The Allowable Cut

for

The Experimental Forest

University of Idaho

College of Forestry, Wildlife and Range Sciences

A draft report to the Experimental Forest Advisory Committee

from

Harold L. Osborne
Forest Manager

April 1, 1987

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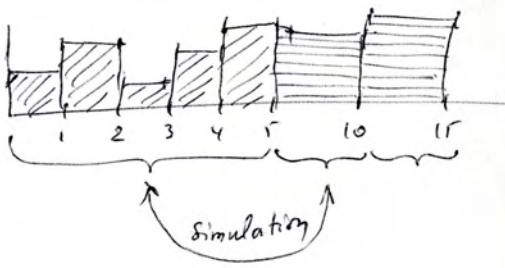
Forest planning:

Operational level ↔ (simulation) strategic level (general)

tactical planning (medium

Forest Planning Algorithm

+ FORPLAN
+ Planning Period Length.



EXECUTIVE SUMMARY

A first approximation of the allowable cut for the University of Idaho Experimental Forest has been calculated using a simple and straightforward method known as the Austrian formula. The forest inventory of 90.58 MMBF (million board feet, gross volume) as it existed in 1980 was used as the data base. Adjustments have been made to the 7155 acre land base to arrive at a timber base of 5340 acres. Major adjustments are the removal of 652 acres in East Hatter Creek for the deer enclosure, 407 acres for natural areas and 756 acres for roads, trails, landings, and administrative and recreation sites. The application of the Austrian formula to the forest data base results in an allowable cut of 2.32 MMBF (gross volume) per year for the Experimental Forest.

The Austrian formula is a volume control harvest regulation formula that is based on the adjustment of the present growing stock to some desired level over an adjustment period. One of the strengths of this formula is that a minimum number of variables are required. Its major weakness is that it is useful for only short-term projections and contains no detail. The allowable cut of 2.32 MMBF board feet approximates the harvest level derived from previous calculations with more sophisticated methods.

The harvest level since 1980 has averaged 1.57 MMBF/year (net volume) which translates to 2.02 MMBF/year (gross volume).

ACKNOWLEDGEMENTS

This report was made possible through the combined efforts of the following individuals. Their names and responsibilities are as follows:

Harold L. Osborne, Forest Manager, Experimental Forest Responsible for project planning and coordination, data manipulation, and report writing.

Joseph H. Boucher, Irregular Help Employee, Former graduate student and member of the Experimental Forest Logging Crew, 1981-1983. His M.S. professional paper was titled "A General Overview of Harvest Scheduling and Its Application on the University of Idaho Experimental Forest" April, 1983. Responsible for data manipulation, data analysis and report writing.

Vaiden Bloch, Irregular Help Employee, Former graduate student and former interim Logging Superintendent. Responsible for digitizing and map making on the Comarc Geographic Information System.

Kevin Bott, Irregular Help Employee, Forest Resources Dept. undergraduate. Responsible for data manipulation and spreadsheet analysis of the data base.

INTRODUCTION

This report was prepared at the direction of the Experimental Forest Advisory Committee, College of Forestry, Wildlife and Range Sciences. The objective is to establish an allowable cut calculation for the 7155 acre Experimental Forest in a clear, straightforward method that is reasonably understandable to lay persons and includes the following information:

1) The acreage remaining in timber harvest potential after appropriate withdrawals for research natural areas, recreation areas, roads, study sites, etc.

2) The areas with reduced harvest considerations.

3) A complete definition of terms and explaination of calculations.

This report is designed to answer basic questions regarding the allowable cut for the Experimental Forest. The procedures and methods used to calculate the allowable cut are fundimental forestry principles. The conclusions reached herein should provide the basis upon which to develop a more sophisticated calculation of the allowable cut to include a sensitivity analysis of management decisions.

Included in this report is a summary of the volume on the Experimental Forest as of 1980, acreage and areas available for future harvest and timber management, and the areas and acreage that have been removed from the timber base. Also included are estimates of current volume increment and estimates of future growth. These data were then used to calculate an allowable cut for the Experimental Forest using a classical approach to the problem. Tables, maps, and charts are presented to provide the reader with a visual representation of the forest.

