PLANS FOR
MANAGEMENT - BLOCK "X"
MENOMINEE INDIAN
RESERVATION

Hellings 1947

PLANS FOR MANAGEMENT

OF

BLOCK "X"

OF

MENOMINEE INDIAN RESERVATION

April 14, 1947
Ann Arbor, Mich.

Thomas Hellings

PREFACE

This report was written to partially fulfill the requirements for the advanced Forest Management course of the School of Forestry and Conservation at the University of Michigan. The purpose of this problem was to devise a suitable plan of management for the Block X of the Menominee Indian Reservation at Neopit, Wisconsin, and also to give the students some practical experience in what they hope is to be their life's work.

I would like to take this opportunity to thank Professor D.M.Matthews of the School of Forestry for his patient instruction, advice and criticism during the working of this problem.

Ann Arbor, Mich.
April 14,1947

Thomas Hellings

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Forestry 104

Problem Number 1

The attached stand table represents average conditions of stocking on a 5500-acre block of the Menominee Indian Reservation in Wisconsin. Under authorization from Congress, the timber on the Reservation is to be harvested under a sustained yield plan of management and the logs manufactured in the Menominee Mill at Neopit, the products being sold for the benefit of the tribe.

It will be assumed that the management at Neopit has adopted the policy of drafting a management plan for each block that it proposes to cut over and that a plan is to be drafted for this block in the light of the following data:

Stocking. It is recognized that the heavy stocking that exists in the uncut virgin stands is not necessary or to be desired under management. Cutting plans will, therefore, aim to reduce current stocking in the light of anticipated growth and existing overmaturity of the stands.

Cutting cycle. An effective cutting cycle of 25 years is to be adopted on all areas. Areas for which plans are drafted may be cut over in a shorter period than the cycle when necessary but will not be cut again for a period of 25 years.

Objectives of Management

A. Size of timber to be grown. Not definite. The reservation is large and an excess of mature timber is available. For the present, at least, timber from 25 to 30 inches d.b.h. will be the objective.

B. Species composition. Hemlock is a low value species and therefore every effort will be made to reduce the representation of this species in the residual stands. It is recognized, however, that it may not be desirable silviculturally or possible economically entirely to eliminate this species.

The present composition of "other species" is as follows:

Maple ---- 30%
Birch ---- 30%
Basswood & Pine --- 20%
Elm and Miscellaneous --- 20%.

Growth. Studies of growth for this block indicate that, under management, a growth rate of 0.2 inches per year can be anticipated.

A. Estimate the cut per acre of each species by size classes and by number of trees and volume in ft. b.m. that can be removed from this block during the first cycle.

B. Estimate in a similar manner the cut per acre at the time the next cutting cycle.

Logging Plan and Basic Cost Data.

The block comprises the timbered portions of Sections 19, 20, 21, 28, 29, 30, 31, 32, and 33 of Township T30NR15E. The main logging road from the mill at Neopit has been constructed to the southwest corner of Section 31 and located to run north from this corner following the west boundary of Sections 31, 30, and 19. The road distance from the S.W. corner of Section 31 to the mill is 7 miles.

To log this area this main road will have to be constructed north to the N.W. corner of Section 19 and spur roads constructed east into the aforementioned sections.

The timber will be skidded by tractors and teams to spur roads and loaded on trucks for transport to the mill. Loading will be accomplished by the ordinary A-frame jammers powered by teams. The topography is such that roads can be constructed on any desired spacing. Landings will be closely spaced and their cost will be negligible and therefore included in the following estimates of road construction cost. Due to the close spacing of landings all road spacing calculations can be based on direct skidding.

Felling and Bucking.

Two man crews will be used. Cost is estimated as follows:

	Cost per 8-hour day
A. Direct labor	
2 men at 80 cents per hour	$12.80
Plus 10% allowance for portal to portal pay	1.28
Plus 20% industrial comp. ins., etc.	2.82
B. Indirect costs	
Supplies and maintenance	1.00
Depreciation tools	0.25
Direct supervision and overhead	3.00
Total	21.15

Cost per man-hour -- 21.15/16 = $1.32

Estimated production per man-hour:

Hemlock -- 0.4 M ft. b.m.
Other spp. -- 0.3 M ft. b.m.

