis has not yet been attempted in Southeast Alaska,* partly because downhill partial cutting by cable systems is the most difficult of the skyline harvesting practices.

Because of a number of factors—such as tree size, accessibility, stand volumes, decay, high logging and roading costs, and relatively low stumpage values—the number of management options in the hemlock-spruce old growth type are limited at present. However, the more windfirm second-growth stands of the future will offer greater treatment opportunities than the present old-growth stands.

Residue management must also be a part of any project plan, along with silvicultural, logging system, and aesthetic considerations. There is usually a tendency to ignore residue because of the limited fire or fuel management problems in coastal Alaska. However, activity-created fuels will combine with naturally occurring materials to produce large residue loads. These residues must be considered from the standpoint of aesthetics, wildlife management, access, watershed protection, timber growth (soil temperature and nutrient cycling), and cyclic fire weather. Specific residue treatments are mentioned in the Fire Chapter, but treatment opportunities will not be simple because these materials have both positive and negative aspects. What is critical is that the manager specifically identify the residue problem, weigh the costs and benefits of various alternatives—including no treatment—and decide on a course of action.

A clearcut, 12 years after cutting.

Treatment Concepts

Foreground—Retention, Partial Retention, and Modification

The objective is to meet the *Retention, Partial Retention,* and *Modification* visual quality objectives in the foreground corridor by converting old-growth spruce-hemlock stands adjacent to the road into small, fast-growing, even-aged stands.

The conceptual treatment goals are: (1) To maintain, by frequent thinning, 30-inch average tree diameter with 36- to 48-inch specimen Sitka spruce on river bottoms for meeting *Retention. Partial Retention* would require 24-inch average d.b.h. and *Modification* would have no special tree diameter target. Contrast of negative elements such as slash, disturbed soil, etc., would meet appropriate VQO definitions, allowing much more latitude in harvest operations in the less restrictive VQOs; (2) to maintain a diverse herb and shrub layer on the forest floor, characteristic of old-growth stands; (3) to break up the monotony of a tree-lined corridor by incorporating small spaces that are in scale with the human observer; and (4) to meet other objectives established by the visual corridor plan or approved land use management plan. The first two goals most closely simulate the appearance of an old-growth forest.

The treatment for the foreground can be adapted with some modification from those described for Westside Douglas-fir, pages 154-155, with the exception that planting may not always be necessary, since prompt and adequate regeneration can be assured without it. All entries must be planned to be logged with cable systems, which may require the building of spur roads, or planned for tractor logging on frozen ground.

This photo depicts the fourth entry Douglas-fir shelterwood as it opens out onto the main travel route to the right. With some variation, this concept should be applicable to spruce-hemlock also. See pages 156-157 for entry details.

Treatment of Blowdown

The decision to harvest or not to harvest blowdown adjacent to the road should be based on the overall objectives of the visual corridor or management plan. These concentrations of downed trees can function as the initial series of small openings within the foreground management zone. Standing trees might be taken with a concentration of blowdown, for example, to create a small clearcut. Where the concentration is too large or where specimen trees are an objective, large, more windfirm green trees can be left, with special care exercised to avoid damaging them during logging and residue treatment. Some form of residue treatment will be necessary to meet the foreground visual quality objectives. This may involve burying, burning, hauling, or lopping and scattering.

Middleground—Partial Retention

The objective is to convert old-growth stands to moderately fast growing even-aged stands, while maintaining a uniformly textured vegetative mantle and keeping color contrast subordinate to the natural landscape character. Tree size is not important, because the density of regeneration, and not tree size, usually determines texture. Removal of all old-growth timber within treatment areas can usually be accomplished within 25 years.

When treating a stand with a two-stage shelterwood cut, there are certain biological tradeoffs. Vegetative responses to shelterwoods differ from responses to clearcutting. In a shelterwood, there will be less soil disturbance and more shading of the forest floor. Both of these conditions will favor natural regeneration of western hemlock, a more shade tolerant species than Sitka spruce. This shading will also result in slower growth of the regenerated trees, because less light is available for photosynthesis. There will also be less biological activity of organisms that decompose the organic duff layer of the forest floor, caused by a lower soil temperature than would occur if the stand were clearcut. These factors will reduce the nutrients and nitrogen available for plant growth. Also, because of the high incidence of dwarf mistletoe (*Arceuthobium tsugense*) in Southeast Alaska's old-growth forests, there is the probability of infecting the regenerating stand with this disease. Growth and fruiting of the individual dwarf mistletoe plants will probably increase because of the greatly improved lighting conditions in the exposed crowns of the shelterwood.

The trees left after the first stage cut will undoubtedly have more bole damage. These wounds will provide infection courts for various fungi, lowering the quality of the trees when they are harvested in the second entry. This, combined with blowdown, will often tempt the manager to harvest the trees sooner than originally planned, in order to salvage mortality. Although early harvest would be a valid prescription, the timber should be left in those areas where aesthetics is an objective until the regenerated stand is capable of meeting the established visual quality objective. The loss of timber value and volume is a tradeoff for the maintenance of visual quality.

A positive silvicultural factor in a shelterwood cut on steep slopes is that there will be more large, live root systems remaining to stabilize the harvested areas, reducing the probability of mass soil movement such as the landslides that sometimes occur years after clear-cutting.

Treatments described below are designed to meet Partial Retention on steep concave and convex slopes up to 65 percent as observed from boats and ferries 1 to 2 miles away. Slope faces will generally be less than 1 mile in width and are often segments of panoramic landscapes.

Timber will be harvested using a skyline cable system extending from the road at the base of the face or at the top of the face. The total yarding distance will be dictated by the capabilities of the skyline system, and the maximum allowable corridor widths that will meet Partial Retention VQO. Cable corridors are spaced 150 to 200 feet apart over the entire width of the face to be treated. Specific slope and site conditions will determine skyline system requirements as described in the following concave and convex slope situations.

As time goes on, it may become possible to remove the overstory in several entries, thus approaching uneven-age management to test other alternatives to the example given here.

Steep Concave Slopes

Year 0: The treatment should begin by removing a percentage of the old-growth trees over the entire face, generally 1/3 to 2/3 of the volume. The percent of removal is dependent on the windfirmness of existing trees, slope positions in relation to prevailing stormwinds, and the distance of the face from the observer.

Road access and landings are located at the base of the slope. Skyline corridors are spaced approximately 150 to 200 feet apart, and will extend up a maximum distance of 2,000 feet along the slope. Multiple stump anchors (rigging to 3 or more stumps) may be necessary to secure adequate tailholds at the top of the cut.

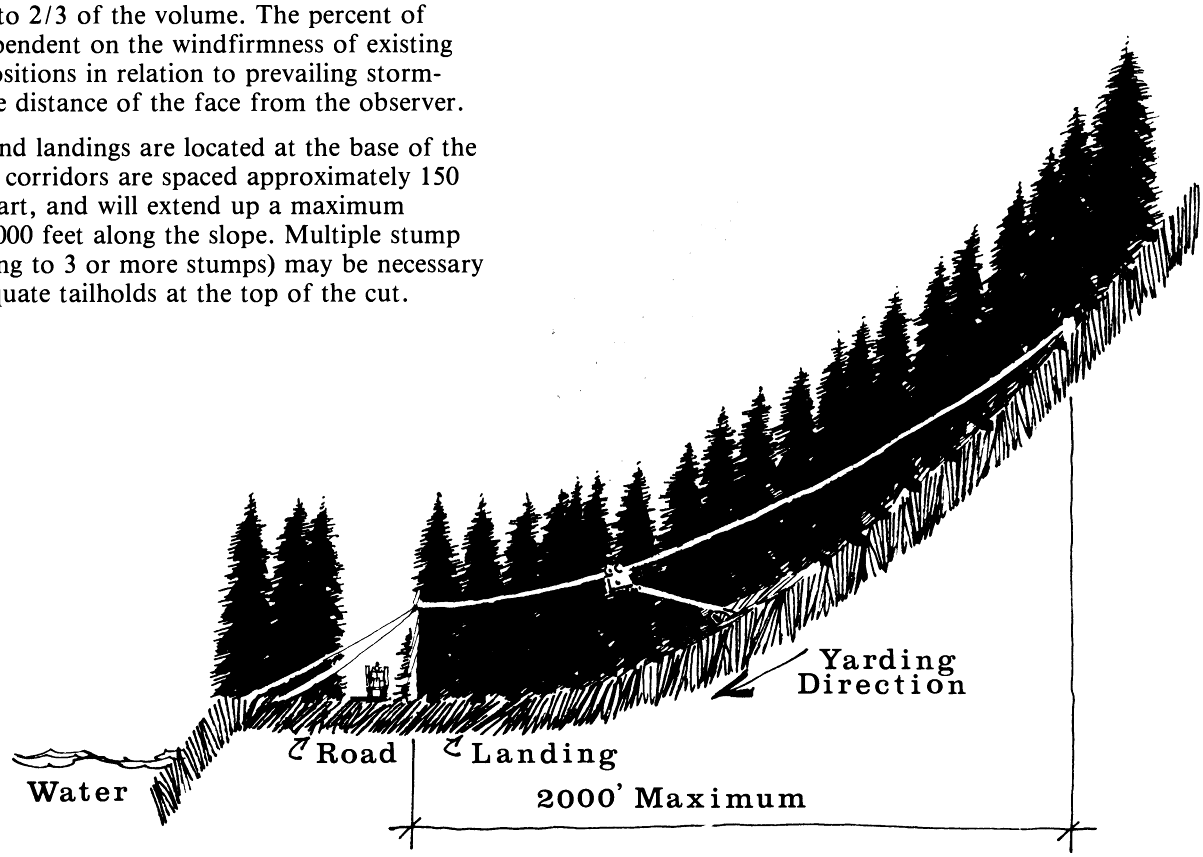
Narrow corridor widths, generally less than 50 feet, are necessary to meet the Partial Retention objective and to minimize tree canopy openings, which may result in blowdown in the residual stand. Techniques for corridor width control are discussed in the logging systems section.

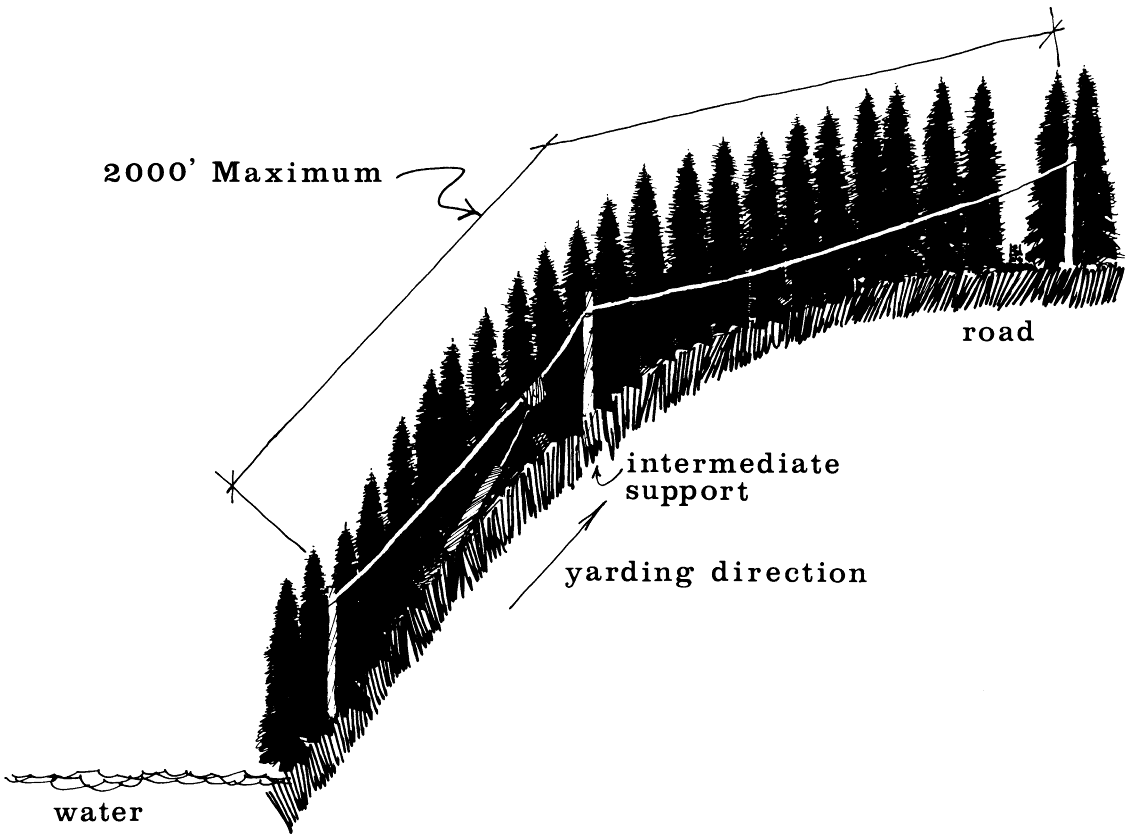
One feasible alternative may be to cable yard 1,000 feet up the slope, and helicopter log the rest of the face. It must be recognized that the use of helicopters in partial cutting old-growth spruce–hemlock will increase helicopter cycle times and, thus, increase cost over clearcutting, caused by the requirement for longer tag lines.

Years 15-25: The second and final conversion entry will normally occur when the young regeneration has reached sufficient height to mask snow beneath the crowns in order to keep color contrast subordinate to natural landscape character. Generally, this will occur by age 25, when the regeneration is 10 to 15 feet high. If snow color contrast is not a problem, the overstory removal may be possible as early as 15 years after the first entry. Less damage will occur to the regeneration at year 15 than at year 25.

Skyline corridors used for year 0 will be used for years 15 to 25. Much of the regeneration in the corridors will be lost during the final removal.

Years 30-40: The stand is now 30 to 40 years old and can be precommercially thinned.



