

CANYON CREEK
MANAGEMENT ANALYSIS

by

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INTRODUCTION

Canyon Creek is a unit of land located just below the Mogollon Rim on the Tonto National Forest consisting of 8,784 acres and includes the 72-acre O. W. Ranch. It is an area that is well suited to a variety of uses such as timber harvesting, livestock uses, and recreation. Many of the uses compete among themselves and also with other values such as natural beauty and wildlife. Several uses enhance one or more outputs but degrade others. The objective of this analysis is to determine in what areas management should be emphasized to maximize the total use of all resources within Canyon Creek.

MANAGEMENT GOALS AND OPTIONS

For this analysis the Canyon Creek Management Unit has been broken down into the following units and shown in Figure 1.

<u>Unit</u>	<u>Description</u>	<u>Acres</u>
A	Mogollon Rim escarpment	4090
B	Timber sites with harvest constraints	3195
C	Potential transportation on timbered sites	107
D	Potential recreation area on timbered sites	144
E	Non-timbered sites with no conflicts	402
F	Private property	72
G	Cut over timber sites with no harvest constraints	277
H	Timbered sites with no harvest constraints	107
I	Canyon Creek and stream side meadows	389

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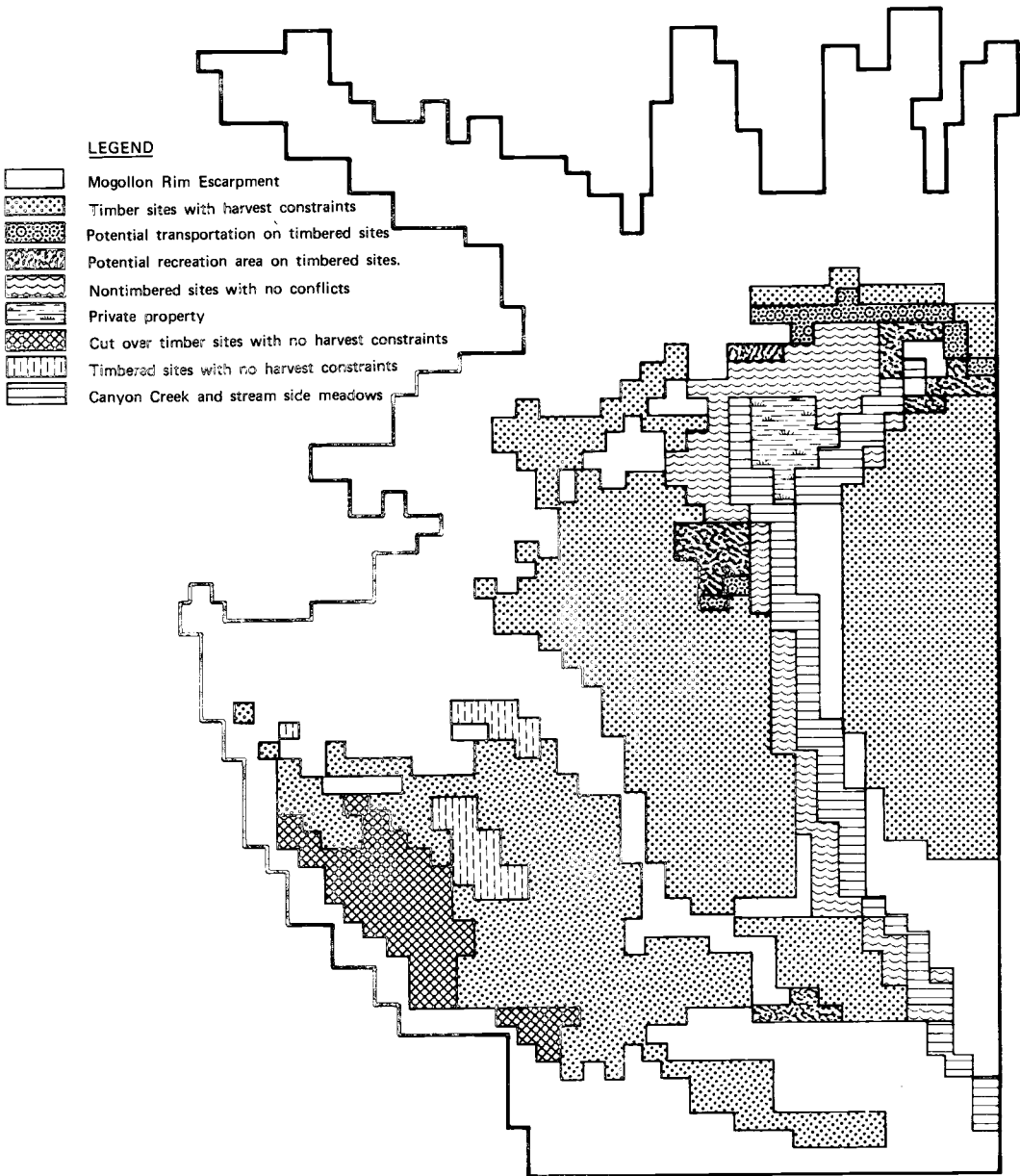