Skidding

Machine Rate for teams:

	Per Hour
Teamster and 1/2 time swamper @ $ .80	1.20
Social security and ind. comp. etc. at 20%	0.24
10% allowance for portal to portal pay	0.14
Depreciation team and harness	0.20
Feed and care of team	0.32
Total	2.10

Rate per min. - 3.5 cents

Average fixed time per turn	3.6 mins.
" round trip time per station	1.0 "
" load - 140 ft. b.m.	

Machine rate for tractor:	Per Hour
Driver @ $1.25	1.25
Hooker @ $ .90	.90
Social security, etc. @ 20%	0.43
10% allowance for portal to portal pay	0.26
Depreciation and supplies and maintenance tractor	3.76
Total	6.60

Rate per min. - $ .11	
average fixed time per turn	7.0 mins.
" round trip speed per station	0.8 "
Average load 700 ft. b.m.	

Loading

Skidding teams will power jammers as trucks arrive at loading points. The estimated loading rate is 15 minutes per M ft. b.m. The regular skidding team machine rate will apply to the cost of loading.

Hauling

A machine rate for the trucks which will be used on the operation is attached hereto. Unloading and delay time at the mill is estimated at 15 minutes per trip on the average.

Road Construction

The main logging road already constructed cost $10,000 per mile and maintenance costs are $200 per mile annually. The additional main road required is to be built to the same standard and costs are estimated to be the same. As the operation is essentially on a sustained yield basis this road investment is not to be amortized. Maintenance costs plus 6% on the capital cost are to be charged against the annual cut.

Trucks can maintain an average round trip speed on this main road of 20 m.p.h.

Branch roads. These roads are to be semi-permanent in character and are estimated to cost $1000 per mile. An average speed of 12 mph is estimated for these spur roads.

The entire cost of these spur roads is to be charged off against the cut of the first cycle. It is estimated that they can be put in condition for future use at the time of the next cut at a cost of $200 per mile.

Production

The mill is estimated to require approximately 18000 M ft. b.m. net log scale per year for the next few years.

The stand is known to be over-mature and it is estimated that defect in the stands currently ready for cut will reduce the scaled volume at the mill to 80% of the gross log scale.

Therefore, all logging costs will have to be increased in proportion to the reduction of net scale to 80% of gross upon which logging costs have been calculated. Production will be planned to deliver at least 14000 M ft. b.m. net logscale at the mill.

Overhead costs

It is estimated that overhead and general supervisional cost chargeable to the woods operations will be $30,000 per year.

C. Estimate the cost of logs at the mill separately for hemlock and "other species" on the basis of a net outturn of 80% of the gross scale and production at the rate required by the mill.

Log Values

For purposes of appraising the value of this block of timber logs will be charged to the mill at the following prices net log scale:

Hemlock	$18.00 per M Ft. b.m.
Maple	27.00 " " " "
Birch	32.00 " " " "
Basswood and pine	35.00 " " " "
Elm and miscellaneous spp.	25.00 " " " "

D. Calculate the total stumpage recovery value from this block separately for the first and subsequent cutting cycles.

In calculating costs and recovery values for the subsequent cycles use the same basic costs as those for the first cycle but remember that branch roads will not have to be rebuilt, but only reconditioned at a cost of $200 per mile.

No reduction in gross scale need be made for defect in estimating the cut and value of the second and subsequent cycles.

E. The foregoing estimates and calculations are to be neatly prepared for attachment to a report to the Office of Indian Affairs.

This report is to include:

I. A brief discussion of the proposed management plan indicating or explaining:

a. The method of determining the volume of the cut of the first cycle.

b. The method of estimating the volume of the cut of the second and subsequent cycles.

c. Silvicultural justification of the cutting plan.

II. A summary of the estimated stumpage recovery values.

III. Recommendations as to the handling of the funds which will be realized as a result of operations on this block of timber.

These recommendations have been requested by the Office of Indian Affairs. This block of timber is carried on the books of the Tribe at a value of $330,000 a figure based on a $3 per M stumpage value applied to the approximate gross volume on the block.

The Office of Indian Affairs desires advice specifically as to:

a. How much of the gross stumpage recovery of the first cycle may properly be credited to the Tribal Profit Fund for distribution?

b. What disposition should be made of the balance of the stumpage recovery revenue?

c. How and at what value the block should be carried on the books of the Tribe after cutting.

This portion of the report will involve appraisal of the block in the light of proper discount and allowance for risk and may be deferred until after discussion and assigned reading dealing with these matters. In other words, all computations are to be satisfactorily completed before preparing the report.