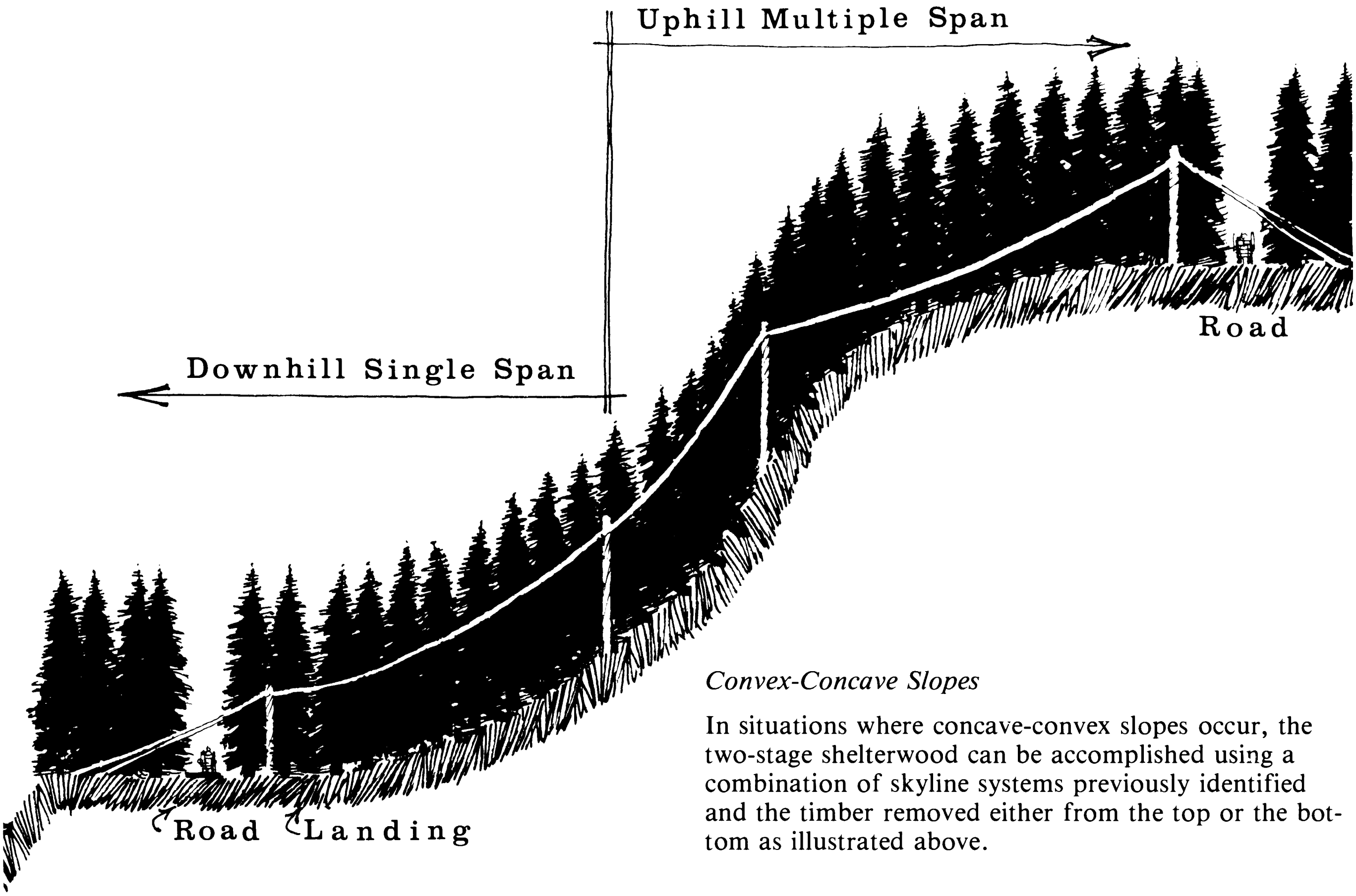


Steep Convex Slopes

Year 0: If the top of the slope can be accessed by a road, the treatment should begin with clearcuts on the top and extend as far down the slope as yarding capability can permit, while still achieving the Partial Retention objective.

The treatment of the remaining face is to remove a percentage of the old-growth timber using a skyline cable system with intermediate supports. The percent removed depends on windthrow potential and on the distance of the face from the observer. Trees would be yarded uphill to landings adjacent to the road. If the top cannot be roaded, then the timber must be taken out at the bottom. The problem of maintaining narrow corridors on convex slopes is not as critical as on concave slopes, if intermediate supports are being used. The use of intermediate supports is more expensive than single span logging because of the extra cost of rigging.

Year 15: The removal of the shelterwood will occur when the understory regeneration has reached sufficient height to absorb snow color contrast. The stand old-growth is removed, and any blowdown that occurred after year 0 is also salvaged.



Convex-Concave Slopes

In situations where concave-convex slopes occur, the two-stage shelterwood can be accomplished using a combination of skyline systems previously identified and the timber removed either from the top or the bottom as illustrated above.

Middleground-Modification VQO

Here the goal is to convert old-growth stands into a mosaic of even-aged stands of varying size and age classes within 140 years, and to increase variety in form, line, color, and texture in the uniformly textured landscape. Each successive entry introduces increasingly larger openings with an associated increase in deviations from natural character.

The long old-growth conversion period and extended rotations are not suggested simply to meet the visual resource management objectives. In Southeast Alaska, the maintenance of a semi-open canopy along the beach fringe and certain adjacent lower slope areas is a necessary and important objective for meeting the requirements for winter deer range habitat management. This objective can easily be incorporated in conjunction with the aesthetic needs.

Meeting the modification VQO in the middleground can be achieved by several design techniques. One technique is to borrow the shape and scale of form of natural openings in the characteristic landscape. This generally requires leaving islands of trees within the clearcut, and special treatment of the edge, such as feathering or height transition. These techniques are difficult to achieve with the limited capabilities of highlead systems, and leave islands in clearcut units are particularly susceptible to blowdown. The other technique, as illustrated in this treatment description, is to follow the edges of landform boundaries so that the line introduced by clearcut units repeats the pattern established by natural line in the landscape.

The initial entries occur in areas of high visual absorption capability and against windfirm boundaries. These areas are usually the top, sides, and sometimes bottom of landform faces. Progressive entries move toward the visually sensitive center face and into the prevailing winds. As variety increases over the landscape, the visual absorption capability of that landscape will increase, enabling the modification objective to be more easily met over time. Timber is harvested by highlead or skyline logging systems. Roads and landings must be located and designed to remain subordinate to natural landscape character.

Landform to be treated.

The intent of the following treatment description is to illustrate how variety can be introduced into the landscape by clearcutting old-growth timber, and does not reflect the only solution to achieving the Modification objective in the middleground viewing position.

Year 0: Units 1 and 2 on top of the ridge are logged by a highlead system to the access road also on the ridgetop. The units begin to introduce small-scale openings in the uniformly textured landscape. The left-hand side of Unit 2 terminates on an edge of a main ridge so that the continuity of the ridgeline is not broken.

Unit 1 introduces the brown color of the rocky mountain top in the background into the middleground landscape.

Unit 3 is logged on both sides of the road located on the bench at the base of the slope. Some beach frontage is cut, as well as the backside of the small ridge. A small portion of the lower slope of the main face is also logged at this time. This introduces the line effect of the tree boles, but they remain subordinate to the landscape character.

Year 20: Unit 4, logged by skyline, is an extension of the opening created by Unit 1. Dips in the edge begin to deviate from the natural line of the ridgetop and valleys. Unit 5 is also an extension of the opening created by Unit 2 and is removed by skyline. Units 4 and 5 introduce larger openings in the landscape. Units 1 and 2 are now about 20 feet high and form backdrops to Units 4 and 5. Unit 6, positioned in a saddle, is an extension of Unit 3. The backside of the ridge adjacent to the beach is logged to minimize blowdown.

Units 1, 2, and 3 are now 20 years old and are ready for precommercial thinning. Because Units 4, 5, and 6 will be skylined through Units 1, 2, and 3, the precommercial thinning should occur after 4, 5, and 6 are clearcut.

Year 40: Units 7, 8, and 9 are logged by highlead. They introduce larger scaled openings adjacent to regenerated stands, and also introduce more variety in line. Unit 9 ties the young stands of Units 4 and 6 together.

Units 4, 5, and 6 are now ready for precommercial thinning. Units 1, 2, and 3 are 40 years old and may be ready for commercial thinning.

The following entries are presented as concepts of what can happen for the remainder of the conversion period. Because of unknowns in windthrow, changes in technology, and changes in the physical condition of the area, the intent is to establish a conceptual landscape pattern that will allow future designers the flexibility to incorporate necessary changes as the landscape character evolves.

Year 60: By the 4th entry, the scale of Units 10 and 11 have increased to the point that they may not quite meet the Modification objective. But because they are located adjacent to stands of varying age classes, they are more easily absorbed into the landscape composition. Unit 11 extends Unit 3 to the base of the slope. Unit 10 removes additional timber from the beach fringe and extends second-growth texture to salt water.

Units 7, 8, and 9 are now ready for precommercial thinning. Units 1 through 6 are ready for commercial thinning.

Year 80: The visually sensitive centerface of the slope is entered on the 5th entry. Units 12 and 13 will be out of scale with landscape character and may not meet the limits of the Modification objective.

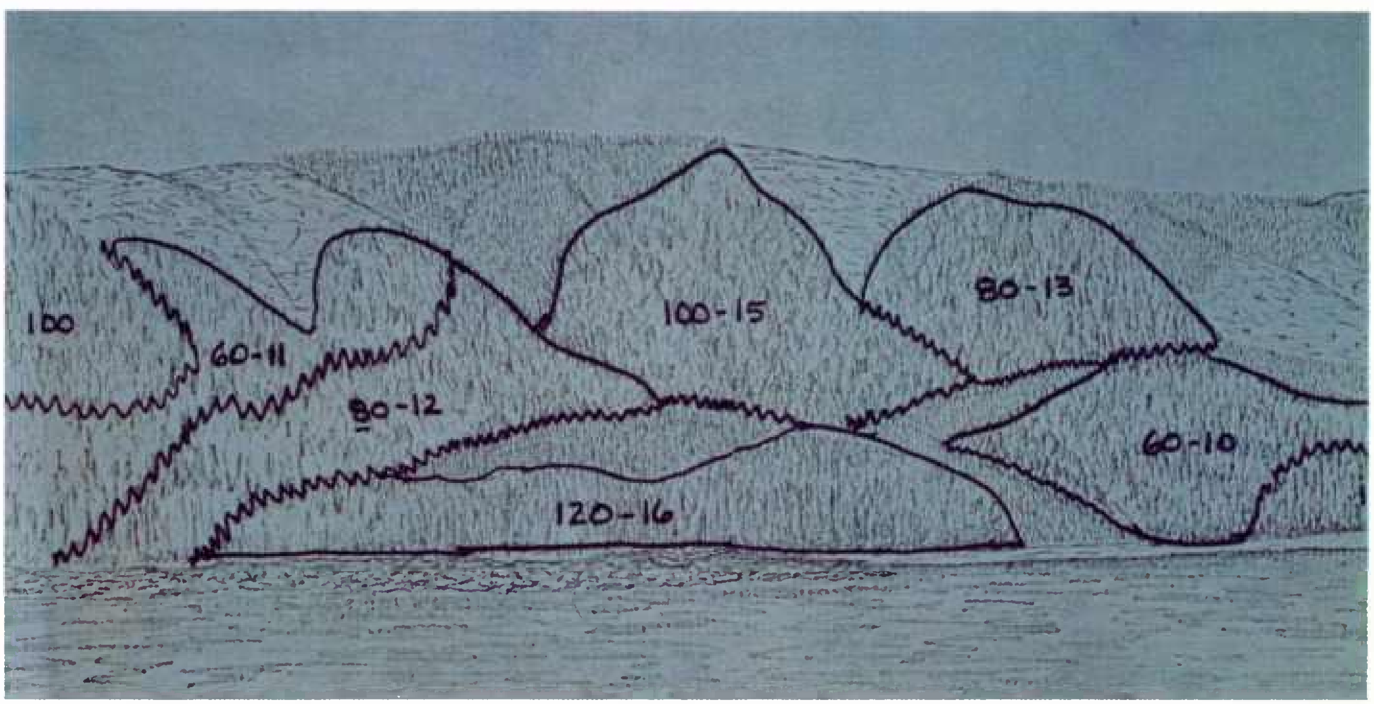
Units 10 and 11 are now ready for precommercial thinning. Units 1 through 9 can be commercially thinned.

Year 100: The final removal of old-growth timber on the centerface occurs at the 6th entry when Unit 15 is clearcut by skyline. Unit 14 removes the remaining beach fringe adjacent to Unit 10.

Units 12 and 13 are ready for precommercial thinning. Units 1 through 11 can be thinned. Units 1, 2, and 3 will have approached the culmination of mean annual increment and Units 1 and 2 may be clearcut or just left alone. Unit 3 should be left for deer winter range. At year 100, the treatment cycle begins to be repeated.

Year 120: The harvesting of Unit 16 removed all remaining old growth in the treatment area. Units 14 and 15 are ready for precommercial thinning. Units 1 and 2 can be clearcut, as well as Units 4, 5, and 6. Units 7 through 13 can be commercially thinned.

As an alternative to this treatment, the treatments described for meeting Partial Retention—middleground could also be applied to Modification—middleground situations. This would allow for the total removal of old-growth timber at a more rapid rate, but would not create the mosaic of stands formed by the above treatment and, therefore, would not meet the stated objective.



Rehabilitation

Introduction

This section assumes that rehabilitation inventory and analysis, including priority setting, have been accomplished as part of viewshed management planning. The following process is suggested for the short-term reduction of negative visual impacts to:

1. Meet the visual quality objective adopted for the area, while moving the stand toward its place in the long-range progression of treatments; or
2. Where the adopted visual quality objective cannot be met, make alterations in existing management situations that will minimize their negative contrast with the characteristic landscape, and move the stand toward its desired long-range progression.

The length of time it takes to rehabilitate an area will depend upon the size of the area needing rehabilitation. Rehabilitation measures for large areas will require careful planning and scheduling of both the number of entries and the length of time necessary to complete the process. It is important for rehabilitative measures to be planned and implemented before the impacted area is reforested.

Process

Once an area has been selected for rehabilitation, seven steps need to be taken.

1. Describe the characteristic landscape. How are the different landscape features seen in terms of form, line, color, and texture?
2. Describe the existing management activities. How are they seen in terms of form, line, color, and texture?
3. Review the visual quality objectives set for the area.
4. From the viewshed plan or treatment examples, determine the treatment that will guide future prescriptions. Assess how the existing situation can best be integrated with the long-range succession of treatments to ultimately meet the established VQO.
5. Select one of the following short-term goals:
   A. Do nothing;
   B. Reduce form or line impacts;
   C. Reduce color or texture impacts;
   D. Combine two or more short-term goals.
6. Develop a rehabilitation plan for the area if short-term goal B, C, or D is selected. This plan should address the following:
   a. How will the treatment move the stand toward its place in the long-range progression of treatments?
   b. What corrective measures will reduce the negative impacts of the existing situation and eventually lead to complete rehabilitation?
   c. How many entries will be necessary to restore the character of the natural landscape?
   d. How much time will be necessary to complete the rehabilitative measures?
7. Develop a logging systems plan to accomplish as many of the rehabilitation goals as feasible.

Short-term Goals for Areas Warranting Rehabilitation

A. Do nothing to rehabilitate existing management situations, but meet the quality objective with all future activities in the area as part of the long-range progression of treatments.

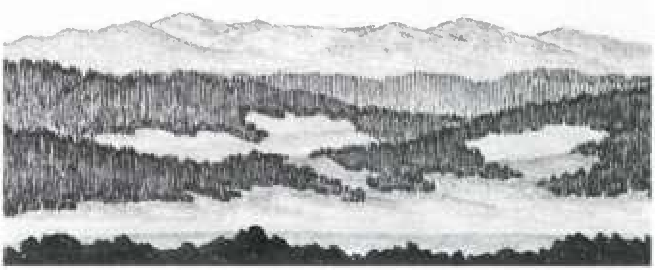
1. May be used when existing management situations do not meet the quality objective(s) set for the area, yet their negative impacts are minimal, such as a geometric-shaped unit that is completely reforested. In this situation, most proposed rehabilitative measures would only cause additional visual impacts.
2. May also be used when a portion of a rehabilitation area has not been altered and the entire landscape surrounding the negative situation has an important visual influence on the total landscape being viewed. The unmanaged areas that are not immediately adjacent to the affected site will seldom warrant rehabilitation. In the management of these surrounding areas, visual quality objectives should be met.