METHODOLOGY

THE FOREST INVENTORY

During the summer and fall of 1980 an inventory of the timber resource on the Experimental Forest was conducted. The primary objective of this inventory was to obtain and establish a data base to be used in harvest scheduling and for evaluation of stands and subsequent stand prescriptions. The forest was

divided into compartments, subcompartments, and stands with the stands delineated on aerial photography on the basis of tree density, tree height, homogeneity of the tree vegetation and habitat type. These delineations were identified as photo strata codes. For example, medium density sawtimber on a grand fir habitat type was coded GF M3. Stands of like coding could then be combined to form photo strata across the forest. Sampling intensity was approximately one sample point for every 2.6 acres. A total of 1854 plots have been measured for the Flat Creek and the West Hatter Creek Compartments (Units) with a cruise intensity of 2.1 percent. The majority of East Hatter Creek was not sampled. The majority of Big Meadow Creek was sampled by students in the Forest Inventory class at a later date and those data were also used in this allowable cut calculation. Stands that did not have forest inventory information available were represented by other stands through use of like photo strata codes. The average coefficient of variation (CV = standard error of the mean/mean) was 57%. High within stand variation resulted in a high coefficient of variation.

The majority of the points were sampled using a 20 BAF factor prism and included a fixed plot to sample small trees. Information recorded that is pertinent to this allowable cut calculation was tree species, diameter, and height. Defect and potential tree use data were recorded in the inventory. However, gross volumes are used in this allowable cut calculation because the growth model projects gross volumes.

The 1980 and subsequent forest inventory information was processed to arrive at stand and subsequently forest volumes through the use of the Experimental Forest Stand Inventory Program (EFSIP) (Lohse et. al. 1982). The forest volume summary is presented in Table 1. The species distribution of the forest is presented in Graph 1.

For further detail on the 1980 forest inventory the reader is referred to Experimental Forest Inventory Documentation, University of Idaho, 1980, In-house report, March 1981 and to the Experimental Forest Stand Inventory Program, EFSIP Documentation and User's Manual.

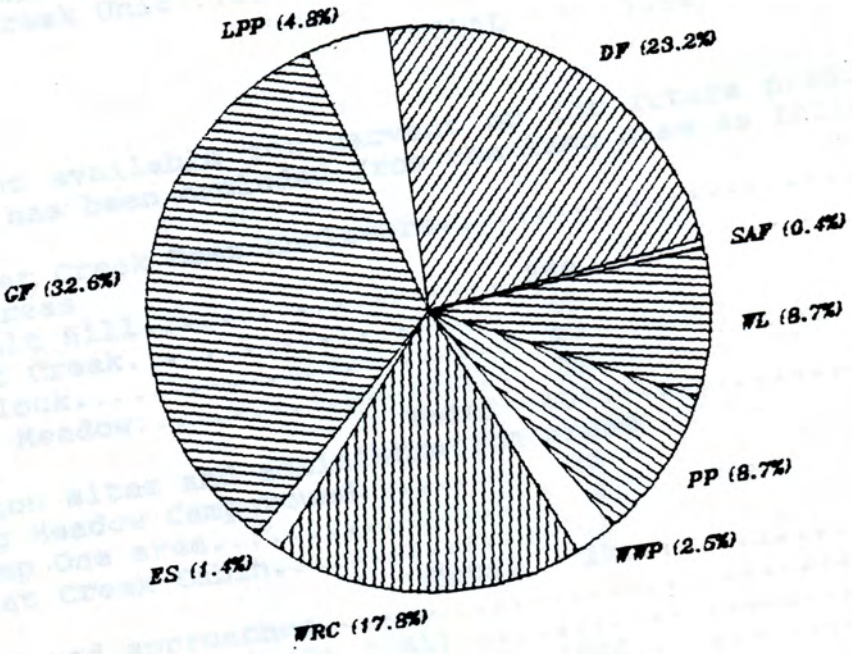
Table 1. 1980 gross volume summary of the University Of Idaho Experimental Forest.

