

VISUAL ANALYSIS:  
AN EMPIRICAL EVALUATION OF DESIGN GUIDELINES  
FOR DOWNHILL SKI TRAILS AND MOUNTAIN SUPPORT FACILITIES

by

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## INTRODUCTION

Forest landscapes in mountain regions occupy a prominent position in both basic and applied research within the field of visual resource management. Downhill ski trails and mountain support facilities produce significant visual impacts in these settings. This thesis is concerned with the investigation of visual guidelines for the design of downhill (alpine) ski trails and mountain support facilities including roads, mid-mountain restaurants, and lift structures. The case study for this investigation is the Beaver Creek Ski Resort at Avon, Colorado.

Chapter One of this thesis outlines the philosophical and psycho-physical context, historical background, and land management context of this research topic. Chapter Two outlines related scientific research, and presents a detailed description of the methodology employed in this study. The purpose of this study is to produce an empirical evaluation of the following guidelines.

1. Minimize the visibility of lift lines.
2. Minimize the visibility of mountain maintenance roads.
3. Stabilize and revegetate disturbed slopes.
4. Avoid skyline corridors in trail layout and avoid placement of buildings or other structures at the skyline.
5. Create irregular/curvilinear shapes and edges in individual trail design and group configuration.
6. Include islands of vegetation in the design of individual trails.

Chapter Three presents analysis of the results of this study, with conclusions and recommendations for further research.

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## CHAPTER 1

### VISUAL RESOURCE MANAGEMENT

Protection of the aesthetic resource in natural landscapes began in this country on a wide scale with the designation of the first national parks early in this century. There developed at that time a broad consensus among the general public that natural landscapes were a valuable national resource worth preserving (Nash, 1973). Since that time, the creation of state parks, national parks, and national forests has protected much of the natural beauty which was threatened by westward expansion and development.

In the past fifteen years a dramatic increase in public concern for environmental issues has brought about a generally more enlightened and sophisticated approach to the management of both public and private lands. One product of this movement has been the formal recognition of the visual resource as an important element deserving the same careful consideration given to the other natural resources in land planning and management. Although the philosophy of visual resource management is not new, there is now a new focus on the articulation of this philosophy and the process of achieving its goals in a systematic and coordinated manner (Our National Landscape, 1973).

#### Legislation and Public Land Management

In 1969 the application of visual resource management to public lands received a formal legislative mandate in the National Environmental Policy Act. This act refers specifically to the aesthetic resource and the need for its identification and consideration in public land management. There followed a series of legislative acts which promoted the implementation of visual resource

management at the Federal level (Palmer, 1981). In response to this legislation, the United States Forest Service and the Bureau of Land Management have developed specific procedures for identification, monitoring, and management of visual resources (USDI/BLM, 1980) and (USDA/USFS, 1974). Although these agencies have each taken slightly different approaches to deal with a wide range of issues in visual resource management, they have developed procedures which conform to the basic process described in this chapter.

### Natural Visual Character

Every physiographic region has a distinctive natural visual character which may be defined as the expression of natural form, line, color, and texture in a variety of patterns which combine to produce interwoven images of rock formations, water forms, vegetation, and landforms in three dimensions (Litton, 1968). Even in natural areas of great visual complexity, these images conform in some degree to characteristic patterns produced by geomorphological processes acting on geologic formations, with associated plant communities responding predictably to local climatic and micro-climatic influences. Within the scope of geologic time this character is quite dynamic; however, within the human time-frame it is stable and often well defined on many levels from regional to local scale.

Human activities usually have an impact on the natural visual character of the land. In some cases this impact is positive, but without planning the impact is often unnecessarily negative. Because natural visual character is a valuable resource, it is worthwhile to take reasonable and appropriate measures to protect that resource. In areas of exceptional natural beauty protection of visual character may call for preservation in a pristine state, allowing for only natural ecological transitions. More often, protection of natural visual



character allows modification in a manner that is visually compatible and harmonious with the native character of the land. This thesis is concerned with the evaluation of one recent effort to achieve visual compatibility and harmony in the design of downhill ski trails and mountain support facilities.

#### Visual Resource Management in Land Planning and Management

Figure 1 illustrates the role of visual resource management within the framework of a comprehensive land management process. Visual harmony is achieved through analysis of both the existing visual character of the landscape and the potential visual character of proposed modifications. The site evaluation and visual design criteria that result are incorporated into the overall design process which must accommodate and establish priorities for all relevant ecological constraints and functional program requirements to produce a design which represents the best possible alternative.

Visual Resource Analysis. Figure 2 indicates a basic structure for visual resource analysis. The application of visual resource management in land-use planning begins with inventory and mapping of the existing resource. Visual character can be determined from aerial photos and topographic maps. More detailed information may be obtained through ground observation and photographic analysis. Analysis and synthesis of this material is expressed in a classification system which incorporates description with an evaluation of relative levels of variety, visual vulnerability, and visual appeal within a regional context. Areas possessing unusual or unique visual qualities are also recognized in this classification. Maps are prepared showing individual units of classification on a topographic base, and these may include the delineation of view-sheds and distance zones from roads, overlooks, recreation facilities, and other critical points of observation. This pool of information can be used to

## Inventory and Assessment

- NATURAL RESOURCES
- WILDLIFE
  - SOILS & MINERALS
  - WATER
  - VEGETATION
  - VISUAL RESOURCE
  - ETC.

- POTENTIAL LAND USE
- AGRICULTURE
  - INDUSTRY
  - COMMERCIAL
  - RESIDENTIAL
  - RECREATION
  - ETC.

## Planning and Monitoring

- EXISTING IMPACTS
- WILDLIFE
  - SOILS
  - WATER
  - VEGETATION
  - VISUALS
  - ETC.

- LAND USE PLANNING
- WILDLIFE
  - WATER
  - SOILS
  - VISUAL MANAGEMENT
  - AGRICULTURE
  - INDUSTRY
  - RECREATION
  - ETC.

- EXISTING DEMANDS and CONSTRAINTS
- ECONOMIC
  - SOCIAL
  - POLITICAL

## Design and Implementation

- POTENTIAL IMPACT ON NATURAL RESOURCES
- WILDLIFE
  - SOILS
  - VEGETATION
  - WATER
  - VISUALS (SIMULATION)
  - ETC.

LAND USE PLAN

SITE SELECTION → SITE Design

PROPOSED DEVELOPMENT

- DESIGN PROCESS
- FUNCTIONAL REQUIREMENTS
  - SITE CONSTRAINTS
  - BUDGET CONSTRAINTS
  - EXISTING TECHNOLOGY
  - FUNCTIONAL DESIGN CRITERIA
  - VISUAL DESIGN CRITERIA
  - ETC.

CONSTRUCTION

Completed Projects

Impact Assessment

## Land Management

figure 1

Inventory →

LANDFORM  
 ROCKFORM  
 WATERFORM  
 VEGETATION  
 WILDLIFE  
 SEASONAL  
 and  
 EPHEMERAL  
 CHANGES  
 CULTURAL  
 MODIFICATIONS

Classification →

- REGIONAL CHARACTER TYPE
- SUBTYPE
- VARIETY LEVEL
- DOMINANCE ELEMENTS
- UNIQUE OR UNUSUAL FEATURES

Analysis and Assessment →

- ACCEPTED STANDARDS OF VISUAL QUALITY/APPEAL (from preference studies)
- VISUAL VULNERABILITY RATINGS and VISUAL ABSORPTION CAPABILITY  
 from: visual impact assessment  
 landscape architecture theory  
 aesthetic theory  
 dominance elements  
 variety levels

DISTANCE ZONES

- FOREGROUND
- MIDDLEGROUND
- BACKGROUND

VIEWER SENSITIVITY

- VIEWER NUMBERS  
 EXPECTATIONS  
 VALUES
- VIEWING LOCATION  
 ANGLE  
 DURATION  
 FREQUENCY

Visual Management Objectives

- RETENTION
- PARTIAL RETENTION
- MODIFICATION
- MAXIMUM MODIFICATION

Visual Resource Analysis

figure 2

produce performance standards or management objectives for potential visual impacts. These standards are usually based on relative visual appeal, distance zones, and viewer sensitivity ratings (USDA/USFS, 1974).

Visual Resource Management: Planning and Design. Figure 3 describes the planning and design process of Visual Resource Management. The information base described above is designed for use by land managers. With this information, potential visual impact of a proposed modification or development can be accurately predicted for any given location, and the relative merits of various site alternatives may be evaluated from the visual standpoint (USDI/BLM, 1980).

This information base may also be used to generate visual design criteria for specific projects in a given locality. The process involves the incorporation of natural lines, forms, colors, and textures in the design of the proposed modification. These natural elements should be drawn from common visual features present in the immediate vicinity of the project site (Wohlwill, 1979).

The success of the visual management program is determined through assessment of visual impacts. This process is initiated upon completion of site selection, but prior to construction. At this time, thorough photo-documentation of preconstruction visual conditions are made from several vantage points. This documentation is in the form of panoramas or photo-mosaics consisting of overlapping photographic frames taken from critical viewpoints (landscape control points) within and without the proposed development (Litton, 1973). The photographs taken during and following construction may then be compared to the preconstruction conditions for analysis and assessment of the net visual impact. This process permits careful evaluation and produces useful information about visual compatibility and visual vulnerability which can be applied to future projects.



## NATURAL VISUAL RESOURCE: INDIVIDUAL AND COLLECTIVE VALUES

The enactment of national legislation that calls for inventory, management, and protection of the visual resource obviously pre-supposes that some significant value accrues to that resource. Prior to the 1960's, management of the natural visual resource usually did not involve careful discrimination between visual appeal, per se, and the other practical utilities that natural landscapes provide (particularly in the case of recreational values). Clearly such a distinction is artificial and useful only in the limited sense that abstraction and isolation of the dynamics of visual aesthetics in the landscape permits investigation in greater depth. This presumably leads to greater understanding.

Individuals engaged in normal working and leisure activities rarely respond to their visual environment with the same sort of conscious recognition of abstract visual appeal that might be exercised in an art gallery (Meinig, 1976) and (Tuan, 1961). It might even be argued that sightseers and tourists actually spend very little time doing this exclusively. One of the reasons that visual appeal in the landscape is difficult to define clearly or approach objectively is that the phenomenon of visual appeal in human perception is tightly bound to rational interpretation of the visual environment for the purpose of discovering practical, functional attributes (Hodgson and Thayer, 1980) and (Ewing and Kulka, 1979). The complexity of this relationship makes it extraordinarily difficult to isolate the phenomenon of visual appeal for investigation. Although intangible and elusive, visual appeal is undeniably real and plays an important role in maintaining human well-being. In fact, for many individuals the perception of natural landscapes is an important source of contemplative fulfillment and spiritual inspiration. Figure 4 provides a rough conceptual model of human visual perception as it relates to landscapes.

POTENTIAL VISUAL ARRAY AS DETERMINED BY EXISTING PHYSICAL FEATURES OF THE LANDSCAPE, GIVEN A PARTICULAR SET OF SEASONAL, EPHEMERAL, AND OBSERVATION FACTORS.

POTENTIAL VISUAL ARRAY AS DETERMINED BY NEUROLOGICAL STRUCTURE IN HUMAN VISION.

CONCIOUS DIRECTION OF EYE MOVEMENT  
CONCIOUS DIRECTION OF SPATIAL LOCATION

- FORM/SHAPE
- LINE
- COLOR/VALUE
- TEXTURE

---

- CONTRAST
- SEQUENCE
- AXIS
- CONVERGENCE
- DOMINANCE
- ENFRAMEMENT
- SCALE
- BALANCE
- PROPORTION
- ISOLATION
- RYTHM
- EMPHASIS
- UNITY
- VARIETY

COMPOSITE MENTAL IMAGE OF LANDSCAPE BUILT UP OVER TIME

ACTUAL ARRAY

RATIONAL/PURPOSEFUL INTERPRETATION

INTUITIVE/EMOTIONAL INTERPRETATION

### Individual Factors:

- KNOWLEDGE ABOUT THE SCENE
- CURRENT POOL OF INFORMATION
- PREVIOUS EXPOSURE/FAMILIARITY
- CURRENT EXPECTATIONS
- IMMEDIATE PURPOSE & OBJECTIVES
- WORK
- LEISURE
- RECREATION
- TRAVEL
- SURVIVAL
- PRESERVATION
- VALUES: ECONOMIC, ENVIRONMENTAL
- PERSONAL, CULTURAL
- ACQUIRED TASTES
- DOMINANT VISUAL ENVIRONMENTS IN THE PAST
- VISUAL EXPLORATION HABITS
- EMOTIONAL ASSOCIATIONS FROM PAST EXPERIENCE
- INNATE PREFERENCE FOR PARTICULAR VISUAL CHARACTERISTICS, PATTERNS AND RELATIONSHIPS

INTERPRETATION & INTEGRATION

SATISFACTION OF PRACTICAL GOALS

### Visual Appeal

- COMPLEXITY
- IDENTIFIABILITY
- UTILITY
- COHERENCE
- HARMONY
- MYSTERY
- VIVIDNESS
- UNITY/VARIETY

SATISFACTION OF EMOTIONAL NEEDS

RESPONSE

## Visual Perception

figure 4

Ultimately, the aesthetic value of natural visual resources rests in pleasurable response and emotional satisfaction among individuals (Murtha and Greco, 1975). One of this century's most enthusiastic admirers of natural beauty was John Muir, a man who spent his lifetime pursuing natural beauty and fighting for its preservation. In Our National Parks Muir writes "that wilderness is a necessity; and that mountain parks and reservations are useful not only as fountains of timber and irrigation rivers, but as fountains of life." He goes on to describe this fountain of life in personal terms:

. . . sauntering in rosiy pinewoods or in gentian meadows, brushing through chaparral, bending down and parting sweet, flowery sprays; tracing rivers to their sources, getting in touch with the nerves of Mother Earth; jumping from rock to rock, feeling the life of them, learning the songs of them, panting in whole-souled exercise, and rejoicing in deep, long drawn breaths of pure wildness. This is natural and full of promise.

Our National Parks, p. 1-2

Muir's taste in natural beauty was dominated by a strong attraction to pristine wilderness, especially the power and grandeur of the rugged mountain landscapes of the western United States. In contrast, another well known champion of natural beauty, Henry David Thoreau, found a similar sort of fulfillment within the environs of Walden Pond, which were perhaps rather common and certainly less wild and dramatic than Yosemite (Nash, 1973). This points up the fact that natural beauty need not be either spectacular, wild, or unique to be valued by individuals. Another case in point is the love expressed by Aldo Leopold for the sand country of Wisconsin in his book, A Sand County Almanac.

The popular and professional recognition that Muir, Thoreau, and Leopold have received is a firm indication that there exists among the general public a broad base of common values and shared experience which confirms the personal values expressed in their writings. In an address to the 1965 White House



Conference on Natural Beauty, President Johnson acknowledged the validity and importance of these collective values and issued a call for action to preserve natural visual resources:

The beauty of our land is a natural resource. Its preservation is linked to the inner prosperity of the human spirit.

The tradition of our past is equal to today's threat to that beauty. Our stewardship will be judged by the foresight with which we carry out these programs.

(President Lyndon Johnson, Proceedings of the White House Conference on Natural Beauty, 1965, p. 15).

#### LANDSCAPE VISUAL AESTHETICS: DESCRIPTION AND ANALYSIS

##### Intuitive Description

The quotation by Muir, above, refers specifically to a typical mountain setting, although the spirit of the passage would apply to many settings. As already noted, Muir loved the mountain landscapes of the West, and he wrote a great deal about them. His primary purpose in this endeavor was to describe, in turn-of-the-century popular literature, the great beauty of these mountains and the magnificence of their myriad lifeforms. In this way Muir persuaded readers who had never been west of the Mississippi to support the National Parks movement. Prominent figures involved in this effort included Thoreau, Horace Greeley, Samuel Hammond, George Catlin, Frederic Law Olmsted, and others. The preservationist writers were joined by several great landscape painters in providing a vivid image of the West's natural wonders for the American public. The landscape painters included George Catlin, Thomas Cole, Frederic Church, Albert Bierstadt, and others. Thomas Moran, a landscape painter, and William Henry Jackson, a pioneer photographer, portrayed the beauty of Yellowstone in

their work, which later played an important role in the drive to designate this area as the first National Park (Nash, 1973).

The success of poetic, narrative, and pictorial description in conveying to the American public the intrinsic value of the western mountains demonstrates that an intuitive, descriptive approach is a useful and effective means of identifying and understanding natural visual resources. The strength of this approach is that it is easily understood by the general public. Its major limitations are: 1) it is not methodical, 2) it tends to be highly subjective, and 3) it makes no clear distinction between the visual resource and other natural resources.

The visual resource management process, described earlier, requires a means of identifying and understanding natural visual resources that are: 1) accurate, comprehensive, and methodical, 2) as objective as possible, 3) straightforward and flexible enough to be interpreted for the general public, and that 4) clearly distinguishes between the visual resource and other natural resources (Fabos, 1971). These requirements, particularly the need for objectivity and ease of interpretation for the public, are difficult to meet. Figure 5 indicates some of the fundamental relationships that exist within the visual resource in the landscape.

#### Methodical Description and Analysis

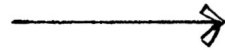
A thorough review of visual resource analysis lies well beyond the scope of this thesis. For this reason the discussion that follows is limited to those aspects of visual resource analysis that relate directly to the case study utilized in this research.

Basic Elements. The most basic elements of the visual resource are shape, form, line, color, and texture. These elements may be described as follows:

## Land Planning, Design and Management

- INVENTORY
- ANALYSIS
- CLASSIFICATION
- MANAGEMENT OBJECTIVES
- MONITORING
- LAND USE PLAN
- PROPOSED MODIFICATIONS
- SITE SELECTION
- VISUAL DESIGN CRITERIA
- IMPACT SIMULATION
- DESIGN
- CONSTRUCTION
- IMPACT ASSESSMENT

## Physical Landscape



- NATURAL VISUAL CHARACTER
- LANDFORM
- ROCKFORM
- WATERFORM
- VEGETATION
- WILDLIFE

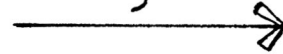
### CULTURAL MODIFICATIONS

- POINT OR CLUSTERED
- POWER PLANTS
- HOMES
- QUARRIES
- AGRICULTURE
- INDUSTRY
- ETC.

### LINEAR

- STRIP DEVELOPMENT
- POWER LINES
- ROADS
- CANALS
- PIPE LINES
- ETC.

## Seasonal and Ephemeral Changes



- LIGHTING
- WEATHER
- SNOW COVER
- FALL COLOR
- WILDLIFE
- LEAF FALL
- ETC.

## Observation Factors



- EXISTING ACCESS
- TRAVEL ROUTES
- MOVEMENT/ LOCATION
- DISTANCE :
- FOREGROUND
- MIDDLEGROUND
- BACKGROUND

### VIEWING

#### POSITION :

- INFERIOR
- NORMAL
- SUPERIOR

#### FIELD OF VIEW

- VIEWING ANGLE
- RATE OF TRAVEL
- VIEW DURATION
- VIEW SEQUENCE

## Potential Visual Array

- PANORAMIC
- FEATURE
- ENCLOSED
- FOCAL
- CANOPIED
- DETAIL
- EPHEMERAL

## Visual Resource

figure 5

Shape is the two-dimensional expression of the mass of an object. If seen in only three dimensions, shape becomes form. Enclosed space may also be said to have a defined shape. In the landscape the perception of shape is often dependent on viewing distance, changing perspective, shading, and backlighting or other types of silhouette contrast.

Line is created at the intersection of two planes or with the extension of a point. Line occurs in the landscape wherever there is a well-defined repetition in a row or continuation in sequence of a distinct visual element. The expression of line may range from sinuous to jagged or angular to straight.