B. Reduce the impact of the form and/or line of management activities upon the landscape.

1. Reshape units:

   Geometric-shaped units are often strong in unnatural form and line, dominating the natural appearing landscape. By reshaping the unit's edge to look more natural (irregular), the strong negative impacts of their unnatural form can be reduced.

Before.



After.

2. Create visual linkage:

   Here management activities lack visual linkage between their patterns and the surrounding landscape. The individual cutting block patterns compete for visual attention with the landscape feature.

Before.

   Visual linkage can be created by connecting the existing units to each other and to any natural openings, thus creating a more balanced, unified pattern among the management activities and the natural landscape. If well designed, it can lead visual attention back to the landscape feature.

Proposed after (sketch).

3. Modify edges:

   Straight edges produce strong line dominance on most landscapes.

   Reduce the negative impacts of straight boundary edges by reshaping to create irregular edges or by "feathering" boundaries to produce indistinct edges.

4. Keep rehabilitative measures within the scale of the landform.

5. Revegetate existing activities:

   Exposed soil, resulting from timber harvesting, road and landing construction, log skidding, fire line construction, etc., often produces strong form and/or line impacts.

   The line dominance of a road's cuts and fills is greatly reduced by simply establishing vegetation on the exposed soil.

Before.

After.

6. Eliminate ridgetop trees:

The visual dominance of sparsely spaced trees, often left along ridgetops, can produce a moderate form and line dominance. The remaining ridgetop trees will also hold one's visual attention to the activity below. By eliminating these single, randomly spaced trees the impact is reduced and one's vision is allowed to extend out of and away from the activity. Careful attention must also be paid to eliminating the vertical ridgetop edge on both sides by cutting across the ridge at an angle.

Before.

After.

C. Reduce the impact of management activities' color and/or texture against the landscape.

1. Revegetate existing activities:

Exposed soil will usually create a strong color contrast upon the characteristic landscape, greatly emphasizing form and line.

Before.

The strong color dominance between the light colored soil and darker surrounding vegetation is reduced by revegetating the exposed soil of road banks and/or harvest units.

After.

2. Reduce sharp textural contrasts by feathering unit edges.

3. Eliminate narrow or small leave strips (of coarse, dark texture) when they provide insufficient areas of natural appearing variety in the landscape composition or contrast in a negative way with surrounding areas.

This narrow leave strip with its unnatural appearing tree bole edge and alignment should be removed.

With the exception of the lower right-hand trees, this leave area has a textured, natural appearing edge and appears to be sufficient enough in mass to be a positive element in the landscape.

4. Eliminate slash, high stumps, root wads, and other logging or road construction debris.

High stumps and logging debris create strong unnatural texture.

Much of the debris has been removed; seeding and fertilizing has also taken place.

D. Reduce the impact of management activities by combining two or more of the short-term goals.

This is for situations where two or more of the above short-term goals could be applied to rehabilitate any given area. Many large landscapes warranting visual rehabilitation will require a combination of the short-term goals and corrective measures to reduce or eliminate the strong form, line, color, and textural contrast created by existing management activities upon the landscape.

Impact: A small patch cut produces strong vertical line and an unnatural shape along the top of a middleground ridge.

Rehabilitation: The negative line and shape were eliminated by harvesting the adjacent trees to a point where the canopy of the surrounding vegetation tapered into the landform.

Impact: The strong, unnatural form of the patch cuts dominates and holds the viewer's attention.

Rehabilitation: The strong form produced by these harvest units was greatly reduced when the existing units were linked together by cutting several of the leave strips. Except for the left unit yet to be altered, this visual linkage now allows for the attention of the eye to move about.

Logging Systems

Introduction

Once management goals and objectives (including visual) have been established for a travel corridor, a logging plan should be prepared to implement the objectives.

The purpose of this section is to provide an introduction to the basic logging systems presently used in the United States and to discuss some general principles and their use to meet visual objectives. Specific steps in plan preparation are covered in detail in the *Forest Engineering Handbook* and the *Sale Planning Handbook*.

Systems

The more common logging systems are described below, along with their capabilities and limitations in achieving desired visual characteristics.

Horse

Horses are used in areas having sensitive visual, soil, watershed, and residual crop tree considerations, such as campgrounds or administrative sites. Horse logging is most adapted to small-sized timber, but it can be used in old-growth stands if the weight of the log does not exceed the pulling capability of the horses.

Silviculture treatments may include salvage, sanitation, or commercial thinning.

The maximum yarding distance is often limited by economics to under 300 feet. Yarding should be done on level ground or downhill. The steepness of slope on which horses may be used is limited to that on which logs can be skidded without rolling to the side or sliding into the horses.

This system can be very effective in minimizing vegetation and soil disturbance, soil compaction, etc.

Concentrated skidding over one route could result in a deep furrow that may cause unacceptable damage to soil, water, and visual resources.

Rubber-Tired Skidder

Rubber-tired skidders are most efficient on slopes up to 35 percent. Skidders are outfitted with a fair lead arch to raise the leading end of the logs off the ground.

Maximum downhill or level skidding distances are 1,500 to 2,000 feet. However, 800 to 1,000 feet often provide the most economical operations for the rubber-tired skidder. High speed, low cost of operation, and flexibility in meeting cutting prescriptions are the advantages of the rubber-tired skidder.

This system can be used to produce harvest openings of varying sizes, shapes, and effects because of its high mobility. Skid trail pattern and soil compaction are factors to be considered on certain forest soils. Proper location of skid trails will be needed to achieve the desired landscape design.

Tractor

The crawler tractor is the conventional logging system on slopes up to 35 percent. It is primarily a downhill yarding system with average skidding distances of 800 to 1,200 feet. Access to the harvest area must be below the unit. As with the rubber-tired skidder, the tractor can produce harvest openings of varying size, shape, dispersement, and edge effect.

Crawler tractor with flexible tracks.

The primary concern in tractor logging as in all ground skidding equipment is soil disturbance. Ground leading logs repeatedly over the same skid trail can cause soil movement, soil compaction, and water concentration in the skid trails. Effects of line and color may be reduced through the use of crawler tractors with flexible tracks.

Tree Harvester

The tree harvester cuts trees at or near ground level, leaving a smooth ground line devoid of visible stumps. The machines are fast in operation—handling 1 to 3 trees per minute.

Tree harvesters operate within a corridor or clearcut on slopes up to 20 percent. The width of the corridor depends on the machine used, but will vary from 15 to 25 feet. The corridor will tend to be wider if the harvester has to move out of the corridor to cut individual trees and then bring them back for bunching.

A corridor also serves as the skid trail for moving bunched logs to the landing area.

Highlead

Highlead is basically a ground lead system (rear of the log trailing on the ground). Usually the incoming logs will follow the profile of the ground, resulting in a pattern of lines radiating from the landing.

Settings with 800 feet yarding distances with long corners of 1,000 feet are most suited to using highlead. Primarily, yarding is uphill; however, downhill is feasible for distances up to 400 feet, depending on steepness of the setting.

The system has no lateral capability other than that provided by the length of the chokers and is applicable only in clearcuts. Shaping of the units can be accomplished by moving the tail block or by using more than one landing.

Skyline

The term "skyline system" refers to many different rigging configurations and a variety of equipment. Skyline systems may use carriages with or without lateral capability, depending on the type of cutting that is required.

Skylines with Lateral Capability

A skyline system with lateral capability has a carriage capable of pulling slack in a skidding line and will maintain a fixed position on the skyline during lateral yarding. This type of skyline system is often referred to as a skyline crane. Such capability in skyline logging is required to accomplish certain techniques that will meet particular visual quality objectives. Such techniques include partial cuts, irregularly shaped clearcuts, feathered edges on clearcuts, islands within clearcuts, and others.

Some skyline crane systems are capable of reaching 2,500 feet. Yarding distance varies depending on equipment size and size of logs to be moved. Equipment ranges from small mobile yarders capable of spanning 1,000 feet to large multiple-span skylines capable of spanning several thousand feet.

Most running skyline yarders have a maximum reach of 1,000 feet and can yard either uphill or downhill. Some have the capability of reaching 2,000 feet.

Every skyline system must have adequate deflection (height above the ground) to carry a payload; it must have ample clearance to fully or partially suspend the logs, and it must be able to maintain a carriage position high enough above the ground to control the logs during lateral skidding.

The lateral reach depends mainly on topography and ground conditions (brush, soil, etc.). In general, 75 feet is the maximum lateral distance that should be used in a partial cut.

A skyline crane system on the right, commonly referred to as a running skyline, with a swing boom tower.

Skyline with lateral capability.

Skylines Without Lateral Capability

Skylines without lateral capability can only be used to pick up logs within choker length of the skyline. Skyline systems such as the slackline and shotgun (flyer) may be used if adequate deflection is available. Shown below is a shotgun carriage that has no lateral capability. It yards only those logs within reach of the chokers (note the long chokers). Normally, distances up to 2,000 feet are within reach of this system.

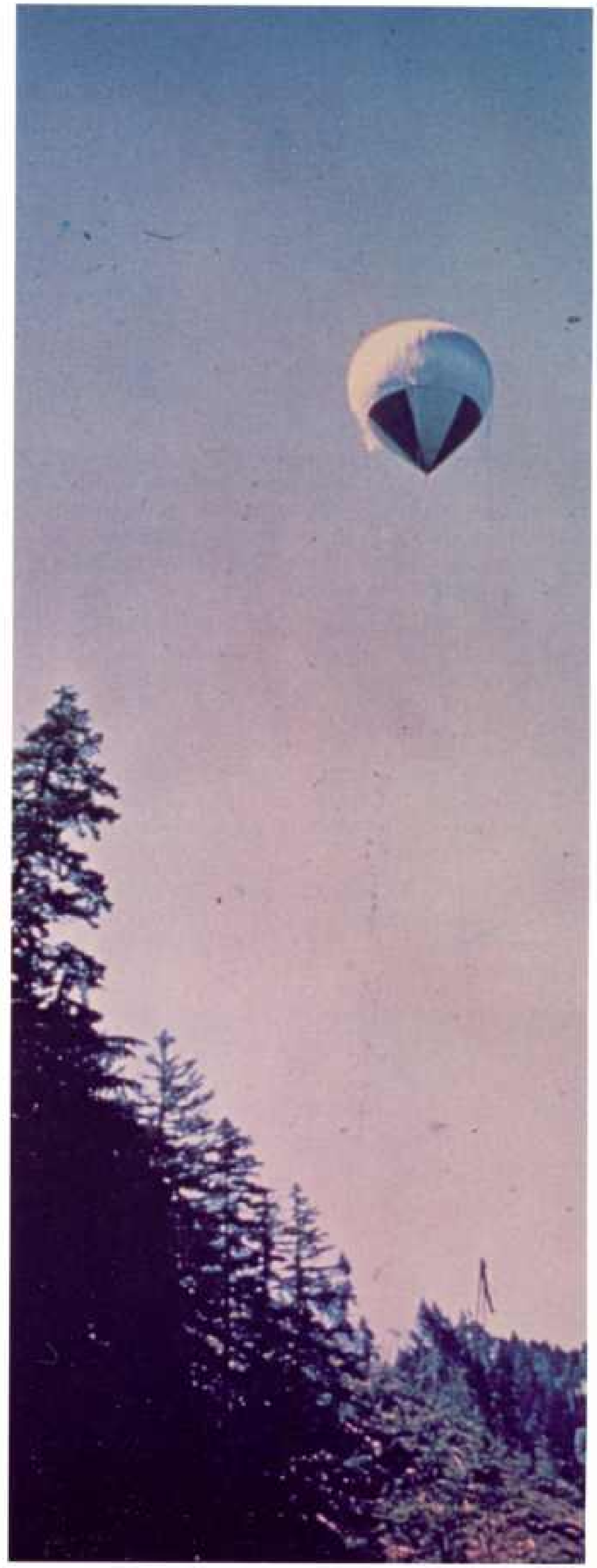
Balloon

The balloon has the advantage of being able to lift logs vertically off the ground and carry them downhill to a landing. Primary use is in clearcuts and in overstory removal when the residual stand is 15 feet or less in height.

This system may be used on an irregular clearcut shape. Lateral yarding can be achieved by pulling the balloon close to the ground and allowing the tag line to be pulled laterally. The balloon will then lift the log vertically, with little log drag. One disadvantage is that clearcuts, of necessity, are generally large in scale.

Weather can be an adverse factor. Wind, rain, and snow affect the operational characteristics of the balloon. Slight winds will blow the balloon off course, creating the potential to damage trees along the edge of the unit or along corridors.

Because the balloon is primarily a downhill logging system, roads must be located below the harvest unit. Landings must be fairly large for landing and decking the logs. In addition to the landing area, a bedding area for the balloon is needed. Yarding distances up to 4,000 feet are operable by this system.



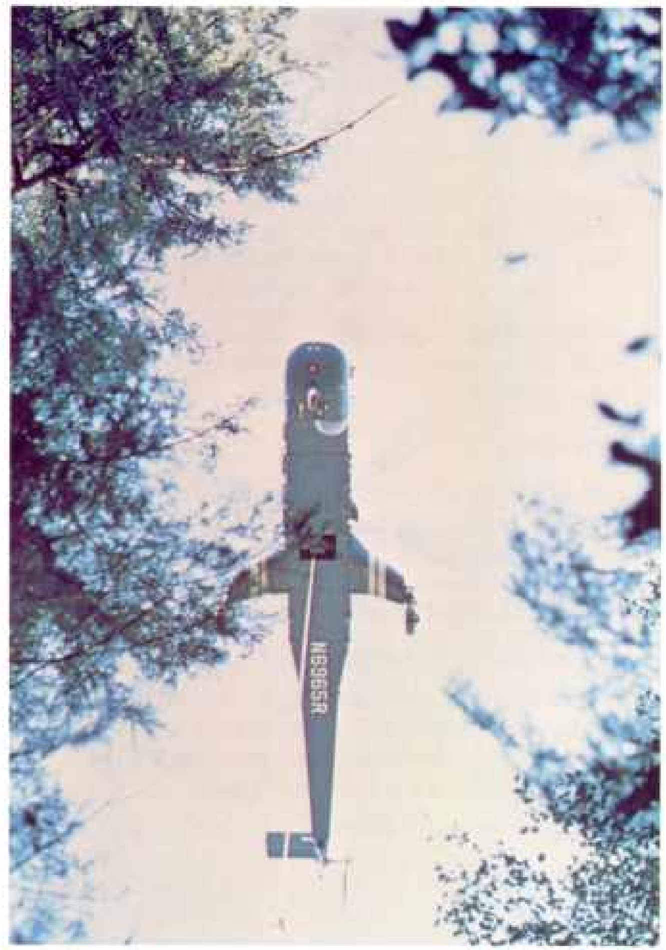
Helicopter

The helicopter provides a very versatile logging system. It can yard in any direction, within elevation and distance limitations, and be operated in any silvicultural prescription.

