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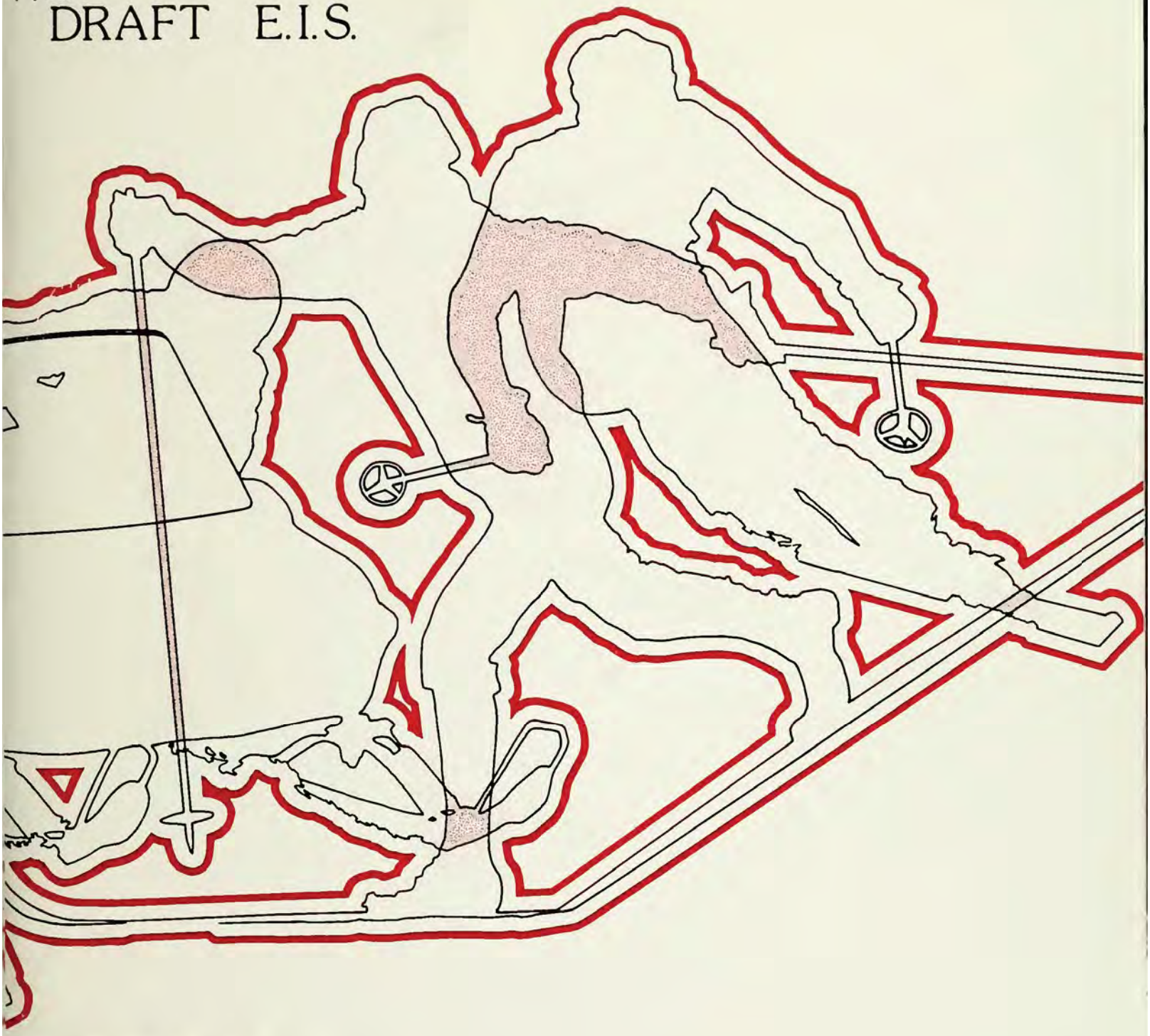

BEAR CANYON

MANAGEMENT PLAN

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BEAR CANYON MANAGEMENT PLAN

AND
DRAFT ENVIRONMENTAL IMPACT STATEMENT

DEPARTMENT OF NATURAL
RESOURCES AND CONSERVATION
FORESTRY DIVISION
32 SOUTH EWING
HELENA, MT 59601

PLEASE RETURN

OCTOBER 1980

CONTENTS

		Page
List of Figures		iv
List of Maps		iv
List of Tables		iv
I.	**Introduction**	1
II.	**Summary**	3
III.	**Legal Mandates**	4
IV.	**Existing Environment**	5
	Historic Use of Area	5
	Physical Characteristics	5
	Biological Characteristics	16
	Cultural Characteristics	19
	Socioeconomic Characteristics	19
V.	**Alternatives**	22
	Alternative 1: Maintain the Current Management Direction	22
	Alternative 2: Intensive Financial Return	22
	Alternative 3: Recommended Alternative	23
	Selection of the Recommended Alternative	23
VI.	**Description of the Proposed Action**	27
	Zone A	28
	Zone B	32
	Zone C	34
VII.	**Impacts of the Proposed Action**	37
VIII.	**Relationship Between Short-term Uses of the Environment and Maintenance And Enhancement of Long-Term Productivity**	41
IX.	**Irreversible and Irretrievable Commitment of Resources**	42
X.	**Individuals Contributing to the Preparation of the Management Plan And Environmental Impact Statement**	43
APPENDIXES		45
	A. Climatological Data	47
	B. Range Management Plan	50
	C. Road and Trail Travel Plan	53
	D. Moose Feeding Habits and Habitat	55
Glossary		58
Literature Cited		59

LIST OF FIGURES

Figure		Page
1.	General Geology of the Bear Canyon Management Unit	10
2.	General Geological Cross Section of Bear Canyon Management Unit	11
3.	Mechanisms for Slope Failure in Surficial Deposits	12

LIST OF MAPS

Map		Page
1.	Location	2
2.	Ownership	6
3.	Land Type	8
4.	Big Game Winter Range	17
5.	Forest Habitat Type	18
6.	Timber Management Potential	20
7.	Intensive Financial Return	24
8.	Recommended Management	26
9.	Roads, Trails, and Use Restrictions	30
B-1.	Range Suitability	52

LIST OF TABLES

Table		Page
1.	Plant-Related Limitations to Land Use	13
2.	Tree Harvest and Construction-Related Limitations to Land Use	14
3.	Physical Characteristics of Bear Canyon Planning Unit Watersheds	15
4.	Forest Land Potential Productivity on the Bear Canyon Planning Unit	16
5.	Primary Industries for Gallatin County	19
6.	Participation Income and Employment in Primary Industries, Gallatin County, 1970 and 1977	21
7.	Revenue Sources of the Recommended Alternative	38
8.	Percentage of Cover Type by Zone	39

INTRODUCTION

THE BEAR CANYON PLANNING UNIT

The Bear Canyon planning unit consists of 5,445 acres of classified state forest in 8½ adjoining sections (see map 1) managed by the Forestry Division of the Department of Natural Resources and Conservation (DNRC). Laws that call for monetary return to the school trust fund from state land, watershed protection, management under the multiple-use concept, and protection of Montana's natural resources provide management guidance, and the State Board of Land Commissioners directs management activities on the Bear Canyon Planning Unit. Because of its location, natural qualities, and array of recreational opportunities, Bear Canyon provides an excellent setting for multiple-use management. The diverse landscape provides recreation, clean water, timber, forage, a wide variety of wildlife species and habitat, and striking scenery. Gallatin Valley residents have benefitted from these resources for many years.

The decision to begin management planning in Bear Canyon was based on several factors. Demands for recreation, forest products, and livestock forage continue and will likely increase—particularly for recreation, since Bear Canyon's proximity to Bozeman will enhance its local market appeal as transportation costs increase. The existing recreational use of Bear Canyon and the apparent potential for development accelerated the planning process begun several years ago.

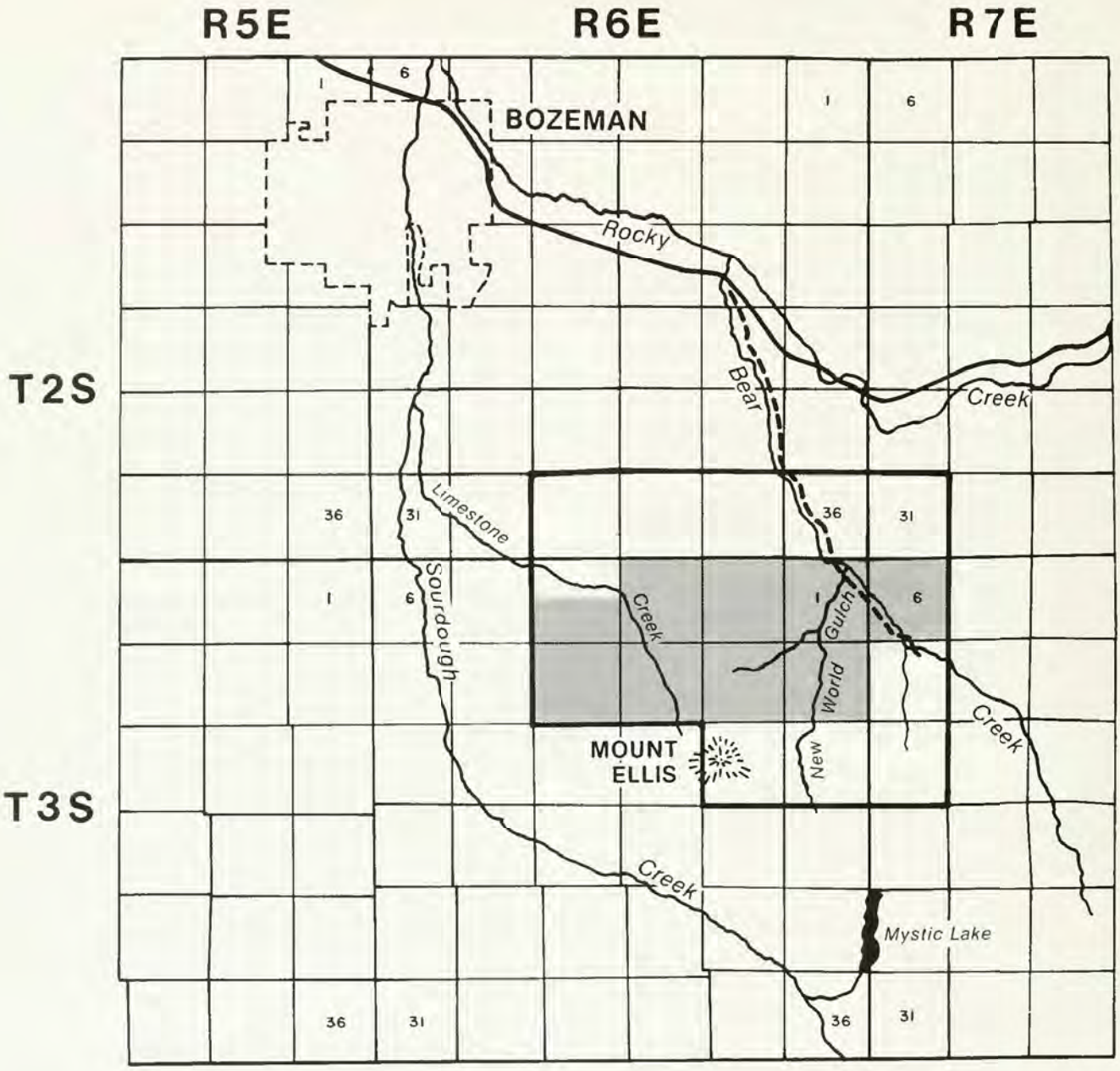
The Bear Canyon ski area was active and skiing was a rapidly growing sport when planning began. At that time DNRC's Forestry Division recognized the potential for ski area expansion as well as for increases in other forms of recreation and also recognized the need to integrate recreational uses and possible development with the other aspects of forest management in Bear Canyon. The objective of such planning is to allocate the use of the resources in the most beneficial manner. This entails the resolution of conflicting uses and the designation of areas primarily suited for particular activities. Efficient resource allocation, the goal of this management effort, must consider natural resource limitations, environmental contraints, social concerns, and legal guidelines to effectively use the limited resources of the Bear Canyon unit to satisfy reasonable resource demands, provide benefits to the school trust fund, and protect the environment.

THE PROPOSED MANAGEMENT PLAN

The proposed plan identifies three zones, each with a different primary management emphasis. Zone A would emphasize developed and dispersed recreation, Zone B would emphasize timber management, and Zone C's primary objective would be watershed and wildlife protection. These designations were based on each zone's primary suitability and don't imply that the zone would be devoted entirely to the primary use. Timber management, wildlife management, range management, and recreational management would all be practiced in each zone, but the intensities would vary from zone to zone. An exception would be Zone C, where timber management is not planned.

Once the plan is adopted, the Forestry Division's Bozeman Unit would implement it over a period of years. Full implementation would require additional funds for the execution of needed field projects discussed in this report. That funding could come from a variety of sources and would be used to improve trails and for other resource-protection projects. Review and revision of the plan is anticipated to occur at ten-year intervals.

BEAR CANYON MANAGEMENT UNIT
MAP 1 LOCATION



SUMMARY

Three alternative management plans are presented in this report:

1. Maintain the current management direction
2. Intensive financial return
3. Recommended alternative

These three alternatives all involve multiple use but would result in different impacts and management emphases.

Alternative 1, maintaining the current management direction, assumes that current programs and activities, including timber management, recreation management, wildlife management, and all other aspects of state forest land management, would continue at present levels. A major effect of this alternative would be to maintain the current level of management consistency and coordination between management activities.

Alternative 2, intensive financial return, would maximize returns to the school trust funds by managing all resources of the unit to their greatest financial advantage. Intensive timber management, livestock grazing and commercial recreation would be encouraged. Resolution of management conflicts would be weighted toward financial return.

Commercial recreation would be encouraged on 30 percent of the unit, in Zone 2-A. Zone 2-B accounts for 50 percent of the total area under this alternative and would be intensively managed for timber. Boundaries for each zone, delineated according to timber values, soil conditions, and recreation potential, are shown on map 7.

Alternative 3, the recommended alternative, provides for a moderate level of timber management with provisions for recreational land use, encouragement of commercial recreational development, livestock grazing, maintenance of scenic quality, and soil, watershed, and wildlife habitat protection.

Three management zones have also been identified for this alternative, as shown by map 8. Zone A comprises 40 percent of the area and places primary management emphasis on developed recreation. Moderate intensity timber management would be the primary objective in Zone B, which contains 40 percent of the total area, while the remaining 20 percent of the unit, Zone C, would have as its primary objective watershed and wildlife management. Zone boundaries in this alternative were delineated according to scenic quality, timber values, recreational potential, and soil conditions.

LEGAL MANDATES

The State of Montana was granted selected sections of federal lands when Montana was admitted into the union. Montana accepted the grants of federal lands (1889 MONT. CONST. ART. XI; 1972 MONT. CONST. ART X) and holds them in trust for the purposes specified. Income derived from the lands is designated for the support of Montana institutions, such as the common schools, agricultural college, mining college, university, asylums, reform school, and public buildings. (25 STAT. 679, 1889).

The majority of the lands granted, sections 16 and 36 in every township, were designated for common schools. The Board of Land Commissioners controls the management and disposition of school lands according to this guideline: "[T]hese lands and funds are held in trust for the support of education and for the attainment of other worthy objects helpful to the well-being of the people of this state." MCA 77-1-202 (1979).

Income derived by land and timber sales, rights of way, mineral royalties, leases and special use permits is deposited into the appropriate interest and income account, and then distributed. Five percent of the income from common school lands is retained in the permanent common school fund. No school lands can be removed from the trust unless the trust is compensated. 36 MONT. ATT'Y GEN. 511 (1976). Forest lands constitute the state forest; they are reserved for watershed protection and forest production, and cannot be sold. MCA 75-5-101 et seq. (1970).

The multiple-use management concept applies to all state lands. MCA 77-1-203 (1979). According to this concept there must be a balancing of the judicious use of the resources and the protection of long-term resource values for future generations. The lands are classified for the primary resource use, but secondary resource values, even if they do not have a classified value, are to be enhanced and maintained. Lands may be used for less than all of their resource capabilities. Wildlife, environmental considerations, and dispersed recreation, which have not produced income directly to the trust, are incorporated into the management framework by the dictates of the multiple-use act and the Montana Environmental Policy Act.

EXISTING ENVIRONMENT

The Bear Canyon planning unit is approximately 6 air miles southeast of Bozeman. Within its boundaries are 4 miles of paved road and 3½ miles of gravel road, as shown by map 1. The unit contains 5,445 acres and borders the Gallatin National Forest on much of the west, south, and east boundaries. Other state land classified as grazing land and administered by the Department of State Lands adjoins for 1¾ miles along the north; the remaining land along the north boundary is private, as shown by map 2.

HISTORIC USE OF THE AREA

Bear Canyon was originally contained within the Fort Ellis Military Reserve and, after being surveyed in the 1870's, was granted to the state of Montana in 1892. Timber figured prominently in the early development of Bear Canyon. A major timber operation consisting of a tie mill at Cooper's Camp, 10 miles up Bear Canyon, and a lath mill on the rail siding near the present Bear Canyon interchange on I-90 was in operation from 1902 until 1914. A 9½-mile-long flume was used to transport ties, timbers, and logs to the siding for transport to such places as the Butte mines. The entire operation ceased in 1914 when fire destroyed the tie mill, homes, school, and stores at Cooper's Camp.

The town of Commissary, once located about five miles up Bear Canyon, owed its existence to the timber operations. Its residents, two hundred at one time but normally forty, probably worked at Cooper's Camp as well as at Park Camp, another lumber camp located 4 miles up New World Gulch at the Base of Mount Ellis. This camp was also short lived. A large forest fire in 1910 burned much of the mill's available timber and continued burning eastward until an unseasonable snow storm stopped it and saved the town of Commissary. Little remains of either the lumber camp or Commissary.

More recently, the area has been a popular location of summer cabins and is also locally popular for skiing, hiking, and cross-country skiing. A small, inactive ski area is located on the unit. The facilities belonged to the Bozeman Ski Club until 1961 when they were sold to Fort Ellis Academy. The ski area was operated by Fort Ellis Academy, or their agents, until 1976 when the single-chair lift (built in 1969) was determined to be unsafe for operation. Since that time the lodge was destroyed by fire; construction of the lodge began in 1979. Other facilities that remain in a usable condition include the existing ski runs, a hill lighting system, a few small storage buildings, and a ski jump.