Color is the transmission or surface reflection of different wavelengths of light. Color has three dimensions: hue, value, and intensity. Hue refers to the particular wavelengths (e.g., red, yellow, blue), value refers to the actual level or intensity of light reflected (e.g., light, medium, dark). Intensity refers to the strength of the hue. In the landscape distant colors are usually muted by a bluish haze in the air, while foreground colors often provide a vivid expression of form and surface detail in plants and rocks. Color is the most variable visual element because it is subject to radical seasonal and ephemeral transformations.

Texture is a surface characteristic that is expressed through value contrast in pattern detail. Texture ranges from fine to coarse, and apparent texture or texture dominance is dependent on viewing distance and lighting.

The dynamic interaction of these basic elements is governed by a number of principles which include contrast, sequence, axis, convergence, dominance/co-dominance, enframement, scale, proportion, balance, rhythm, emphasis, form isolation, and surface variance. R. Burton Litton examines most of these principles and other important factors in landscape perception in "Forest Landscape Description and Inventories," USDA/USFS Research Paper PSW-49,

1968, and "Aesthetic Dimensions of the Landscape" in Natural Environments, Krutilla ed., 1972, John Hopkins University Press. Another excellent source of information on this subject is USDA/USFS Agriculture Handbook Number 434, "National Forest Landscape Management, Volume 1," 1973.

Contrast. Among the principles listed above, the most fundamental is contrast. Obviously all visual discrimination operates on the basis of some form of contrast, and useful distinctions between types of contrast can be made. Appropriate contrasts of line, form, color, and texture have a positive visual impact in the landscape because they conform to the unifying theme of an area's natural visual character. In this case, contrast is a source of desirable variety which adds visual interest. On the other hand, inappropriate contrast can have a disruptive, negative visual impact because it violates the dominant unifying theme in the landscape (Wohlwill, 1979). Any given modification, when considered in isolation, contains a certain level of internal line, form, color, and texture contrasts which may either contribute to or detract from the inherent visual appeal of the modification. This internal contrast, when placed within the visual context of a natural setting, may be judged appropriate or inappropriate depending on the landscape's natural visual character. It follows that the visual appeal of the modification in a particular setting is largely a function of its effective contrast which is positive, neutral, or negative in net visual impact, depending on the "appropriateness" of its internal visual content within the natural setting. Simply stated, if the appearance of a modification deviates from the natural visual character of the setting, inappropriate contrast will result, and the net visual impact will be negative (Feimer, et. al, 1981). However, one important exception to this general rule should be noted: In special cases (for example, the bridges of Maillart in Landscape Architecture, Simonds, 1961) visual contrast that does not conform to the dominant unifying

theme of the landscape may enhance the positive visual qualities of both the modification and the landscape. This effect is usually very dramatic and difficult to achieve. It requires that the modification powerfully expresses the internal integrity of its own form in the manner of great sculpture. "The purposeful creation of sharp contrasts in the natural environment can be beneficial at times. The introduced object, however, must be so well conceived that it can withstand or even thrive on the close scrutiny that its prominence will invite" (p. 31, National Forest Landscape Management, Volume 1, USDA/USFS). This kind of contrast does not represent a feasible or realistic design objective for the great majority of projects normally associated with landscape development.

Edge. Contrasting surface qualities of color, value, and texture create edge definition. For example, the transition from a forested hillside to an open meadow describes a line or edge which is created by the contrast between the coarse-textured dark greens of trees and branches and the fine-texture light greens of meadow grass. Edges are frequently the focus of attention and visual scrutiny.

Form. Edges and surface shading in turn help to define the form of the land, rocks, water, and vegetation. The expression of this shape or form is dependent on viewer position and lighting. An observer moving through a landscape builds a three-dimensional mental image which becomes increasingly accurate as a model of the actual landscape with the addition of visual information from each new perspective.

Unity, Variety, and Natural Visual Character. Images of landforms, rockforms, waterforms, and vegetation make up the natural visual character of an area. This natural visual character is a composite which is built upon a "vocabulary" of characteristic patterns which are the visual expression of

natural systems interacting with the land. Within a given region of locality the "visual vocabulary" consists of a limited number of characteristic native patterns. Just as language exists as the arrangement and rearrangement of a limited vocabulary according to a system of rules, so natural visual character exists as the arrangement and rearrangement of a limited number of characteristic visual patterns (Litton 1968 and Litton 1972). The system that governs this arrangement is the climate, local geology, and native ecology of an area. In this sense, natural visual character is the visual manifestation of natural ecological processes linked to the land. This brings the discussion back to critical principles that operate in visual appeal: unity and variety.

Marjorie Bevin describes the principle of unity and variety as follows:

A composition devoid of any unifying element will nearly always seem haphazard and chaotic. A composition that is totally unified, without relief of variety, will nearly always be boring. These two overriding principles of design, unity and variety, are like two sides of the same coin. Unity represents the control of variety, whereas variety provides visual interest within unity.

pg. 102, Design Through Discovery

It is beyond the scope of this work to embark upon a philosophical examination of mankind's place in nature; nevertheless a few brief observations on this relationship are in order. There are two basic forces that operate in the landscape as a source of visual unity and variety: man and nature. Both natural landscapes and urban landscapes, or cityscapes, can hold great visual appeal because both display a dominant source of unity and variety in design. This means that in the city, as a general rule, natural elements are composed to complement and provide variety within an urban setting. An example would be a tree-lined avenue: the trees follow the street and the integration of natural and built elements can be quite appealing. In this case, where natural features

are subordinate to built form, the trees provide desirable visual variety and interest. The reverse of this situation also holds true; however, there is a fundamental difference. It is a relatively simple matter to plant trees along a road in a way that enhances the visual character of the road. It is more difficult to locate and construct a road within a forest in a way that respects, much less enhances, the natural visual character of the forest (Hendrix and Fabos, 1975).

Visual Compatibility. As a general rule the potential negative visual impact of any proposed modification to the natural landscape may be minimized or eliminated in the design through avoidance of inappropriate forms of contrast and the incorporation of natural lines, forms, colors, and textures commonly found in the immediate vicinity of the project site. This procedure, in effect, constitutes a limited application of the principles of camouflage. This is not to suggest that all development should simply disappear into the landscape (Wohlwill, 1979).

Variety and Visual Vulnerability. Aesthetic theory and research in psychometrics indicate that both very low levels and very high levels of visual contrast or variety can be undesirable in the landscape, and that some intermediate level of appropriate contrast is optimum (Wohlwill, 1968) and (Berlyne, 1960 and 1967). It follows then that landscapes that have few contrasts of natural line, form, color, and texture would benefit from the addition of appropriate contrast through development activities that offer added interest and variety. In landscapes that naturally possess an optimum level of appropriate contrast it may be hypothesized that the addition of effective contrast through modification would have a negative visual impact. It may also be assumed that landscapes high in natural contrasts can absorb a given level of potential contrast with relatively little net visual impact as compared to the



impact, positive or negative, produced by the same modification in a low-contrast landscape. This is known as visual absorption capability or visual vulnerability, and it is primarily a function of the level of variety or contrast present in the landscape, the topographic relief, the vegetation height, and the viewing angle. Seasonal factors such as fall coloring and snow cover can also have a significant influence on a landscape's visual absorption capability (Litton, 1974).

In "Visual Vulnerability of Forest Landscapes," Litton (1974) observes that landscapes dominated by convergent and focalizing lines, or enclosed landscapes, tend to be more vulnerable. He also notes that complex surface patterns of landform, rockform, and mixed vegetation mosaics tend to obscure modifications. Whereas an expanse of uniform vegetation with a smooth, even texture is highly vulnerable to impacts. Skylines, ridgelines, waterline edges, and junctions between dissimilar woody vegetation are identified as vulnerable zones, as are areas where light-colored, disturbed soil will stand out against darker vegetation. Litton goes on to note that, in general, impacts at higher locations and on steeper slopes are highly visible as compared to low rolling or flat locations.

Visual Design Criteria. When unplanned development takes place in predominantly natural landscapes, the result is most often visually chaotic. In situations where development is proposed and the integrity of natural visual character is to be preserved as a unifying element in the landscape, visual criteria can be generated to guide the design and assure an acceptable visual impact. The case study in this thesis presents an evaluation of the performance of specific visual criteria that have been applied to the design of ski trails and mountain support facilities at Beaver Creek, a major Colorado resort.

## DOWNHILL SKIING: POTENTIAL VISUAL IMPACTS

The growth of the ski industry in the past twenty years has brought significant changes to many landscapes throughout the mountain states (Lindsay and Mittmann, 1979). Development within a major resort may be divided into three general categories: mountain, base, and associated development. The base and associated development consist of roads, parking, ticket and lift loading areas, restaurants, bars, retail shops, lodging and residential development, and recreation facilities such as tennis courts and golf courses. The mountain development usually consists of ski trails, lifts, mid-mountain restaurant, and mountain maintenance roads. Each of the features of mountain development may be considered on an individual basis in terms of potential visual impact. As already noted, the actual or effective visual impact of these modifications depends in large part upon the setting. Nevertheless, it is useful at this point to draw a generalized picture of their potential visual impact.

### Trails

The trails present the greatest potential net impact as well as the most variable and complex impact. The width of the trails and the trail spacing or density on the mountain may vary considerably. The trails may never stray very far from the fall line (perpendicular to the contour), however, some trails cut a very clean, straight path down the mountain while others may be seen to meander slightly, producing a cascading or sinuous appearance. Trails cut through solid stands of aspen or conifers stand out more than trails cut through scattered trees or natural openings. Some trails are completely cleared of trees while others incorporate islands of trees which take a wide range of shapes and sizes. Where the trails meet ridgelines or crests, they may create notches or corridors

on the skyline from some perspectives. In summer and fall ski trails that have not been properly revegetated will display exposed soil at points of erosion, creating contrasts of value, color, and texture.

### Lifts

Lift structures vary in style, size, height, and color, but are always erected in straight lines perpendicular to the contour. The area beneath the lifts must be cleared of most woody vegetation. The clearings for the lift lines may be integrated into the ski trails or natural openings or they may take a completely separate, straight path up the mountain. Lift line clearings, like ski trails, stand out in solid stands of trees and may also create notches at the skyline given the right point of view.

The complex of ski trails and lift lines can potentially introduce a wide range of form/shape, line, value, texture, and scale contrasts. The net impact of these contrasts is in part a function of several landscape and seasonal factors relating to visual vulnerability as noted earlier. Primary among these are viewing angle, steepness of slope, snow cover contrasts, fall coloring patterns, and color, value, and texture variety in vegetation patterns. Another important factor is rolling, dissected, or folded topography which interrupts and partially conceals ski trails behind minor ridgelines.

### Roads and Restaurants

Mountain maintenance roads provide access to mountain facilities and may introduce line and value contrasts. The visual impact depends on siting, alignment, and extent of cut and fill slopes. Mid-mountain restaurants may introduce color and value contrasts or present a prominent profile at ridgelines or skylines.

Appendix A contains selected ground photographs which display examples of these impacts. A good source of aerial perspective photographs and planning information is Planning Considerations for Winter Sports Resort Development, USDA/USFS and National Ski Areas Association, 1973.

#### UNITED STATES FOREST SERVICE AND DOWNHILL SKIING

The United States Forest Service manages large tracts of land in the mountain states and is charged by Congress to provide for multiple use of these lands through a program of utilization and conservation of natural resources. The uses encompass a broad range of activities including timber harvest, cattle and sheep grazing, transportation, and active recreation. Recent population growth in Colorado has contributed to an increase in demand for recreation in that state. Downhill skiing is an important part of that demand and an important part of the regional economy. The Forest Service has granted permits for downhill skiing facilities within the National Forest in response to this demand.

#### Beaver Creek Case Study

In 1976 construction began on Beaver Creek, a major ski resort on Interstate 70 at Avon, a few miles west of Vail Colorado. When the Forest Service issued a permit for the construction of ski trails and mountain support facilities at Beaver Creek, the development became the subject of the first intensive field investigation of the application of the Forest Service Visual Management System to winter sports and major resort development. The mountain development at Beaver Creek is also the case study selected for this thesis.

### USFS Visual Management System at Beaver Creek

The visual analysis that was performed at Beaver Creek, through a cooperative research agreement between the U.S. Forest Service and Texas Tech University, was extensive and thorough, including post-construction assessment (Mittmann, Mertes, and Musiak, 1983). The analysis included complete photo-documentation from several landscape control points, part of which provided the basis for the visual materials used in this study. Figure 6 shows a photograph taken from landscape control point #1 looking south from I-70 up into the valley that the resort now occupies (Figure 7).

### Natural Visual Character at Beaver Creek

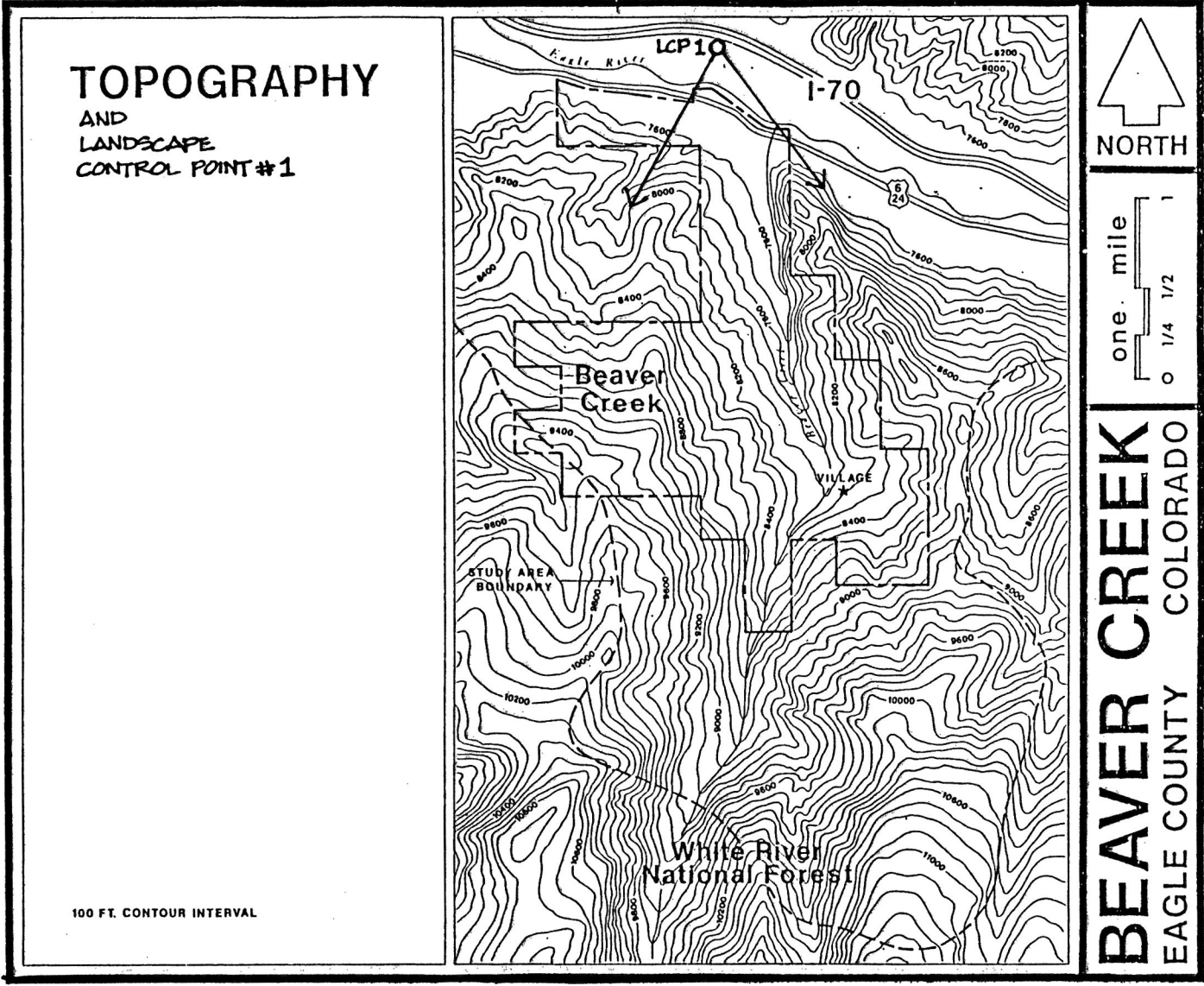
This view from I-70 can be categorized as a focal landscape by virtue of the convergent ridgelines and as a feature landscape due to the dominance of the major rock outcroppings at left. The valley floor holds the Beaver Creek drainage at the foot of the eastern ridge and an open meadow which runs into scrub vegetation on the hillside at far right. The major vegetation pattern is a curvilinear mosaic of aspen and conifers. This pattern is most pronounced in the fall when the bright yellow aspen contrast sharply against the dark green conifers. The vegetation mosaic is also evident winter through summer as the dark green conifers provide moderate color and value contrast against either medium grey or medium green stands of aspen. The meadow grasses and rock outcroppings provide the lightest colors and values on the ground, excluding snow. The rock outcroppings, when partially shaded, display pronounced value contrasts.

The scene lies mostly within the middleground (1/3 mile to 3 miles) with the relatively flat valley floor providing strong edge contrasts in horizontal lines where the grass runs into trees. These lines slope up gently to the



Figure 6. L.C.P. #1, wide angle

FIGURE 7



rolling topography and sweeping archs of the western hillside. The mountain centered between convergent ridgelines is similar in character to the western hillside with the exception of a bald spot at the top which may hold snow well into the summer. Directly below this area lies the wide V-shaped valley of the upper reaches of Beaver Creek. The eastern ridgeline rises abruptly from the valley floor and displays jagged rock outcroppings above steep, sparsely vegetated slopes.

Aside from the open meadow and a large park concealed high on the western hillside, there are only small, scattered openings in the tree cover. The main source of texture or pattern variety on the mountain at center and the western hillside at right is the forest vegetation pattern. This pattern consists of scattered islands of contrasting vegetation which are encompassed by irregular, curvilinear edge transitions of aspen/conifer. The texture of this pattern, as seen in the middleground, ranges from medium to coarse. The texture on the eastern ridge also ranges from medium to coarse, but the pattern is distinctly different. The steep slopes of the eastern ridge display a sequence of pronounced straight, line contrasts. These lines are terminated at the top by the rugged rock outcroppings which extend in a broken line across the crest of the ridge, adding coarse-textured value contrasts.

#### Mountain Visual Impact at Beaver Creek

The visual quality of the mountain at Beaver Creek is important in several different respects. The developers want the mountain to look attractive to skiers during the ski season; the resort, however, operates year-round and must appeal to non-skiers as well. A major factor in this appeal is the natural visual character of the mountain setting. Protecting the natural setting and using it as a unifying visual element is a critical part of the overall design



concept for Beaver Creek. The U.S. Forest Service, as a matter of policy, is concerned about the visual impact of all of their management decisions (McGuire, 1970), and the I-70 highway corridor through the mountains of Colorado is an area where visual impacts are a prime consideration. The viewing public includes skiers, year-round recreationists and tourists, and local residents. These groups, though not mutually exclusive, hold a wide range of values and expectations for visual quality, some of which may be conflicting.

The U.S. Forest Service was involved in the mountain design process and worked with the Beaver Creek design team. The goal of this design effort was to produce a safe, high-quality skiing experience without compromising visual quality or disrupting ecological systems. The program requirements and design constraints of a major skiing facility are very complex. For example, the natural ecology must be carefully considered, particularly wind and solar exposures, slope stability, and cleared slope stabilization and revegetation required to prevent erosion and protect water quality in nearby streams. The impact of clearing on forest stands and wildlife habitats must also be considered. Also, there are the many functional requirements that must be met. For example, the snow grooming equipment must be able to cover the slopes easily and efficiently, and a safe distance of unobstructed view must be maintained at critical locations on the slope. There are also speed and pacing considerations as well as coordination of flow characteristics and lift capacity that must be made. Creating an appealing on-slope visual experience is also important, as is providing a variety of skiing terrain for all levels of ability. Clearly, the off-slope visuals are one aspect of a much larger set of objectives and constraints that must be accommodated in the planning and design process.