The result is that in such silvicultural activities as clearcutting, the versatility in size, shape, edge effect, and distribution are almost unlimited. Color contrast is less because of relatively little site disturbance. The visual quality objectives of *Retention* or *Partial Retention* can be more easily accomplished, even in continuous textured landscapes.

With little or no road access, slash disposal is often a major problem. Scarification in helicopter logged areas may be inadequate for seedling germination and growth.

Large landings are needed to safely handle and store the tremendous volume of timber that the helicopter is capable of yarding in 1 day.



Application and Techniques

Accomplishing the silviculture treatments outlined in this chapter to achieve specific Visual Quality Objectives and Corridor Goals involves three primary considerations:

1. *Windfirmness* of the stand.
2. *Form, Line, and Color Contrasts* introduced by the physical requirements of the logging system, particularly as they apply to retaining the continuous texture characteristics of the vegetation.
3. Capability of achieving *Natural-Appearing shape, edge effect, leave islands, and variety in size and dispersement.*

Windfirmness

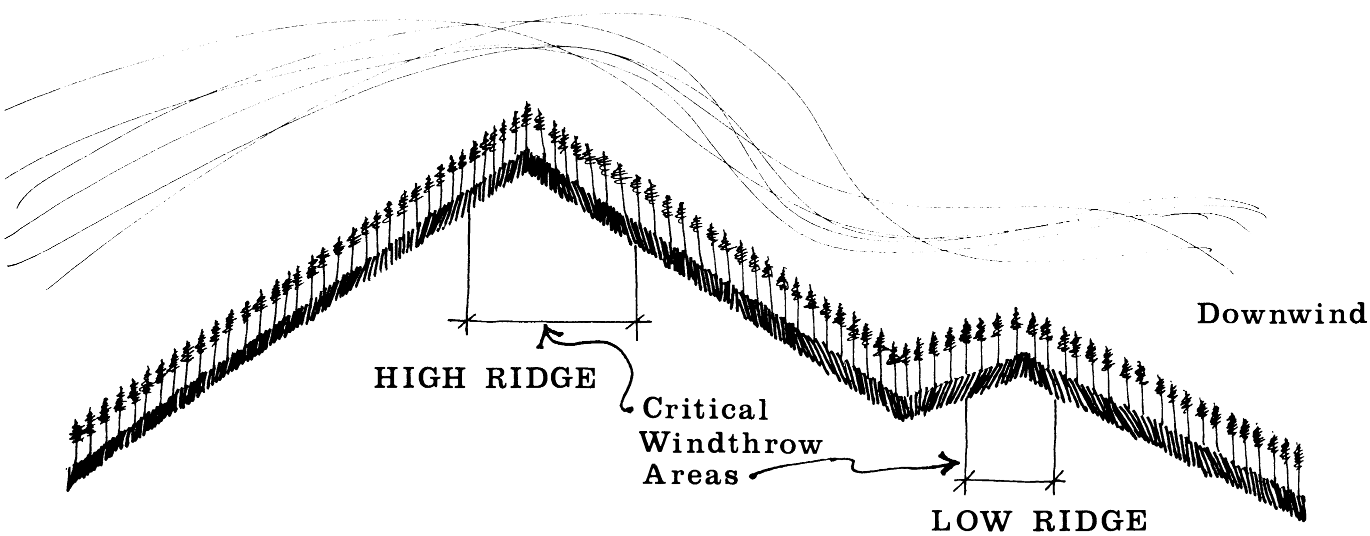
The direction of prevailing storm winds should be determined before unit boundaries are set. Boundaries that funnel the wind into the residual stand should be avoided. Blowdown risk *increases* whenever storm wind direction is changed from its established pattern.

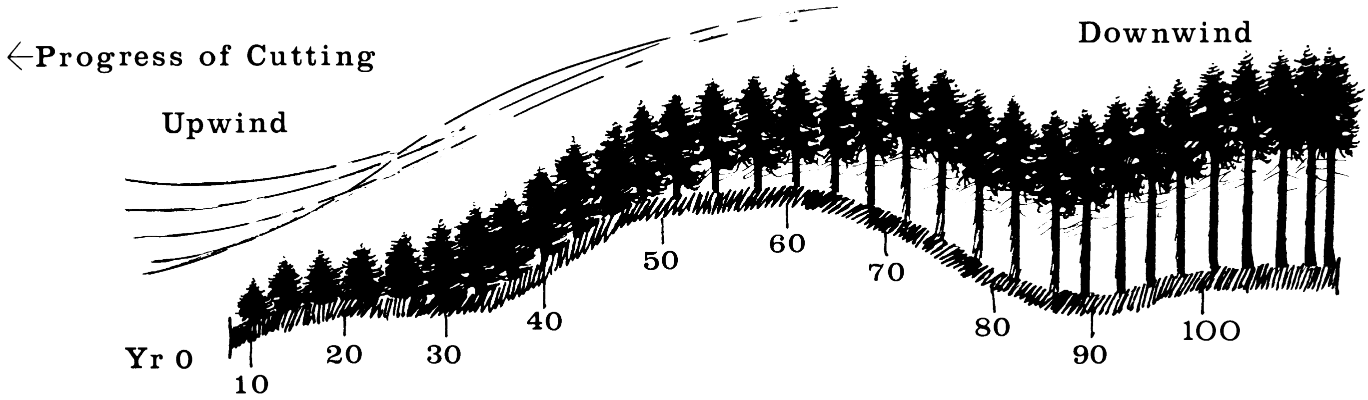
Situations that can be classified as high wind risk are:

1. Upper slopes, particularly the lee (downwind) slope to the storm wind. Many tree species appear to have a more highly developed root structure on the downhill side than on the uphill side.
2. Moderate to steep slopes.
3. Shallow soils.
4. Slowly drained soils.
5. Trees growing in dense stands.
6. Trees on small ridges or flats on the lee side of a higher ridge.
7. Ridgetops, saddles, or gaps in ridges where winds are accelerated.
8. Stands infected with butt rot or root rot.
9. Stands where there is evidence of old blowdown.

Situations that can be classified as low wind risk include:

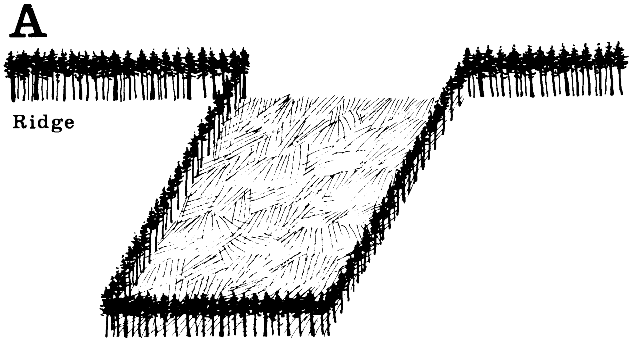
1. Middle to lower slopes, as well as stream bottoms.
2. Flats and gentle slopes, except on the lee side of a higher ridge.
3. Medium to deep soils.
4. Moderate to rapidly drained soils.
5. Young stands of sound trees.
6. Open grown trees.
7. Boundaries parallel to the wind.
8. Hardwood stands and mixed hardwood-conifer stands.

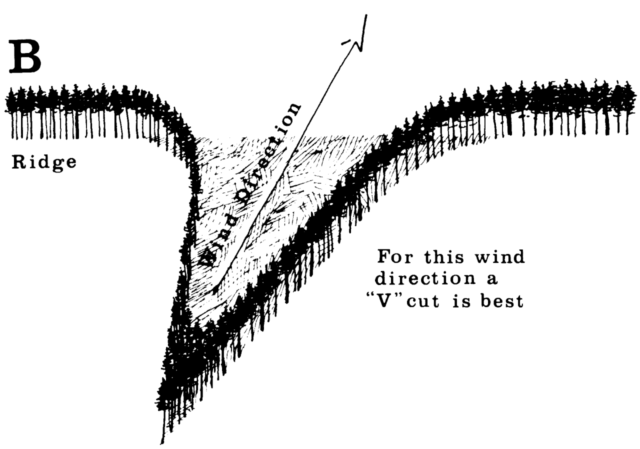




If possible, harvesting should progress into the wind. Do not make vee-shaped indentations in unit boundaries that funnel wind into the residual stand. Do not make heavy partial cuts in stands that have never been exposed to the wind, if they are high wind risk situations. See also page 164 for solutions to windthrow problems.

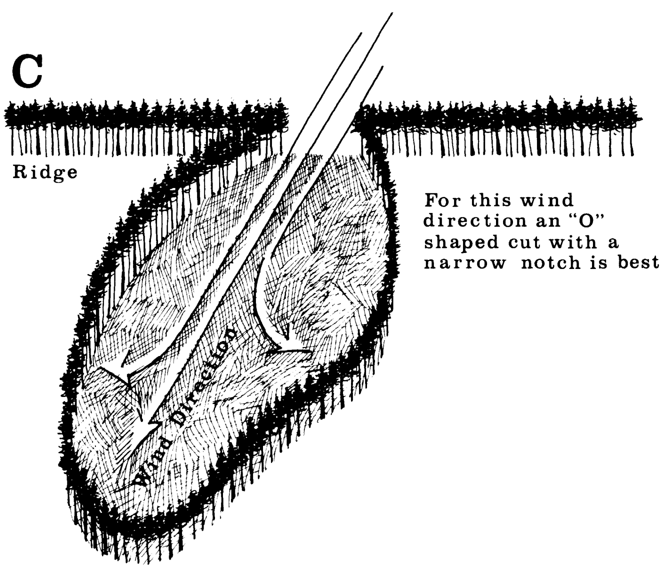
A "Notch" type cut is visually undesirable regardless of wind direction





Good silvicultural prescriptions and desirable Visual Quality Objectives are of little value if natural forces of wind are not recognized.

Notch effects on ridgelines (A) can be reduced by shaping units to take into account the direction of storm winds. Units facing into the storm wind should flare out as they approach the ridgetop and cross it at an angle (B). Units on the lee side of the ridge should flare in so that notch effects are minimized (C).



Form, Line, and Color Contrasts

Logging systems may introduce unacceptable form, line, and color to the landscape. The major areas of concern are:

1. Skidroad or skyline corridor width.
2. Landings.
3. Truck roads.

Corridor Width Control

Tractor skidroad width is not generally a problem, if skidroads are bucked out[6] to blade width prior to skidding. Skyline corridor width, however, is often more complicated to control. Skyline corridor width is a function of:

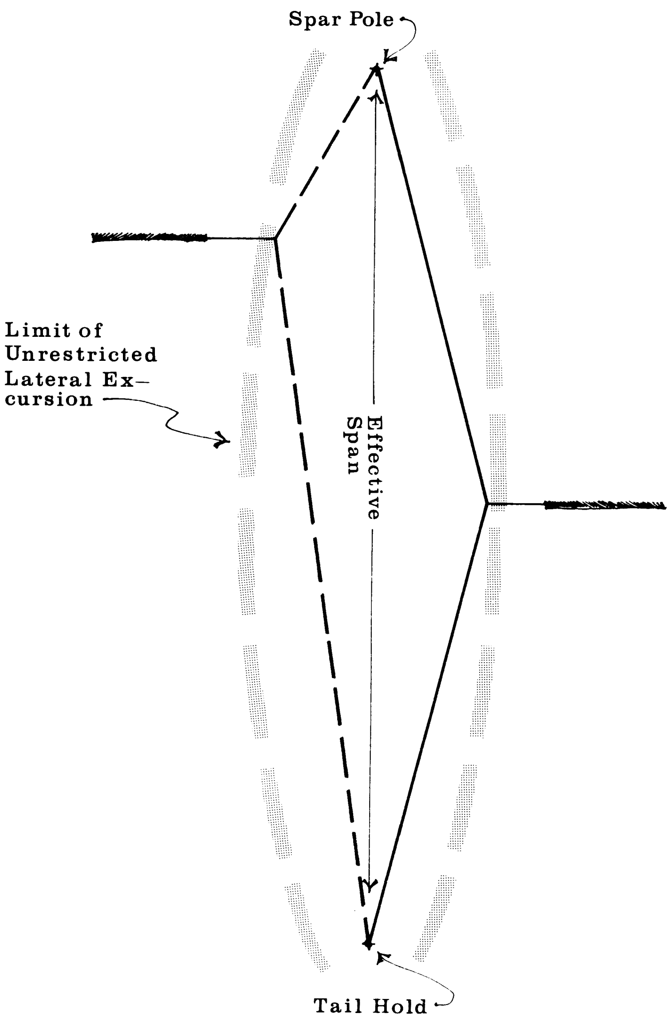
1. Effective skyline span,
2. Log load,
3. Skyline height,
4. Skyline tension,
5. Rub tree frequency and size,
6. Position of carriage in span,
7. Lateral ground slope, and
8. Lateral yarding distance.

Rub trees are the most efficient method of reducing corridor width. Rub trees act to reduce the effective span[7] of the skyline.

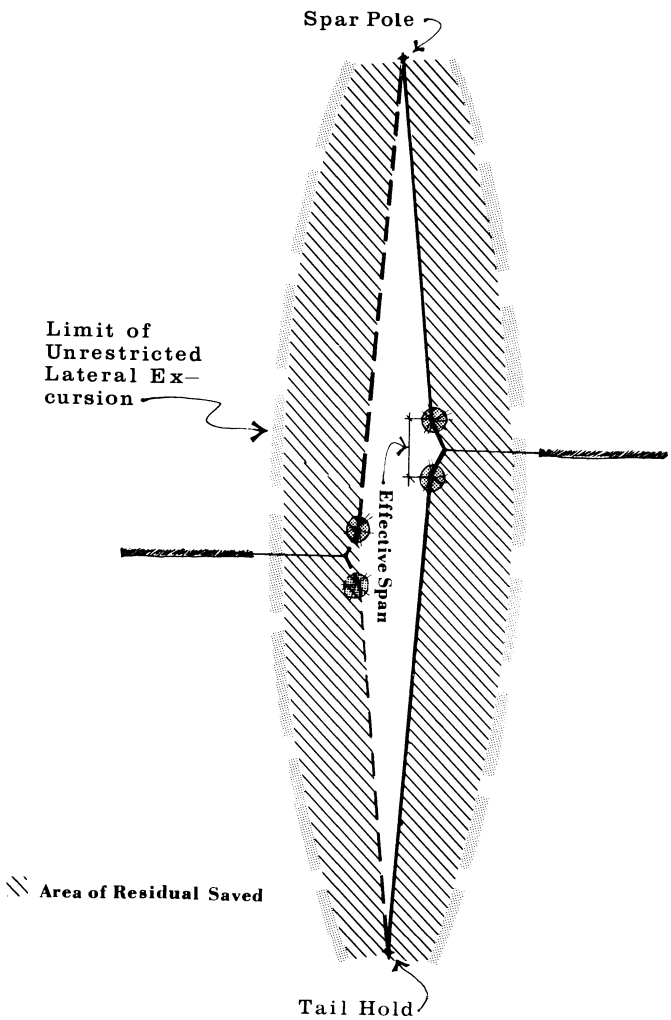
To avoid breakage, rub trees should be comparable in size to the trees being yarded. Skyline height should be controlled so that the skyline makes contact with the rub tree in the lower one-third of the tree bole, or the rub tree may be pulled over, or its top may be broken out.