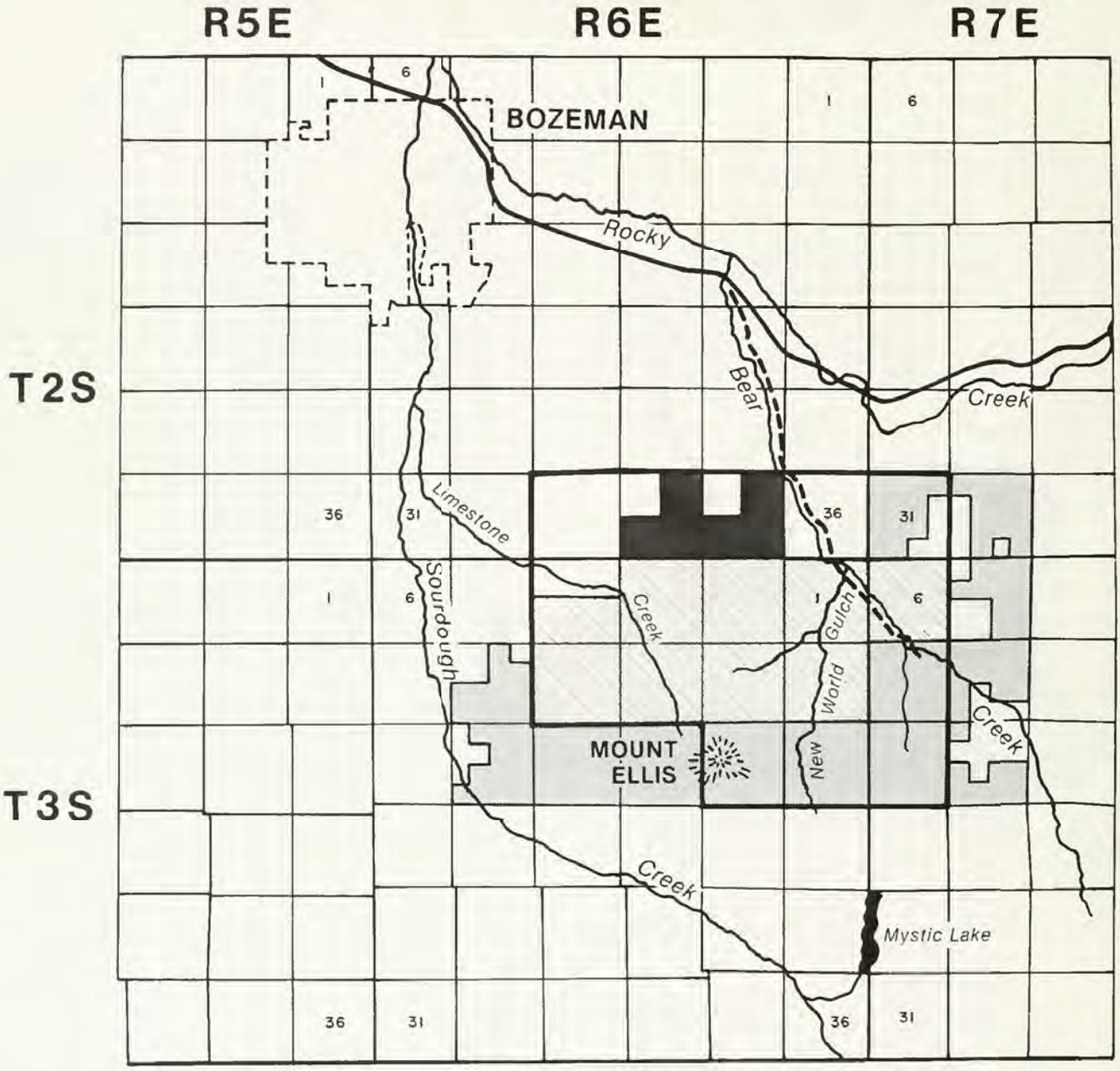
Residential development within the Bear Canyon unit is currently confined to the immediate vicinity of the Bear Canyon Road and ski area. Seven residences occupy cabin sites on state land in Bear Canyon; additionally there are three privately owned lots along the old flume right-of-way through the planning unit. A small subdivision containing four lots totaling 48 acres borders the planning unit on the north. An elementary school and forty residences are located between the planning unit and I-90 along the Bear Canyon Road.

PHYSICAL CHARACTERISTICS

Climate

Bear Canyon's climate can be generally described as a mountain valley climate with warm, sunny, summer days, cool nights, and relatively cold, snowy winters, although mild winter weather is not unusual. Most winter precipitation falls as snow, with average total snowfall ranging from 100 inches at 5,500 feet to 150 inches at 6,800 feet. Total annual precipitation varies from 21 to 29 inches at these elevations (USDA 1978). This compares with 85 inches of snowfall and 14 inches of average annual

BEAR CANYON MANAGEMENT UNIT
MAP 2 OWNERSHIP



Management Unit and Adjacent Ownership

- State of Montana (Classified Grazing Land)
- Gallatin National Forest
- Private
- State of Montana (Classified Forest Land)

precipitation in Bozeman. The periods of May-June and October-December receive the greatest precipitation; January-February and July-August are the driest periods. Summer storms are characteristically showers or thundershowers infrequently accompanied by hail, but steady rains also occur in early June and late September. Storm probabilities indicate that a six-hour storm with a probability of occurring once in 25 years would deliver 1.6-2.0 inches of precipitation, while a 25-year, 24-hour storm would yield 2.4-3.1 inches (Montana DNRC 1976a).

Geology

The entire stratigraphic sequence from the Precambrian crystalline complex through the Mesozoic sedimentary rocks common to the Bozeman area is exposed in the Bear Canyon Unit (see figure 1). The uplifted block of Precambrian metamorphic rocks in the west end of the Bear Canyon area has exposed this sequence up through shales deposited just prior to the 60-million-year-old Rocky Mountain formation. Folding, faulting, and the relative resistence to erosion of the sedimentary rocks in the eastern two-thirds of the area have produced a complex structure that has strongly affected topography, drainage patterns, and slope stability.

Uplift in the west (the Mount Ellis Ridge) and dropping in the east along with compressional stress has produced a series of north-south trending anticlines and synclines (see figure 2). Sedimentary beds near the uplifted block exhibit steep dip angles with some overturning of beds and thrust faulting over younger formations to the east. The main Bear Canyon valley consists of gently folded beds of young sediment; toward the east end of the area the more resistant limestones have been exposed by erosion. A high-angle normal fault raised the sedimentary beds in the north end of the unit. None of these faults is active now, but they had a strong influence on the present topography and have also affected drainage direction, as with Moonshine Gulch (Montagne 1979). Stream patterns have generally become entrenched by eroding soft sediments but, once entrenched, have successfully eroded channels through the harder sediments encountered in minor anticlines and synclines.

Tilting and subsequent dissection of alternating sandstones and shales has resulted in mass failures on many steep, wet slopes. Many of these slumps and flows have become relatively stable but could be activated by actions that cut slope toes or add water. Typical mechanisms for slope failure are illustrated in figure 3.

The possibility of the occurence of commercial minerals in the Bear Canyon area is slight. No minerals have been reported in concentrations considered feasible to mine. Small coal seams are found to the east and north of the Bear Canyon unit. The limestone formations found in the Bear Canyon area hold large quantities of oil in other parts of Montana. The anticlinal dome structure associated with oil entrapment may be present but fracturing from severe folding and faulting may have kept such entrapment localized and small. Oil exploration companies have applied to the Department of State Lands (which administers subsurface resources in Bear Canyon) for exploration leases, but the leases have not been granted.

Soils

Map 3 shows the land types found in the Bear Canyon planning unit, categorized according to variations in land form, soil development, bedrock, geology, and vegetation. Combined with the interpretations provided in tables 1 and 2, map 3 explains limitations on land use in the Bear Canyon unit. The limitations on some land types are severe because of mass failure hazard, indicated usually by the presence of steep slopes, clay soils derived from shales and mudstones, sedimentary beds dipping in the same direction as the slope, vegetation indicative of abundant free water, or rough, broken topography indicative of a history of mass failure.

The definitions of the slight, moderate, and severe ratings in tables 1 and 2 are as follows:

Slight: Construction and maintenance costs would be relatively inexpensive, and little or no environmental degradation would be expected.

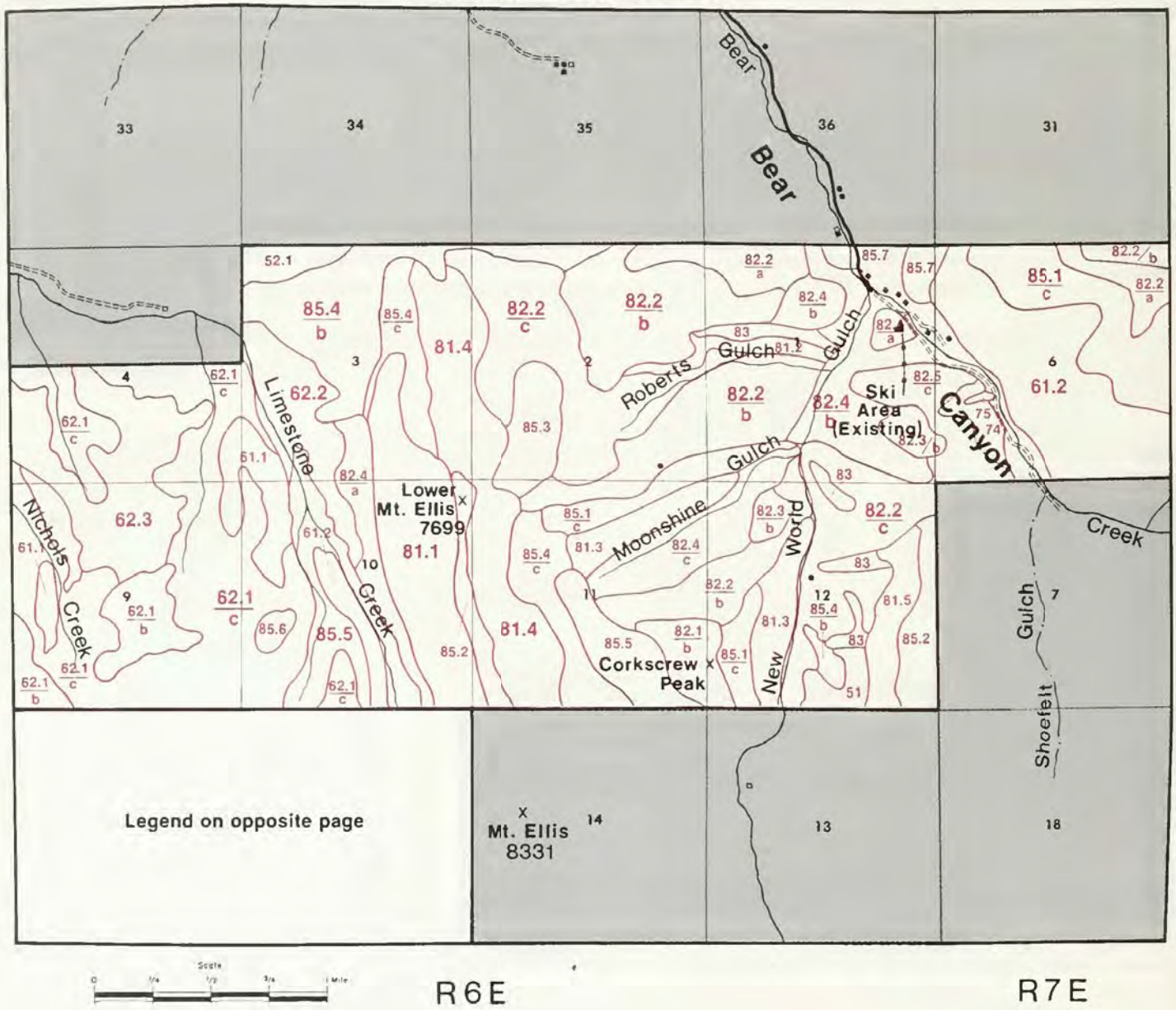
Moderate: Costs of construction and maintenance would be higher if environmental degradation were to be mitigated. If there were no attempt at mitigation, environmental damage would probably be significant.

Severe: Construction and maintenance costs would be high, and environmental damage would be high even if mitigation were attempted. The cost of reducing environmental damage to acceptable levels in these areas may be prohibitive.

Combining these ratings with the numbered limitation reasons given in tables 1 and 2 provides a description of the capabilities of each land type. For example, in table 1, the limitations to seedling establishment for land-type unit 62.3 are "SV 1, 2, 4, 7." The limitation for seedling establishment would be severe because of physical impediment (support related) (No. 1 in the key at the bottom of table 1), water availability (No. 2 in the key), nutrient availability (No. 4), and competition at seedling stage (No. 7).

BEAR CANYON MANAGEMENT UNIT

MAP 3: LAND TYPE

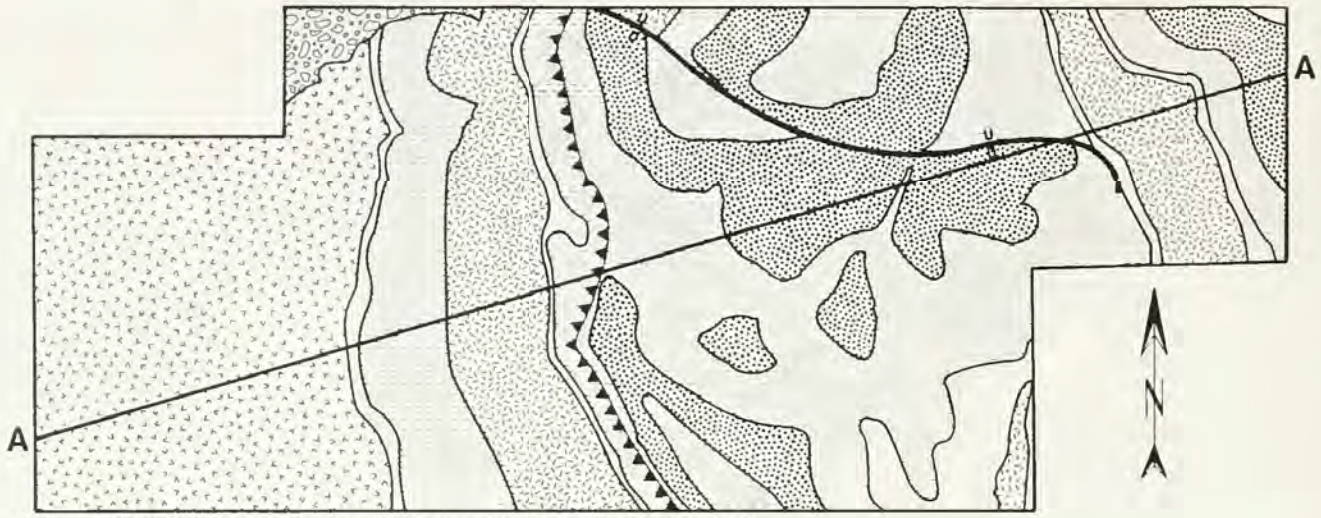


LEGEND

51 Talus Slopes
52.1 Colluvial-alluvial Slopes
61.1 Streamcut Breakland · weak pluvial, granitic
61.2 Streamcut Breakland · strong pluvial, limestone
62.1 Pluvial Dissection · churned, granitic
62.2 Pluvial Dissection · pluvial, mixed sedimentary
62.3 Pluvial Dissection · pluvial, granitic
74 Rotational Slumping
75 Landflow
81.1 Structural Breakland · pluvial, limestone
81.2 Structural Breakland · weak mass wasting
81.3 Structural Breakland · moderate mass wasting
81.4 Structural Breakland · avalanches, limestone
81.5 Structural Breakland · avalanches, quartzite
82.1 Dip Slopes · churned
82.2 Dip Slopes · pluvial, mixed sedimentary
82.3 Dip Slopes · pluvial, sandstone
82.4 Dip Slopes · mass wasting, mixed sedimentary
82.5 Dip Slopes · mass wasting, clay shales
83 Scarp Slopes
85.1 Structural Control · pluvial
85.2 Structural Control · churned, limestone
85.3 Structural Control · churned, mixed sedimentary
85.4 Structural Control · colluvial-alluvial, mixed sedimentary
85.5 Structural Control · colluvial-alluvial, clay shales
85.6 Structural Control · mass wasting, granitic
85.7 Structural Control · mass wasting, mixed sedimentary

Slope Phases · a · 0-20%
b · 20-40%
c · 40-60%

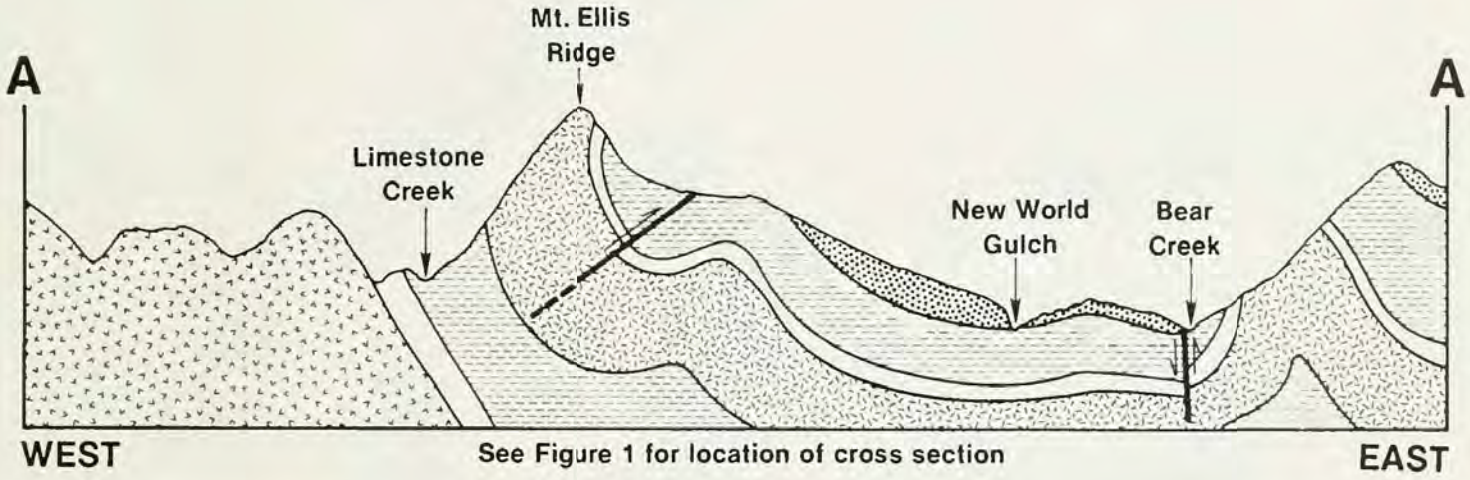
FIGURE 1
GENERAL GEOLOGY OF THE BEAR CANYON MANAGEMENT UNIT



Source: USGS Mystic Lake Quadrangle, Montana, Geologic Inventory Map I-398

ROCK TYPE	FORMATIONS
Alluvium and Colluvium	
Sandstone with thin beds of Shale and Limestone	Kootenai
Interbedded Shale, Sandstone, Siltstone and Limestone	Mowry and Thermopolis Shales, Morrison, Swift, Rierdon, Piper, Grove Creek and Snowy Range, Pilgrim Limestone, Park Shale, Meagher Limestone, Wolsey Shale
Limestone and Dolomite	Amsden, Madison Group, Three Forks Shale, Jefferson Dolomite, Bighorn Dolomite
Quartzite	Quadrant Quartzite, Flathead Quartzite
Gneiss, Schist and Granite	
U / D Fault	
Overturned Thrust Fault	
A—— Location of Cross Section	

FIGURE 2
GENERAL GEOLOGICAL CROSS SECTION OF BEAR CANYON MANAGEMENT UNIT



Fault Line

Metamorphic (gneiss, schist, granite)

Sedimentary (quartzite)

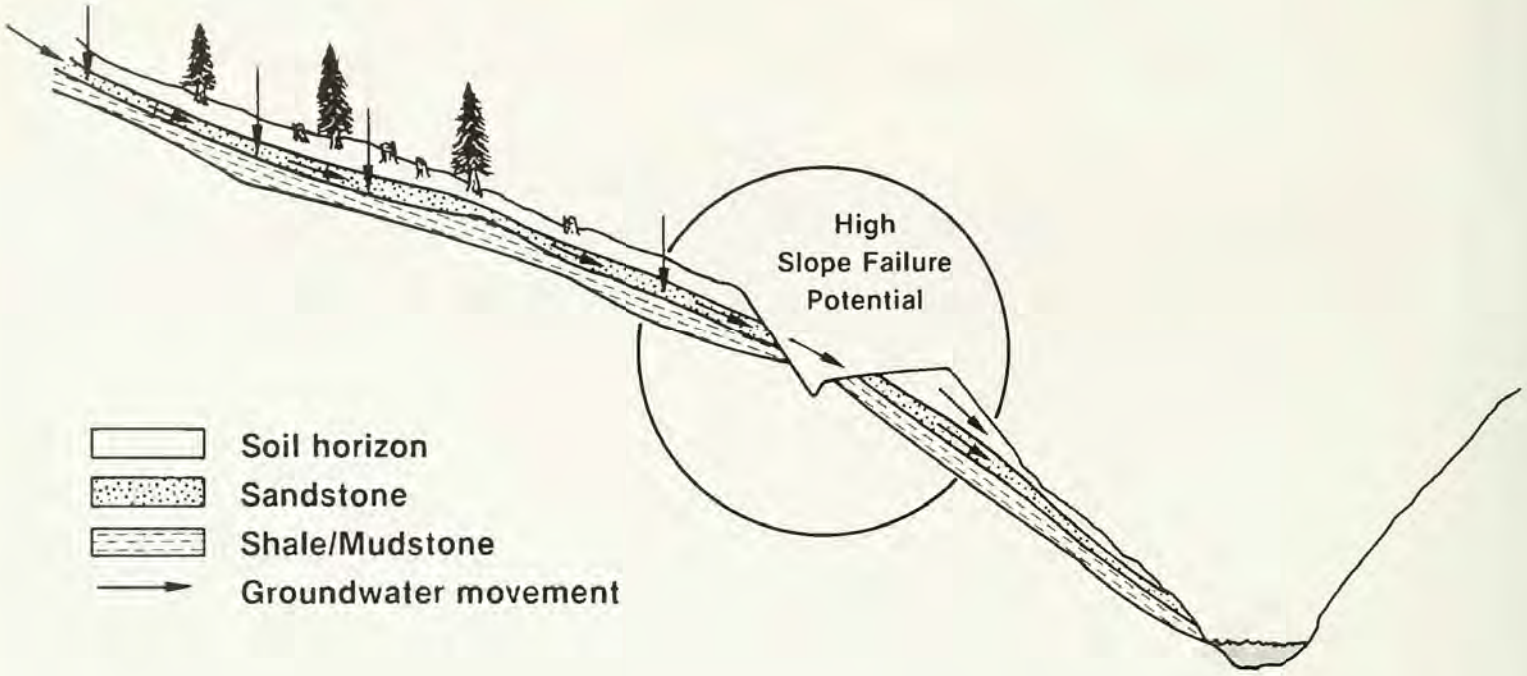
Sedimentary (limestone, dolomite)

Sedimentary (interbedded-shale, siltstone, limestone and sandstone)

Sedimentary (sandstone with thin beds of shale and limestone)

FIGURE 3

MECHANISMS FOR SLOPE FAILURE IN SURFICIAL DEPOSITS



Interbedded sandstones and shales/mudstones are prevalent in the Bear Canyon area.