		COMPARTMENT NAME AND NUMBER					
		FLAT CREEK # 01	EAST HATTER # 02	WEST HATTER # 03	BIG MEADOW # 04	FLANNIGAN CREEK # 05	FOREST TOTALS
TIMBER BASE ACRES		2545	324	2141	715	160	5885
BREAKDOWN OF VOLUME BY SPECIES (VOLUMES IN MMBF)	DF	8.11	1.09	7.91	2.95	0.94	21.00
	WL	2.83	0.34	1.43	2.72	0.53	7.85
	PP	3.25	0.20	3.42	0.65	0.38	7.90
	WWP	1.15	0.14	0.41	0.53	0.00	2.23
	WRC	6.52	0.69	4.23	4.15	0.50	16.08
	SF	13.95	1.50	9.03	4.50	0.56	29.55
	LPP	1.27	0.33	2.50	0.20	0.03	4.33
	ES	0.89	0.12	0.03	0.23	0.00	1.26
	SAF	0.28	0.04	0.00	0.06	0.00	0.38
TOTAL VOLUME EACH COMPARTMENT		38.25	4.45	28.95	15.98	2.94	90.58
						TOTAL FOREST VOLUME =	90.58

Graph 1

PERCENT OF GROSS VOLUME BY SPECIES

UNIVERSITY OF IDAHO EXPERIMENTAL FOREST



ACREAGE ADJUSTMENTS

The Experimental Forest consists of 5 separate units of land comprising 7155 acres as follows:

Flat Creek Unit	2765
East Hatter Creek Unit	1231
West Hatter Creek Unit	2159
Big Meadow Creek Unit	840
Flannigan Creek Unit	160
TOTAL	7155

Acreage not available for harvest or for future production of sawtimber has been excluded from the land base as follows:

East Hatter Creek Deer Enclosure		652
Natural areas		
Basalt Hill	250	
Flat Creek	41	
Hemlock	27	
Big Meadow	89	
Total	407	407
Recreation sites and administration areas		
Big Meadow Campground	22	
Camp One area	4	
Flat Creek Cabin	1	
Total	27	27
Highways and approaches		23
Existing roads, 1980 (26.3 mi)		96
Existing skidtrails and firelines, 1980		51
Existing landings, 1980		14
Future roads and those constructed since 1980 (40.8 mi)		148
Future skidtrails and firelines		309
Future landings		88

Roads total = 67.1 miles, 244 acres
Trails and firelines total = 360 acres
Landings total = 102 acres

Total acres removed from the Experimental Forest timber base.....1815

Acres remaining in the forest base after all timber base acres have been entered for harvest 5340

Note: No reductions or adjustments have been made with regard to reduced harvest considerations. At this time there appears to be no justification for removing volume from the allowable cut base for any reason other than the exclusions detailed above. There still appears to be considerable flexibility in

where the annual cut is obtained. The sensitive areas such as riparian zones can remain in the allowable cut base through the application of appropriate silvicultural practices.

The reader is directed to the appendix for detailed maps of the four major compartments of the forest. These maps portray the forest as it exists in February 1987 and show the following:

Areas where no timber harvest has been conducted.
Areas that have been regenerated by the clearcut, seedtree or shelterwood method and no volume remains.
Areas where timber harvest has occurred using the seedtree, shelterwood, and selection methods or have been commercially thinned and where merchantable volume still remains.
Areas designated as reserve natural areas.
Areas designated as recreation and administrative sites.
The East Hatter Creek Deer Enclosure.

CALCULATING THE ALLOWABLE CUT

The Austrian formula (Davis, 1987) was used to calculate the allowable cut for the Experimental Forest. This formula was chosen because it is simple, straightforward, and contains the principle components of growing stock and growth. The Austrian formula traditionally has been used to approximate the allowable cut of forest acreages that resemble the stand structure of the Experimental Forest. The forest is comprised of largely unmanaged overmature stands that are growing at a rate less than can be reasonably be expected for the unmanaged state.