[6]*Bucked out.*—windfall trees are cut at skidroad edges to prevent damage to the residual stand when they are cleared away or bumped by the tractor.

[7]*Effective skyline span.*—the distance between restraints on the skyline.

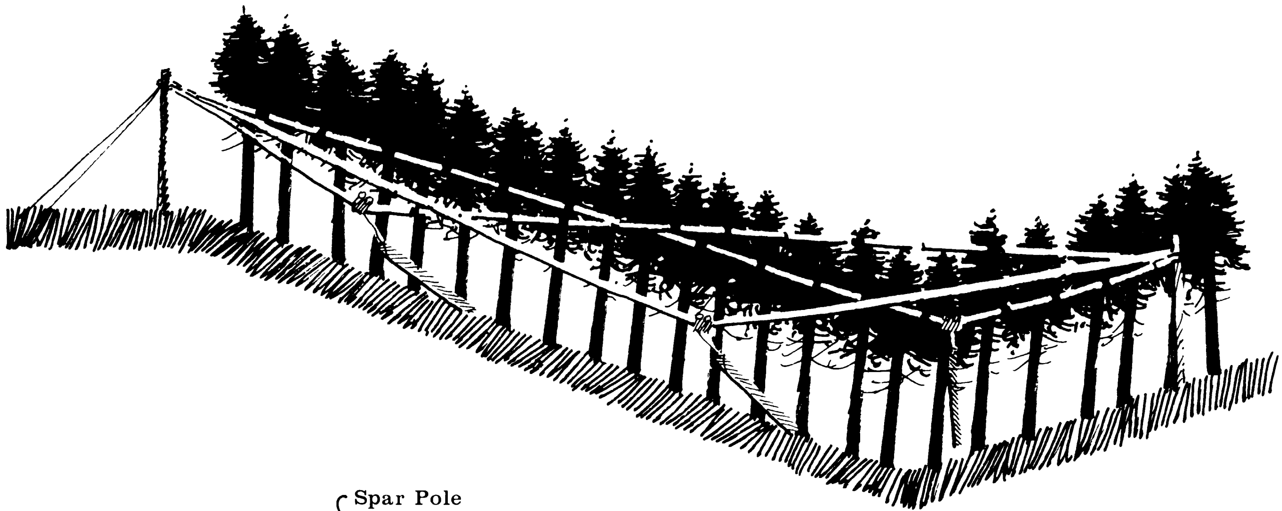


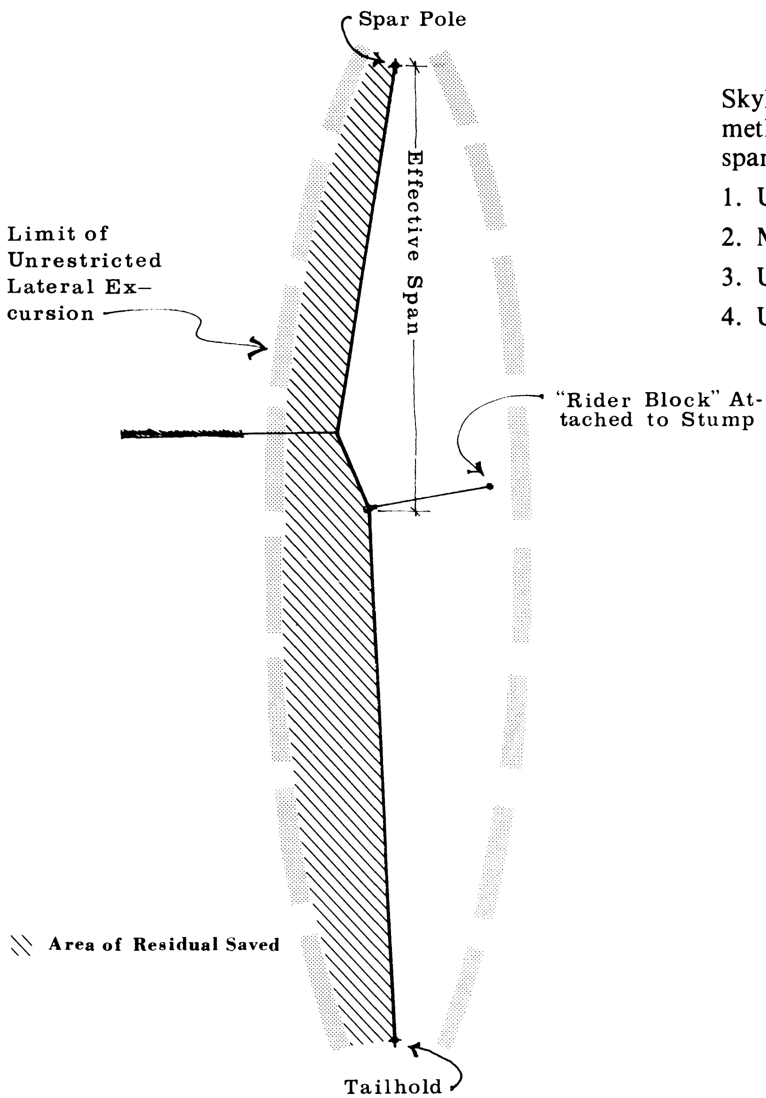
WITHOUT RUB TREES



WITH RUB TREES

It frequently occurs that rub trees are not in the right location, and the skyline makes contact too high on the bole. As illustrated, the height of the skyline above the ground is variable; the lowest height is often at midspan.

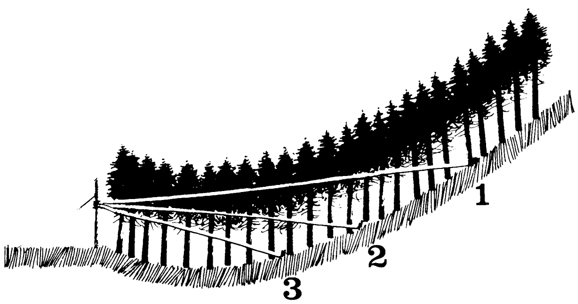




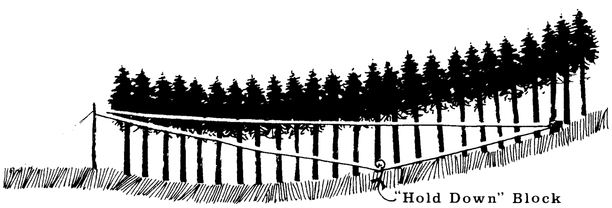
USE OF ARTIFICIAL RESTRAINTS

Skyline height can be controlled by a number of methods, all of which shorten the effective skyline span. These methods include:

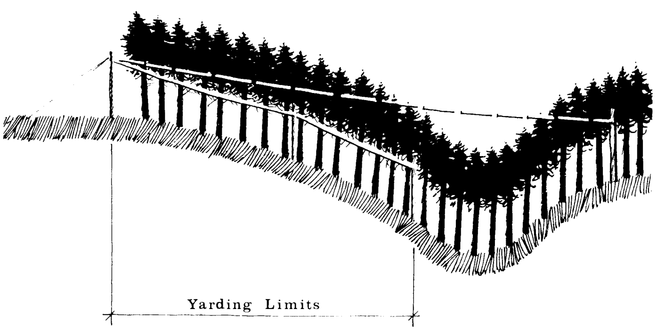
1. Use of artificial restraints.
2. Moving the tailhold as yarding is completed.
3. Use of "hold-down" blocks.
4. Use of intermediate supports.



MOVING THE TAILHOLD AS YARDING IS COMPLETED



USE OF "HOLD DOWN" BLOCKS



USE OF INTERMEDIATE SUPPORTS

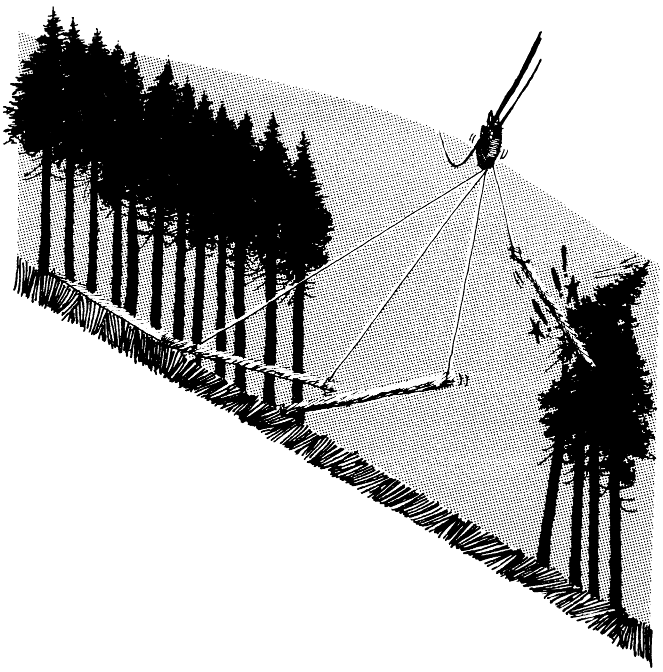
Control of the skyline with restraining devices should not be recommended without first consulting State and local logging safety codes. Engineering design principles should be used.

It is usually most difficult to control skyline corridor width when large-diameter timber is being yarded, since large equipment must be used. Small-diameter material generally poses the fewest problems for corridor width control.

Since any additional work required during yarding increases the yarding cost, the number of times special height control activities are required should be minimized. Height control activities, however, may be preferable to entirely changing the yarding system.

Other corridor control measures include increasing skyline tension (larger lines) and/or reducing load size. In general, controlling the effective span length is the most positive method of maintaining required corridor width.

If lateral slopes are over 30 percent and full suspension occurs as the logs are pulled down to the skyline corridor, the logs may swing into the residual stand, breaking out tree tops. In this case, stand damage can be minimized by restricting lateral yarding to the downhill side of the skyline, or to one log length on the uphill side.



Corridor widths of 10 to 15 feet are quite reasonable if the skyline height is in the lower third of the residual stand and appropriate corridor control measures are used. If logs become fully suspended in the canopy, the turn may break tops out of trees up to 25 feet on each side of the corridor.

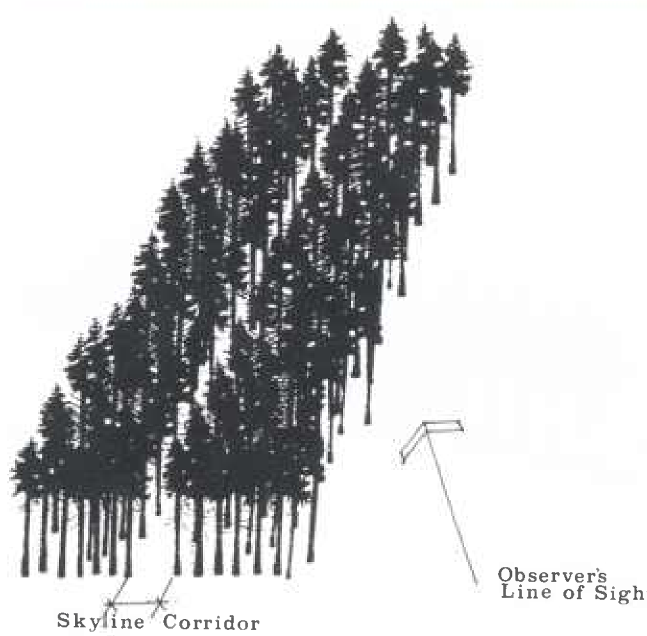
Example

The majority of the skyline corridors located from top to bottom every 200 feet across the face of this hillside are not evident. Rub trees were used, without height control measures. The rub trees were removed after the large, mature timber had been yarded to the landing. The result is narrow skyline corridors (10 to 15 feet wide) with closed canopies, retaining the continuous texture characteristic.

Visual impacts of skyline corridors can often be further reduced by orienting them at angles to the observer's line of sight.

Example

Note the effect of the corridor on the left, which is oriented away from the observer, as opposed to the corridor on the right, which is oriented more directly toward the observer. When the corridor angle is such that the sun will cast shadow into the corridor continually, the line effect is also greatly subdued.



Roads and Landings

This discussion is limited primarily to roads within or adjacent to harvest units. Chapter 4 of this Handbook series (Agriculture Handbook No. 483) deals with roads outside harvest areas. Many of the techniques found in the roads chapter can also be used to mitigate the impacts of roads and landings within the units and, therefore, should be used in conjunction with these treatments.

Reduction of form, line, and color contrast can be separated into the following concepts:

1. Reduce form and line impact by proper visual *location* of roads and landings.
2. Reduce road line width.
3. Reduce line density.
4. Break up line into short segments of varying length.
5. Reduce line to texture.
6. Reduce landing form and line.
7. Reduce color contrast.

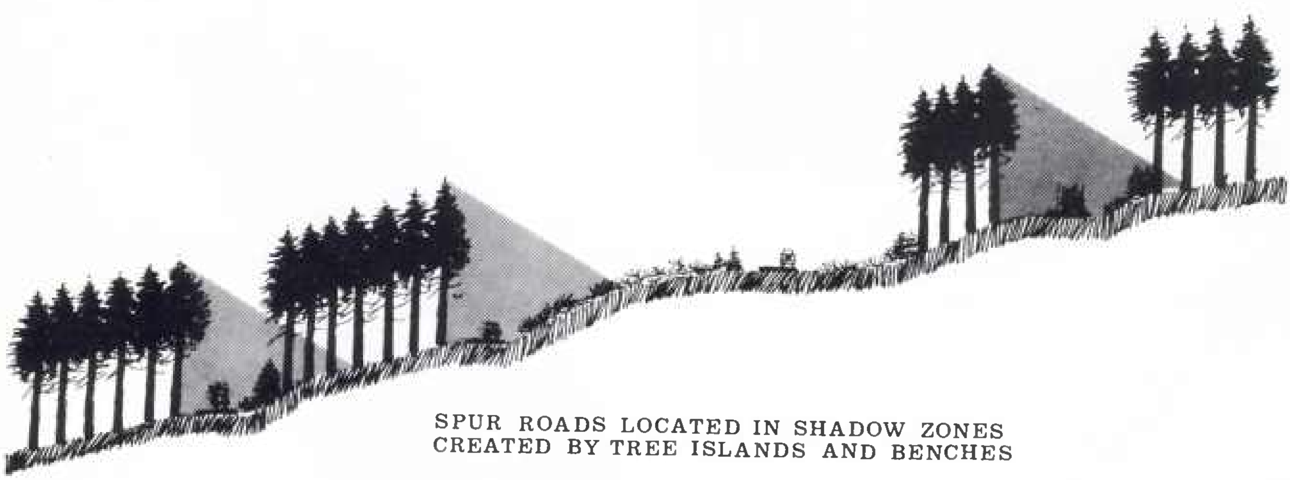
Road and Landing Location

Proper location of roads can often contribute significantly in the reduction of line and color impacts, making other measures either unnecessary or less costly and easier to accomplish. Roads and landings located at breaks in topography, such as benches and ridgetops, or behind existing tree groupings are usually of much less impact than roads located on steep side slopes. By taking advantage of natural topographic features, cut and fill slopes can be greatly minimized.