Sandy soils and sandstone transmit water to the impervious shale layer.

Water is concentrated along the sandstone-shale interface.

High concentration of groundwater induces slope failure on the lower one-third of the slope, especially where natural slope hydrology is disrupted.

Removal of vegetation reduces transpirational surface, increasing the quantity of ground water and the opportunity for slope failure.

Road drainage features that concentrate water may also induce slope failure.

TABLE 1 PLANT-RELATED LIMITATIONS TO LAND USE

LAND TYPE	SEEDLING ESTABLISHMENT (trees)	TREE GROWTH	REGENERATION OF: DISTURBED SURFACES	REGENERATION OF: CUT BANKS
51	Sv 1, 2, 5	Sv 1, 2, 5	Sv 2, 4	Sv 2, 4
52.1	Sv 2, 3, 7	Sv 2, 3, 7	St	St
61.1	M-Sv 2, 7	St	Sv 2	Sv 2, 4
61.2	Sv 2, 5	Sv 1, 2, 4, 5, 6	Sv 2, 4	Sv 2, 4, 6
62.1b	M 7	St-M 1	M-Sv 2, 4	M 4
62.1c	St	St	M-Sv 2, 4	M 4
62.2	Sv 2, 5, 7	Sv 7	M 2	M 2
62.3	Sv 1, 2, 4, 7	Sv 1, 2, 7	Sv 2, 5	Sv 2, 4
74	St-M 1, 2, 7	St-M 1	M-Sv 1, 2	St-M 2
75	M 1, 2, 3	Sv 1, 3	M-Sv 1	Sv 1
81.1	Sv 2	Sv 2, 4, 6	Sv 2, 5	Sv 2, 6
81.2	Sv 1, 2, 3, 5	Sv 2, 3, 5	Sv 1, 2	Sv 2, 5
81.3	M-Sv 2	M-Sv 1, 2, 7	M-Sv 1, 2	M
81.4	Sv 1, 5, 7	Sv 1, 2, 5, 6	M 2	M-Sv 5
81.5	Sv 1, 5, 7	Sv 4, 5	M-Sv 2, 4	Sv 2, 4
82.1b	M-Sv 1, 2, 5	M-Sv 2, 4, 5	M-Sv 1, 2, 4, 5	M-Sv
82.2a	St-M 7	St-M 1	St	St
82.2b	St-M 7	St-M 1	St	St
82.2c	St-M 2, 7	St	St	St
82.3b	St-M 2, 7	M 1, 2	M 2	M 2, 4
82.3c	St-M 2, 7	M 2	M 2	M 2, 4
82.4a	St	St-M 1, 3	St	St
82.4b	St	St-M 1	St	St
82.4c	St-M 7	St-M 1	St	M 1
82.5c	St-M 7	St	St	St
83	Sv 1, 2, 5, 7	Sv 2, 5	Sv 2, 5	Sv 2, 5
85.1b	M-Sv 1, 2, 5, 7	M-Sv 2, 5	M-Sv 2, 5	M 2, 5
85.1c	M-Sv 2, 7	M-Sv 2, 5	M 2	M 2
85.2	Sv 1, 2, 5, 7	Sv 1, 2, 5, 6	M-Sv 1, 2, 5	Sv 2, 5, 6
85.3	Sv 1, 2, 5, 7	Sv 2, 7	St-M 1, 2, 5	M-Sv 2, 5
85.4b	M-Sv 2, 7	St-M 1	St	St
85.4c	St-M 2, 7	M-Sv 1, 5	St-M 2, 5	St
85.5	St-Sv 1, 5, 7	St-Sv 1, 3, 5, 7	St	St
85.6	St	St-M 2	St	M 1, 4
85.7	M-Sv 2, 3, 7	St-M 1, 2, 3	St	M-Sv 1

NOTE: St = Slight, M = Moderate, Sv = Severe

Reasons for limitations:

1. Physical impediment (support related)
2. Water availability
3. Air availability
4. Nutrient availability
5. Temperature (hot or cold)
6. Toxic elements ($CaCO_3$)
7. Competition at seedling stage

TABLE 2 TREE HARVEST AND CONSTRUCTION-RELATED LIMITATIONS TO LAND USE

UNIT #	STEM REMOVAL (trees)	OVERLAND EQUIPMENT USE	ROAD CONSTRUCTION	USE OF SITE, & MATERIALS FOR ROAD	FOUNDATIONS
51	NA	Sv 2	Sv 10	Sv 10	Sv 10
52.1	NA	St	M 10	M 3, 10, 16, 17	Sv 1, 9, 17
61.1	Sv 4, 5, 13	M 1	Sv 1, 4, 5	M 5	Sv 1
61.2	Sv 4, 5	Sv 1	Sv 1, 4, 7, 19	M 10	Sv 1
62.1b	M 13	St	St	St	M 1
62.1c	M 13	M 1	M 1, 4, 5	M 5	Sv 1
62.2	M 4, 5, 13	M 1	M 1, 4, 5	St	M-Sv 1
62.3	M 13	St-M 1	M 1, 4, 5	M 5	Sv M 16
74	Sv 9	Sv 1, 2	Sv 9, 10	M 10	Sv 1
75	Sv 9	Sv 2, 9, 17	Sv 9, 17	Sv 3, 8, 17	Sv 1, 9
81.1	Sv 5, 20	Sv 1	Sv 1, 19	M 10	Sv 1
81.2	Sv 4, 5	Sv 1	Sv 1, 4	Sv 3	Sv 1
81.3	Sv 4, 5, 9	Sv 1	Sv 1, 4, 9	Sv 3	Sv 1
81.4	M-Sv	Sv 1	Sv 1, 18	M 10	Sv 1
81.5	St	Sv 1	Sv 1, 10	Sv 7, 10	Sv 1, 10
82.1b	M 13, 14	St	St	M 10	M 1
82.2a	St	M 6	M 8, 17	M 3, 16, 17	M-Sv 3, 16, 17
82.2b	M 9	M 1, 6	M 17	M 3, 16, 17	M-Sv 1, 3, 16
82.2c	M-S 5	Sv 1	M 9	M 3, 16, 17	M-Sv 1, 3, 16
82.3b	St	St	St	St	M 1
82.3c	St	Sv 1	M 5	M 5	Sv 1
82.4a	St	M 5, 6, 8, 17	St	M 3, 17	Sv 1, 3, 9, 16
82.4b	M 4, 9	M 1, 5, 6, 8, 17	M 4, 9	M 3, 17, 16	Sv 1, 3, 9, 16, 17
82.4c	M-Sv 4, 5, 9	Sv 1, 5, 6, 8, 17	Sv 4, 9	M 3, 5, 16, 17	Sv 1, 3, 9, 16, 17
82.5c	M 9	M-Sv 1, 6, 17	M-Sv 9	M-Sv 9, 17	Sv 1, 3, 9, 16, 17
83	NA	Sv 1	Sv 1, 10	M 3, 10	Sv 1
85.1b	M 4, 5	M-Sv 1, 5	M 1	M 7	Sv 1
85.1c	M 13, 20	M 1	St-M 1	St-M 3, 17	M-Sv 1
85.2	Sv 5, 15, 20	M-Sv 1, 2	M 1, 2, 10	Sv 7, 10	M 1
85.3	NA	St	St	M 7	M 1
85.4b	St	St-M 6, 17	St	St	M 1
85.4c	M 5	Sv 1	M 1	M 7	Sv 1
85.5	M-Sv 4, 13	Sv 6, 8, 17	Sv 3, 8, 17	Sv 3, 16, 17	Sv 1, 3, 8, 16, 17
85.6	M-Sv 4, 5, 9	M 1, 5, 6, 8, 17	M 1, 3, 5	M 5	Sv 1, 3, 9
85.7	Sv 4, 9	Sv 1	Sv 1, 9	Sv 3, 17	Sv 9, 17

NOTE: St = Slight, M = Moderate, Sv = Severe.
Reasons for limitations:

1. Slope steepness
2. Surface obstructions or roughness
3. Clay content
4. Sediment delivery rate (buffer capacity)
5. Erosive
6. Soil compaction hazard
7. Shallow hard bedrock
8. Poor soil drainage
9. Mass failure hazard
10. Stone content
11. Shrink-swell
12. Percolation rate
13. Windthrow
14. Nutrient cycling
15. Access
16. Frost heave
17. Low bearing capacity
18. Avalanche (snow)
19. Rock slide
20. Regeneration or revegetation problems

TABLE 3 PHYSICAL CHARACTERISTICS OF BEAR CANYON PLANNING UNIT WATERSHEDS

Watershed	Drainage Area Acres	Miles	% State Ownership	Drainage Density[1]	Channel Gradient (%) Upper (Forested)	Lower (Nonforested)	Total	Channel Length By Stream Order[2] 1	2	3	Total	% in Elevation Zone (1000 s ft) 4-5	5-6	6-7	7-8	Average Annual Runoff (Ac ft)	25-Year Peak Runoff (c f s)	Area of Lakes & Ponds (Acres)
BEAR CREEK WATERSHED																		
New World Gulch	3520	5 5	52 7	0 95	9 0		9 0	4 3	0 9	0	5 2	0	13	75	12	2354	117	0
Bear Creek	9261	14 5	12 0	0 94	4 1	1 6	3 3	5 6	3 9	4 1	13 6	2	25	59	14	6287	—	4 3
TOTAL	12781	20 0	23 2	0 94				7 9	4 8	4 1	18 8	1	22	64	13	8641	332	4 3
LIMESTONE CREEK WATERSHED																		
Nichols Creek	1062	1 7	33	1 b	14 6	2 5	8 4	2 8	0	0	2 8	0	62	38	0	538	68	0
Limestone Creek	3836	6 0	42	1 7	5 3	2 0	3 8	5 6	4 5	0	10 1	0	61	38	1	1971		0
TOTAL	4898	7 7	39	1 7				8 4	4 5	0	12 9	0	61	38	1	2555	205	0

[1] Miles of stream channel per square mile of drainage area.
[2] Stream order: first order streams are the smallest unbranched tributaries (Horton 1945).

Watersheds

The planning unit is drained by two principal watersheds. The Bear Creek watershed includes 2,934 acres, 54 percent of the unit. Limestore Creek accounts for 1,966 acres, 36 percent of the area; both are perennial streams. The remaining 10 percent, 545 acres, consists of portions of other watersheds; table 3 further describes watershed characteristics and flow regimes.

Only a limited amount of water quality data is available for the area. Both Bear Canyon and New World Gulch are capable of contributing large quantities of sediment during high-flow periods and very little during low-flow periods. Sedimentation in New World Gulch is aggravated by the existing trail's location, condition, and recreational use. Sedimentation during high flows on Bear Creek is partially due to the poorly located jeep trail that continues upstream from the ski area (DNRC 1979a).

A portion of the New World Gulch trail has been relocated to reduce stream sedimentation, and several foot bridges have been installed at creek crossings. These improvements were accomplished through federal employment projects.

There also are natural reasons for variation in water quality. The streams flowing through limestone, sandstone, and shale areas carry approximately twice the dissolved solids of streams arising in metamorphic substrates in the planning unit (DNRC 1979a).

Limestone Creek differs from New World Gulch and Bear Creek in that man's activities have contributed little if any to stream sedimentation. Livestock grazing (none in recent years) and occasional pedestrian, horseback, or motorbike traffic are the only human influences in this drainage. No roads, logging areas, or other developments exist along Limestone Creek (except for a narrow trail constructed many years ago part way up the East Fork), which is fortunate, since unstable soils and boggy conditions are common in this nearly pristine drainage.

Air Quality

There are no comparative data to link Bear Canyon with the nearest air quality monitoring station recently installed on the Montana State University Campus.

There are several sources of air pollution (primarily particulates) in Bear Canyon:

1. Dust from the Bear Canyon road.
2. Smoke from home heating systems.
3. Smoke from debris burning by residents.
4. Smoke from occasional slash burning.
5. Automobile exhaust and other minor contributors.

There has been no report of air quality problems or any other reasons to suspect that increases in the number of residences or the addition of other minor

pollution sources will be significantly detrimental to air quality in Bear Canyon (Bolstad 1979). Even so, there is reason for caution: natural cleansing of the airshed is only fair. The relatively deep, narrow canyon faces north, decreasing the effectiveness of the west wind's ventilation of Bear Canyon. The northern orientation of the canyon also decreases solar heating of the canyon which reduces the intensity of diurnal winds, particularly in the winter when the solar angle is low and inversion stability is generally more pronounced.

Fire

Bear Canyon is not prone to large numbers of fires. The last large fire occurred in 1910, burning much of Mount Ellis and Bear Canyon; since that time there have been few reported fires. Only two wildland fires, both smaller than one acre, have occurred between 1940 and the present, one started by a campfire in Bear Canyon and the other, along the Mount Ellis Ridge, caused by lightning. Bear Canyon lies in a low lightning intensity zone. Despite the low rate of fire occurrence, Bear Canyon is subject to periodic large fires when weather and vegetation conditions combine to create extreme burning conditions, as in 1910.

BIOLOGICAL CHARACTERISTICS

Wildlife

A comprehensive wildlife species list for the planning unit is not available at this time. Observations and communications with the Department of Fish, Wildlife, and Parks indicate that a considerable variety of wildlife exists. Besides the usual small mammals and birds, there are mountain grouse, deer, elk, moose, and black bear.

The cliffs on the east side of Bear Canyon can provide suitable nesting sites for prairie and peregrine falcons. Prairie falcons are known to nest on the cliffs, but peregrine falcons have not been observed in Bear Canyon or elsewhere in the Gallatin Valley. There is a bald eagle nesting site in the planning unit. The bald eagle is classified as endangered; other threatened or endangered species have not been reported.

The winter range map (map 4), prepared in cooperation with the Department of Fish, Wildlife, and Parks, shows that nearly the entire area is moose range. Moose are in evidence throughout the unit; browsed areas and trails are abundant. There is less evidence of deer, elk, and black bear. Moose are the dominant big game species in Bear Canyon and have received considerable study. One such study, which spanned eight years and was completed in 1973, concentrated on moose populations in the Gallatin and Madison drainages, including Bear Canyon (Montana Department of Fish and Game 1974). Information from this study and from the planning unit is used in appendix D to further describe moose activity and habitat on the unit.

Fisheries

Bear Canyon has limited fishing potential. The Department of Fish, Wildlife, and Parks is aware of only rough fish in Bear Creek. Trout may be found in Limestone Creek, a small stream that may not support sport fishing within the planning unit.

Timber

Lodgepole pine is the dominant timber species in Bear Canyon, followed by Douglas fir, spruce, and subalpine fir. The lodgepole pine stands in Bear Canyon represent several age classes and result from major forest fires during the past 150 years.

Potential productivity was determined by first identifying habitat types within the unit (shown on map 5) and then using published productivity ratings for habitat types east of the continental divide (Phister et al. 1977). Table 4 lists the number of acres found in each potential productivity class.

Approximately 40 percent of the potentially productive lands in the Bear Canyon Planning Unit are effectively removed from the currently available timber base because of unstable soils, excessively wet soils, steep slopes, and the potentially adverse watershed impacts associated with timber management in these areas.

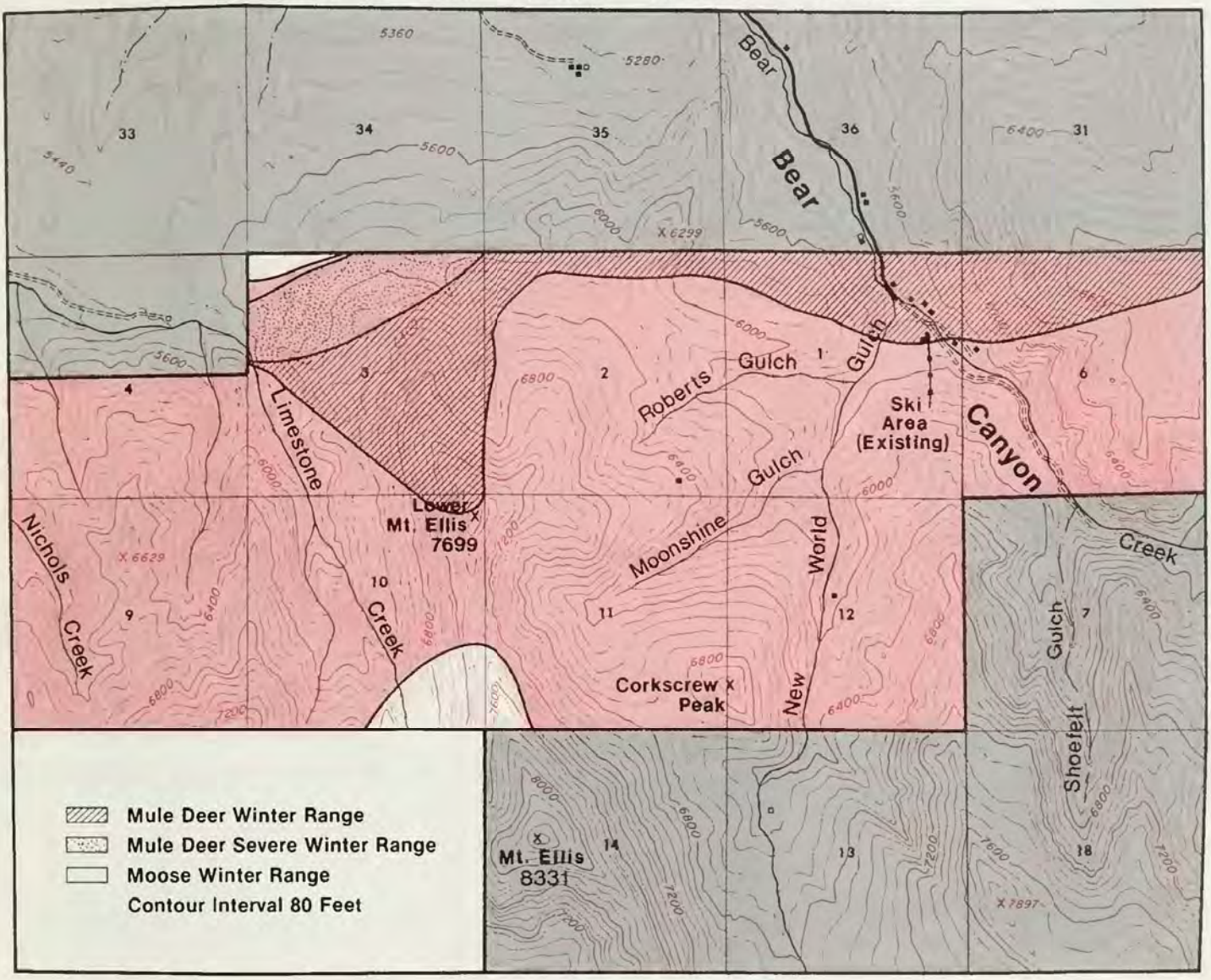
TABLE 4 FOREST LAND POTENTIAL PRODUCTIVITY ON THE BEAR CANYON PLANNING UNIT

PRODUCTIVITY CU. FT./ACRE/YEAR	ACREAGE	PRODUCTIVITY CLASS[1]
Nonforested	70	
Less than 20 (noncommercial)	448	V, Very Low
20-49	564	IV, Low
50-84	4,108	III, Moderate
85-119	255	II, High

[1]These classes are relative only to the state of Montana. Class I, Very High, does not occur on the planning unit.