LAKE STATES REGION

MACHINE RATE FOR LOGGING TRUCK
(Based on 2000 Hour Year and 3 Year Life)

Fixed Cost per Hour

License and Insurance

Registration	$55.00	
Public liability: $50,000/100,000 plus $25,000 Property Damage	52.20	
Collision ($50 Deductible)	40.00	
Fire and Theft	32.00	
	$179.20	÷ 2000 hours = $0.09

Depreciation

Original cost	$3000.00	
Less tires	400.00	
	$2600.00	
Less wrecking value	200.00	
To be depreciated	$2400.00	÷ 6000 hours = 0.40

Labor (Michigan data)

Driver's wages		1.25
Social security, workmen's compensation, etc., at 20%		0.25
Total Fixed Cost per Hour		$1.99

Operating Cost per Hour

Oil at $0.30 per qt. - 10 qts. every 50 hours	0.06	
Repairs - average of $500.00 per year	0.25	
Greasing and general maintenance	0.05	
Fuel (average)	0.50	
Tires - $400.00 ÷ 1,000 hours	0.40	
Total Operating Cost per Hour		$1.26
Hauling Cost per Hour		3.25

Average load - Hemlock 2.5 M ft. b.m.
Other species - 2.0 M ft. b.m.

PER ACRE STAND TABLE FOR BLOCK X OF THE MENOMINEE INDIAN RESERVATION

D.B.H.	Hemlock No. Trees	Hemlock B.A.	Other spp. No. Trees	Other spp. B.A.	Total Stand No. Trees	Total Stand B.A.	Hemlock Vol.per tree ft.b.m.	Hemlock Total ft.b.m.	Other Species Vol.per tree ft.b.m.	Other Species Total ft.b.m.	Volume Total stand ft.b.m.
10	5.5	3.00	8.0	4.36	13.5	7.36	30	165	30	240	405
12	4.0	3.14	6.0	4.71	10.0	7.85	80	320	90	540	860
14	4.0	4.28	5.0	5.34	9.0	9.62	130	520	150	750	1270
16	4.0	5.60	4.5	6.30	8.5	11.90	190	760	210	945	1705
18	3.8	6.71	4.0	7.06	7.8	13.77	270	1025	280	1120	2145
20	3.2	7.00	3.2	7.00	6.4	14.00	360	1150	360	1150	2300
22	2.8	7.40	2.7	7.13	5.5	14.53	480	1345	440	1190	2535
24	2.1	6.60	2.2	6.91	4.3	13.51	620	1300	530	1170	2470
26	1.5	5.54	1.5	5.54	3.0	11.08	770	1155	630	945	2100
28	1.0	4.28	1.0	4.28	2.0	8.56	910	910	740	740	1650
30+ (av.32")	1.0	5.59	1.0	5.59	2.0	11.18	1210	1210	1030	1030	2240
Total	32.9	59.14	39.1	64.22	72.0	123.36		9860		9320	19630

CHAPTER II 25 YEAR CYCLE

Determination of Cut - 25 year Cycle

The first step in determining the cut was to prepare a classified stand table from the data in the per acre stand table given in the problem. However, before this could be done the basal area to be the objective had to be decided upon. This was obtained from a curve of basal areas for various diameters breast height. This curve was based on data from Gevorkiantz of the Lake States Experiment Station. As shown in the beginning of the Appendix the basal area I decided to use as normal stocking was 103 square feet for the four merchantable age groups. After the percent of Basal Area in each group was determined the stand was then classified by utilizing the basal area control method. This method consists of multiplying the present total basal area by the percent of basal area in each group, and then starting with the 10" diameter class add the individual size class basal areas together until the sum equals the basal area required for the group. After doing this for all four groups the stand table was further classified into two groups, the hemlock and the other species.

The average diameter breast height(DBH) was determined by dividing the basal area of each age group by the number of trees in the group and by consulting a set of basal area tables to find what diameter corresponded with the resulting average basal area. The number of trees desired in each group at the end of twenty five years was then calculated by dividing the proposed basal

area by the basal area of the average tree in twenty five years. This is determined by adding 0.2" per year or 5" to the present average DBH and looking the basal area up in the tables. The volume of the first cycle cut was then able to be calculated.