In addition, topographic breaks frequently exhibit a natural line element, from which road location can borrow. This line element is partly established by a visual shadow zone, which will further aid in reducing the contrast of the road.

In this overstory removal, the road was located at the break and at the ridge line, a very subtle impact.

Here the road was located at the natural edge between the rocky nonproductive area and the vegetation.



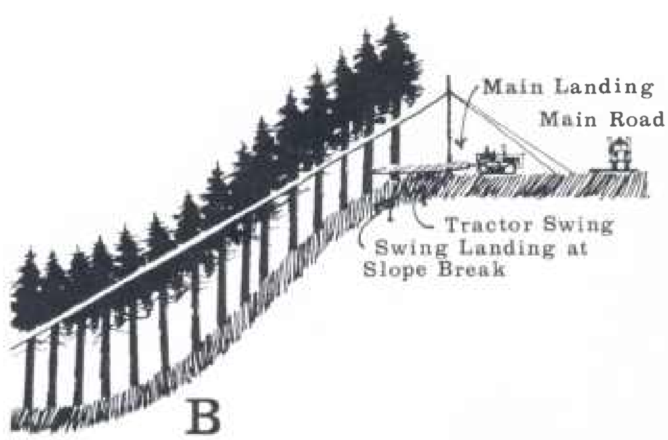
The cut and fill slopes in this well stocked unit have not been revegetated. The road and landings were located at the top of the unit in the only segment not screened from view across the lake. The result, as shown in the lower photo, is a stronger contrast of line than should occur in a unit this well stocked with new trees.

For logging purposes, the best road location also frequently occurs on or near a break in the slope.

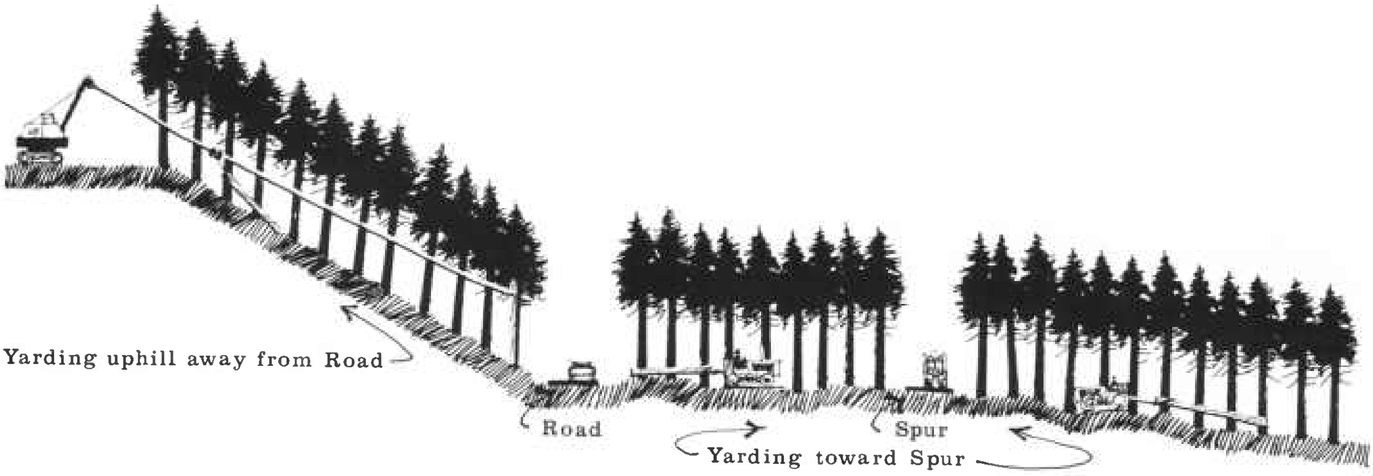
This provides the best access to the landings needed for cable logging, and sometimes serves to separate ground that can be logged by tractor from ground that must be cable logged. If, because of visual considerations, it is not desirable to locate the road on the break, other alternatives must be considered. One possibility is a swing, or second yarder, which moves the logs from the break to a second landing outside the visible area. The swing machine can be a tractor, skidder, or a cable machine. Another alternative is to use a multispan system by rigging an intermediate support at the slope break.

UPHILL MULTIPLE-SPAN SKYLINE

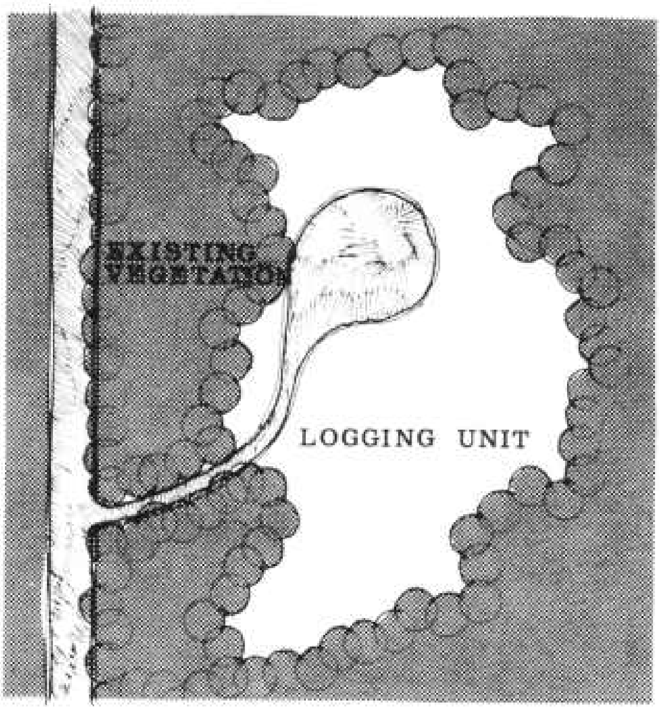
ROAD AT SLOPE BREAK



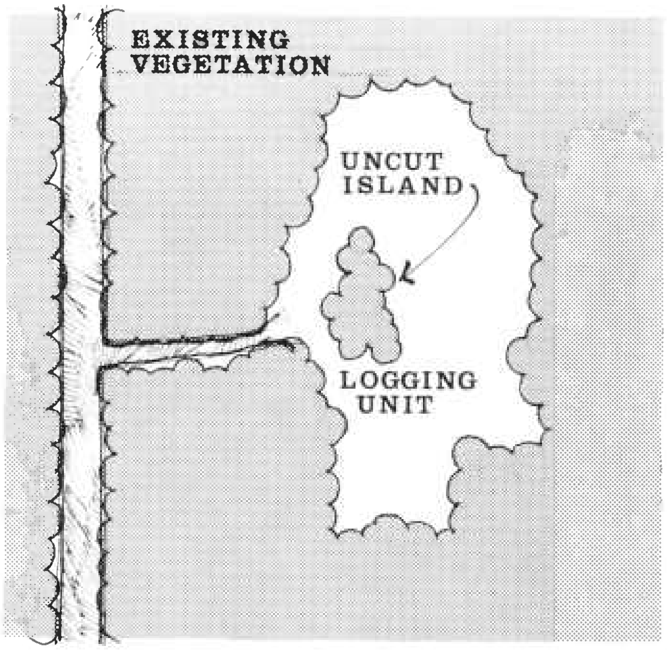
SINGLE SPAN SKYLINE WITH TRACTOR SWING



When harvesting along sensitive public travel routes, yarding should be toward *landings located away from the sensitive route.* This may require the construction of spur roads parallel to the travel route, so that logs can be yarded away from the main travel route.



Landings can sometimes be located adjacent to travel routes, behind existing vegetative or landform screening. Spur roads should be curved, where possible, to prevent observers from looking directly into the unit.



When curved spur roads are not feasible, the same effect can sometimes be achieved by leaving an uncut island at the entrance to the unit.

Road and Landing Width

Location of roads on slope breaks or benches automatically tends to reduce line width by minimizing cut and fill slopes. Where such location is not possible, or is insufficient to meet Visual Quality Objectives, reduction in line width must rely on engineering design. In such cases, the percent side slope and screening ability of existing vegetation must be considered. Engineering design controls the width of the road surface and the amount of cut and fill needed to build the road. The size of cuts and fills can be minimized by fitting the road closely to the terrain, and by using a road surface of minimal width. Other techniques for reducing line width can be found in the Roads Chapter (Agriculture Handbook No. 483).

When planning roads, State and Federal safety codes for logging and road construction must be consulted. These codes usually require that any trees presenting safety problems shall be cut. Within safety code requirements, however, clearing limits should be as narrow as possible. For species that permit it, filling over the base of trees at the toe of the fill should be considered.

Reducing Road Line Density (Number of Roads per Area)

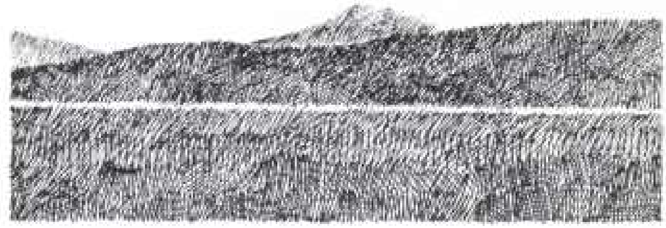
Road density is a function of topography and yarding system capabilities. Cable logging system capabilities are well defined by the principles covered in the *Cable Logging Systems Handbook* (Studier and Binkley n.d.) and the *Chain and Board Handbook* (Binkley and Sessions n.d.).

On ground suitable for tractor logging, road spacing is not limited physically; it may be limited by economic, hydrologic, or visual considerations.

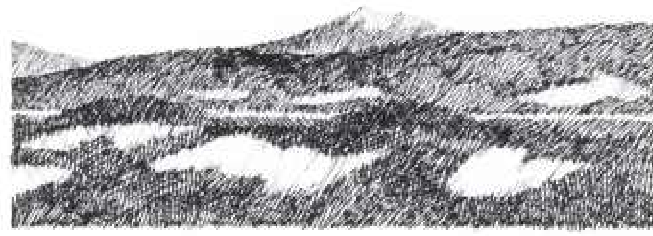
In sensitive areas, road density may be effectively decreased through the use of multi-span, long single span, or helicopter logging. Basic principles of logging engineering should be used to determine the physical and economic feasibility of these systems.

Reducing Line to Texture

Roads that create visible openings in the canopy can sometimes be made less obvious by creating other openings of a similar size. This, in effect, adjusts the natural textural pattern of the forest canopy to blend with the road. Again, the potential for this type of solution is dependent upon the engineering design of the road. Continuous sustained grades rarely blend well with the natural landscape.



Road appears as line.



With leave islands to break up the line, plus additional openings, the impact is softened to one of texture.

Reducing long-line impacts to short-line segments or small spot forms often tends to reduce its negative or unnatural appearing character.

Reducing Landing Form and Line

A landing is a place where logs are collected and temporarily stored until they can be transported to a mill or interim storage area (cold deck). Landings must be large enough to accommodate equipment and still have ample space to safely store and load logs. The visual impact of landings is mostly related to their size. Landing size is determined largely by topography and size and type of equipment to be used.

Equipment Size and Type

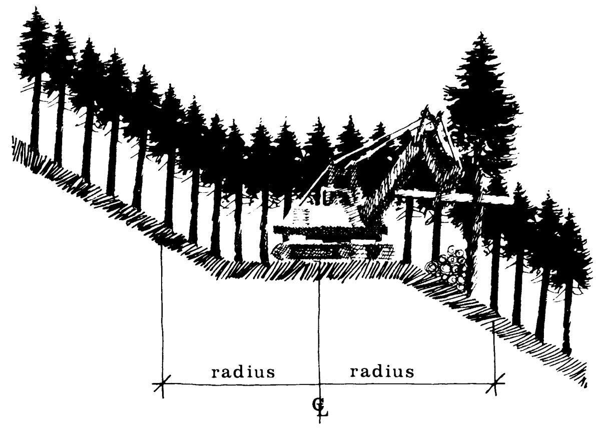
Equipment type, size, and design all influence the impact landings have upon the landscape. Tractor landings tend to be located on roads below gentle and moderate slopes, while cable landings tend to be above the area to be yarded.

When tractor logging, steep road banks should be avoided.

If existing road beds are used for tractor landings, adequate room for equipment to enter and leave the landings must be provided, along with adequate drainage.

Equipment selection in cable settings plays a large part in the shape and size of the landing required. Whether a machine is a swing boom, mobile fixed boom, or vertical tower dictates not only the size of landing, but also the type. Normally a swing boom yarder can use a road for a continuous landing, with logs positioned either in the road or below it for later loading. If side slopes exceed 50 percent, logs should be decked on the road; a loader or swinging graple skidder may be used to deck the logs. In this situation only the road width necessary for the machines is required as a landing. When using swing boom machines, the swing radius required for the boom can create an impact. An area directly below the landing must be cleared of standing trees, to allow room to swing the boom for decking.

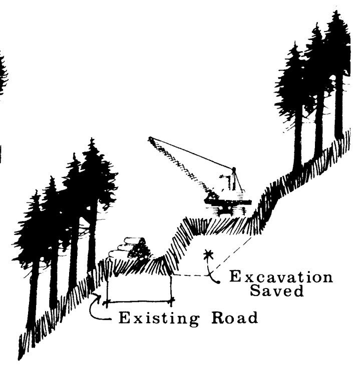
Constructed landing size can often be reduced by using standing trees to deck against, if permitted by local safety codes.



REMOVE TREES IN SWING RADIUS

If a fixed boom yarder is used and slopes are too steep below the landing or inadequate room exists, then a turnout or split level landing is needed to allow decking room.