FIGURE 1.

CANYON CREEK UNIT

The following management goals have been established for Canyon Creek.

1. Cut a timber volume that is no greater than the present salvage volume of five (5) board feet per acre per year (BD. FT./Ac./Yr.).
2. Graze livestock and sheep at stocking levels which are equal to or below the present level of 851/AUM's (animal unit months).
3. Keep sediment below 27.0 acre feet per year (the yield from sheet erosion under present conditions).
4. Maintain or increase the present level of water production of 1200 acre feet per year.
5. Provide recreation facilities for campers and picnickers up to a PAOT (persons at one time) limit of 25,000 visitor days.
6. Maintain or improve wildlife habitat and natural beauty. (This would be an average rating of 5.0 units per acre based on a scale of 1-10.)

To achieve this multiple set of goals the District Ranger has outlined a list of five management options that he can implement. Four of these are Forest Service management options, and the fifth, land subdivision, is an out-service imposed activity.

PRESENT CONDITION

Leave the entire area in present condition. This would mean timber harvesting would be limited to salvage sales only. Continue grazing use on the OW allotment and sheep driveway, and no campgrounds would be developed.

TIMBER HARVEST

Cut timber in volumes that do not exceed the annual growth on areas that have the fewest silvicultural constraints. Other activity levels are those of the present condition.

RECREATION EMPHASIS

Develop all suitable recreation sites to provide for a maximum of 25,000 Visitor Days (VD). Improve fisheries habitat along Canyon Creek. Other activity levels would be the same as present condition.

GRAZING REDUCTION

Reduce grazing by 50 percent on the OW allotment and eliminate all use on the sheep driveway. There would be timber harvesting on commercial sites and the same recreation and fisheries developments as outlined in the recreation option.

LAND SUBDIVISION

Subdivide the 72 acres of private lands. This would mean elimination of the livestock grazing on the OW allotment; continued use of sheep driveway; timber harvesting would be limited to salvage sales only. No recreation facilities would be constructed; however, stream habitat improvement work would be done along Canyon Creek.

ANALYSIS PROCEDURE

To define the effects and permit an evaluation of which management option would best meet the stated goals, it is necessary to develop coefficients that describe each option. To do this the present condition was described for each unit of land. Each alternative was then described as some amount of change from the present condition. The changes were determined from information supplied by the District Ranger, known responses for similar areas, professional knowledge, research results, and computer simulation.

To evaluate this problem a decision analysis technique called GOAL PROGRAMMING^{1/} was used. This is a linear program technique that allows the user to evaluate multiple objectives.

A matrix was constructed that described each unit of land under each management option. The constraints were the management goals and the number of acres in each unit.

COEFFICIENT DEVELOPMENT

TIMBER GROWTH

The present average annual growth rate is 824 BD.FT./AC./YR. This is the amount that can be harvested on units C, D, and H which are not constrained silviculturally. The present silvicultural prescription is for a selective cut to be made every twenty years.

^{1/}Lee, S. M., 1972, "Goal Programming for Decision Analysis", Philadelphia: Averback Publishers, Inc., 387 pages.

Units B and H are steeper and can only be harvested within certain silvicultural constraints with an estimated removal of 475 BD.FT./AC./YR.