### General Visual Criteria

The general visual criteria adopted for off-slope, mountain visuals at Beaver Creek may be state as follows (Kirkling, 1982):

- reduce line, color, value, and texture contrasts
- borrow shape from natural openings
- borrow shape from landform configuration
- leave islands of untouched vegetation
- create natural appearing edges
- minimize the visibility of roads and other service structures
- avoid skyline corridors

(Adapted from National Forest Landscape Management, Vol. 2, Chapter 5, Timber, USDA/USFS Agricultural Handbook no. 559)

### Visual Guidelines

These general criteria, in application to mountain design, may be translated into several relatively discrete visual guidelines as follow (Kirkling, 1982):

1. Minimize the visibility of lift lines.
2. Minimize the visibility of mountain maintenance roads.
3. Stabilize and revegetate disturbed slopes.
4. Avoid skyline corridors in trail layout and avoid placement of buildings or other structures at the skyline.
5. Create irregular/curvilinear shapes and edges in individual trail design and group configuration.
6. Include islands of vegetation in the design of individual trails.

Compliance with the guidelines was evaluated in the design process through the use of Perspective Plot computer simulations which provide topographically accurate portrayals of mountain design from any perspective.

## CHAPTER 2

### STUDY OBJECTIVES AND RESEARCH CONTEXT

#### Statement of Purpose

The purpose of this study is to evaluate empirically the visual criteria applied to mountain design at Beaver Creek. Evaluation of visual design criteria serves several useful functions. It provides information about the visual vulnerability of landscapes, which feeds back to the formulation of criteria for visual absorption capability ratings. The information produced also contributes to visual impact assessment and the evaluation of visual management objectives and land use plans. The primary function filled by this research, however, is the testing of assumptions regarding design criteria and visual appeal and the objective evaluation of the performance of specific criteria in application. This information can be used to refine future visual design criteria; ineffective or counter-productive criteria may be revised or eliminated and effective criteria confirmed.

Controlled, empirical study offers an opportunity to obtain a relatively high degree of objectivity through statistical analysis of viewer response drawn under uniform conditions allowing the isolation and control of critical variables. There is also, at this time, a need to develop methodologies with a proven track record of reliability. Research of this kind is essential for establishing a body of factual knowledge which advances both the theoretical credibility and the practical application of visual resource management (Palmer, 1981; Feimer et al., 1981; Zube et al., 1982; Priestley, 1983).

### Strengths and Limitations

In studies of environmental perception the process of creating an experimental structure for control of variables within a uniform format inevitably means that response will be drawn under conditions significantly unlike real life situations. This trade-off between control of variables and realism in study procedure represents at once both the strength and the most serious drawback of controlled, empirical investigation. This approach and its results should be confirmed through field studies and on-site surveys.

### Hypotheses

The visual criteria and special guidelines applied to mountain design at Beaver Creek (p. 28 of this thesis) were formulated from two basic assumptions regarding visual appeal. These assumptions constitute the hypotheses to be tested in this investigation. They may be stated as follows:

1. That among the general public a direct positive correlation exists between naturalistic appearance and off-slope visual appeal in the design of ski trails and mountain support facilities.
2. That mountain design which conforms to these specific guidelines (p. 28) will be perceived by the general public as being more naturalistic in appearance than other designs which do not conform (each guideline could be stated as a sub-hypothesis).

### Research Context

Within the context of visual analysis research this study falls into that group which is focused on understanding the visual harmony and compatibility of cultural modifications in nature settings. Within the framework offered by Priestly (1983) this study falls into the categories of "Landscape Impact

Studies/Landscape Impact Prediction and Assessment" and "Project Evaluation." Within the framework offered by Zube et al. (1982) this study falls into the psychophysical and cognitive paradigms.

#### Related Research

Careful review of research literature failed to produce other studies of visual aesthetics in the design of ski trails and mountain support facilities. Ewing and Kulka (1979) have identified the mean perceived length of slopes and mean perceived level of crowding as important factors determining ski resort attractiveness. This study, however, did not focus on aesthetic visual appeal per se. Schomaker (1978) included three views of ski areas in a study comparing viewer response to photographs and sketches. However, Schomaker did not specifically discuss viewer response to these three scenes.

Related Visual Content. In the area of timber management and visual impact assessment of timber harvest methods, work has been done that relates directly to ski slope visuals (Burke, 1975; Schomaker, 1978; Walters et al., 1979; Nickerson, 1979). This is due to the similarity of the vegetation manipulation and soils manipulation of the two activities and to similar resultant visual impacts in mountain forest landscapes. The United States Forest Service, in National Forest Landscape Management, Vol. 2, Chap. 5, TIMBER, provides analysis of potential visual impacts, particularly in middleground perspectives, and presents guidelines formulated to minimize deviations from natural visual character. The specific guidelines evaluated in this thesis were adapted from visual criteria for timber harvest methods presented in the Forest Service TIMBER volume. Schomaker (1978) investigated preference of the general public for illustrations depicting a variety of timber harvest methods. The illustrations were photographed from the USFS National Forest Landscape Management series, and the

results showed complete agreement between judgments of the general public and the professional judgments presented in these publications.

Daniel and Boster (1976) and Daniel, Wheeler, Boster, and Best (1973) have investigated various timber harvest techniques, employing Signal Detection Theory from psychometrics. This work presents an innovative approach to objective quantification of visual quality which might be adapted to evaluation of ski slope visuals. Unfortunately, the authors have excluded middleground views in their research in favor of foreground photographs of forest stands which have a relatively limited field of view. For reasons to be explained later in this chapter, the case study presented in this thesis is focused on the middleground view; therefore, direct comparison of results may not be made.

Related Hypotheses. Research into visual compatibility and congruity of development in natural settings is limited. Wohlwill (1976, 1978), Wohlwill and Harris (1980), and Wohlwill and Heft (1977) evaluated the visual congruity of a variety of park structures in photographs, and compared a factory to a tourist lodge in natural settings presented as photographs of a model. These studies produced evidence that contrast/obtrusiveness and fittingness/congruity are important determinants of evaluative judgments concerning visual appeal. This work seems to support the general assumption that the incorporation of natural line, form, color, and texture in modifications to natural settings contributes to visual appeal. Wohlwill qualifies this assumption, noting that impressions regarding functional compatibility are likely to influence reported visual appeal. Wohlwill's research also supports the hypothesis that the relationship between visual appeal and contrast/diversity follows an inverted U-shaped curve where some intermediate level of contrast or variety is considered most desirable. Here the distinction between appropriate and inappropriate forms of contrast comes into play, both in terms of aesthetic unity and variety and perceived functional or environmental compatibility.

In an evaluation of a wide variety of land uses, based on pre-impact/post-impact comparisons, Feimer, Sardon and Craik (1981) found that compatibility, congruity, and intactness are significantly correlated with scenic beauty, indicating that changes in character and coherence result in changes in aesthetic quality. In this study naturalness, fittingness, compatibility, and appropriateness were most often mentioned as factors influencing the severity of visual impacts. Zube (1973) has also identified perceived degree of naturalism as an important determinant of scenic values in common rural landscapes of the northeastern United States. A study of scenic resources in the southern Connecticut River Valley conducted by Zube, Pitt, and Anderson (1974) also produced evidence of general preference for more natural landscapes where deviations from natural visual character detract from scenic quality.

A comprehensive listing of related research can be found in Zube et al. (1982, pp. 10-11) under the headings of "Forest" and "Natural/Man-made" research contexts.

Related Research in Landscape Portrayals. Shafer and Richards (1974) compared viewer reactions to a wide variety of outdoor scenes and photographs of those scenes. Results in this study indicate that color photography adequately depicts natural and cultural landscapes if representations include most of the features actually present. Daniel and Boster (1976, p. 51) also found that response to photographs is highly correlated with response to the actual landscape as did Zube et al. (1974, pg. 6).

Schomaker (1978) investigated the correspondence between photographs of actual landscapes and color or black and white sketches prepared from the photographs. The results indicate that color sketches produced reasonably good correspondence, particularly where some type of development dominated the scene. When part of the sketches were evaluated by a panel of experts, they found

problems with unrealistic depth and color and a tendency to overemphasize the features of landscape development. The graphic technique involved was not discussed.

Feimer et al. (1979) investigated the reliability of visual impact assessment methods involving both direct ratings and pre-impact/post-impact comparison, operating with a collection of landscape descriptors. The results indicated: 1) low reliability for small numbers of raters, 2) higher reliability for preimpact ratings, 3) higher reliability for direct ratings than for comparative ratings, and 4) higher reliability for photographic simulations than for sketches. However, Sims (1974) found that detailed line drawings could produce good response equivalence.

Sheppard (1982, 1983) has evaluated a variety of simulation techniques and found that a wide field of view, accuracy, and moderate detail contributes to unbiased response. An engaging quality was also identified as a factor contributing to unbiased response. Sheppard recommends that only important or representative views should be shown and that simulation should be careful and restrained and exhibit a balance of artistic skill and expression.

Palmer (1981) discusses simulation techniques in a more general overview of visual quality and impact assessment methods and concludes "that existing research does tend to support the validity of simulation" (pg. 290). Palmer also looks at other important aspects of this research, such as response formats and respondent selection, providing a good, general source of information and an extensive bibliography. Appleyard (1977) offers analysis of the issues relating to presentation media and simulation techniques, and the Bureau of Land Management publication, Visual Resource Management (1980), provides good examples of some of the more sophisticated simulation techniques.



## STUDY DESIGN

### Study Concept

In order to test the hypotheses (pg. 30), a view of the as-built mountain development at Beaver Creek is selected in which all of the features are judged to be in substantial compliance with the guidelines (pg. 28). The view must also adequately represent the natural visual character of the setting. This view is carefully reproduced as an illustration which, in turn, is reproduced and in the process is manipulated graphically so as to introduce violations of the guidelines. If the guidelines contribute to naturalistic appearance, and if naturalistic appearance is judged by the general public to be visually appealing, then most individuals may be expected to discriminate on these terms between altered designs which display significantly different levels of compliance with the guidelines.

This approach can generate a series of illustrations within which each of the six guidelines may be manipulated independently of each other. This allows the pairing and re-pairing of altered designs for comparisons which present the same variation of visual content within several different visual contexts. For example, a comparison may consist of one design in which the guidelines for lifts and islands are violated, and another design which displays those same violations plus skyline and road guideline violations. In this case the variable content is the violation of skyline and road guidelines, and the fixed context is the violation of lift and island guidelines found in both illustrations. This same variable content (skyline and road violations) might also be presented for comparison within several other fixed contexts (for example, trail configuration and revegetation violations or as built). In this manner it is possible to obtain repeated independent measures of the effectiveness of individual

guidelines within a variety of contexts which avoid absolute redundancy. This is desirable because repeated measures produce more reliable results, particularly when varied contexts serve to sustain the active interest of the respondents resulting in the exercise of genuine discrimination.

#### Response Formats

This study employs two basic procedures or response formats which provide the structure within which different designs are evaluated and judgments are made regarding naturalistic appearance and visual appeal. These procedures are: 1) paired comparison with magnitude estimation and 2) rank ordering with content analysis.

Paired Comparison/Magnitude Estimation. The paired comparison is the opening procedure in this study. The respondents are asked to select between two altered designs, one of which displays greater compliance with the guidelines than the other. This procedure is divided into two phases, one that requires selection on the basis of naturalistic appearance followed by another based on visual appeal. Each set of judgments is followed by a magnitude estimation procedure where the respondents are asked to rate the magnitude of the difference between the members of each pair in the level of naturalistic appearance, or visual appeal, displayed by each.

It is expected that respondents gradually become familiar with the illustrations and start to form some opinions regarding visual appeal while performing the relatively straightforward task of selecting the most naturalistic member of each pair. The magnitude estimation is performed with a set of pairs once the respondent has seen them all and begun to develop a sense of the range of magnitudes involved. The selection for visual appeal which follows, and the magnitude estimation for visual appeal, repeat the same sequence of response

formats used with naturalistic appearance, once familiarity and preference have begun to develop.

In both the naturalistic appearance phase and the visual appeal phase all of the guidelines are tested twice each as the variable content within two different fixed contexts. The respondents are also given the option of indicating that they see "no difference" between the members of any particular pair of illustrations. This serves to establish a threshold level of discrimination for each individual respondent and helps eliminate arbitrary selections or prolonged judgment intervals which might retard the progress of the session and frustrate the respondents. The no-difference option also covers the possibility that although the actual visual content differs, the affective individual response could be the same for both members of a pair (Payne, 1980, pg. 59).

Rank Ordering/Content Analysis. In the rank ordering procedure the respondents are asked to rank a set of four separate illustrations in order of increasing naturalistic appearance or visual appeal. Each set consists of one illustration which depicts the mountain development as built, another illustration which depicts the violation of all six of the guidelines, and two intermediate designs. The rank ordering is a slightly more involved task, therefore, it follows, and benefits from, the experience gained in the simple paired comparison procedure. The rank ordering is also divided into two phases which focus on the judgment dimensions of naturalistic appearance and visual appeal respectively. This provides a reliability check through the comparison of response from two different procedures on the same measures and visual content. In addition, the rank ordering procedure presents an opportunity to test the total compliance of the mountain as built against several different design alternatives.

The final procedure is the content analysis. The respondents are asked to examine the illustration which they selected as having the lowest level of visual appeal in the previous rank ordering procedure. The respondents then indicate on a clear overlay those features which they feel detract from the visual appeal of that particular mountain design. The negative features are simply circled or identified by arrows. A brief written note of explanation is also asked for. This content analysis serves to validate the response drawn from the other procedures by identifying the actual basis of that response in the illustration. It also potentially serves to identify any serious misinterpretation of the illustration and could identify unexpected relationships because it allows for a more open, unstructured response.

Visual Materials: Selection and Composition

Foreground Views. The visual impact of each of the features associated with mountain development is in large part a function of the viewing angle and viewing distance. In general a foreground view of mountain development is most prevalent on-slope. An off-slope foreground view of the mountain from a viewer normal or viewer inferior position is likely to provide only a very limited view of the mountain development. The lift structures, if present, may stand out in the foreground. A separate narrow lift cut will dominate the foreground view if the viewing angle is direct; however, with a shift in perspective to either side, the lift cut may seem to blend into the landscape. Skyline corridors and roads may also stand out or dominate a foreground view, but here again a shift in viewing angle may cause them to disappear into the landscape. In the foreground the appearance of the ski trails is likely to be dominated by vegetation details, the forest/trail edge transition, and soil color contrasts if there are erosion problems. It would be unusual for a foreground perspective to provide a view of

the mountain restaurant or a full view of trail shape and trail network configuration. As a rule foreground visual impact is quite variable with relatively small changes in viewing location resulting in important changes in the viewing angle and consequently the visual impact of the mountain development.

Middleground Views. Because of the general nature of foreground views of mountain development just described, they were not considered a viable option for the testing of all the guidelines. It would be extremely difficult to find a single foreground view of a combination foreground/middleground view of the mountain which adequately presents all of the features covered by the guidelines. The use of multiple views is ruled out because the work, expense, and time required to prepare more than one perspective would be prohibitive. The use of aerial perspectives or viewer superior perspectives is also ruled out as being too unusual or atypical even though such perspectives probably provide the clearest overall view of mountain development. Therefore, the case study requires a middleground view of mountain development from an observer normal perspective.

Observer normal middleground perspectives can provide reasonably good views of the mountain development within the larger context of the natural visual character of the landscape. This allows the observer to judge all of the features of mountain development as a complete design within a natural setting. This middleground view must adequately display all of the features addressed by the guidelines. It would also be desirable if the view selected is, in fact, an important view in terms of viewer number, sensitivity, and viewing duration. It is not, however, the purpose of this study to evaluate the visual impact of mountain development at Beaver Creek as a whole. Rather, it is the purpose of this study to evaluate the performance of the guidelines using the mountain at Beaver Creek as a case study. The view selected must, therefore, accommodate the

study concept, presenting an opportunity to manipulate all of the features as required. A prime objective is to select a view in which the mountain design, as built, is judged to be in substantial compliance with all of the guidelines. This view must also adequately represent the natural visual character of the setting.

View Selection. The view selected for investigation is located from landscape control point #1 on I-70. This view is presented in Figure 6 and discussed on page 23 of this thesis. This particular view is one of the views that was simulated with the perspective plot program in the design process. It also is considered a high priority view due to the heavy viewing traffic on I-70 and the concentration of development at Avon seen in the foreground. The foreground detail of the development at Avon is omitted from the illustrations produced for this study because it was anticipated that this would distract the respondents.

The mountain development is seen in this view from I-70 to occupy the focal point created by the converging ridgelines. This particular view presents the features of mountain development in substantial compliance with all of the guidelines Figure 6, (with detail, Figure 8). Guideline #1, "minimize the visibility of the lift lines and mountain restaurants," is seen to be in compliance. The lift lines present in this scene have been integrated into the ski trails and the roof of the midmountain restaurant is barely visible behind a minor ridgeline off of the skyline. Guideline #2, "minimize the visibility of the mountain maintenance road," is seen to be in compliance. Due to careful siting and construction, the maintenance road is not visible, although it is present in the scene and lies across the face of the mountain. Guideline #3, "stabilize and revegetate disturbed slopes," is also seen to be in substantial compliance. Guideline #4, "avoid skyline corridors in trail layout and avoid



Figure 8. L.C.P.#1, detail

placement of buildings or other structures at the skyline," is seen in the unbroken skyline. Guideline #5, "create natural appearing (irregular, curvilinear) shapes and edges in individual trail design and group configuration," is seen in the sinuous or cascading appearance of the trail network. Guideline #6, "include islands of vegetation in the design of individual trails," is also evident.

The photograph of the mountain used to prepare the illustrations for this study was taken with a 50mm lens at a distance of 2.5 miles from the ski slopes. This provides a relatively wide field of view from a fixed position. The photograph was taken in July on a sunny day, showing some sidelighting at the trail edges. The selection of a photograph was made on the basis of three considerations. In order to test the validity of the revegetation guidelines (#3), there can be no snow cover. In addition, it is assumed that summer presents a more visually vulnerable view than fall because the autumn color of the aspen tends to mask the pattern of the ski trails. It was also assumed that most observers would be slightly more inclined to respond to the mountain visuals on an aesthetic basis when evaluating an off-season view as opposed to a winter view.

Composition Criteria. As stated in the study concept, the production of the visual material involves altering the as-built design through graphic manipulation so as to introduce violations of the guidelines. The introduction of experimenter bias in this situation is controlled by adherence to the following criteria for graphic manipulation:

1. The basic as-built layout of the mountain development is not significantly altered. Trails and lifts will neither be added or removed.



2. The appearance of the altered features is based on photographs of existing impacts.
3. The altered features depart from the as-built condition only to the extent that violations of the guidelines are clearly evident but not exaggerated.
4. The altered features conform to the actual topographic base of the site.
5. The graphic manipulation technique blends with the graphic technique of the original illustration, so it is not evident that any illustration has been altered.
6. There is a single standard version of each guideline violation for use in all of the illustrations.

#### STUDY IMPLEMENTATION

##### Visual Materials: Preparation

Image Transfer. The original illustration (figure 9, map pocket) was drawn from a color slide of the photograph presented in Figure 6. This slide was projected onto a base sheet and was traced with pencil. A portion of the bottom half of the slide was blacked out as already noted. The dimensions of the projected image traced on the base sheet are 32 inches wide by 16 inches. The result is a 35-degree field of view.

Once the image was traced onto the base sheet, the finished rendering was started on a Mylar overlay. The projected image of the slide and several photographic print enlargements were used to guide the finished rendering. It should be noted also that the illustrator is very familiar with the site and worked with photographic coverage from several landscape control points as well

as a 1:9600 site plan on a topographic base which shows the liftline, restaurant, road location, and trail layout.