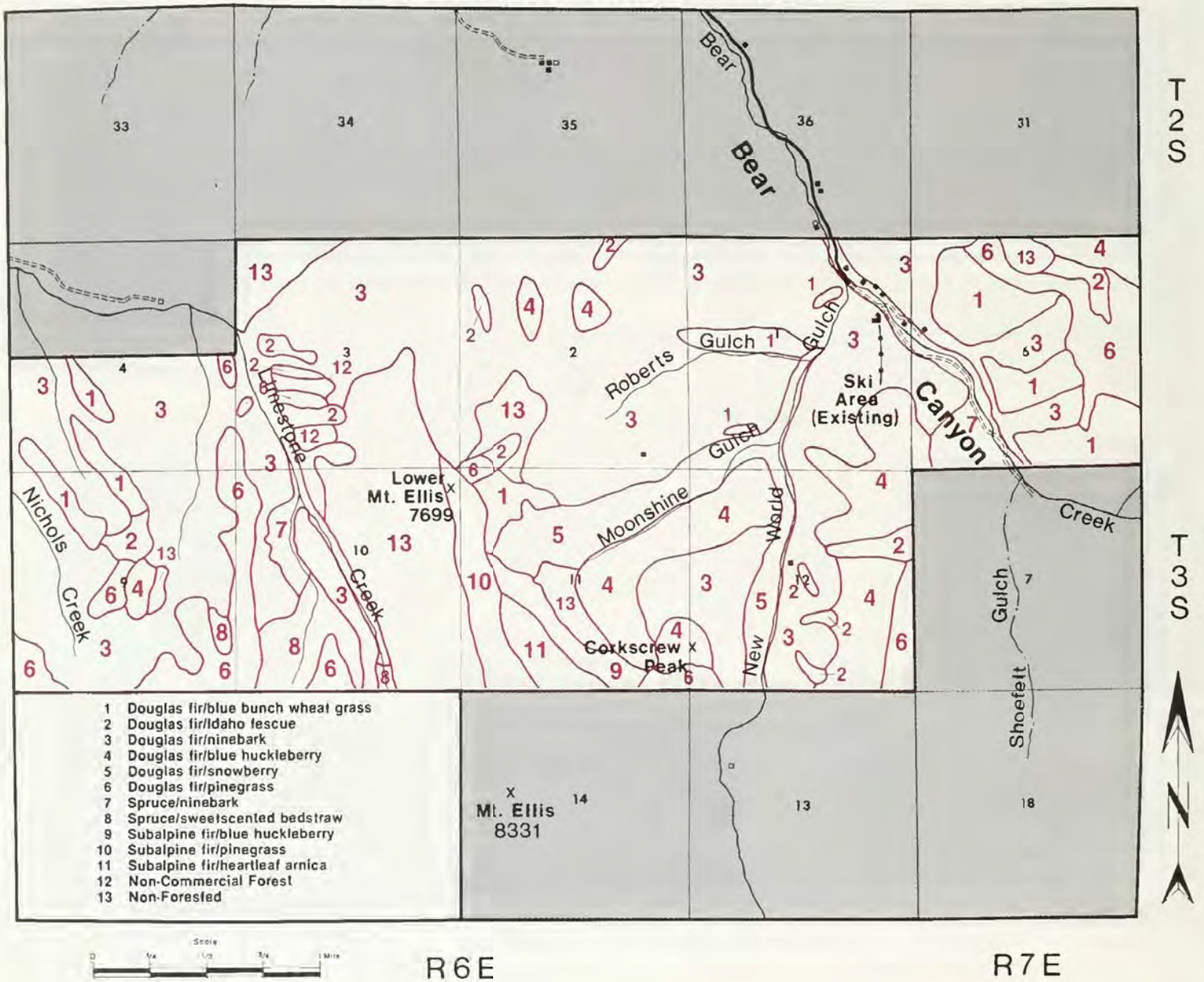
BEAR CANYON MANAGEMENT UNIT

MAP 4: BIG GAME WINTER RANGE



BEAR CANYON MANAGEMENT UNIT

MAP 5: FOREST HABITAT TYPE



Map 6 shows the suitability of land within the planning unit for timber management and is based on potential timber productivity and on soil and other land related conditions. The soil condition classes shown on map 6 are broad, in that different soils can be categorized similarly for a variety of reasons. Map 3 provides the characteristics and limitations for soils found on the planning unit.

The timber in Bear Canyon is experiencing only minor disease problems, but a substantial mountain pine beetle infestation is in progress in the lodgepole pine stands. The mountain pine beetle typically attacks mature stands of lodgepole pine. The only practical preventive measure is to return these mature stands to a young and vigorous condition by harvesting and regeneration of the stand. Harvesting, where environmentally practical, will in most cases consist of complete or nearly complete removal of lodgepole pine. The resulting cut will resemble either clearcutting or selection cutting, depending upon the species composition of the stand. Much of Bear Canyon, about 2,700 acres, is predominantly lodgepole pine, although about 700 acres cannot be treated due to prohibitive environmental conditions.

Range

DNRC conducted a range evaluation in 1974 to determine which portions of the Bear Canyon planning unit had vegetation and physical characteristics suitable for livestock grazing (Montana DNRC 1974). The survey showed that while the planning unit occupies 5,445 acres, only 850 acres are grazed and 80 percent of the grazing occurs on just 140 acres, the primary range. The use of such a small part of the available area results from natural barriers that tend to restrict cattle movement. The range evaluation report recommended that grazing be reduced to the capacity of the primary range, 60 animal unit months (AUMs).

Little or no grazing occurred between 1974 and 1980, which resulted in substantial range improvement. Inasmuch as range conditions have improved since the recommendations were issued in 1974, the range allotment has been revised to currently provide 84 AUMs of grazing. Stocking levels may be adjusted annually by the Forestry Division.

The current grazing license stipulates that some existing roads and trails through the Bear Canyon planning unit to the national forest are open to the public. This stipulation allows public access to Mystic Lake through New World Gulch and Moonshine Gulch as well as public use of the Bear Canyon road.

Appendix B contains a range suitability map, a summary of range conditions, and a range management plan.

CULTURAL CHARACTERISTICS

There are no registered historical sites or archeological sites on the Bear Canyon planning unit (Korte 1979). However, an archaeological survey of the Gallatin National Forest has located sites adjacent to the unit, including a prehistoric human habitation site along Bear Creek, one-fourth of a mile south of the management unit (Taylor 1979).

SOCIOECONOMIC CHARACTERISTICS

Gallatin County grew more rapidly in population than Montana as a whole between 1970 and 1977. Both population and employment increased at faster rates than the statewide averages, and there were relatively more net immigrants into Gallatin County than into Montana. Per-capita income was $3,931.00 (in 1972 dollars) in 1977, 9 percent less than Montana's average. The growth rate of this economic indicator was roughly equal to the Montana average from 1970 to 1977. Even though the 1977 population was less than 40,000, Gallatin County has an urban economy; trade and commerce account for a disproportionate share of the economic activity.

Primary industries for Gallatin County are listed in table 5, in order of importance.

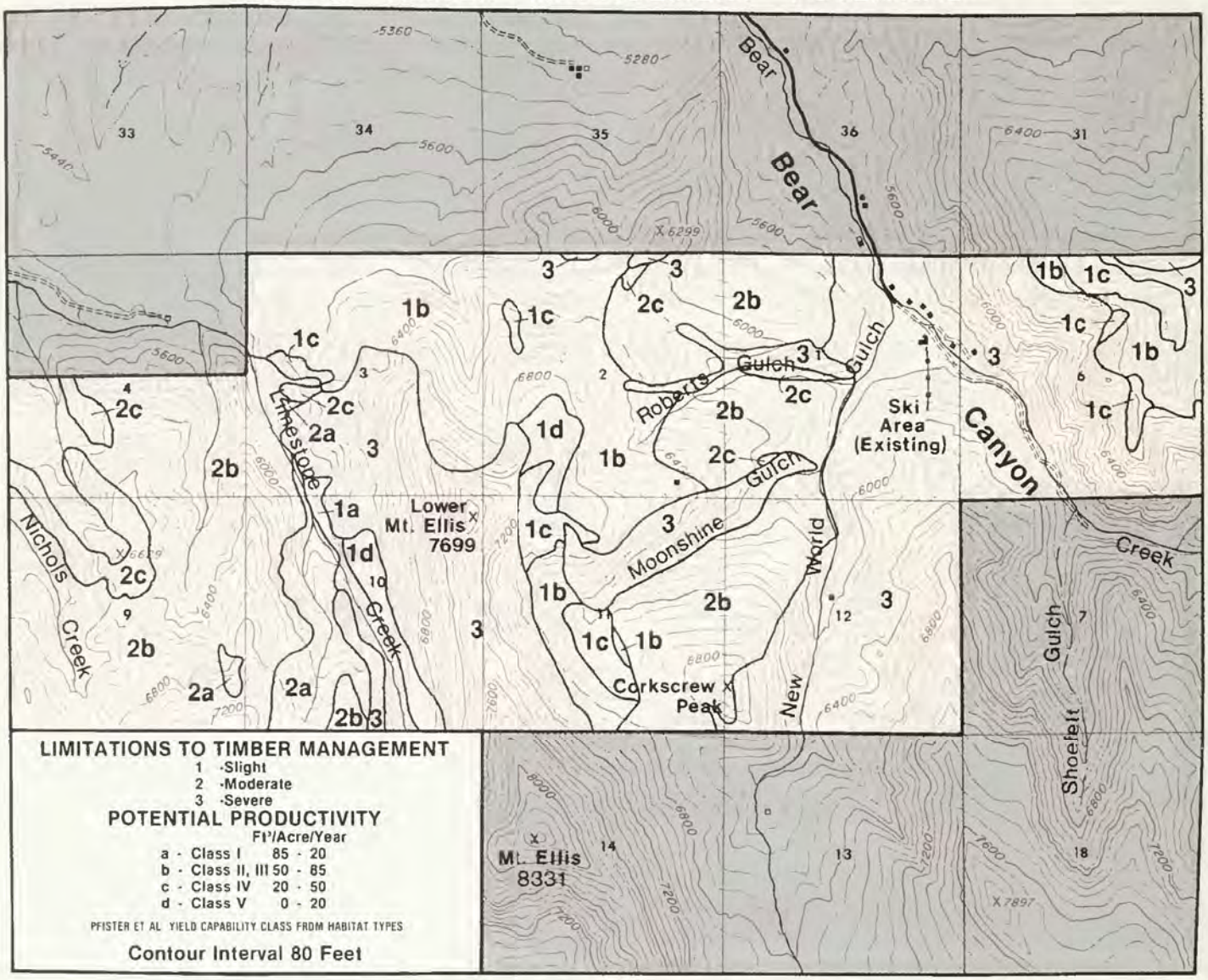
TABLE 5 PRIMARY INDUSTRIES FOR GALLATIN COUNTY

	PERCENTAGE OF LOCAL ECONOMIC BASE[1]
Montana State University	40
Agriculture	25
Federal Government	12
Manufacturing	6
Railroads	6
Retail Trade	5
Hotels and Motels	5
Mining and Other	1

[1]Measured by real earnings of workers.

BEAR CANYON MANAGEMENT UNIT

MAP 6: TIMBER MANAGEMENT POTENTIAL



Despite the importance of Montana State University to the local economy, it was not the major source of Gallatin County's recent economic growth. With the exception of agriculture, all of the primary industries contributed to the rise in the economic base. The greatest increases were in manufacturing and retail trade. Table 6 shows the changes that ocurred in the primary industries from 1970 to 1977; manufacturing increased about 75 percent and retail trade nearly 100 percent (Polzin 1979a.)

The impact of recreation on the Gallatin County economy is unmeasured, but some information is available for a major component of Gallatin County recreation—skiing. The economic impacts of recreation are largely reflected in the retail trade and the hotel-motel industries which, as shown by table 6, increased nearly 100 percent and 40 percent respectively. Interestingly, employment in these industries increased more rapidly than participation income; retail trade employment increased 120 percent and hotel-motel employment increased 85 percent from 1970-77. During that time, skiing in Gallatin County has also increased dramatically, from 120,000 skier visits in the 1972-73 ski season to nearly 260,000 skier visits in the 1977-78 season. The majority of this increase, which includes a large number of nonresident skiers, is due to the establishment of Big Sky ski area. About 125,000 skier visits are made by nonresidents, whose contributions to the local economy account for approximately 2 percent of the local economic base (Polzin 1979c). The total economic impact of recreation also includes local skiers and summer tourism, hunting, fishing, snowmobiling, cross-country skiing and other recreational activities. Recreation accounts for an important, though not dominant, portion of the Gallatin County economy, and at least part of the recreational component has been rapidly growing. Skiing is projected to continue growing but at a less rapid rate than occurred during the decade of the 70's (Polzin 1979b).

Fire Protection

The Fort Ellis Volunteer Fire Department and Gallatin County have primary wildland and structural fire protection responsibilities for the Bear Canyon planning unit, but DNRC's Forestry Division does have indirect responsibilities. Planning, organizational assistance, wildland fire equipment, and fire suppression support in the event of fire beyond the county's ability to control are supplied by the Forestry Division as specified in the state-county cooperative agreement (Polzin 1979b).

TABLE 6 PARTICIPATION INCOME AND EMPLOYMENT IN PRIMARY INDUSTRIES, GALLATIN COUNTY, 1970 AND 1977

	PARTICIPATION INCOME (Thousands of 1972 Dollars)			EMPLOYMENT		
	1970	1977	Change 1970-1977	1970	1977	Change 1970-1977
Nonagricultural Primary Industries						
Manufacturing (part)	$ 2,731	$ 4,755	$ 2,024	369	571	202
Railroads	2,606	3,173	567	234	225	-9
Retail trade (part)	2,382	4,670	2,288	387	857	470
Hotels, motels, and lodging places	1,243	1,729	486	325	600	275
Federal government	5,240	6,305	1,065	465	517	52
Montana State University	18,486	20,436	1,950	7,080	7,277	197
Mining and other primary industries	431	1,218	787	69	127	58
Subtotal	**33,119**	**42,286**	**9,167**	**8,929**	**10,174**	**1,245**
Agriculture	11,785	1,402	-10,383	1,320	1,076	-244
Total	**44,904**	**43,688**	**-1,216**	**10,249**	**11,250**	**1,001**

SOURCE: U.S. Department of Commerce 1979, also includes previously unpublished data from the Montana Department of Labor and Industry and Montana State University

[1]Includes both full- and part-time employment. The data are not adjusted for multiple jobholders.

ALTERNATIVES

A wide range of alternatives was considered while developing a management plan for the Bear Canyon Unit. The choice was narrowed to three alternatives that were feasible from an economic and environmental standpoint.

The planning unit is well suited to integrated resource management, with about 55 percent of the area suitable for timber management, 40 percent with high recreational potential, and 20 percent with natural area potential. Some overlapping occurs between recreation and timber management, but most of the areas do not have significant conflicts in use. The three alternatives discussed here are multiple-use alternatives.

ALTERNATIVE 1: MAINTAIN THE CURRENT MANAGEMENT DIRECTION

Alternative 1, current management, assumes that current program and activities would continue at their present levels. This alternative would provide a single management zone where current management programs would continue. All activities would be individually considered without being coordinated by an overall management planning strategy.

Current management provides natural area protection, fire management, insect and disease management, and range management at levels similar to those of the recommended alternative. Other management categories are different from the recommended alternative. Management of transportation, timber, recreation, wildlife, and watersheds are currently integrated to the greatest extent possible during project planning but generally on a smaller scale than in the proposed plan.

Currently, the entire planning unit can be considered for moderate-intensity timber management, although environmental concerns will prevent activity in some areas. There is no formal recognition of the recreational potential in the Bear Canyon planning unit. This increases the chance for compromising recreation potential through other activities, particularly timber harvesting.

Environmental Impacts of Alternative 1.

Stream turbidity would likely remain constant or perhaps increase due to the lack of trail use regulation and maintenance, particularly if use increases.

Alternative 1 does not designate an area for recreational development; because of this, it offers a reduced risk of environmental degradation due to recreational activities that might involve construction.

Socioeconomic Impacts of Alternative 1.

Revenue potential to the trust fund would remain about constant. A mix of timber, range, recreation, and wildlife benefits would be provided; although the grazing authorization might not be modified to allow increased public access to the lands within the planning unit. Accustomed uses of the unit would continue, but potential recreational development could be curtailed by timber sale activities that could conflict with recreation.

Public awareness and involvement in the management of the Bear Canyon Planning Unit would be less than under the recommended alternative.

ALTERNATIVE 2: INTENSIVE FINANCIAL RETURN

This alternative would maximize immediate returns to the school funds using all the resources of the unit. Intensive timber management, livestock grazing, and commercial recreational developments would be encouraged. Resolution of management conflicts would be weighted toward financial return.

The planning unit would be divided into three zones as shown by map 7: Zone 2-A (primarily recreational management), Zone 2-B (primarily timber management), and Zone 2-C (wildlife and watershed management). Recreational potential, timber values, and soil conditions were used to determine the productive potential of Bear Canyon lands and to place them in the appropriate zone.

Alternative 2 is similar to the recommended alternative except that high-intensity timber management would be practiced (compared to moderate-intensity management) on a larger area. Under this plan there would be no buffer zone between the intensive timber management zone and the developed recreation area, thereby providing additional land for timber management. Zone 2-C would be managed to protect watershed and wildlife values.

Environmental Impacts of Alternative 2.

Short-term increases in sedimentation and erosion accompany road construction and timber harvest, and long-term sedimentation is a function of road use and maintenance. Both long- and short-term sedimentation would be expected to increase under this alternative because of the accelerated timber management activity over a larger area. An increase in road construction and timber harvesting would be detrimental to big game because of reduced cover and improved human access, although the greater vegetative diversity maintained over time would be beneficial to many game and nongame species.

Maximization of income from all available resources would substantially increase the risk of unacceptable impacts to wildlife, soil stability, and water quality, particularly because the unit has severe management constraints, the limits of which are not precisely known.

Socioeconomic Impacts of Alternative 2.

The availability of forest products and opportunities for intensive recreational development would be improved. However, the accelerated activity would decrease aesthetic values and reduce the opportunity for competing but non-income-producing uses. Conflicts between timber management and recreational interests would increase.

Increased entries from timber management would reduce long-term fire hazards, increase short-term fire hazards, and increase the risk of man-caused fire.

Substantially increased budgetary appropriations would also be required to intensively manage the timber, creating a larger tax burden than the other alternatives.

ALTERNATIVE 3: THE RECOMMENDED ALTERNATIVE

Alternative 3 provides for a moderate level of timber management with provisions for recreational land use, encouragement of commercial recreational development, livestock grazing, maintenance of scenic quality, and soil, watershed, and wildlife habitat protection.

Three management zones have also been identified for this alternative, as shown by map 8. Zone A comprises 40 percent of the area and places primary management emphasis on developed recreation. Moderate-intensity timber management would be the primary objective in Zone B, which contains 40 percent of the total area. The remaining 20 percent of the unit, Zone C, would emphasize watershed and wildlife management. Zone boundaries in this alternative were delineated according to scenic quality, timber values, recreational potential, and soil conditions. The primary use for each zone will not exclude secondary uses; rather, the zone designation indicates overall suitability and management emphasis.

This alternative, and the potential environmental and social impacts of it, are further discussed in the following section, "Description of the Proposed Action."