All timber units will have over mature and dead material removed in salvage sales which will amount to an estimated five (5) BD.FT./AC./YR. This amount will be removed under all alternatives except timber and grazing option.

GRAZING

The present permitted use is 125 AUM sheep use on sheep driveway, 726 AUM cattle use on OW allotment, for a total of 851 AUM use on the Canyon Creek Unit.

It is estimated that 75 percent of the use in the OW allotment occurs in Units I and E, with the remaining 25 percent spread over all other units with the exception of Unit A.

<u>Unit</u>	<u>AUM</u>	<u>Acres</u>	<u>Grazing Coefficient</u> <u>AUM/Ac.</u>
I & E	545	791	0.689
B thru H	181	3902	0.079

For a 50 percent cattle reduction on OW Allotment:

<u>Unit</u>	<u>AUM</u>	<u>Acres</u>	<u>Grazing Coefficient</u> <u>AUM/Ac.</u>
I & E	272	791	.343
B thru H	91	3902	.023

The sheep driveway is primarily in Unit A or a grazing coefficient of 0.0299 AUM's/AC.

SEDIMENT

Average annual sediment yields were computed using the computer program EROSON² which uses a factorial approach originally developed by Musgrave. The factors included in the program are soil characteristics, such as basic erosion rates and erodibility, precipitation, slope, and vegetative cover characteristics. Values were determined for different vegetative cover densities which represented each land use.

2/Anderson, David A., "Guidelines for Computing Quantified Soil Erosion Hazard and On-Site Soil Erosion", 1969, USDA, Forest Service, 35 pp.

Table 1 contains the sediment coefficients developed for each unit of land.

Table 1. Sediment Yields (S.Y.) AF/AC/Year for Different Management Options Represented by Different Ground Covers Percents (%)

Unit	Slope	Present Condition		Timber %	Recreation %	Grazing %	Land Subdivision	
		%	S.Y.				%	S.Y.
A	10	60	.00324			70	.00166	
G	15	70	.00079		20	.01315	.00008	
I, F	5	60	.00008		30	.00049	.00033	.00049
C, D, E	25	70	.00116	40	20	.01981	.00046	
B, H	35	60	.00383	40	30	.000592	.00059	

WATER

Average annual water yields were simulated using the mathematical process model called BURP^{3/}. This computerized model uses elevation adjusted precipitation and temperature, soil moisture storage capacities, recession coefficients, rooting depths, vegetation interception rates, and other measurable variables of the hydrologic cycle to simulate the excess water yields from a uniform unit of land. By changing such use associated variables as rooting depths or interception rates, the yield for each use can be simulated. A 10 percent increase in yields was used for commercial timber harvests. Table 2 contains the water yield coefficients for each unit of land.

Table 2. Water Yields for Different Units as Computed by BURP

Unit	Area		Water Yield		
	Ac.	Sq. Mi.	In.	AF	AF/AC/Year
A	4090	6.39	3.0	1,022	0.249
B	3195	4.99	0.42	112	0.035
C, D, E, G, H	1037	1.62	0.53	46	0.044
F	72	.11	0.48	3	0.039
I	389	.61	0.32	10	0.027

NATURAL BEAUTY

The coefficients for Natural Beauty are based on a rating scale of 1-10. Each management option was compared against the criteria of form, composition, color, and water. A pair-wise comparison procedure called DARE^{4/} was then used to develop percentage points for each option. An interactive computer program called DECIDE was used to facilitate computations. The best management option, Timber Harvest, was used as a basis to set up the ratings; i.e., since this was considered the best with a rating of 8.5, others were ranked below this value with the DECIDE percentage points.

^{3/}USDA-Forest Service, "A Water Balance Program", July 1968, 31 pp.

^{4/}Decision Alternative Ration Evaluation, Albert J. Klee, The American City, Buttonheim Publishing Corporation, February 1970.

WILDLIFE

The procedure used to develop Natural Beauty coefficients was also used for Wildlife. Criteria of food, water, shelter, and privacy were used to rate the habitat for elk. The Timber Harvest option was also used as a basis to set up the ratings.