Graphic Technique. The finished rendering was done on the Mylar with ink and pencil. Technical drafting pens were used for the ink work. The ink was used for most of the line work, and the pencil was used primarily for shading. This graphic technique was pretested through a Mylar intermediate for the first and second generation print quality. The scene was rendered from the background working forward. A very fine pen point was used for the line work in the background. Progressively heavier pen points were used as the line work moved through the middleground towards the viewer. Shading was layed on over the ink work with pencil at convenient intervals.

Image Manipulation and Print Production. Figure 9 (map pocket) presents a reproduction of the original illustration depicting the mountain design as built. Once this original rendering was completed, six Mylar reproducible copies were made directly from it. The Mylar reproducible image was reversed so that erasures could be made on the back side. At this point the process of graphic manipulation was initiated on the Mylar copies. Study sketches of each of the six standard guidelines had been made earlier to guide the process which consisted of erasing portions of the original image and redrawing the new features with ink and pencil on the front. Guideline violations were added to each of the six Mylar reproducibles one at a time, and blackline diazo prints were made from the Mylar sheets after each addition. The sequence of addition was staggered so that six different series of illustrations were produced as indicated in Figure 10.

The first group of prints consists of six illustrations, each depicting the violation of a different guideline. These were used for quality control in making the rest of the additions. Subsequent manipulations were made on a light

MYLAR SERIES

|                | A<br>ADDITION<br>SEQUENCE | B<br>ADDITION<br>SEQUENCE | C<br>ADDITION<br>SEQUENCE | D<br>ADDITION<br>SEQUENCE | E<br>ADDITION<br>SEQUENCE | F<br>ADDITION<br>SEQUENCE |                           |
|----------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|
| PRINT GROUP #1 | 1                         | 2                         | 3                         | 4                         | 5                         | 6                         | ONE GUIDELINE VIOLATED    |
| PRINT GROUP #2 | 2                         | 3                         | 4                         | 5                         | 6                         | 1                         | TWO GUIDELINES VIOLATED   |
| PRINT GROUP #3 | 3                         | 4                         | 5                         | 6                         | 1                         | 2                         | THREE GUIDELINES VIOLATED |
| PRINT GROUP #4 | 4                         | 5                         | 6                         | 1                         | 2                         | 3                         | FOUR GUIDELINES VIOLATED  |
| PRINT GROUP #5 | 5                         | 6                         | 1                         | 2                         | 3                         | 4                         | FIVE GUIDELINES VIOLATED  |
| PRINT GROUP #6 | 6                         | 1                         | 2                         | 3                         | 4                         | 5                         | SIX GUIDELINES VIOLATED   |

Guidelines:

1. MINIMIZE THE VISIBILITY OF LIFT LINES.
2. MINIMIZE THE VISIBILITY OF THE MOUNTAIN MAINTENANCE ROAD.
3. STABILIZE AND REVEGETATE DISTURBED SLOPES.
4. AVOID SKYLINE CORRIDORS IN TRAIL LAYOUT, AND AVOID PLACEMENT OF STRUCTURES AT THE SKYLINE.
5. CREATE NATURAL APPEARING (IRREGULAR, CURVILINEAR) SHAPES AND EDGES IN INDIVIDUAL TRAIL DESIGN AND GROUP CONFIGURATION.
6. INCLUDE ISLANDS OF VEGETATION IN THE DESIGN OF INDIVIDUAL TRAILS.

- 5\*
- 56\*
- 561\*
- 5612\*
- 56123\*
- 561234\*

\*PRINTS AT EACH STAGE

**Mylar Series: graphic manipulation sequence**

figure 10

table with the Mylar sheet overlaid on the appropriate print from the first group. This helped to ensure that the manipulations were all reasonably well standardized. Unfortunately, prolonged exposure on the light table caused the first group of prints to fade to a point that they were rejected for use in the study. All of the prints that were used in the study were made from the Mylar reproducible copies of the original rendering.

The process of producing six complete series of illustrations took several days. Although all of the prints were run from the same roll stock, day-to-day fluctuations in the diazo printing process produced minor variations in the overall color and value quality of the prints. All of these blackline prints faded within 24 hours to a dark brown color which varies slightly from print to print. This print quality problem could have been corrected by reproducing all of the prints on a large format Xerox machine or as photo mechanical transfers. However, the problem was not judged to be serious enough to warrant a significant increase in production costs. Instead, the respondents were directed to ignore this variation in print quality in making their judgments. Photographic slides were rejected as an intermediate presentation medium because this would have resulted in a significant deterioration in the level of detail and the graphic quality of the image.

Color. Ski trails and mountain support facilities do not normally introduce pronounced color contrasts into the landscape, particularly when viewed in a middleground perspective. For this reason and because of the time demand, quality control difficulty, and expense of making a color presentation, the decision was made not to use color. All of the guideline features may be suitably altered without the use of color. However, the graphic manipulation required to violate the guideline on slope revegetation would benefit from the addition of color.

Appendix B contains details of the illustrations displaying the various altered features as they were presented to the respondents in the study.

### Pretesting

Pretesting was conducted on an informal basis with several volunteers who evaluated the prints to be used in the study. These volunteers included both professional designers and "non-designers or general public," as well as skiers and non-skiers. The pretesting indicated several potential problems. Some of the respondents did not recognize all of the features on the mountain, particularly the slope erosion. Pretesting also indicated that some respondents have difficulty discerning a difference between two illustrations where the variable content involves only one or two guidelines. In addition, the time range required for judgment intervals was indicated in the pretesting.

The wording of the instructions was pretested and, in one case, subsequently adjusted. This concerned the instructions for the paired comparison selection for naturalistic appearance. Initially the respondents were asked to select the design which displays the least amount of contrast with the natural visual character of the setting (as seen in a preconstruction photograph). In pretesting, however, it was found that this wording led to some confusion as to whether the respondent was being asked to select the design which displays the least amount of internal contrast or to select the design which deviates the least from the natural visual character of the setting. Theoretically, the level of internal contrast does not necessarily correspond directly with the degree of deviation from the natural visual character. In light of this potential problem the instructions were changed to simply direct the respondent to select that design which looks most naturalistic.

### Presentation Format

Difficulty Level. Based on the difficulty levels indicated in the pretesting, the paired comparisons are set up to test the guidelines in pairs. Each pair of illustrations depicts designs which display a variable content of two guidelines (which are complied with in one design and violated in the other). A difference of two guidelines is also maintained in the rank ordering procedure.

Paired Comparison. The illustrations are presented as four sets of four pairs in the paired comparison procedure. Each set tests all of the guidelines in a different context as indicated in Figure 11 which presents the content/context relationships of the four sets. Judgments are distributed across the visual material so that each paired comparison selection involves a new content/context relationship. Each pair of illustrations is mounted in an over-under fashion on a single sheet of cardboard. This arrangement makes it easier to compare members of a pair because it requires a shorter eye travel distance as compared to a side-by-side format.

Rank Ordering. The illustrations are presented as four sets of four separate mounted illustrations in the rank ordering procedure. Each set tests all of the guidelines and consists of illustrations taken from the same Mylar series as indicated in Figure 12. There are two sets of two identical series or content sequences; however, the study is structured so that the respondents work with a different series in each procedure.

Station Rotation. The study format accommodates up to four respondents per session. The sets of illustrations are placed one each at four different tables or stations. The respondents are directed to rotate from station to station at intervals set to eliminate repetition and to distribute the judgments evenly across all of the illustrations. This reduces the number of illustrations needed for the study. Station rotation also serves to distribute the warm-up effect across all of the pairs when total response is considered for each pair.

## Variable Content Pairings

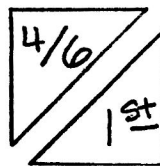
1&2    3&4    5&6    6&1

|             |                        |                        |                        |                        |
|-------------|------------------------|------------------------|------------------------|------------------------|
| Station # 1 | 2/4<br>4 <sup>th</sup> | 0/2<br>2 <sup>nd</sup> | 4/6<br>1 <sup>st</sup> | 3/5<br>3 <sup>rd</sup> |
| Station # 2 | 0/2<br>2 <sup>nd</sup> | 4/6<br>1 <sup>st</sup> | 3/5<br>3 <sup>rd</sup> | 2/4<br>4 <sup>th</sup> |
| Station # 3 | 3/5<br>4 <sup>th</sup> | 2/4<br>2 <sup>nd</sup> | 0/2<br>3 <sup>rd</sup> | 4/6<br>1 <sup>st</sup> |
| Station # 4 | 4/6<br>4 <sup>th</sup> | 3/5<br>3 <sup>rd</sup> | 2/4<br>1 <sup>st</sup> | 0/2<br>2 <sup>nd</sup> |

### EXAMPLE :

FOUR GUIDELINES VIOLATED  
IN ONE OF THE ILLUSTRATIONS

SIX GUIDELINES VIOLATED IN  
THE OTHER ILLUSTRATION



THIS PAIRING IS THE  
FIRST PRESENTED  
IN THIS SET.

3&4 VARIABLE CONTENT PAIRING :  
GUIDELINES #3 & #4 ARE COMPLIED WITH IN ONE ILLUSTRATION  
AND VIOLATED IN ANOTHER. BOTH ILLUSTRATIONS DEPICT  
THE VIOLATION OF TWO OTHER GUIDELINES WHICH ARE THE  
SAME IN EACH ILLUSTRATION.

### Paired Comparison: content/context

figure 11

Station # 1 - 4 illustrations

Station # 4 - 4 illustrations

Content:

1. NO GUIDELINES VIOLATED
2. GUIDELINES # 4 & # 5 VIOLATED
3. GUIDELINES # 4, # 5, # 6 & # 1 VIOLATED
4. ALL GUIDELINES VIOLATED

Station # 2 - 4 illustrations

Station # 3 - 4 illustrations

Content:

1. NO GUIDELINES VIOLATED
2. GUIDELINES # 2 & # 3 VIOLATED
3. GUIDELINES # 2, # 3, # 4 & # 5 VIOLATED
4. ALL GUIDELINES VIOLATED

**Rank Ordering: visual content**

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**figure 12**



### Subject Selection

It is the purpose of this study as stated in the hypotheses to investigate the viewing response of the general public. This response is represented in this study through a surrogate population of respondents consisting of college students from non-design disciplines. These students were recruited through an advertisement placed in the student newspaper. A small number of volunteers drawn from the Landscape Architecture Department were also included in the study. No effort was made to specifically recruit either skiers or non-skiers.

### Informed Consent

The informed consent statement (Appendix C) serves to orient the respondents as to the general nature of the study. This includes a brief discussion of the procedures and judgments involved.

### Instructions

The general instructions (Appendix C) explain the study in greater detail and serve to control some of the potential problems identified in the pretesting. All of the features of the mountain development that are present in the illustrations are listed with the exception of the slope erosion. The slope erosion is not specifically identified because it is assumed that this could introduce a functional/environmental bias into the response. Theoretically, the respondents should be able to arrive at an aesthetic judgment regarding naturalistic appearance or visual appeal without the benefit of knowing the functional/environmental significance of the features being evaluated. It is assumed that this situation does, in fact, arise under actual viewing circumstances in the field.

In the pretesting it was found that some respondents are inclined to base their judgments on functional considerations. For example, a skier asked to select the most visually appealing design might select the design that appears to offer the most desirable skiing characteristics (Ewing and Kulka, 1979). This problem is addressed in the general instructions where it is explained that all of the judgments are to be based on an evaluation of visual quality, not functional characteristics.

When the respondents are asked to make a judgment concerning visual appeal, a specific context is provided. The respondents are directed to imagine they have a home near this ski resort and that the illustrations represent options for a view from their living room window. This context provides an aesthetic orientation involving significant personal investment which serves as a common basis for all responses involving visual appeal.

The season depicted in the illustrations is also noted in the general instructions. At this point the respondents are presented with a color slide taken of the setting prior to the development. This photograph, taken from landscape control point #1 in July, corresponds directly with the view presented in the illustrations. Presentation of this slide identifies the season depicted in the illustrations and provides a standard base of reference for judgments concerning naturalistic appearance. It also helps to compensate for the absence of color and should serve to reinforce the graphic communication of the illustrations in general.

The problem with irregular print color/value quality is explained in the general instructions, and examples are shown. The respondents are asked to ignore these differences in making their judgments. It is also noted in the general instructions that all judgments are essentially subjective.

The specific instructions written for the study procedures are included in Appendix C.

### Session Description

In a typical session four respondents are present, each at a different table or station. After they read the informed consent statement, the general instructions are read, the slide and print examples are shown, and any questions are answered. Each respondent has a personal booklet of instructions and response forms. The respondents examine the four pairs of illustrations on the table in front of them, make a selection for naturalistic appearance, and record the selections on page one of their booklets. They also record the station number on this page. The respondents are then directed to rotate clockwise to the next station. They again make a selection for naturalistic appearance with four new pairs of illustrations and record these answers and the new station number on page two. Next they turn to page three and rate the magnitude of the difference in the level of naturalistic appearance displayed by the designs in each pair. The magnitude estimation is done with the same set of pairs that have just previously been examined. This concludes the naturalistic appearance phase of the paired comparison procedure.

In the visual appeal phase that follows the respondents are again directed to rotate clockwise to the next station and begin making paired comparison selections for visual appeal. This phase repeats the same sequence of procedures described above with the new sets of pairs located at the remaining two stations. Once this phase is completed, each of the respondents will have seen all of the four sets of illustrations one time each.

As indicated in the content/context matrix for the four sets (Figure 11), every pair of illustrations presents a unique content/context relationship while all of the guidelines are tested at each station. This provides two evaluations per respondent for each content pairing in both the naturalistic appearance phase and the visual appeal phase. It should also be noted that two of the guidelines,

#1 and #6, occur twice in the content pairing of each set. This duplication is made in order to permit the presentation at every station of each of the content pairings within each of the four contexts. The sequence of the content pairings is different for each station, and the placement (top/bottom) of hypothetical "hits" and "misses" is random.

Upon completion of both phases of the paired comparison, the rank ordering procedure is started. Every station has a set of four separate, mounted illustrations which the respondents are asked to rank in order of increasing naturalistic appearance. Once this ranking is recorded, the respondents move laterally to the next station where they rank a different set of four illustrations in order of increasing visual appeal. Figure 10 identifies the content sequence of the illustrations at each station. Each set of four illustrations is selected from the same Mylar series, with one illustration depicting the mountain as built, another depicting the violation of two guidelines, a third showing four violations, and a fourth depicting the violation of all six guidelines. The lateral station rotation ensures that all respondents are presented with two different content sequences for ranking of naturalistic appearance and visual appeal, respectively.

Content analysis is performed upon completion of the visual appeal ranking. The respondents are directed to place a clear plastic overlay on the illustration that they selected as displaying the least visually appealing design in the previous ranking. They then proceed to identify features which they feel detract from the visual appeal of that mountain design. This is the final procedure.

Once the respondents have completed the content analysis, they are asked to fill out a sheet of personal information (Appendix C) which includes skiing experience, design experience, and previous exposure to mountain environments. The respondents are free to leave after this sheet is filled out; however, the

interviewer frequently engaged some of the respondents in a brief conversation about the study at this time. Questions were asked concerning the general flow of the session and whether there were any problems with the illustrations, the procedures or the instructions.

#### Time Requirements

The time required to complete a typical session ranged from 30 to 40 minutes. It was not necessary to put a time limit on any of the judgment intervals. The respondents work at their own pace through each set of illustrations. Station rotation does not take place until all of the respondents have completed the selections at the station they are at. Normally the judgment intervals are shorter as the session progresses and the respondents become familiar with the illustrations.

## CHAPTER THREE

### ANALYSIS

#### Analysis: Paired Comparison

Analysis of viewer response in the paired comparison procedure consists of a frequency breakdown in three categories: 1) selections supporting the hypotheses or "hits," 2) selections contradicting the hypothesis or "misses," and 3) no difference options. For each individual respondent two responses are drawn on each of the four content pairings (Guidelines #1 and #2, #3 and #4, #5 and #6, #6 and #1) for both naturalistic appearance and visual appeal. Each individual response pattern was checked for reliability, and those respondents who did not produce an minimum level of consistency of 50% in the paired comparison procedure were eliminated from the results. Five respondents were dropped on this basis from an original population of 51 respondents.

For the purpose of simplifying the text, the following abbreviated notations are used to represent the pairing of visual guidelines which were tested as the variable content in each procedure.

#### Lifts and Roads

##### Guidelines #1 and #2:

#1 - Minimize the visibility of lift lines.

#2 - Minimize the visibility of mountain maintenance roads.

#### Revegetation and Skyline

##### Guidelines #3 and #4:

#3 - Stabilize and revegetate disturbed slopes.

#4 - Avoid skyline corridors in trail layout, and avoid placement of buildings at the skyline.

#### Runs and Islands

##### Guidelines #5 and #6:

#5 - Create irregular/curvilinear shapes and edges in individual trail design and group configuration.

#6 - Provide islands of vegetation in the design of individual trails.

#### Islands and Lifts

##### Guidelines #6 and #1:

#6 - Provide islands of vegetation in the design of individual trails.

#1 - Minimize the visibility of lift lines.

Naturalistic Appearance. Table 1 presents the frequency breakdown for the remaining 46 respondents in the paired comparison selection for naturalistic appearance. For the content pairing of lifts and roads (Guidelines #1 and #2) the response consists of 57% hits, 14% misses, and 29% no difference. For the content pairing of revegetation and skyline (Guidelines #3 and #4) the response consists of 66% hits, 12% misses, and 22% no difference. The response for the content pairing of runs and islands (Guidelines #5 and #6) consists of 92% hits, 4% misses, and 3% no difference. The response for the content pairing of islands and lifts (Guidelines #6 and #1) consists of 89% hits, 10% misses, and 1% no difference. This draws a total of 280 hypothetical hits, 37 hypothetical misses, and 51 no difference selections. These numbers establish a clear trend

supporting the hypothesis regarding naturalistic appearance for each pairing of the guidelines. The breakdown indicates that the pairing of runs and islands (Guidelines #5 and #6) and the pairing of islands and lifts (Guidelines #6 and #1) produce the strongest influence on the perception of naturalistic appearance.

Magnitude Estimation - Naturalistic Appearance. Table 2 presents the mean ratings for the magnitude of difference in the level of naturalistic appearance displayed by each pair of designs evaluated. The scale utilized in this procedure provides a range of values from 0 (very similar) to 10 (very different). For the hypothetical hits the mean ratings for the content pairing of runs and islands (Guidelines #5 and #6) and islands and lifts (Guidelines #6 and #1) show a greater magnitude than the means for the other content pairings. This would seem to be consistent with the results in Table 1. This procedure indicates that most of the respondents considered the differences between the designs to be significant at a level clustered around the mid-point on the scale between "very similar" and "very different."

Visual Appeal. Table 3 presents the frequency breakdown in the paired comparison selection for visual appeal. For the content pairing of lifts and roads (Guidelines #1 and #2) the response consists of 64% hits, 13% misses, and 23% no difference. For the content pairing of revegetation and skyline (Guidelines #3 and #4) the response consists of 65% hits, 13% misses, and 22% no difference. The response for the content pairing of runs and islands (Guidelines #5 and #6) consists of 84% hits, 15% misses, and 1% no difference. The response for the content pairing of islands and lifts (Guidelines #6 and #1) consists of 83% hits, 15% misses, and 2% no difference. This draws a total of 272 hypothetical hits, 52 hypothetical misses, and 44 no difference selections. These numbers establish a clear trend supporting the hypothesis regarding visual appeal for each pairing of the guidelines. The breakdown indicates that the



pairing of runs and islands (Guidelines #5 and #6) and islands and lifts (Guidelines #6 and #1) produce the strongest influence on the perception of visual appeal, as they did with naturalistic appearance. The close correlation between Table 1 and Table 3 strongly supports the hypothesis regarding the link between naturalistic appearance and visual appeal.

Magnitude Estimation - Visual Appeal. Table 4 presents the mean ratings for the magnitude of difference in the level of visual appeal displayed by each pair of designs evaluated. The results presented in this table mirror the results presented in Table 2, again supporting the hypothesis regarding the link between naturalistic appearance and visual appeal.