The harvest cut was of course all of Group IV. This consisted of 3.7 M of hemlock and 3.1 M of other species or a total Of 6.8 M. As one of the purposes of the management plan was to eliminate the hemlock as quickly as possible all thinnings were taken first from the hemlock in each group and then from the other species. All thinnings were taken from the smallest diameter classes in each group because they are considered to be those trees that are putting on the slowest growth. The thinnings were practically entirely hemlock and amounted to 5.2 M bringing the total first cycle cut to 12 M per acre or 66,000 M for the entire block.

Determination of Cut - Second Cycle

A stand table showing the number of trees per acre in the stand in twenty five years was then compiled. The harvest cut would consist of all of Group IV, which is the present Group III, and would be 7.7 trees having a volume of 5.8 M, composed of 1.3 M of hemlock and 4.5 M of other species. The thinnings were determined by subtracting the number of trees in the higher group from the number of trees in the next lower group giving the number of trees to be removed from each group. As in the first cut, all thinnings were taken from the hemlock first and also from the smallest diameter classes. The thinnings in group I were considered to be about the same as in the first cut. The volume of the

thinnings for the second cycle was 1.6 M of hemlock and 1.8 M or a total of 3.4 M. This brought the total second cycle cut to 9.2 M per acre or 50,600 M for the entire block. This volume was assumed to be the amount that could be cut in all subsequent cycles.

Silvicultural comments

As all good management plans must consider the silviculture of the stand it seems as if a cut of 12 M per acre or 61% is entirely too severe. However, when the fact that the stand is at present overstocked is taken into consideration that relationship doesn't have too much significance. The only danger lies in the fact that the stands' composition is changed rather abruptly with the removal ofsuch a large percentage of the hemlock. Therefore, it is advisable to investigate the possibility of shortening the cycle,bothfrom a silvicultural angle and the financial angle.

Stumpage Recovery Values - First Cycle

In computing the estimated costs, prior to determining the value of the cut, a logging plan had to be devised. By using the methods described in D.M.Matthews' book, "Cost Control in the Logging Industry", the economic road spacing was determined, thereby bringing the road construction cost and the variable skidding cost into balance. The main road cost and the overhead cost were both calculated on the basis that 22,500 M would have to be removed to allow for defect in the first cycle so that the mill at Neopit would be supplied with the necessary 18,000 M.

Considering the defect to be a form of underrun, the value of the stumpage at the mill had to be altered by taking 80% of the net log price. By subtracting the total cost from the altered log value the value of the stumpage per M board feet(gross) was found. Then the stumpage per acre was found by multiplying the stumpage per M by the volume out of each species from one acre. This gave a stumpage value of $82.14 per acre or a total stumpage recovery for the first cycle of $451,800 for the entire block.

Stumpage Recovery Values - Second Cycle

The costs of the second cycle cut were computed in a similar manner as the first cycle, except that the spur road construction cost was changed to a maintainance cost and the main road cost and overhead were computed on a basis of 18,000 M because the defect was considered to be eliminated in the first cycle.

The stumpage recovery was also computed in the same manner as the first cycle with the exception that the mill log price did not have to be reduced to allow for defect. This gave a stumpage value per acre of $140.30 or a total stumpage recovery for the second cycle of $772,200.

Distribution of Stumpage- First Cycle

It was decided that a certain amount of the stumpage should remain in a reserve fund to allow for risk. After some discussion it was decided to use 40% for this allowance. This permitted $49.28 per acre or a total of $271,000 to be put in the Tribal Profit Fund and $32.86 per acre or a total of $180,800 to be put

into the Reserve Fund.

Financial Valuation - 25 Year Cycle

By using the valuation methods described in D.M.Matthews' book,"Management of American Forests", the present worth of the block was calculated to be about $154 per acre. However, the value to be carried on the books of the Tribe should only be concerned with the discounted value of the second cyclic cut and all subsequent cuts. After allowing for risk the final value was found to be about $47 per acre or a total of $258,300. This is considerably less than the present $60 per acre and shows that under this plan the block is not woth as much as they had anticipated.

CHAPTER II - 15 YEAR CYCLE

Determination of Cut - 15 year Cycle

The procedure for classifying the stand for the 15 year cycle was the same as for the 25 year cycle. The merchantable part of the stand was divided into seven groups, the whole stand being 10 1/3 age groups of 3" diameter classes. Values were again taken from the curve of basal areas and normal full stocking for the merchantable groups was determined as 105 square feet. The basal area control method was again used and the stand table reclassified into basal areas, number of trees and volume for each group. The new average diameter was calculated for each group and the number of trees desired in each group in 15 years was determined.