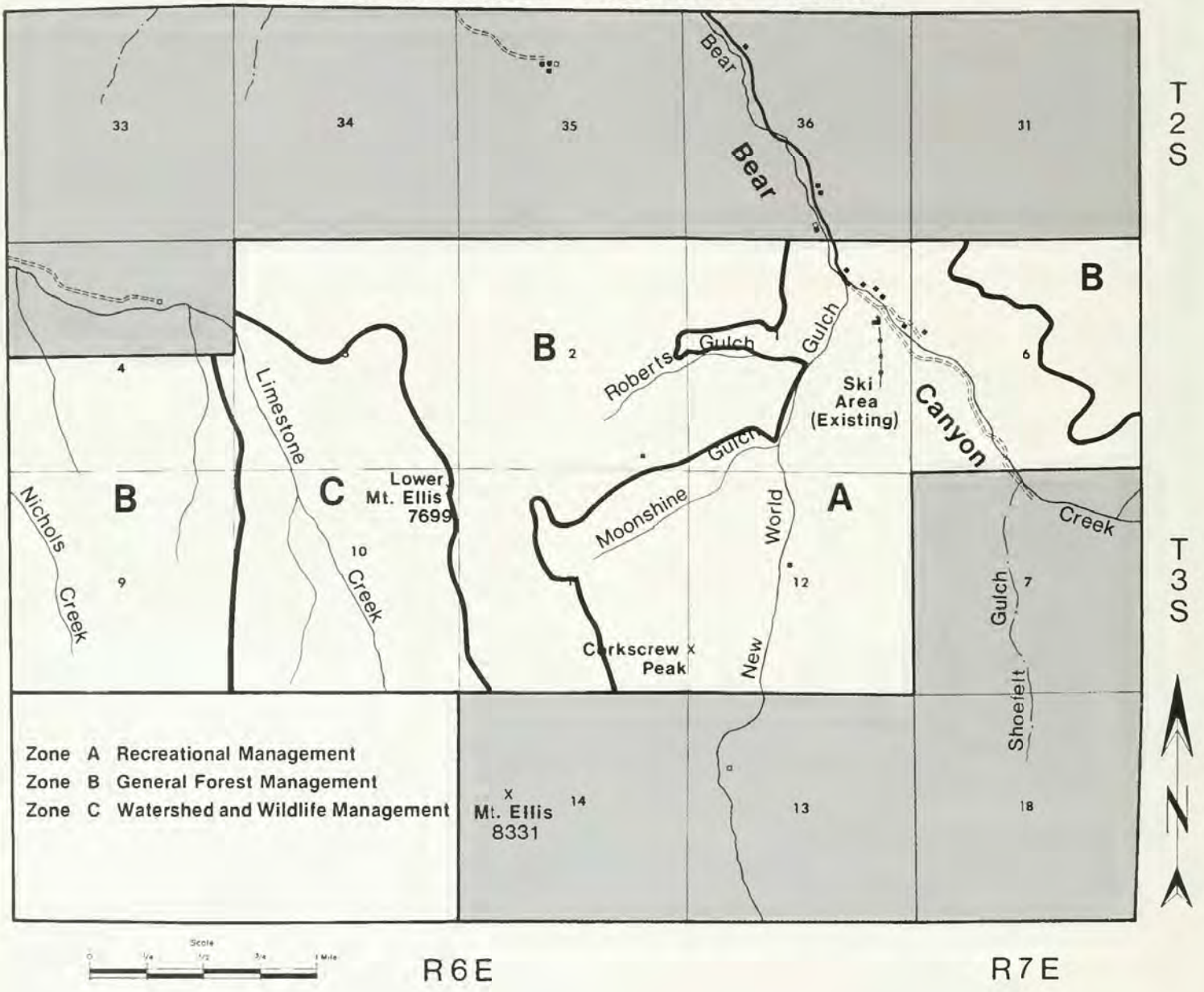
SELECTION OF THE RECOMMENDED ALTERNATIVE

Basis for Rejection of Alternative 1

This alternative does not recognize that the Bear Canyon planning unit is composed of several zones suited for different uses. Since there would be no distinction between zones, there would be an increased opportunity for potentially detrimental actions to occur, particularly in areas that are suited for both timber management and recreational development. The lack of provision for recreational management may inhibit recreational development and therefore reduce income potential for the planning unit.

BEAR CANYON MANAGEMENT UNIT

MAP 7: INTENSIVE FINANCIAL RETURN



The current management alternative doesn't include a management plan for the unit and relies upon the **Goals, Objectives, and Policies Manual** of DNRC's Forestry Division for general direction. This may lead to difficulty in maintaining continuity among successive managers and reduces public participation in the management of the unit.

Alternative 1 has been rejected because it fails to provide for the integration of a major resource use, recreation, with other uses, primarily grazing and timber management. The need for such integration has not dissipated; instead, it has intensified with the receipt of an application to expand the existing ski area.

Basis for Rejection of Alternative 2

Alternative 2 integrates recreation, timber management, and grazing, and satisfies the basic deficiencies recognized in the current management. However, it maximizes the use of each resource, thereby increasing conflicts among uses and increasing environmental stress in an area that is acknowledged to be sensitive to construction and to reductions in vegetative cover.

This alternative has been rejected because intensive production does not appear to be environmentally sound, and may not be economically sound due to abnormally high operating costs on marginal sites.

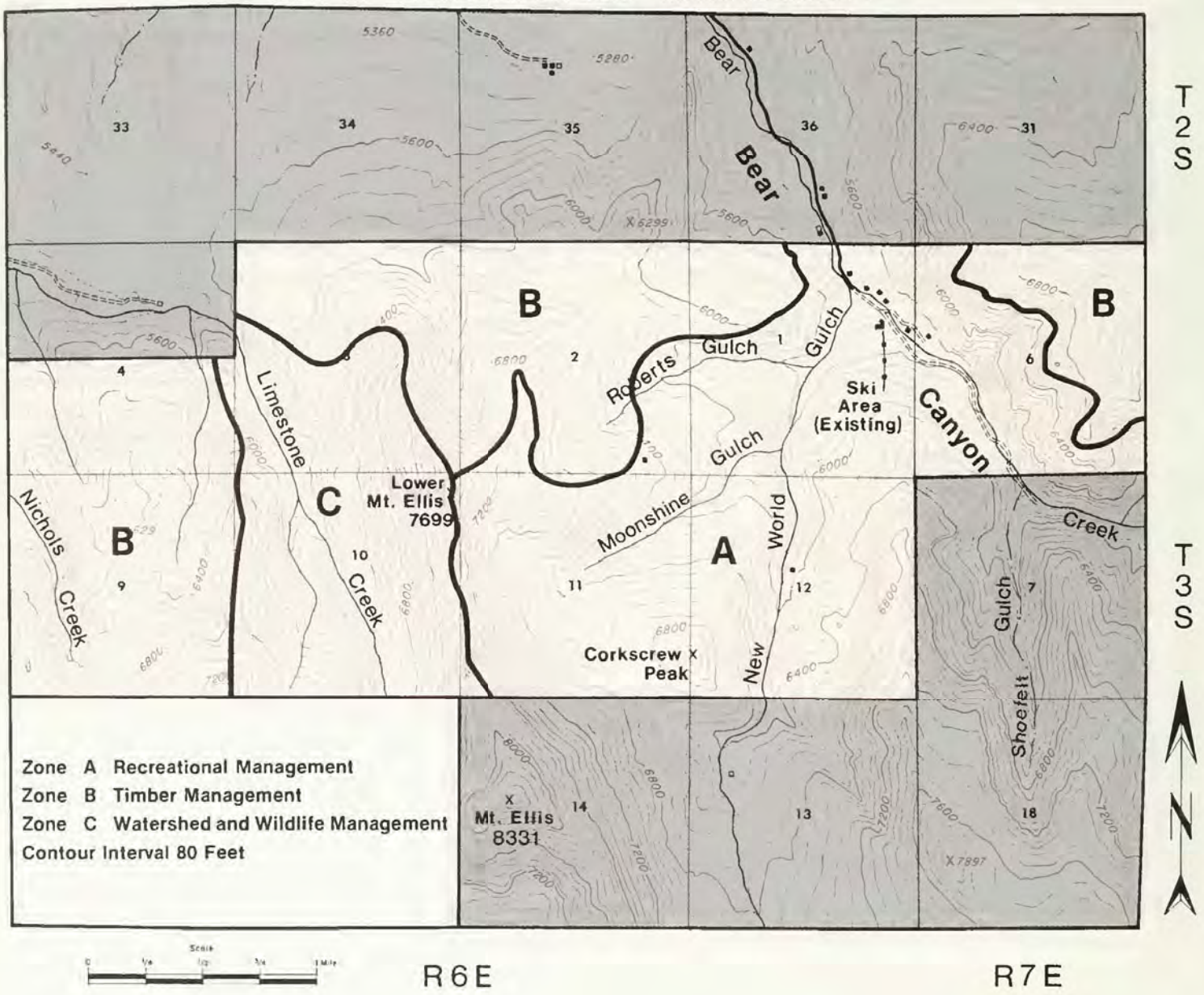
Basis for Acceptance of Alternative 3

The recommended alternative results in less income than alternative 2, but lowers administrative and operating costs as well. Furthermore, the recommended levels of timber and recreational management would create fewer user conflicts and lower the risk of unacceptable environmental consequences.

Alternative 3 was selected because it satisfies the original goal of providing a framework for the integration of recreational management with timber and range management while maintaining or enhancing water quality, air quality, and wildlife habitat. The recommended alternative benefits both the public and the school trust fund through integrated resource use within the land suitability and environmental constraints of the Bear Canyon planning unit.

BEAR CANYON MANAGEMENT UNIT

MAP 8: RECOMMENDED MANAGEMENT



DESCRIPTION OF THE PROPOSED ACTION

This section proposes specific management guidelines for each management zone and discusses the potential socioeconomic and environmental impacts related to the implementation of this plan. The management guidelines, objectives, and zone boundaries were established by an interdisciplinary planning team consisting of foresters familiar with Bear Canyon, specialists in forest hydrology, soils science, timber management, and planning, and specialists in fire management and range management. Other agencies and individuals consulted during the preparation of this plan include the Montana Department of Fish, Wildlife, and Parks, U.S. Soil Conservation Service, Gallatin National Forest, local residents, and others. The recommendations made by this team were based upon resource suitability, legal direction, and historical use.

The designation of management zones within the Bear Canyon planning unit provides the framework upon which management decisions can be based. Particular activities have been preempted, restricted, or encouraged in each zone, for the dual purpose of providing the land manager with guidance for decision making and providing continuity in the management of designated areas.

The management goals for the entire planning unit are as follows:

1. To conduct a management program on state forest lands in Bear Canyon so as to secure the largest measure of legitimate and reasonable advantage to the state school funds.
2. To provide for multiple use of state forest lands in Bear Canyon so that they are used in that combination best meeting the needs of the people and the beneficiaries of the trust.
3. To manage state forest lands in Bear Canyon so as to conserve water, soil, and young stands of timber.

The management objectives for the planning unit are:

1. To consolidate scattered state-owned land into a contiguous unit through land exchange.
2. To negotiate with adjacent landowners necessary access for land management activities.
3. To negotiate with adjacent landowners access across state land in a manner most beneficial to all parties.
4. To provide revenue for the school trust fund and to provide forest products while maintaining or enhancing the land's productivity through timber management.
5. To provide revenue for the school trust fund and beneficial public services through management of developed recreation.
6. To provide revenue for the school trust fund while maintaining range productivity through range management.
7. To protect and enhance where possible wildlife habitat, scenic quality, watershed, air quality, and traditional dispersed recreational values.
8. To prevent degradation of areas with natural area potential.
9. To prevent the loss of significant cultural or historical resources that may occur within the Bear Canyon planning unit.
10. To seek to provide additional wildlife baseline data to help maintain and enhance wildlife habitat.

The consolidated nature of state land in Bear Canyon makes it a desirable area to expand through land exchange. DNRC is currently discussing with the U.S. Forest Service the possibility of exchanging National Forest Land in Bear Canyon for other state land.

ZONE A

Zone A is 2,278 acres in size and contains areas with significant potential for commercial recreational development as well as hiking, camping, hunting, cross-country skiing, and other forms of dispersed recreation. Recreational management, both developed and dispersed, will be the primary objective in Zone A. Other activities will be adjusted to complement the zone's recreational character or to minimize conflict with the zone's primary use.

The boundaries of this zone were determined by a variety of factors, including soil conditions, previous use, timber values, accessibility, topography, and scenic quality (see map 8). Portions of the zone were included strictly due to scenic quality, such as the limestone cliffs in Bear Canyon; other areas have limited potential for timber management but suitable topography for downhill skiing, a historic use in those areas. Some areas with good timber management potential are included because of their recreational potential or to provide a buffer strip between recreational and timber management areas. Other parcels were included in Zone A because of traditional uses or unstable soil conditions that limit other uses. Some of these relationships can be seen by comparing the timber potential map (6) and the land type map (3) with the recommended alternative map (8).

Management Goals for Zone A

1. To provide revenue for the school trust fund through commercially developed recreation, low-intensity timber management, and livestock grazing.
2. To maintain and enhance visual quality and traditional recreation opportunities.

Management Objectives and Guidelines for Zone A

A. Developed Recreational Management

1. Developed recreational management objective—to provide opportunity for suitable commercial recreational development.

2. Developed recreational management guidelines
   a. Applications for proposals for recreational developments will be individually examined.
   b. Additional cabin sites will not be considered during this planning period to avoid conflicts with potential recreational developments.
   c. Motorized vehicles (except for authorized vehicles) will be restricted to designated areas within the zone as shown by map 9.
   d. This zone contains important habitat for moose and areas with severe limitations due to the potential for mass soil failures; potential developments will carefully consider and mitigate adverse environmental impacts to the greatest extent possible.

B. Dispersed Recreational Management

1. Dispersed recreational management objective—to provide the opportunity for dispersed recreation while protecting the environment.

2. Dispersed recreational management guidelines
   a. The existing trail system will be signed and maintained to facilitate use and protect natural resources.
   b. Intensified public use may require designation of alternate sites in order to protect the area's resources. Picnic tables, fire containers, and limited sanitation facilities may be provided at alternate sites depending upon funding and maintenance arrangements.
   c. Designation of remote camping areas may be necessary with increased use; fire containers may be needed.
   d. Motorized vehicles will be restricted to designated areas within the zone, except for authorized and emergency vehicles as described in appendix C.
   e. Management activities in the vicinity of the cliffs in Bear Canyon and the Mount Ellis Ridge will protect the natural character of the landscape.
   f. The existing grazing authorization will be modified to allow access for recreational uses as described in appendix C.

C. Timber Management

1. Timber management objective—to create a variety of age classes and mixed species composition through periodic harvest.

2. Timber management guidelines
   a. Timber production will be of low intensity and secondary to recreational objectives.

b. Visual resources have a high priority in this zone; timber management will consider this resource and avoid adverse impacts.
c. Corkscrew Peak and the area north of Moonshine Gulch contain the principal timber resources of Zone A. Timber management in these areas will remain at low intensity, giving full consideration to potential recreational developments.

D. Insect and Disease Management

1. Insect and disease management objective—to reduce the loss of forest products due to injurious insects and diseases.

2. Insect and disease management guidelines
   a. Mature stands of timber will be converted to younger age classes.
   b. Homogeneous stands will be converted to stands of mixed species.
   c. Salvage logging of merchantable mortality and high-risk trees may be employed where consistent with environmental and recreational constraints.

E. Natural Area Management and Cultural Preservation

1. Natural area management objective—to prevent degradation of areas possessing natural area potential.

2. Natural area management guidelines
   a. The limestone cliffs in Bear Canyon and the Mount Ellis Ridge have a potential for natural area designation due to significant vegetation, wildlife, and scenic quality.
   b. Natural area potential will be assessed prior to management activities in these areas.
   c. Any discovery on state-owned land of any sites, objects, or structures that are significant to American history or culture or discovery of any fossilized plants or animals that are scientifically rare and critical will promptly be reported to the State Historic Preservation Officer and all reasonable steps taken to protect such findings.

F. Fire Management

1. Fire management objective—to reduce and prevent, where possible, damage to property and natural resources due to wildfire.

2. Fire management guidelines
   a. The Cooperative Fire Control Agreement with Gallatin County will be maintained.
   b. A fire protection program in cooperation with the Gallatin National Forest will be maintained.
   c. Remote camping sites will be located and fire containers installed, as funding allows, to prevent the escape and spread of fire.
   d. Formal cabin site inspections for fire hazards and lease compliance will be conducted every five years, and informal inspections as required.
   e. Naturally occurring fire hazards will be reduced by harvesting timber mortality.
   f. Fire hazards created by forest products sales will be reduced within eighteen months of sale completion, in accordance with applicable policies and regulations.

G. Watershed Management

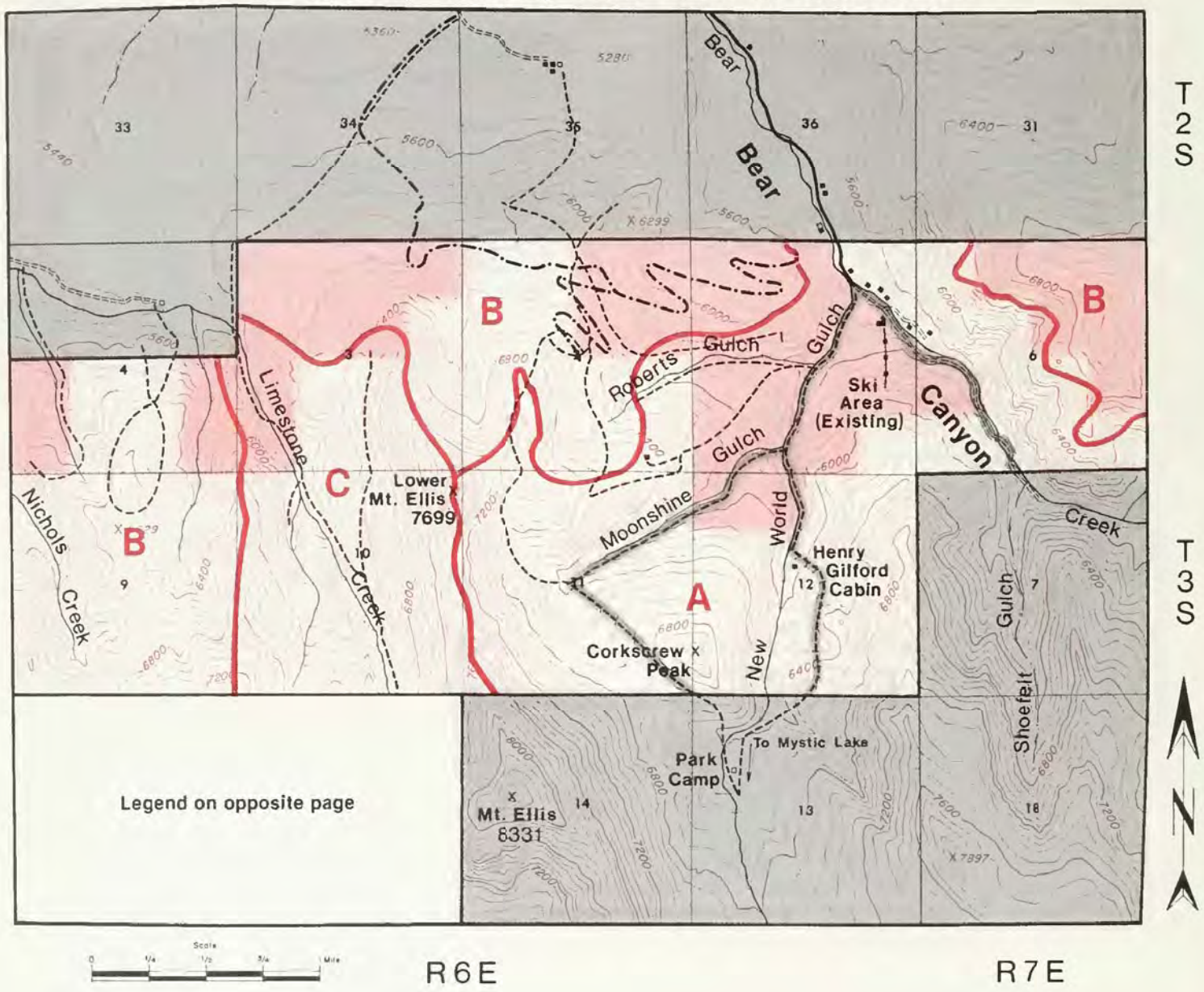
1. Watershed management objective—to prevent degradation of or to improve water quality in New World Gulch and Bear Creek.

2. Watershed management guidelines
   a. A maximum allowable water yield[1] increase (due to resource management activities) of 10 percent has been established for this zone. These standards are designed to reduce sedimentation from streambank erosion due to increased flows.
   b. Facilities and development activities will be designed to mitigate adverse impacts to existing ground and surface water quality standards.
   c. Portions of the existing New World and Moonshine Gulch trail system will be relocated as time and funding allows to alleviate existing problems with streambank stability and sedimentation.

[1]Water yield (streamflow) increases when vegetation is removed during harvesting or construction activities due to faster snowmelt and reduced transpiration. These increases gradually return to normal as the vegetative cover is reestablished. Adherence to this guideline would tend to limit the total acreage cleared or logged over a period of years to prevent excessive water yields.