Landscape Architecture students / non-design students. In Chapter Two it was noted that the respondent population consists of university students drawn from non-design disciplines (N=32) and a smaller number of students drawn from the Dept. of Landscape Architecture (N=14). This research assumes that the students from non-design disciplines constitute a suitable surrogate population representing the general public. This assumption does not extend to the Landscape Architecture students, however. It is of interest, therefore, to consider the response from these two groups separately.

Tables 5a and 5b present the response frequency breakdown for naturalistic appearance for the Landscape Architecture students and the non-design students, respectively. Table 5a indicates a very strong pattern of response supporting the hypothesis regarding naturalistic appearance. In this case the gap between the strength of the Guidelines #5 and #6 and Guidelines #6 and #1 content pairings and the other content pairings is nearly closed. On the other hand, the frequencies in Table 5b indicate the widening of this gap. Nevertheless, the numbers for the non-design students clearly support the hypothesis regarding naturalistic appearance for all of the content pairings.

Tables 6a and 6b present the response frequency breakdown for visual appeal for the Landscape Architecture students and the non-design students, respectively. Table 6a mirrors Table 5a, strongly supporting the link between naturalistic appearance and visual appeal for the Landscape Architecture students. Table 6b also supports the link between naturalistic appearance and visual appeal for the non-design students for all of the content pairings. In this table the gap between the Guidelines #5 and #6 and Guidelines #6 and #1 content pairings and the other pairings is seen to have closed slightly.

Firm Response Analysis. As noted earlier, for every respondent two responses are drawn on each of the four content pairings. This permits a breakdown of the response patterns from the standpoint of individual response consistency. This analysis of individual response consistency was performed for each respondent. The analysis indicates that the response patterns identified in Tables 1 through 6 remain intact when considered from the standpoint of individual response consistency. This same approach may also be used to track individual response patterns for each content pairing regarding the link between naturalistic appearance and visual appeal. This analysis again shows the response patterns previously identified remain intact for all content pairings for both the Landscape Architecture students and the non-design students.

Analysis: Rank Ordering

In the rank order procedure the respondents were asked to rank four illustrations in order of increasing naturalistic appearance and visual appeal. This task is more complex than a simple paired comparison selection. The odds of obtaining the hypothetically correct ranking, at random in a single trial, are one in sixteen. The frequencies obtained for each sequence generated are found in Table 7a and 7b (naturalistic appearance) and Table 8a and 8b (visual appeal).

The accuracy of any given sequence may be judged by the number of transposed, or out of sequence, rankings, and the "distance" of the transposition (for example, switching the second and third position is obviously not as serious a violation of the hypothetical ranking as switching the first and last positions).

Examination of these tables shows that the Landscape Architecture students produced rankings for naturalistic appearance (Table 7a) which perfectly match the hypothetical ranking with the exception of one minor transposition. Their rankings for visual appeal (Table 8a) also match the hypothetical sequence in 11 out of 14 trials, with 3 minor transpositions. This strongly supports the results obtained for this group in the paired comparison procedure.

The non-design students produced rankings for naturalistic appearance (Table 7b) which match the hypothetical sequence in 23 out of 32 trials. All of the transpositions in this case were minor, that is, they involved a single, side by side switch. The results for this group in visual appeal ranking (Table 8b) indicate a greater range of response variability for this aspect of visual quality. The non-design students produced 19 rankings which match the hypothetical ranking, 6 rankings which involve a single, minor transposition, and 7 rankings which involve one or more major transpositions. These rankings clearly support the hypothesis regarding the link between naturalistic appearance and visual appeal for the majority of respondents in this group, however, it appears that a minority (7 out of 32) recognize naturalistic appearance in mountain design, but do not necessarily prefer it from the standpoint of visual appeal.

#### Content Analysis

The Content Analysis procedure provides a validity check on the Paired Comparison and Rank Ordering procedures. In the Content Analysis the respondents

were asked to identify those features which they felt detracted from the visual appeal of the mountain design. This allows for an open ended response which can be evaluated for confirmation or contradiction of any of the guidelines on an individual basis. The results of this procedure are as follows:

|                        |                            |                            |
|------------------------|----------------------------|----------------------------|
| Guideline #1 (lifts)   | - 21 respondents confirmed | 0 respondents contradicted |
| Guideline #2 (roads)   | - 24 respondents confirmed | 0 respondents contradicted |
| Guideline #3 (reveg.)  | - 2 respondents confirmed  | 0 respondents contradicted |
| Guideline #4 (skyline) | - 36 respondents confirmed | 0 respondents contradicted |
| Guideline #5 (runs)    | - 20 respondents confirmed | 0 respondents contradicted |
| Guideline #6 (islands) | - 30 respondents confirmed | 2 respondents contradicted |

These results support the results obtained in the other procedures for all of the guidelines except the revegetation guideline (#3). This guideline was confirmed by only two respondents, indicating that the skyline guideline (#4), with which it was paired, carried the revegetation guideline through the paired comparison procedure. The respondents that were questioned about this feature following the study sessions replied that they had assumed that it was an artifact of poor print quality, and had ignored it. This particular problem became apparent early on in the study, however, the decision was made to accept this conflict rather than drop the instructions regarding the true variations in print quality. Clearly the graphic communication of the revegetation guideline violation was inadequate. The use of color in the illustrations would have strengthened the graphic communication of this feature. As it stands this guideline was, in effect, untested.

## CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

This study, when considered as a whole, strongly supports the primary hypotheses presented in Chapter Two (p. 30). These results indicate that the guidelines promote both naturalistic appearance and visual appeal in mountain design. The situation involving the revegetation guideline (#3) presents a problem, however, it should be noted that slope stabilization and revegetation is essential from the standpoint of environmental/ecological impact, irregardless of the visual impact.

The differences in the relative strengths of the content pairings noted in the analysis of the results from the Paired Comparison procedure suggest that some of the guidelines may be more important than others. However, the guidelines would have to be re-paired or tested individually in order to learn more about their relative strengths. Nevertheless, the results indicate that the guidelines are all effective, (with the possible exception of the revegetation guideline). The Rank Ordering procedure, in particular, indicates that the guidelines are very effective when applied together as a coordinated unit in a well conceived design. It appears that the guidelines do in fact operate to manage the visual contrast that is inevitably introduced into the landscape as a result of mountain development, in a manner that promotes appropriate visual contrast and minimizes or eliminates inappropriate contrasts.

The major limitation of this study is the small sample size, and the use of a surrogate population of university students. This was unavoidable given the time and funding constraints of the study. If this study was to be continued beyond this point, it would be of interest to investigate the influence of a re-pairing of the guidelines for testing, or perhaps testing of the guidelines individually; and of course, it would be desirable to tap into a larger

population of respondents more representative of the general population. It would also be worthwhile to investigate the application of these guidelines with a different basic trail layout, in a different mountain setting.

Another fundamental limitation of this study is the use of a static two dimensional media to represent a three dimensional landscape which is subject to the daily and seasonal visual transformations noted in Chapter One. The results of this study must be confirmed in the field. It would also be interesting to investigate the relationship between off-slope visual quality and on-slope visual quality in the field, with regard to the special preferences of skiers.

TABLE 1. PAIRED COMPARISON/  
Naturalistic Appearance

| Content Pairing                                    | "Hits"                          | "Misses"                        | NO DIFFERENCE                   |
|--|---------------------------------|---------------------------------|---------------------------------|
| Lifts guideline #1 and Roads guideline #2          | FREQUENCY = 52<br><u>56.52%</u> | FREQUENCY = 13<br><u>14.13%</u> | FREQUENCY = 27<br><u>29.35%</u> |
| Revegetation guideline #3 and Skyline guideline #4 | FREQUENCY = 61<br><u>66.30%</u> | FREQUENCY = 11<br><u>11.96%</u> | FREQUENCY = 20<br><u>21.74%</u> |
| Rungs guideline #5 and Islands guideline #6        | FREQUENCY = 85<br><u>92.39%</u> | FREQUENCY = 4<br><u>4.35%</u>   | FREQUENCY = 3<br><u>3.26%</u>   |
| Islands guideline #6 and Lifts guideline #1        | FREQUENCY = 82<br><u>89.13%</u> | FREQUENCY = 9<br><u>9.78%</u>   | FREQUENCY = 1<br><u>1.09%</u>   |

TABLE 2.

Magnitude Estimation /  
Naturalistic Appearance

0 = very similar 10 = very different

Content  
Pairing

Mean Rating of Difference

"HITS"

"MISSES"

Lifts  
guideline #1  
and  
Roads  
guideline #2

4.2

2.0

Revegetation  
guideline #3  
and

3.9

2.8

Skyline  
guideline #4

Runs  
guideline #5  
and

6.7

6.0

Islands  
guideline #6

Islands  
guideline #6  
and

5.6

3.5

Lifts  
guideline #1



TABLE 3. PAIRED COMPARISON/  
Visual Appeal

| Content Pairing                                    | "Hits"                           | "Misses"                         | NO DIFFERENCE                    |
|--|----------------------------------|----------------------------------|----------------------------------|
| Lifts guideline #1 and Roads guideline #2          | FREQUENCY = 59<br><u>64.13 %</u> | FREQUENCY = 12<br><u>13.04 %</u> | FREQUENCY = 21<br><u>22.82 %</u> |
| Revegetation guideline #3 and Skyline guideline #4 | FREQUENCY = 60<br><u>65.22 %</u> | FREQUENCY = 12<br><u>13.04 %</u> | FREQUENCY = 20<br><u>21.74 %</u> |
| Runs guideline #5 and Islands guideline #6         | FREQUENCY = 77<br><u>83.70 %</u> | FREQUENCY = 14<br><u>15.22 %</u> | FREQUENCY = 1<br><u>1.09 %</u>   |
| Islands guideline #6 and Lifts guideline #1        | FREQUENCY = 70<br><u>82.61 %</u> | FREQUENCY = 14<br><u>15.22 %</u> | FREQUENCY = 2<br><u>2.18 %</u>   |

TABLE 4.

Magnitude Estimation /  
Visual Appeal

0 = very similar 10 = very different

Content  
Pairing

Mean Rating of Difference

"HITS"

"MISSES"

Lifts  
guideline #1  
and

4.9

2.0

Roads  
guideline #2

Revegetation  
guideline #3  
and

4.2

4.0

Skyline  
guideline #4

Runs  
guideline #5  
and

5.6

4.4

Islands  
guideline #6

Islands  
guideline #6  
and

5.4

6.7

Lifts  
guideline #1

TABLE 5a. PAIRED COMPARISON/  
Naturalistic Appearance

Landscape Architecture students

| Content Pairing                                    | "Hits"                           | "Misses"                        | NO DIFFERENCE                   |
|--|----------------------------------|---------------------------------|---------------------------------|
| Lifts guideline #1 and Roads guideline #2          | FREQUENCY = 21<br><u>75.00 %</u> | FREQUENCY = 3<br><u>10.71 %</u> | FREQUENCY = 4<br><u>14.28 %</u> |
| Revegetation guideline #3 and Skyline guideline #4 | FREQUENCY = 23<br><u>82.14 %</u> | FREQUENCY = 1<br><u>3.57 %</u>  | FREQUENCY = 4<br><u>14.29 %</u> |
| Runs guideline #5 and Islands guideline #6         | FREQUENCY = 27<br><u>96.43 %</u> | FREQUENCY = 1<br><u>3.57 %</u>  | FREQUENCY = 0<br><u>0.00 %</u>  |
| Islands guideline #6 and Lifts guideline #1        | FREQUENCY = 26<br><u>92.86 %</u> | FREQUENCY = 1<br><u>3.57 %</u>  | FREQUENCY = 1<br><u>3.57 %</u>  |

TABLE 5 b. PAIRED COMPARISON/  
Naturalistic Appearance

non-design students

| Content Pairing                                    | "Hits"                           | "Misses"                         | NO DIFFERENCE                    |
|--|----------------------------------|----------------------------------|----------------------------------|
| Lifts guideline #1 and Roads guideline #2          | FREQUENCY = 31<br><u>48.44 %</u> | FREQUENCY = 10<br><u>15.63 %</u> | FREQUENCY = 23<br><u>35.94 %</u> |
| Revegetation guideline #3 and Skyline guideline #4 | FREQUENCY = 38<br><u>59.38 %</u> | FREQUENCY = 10<br><u>15.63 %</u> | FREQUENCY = 16<br><u>25.00 %</u> |
| Runs guideline #5 and Islands guideline #6         | FREQUENCY = 58<br><u>90.63 %</u> | FREQUENCY = 3<br><u>4.69</u>     | FREQUENCY = 3<br><u>4.69</u>     |
| Islands guideline #6 and Lifts guideline #1        | FREQUENCY = 56<br><u>87.50 %</u> | FREQUENCY = 8<br><u>12.50 %</u>  | FREQUENCY = 0<br><u>0.00 %</u>   |

TABLE 6a. PAIRED COMPARISON/  
Visual Appeal

Landscape Architecture students

| Content Pairing                                    | "Hits"                          | "Misses"                       | NO DIFFERENCE                  |
|--|---------------------------------|--------------------------------|--------------------------------|
| Lifts guideline #1 and Roads guideline #2          | FREQUENCY = 22<br><u>78.57%</u> | FREQUENCY = 3<br><u>10.71%</u> | FREQUENCY = 3<br><u>10.71%</u> |
| Revegetation guideline #3 and Skyline guideline #4 | FREQUENCY = 25<br><u>89.29%</u> | FREQUENCY = 0<br><u>0.00%</u>  | FREQUENCY = 3<br><u>10.71%</u> |
| Runs guideline #5 and Islands guideline #6         | FREQUENCY = 27<br><u>96.43%</u> | FREQUENCY = 1<br><u>3.57%</u>  | FREQUENCY = 0<br><u>0.00%</u>  |
| Islands guideline #6 and Lifts guideline #1        | FREQUENCY = 26<br><u>92.86%</u> | FREQUENCY = 1<br><u>3.57%</u>  | FREQUENCY = 1<br><u>3.57%</u>  |

TABLE 6b. PAIRED COMPARISON/  
Visual Appeal

non-design students

| Content Pairing                                    | "Hits"                          | "Misses"                        | NO DIFFERENCE                   |
|--|---------------------------------|---------------------------------|---------------------------------|
| Lifts guideline #1 and Roads guideline #2          | FREQUENCY = 37<br><u>57.81%</u> | FREQUENCY = 9<br><u>14.06%</u>  | FREQUENCY = 18<br><u>28.12%</u> |
| Revegetation guideline #3 and Skyline guideline #4 | FREQUENCY = 35<br><u>54.69%</u> | FREQUENCY = 12<br><u>18.75%</u> | FREQUENCY = 17<br><u>26.56%</u> |
| Runs guideline #5 and Islands guideline #6         | FREQUENCY = 50<br><u>78.13%</u> | FREQUENCY = 13<br><u>20.31%</u> | FREQUENCY = 1<br><u>1.56%</u>   |
| Islands guideline #6 and Lifts guideline #1        | FREQUENCY = 50<br><u>78.13%</u> | FREQUENCY = 13<br><u>20.31%</u> | FREQUENCY = 1<br><u>1.56%</u>   |

TABLE 7a. Rank Order /  
Naturalistic Appearance  
Landscape Architecture students