Turnout Landing



Split-Level Landing

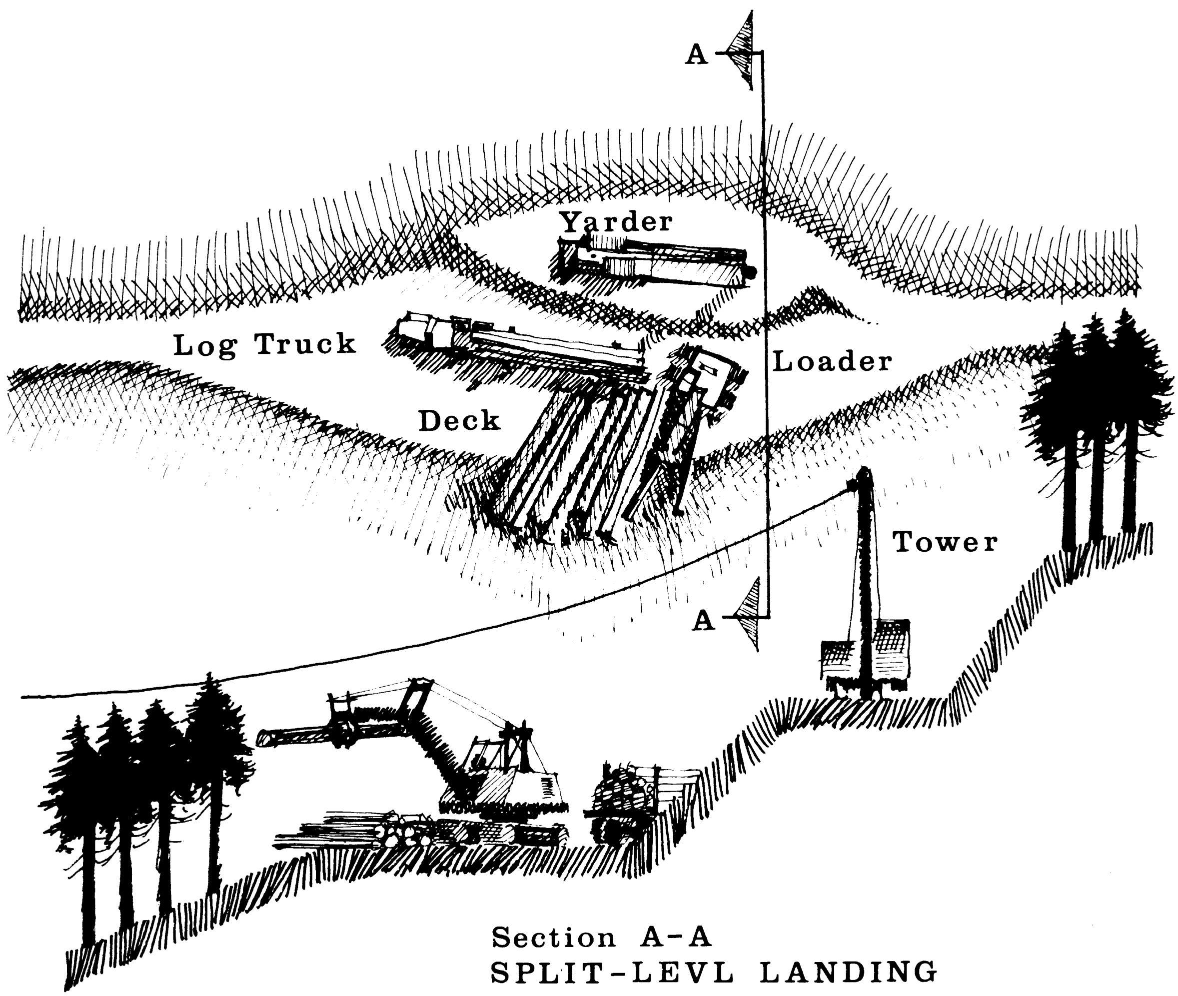
Fixed tower equipment is generally larger than mobile equipment, and requires a full-time loader. For this reason it is mainly used on centralized rather than continuous landings. Either portable yarder-tower combinations or rigged trees fit this category.

All landings should be of sufficient length, approximately 100 feet, to allow for safe maneuverability of equipment and trucks while providing room to park crew buses, pickups, and fire equipment.

Topography

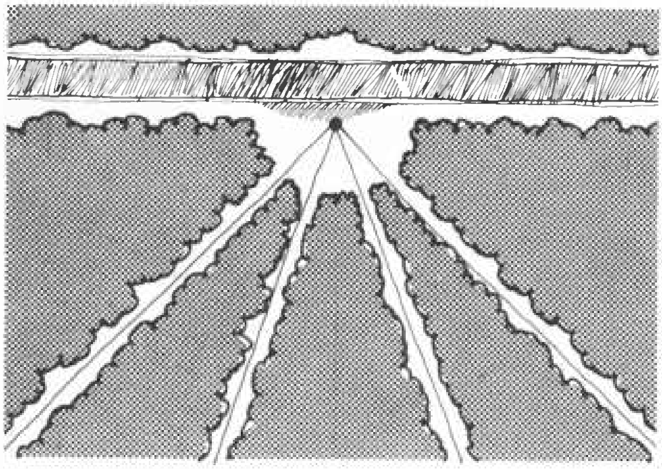
For landings in flat topography, drainage is the primary concern. On ridgetops and sidehills where side cast excavation often introduces undesirable form and color, end haul of excavated material should be considered. If swing equipment is used, side slope landings are less critical than for fixed boom or tower equipment.

If side slope landings must be used for large equipment, split-level landings have the advantage of reducing excavation while providing more room for loading and log storage. However, the yarder access trail may introduce additional line and color to the seen area.

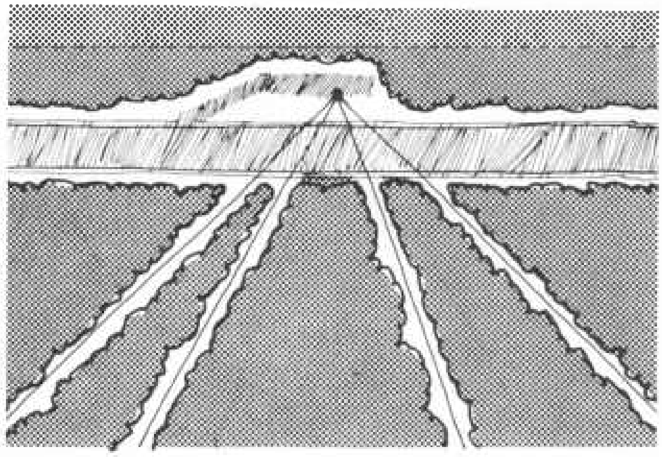


Section A-A
SPLIT-LEVL LANDING

If the yarder must set up on a road in topography requiring fan-shaped settings, converging corridors at the landing may resemble the appearance of a small clearcut. If the yarder is located behind the road, the convergence of corridors is not nearly as pronounced.



Yarder on road with turnout.

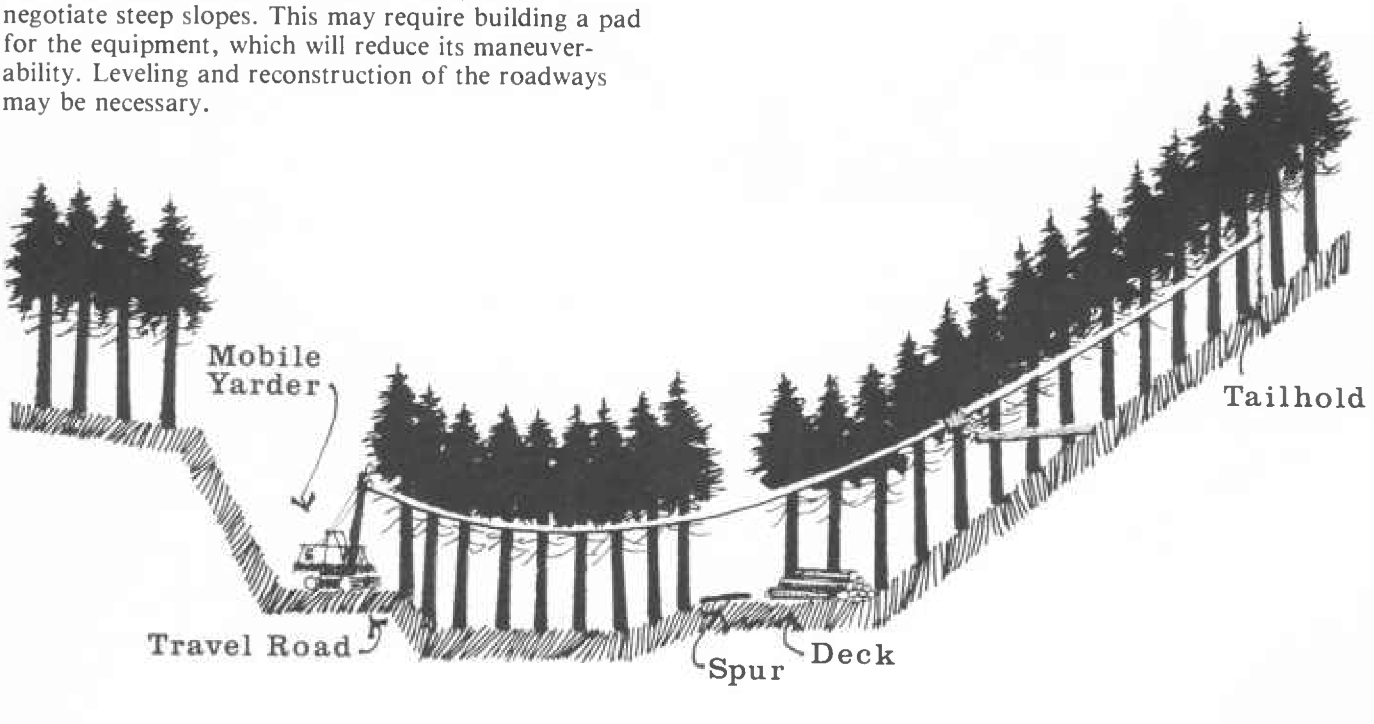


Yarder behind road.

This illustration suggests another method for screening a landing from the observer when the yarder must sit on the road. In this example, adequate payload capability and crew safety is maintained, but the log landing is separated from the observer.

If yarding is downhill, as indicated, landing width must include a runout area for rolling material. Yarding downhill over high cutbanks should be considered unsafe and impractical.

Road grades may present problems since some mobile equipment, such as yarders and loaders, cannot negotiate steep slopes. This may require building a pad for the equipment, which will reduce its maneuverability. Leveling and reconstruction of the roadways may be necessary.



Avoid road surface materials that have a high color contrast such as shown on the access road entering this important public travel route.

Reducing Color Contrast

While reduced size and proper location may mitigate the visual impact of roads and landings, these facilities may still fail to meet the adopted VQO unless a reduction in color contrast is also accomplished. The Roads chapter, Agriculture Handbook No. 483, provides numerous techniques for reducing contrasting soil color. The key factors that must be matched to site conditions are moisture requirements and relative ease or difficulty of establishment. These techniques may become even more important as the harvest unit greens up. Roads, landings, and cut and fill slopes remain unvegetated, so that color contrast is often intensified.

Example

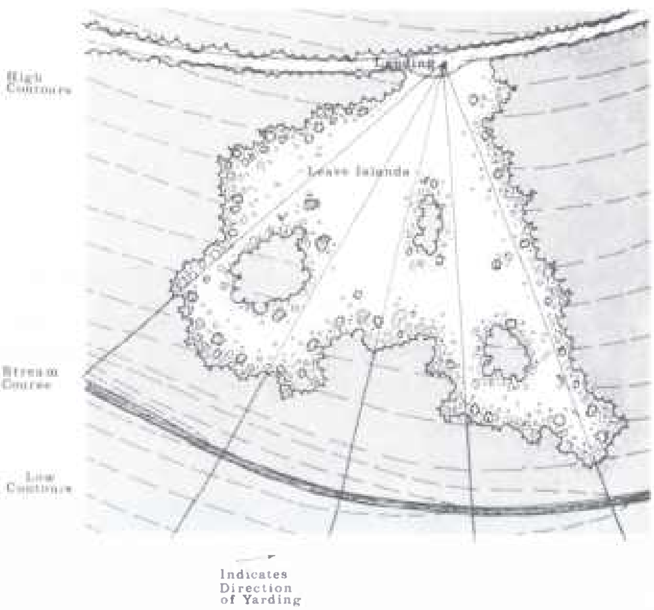
The roads and landings in lower left photo could have been reduced to little if any line impact if seeding and fertilizing had been accomplished as shown below. The road in the top left photo would have further required treatment of the running surface with a coating such as oil or asphalt.

Road cut and fill seeded and fertilized.

Natural-Appearing Shapes, Edges, Leave Islands, and Variety

The more common techniques used to achieve these design elements are:

1. Pull logs laterally to a point where they can be yarded forward to the landing. For cable systems, this requires either a logging system with lateral yarding capability or bunching logs prior to forwarding. Because of limited lateral yarding distance, cable systems are most effective when shaping small units (see "scale" on page 61, Agriculture Handbook No. 434). Shaping larger units generally requires greater undulation of the edge to be in scale. As also illustrated here, it can be done effectively by significant changes in yarding distance in adjacent cable corridors.



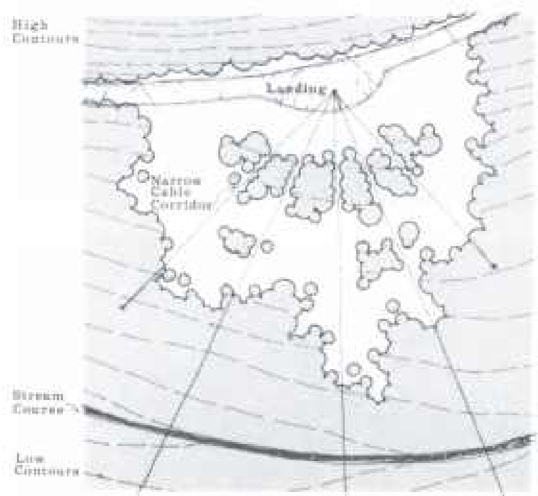
This sketch illustrates achieving shape and feathered edge by lateral yarding.

Helicopters with *sufficient* tagline length can also carry out edge feathering. Slash treatment, felling difficulties, and windthrow risk should be considered.

2. Fly logs over the uncut stand. This requires the use of a helicopter or sufficient skyline clearance to provide for full suspension over the canopy. However, a corridor is still needed.

The corridor beyond the unit need only be wide enough to raise and lower the skyline without it "hanging up" on branches.
Such a line is barely evident in this photo (arrows).

3. Drag logs through the lower third of the canopy. This may require the use of techniques discussed under Corridor Width Control.



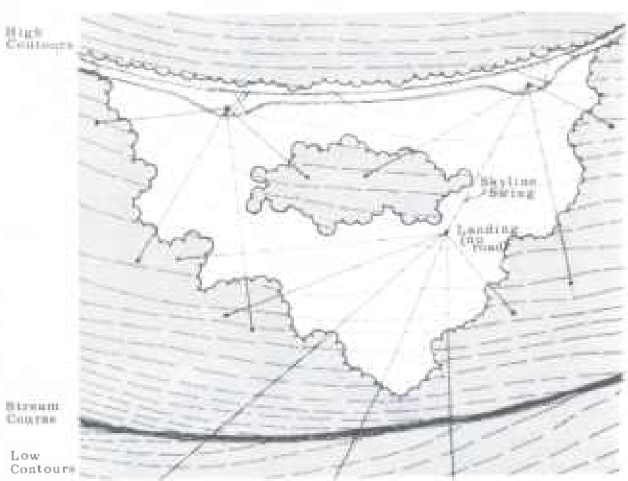
This sketch illustrates achieving shape and leave islands. Note that landing impact is minimized by island location.