BEAR CANYON MANAGEMENT UNIT

MAP 9: ROADS, TRAILS, AND USE RESTRICTIONS



LEGEND

ALL ZONES

1. Prior to Feb. 28, 1982, public access during the grazing period is limited to the trails and unimproved road designated in dark gray.
2. After Feb. 28, 1982, off-road use outside the grazing area (unshaded) and all roads and trails in the unit will be open.
3. Off-road use is restricted to pedestrian, horse, and snowmobile use, except in Zone C where no motorized vehicles are permitted.

ZONE A

1. Trails and off-road areas will be open to pedestrian use year round.
2. Off-road areas will be open to snowmobiles, but closed to all other vehicles.
3. Trails will be closed to horse and motorcycle use during the wet part of the spring. (The opening date is expected to be June 15 but may vary.)

ZONE B

1. Roads and trails will be open to pedestrian, horse, motorcycle, and snowmobile use.
2. Off-road areas will be open to pedestrian and horse travel, but will be closed to all vehicles except snowmobiles.

ZONE C

Trails and off-road areas will be open to pedestrian and horse use, but closed to all vehicles.

d. Harvesting and related soil disturbance will be significantly reduced within 200 feet of streams and wet areas to provide a buffer strip and protect the integrity of such areas.

e. Existing roads and trails requiring reconstruction to regain access will be carefully examined for alternate locations that would reduce sedimentaiton.

H. Range Management

1. Range management objective—to provide livestock forage and maintain range productivity.

2. Range management guidelines
   a. The existing license will be revised to allow 22 AUMs of grazing in those areas identified as having significant grazing potential.
   b. Improved range management techniques will be employed, compatible with the primary objectives of this zone.
   c. Grazing potential will be reevalutated within this ten-year planning period.

I. Transportation Management

1. Transportation management objective—to provide efficient, environmentally sound road and trail systems to achieve management goals in this zone.

2. Transportation management guidelines.
   a. Any improvement or reconstruction of the Bear Canyon Road will be made according to Gallatin County road specifications.
   b. Any access roads constructed for management purposes will be of low standard and used for multiple use. Entry into this zone will be restricted until roads are constructed.
   c. Transportation routes are not currently planned for Zone A, but if any are constructed they would have to avoid the lower slopes and valley bottoms in Moonshine and New World gulches due to unstable soil conditions.
   d. Road related to proposed recreational developments will be evaluated as they are proposed and will be consistent with the visual and environmental constraints of this zone.

J. Wildlife Management

1. Wildlife management objective—to protect or enhance wildlife habitat where possible and to reduce adverse impacts where conflicts exist.

2. Wildlife management guidelines
   a. Before the implementation of any management action, the Montana Department of Fish, Wildlife, and Parks will be consulted.
   b. The cliffs in Bear Canyon are suitable for prairie or peregrine falcon nesting. Prairie falcons have nested on the cliffs but peregrine falcons are not known to exist in the area. Potential impact will be investigated prior to taking any action that may adversely affect these species.
   c. Clearcut areas will be small and irregularly shaped, and vehicular traffic will be restricted to avoid adverse impacts on wildlife. Under usual circumstances such areas will be 40 acres or less.
   d. Drainage bottoms are important moose winter range and will be protected from additional development, along with timbered escape corridors adjacent to these drainages.

ZONE B

Timber management will be primarily emphasized in this zone, which occupies 2,211 acres, about 40 percent of the planning unit. Its primary suitability is for timber production, based upon its level of productivity, suitable topography, and manageable soil conditions. Scenic values and potential for recreational development have also influenced the boundaries of Zone B since some lands with good timber potential but a greater recreational potential are included in Zone A.

Other uses or needs will be considered in this zone. Adverse impacts to soil, water quality, wildlife, livestock grazing, and recreation are considered before each management activity and mitigated to the greatest extent possible. These additional values will be enhanced wherever possible in conjunction with normal management activities.

Management Goals for Zone B

1. To provide revenue for the school trust fund through forest product sales and livestock grazing.

2. To promote secondary values, including wildlife, recreation, and range, wherever possible.

Management Objectives and Guidelines for Zone B

A. Recreation Management

1. Recreation management objective—to maintain (and improve where possible) dispersed recreational opportunities.

2. Recreation management guidelines
   a. Recreational developments, including cabin site leases, are not compatible with the proposed management of this zone.
   b. The current grazing lease will be modified upon renewal to allow public use, as described in appendix C.
   c. Existing trails will be reopened or rerouted following harvesting operations.
   d. Recreational vehicles will be permitted. Restrictions may be imposed to protect the resource.

B. Timber Management

1. Timber management objective—to maintain and enhance stand productivity and vigor through managed sales of forest products.

2. Timber management guidelines
   a. Timber harvest activity will be of moderate intensity and designed to produce evenaged stands.
   b. Regeneration of harvest units will strive for a composition of mixed species.
   c. Cutting units will normally be under 40 acres, irregularly shaped, and adjoined to natural openings where possible to reduce visual impacts.
   d. Adverse impacts on wildlife, recreation, and aesthetics will be minimized, consistent with the primary goals for Zone B.

C. Insect and Disease Management

1. Insect and disease management objective—to reduce the loss of wood fiber due to injurious insects and diseases and to recover merchantable material that would be lost due to natural mortality.

2. Insect and disease management guidelines
   a. Infested stands will receive a high priority for treatment; harvest will be consistent with the timber management guidelines.
   b. Timber stands will be converted to younger age classes of mixed species to reduce the risk of major insect attack.

D. Natural Area Management and Cultural Preservation

1. Natural area management objective—to prevent degradation of areas possessing natural area potential.

2. Natural area management guidelines
   a. Further natural area examinations will not be required prior to management actions.
   b. Any discovery on state-owned land of any sites, objects, or structures that are significant to American history or culture, or discovery of any fossilized plants or animals that are scientifically rare and critical will promptly be reported to the State Historic Preservation Officer and all reasonable steps taken to protect such findings.

E. Fire Management

1. Fire management objective—to reduce and prevent, where possible, damage to property and natural resources due to wildfire.

2. Fire management guidelines
   a. The Cooperative Fire Control Agreement with Gallatin County will be maintained.
   b. A fire prevention program in cooperation with the Gallatin National Forest will be maintained.
   c. Fire hazards created by forest product sales will be reduced within eighteen months of sale completion and in accordance with state policies and regulations.
   d. Naturally occurring fire hazards will be reduced by harvesting merchantable timber mortality.

F. Watershed Management

1. Watershed management objective—to prevent degradation of water quality in New World Gulch, Bear Creek, and Nichols Creek.

2. Watershed management guidelines
   a. A maximum allowable water yield increase of 10 percent over normal yields has been established for this zone. Management actions which contribute to excessive increases will be avoided. These standards are designed to prevent excessive streambank and channel bed erosion due to increased flow.
   b. Management activities within 200 feet of streams or wet areas will be designed to protect the integrity of such areas.
   c. Hydrologic and soil conditions will be examined for each project proposal.
   d. Excessive ground water can create unstable soil conditions. Harvest methods and cutting unit locations will be designed to modify peak flows and maintain adequate vegetative cover to provide for transpirational water use.
   e. Techniques to prevent erosion will be employed on spur roads and secondary roads prior to temporary seasonal closures and permanent closures.

G. Range Management

1. Range management objective—to provide livestock forage and maintain range productivity.

2. Range management guidelines
   a. The existing grazing authorization will be revised to conform to the capacity of the primary range (55 AUMs) until such time as the secondary range can be used.
   b. Range carrying capacity will be reevaluated during planning.

H. Transportation Management

1. Transportation management objectives—to provide efficient, environmentally sound road and trail systems to support the management objectives of this zone.
2. Transportation management guidelines
   a. A permanent primary road system will be developed to provide access for timber management.
   b. A permanent secondary road system will be developed to individual timber sales. Public access will be restricted on these roads.
   c. Spur roads within timber sales will be closed upon sale completion.

I. Wildlife Management

1. Wildlife management objective—to protect or enhance wildlife habitat where possible and to minimize adverse impacts where conflicts exist.

2. Wildlife management guidelines
   a. The shrubby vegetation in drainages will be preserved.
   b. Escape corridors of dense timber will be maintained along drainages.
   c. Escape corridors will be maintained between cutting units.
   d. The Department of Fish, Wildlife, and Parks will be consulted before initiating each management action.

ZONE C

Zone C, the Limestone Creek drainage, is unique. In contrast to New World Gulch and Bear Canyon, which are partially developed and receive considerable use, Limestone Creek is virtually pristine and receives light use. The undisturbed nature of this 956-acre zone is complemented by impressive scenery and an abundance of wildlife, including moose and bald eagle.

Steep, rocky hillsides that are unstable in many areas and remain partially denuded by previous fires occur along the upper slopes of Limestone Canyon. The valley bottom is relatively wide and wet with numerous boggy spots and unstable areas along the lower slopes. This combination of conditions have provided important wildlife habitat and precluded man's development of the area. The severe topographic and soil conditions present in the Limestone Creek drainage will continue to prevent development of the timber resource.

This zone contains a significant timber resource, including the most productive sites on the Bear Canyon planning unit. All age classes of timber are present, but much of it is old-growth, deteriorating lodgepole pine. Salvage operations are not possible because conventional logging systems are not environmentally acceptable and more advanced techniques are not likely to be economically feasible.

Management Goals for Zone C

1. To protect the Zone's unique water, wildlife, and scenic resources.

2. To provide revenue to the school trust fund through livestock grazing.

Management Objectives and Guidelines for Zone C

A. Recreational Management

1. Recreational management objective—to provide dispersed recreation while protecting the natural resources of this zone.

2. Recreational management guidelines
   a. Cabin site authorizations will not be granted due to environmental constraints and lack of access.
   b. The grazing authorization will be modified to allow public access.
   c. The use of motorized recreational vehicles will not be permitted within this fragile watershed and important wildlife habitat.
   d. Management activities will be designed to protect the natural character of the Mount Ellis Ridge and other significant visual resources.

B. Timber Management

1. Timber management objective—to protect, to the greatest extent possible, the timber resource from loss due to fire, insects, or disease.

2. Timber management guidelines
   a. Timber harvesting will be precluded in this zone because it cannot be economically performed in an environmentally sound manner.
   b. The timber in this zone will not be considered part of the timber base on the Bear Canyon planning unit.

C. Insect and Disease Management

1. Insect and disease management objective—to reduce the loss of forest products due to injurious insects and diseases.

2. Insect and disease management guidelines
   a. Salvage of infested stands is not now economically and environmentally feasible in this zone.
   b. Treatments to reduce insect infestations that don't require access by road may be employed where appropriate to prevent the infestation's spread to unaffected areas.

D. Natural Area Management and Cultural Preservation

1. Natural area management objective—to prevent degradation of areas possessing natural area potential.

2. Natural area management guidelines
   a. Significant scenic, biological, educational, or scientific values are recognized in this zone; therefore, a natural area study for this zone will be considered if an adequate source of funding becomes available to compensate the school trust fund.
   b. Any discovery on state-owned land of any sites, objects, or structures that are significant to American history or culture or discovery of any fossilized plants or animals that are scientifically rare and critical shall promptly be reported to the State Historic Preservation Officer and all reasonable steps taken to protect such findings.

E. Fire Management

1. Fire management objective—to reduce and prevent, where possible, damage to natural resources due to wildfire.

2. Fire management guidelines
   a. The Cooperative Fire Protection Agreement with Gallatin County will be maintained.
   b. A fire prevention program in cooperation with the Gallatin National Forest will be maintained.

F. Watershed Management

1. Watershed management objective—to prevent degradation of water quality and the riparian zone in the Limestone Creek drainage.

2. Watershed management guidelines
   a. Watershed protection is a primary objective in Zone C.
   b. Conventional road building is not considered feasible along the lower slopes

or in the valley bottom due to unstable soils and a high water table.

c. Any management activity within 200 feet of a stream or wet area will be designed to protect the integrity of the stream or wet area.

G. Range Management

1. Range management objective—to provide livestock forage and improve range productivity.

2. Range management guidelines
   a. The existing grazing authorization will be revised to conform with the carrying capacity of the primary range (7 AUMs).
   b. Range carrying capacity will be reevaluated during the planning period.

H. Transportation Management

1. Transportation management objective—to provide environmentally sound transportation systems to support necessary management activities.

2. Transportation management guidelines
   a. Severe road construction conditions preclude conventional forest road construction in much of Zone C, therefore road construction will not be allowed.
   b. Nonmotorized use of the current trail system will be permitted.

I. Wildlife Management

1. Wildlife management objective—to protect or enhance wildlife habitat.

2. Wildlife management guidelines
   a. Any management activities will include the protection of the bald eagle; other threatened or endangered species have not been reported. No disturbance is permitted within 330 feet of a bald eagle nesting site and only limited disturbance within 660 feet.
   b. Wildlife habitat will not be altered by timber harvesting during the planning period.
   c. The Montana Department of Fish, Wildlife, and Parks will be consulted before the implementation of actions that might adversely affect wildlife in this zone.

IMPACTS OF THE PROPOSED ACTION

SOCIOECONOMIC IMPACTS

Impacts

Recreation has received major emphasis in this plan and would be affected in a number of ways. The recreation emphasis in Zone A maintains for recreational use land that is suitable by restricting or reducing other uses that would conflict, primarily timber management. Other, currently closed land and trails in all three zones are to be made available for public access in 1982.

Some adverse impacts to recreation will also result from the implementation of this plan. Adverse visual impacts will occur from timber management activities in zones A and B, although this impact is less than would be expected from either Alternative 1 or Alternative 2. Increased recreational use, particularly after February 1982, will reduce solitude. The plan will also restrict use of the New World Gulch and Moonshine Gulch trails by prohibiting horse and motorcycle use during spring breakup on these trails and the others in Zone A following their opening in February of 1982.

Timber management activities in Zone B and, to a more limited extent, Zone A have positive impacts on the school trust fund and the local forest products industry, as does salvage of natural timber mortality; table 7 provides the sources of revenue by zone for the unit. The plan does reduce the potential volume of timber production, however, by limiting timber management on approximately 800 acres in Zone A to low-intensity management. The loss of forest products doesn't mean the school trust fund will necessarily suffer, since potential recreational income from this area and other lands not suited to timber management could more than make up for the lost revenue. Timber management activities will also cause periodic short-term degradation of air quality from dust created during harvesting and from open burning for hazard reduction. Roads associated with timber sales may increase the risk of man-caused fire by improving access but will also improve initial attack capabilities.

TABLE 7 REVENUE SOURCES OF THE RECOMMENDED ALTERNATIVE

	TIMBER			
	ACREAGE	INTENSITY OF MANAGEMENT	COMMERCIAL RECREATION	RANGE
Zone A 2,278 acres	800	Low	1,000 acres[1]	22 AUMs
Zone B 2,211 acres	2,000	Moderate	—	55 AUMs
Zone C 956 acres	0		—	7 AUMs

[1]There is the **potential** for development of this much area. Whether it would be developed, of course, would depend on the willingness of developers.

The natural character and pristine conditions of Zone C will be maintained, thereby avoiding the risk of irretrievable damage to a potential natural area. This action will result in the loss of forest products due to natural mortality and fungal rots in the overmature stands found in this drainage. However, this is not an economic loss since the cost of logging this area in an environmentally sound manner would exceed the value of the timber. Conventional logging would very likely cause severe damage to the watershed because of steep slopes and excessively wet conditions in the narrow valley bottom. On the other hand, suspension of logging will allow the buildup of fuels and increase the risk of a major wildfire.

A final socioeconomic impact of this management plan may be the encouragement of interested organizations to develop financial support for natural area designation of Zone C.

Mitigation

Visual impacts will be mitigated by retaining a buffer zone within Zone A in which low-intensity forest management will be practiced with emphasis on protecting visual quality. This buffer zone will screen Zone B from much of Zone A. Adverse effects on air quality resulting from slash burning will be reduced by burning during periods of adequate atmospheric ventilation in compliance with Montana air quality standards.

VEGETATION IMPACTS

Impacts

The recommended management plan would affect vegetation through timber management, changes to the range allotment, and construction activities associated with potential recreational developments. Timber management activities include clearing for roads and landings and other changes due to logging. Many of the currently pure or nearly pure stands of lodgepole pine will be converted to stands of mixed species. The range allotment has been reduced from 272 AUMs to 84 AUMs. Light grazing pressure since 1975 has allowed the range condition to improve, and these modifications will help to avoid future deterioration. Potential recreational developments could result in building construction and in land clearing for parking and ski runs or other improvements.

Mitigation

Vegetative cover is a key factor in maintaining soil stability and preventing erosion. Efforts to promote revegetation will include use regulation, water runoff control, and seeding. Prompt regeneration of logged areas will be a high priority.

WATER QUALITY IMPACTS

Impacts

Use of the trails in New World and Moonshine gulches has created stream sedimentation problems in the past. Stream sedimentation from these trails is expected to continue, but at a reduced rate due to the reduction in AUMs of grazing, proposed trail use regulations, and trail maintenance or improvements.

Timber harvesting and related road construction results in large, short-term increases in stream sedimentation as well as smaller long-term increases. The short-term increases are related to construction. The long term increases are a function of road use and maintenance and the slightly increased

erosive potential of the stream itself, since streamflows generally increase following logging until normal vegetative cover is restored. Construction increases the risk of mass soil failures in some soil types found in the planning unit. Such failures would have little impact on water quality unless this were to occur near drainage channels or streams.

Mitigation

Trail use regulations are planned for zones A and C to prevent or reduce sedimentation from the trails, and additional trail improvement will be made as funding becomes available. Buffer zones 200 feet wide along streams and wet areas will trap sediment, prevent streambank deterioration, prevent water temperature increases, and keep logging debris out of the waterways. Careful examination of proposed road locations and restricting road placement over sites with severe slope stability limitations should reduce the risk of mass soil failure and subsequent sedimentation. Examination of road locations prior to reconstruction of roads may reduce sedimentation by eliminating poorly placed roads.

WILDLIFE IMPACTS

Impacts

Wildlife in the Bear Canyon unit would be influenced primarily by the proposed recreation and timber management. Construction and logging would temporarily displace some big game animals. These would usually occur during the summer and fall months but may also occur during winter and spring in mild years.

Potentially greater impacts can occur from long-term uses and habitat changes resulting from roads, logging, recreational developments, and livestock use. However, the recommended alternative should not create significant adverse wildlife impacts. Timber harvesting helps to diversify the vegetation and can improve summer range for elk, deer, and moose, but this is of limited benefit since winter range is the critical factor in Bear Canyon. Inasmuch as cover and summer range will not be adversely affected and additional road use will be limited, there should be little impact during the summer.

Winter range is generally more limited than summer range, and since winter is the period of greatest stress for wildlife, the impacts of this plan on wintering moose, the dominant species during the winter, is of primary importance.

A comparison of cover types indicate that Zone C is the most favorable toward moose. Zones A and B are more difficult to rate, with Zone A perhaps a little better during the winter, due to the greater amount of the highly preferred spruce type. However, Zone B would appear to offer slightly better summer habitat and perhaps winter range as well, due to the larger Douglas fir cover type and the decreased noncommercial type, which is low in productivity. Table 8 shows the percentage of each cover type by zone.

TABLE 8 PERCENTAGE OF COVER TYPE BY ZONE (%)

	ZONE A (2278 ac)	ZONE B (2211 ac)	ZONE C (955 ac)
Lodgepole pine	50	61	21
Douglas fir	15	25	25
Spruce-fir	3	1	
Lodgepole pine—seedling & sapling[1]			41
Aspen		1	1
Nonforested	9	9	2
Noncommercial[2]	23	3	10

[1]This cover type may be close to a 5- to 10-year-old clearcut in perferability because of the abundance of shrubs and limited timber cover.

[2]The noncommercial areas are low in productivity and are not likely to provide significant moose habitat, particularly since they generally occupy the higher elevations.

No changes are expected to occur in Zone C, while logging activities in Zone B could improve the moose habitat. Currently about 60 percent of Zone B is in lodgepole pine, the cover type least preferred by moose, and the cover type with the highest priority for harvesting. Harvesting in lodgepole pine improves its quality as moose summer range and may also encourage the development of additional winter range since regeneration of Douglas fir, an important component of their winter diet, would be promoted.