Hypothetically Correct Ranking  
frequency = 13

Minor Transpositions  
frequency = 1

Major Transpositions  
frequency = 0

TABLE 7b. Rank Order /  
Naturalistic Appearance  
non-design students

Hypothetically Correct Ranking  
frequency = 23

Minor Transpositions  
frequency = 9

Major Transpositions  
frequency = 0



TABLE 8a. Rank Order /  
Visual Appeal  
Landscape Architecture students

Hypothetically Correct Ranking  
frequency = 11

Minor Transpositions  
frequency = 3

Major Transpositions  
frequency = 0

TABLE 8b. Rank Order /  
Visual Appeal  
non-design students

Hypothetically Correct Ranking  
frequency = 19

Minor Transpositions  
frequency = 6

Major Transpositions  
frequency = 7

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APPENDIX A





APPENDIX A



APPENDIX A



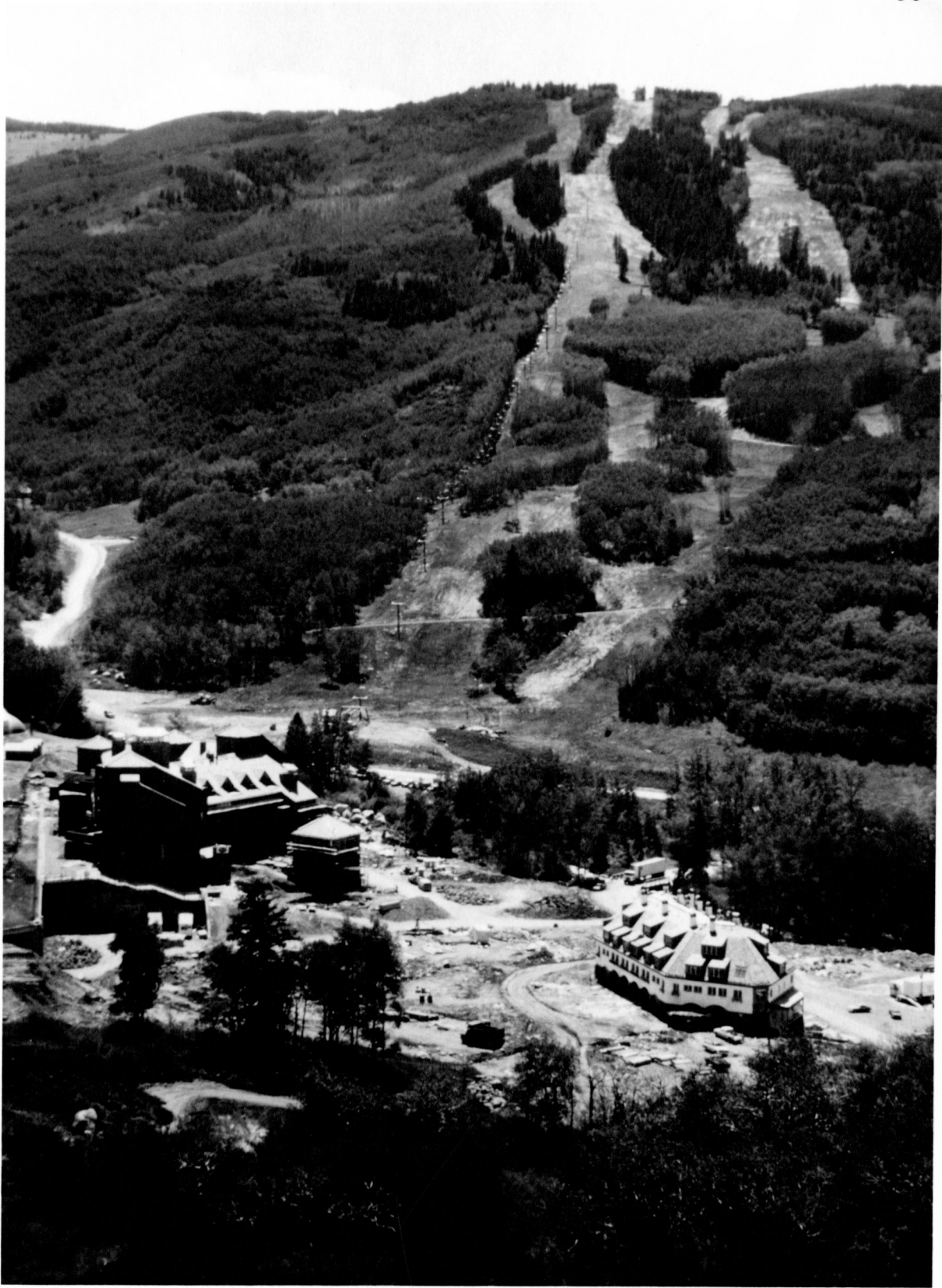
APPENDIX A



APPENDIX A



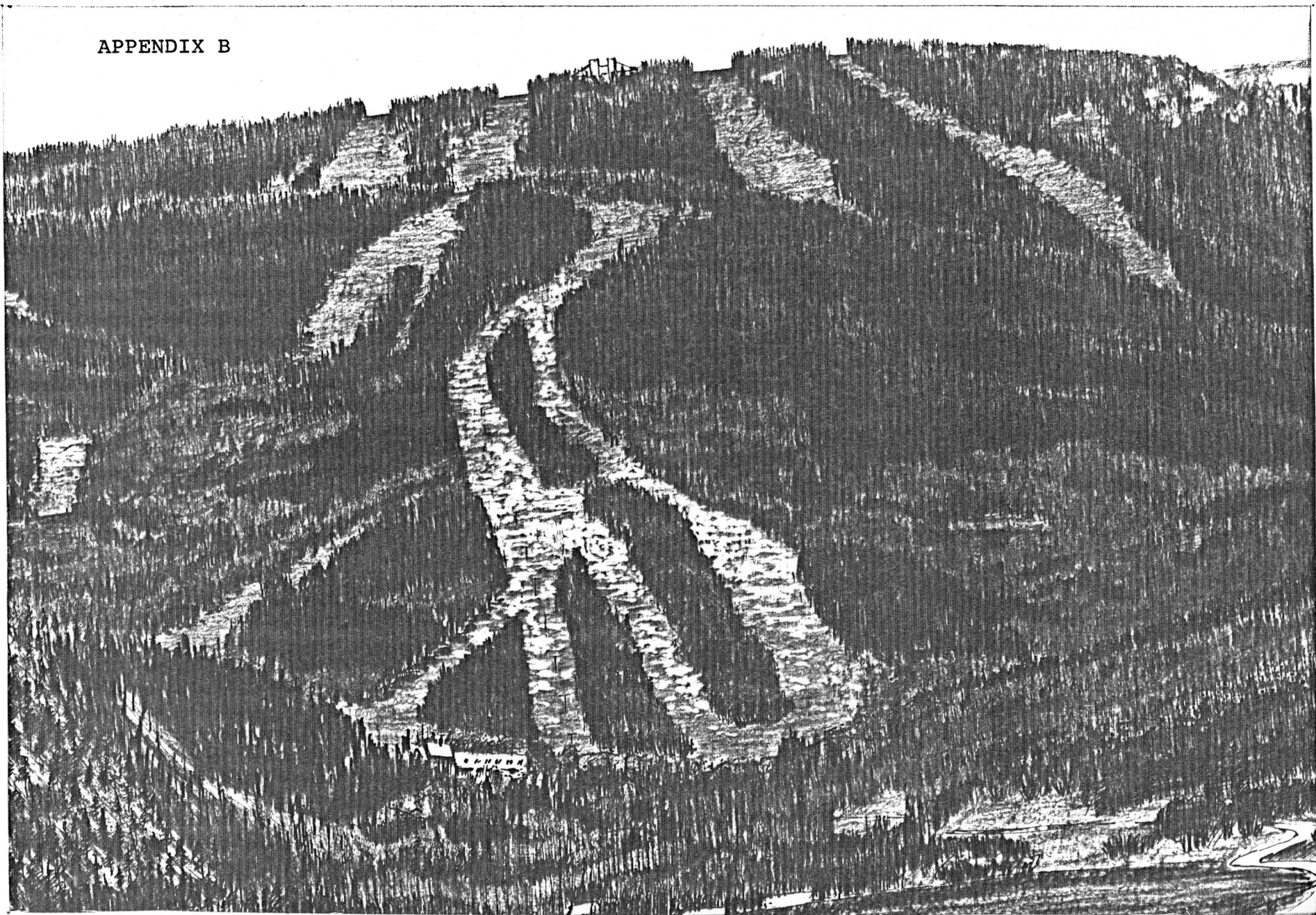
APPENDIX A



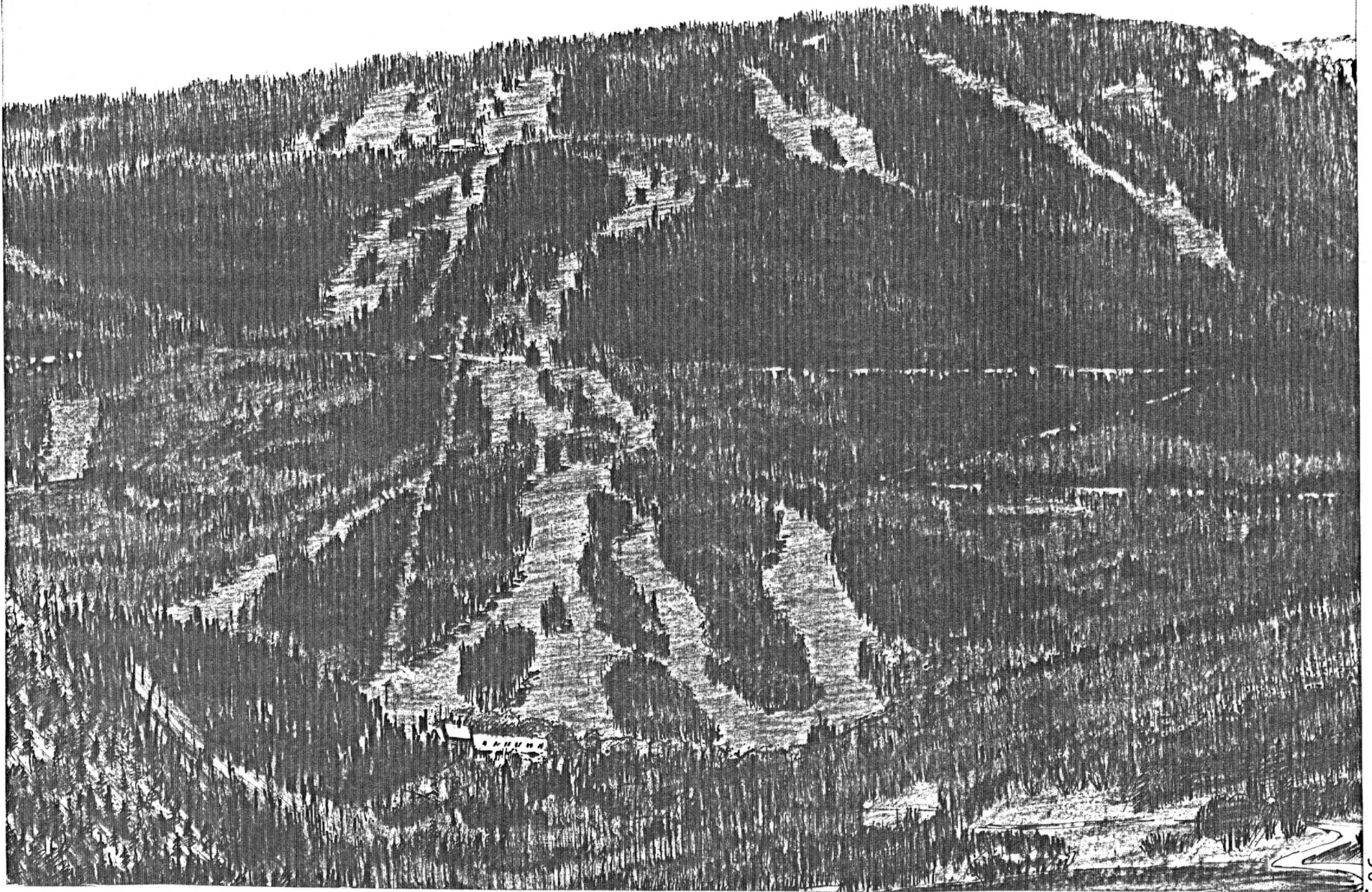
APPENDIX A



APPENDIX B

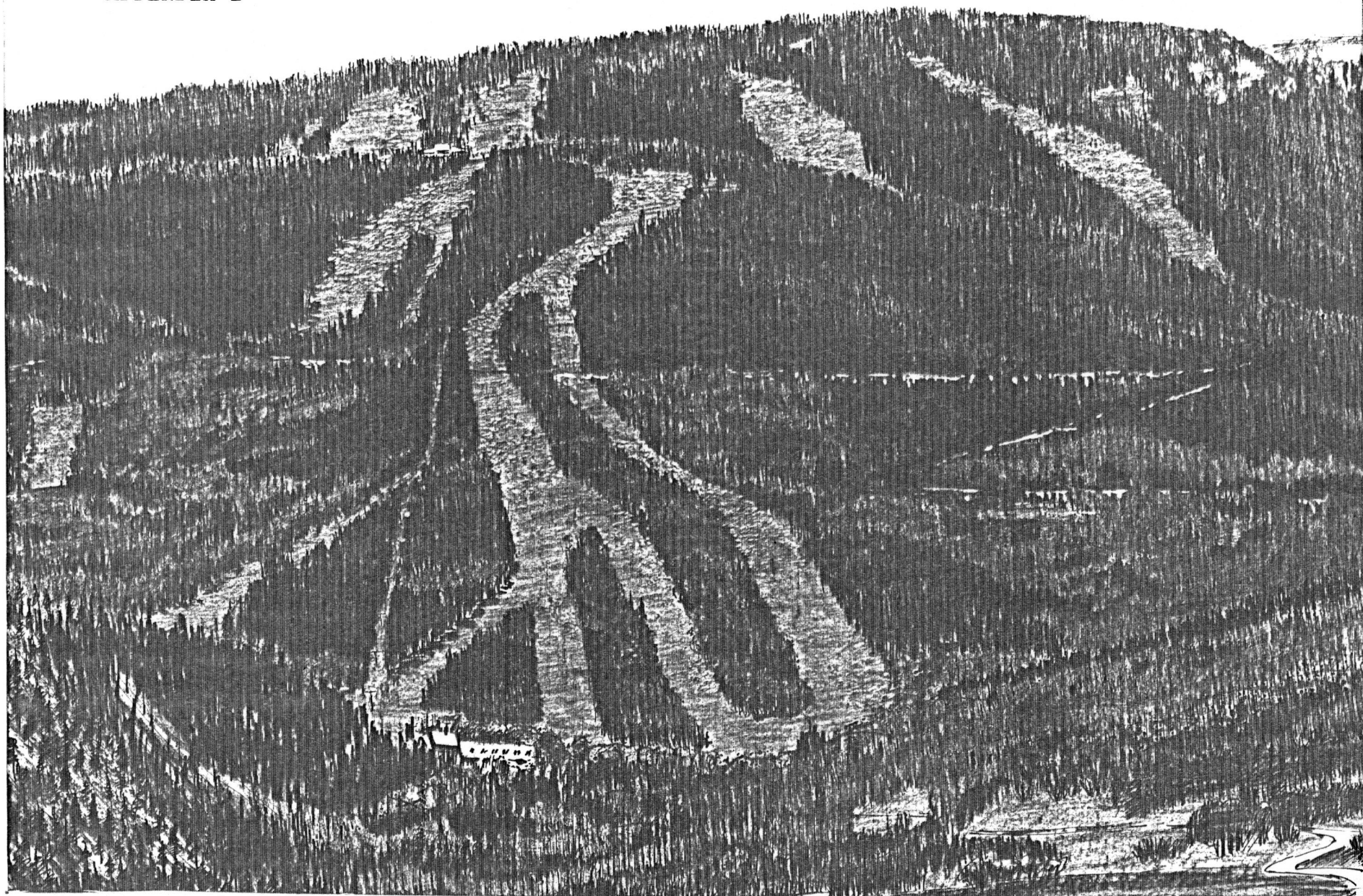


APPENDIX B

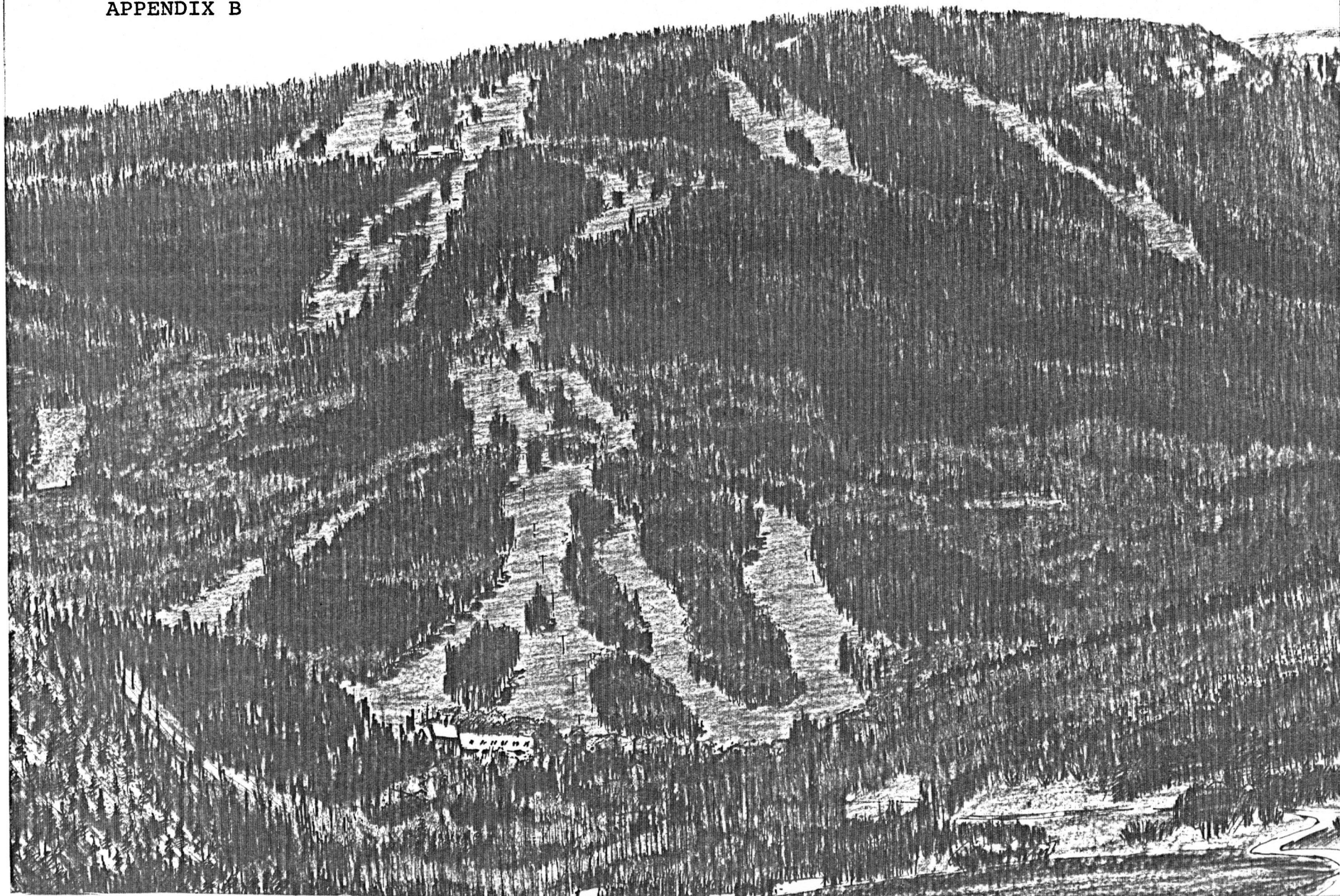




APPENDIX B

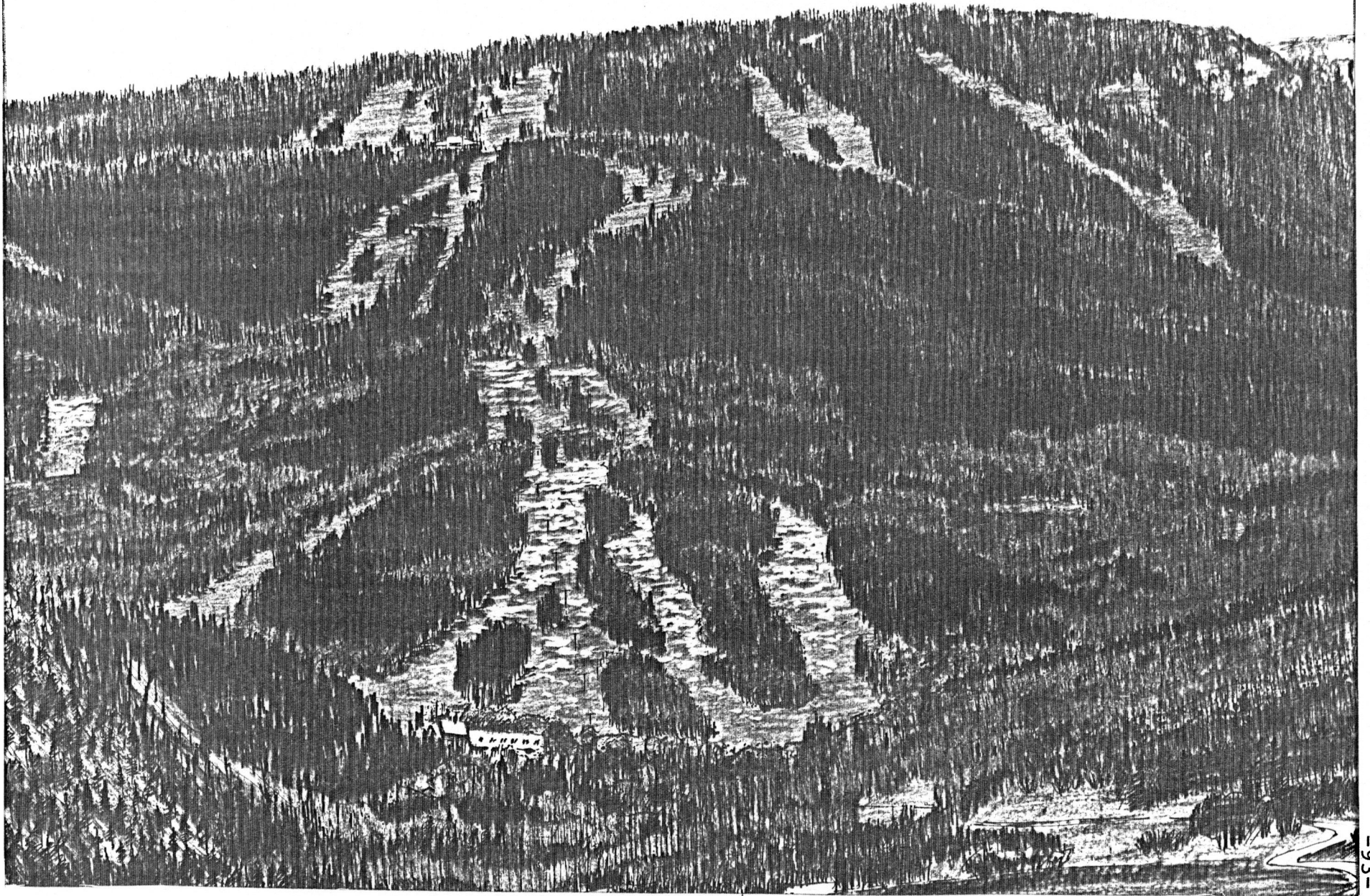


APPENDIX B

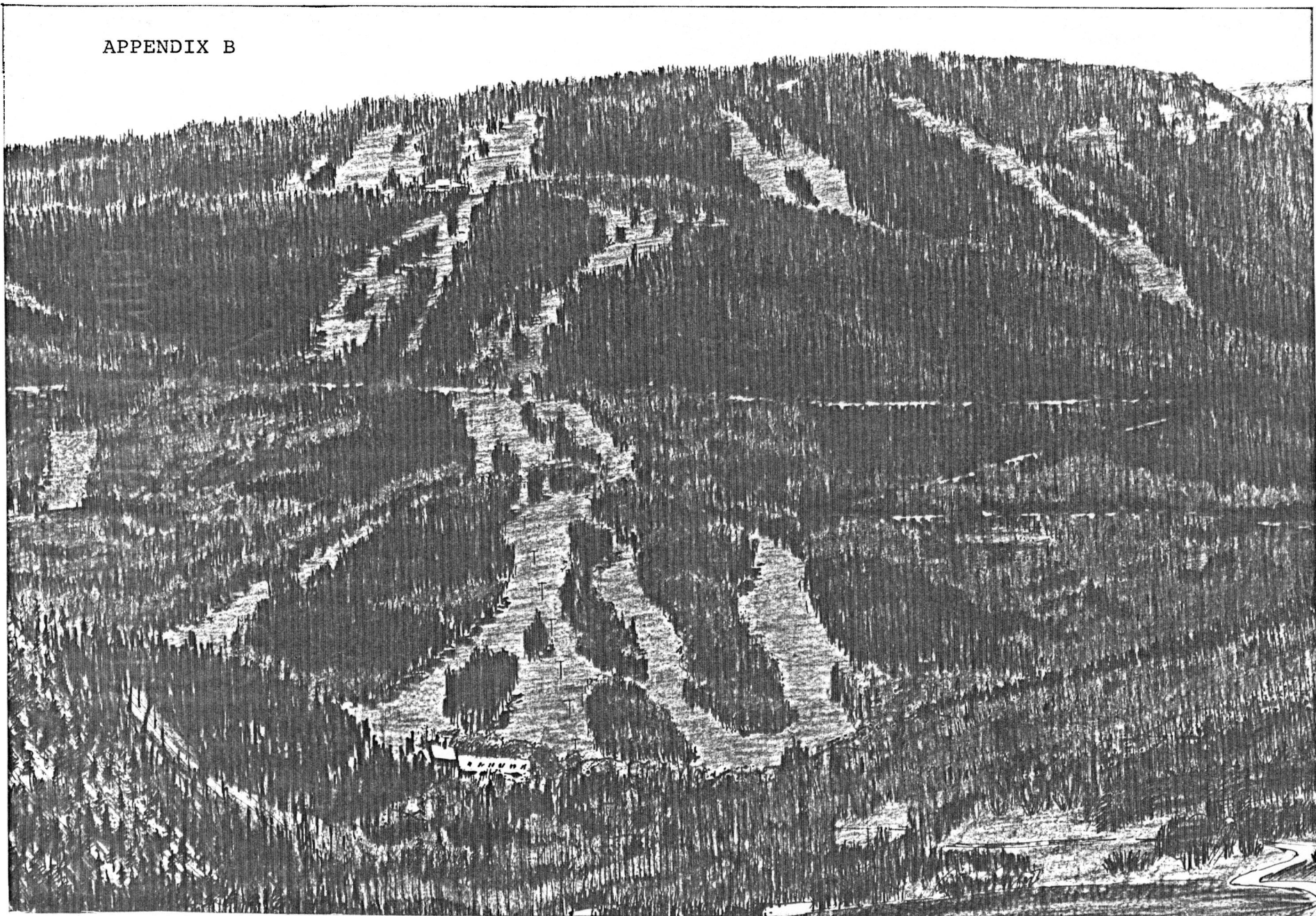




APPENDIX B

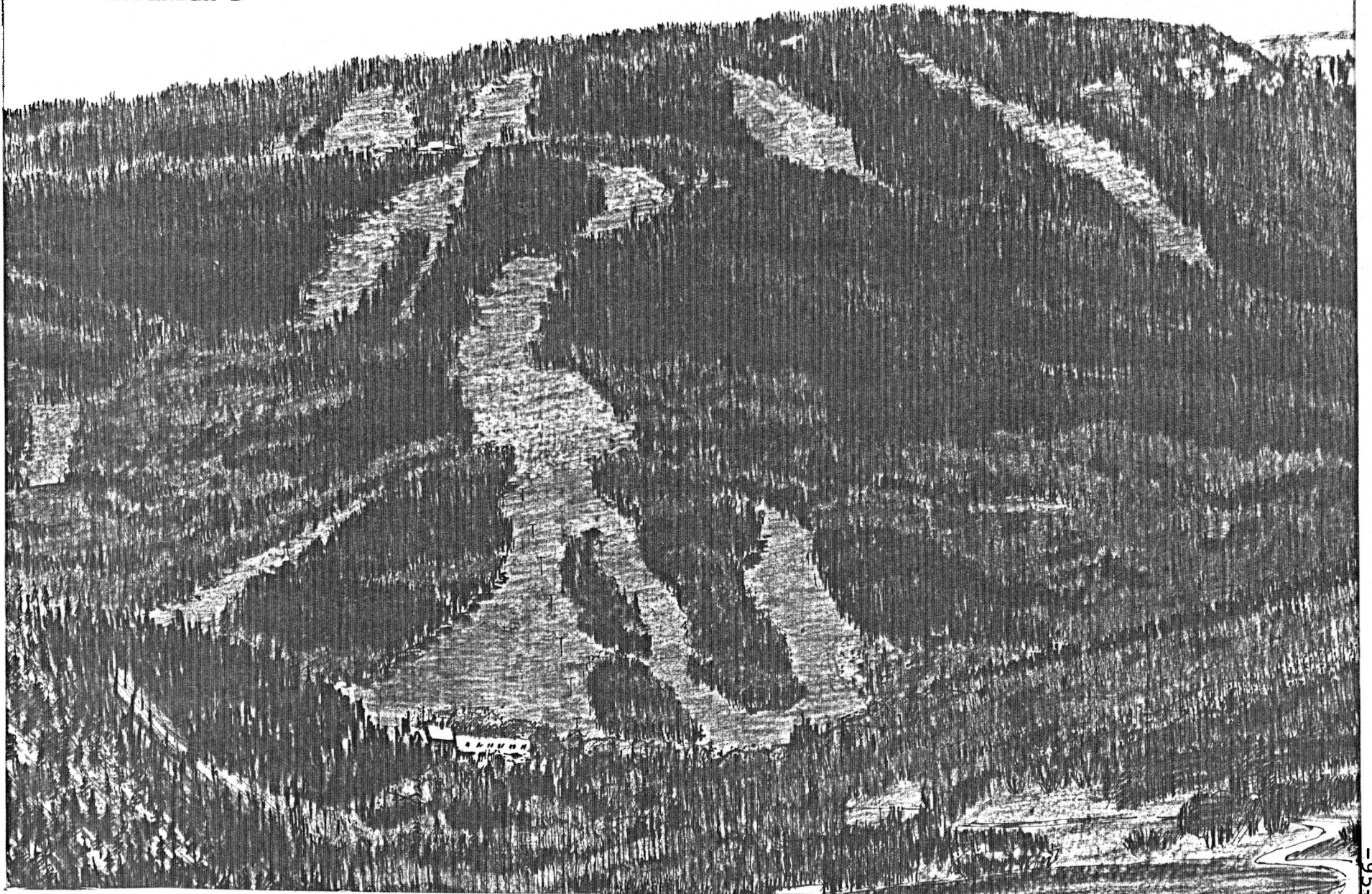


APPENDIX B

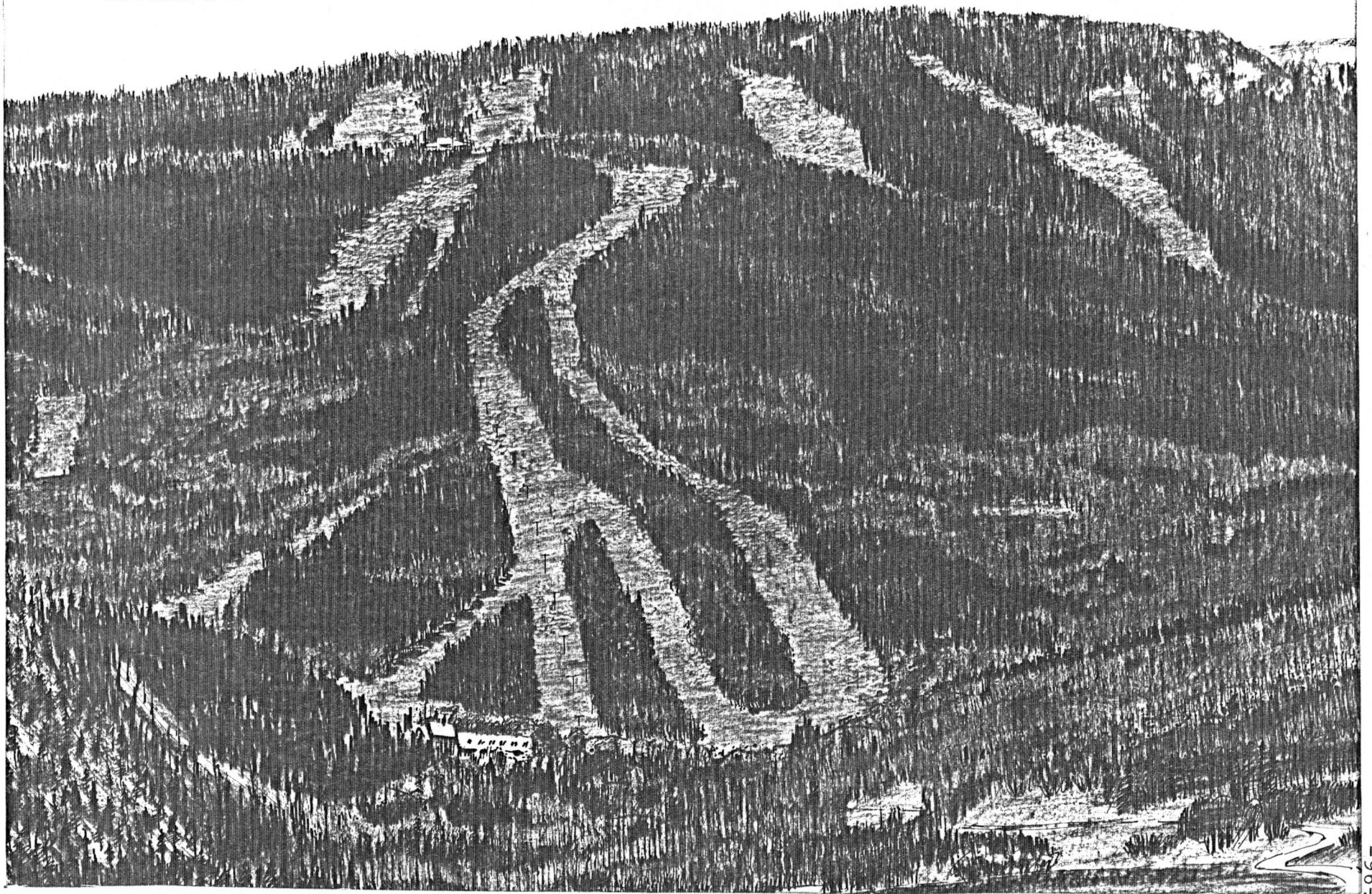




APPENDIX B



APPENDIX B

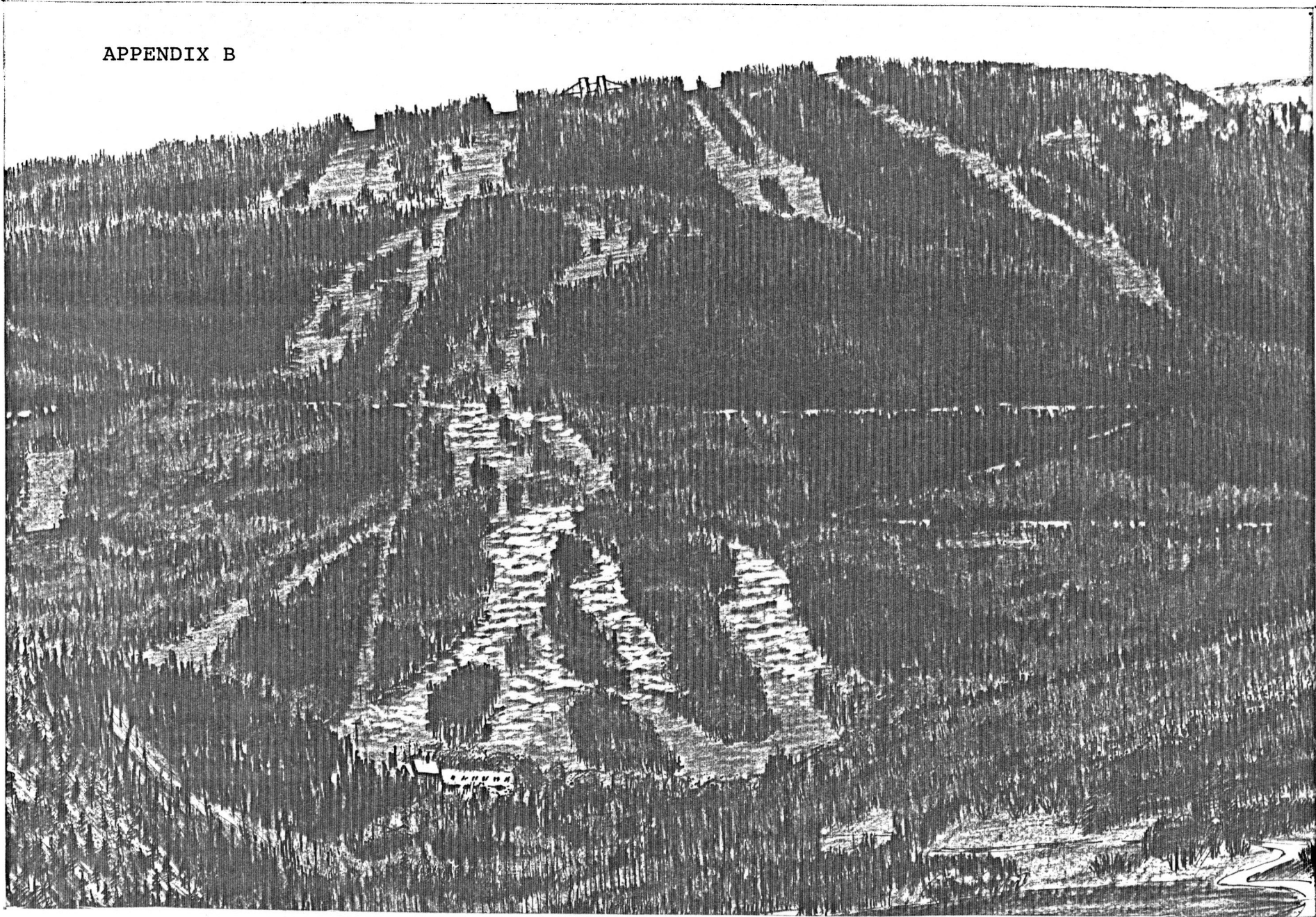




APPENDIX B

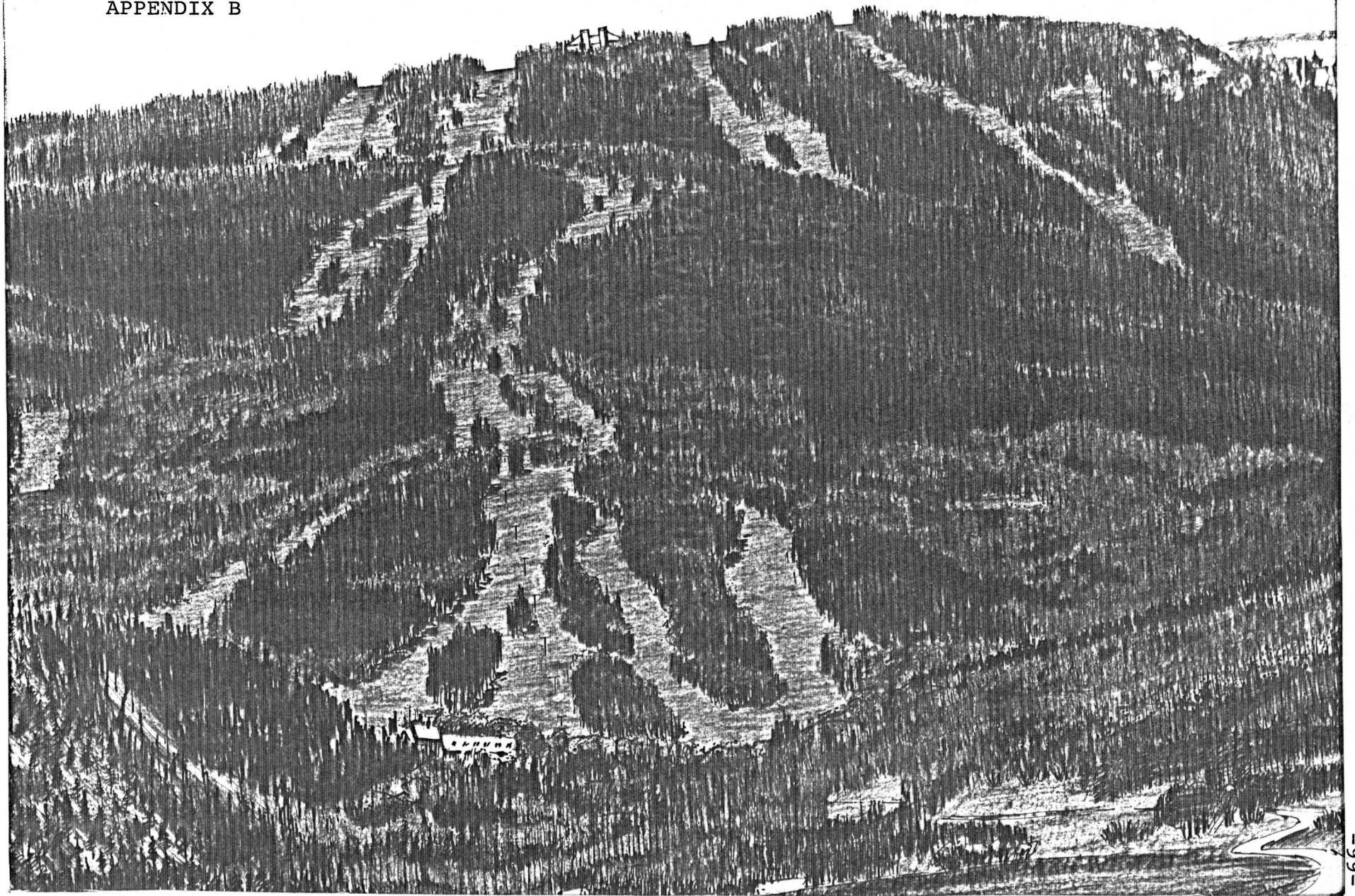


APPENDIX B

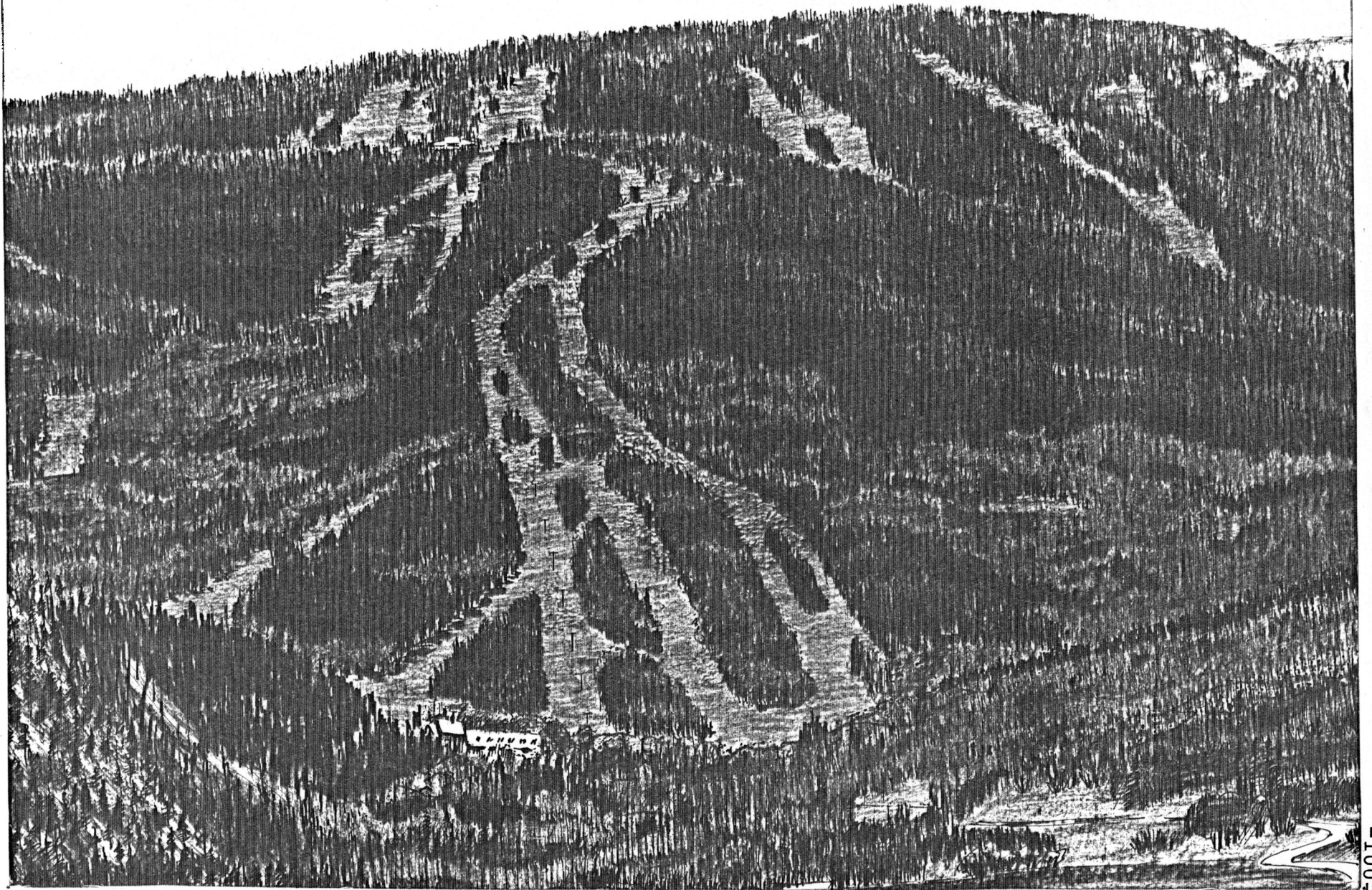




APPENDIX B

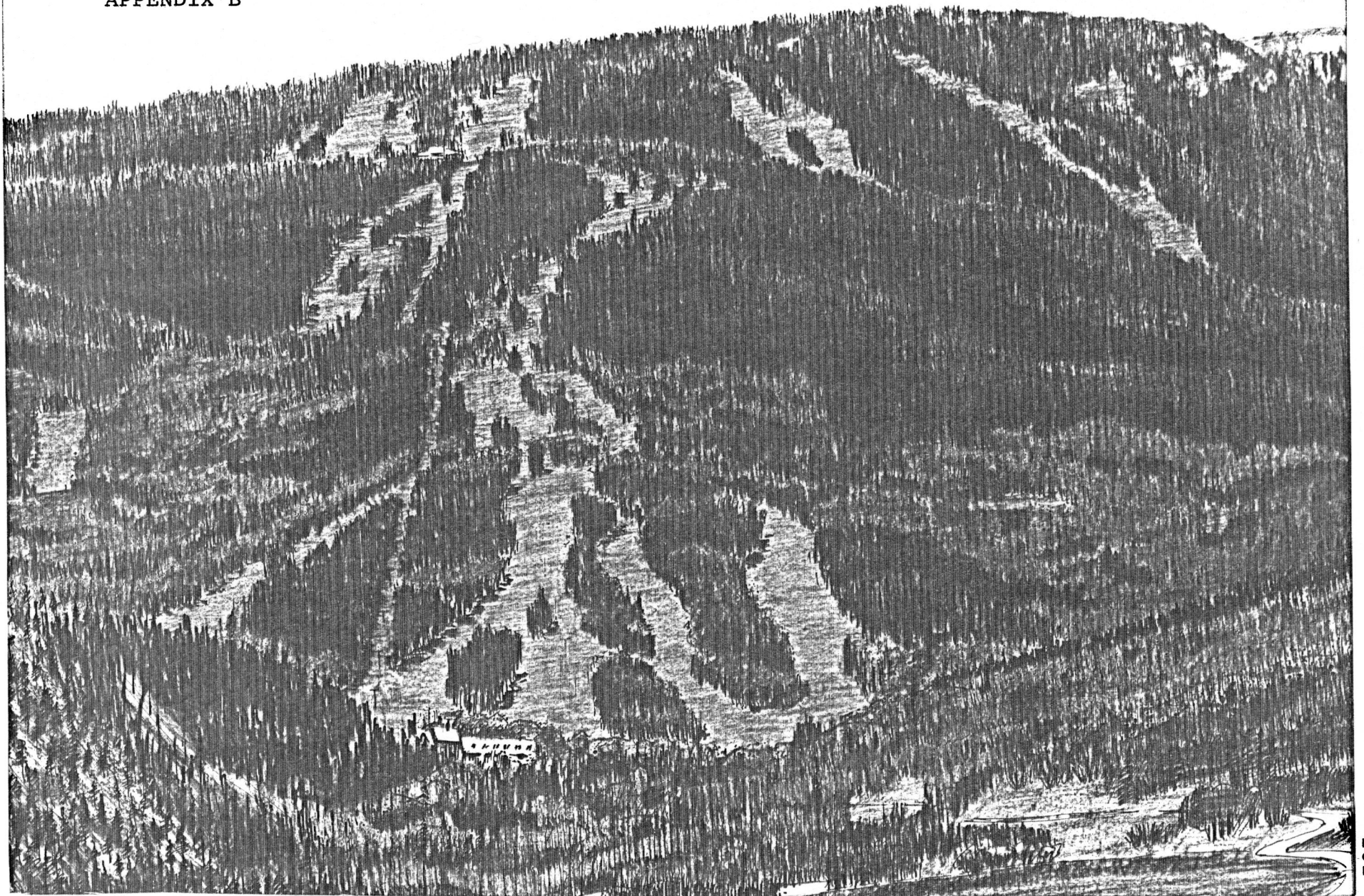


APPENDIX B





APPENDIX B



GENERAL INSTRUCTIONS

The judgments and responses you will be asked to make in this study have been selected to evaluate a variety of visual impacts frequently associated with ski trails and support facilities. All of the illustrations used in this study are intended to represent realistic, alternative design solutions for the layout of ski trails, lifts, maintenance road and mid-mountain restaurant at a specific location in the Rocky Mountains. The judgments that you will be asked to make do not call for an evaluation of the functional characteristics of the design. All that is required is an evaluation of the visual qualities of the design.

The illustrations show the design alternatives as they would appear in the summer months -(as seen in this color slide of the setting). The diazo printing process which was used to produce the illustrations often results in some deviations from uniform print quality. These deviations consist of minor differences between prints in overall color and darkness, or value - (as seen in this example). In every judgment it is important that you make an effort to ignore this variation in overall print quality, and concentrate on the features of ski trails and support facilities, and the visual impact within the setting of the different designs. The illustrations are large, but only the mountain in the center displays the different layouts of trails and facilities that you will be evaluating - (as outlined in red in this example). The rest of the illustration portrays the setting which these features occupy and relate to visually. No changes have been made in this portion of any of the illustrations.

You will be asked to compare the visual impact of different designs, and assess the level of visual compatibility that each design displays within the setting. The features that have been manipulated within the illustrations

APPENDIX C

may have a positive, neutral, or negative visual impact in your judgment. There are no incorrect responses because all of the judgments to be made are essentially subjective. All of the comparisons that will be made will involve some new combination of features, but the similarities will be apparent, and some of the comparisons will seem repetitive. Simply evaluate each comparison on an individual basis, and respond accordingly. Please wait until all of the procedures have been completed before discussing the comparisons with the other participants.

INFORMED CONSENT

The purpose of this study is to obtain information about people's perception of visual quality in the design of trails and support facilities for downhill skiing. The procedure will require each respondent to make a number of judgments regarding aspects of visual quality displayed in illustrations depicting various design concepts for downhill skiing at a specific location. The aspects of visual quality to be investigated are naturalistic appearance and visual appeal. The judgments will be structured around two basic procedures: paired comparison and rank ordering. In the paired comparison the respondents will be asked to examine pairs of illustrations presented as diazo prints, to select that member of the pair which more nearly displays a particular visual quality, and rate the magnitude of the difference between the members of the pair. The rank ordering will also utilize diazo prints of the illustrations, in sets of four. The respondents will be asked to arrange the sets in order of increasing conformance with a particular visual quality. One phase of the rank ordering will also require very brief graphic and written notations to be made. Both the paired comparison and the rank ordering procedures will be repeated in order to obtain information regarding naturalistic appearance and visual appeal. The entire procedure will take less than 50 minutes to complete. Respondents in this study may refuse to answer any questions or perform any tasks which seem threatening or in any way objectionable. Every respondent is free to withdraw from the study at any time. The identity of the respondents will be held confidential. At the back of this folder is a page of personal information to be filled out at the end of this session.