The Austrian Formula

$$\text{Annual cut} = I + ((Ga - Gr)/a)$$

where:

I = Current increment

Ga = Present growing stock level

Gr = Desired growing stock level on the regulated forest

a = The period of adjustment in years to bring the forest to a regulated state

All volume figures are expressed as MMBF (million board feet) gross volume

Assumptions made in order to apply the Austrian formula to the Experimental Forest:

1) The forest will be managed in order to attain a regulated structure.
2) A 70 year adjustment period was assumed.
3) The maturity of future stands will be determined by economic criteria. Replacement stands will reach maturity in 70 years.
4) The effect of the time preference of money has no effect on the harvest of existing stands.

"The essential requirements of a fully regulated forest are that age and size classes be represented in such proportion and be consistently growing at such rates that an approximately equal annual or periodic yield of products of desired size and quality may be obtained in perpetuity. A progression of size and age classes must exist such that an approximate equal volume and size of harvestable trees are regularly available for cutting." (Davis 1987)

The allowable cut for the Experimental Forest was calculated as follows:

Annual cut = I + ((Ga - Gr)/a)

I = 2.54 MMBF
Ga = 90.58 MMBF
Gr = 106.26 MMBF
a = 70 years

Therefore: The allowable cut = 2.54 + ((90.58 - 106.26)/70)

= 2.54 -.22

= 2.32 MMBF

The source and derivation of the values used in the above allowable cut calculation are as follows:

Table 1 gives the gross volume inventory summary for the forest by compartment. The 1980 growing stock level for 5885 acres was 90.58 MMBF (million board feet). The average gross volume per acre is 15,392 board feet.

The increment (I) for the forest was arrived at by analyzing the predominant photo strata types for current growth using Version 5.1 of the Stand Prognosis Model (Wykoff et. al. 1982). The prognosis model is a distance independent individual tree growth model useful for simulating growth in natural and managed stands in the northern Rocky Mountains. This model outputs yield functions from which current annual increment (CAI) was obtained. Growth of the representative photo strata were weighted by the strata representation to arrive at a forest average as follows:

Photo strata	CAI	% representation
GF M3	330	45
WC M3M4	490	33
WC H2H3	550	22

Average increment (CAI) = 431 board feet/acre/year

Therefore I = 431 board feet/acre/year * 5885 acres = 2.54 MMBF/year.

The desired growing stock level (Ga) was determined for the 5340 acre regulated forest (5885 acres adjusted for future roads and landings = 5340 acres) through the use of the Stand Prognosis Model by simulation projections of a variety of managed replacement stands. The average gross volume per acre on a 70 year rotation is calculated to be 39,796 board feet or 568 board feet/acre/year. Since the regulated forest will have a even distribution of stands from one to 70 years of age, the average volume per acre will be one-half the final volume per acre.

Therefore (Gr) = 39798/2 * 5340 acres = 106.26 MMBF

RESULTS AND DISCUSSION

The allowable cut for the University of Idaho Experimental Forest has been calculated to be 2.32 MMBF using the Austrian formula. The 7155 acre land base has been reduced by 1815 acres to arrive at a regulated forest base of 5340 acres.

The Austrian Formula has served to provide us with an allowable cut level from which to operate. The Austrian Formula does not provide the detail that sophisticated models provide. Linear models such as the Multiple Use Sustained Yield Calculations (MUSYC) (Johnson et.al. 1979) have the ability to test the impacts of management decisions. MUSYC for example, can provide harvest schedules having volume or economic maximization while giving some guidance regarding the spatial distribution of the harvests to reach these goals. By utilizing a linear model such as MUSYC we are able to determine the opportunity cost in either volume or value lost as the result of certain constraining management decisions.

Other classical forest regulation formulas (i.e. Hanzlik, VonMantel, and Hundeshagen) have been used to test the validity of the conclusion reached through the use of the Austrian Formula. These calculations are included in Appendix I and serve to demonstrate that the allowable cut level of 2.32 MMBF appears to be conservative when compared to the results obtained by utilizing other classical harvest regulation formulas.

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Taylor, William R., A Management Plan for the West Hatter Creek Unit of the Moscow Mountain Experimental Forest, University of Idaho School of Forestry Thesis, 1949.