The use of swing yarders has decreased in recent years with the increasing use of truck roads, but the method is still available. It should be recognized that both line and color will be introduced to the landscape when access is provided for the swing yarder and the swing landing.

Example
If topography is too steep or rough, a "cut road" may have to be constructed as illustrated in this photo.

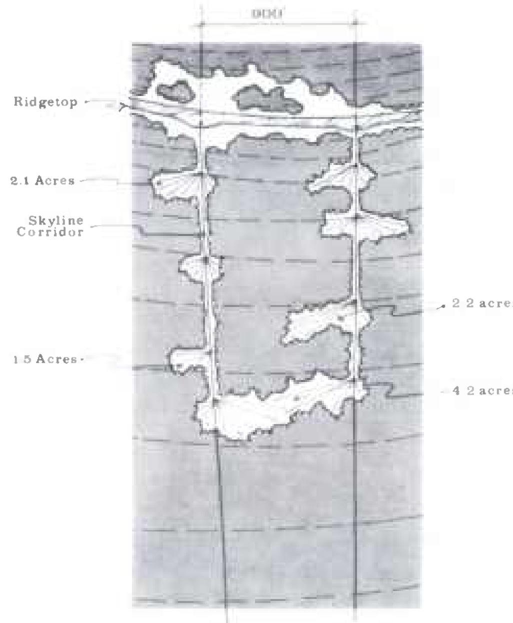
The following factors should be considered when planning the use of swing yarders:

1. Avoid moving swing yarders on slopes over 65 percent.
2. Avoid moving swing yarders in rocky terrain.
3. Choose areas with natural swing landings to avoid unnecessary excavation.



Achieving shape and leave islands by the use of swing yarders is illustrated in this sketch.

In smaller timber, openings can be created by bunching logs along the main skyline corridor, and then yarding to the landing.



Layout

Laying out designed unit or subunit boundaries can consume substantially more time than is required for less complex activities. Additional time is needed for reconnaissance, running ground profiles, traversing the unit, and for cruising and marking timber. A complex VRM setting may require up to eight times the man-hours expended on a comparable geometric unit. Costs are affected not only by the intricacy of the design, but by the experience level of the layout personnel with VRM techniques, as well as by access to the unit.

Details on layout procedures can be found in the *Timber Sale Planning Handbook*.

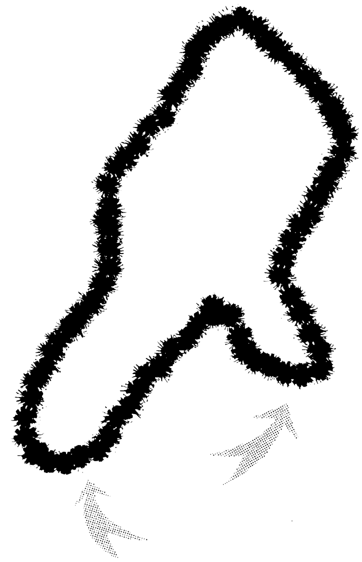
Logging Unit Design in Relation to Broadcast Burning Clearcuts

There are many influences on the size and shape of clearcut units. *One* of these is the need to be economically and safely burnable when broadcast burning is the planned treatment.

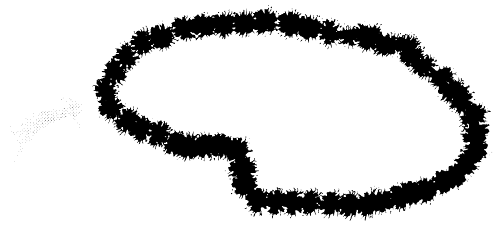
Irregularly shaped clearcuts can be, if not designed properly, extremely difficult and hazardous for broadcast burning operations. Since burning is the usual followup method of residue treatment, harvest unit boundaries must be designed to be tenable during burning.

Unit Design and Layout

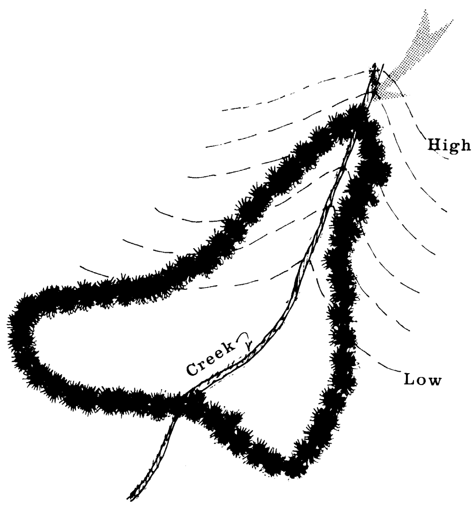
Long narrow fingers, as indicated by the arrows in this example, are extremely difficult to broadcast burn and keep within the prescribed boundary.



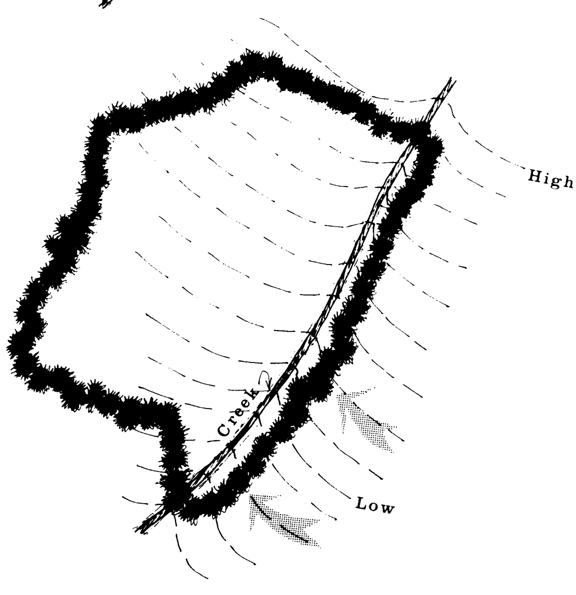
This unit is still difficult, but acceptable for burning. The finger on the left side (arrow) is broad and shallow enough that burn control can be maintained.

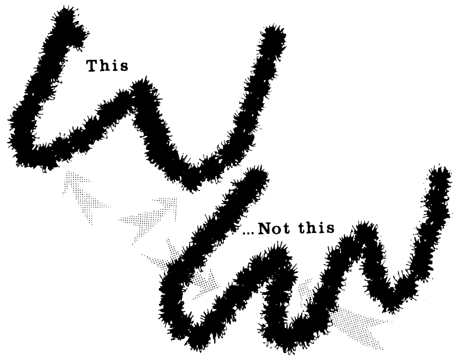


If at all possible, the upper corners of units should never terminate as fingers in steep draws or ravines. Fuel buildups tend to be greater in those locations. The draw tends to act as a chimney during burning, and may carry convective heat and flame across control lines.

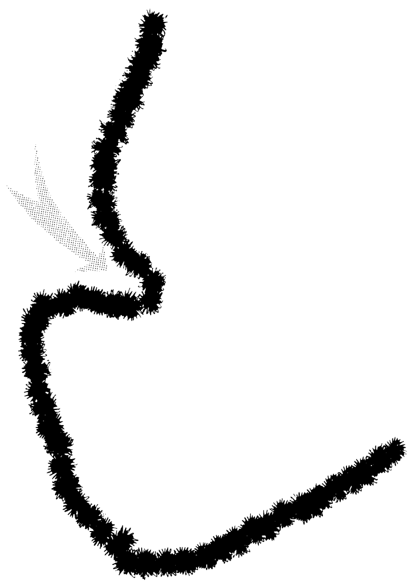


Also avoid designing a unit with a sharp ravine along one edge. Fuels are usually more heavily concentrated in these locations, and perimeter burn control is considerably more difficult.

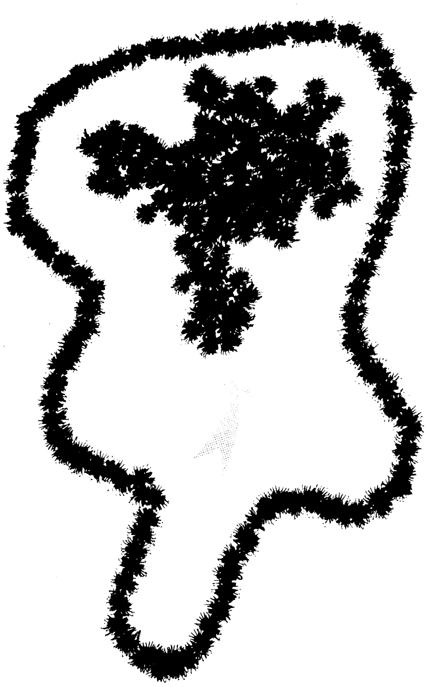




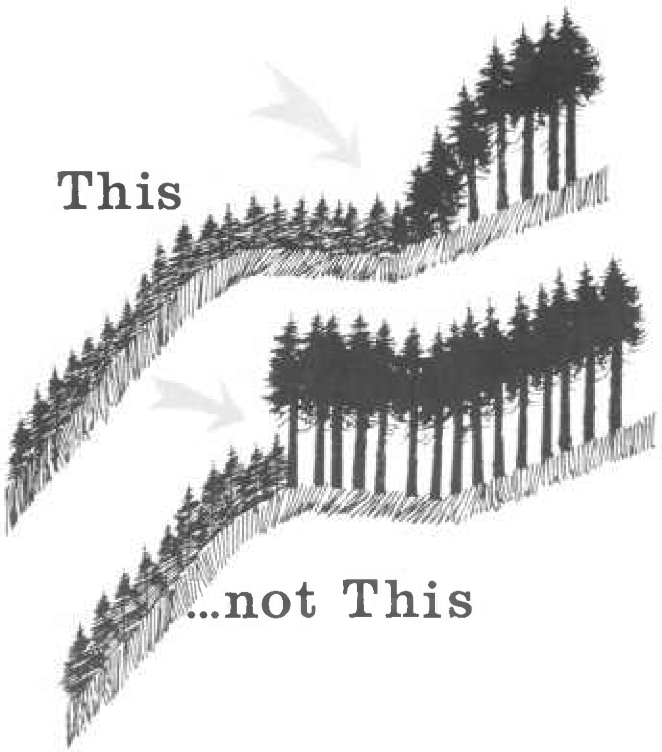
When designing a unit with fingers extending downhill, avoid narrow gaps. Heat from burning in these confined areas may scorch or kill adjacent timber. Wide fingers can be handled more easily in the burning operation. The same principle applies to the location of fingers in any direction. Maintain sufficient width in design to avoid narrow confinements, where heat from burning is intensified.



Sharp "dog legs," as shown in this illustration, should be avoided wherever possible. A unit with this feature is extremely difficult to burn and may require costly fuel modification. Moderate or undulating curvatures in unit boundaries are more practical and can be handled by a skilled crew, under properly prescribed burning conditions.



Where uncut islands of trees are left within clearcuts to break up the form, perimeter burning difficulty is increased. Such situations may require special fuel modifications or special treatment measures during burning. Avoid locating these "islands" at the head of sharp ravines or on extremely steep side slopes, where convective heat from burning will be intensified.



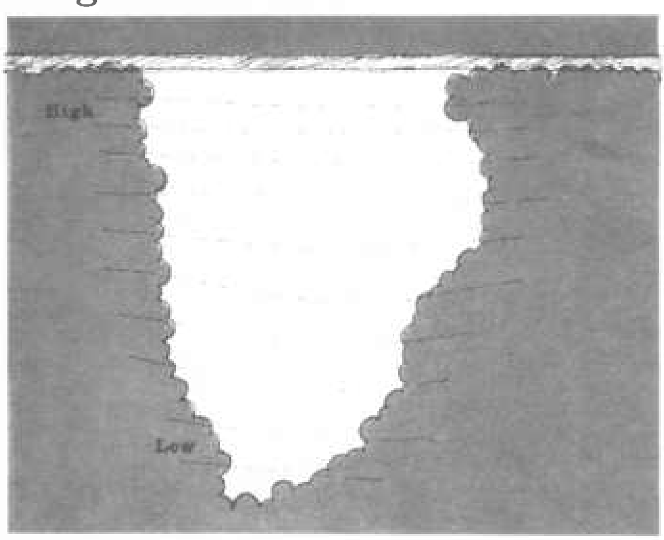
The top, or upslope, perimeter of a cutting unit should, wherever possible, be carefully located to assure maximum control and safety during perimeter firing. Most slopes have undulations or slight benches when examined in detail. If possible, upslope boundaries should be located where there is a break in the slope, and where tree density is less.

The top illustration here shows a good location for an upslope boundary. The bottom sketch illustrates a location where convective heat from burning is more likely to scorch or kill perimeter trees and may increase chances of fire escape.

Where boundaries of clearcuts are located just over a break in slope or where fuel density is less, retention of the desired visual screen is made much easier.

Feathered or partial cut edges must either have the residue material pulled out of them into the clearcut for burning, or be "underburned" within the partial cut prior to burning the clearcut.

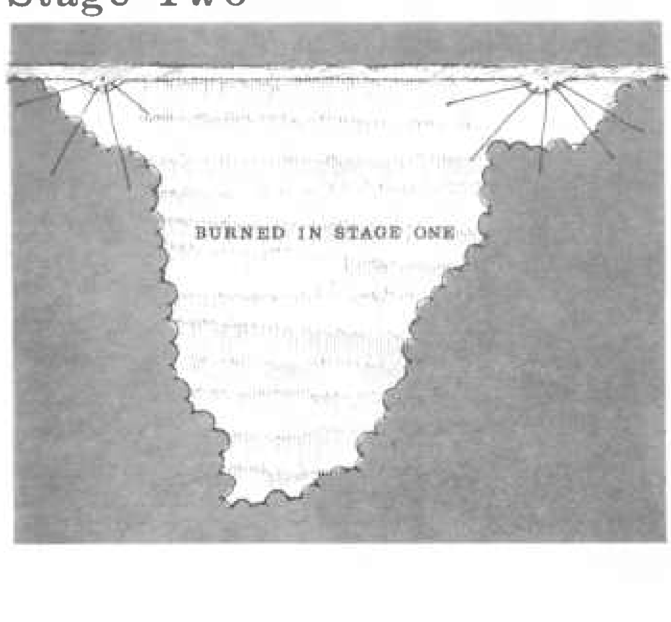
Stage One



Stage Cutting Clearcuts to Facilitate Logging and Burning

Shown at the left is an example in which a clearcut unit was cut in two stages to facilitate both logging economics and burning. The initial cutting, which harvested the majority of the unit, was done by an economical logging system. Its sides were left straight to the ridgetop to facilitate easier broadcast burning. A minor amount of cutting (upper corners) was done in the second stage, to give the unit its irregular shape and natural appearing edge effect. Debris was either "yummed" or hand piled and burned, or left undisturbed, accepting some risk in the small areas.

Stage Two



Appendix

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