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PAIRED COMPARISON  
selection of the most naturalistic design

Page \_\_\_\_\_

Station # \_\_\_\_\_

I.D.# \_\_\_\_\_

First, record the station number in the space provided above. Now turn to the first pair of illustrations in the set, and compare them to the photograph projected at the front of the room. Examine the layout of ski trails and support facilities depicted in each illustration, and select the design which looks most naturalistic. Record this selection in the space provided below. If you do not see any difference between the two designs in the level of naturalistic appearance displayed, then mark the box labeled "no difference".

First Pair - most naturalistic design

check one: \_\_\_\_\_ TOP

\_\_\_\_\_ BOTTOM

\_\_\_\_\_ NO DIFFERENCE

Second Pair - most naturalistic design

\_\_\_\_\_ TOP

\_\_\_\_\_ BOTTOM

\_\_\_\_\_ NO DIFFERENCE

Third Pair - most naturalistic design

\_\_\_\_\_ TOP

\_\_\_\_\_ BOTTOM

\_\_\_\_\_ NO DIFFERENCE

Fourth Pair - most naturalistic design

\_\_\_\_\_ TOP

\_\_\_\_\_ BOTTOM

\_\_\_\_\_ NO DIFFERENCE

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PAIRED COMPARISON

Page \_\_\_\_\_

magnitude of difference: naturalistic appearance

Station # \_\_\_\_\_

I.D.# \_\_\_\_\_

First record the station number in the space provided above. Now, turn to the first pair of illustrations in the set and compare the relative levels of naturalistic appearance displayed in each design. Using the scale provided below, rate the magnitude of the difference between these two designs in the level of naturalistic appearance displayed by each.

First Pair - circle the number on the scale which most nearly represents the magnitude of the difference in the level of naturalistic appearance displayed in these two designs.

very similar

very different

|   |   |   |   |   |    |
|---|---|---|---|---|----|
| * | * | * | * | * | *  |
| 0 | 2 | 4 | 6 | 8 | 10 |

Second Pair - circle one

very similar

very different

|   |   |   |   |   |    |
|---|---|---|---|---|----|
| * | * | * | * | * | *  |
| 0 | 2 | 4 | 6 | 8 | 10 |

Third Pair - circle one

very similar

very different

|   |   |   |   |   |    |
|---|---|---|---|---|----|
| * | * | * | * | * | *  |
| 0 | 2 | 4 | 6 | 8 | 10 |

Fourth Pair - circle one

very similar

very different

|   |   |   |   |   |    |
|---|---|---|---|---|----|
| * | * | * | * | * | *  |
| 0 | 2 | 4 | 6 | 8 | 10 |

APPENDIX C



PAIRED COMPARISON

Page \_\_\_\_\_

selection of the most visually appealing design

Station # \_\_\_\_\_

I.D.# \_\_\_\_\_

First record the station number in the space provided above. Now turn to the first pair of illustrations in the set and examine the layout of the ski trails and support facilities depicted in each illustration. Imagine that you live in the mountains, and these illustrations represent the view from your livingroom window. Look at each design and select the one that holds the greatest visual appeal for you, that is the one that you would most enjoy viewing through your livingroom window. Record this selection in the space provided below. If you do not see any difference in the level of visual appeal displayed in the two designs then check the box labeled "no difference".

First Pair - most visually appealing design

check one:    \_\_\_ TOP  
                  \_\_\_ BOTTOM                    \_\_\_ NO DIFFERENCE

Repeat this procedure with the following three pairs of illustrations in the set.

Second Pair - most visually appealing design

check one:    \_\_\_ TOP  
                  \_\_\_ BOTTOM                    \_\_\_ NO DIFFERENCE

Third Pair - most visually appealing design

check one:    \_\_\_ TOP  
                  \_\_\_ BOTTOM                    \_\_\_ NO DIFFERENCE

Fourth Pair - most visually appealing design

check one:    \_\_\_ TOP  
                  \_\_\_ BOTTOM                    \_\_\_ NO DIFFERENCE

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PAIRED COMPARISON.

Page \_\_\_\_\_

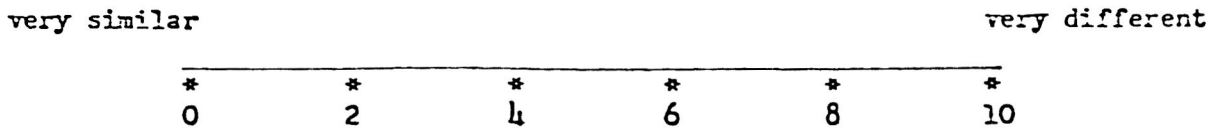
magnitude of difference rating: visual appeal

Station # \_\_\_\_\_

I.D.# \_\_\_\_\_

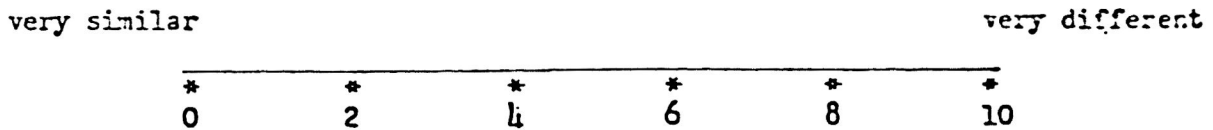
First record the station number in the space provided above. Now turn to the first pair of illustrations in the set and compare the relative levels of visual appeal displayed in each design. Using the scale provided below, rate the magnitude of the difference between these two designs in the level of visual appeal displayed by each.

First Pair - circle the number on the scale which most nearly represents the magnitude of the difference in the level of visual appeal displayed in these two designs.

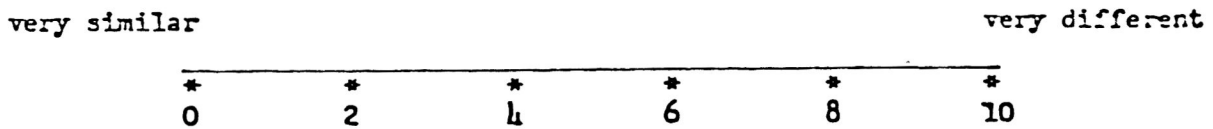


Repeat this procedure with the following three pairs of illustrations in the set.)

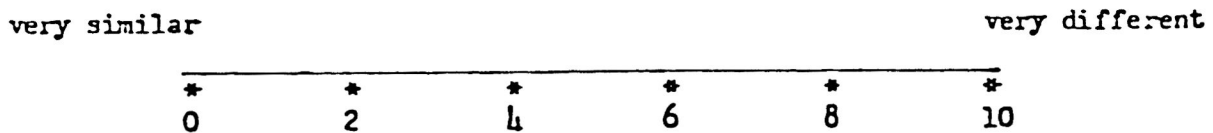