RECREATION

At the present time there is approximately 4500 VD/Yr. of recreation use in the Canyon Creek area. This is split about equally between campers and picnickers.

It is estimated that 85 percent of present use occurs along the stream units I and E.

<u>Unit</u>	<u>Acres</u>	<u>VD</u>	<u>Recreation Coefficient VD/AC/YR</u>
I & E	791	3825	4.84
B, C, D, G, H	3830	1125	0.294

For the recreation alternative facilities would be constructed in units C and D providing 25,000 VD/Yr. capacity; fisheries habitat work in Unit I would provide an additional 3200 VD/Yr; and an increase of 1000 VD/Yr. of dispersed usage can be expected in units B, E, G, and H.

<u>Unit</u>	<u>Acres</u>	<u>VD</u>	<u>Recreation Coefficient VD/AC/YR</u>
C & D	251	25,000	99.60
I	389	3,200	8.23
B, E, G, H	3981	1,000	0.251
E	402	4,825	5.087

RESULTS

Tables 3 and 4 give the results of this analysis for each management goal and the resulting acreage allocation, by management option. The following is a discussion of each management goal.

Table 3. Canyon Creek Analysis
Management Goal Achievement

MANAGEMENT GOAL	UNITS	AMOUNT DESIRED	AMOUNT ACHIEVED	DIFFERENCE	
				POSITIVE	NEGATIVE
TIMBER	MBDFT	500	1,275	775	
GRAZING	AUM	851	417		434
SEDIMENT YIELD	AF	27.0	17.6		9.4
WATER YIELD	AF	1,200	1,194		6.5
NATURAL BEAUTY	RATE	5.0	5.9	0.9	
WILDLIFE HABITAT	RATE	5.0	5.0		
RECREATION	VD	25,000	8,980		16,020

Table 4. Canyon Creek Analysis
Acreage Allocation

UNIT	PRESENT CONDITION	TIMBER HARVEST	RECREATION EMPHASIS	GRAZING REDUCTION	LAND SUBDIVISION
A				4,090	
B		692		2,503	
C		107			
D		144			
E				402	
F	72				
G				277	
H				107	
I				389	
TOTAL	72	943		7,768	

TIMBER

The harvest level of 500 MBDFT was exceeded by 775 MBDFT. This is the amount that would be removed every 20 years which is the normal silvicultural prescription. This is not an annual yield every year.

There is a direct conflict between the timber yield and recreation developments on Units C and D. To achieve the timber goal meant no campground developments. In subsequent analysis when timber was constrained to the 500 MBDFT, the recreation goal of 25,000 VD was met.

GRAZING

The present grazing level of 851 AUM's was not achieved. The difference of 434 AUM's is a reduction of 50 percent from the present stocking levels. It is very significant that nearly all the acreage (88%) was allocated to the grazing option.

SEDIMENT

Sediment yields were decreased by 9.4 acre feet from present levels in this analysis. This is due in large part to the increase in vegetative cover as a result of limiting livestock and recreation usage.

WATER

Water yields were essentially achieved. The small difference (6.3 acre feet) is only 0.5 percent of the total yield. It is possible that some of the differences are attributable to rounding errors in developing the coefficients. This result was also obtained in subsequent analysis when timber was constrained and acreage allocation was not to Units C and D where small increases are possible.

NATURAL BEAUTY

A small increase was noted for Natural Beauty. By breaking up the existing homogeneous stands of Timber with some selective cutting, Natural Beauty is enhanced.

WILDLIFE HABITAT

There was an increase over the present condition rating of 4.7 which again reflects the improvement in elk habitat. This was also achieved by breaking up the timber stands and providing less competition from livestock.

RECREATION

The desired goal of 25,000 VD was not achieved primarily because facilities were not constructed in Units C and D.

SUMMARY

As a result of this analysis, the management direction for the Canyon Creek Unit should be along the following lines:

1. Efforts should be made to reduce livestock levels.
2. Timber harvesting should be restricted to salvage sales and small selective cuts on Unit B.
3. Development of campgrounds and roads in Units C and D can be accomplished if timber harvesting is not done.
4. The private land in Unit F should not be subdivided.
5. Stream improvement work should be done in Canyon Creek (Unit I) accompanied by livestock control.