This plan encourages recreational development in Zone A and allows snowmobile use to continue in zones A and B. Recreational development such as downhill skiing should not be significantly adverse to the moose population because the human activity would be confined to a relatively small area and because heavy snow accumulations would restrict big game use of that area as well. Shrubby drainage ways are the most critical to wintering moose, and snowmobiles can have a severe impact in these areas. The impact of snowmobiles in wide valley bottoms such as New World Gulch, with escape cover

available, would not be excessive, but the impact could be severe in narrow valleys with steep sides such as Limestone Creek (Foss 1980). Since Zone C (Limestone Creek drainage) is closed to motorized vehicles, there should be minimal adverse impact to moose there.

The potential for overuse of the primary range (valley bottoms) by livestock is also reduced, which would have a beneficial impact for moose.

Mitigation

Several steps are planned to prevent habitat loss and excessive stress for wildlife. Buffer zones along streams and wet areas will help to protect critical winter range, and escape corridors of coniferous trees will be left. Secondary roads to individual timber sales and spur roads within sales will be closed upon completion of each sale. Snowmobile use of sensitive wildlife areas (Zone C) will be prohibited.

RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Short-term uses of the Bear Canyon planning unit are described in chapter VI. Basically, they conform to the primary uses of the three management zones: recreation, timber management, and wildlife and watershed management.

Zone A emphasizes recreation, particularly commercial recreation that reduces the productive capacity of the zone for timber but doesn't influence range productivity. Because over 50 percent of Zone A is unsuitable for timber production, no loss in productivity is anticipated for that half of the unit. The remaining 800 acres of Zone A are suitable for timber management, but the timber will be managed at a low intensity to avoid compromising recreational potential for as long as recreational management is emphasized in Zone A. Low level timber management will result in reduced timber production from the affected acreage. Long-term potential productivity will not be affected except for possible construction areas. Construction, if it occurs, could reduce long-term productivity on 10 to 15 acres depending upon the nature of the development.

Timber management is the primary objective in Zone B. Management actions will strive to enhance long-term timber and range productivity in this zone. Roads are necessary to achieve the desired level of management; construction of these improvements will reduce long-term productivity of the construction sites. However, these losses are unavoidable if the productive capacity of the remainder is to be utilized.

Wildlife and watershed management will be emphasized in Zone C; timber management is not practical at this time, although livestock grazing will continue. The productive capacity of the land will not be damaged. This zone is not considered part of the timber base of the Bear Canyon unit because of watershed and soil considerations. The use of conventional timber management methods could induce mass soil failures and increase stream sedimentation, impairing the zone's productive capacity and causing downstream damage. Advanced harvesting systems, such as helicopter logging, would allow environmentally sound management of Zone C but are not economically feasible at this time and might reduce the natural area potential for this zone.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The implementation of the proposed Bear Canyon Management Plan will result in some irreversible and irretrievable resource losses. Road construction and logging normally result in some soil loss and at least temporary reductions of water quality. The loss of timber production from the actual roadbed is another irretrievable loss; approximately 8½ acres will be committed to permanent roads in Zone B under the proposed plan. Other commitments include approximately 800 acres of manageable timber land in Zone A set aside for recreational development. This area will receive only low-intensity timber management, resulting in reduced production, a loss that is irretrievable but can be reversed in the future. Zone A's productive capacity would not be impaired except for those areas used for permanent improvements.

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APPENDIXES

A. Climatological Data
B. Range Management Plan
C. Road and Trail Travel Plan
D. Moose Feeding Habits and Habitat

APPENDIX A
CLIMATOLOGICAL DATA

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
IN COOPERATION WITH COOPERATIVE EXTENSION SERVICE
CLIMATOGRAPHY OF THE UNITED STATES NO. 20 - 24

CLIMATOLOGICAL SUMMARY

LATITUDE 45° 40'
LONGITUDE 111° 03'
ELEV. (GROUND) 4856

STATION BOZEMAN, MONTANA
STATION NO.: 24-1044-2

MEANS AND EXTREMES FOR PERIOD 1940 - 1969 (30 years)

Month	Temperature (°F)							*	Precipitation Totals (Inches)							Mean number of days					Month
	Means			Extremes								Snow, Sleet						Temperatures				
																	Max.		Min.		
	Daily maximum	Daily minimum	Monthly	Record highest	Year	Record lowest	Year	Mean degree days	Mean	Greatest daily	Year	Mean	Maximum monthly	Year	Greatest daily	Year	Precip. .10 inch or more	90° and above	32° and below	32° and below	0° and below	
(a)	30	30	30	30		30		30	30	30		25	30		30		30	30	30	30	30	
JAN	30.7	10.1	20.4	58	1969	−36	1949	1372	.94	77	1942	15.0	32.8	1963	10.0	1963 +	3	0	15	30	8	JAN
FEB	35.8	15.8	25.9	62	1950	−29	1956 +	1106	.68	.88	1942	9.7	22.1	1940	7.0	1946	2	0	9	27	3	FEB
MAR	41.0	19.2	30.2	70	1966 +	−23	1955	1074	1.41	1.04	1967	16.9	36.9	1967	20.0	1968	4	0	6	28	2	MAR
APR	53.7	30.4	42.1	81	1962	2	1945	680	1.84	1.53	1951	10.5	37.0	1955	14.0	1955	5	0	1	19	0	APR
MAY	63.3	38.5	50.9	89	1954	16	1954	429	2.61	2.06	1952	2.9	24.3	1965	13.0	1964	7	0	*	6	0	MAY
JUNE	70.2	44.9	57.6	91	1966 +	26	1951	232	3.27	2.08	1944	.3	6.0	1943	6.0	1943	8	-	0	1	0	JUNE
JULY	81.5	51.1	66.3	98	1960	32	1955 +	45	1.19	1.45	1962	0	T	1952	T	1952	4	3	0	*	0	JULY
AUG	80.3	49.4	64.9	99	1961	29	1965	70	1.36	1.33	1964	T	1.0	1964	T	1964	4	3	0	*	0	AUG
SEPT	69.5	41.5	55.6	95	1947	16	1965	288	1.76	1.69	1947	.5	6.4	1965	3.0	1965	5	*	*	4	0	SEPT
OCT	58.7	33.4	46.1	82	1957	9	1961	581	1.44	1.07	1953	4.3	19.0	1969	10.0	1969	4	0	*	14	0	OCT
NOV	42.4	21.9	32.2	70	1965	−26	1959 +	976	1.26	.91	1947	10.9	22.5	1960	8.0	1960	4	0	6	26	1	NOV
DEC	34.9	15.5	25.2	59	1957 +	−29	1964	1229	.85	.88	1955	12.5	26.8	1967	10.5	1940	3	0	12	30	4	DEC
YEAR	55.2	30.0	43.1	99	1961	−36	1949	8082	18.61	2.08	1944	83.5	37.0	APR 1955	20.0	1968	53	6	49	185	18	YEAR

(a) Average length of record, years.

T Trace, an amount too small to measure.

** Base 65°F

\+ Also on earlier dates, months, or years.

* Less than one half.

CLIMATE OF BOZEMAN, MONTANA

Located at the base of the western slope of the Bridger Mountain Range at a point where the valley is about 10 miles wide east to west, Bozeman experiences essentially a mountain valley climate. In the weather station vicinity the ground slopes downward to the north at a rate of about 80 ft. to a mile, but the valley flattens and broadens to the northwest for several miles before narrowing into a shallow canyon near Logan. Except for the narrow Gallatin River opening at Logan, the Bozeman section of the Gallatin Valley is surrounded by mountains.

Precipitation in the Bozeman area varies considerably. Belgrade Airport, 11 miles northwest and 400 ft. lower than the Bozeman station, receives on the average about 5 inches per year less than Bozeman, while annual totals in the surrounding mountains, particularly east and south, are generally much larger. Differences in snowfall are similar, the eastern edge of the valley (including Bozeman) usually receiving larger amounts than the western edge. Temperature differences away from the steep mountain slopes are not large within the valley, but the lower elevations of the valley just above Logan are often a bit cooler at night than at Bozeman, due mainly to the fact that cold air (being more dense than warmer air) seeks the lowest level it can find. Conversely, afternoon temperatures at Bozeman are frequently a little cooler than at the lower points in the valley, but in the absence of showers or other local effects, the differences between Bozeman and Belgrade are usually less than 4°F.

Summers are generally pleasant and are characterized by warm days, cool nights and a high percentage of possible sunshine. Hot weather is infrequent, as the comparative data table above shows. In the 30 years summarized, the greatest number of days in one year with 90° or higher maximums was only 17 in 1961. Conditions humid to an uncomfortable degree are rarely experienced. Summer precipitation falls mostly as showers, sometimes accompanied by thunder and lightning, occasionally but not often with some hail. However, hail damage in the Bozeman area, although it has occurred a few times, has been relatively light and scattered. Near the beginning of summer in June, as well as during the last couple of weeks of summer in September, showers occasionally have given way to steady rains which can total as much as an inch or more in 24 hours.

Winters are relatively cold, and occasionally a winter month has had a week or more of severely cold weather. In the 30 years summarized, there have been only two winter months during which Bozeman temperatures averaged less than 10°F., and no months averaged below zero. Mild winter weather is not unusual. Most winter precipitation falls as snow.

Prior to 1931, a few temperatures of over 100° were reported, including 104° in July, 1877 and 1892, and 112° in August, 1875. The 104° in 1892 has been verified, but the 1875 and 1877 readings were made at Ft. Ellis (about 4 miles east of the present site) and cannot now be verified, particularly as to the character of the instrument exposure. The 112° August, 1875 record is considered doubtful. In 1872 minima of −53° were recorded at Ft. Ellis in both January and February. These values do not seem impossible for the Ft. Ellis site, because of differences in general exposure between the Fort and the College. It is likely that the Fort location would experience more radiation and drainage cooling than the College, and therefore it would be expected that Ft. Ellis minimum readings would be somewhat lower than at the College. While −53° seems reasonable as a record low for Ft. Ellis, it does not seem likely that it was that cold those mornings in Bozeman proper — or where the city is now located. The coldest recorded for any Bozeman location (since 1892) was the −43° observed in February, 1936.

Issued in furtherance of cooperative extension work in agriculture and home economics, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Torlief S. Aasheim, Director of Extension Service, Montana State University, Bozeman, Montana.

Tables and text prepared under direction of Grayson V. Cordell Jr., ESSA Weather Bureau State Climatologist, WBO Helena, Montana, September 25, 1970.

BOZEMAN (MONTANA STATE UNIVERSITY)
Average Temperature (°F)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Ann'l
1940	13.6	24.8	36.0	41.4	54.8	60.8	67.4	66.4	58.0	48.6	24.6	28.0	43.7
1941	23.6	26.3	36.2	42.0	53.0	58.4	65.6	64.6	49.3	42.8	34.8	22.6	43.3
1942	15.1	15.4	27.2	43.4	46.8	53.7	65.4	64.2	55.2	46.1	30.9	27.9	40.9
1943	15.4	27.0	18.2	46.8	46.4	54.5	64.4	63.8	56.2	47.8	35.0	23.6	41.6
1944	22.3	23.8	27.7	44.4	52.5	54.3	62.6	61.8	55.8	50.3	31.9	21.2	42.4
1945	25.6	27.0	33.3	36.2	48.4	52.8	65.0	65.0	52.8	48.8	30.4	22.1	42.3
1946	23.0	26.4	35.6	41.6	47.0	57.6	66.8	63.8	54.8	39.0	29.6	29.2	43.4
1947	21.1	27.2	33.2	42.8	54.2	54.6	69.0	65.6	54.7	49.4	26.8	24.4	43.6
1948	22.6	22.0	25.4	43.8	52.4	60.2	63.1	64.0	57.5	46.5	29.9	17.6	42.1
1949	5.3	20.7	29.8	46.0	54.1	56.7	66.7	68.0	56.0	39.5	42.4	24.4	42.6
1950	13.3	30.1	29.6	40.7	47.2	56.3	62.4	62.1	—	46.6	31.6	28.7	40.8
1951	16.3	24.5	23.5	41.0	51.7	52.1	66.0	61.7	52.4	41.6	30.5	19.0	40.0
1952	18.9	23.9	25.8	46.0	51.2	60.0	64.9	65.8	58.5	48.7	27.9	25.5	43.1
1953	33.7	27.5	35.9	38.3	46.5	57.9	68.7	67.3	59.5	49.6	38.7	28.6	46.0
1954	20.9	34.7	26.4	44.0	51.7	55.5	69.4	64.0	56.5	44.2	40.8	25.0	44.4
1955	19.5	19.4	22.0	37.3	50.4	56.9	65.3	69.0	55.4	47.6	23.3	22.4	40.7
1956	21.1	19.9	30.5	41.0	52.0	62.2	67.1	62.5	58.9	46.3	31.1	28.8	43.4
1957	9.4	26.1	32.6	40.2	52.4	58.6	66.5	65.9	56.6	43.9	29.9	31.8	42.8
1958	26.4	30.6	29.3	40.5	59.5	58.8	62.4	67.3	55.5	48.7	32.3	28.3	45.0
1959	25.9	21.2	34.0	42.1	46.2	61.3	66.9	64.4	53.5	43.7	28.5	29.2	43.1
1960	20.4	20.8	31.7	40.8	49.8	59.3	70.3	64.3	57.4	46.3	32.9	24.9	43.2
1961	26.8	35.3	36.5	39.9	51.9	65.6	69.5	69.5	48.8	42.5	29.4	22.3	44.8
1962	15.6	23.9	29.3	45.9	50.0	59.7	64.1	63.3	55.0	48.4	35.6	30.5	43.5
1963	12.0	34.9	36.1	41.5	51.9	58.3	66.5	67.1	61.8	51.9	35.4	22.8	45.0
1964	24.3	26.3	27.1	40.0	51.1	56.9	69.8	62.7	53.8	48.5	31.4	25.6	43.1
1965	29.2	28.0	23.5	42.9	47.5	57.8	65.4	62.7	44.5	50.4	36.8	28.1	43.1
1966	25.7	25.8	33.7	40.5	54.9	57.0	69.2	64.2	60.1	45.2	33.6	26.6	44.7
1967	29.7	31.4	29.5	37.6	49.9	56.6	67.6	68.0	61.6	45.7	32.2	18.5	44.0
1968	20.8	28.4	38.1	38.8	47.8	57.2	66.4	60.5	54.2	45.7	32.6	20.6	42.6
1969	15.7	22.2	26.9	46.6	54.4	56.1	65.6	67.8	59.1	38.2	36.4	28.5	43.1

STATION HISTORY

Weather records in the Bozeman vicinity have been kept at (1) Fort Ellis, (2) in Bozeman about ½ mile north of the College, and (3) at three locations on the College Campus. Details are as follows:

1) Ft. Ellis, Latitude 45° 40', Longitude 110° 58', Elevation 4,907 feet, about four miles east of present Bozeman Post Office. Station known as Ft. Ellis and records (with a few missing months) were kept 1868-1886. There are no records of types and exposures of instruments used. There are no records for the Bozeman area between 1886 and 1892. Some Ft. Ellis data seem doubtful.

2) Bozeman, Latitude 45° 41', Longitude 111° 03', Elevation about 4,900 feet. Instruments were standard, but there is no record of exposure details. Stations was known as "Bozeman [Bozeman (1)]" during this period, 4/1/1892 to 9/30/98 with a break between 6/1/93 and 3/31/94. Mr. W. W. Alderson was observer 4/1/92 to 5/31/93; Mr. Lee Warner from 4/1/94 to 9/30/98. There were no Bozeman observations after 9/30/98 until 1/1/1900.

BOZEMAN (MONTANA STATE UNIVERSITY)
Total Precipitation (Inches)

Year	Jan.	Feb	Mar	Apr	May	June	July	Aug	Sept.	Oct	Nov	Dec	Ann'l
1940	1.48	1.22	1.28	3.33	1.38	2.99	0.61	0.45	2.48	1.05	1.25	1.11	18.63
1941	0.20	0.44	0.78	3.50	1.45	3.17	1.26	1.80	4.60	1.17	2.74	1.76	22.87
1942	2.15	1.71	1.48	0.79	2.44	2.68	0.47	0.53	1.54	1.22	1.78	0.45	17.24
1943	0.88	0.32	1.07	3.07	2.01	2.50	1.90	1.24	0.91	1.95	0.74	0.59	17.18
1944	0.12	0.73	0.96	0.60	3.00	7.98	1.70	1.42	2.13	0.97	0.73	0.59	20.93
1945	0.36	0.47	1.15	1.15	3.67	4.10	0.76	1.73	1.84	1.15	1.18	1.97	19.53
1946	1.26	1.13	2.36	1.43	3.03	1.38	1.47	0.76	1.97	2.35	0.85	0.59	18.58
1947	0.83	0.44	3.02	1.38	1.05	6.78	0.37	0.80	4.58	0.69	3.25	0.45	23.64
1948	1.11	0.65	0.89	2.04	2.37	4.87	1.58	1.91	0.60	0.52	1.53	1.43	19.50
1949	1.89	0.86	1.07	2.06	1.92	3.73	0.51	0.55	2.21	1.21	0.51	0.59	17.11
1950	0.74	0.75	2.00	0.99	2.07	2.10	2.74	1.86	1.99	0.87	1.10	0.92	18.19
1951	0.46	0.49	1.75	1.84	1.52	1.61	0.87	2.36	2.23	4.46	0.81	1.80	20.20
1952	1.24	1.19	1.59	1.99	6.63	2.02	1.28	1.16	0.56	0.21	1.29	0.41	19.57
1953	0.65	1.05	1.04	2.05	3.23	3.13	0.63	0.42	1.00	1.39	1.13	0.68	16.40
1954	1.10	0.13	1.19	0.44	1.70	3.70	0.66	1.32	1.21	0.88	0.07	0.28	12.68
1955	0.54	1.00	1.33	3.51	2.70	2.23	1.55	0.12	1.11	2.04	0.78	2.16	19.07
1956	0.78	0.16	1.27	1.66	2.06	1.06	0.46	0.95	0.97	1.12	0.52	0.29	11.30
1957	0.74	0.20	1.16	1.27	2.80	4.68	1.52	0.70	0.85	1.46	0.56	0.58	16.52
1958	0.82	0.88	1.52	1.91	0.37	2.43	3.25	2.52	1.40	0.41	1.69	0.91	18.11
1959	0.79	1.12	1.58	1.37	4.08	2.42	1.63	0.74	2.35	1.93	0.90	0.67	19.58
1960	0.78	0.71	1.77	2.32	2.33	1.18	0.37	2.14	0.43	0.88	1.02	0.68	14.61
1961	0.11	0.84	0.82	2.49	1.39	0.82	0.71	0.58	4.90	2.11	1.10	0.25	16.12
1962	1.27	0.49	1.32	1.12	3.86	1.55	3.08	2.14	0.64	1.15	3.01	0.34	19.97
1963	1.76	0.53	1.06	1.98	3.29	3.13	1.09	0.80	2.00	0.94	0.61	0.67	17.86
1964	0.48	0.67	1.19	2.12	3.11	3.72	0.91	3.80	0.08	1.29	1.57	0.91	19.85
1965	0.97	0.50	0.45	2.24	4.16	3.76	0.68	2.23	2.42	0.45	0.75	0.61	19.22
1966	0.75	0.22	1.18	1.10	2.54	2.84	0.46	1.26	1.08	1.53	0.98	0.69	14.63
1967	1.17	0.76	3.28	1.45	2.05	4.44	1.12	0.27	1.21	3.48	2.09	1.62	22.94
1968	0.91	0.44	2.13	1.42	4.03	3.78	1.08	2.63	2.77	1.37	2.65	0.35	23.56
1969	1.95	0.44	0.46	2.51	1.92	7.37	1.70	1.50	0.86	3.02	0.58	1.09	23.40

3) Bozeman Agricultural College is the present site, at Latitude 45° 40', Longitude 111° 03', Elevation 4,856 feet, about 1½ miles SW of the Bozeman Post Office, and across the street SE of the Agricultural Engineering Building where it has been since 3/15/47. Established originally on the College Campus on January 1, 1900, it was moved a short distance 8/6/13 to a point near the then Chemistry Building; then on 3/15/47 it was moved 500 feet N and 44 feet lower to the present site. Instrumentation and exposure at the College have been standard, evaporation equipment (Class A) was added to the station April 1, 1919. The record has been published since 1948 as "Bozeman Agricultural College", but prior to 1948 (and after 1/1/1900) it was published as "Agricultural College" with footnote in most of the publications carrying Bozeman data indicating "Post Office Bozeman". Observers at the College have been: Prof. E. Burke, 1/1/00 to 3/19/43; A. R. Patton, 3/20/43 to 8/31/43; O. E. Sheppard, 9/1/43 to 6/30/46; Dr. P. C. Gaines, 7/1/46 to 3/14/47; Mr. O. W. Monson, 3/15/47 to 7/1/61. J. M. Caprio: 7/1/61 to date.