Second Pair - circle one



Third Pair - circle one



Fourth Pair - circle one



APPENDIX C

RANK ORDERING  
for visual appeal

Page \_\_\_\_\_

Station # \_\_\_\_\_

I.D.# \_\_\_\_\_

First record the station number in the space provided above. On the table is a set of four separate illustrations. Spread these out on the table so you can look at all four, and compare the design of ski trails and support facilities displayed in each. After you have studied each design, select the one which holds the most visual appeal for you. Next, select the design which holds the least visual appeal for you. Now place the remaining two illustrations in between so that the entire set is arranged in order of increasing visual appeal. Once you have done this, record the ranked order of the set in the spaces provided below. Use the color code in the upper right hand corner of each illustration to indicate the sequence.

\_\_\_\_\_  
(color code) MOST VISUALLY APPEALING DESIGN IN THE SET

\_\_\_\_\_  
(color code) MORE VISUALLY APPEALING DESIGN - INTERMEDIATE

\_\_\_\_\_  
(color code) LESS VISUALLY APPEALING DESIGN - INTERMEDIATE

\_\_\_\_\_  
(color code) LEAST VISUALLY APPEALING DESIGN IN THE SET

CONTENT ANALYSIS : Now, take the illustration which displays the design which holds the least amount of visual appeal for you, and place the clear plastic overlay on top of it using the clamps provided. Try to position the overlay so that the green border lies between the double borders on the illustration. Fill in your identification number in the space provided in the top-right of the overlay. Now, using the green pen provided, indicate on the clear overlay those features in the illustration which you feel detract from the visual appeal of the design and layout of ski trails and support facilities. Simply circle these features, or draw arrows to point them out. Also, make some written notes which provide a brief explanation of your reactions.

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PERSONAL INFORMATION

Age

- under 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 and up

Gender

- male
- female

Experience Downhill Skiing

- none
- beginner
- intermediate
- advanced

Exposure to Mountain Environments in the Western United States

- none
- fewer than four visits
- infrequent trips and vacations (fewer than once a year)
- frequent trips and vacations (at least once a year)
- previous resident

Membership or Support of Private Environmental Organizations (such as the National Wildlife Federation, Audobon Society, etc.)

- yes (current)
- yes (past)
- no

Design Related Experience and/or Formal Instruction in Design or Visual Aesthetics

please describe briefly:

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DATA SHEET - Content Analysis

I.D.# \_\_\_\_\_

Sta.# \_\_\_\_\_

set \_\_\_\_\_

Color Code \_\_\_\_\_

GUIDELINES

confirmed

contradicted

1. lifts

2. roads

3. reveg

4. skyline

5. runs

6. islands

Indication of misinterpretation:

Indication of response to visual features not covered by the guidelines:

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VISUAL ANALYSIS:  
AN EMPIRICAL EVALUATION OF DESIGN GUIDELINES  
FOR DOWNHILL SKI TRAILS AND MOUNTAIN SUPPORT FACILITIES

by

ROBERT B. JOSEPH

B.A., Kansas University, 1974

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AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the  
requirements for the degree

MASTER OF LANDSCAPE ARCHITECTURE

Department of Landscape Architecture

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

1986

## ABSTRACT

The purpose of this research is to investigate the perception of visual quality in the design of trails and mountain support facilities for downhill skiing. The following design guidelines are evaluated through a controlled, empirical study:

1. Minimize the visibility of lift lines.
2. Minimize the visibility of mountain maintenance roads.
3. Stabilize and revegetate disturbed slopes.
4. Avoid skyline corridors in trail layout, and avoid placement of buildings at the skyline.
5. Create irregular/curvilinear shapes and edges in individual trail design and group configuration.
6. Provide islands of vegetation in the design of individual trails.

The hypothesis states that the application of these guidelines produces naturalistic appearance and visual appeal. In order to test the hypothesis a photograph from the case study development (Beaver Creek, Colorado) is selected to present a view of the ski trails and mountain support facilities where all of the features were judged to be in substantial compliance with the guidelines listed above. This photograph is reproduced as a set of illustrations which are manipulated graphically to introduce violations of the guidelines. These illustrations are then compared and evaluated for naturalistic appearance and visual appeal in a paired comparison response format and a rank ordering response format. The respondent population (N=46) consists of college students drawn from a variety of disciplines.

The results from both response formats strongly support the efficacy of these guidelines in the design of ski trails and mountain support facilities as a means of preserving naturalistic appearance and enhancing visual appeal.

**Figure 9**  
**Study Illustration**  
**Map Pocket**