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APPENDIX I

Alternative Allowable Cut Formulations

1. Hanzlik Formula

Allowable Cut = (Vm/R) + I

Where:

Vm = Existing volume over rotation age
R = Rotation
I = current annual Increment

Vm = 90.58 MMBF
R = 70 years
I = 2.54 MMBF

Allowable Cut = (90.58/70) + 2.54

Allowable Cut = 3.83 MMBF/year

2. Hundeshagen's Formula

Allowable Cut = (Yr/Gr) * Ga

Where:

Yr = growth of Regulated forest
Gr = growing stock in regulated forest
Ga = growing stock in existing forest

Yr = 3.04 MMBF/year
Gr = 106.26 MMBF
Ga = 90.58 MMBF

Allowable cut = (3.04/106.26) * 90.58

Allowable cut = 2.59 MMBF/yr

3. Von Mantels Formula

$$Ya = \frac{2(Ga)}{R}$$

Where:

Ga = growing stock of existing forest
R = Rotation
Ya = Allowable cut

Ga = 90.58 MMBF
R = 70 years

$$Ya = \frac{2 * 90.58 \text{ MMBF}}{70}$$

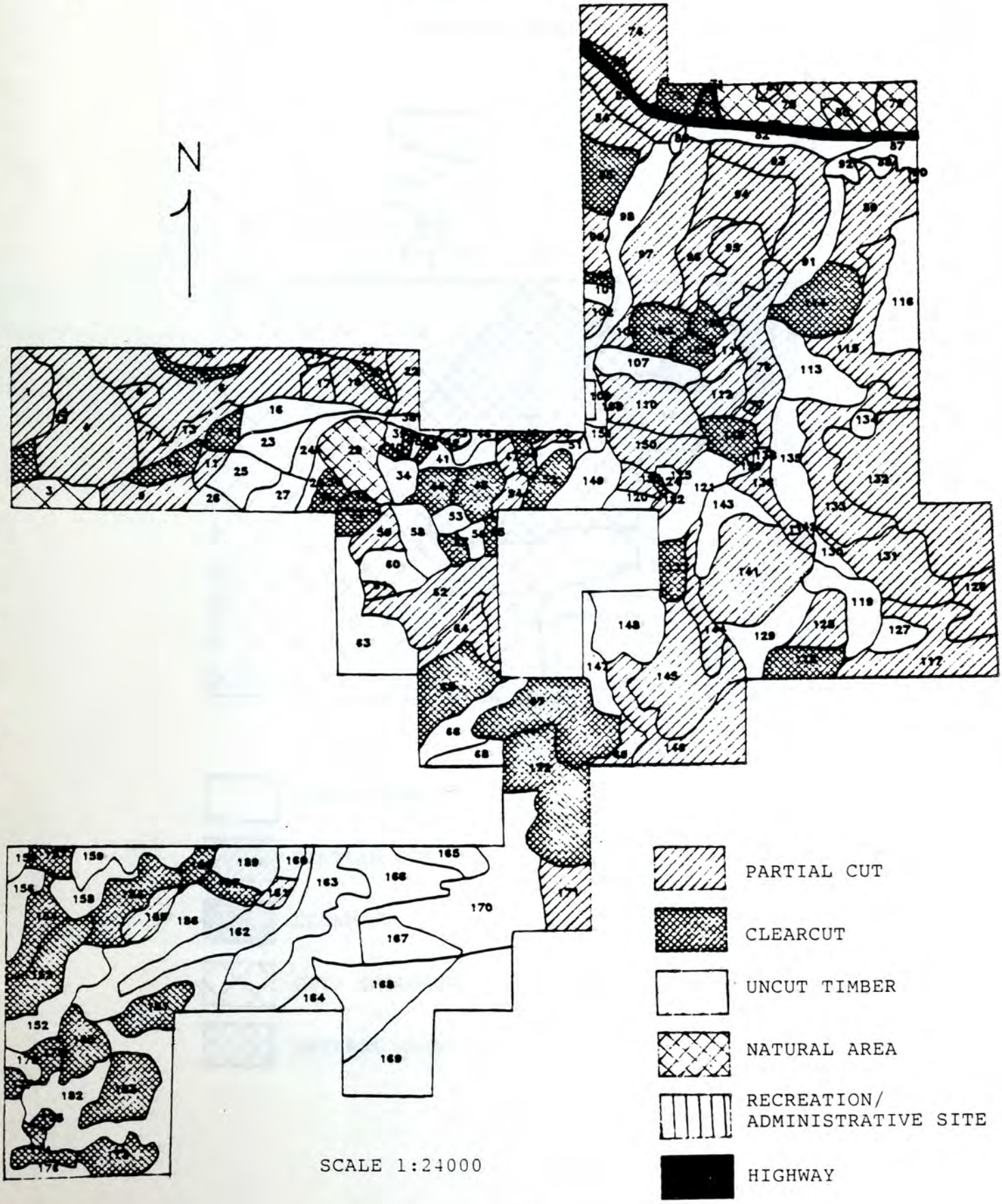
Ya = 2.59 MMBF/year

APPENDIX II

Stand Maps of Compartments

STAND MAP OF THE FLAT CREEK UNIT

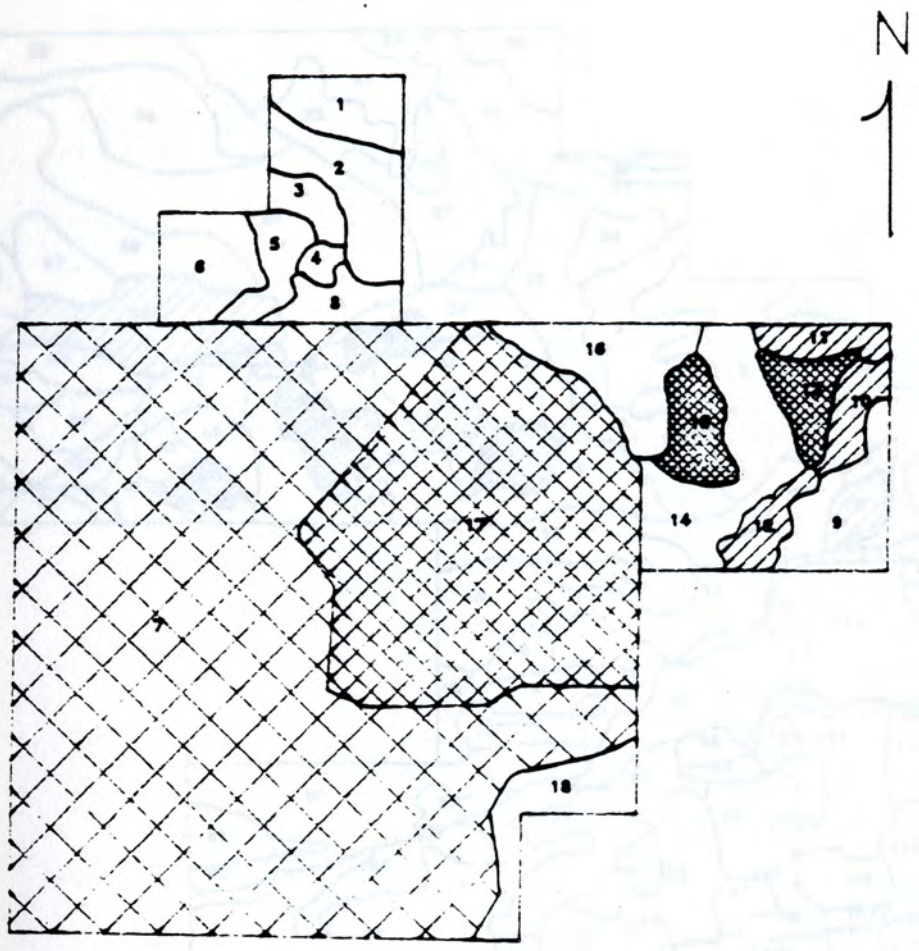
AS OF FEBRUARY 1987



STAND MAP OF THE EAST HATTER CREEK UNIT

AS OF FEBRUARY 1987

SCALE 1:24000



UNCUT TIMBER

PARTIAL CUT

CLEARCUT