There was a record kept briefly at the College Experiment Farm Station from 2/1/96 to 1/30/98, and data for this point were published as "Bozeman (2)". This site seems to have been about ½ mile SW of the present site. The present (9/1/70) exposure of instruments is rated as very good.

APPENDIX B
RANGE MANAGEMENT PLAN

Currently, 5,445 acres, the entire Bear Canyon planning unit, are included in the grazing authorization. However, a grazing survey (Montana DNRC 1974) has shown that the major portion of the area is unsuitable for grazing, and actual livestock use was confined to about 850 acres, with 80 percent of the use occurring on 140 acres of primary range. The range suitability map identifies primary and secondary range. The number of AUMs authorized has been adjusted to 84 during the June 15-October 15 grazing period, to prevent overgrazing. Further adjustments of the grazing allotment are not anticipated, but future changes can be made if future surveys indicate range deterioration is occurring or if range productivity is increasing.

The grazing permittee may request closure of the grazing area to the public during the grazing period. Such a closure may be granted if evidence of stock harassment, property damage, or sufficient other cause is shown.

The grazing authorization specifically reserves public access to the Gallatin National Forest through existing roads and trails. This includes the Bear Canyon Road above the ski area lodge, the New World Gulch Trail, and the Moonshine Gulch Trail. These are the only trails currently open to public use (subject to use restrictions as provided in appendix C); however, the size of the grazing authorization and the number of open trails may be altered in 1982.

Upon approval of this plan, the boundary will be reduced from the entire area to the proposed boundary shown on map B-1. Also, all other mapped roads and trails shown on map 9 will be opened to public access under restrictions imposed by DNRC in appendix C.

RANGE CONDITIONS

Range Suitability

A survey was conducted to determine what portion of the Bear Canyon unit is physically grazeable and if the vegetative cover of the grazeable area is conducive to livestock use. First, that portion of the area that is currently used was delineated—basically, the stream bottoms and lower open areas. Additional area, if grazeable with improved livestock control, was also included (these conform to primary and secondary range types).

Carrying Capacity and Range Types

Range types were delineated on aerial photographs of the area and a range capacity and condition determination made on a small representative site within each type. Following is a list of the nine general range types and some comments as to the condition, relative suitability for grazing, and carrying capacity of each. Areas 1 and 2 have received very heavy grazing pressure in the past, probably a combination of summer use by cattle and winter use by horses and elk.

1. Douglas fir tall forb (DF forb)—On open south slopes near the ridge top with about 10 percent canopy cover. Large amounts (60 percent) of the ground cover are forbs, including tall larkspur (Delphinium occidental), a plant poisonous to cattle in the spring and early summer.

   Condition—POOR
   Carrying Capacity—10 acres/AUM
   Potential—3 acres/AUM

2. Tall forb (Tall Forb)—A tall forb community has replaced the dry meadow that would be expected here. Tall larkspur makes up about 15 percent of vegetation.

Carrying Capacity—8 acres/AUM
Potential—2 acres/AUM

3. Douglas fir-lodgepole-grouse whortle berry-huckleberry (DF-LPP/Vaca-Vasc)—Heavily timbered north slope with limited grazing value. Cattle make some use of area while moving to open ridges

Condition—GOOD
Carrying Capacity—30 acres/AUM
Potential—30 acres/AUM

4. Stream bottoms (Bottoms)—Narrow brushy stream bottoms with small perennial streams. Bottoms are rarely over 130 feet wide and more typically 30 to 70 feet wide towards upper portions and are frequently brushy, with alder and hawthorn predominating. This type produces good quality shrub forage on subirrigated portions. Vegetation is composed of about 30 percent grasses, 40 percent forbs, and 30 percent shrubs. Grasses are mostly invaders including timothy (Phleum pratense), orchard grass, (Dactylis glomerata) and Kentucky bluegrass (Poa pratenses). A variety of broadleaf plants occur. Dominant shrubs include hawthorn, alder, gooseberry and ninebark. The type is still productive, although the native grasses have been largely replaced.

Condition—POOR
Carrying Capacity—3 acres/AUM
Potential—About 1 acre/AUM

5. Douglas fir ninebark (DF/phma)—Moderately open Douglas fir forest with brush understory. Some small openings provide minimal grazing.

Condition—GOOD
Carrying Capacity—15 acres/AUM
Potential—15 acres/AUM

6. Kentucky bluegrass/forb (Popr/Forb)—A bunch-grass type that has deteriorated, as indicated by the large amount of forbs in the plant composition and less desirable grasses present.

Condition—FAIR
Carrying Capacity—5 acres/AUM
Potential—3 acres/AUM

7. Lodgepole pine/ninebark (LPP/phma)—More open than previous timber types; gentle slope; more grasses than other timbered areas. Presently receives only fringe use

Condition—GOOD
Carrying Capacity—10 acres/AUM
Potential—10 acres/AUM

8. Bluebunch wheatgrass/forbs (Agsp/Forb)—Open ridge similar to 1 and 2 but in better condition; does not appear to get any cattle use. Some transient horse use evident. Signs of heavy browsing around perimeter. Probably used as winter area by elk. Certain parts of type that may blow clear of snow shows signs of heavy use.

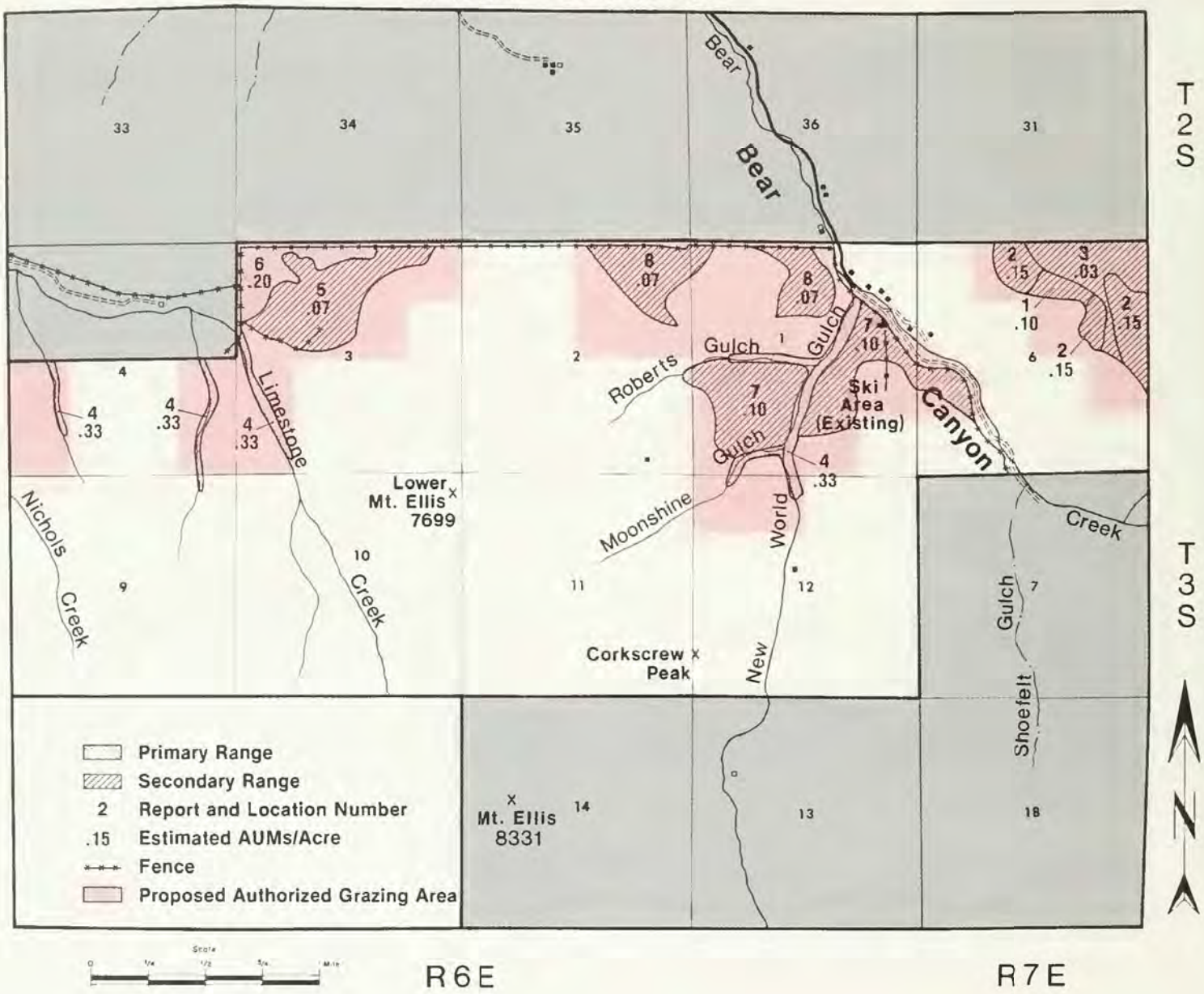
Condition—FAIR to GOOD
Carrying Capacity—5 acres/AUM
Potential—3-4 acres/AUM

9. Douglas fir-lodgepole/ninebark (DF-LPP/Phma)—Similar to 5 but with more lodgepole pine.

Condition—GOOD
Carrying Capacity—15 acres/AUM
Potential—15 acres/AUM

BEAR CANYON MANAGEMENT UNIT

RANGE SUITABILITY



APPENDIX C
ROAD AND TRAIL TRAVEL PLAN

The proposed regulations for motorized and non-motorized use of the Bear Canyon planning unit are given below and summarized on map 9. The travel plan contains resource protection requirements and financial constraints.

The current grazing authorization includes the entire Bear Canyon planning unit. The grazing permittee may request that public access to the grazing area be restricted during the grazing period. The request may be granted if sufficient cause is shown. However, the Bear Canyon Road, Moonshine Gulch Trail, and New World Gulch Trail will remain open, subject to use restrictions provided below under "Zone A". Planned modifications to the grazing authorization will allow public access on all the mapped roads and trails shown on map 9.

Resource protection from overuse must also be considered when permitting public recreational use of state forest lands. Protection from soil erosion and stream sedimentation is generally accomplished through use regulations and maintenance of roads and trails. Since DNRC does not have the funds to provide adequate maintenance of roads and trails in Bear Canyon, regulation of road and trail use must be relied upon to prevent erosion. Some trail work has been done in New World Gulch using labor provided through federal employment programs, but these programs are not permanent. Improving the trails in Moonshine Gulch has high priority but cannot be assured at this time.

The following regulations for road and trail use are designed to permit diverse recreational opportunities within the constraints of the available resources. These regulations are subject to change, depending upon resource conditions and the extent of trail maintenance and improvement that can be accomplished. If excessive sedimentation ocurs under these regulations, vehicle and horse use may be further restricted.

ALL ZONES

Off-road use is restricted to pedestrian, horse, and snowmobile use, except in Zone C where no motorized vehicles are permitted.

ZONE A

Roads

No roads are planned for Zone A at this time. Roads may be necessary for maintenance or construction if recreational facilities are developed, but the roads would be open to authorized vehicles only.

The Bear Canyon Road is washed out above the ski area, and is not scheduled for repair. However, a timber sale is planned by the Gallatin National Forest which would relocate the Bear Canyon Road. The new road would remain open to the public.

Trails

The New World Gulch Trail and Moonshine Gulch Trail are the only trails open for public use.

Proposed trail regulations for Moonshine Gulch and New World Gulch:

1. Open year round to pedestrian use.
2. Open to snowmobile use during the winter.[1]
3. Open to motorcycle and horse use during the summer and fall months, closed during the spring until June 15. Periods of closure may vary depending upon soil moisture conditions and may include portions of the fall if excessively wet conditions prevail.

These regulations will also be applied to those trails in Zone A to be opened in February of 1982. Off-road vehicles other than snowmobiles will be restricted to the mapped roads and trails.

ZONE B

Roads

Zone B is currently unroaded. The proposed road shown on map 9 would be open to vehicular use pending approval of this plan. Access to the road will be controlled by adjacent lease holders.

Secondary roads and spur roads, not mapped, will be closed following timber sale closure.

Trails

Upon approval of this plan, the roads and trails shown on map 9 will be open for vehicular, horse, or pedestrian use. Off-road vehicles other than snowmobiles will be restricted to mapped roads and trails.

[1]Snowmobile use may be restricted if conflicts occur with potential commercial development or with cross-country skiers.

ZONE C

Roads

There are no roads in Zone C, nor are any planned.

Trails

Sensitive wildlife habitat and fragile watersheds require Zone C to be closed to motorized vehicular use. Planned modifications to the grazing authorization will open the mapped trails and areas outside the new grazing boundaries to pedestrian or horse traffic.

APPENDIX D
MOOSE FEEDING HABITS AND HABITAT

Moose food habits vary by season, but they rely heavily on browse species year round, use forbs to a limited degree, and eat little grass.

Table D-1 provides a breakdown of moose food habits in the lower Gallatin. Other plants of seasonal or local importance are serviceberry, cottonwood, aspen, wild rose, and mountain maple.

The cover types used by eight radio-equipped moose during summer and winter are shown in Table D-2. Spruce-fir types, the most preferred, are not well represented in the lower Gallatin moose range. Aspen and Douglas fir types are also heavily used, and nonforested and logged types are well used during the summer (probably being restricted by snow depth during the winter).

TABLE D-1 SEASONAL FEEDING HABITS OF MOOSE IN THE LOWER GALLATIN (%)

	FALL (Sept-Nov)	WINTER[1] (Dec-March)	SPRING (April-mid-June)	SUMMER (Mid-June-August)
Browse				
Willow	22	30	44	36
Douglas fir	18	40	0.3	—
Subalpine Fir	16	3	—	—
Huckleberry	13	—	13	—
Thimbleberry	—	—	—	20
Red Dogwood	2	8	4	—
Ribes Spp.	2	5	15	0.1
Other Browse	13.6	13.2	20.9	10.3
TOTAL	**86.6**	**99.2**	**97.2**	**66.4**
Total Forb	12.6	0.2	2.2	33.6
Total Grass	0.7	0.6	0.5	—

SOURCE Montana Department of Fish and Game 1974

[1]These data are the results of eight rumen sample examinations and may not accurately reflect food habits for the Bear Canyon area since the small number of samples were obtained from road kills, mostly in the western portion of the study area.

TABLE D-2 SEASON USE OF COVER TYPES BY MOOSE IN THE LOWER GALLATIN

Type	WINTER		SUMMER	
	Percentage of Total Area	Percentage of Observations	Percentage of Total Area	Percentage of Observations
Lodgepole Pine	74	37	60	18
Douglas fir	14	39	28	55
Logged	7	7	2	0
Spurce-fir	2	9	1	20
Nonforested	2	7	4	0
Aspen	1	2	2	7
Old Burn	T	0	4	0
Cottonwood	—	—	T	0
TOTAL ACRES	5,575		7,180	

SOURCE: Montana Department of Fish and Game 1974

NOTE: The percentage of use and percentage of each cover type is derived from the actual use area of eight radio-equipped moose, including one in Limestone Creek, February 1969-April 1971.

Table D-2 also shows that use of lodgepole pine is light. This use improves in lodgepole pine clearcuts (after 10-15 years) and decreases in spruce-fir clearcuts as shown by table D-3.

TABLE D-3 MOOSE PELLET GROUPS COUNTED IN DIFFERENT-AGED CLEARCUTS IN THE SPRUCE-FIR AND LODGEPOLE PINE TIMBER TYPES AND ADJACENT UNCUT TIMBER, LOWER GALLATIN STUDY AREA

TIMBER TYPE	YEARS SINCE LOGGED	ACRES SAMPLED	PELLET GROUPS PER 100 ACRES
Spruce-fir[1]	Uncut	70	27
Spruce-fir[1]	5-6	150	7
Lodgepole Pine	Uncut	150	3
Lodgepole Pine	2	230	0
Lodgepole Pine	14-21	165	7

[1]Included up to approximately 40 percent lodgepole pine in the canopy.

SOURCE: Montana Department of Fish & Game 1974

The relative preference of the cover types occurring in the lower Gallatin are shown in Table D-4. These data are derived from Table D-2 and use lodgepole pine as a baseline comparison; for example, Table D-4 shows that summer use of the aspen type is about four times greater than summer use of lodgepole pine type.

TABLE D-4 COMPARISON OF MOOSE HABITAT PREFERENCE OF SEVERAL COVER TYPES TO LODGEPOLE PINE

	SUMMER	WINTER[1]
Lodgepole Pine	1:1	1:1
Douglas fir	5.6:1	6.5:1
Logged	2:1	0
Spruce-fir	9:1	6.5:1
NF	7:1	0
Aspen	4:1	11.5:1

[1]Winter use of the lodgepole pine cover type is about 60 percent of summer use.

The information concerning habitat preferability provides a means of comparing moose habitat in Bear Canyon to that of the general vicinity. The "percentage of total area" column in Table D-2 shows the cover types for summer and winter moose ranges of eight individual moose in the lower Gallatin. These can be compared to Table D-5, which shows the percentage of each cover type on the Bear Canyon planning unit, but strict interpretations of these data should be avoided, since table D-2 is based entirely on a few individual moose. Nevertheless, suitable cover types in Bear Canyon compare favorably with the Lower Gallatin vicinity. Preferred cover types are more abundant or equally abundant in Bear Canyon, and lodgepole pine, the least preferred, is relatively less abundant.

TABLE D-5 COVER TYPES ON THE BEAR CANYON PLANNING UNIT

COVER TYPE	PERCENTAGE OF TOTAL AREA
Lodgepole pine	49.6
Douglas fir	21.0
Spruce-fir	1.6
Lodgepole pine seedlings and saplings[1]	7.3
Logged	——
Aspen	0.5
Nonforested	8.0
Noncommercial	12.0

SOURCE: Montana DNRC 1976b

[1]This cover type may be close to a 5-10-year-old clear cut in preferability because of the abundance of shrubs and limited timber cover.

GLOSSARY

AUM (Animal Unit Month)
A month's tenure upon range by one mature bull or one mature, 1000-lb. cow and her unweaned calf.

Classified Forest Land
State-owned land that has been legally designated "forest land." Surface resources of these lands are administered by the Department of Natural Resources and Conservation's Forestry Division. Sub-surface resources are administered by the Department of State Lands. All revenues are earmarked for the school trust fund.

Classified Grazing Land
State-owned land that has been legally designated "Grazing Land." Surface and subsurface resources are administered by the Department of State Lands; revenue is earmarked for the school trust fund.

Climax
The culminating stage in plant succession for a given environment; the vegetation type that reaches a stable condition.

Cu. Ft./Acre/Yr
The volume (in cubic feet) of stem wood produced on one acre in one year.

Developed Recreation
Commercial recreational facilities that concentrate use in a relatively small area such as campgrounds or downhill skiing facilities.

Dispersed Recreation
Noncommercialized recreation not requiring specific facilities such as remote camping, hunting, hiking, and cross-country skiirg.

Evenaged
Of a crop or stand composed of trees having no, or relatively small, differences in age. By convention, the maximum difference admissible is generally 10 to 20 years, with rotations of 100 years.

Fire Hazard
That part of the fire danger contributed by the fuels available for burning.

Fire Risk
The chance of fire starting, as affected by causative agencies (for example, travelers or lightning).

Intensive or High Intensity Timber Management
A timber management scheme of intensive investment in forest stands in order to produce maximum timber yields in the shortest amount of time. Investment treatments normally include planting, weeding and cleaning, fertilization, thinning, and protection from fire. A relatively high-investment, high-return management scheme.

Low Intensity Timber Management
A timber management scheme of limited investment designed to produce healthy stands with less than their maximum potential yields. Usually employs natural regeneration and lengthened rotation. Fire protection may be less intensive, and investment treatments are employed only as necessary to protect the health of the stand.

Mass Soil Failure (slumping)
A sudden or continuing downslope flow of soil due to excessive moisture or the removal of structural support below the failure.

Moderate Intensity Timber Management
A timber management scheme of moderate investment designed to produce yields near maximum potential within reasonable time periods. Investments may include planting, thinning, weeding and cleaning, and fire protection.

Salvage Cutting
Cutting primarily to recover dead and downed material and scattered, poor-risk trees that will not be merchantable if left in the stand until the next scheduled cut.

Seral
A biotic community considered a developmental, transitory stage in an ecologic succession

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