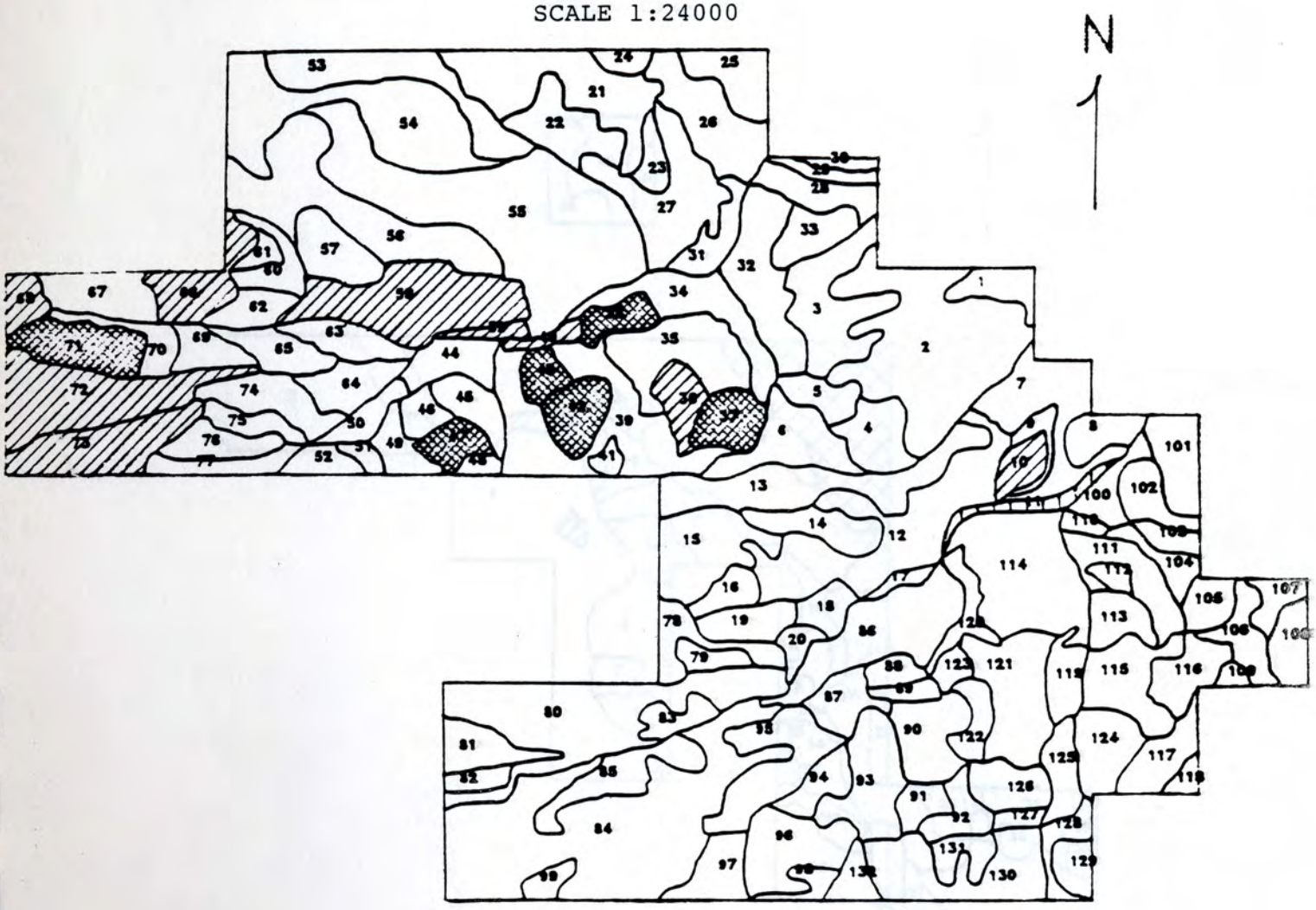
DEER ENCLOSURE

NATURAL AREA

STAND MAP OF THE WEST HATTER CREEK UNIT

AS OF FEBRUARY 1987

SCALE 1:24000



UNCUT TIMBER

PARTIAL CUT

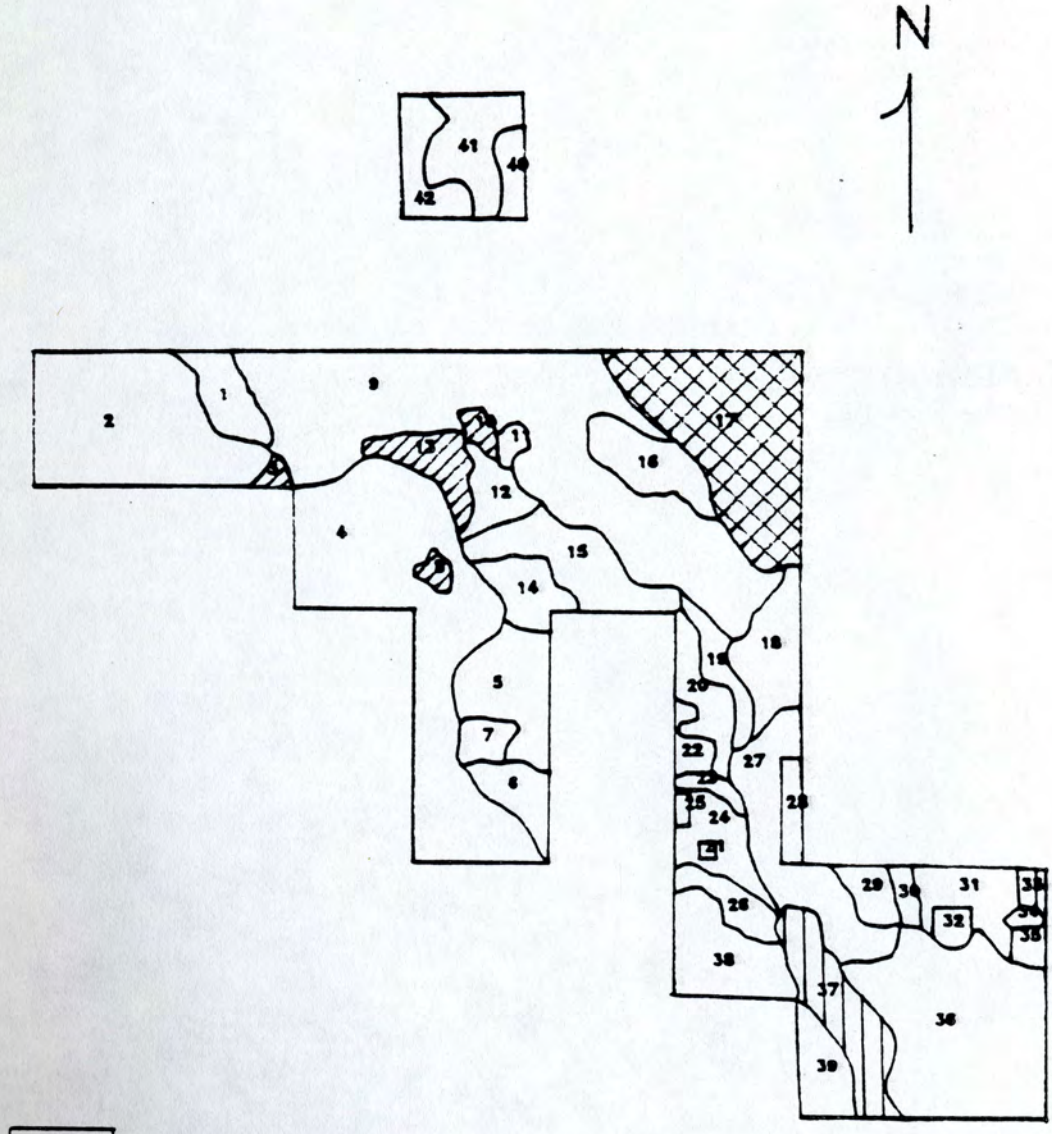
CLEARCUT

RECREATION/
ADMINISTRATIVE SITE

STAND MAP OF THE BIG MEADOW CREEK UNIT

AS OF FEBRUARY 1987

SCALE 1:24000



UNCUT TIMBER

PARTIAL CUT

NATURAL AREA

RECREATION/
ADMINISTRATIVE SITE