The harvest cut, as before, consisted of all of the last group, ie, Group VII, and was made up of 2.2 M of hemlock and 1.8 M of other species for a total of 4 M. The thinnings were determined by subtracting the number of desired trees in 15 years from the present number of trees in each group. They were again taken first from the hemlock and from the smallest diameters inthe groups. They were exclusively hemlock in this cycle and amounted to 5 M, bringing the total first cycle cut to 9 M per acre or 49,500 M for the entire block.

Determination of Cut - Second Cycle

A stand table showing the number of trees per acre in the stand in fifteen years was then compiled. The harvest cut at that time would be all of Group VII, which is the present Group

VI, and would be 4 trees having a volume of 3.3 M, composed of 1 M of hemlock and 2.3 M of other species. The thinnings were determined in the same manner as before. Their volume was 2.6 M of hemlock and 0.5 M of other species or a total of 3.1 M. This brought the total second cycle cut to 6.4 M per acre or 35,200 M for the entire block.

Determination of Cut - Third Cycle

In order to make a good comparison between the 15 year plan and the 25 year plan a third cyclic cut had to be calculated because the hemlock was not eliminated in two cycles under the 15 year plan. The cut was computed in the same manner and resulted in a harvest cut of 0.6 M of hemlock and 2.7 M of other species, or a total of 3.3 M. The thinnings amounted to 1.0 M of hemlock and 1.7 M of other species, or a total of 2.7 M. The total cut for the third cycle was 6 M per acre or 33,000 M for the entire block and was assumed to be the same for subsequent cycles.

Silvicultural Comments

From a silvicultural standpoint this plan seems superior to the 25 year plan as it only removes 9 M or 46% of the stand. It also only removes only 72% of the hemlock instead of 90% in the first cycle, so the composition is not altered as much. The shorter cutting cycle is always better from the silvicultural aspect because it is approaching nature's own cycle and does not take such a large bite out of the stand.

Stumpage Recovery Values - First Cycle

As in the 25 year plan, a logging plan had to be devised so

that costs could be estimated. The new economic road spacing was determined and the costs calculated on this new basis. The main road and overhead were again calculated allowing for the 20% defect. The net log price was reduced again to allow for the underrun. The total stumpage for all species was found to be $55.24 per acre or $304,100 for the entire block for the first cyclic cut.

Stumpage Recovery Values - Second Cycle

The costs were computed in a similar manner as in the first cycle, except that the spur road construction cost was changed to a maintainance cost and the main road cost and overhead were calculated on the basis of 19,580 M because the defect was considered to be only 60% eliminated in the first cut. This meant that there was still 8% of defect left in the second cut and had to be again considered as underrun. The mill log price was reduced proportionally and the stumpage value determined. It was equal to $69.74 per acre or $383,400 for the entire block for the second cyclic cut.

Stumpage Recovery Values - Third Cycle

The costs were computed in a similar manner as in the second cycle of the 25 year plan. The spur road maintainance was calculated on the basis of only a 6M cut, so consequently was increased over the previous cycle. The main road cost and over head were calculated on the basis of a total annual cut of 18, 000 M, because the defect was assumed to be entirely eliminated in the first two cycles. The stumpage value was determined to be $94. 32 per acre or $519,100 for the entire block for the third cycle.

Distibution of Stumpage- First Cycle

Using the 40% allowance for risk it was determined that $33.14 per acre or a total of $182,460 was to be put in the Tribal Profit Fund for distribution and the balance of the stumpage recovery or $21.10 per acre or a total of $121,640 was to be put in the Reserve Fund.

Financial Valuation - 15 Year Cycle

The present worth of the block was calculated to be about 151 dollars per acre. The value to be carried on the books for the next 15 years is the properly discounted value of the second cyclic cut, the third cyclic cut and all subsequent cuts. After allowing for risk the final value was found to be about $59 per acre or a total of $324,500. This value is almost equal to present $60 per acre at which the block is now carried.

After the second cyclic cut the book value will have to be changed to just the discounted value of the third and all subsequent cycles. This final value after allowing for risk is about $66 per acre or a total of $356, 300.

Comparison of the Two Plans

As stated before, the 15 year plan is the better one from the silvicultural standpoint. From the financial standpoint the 25 year plan has a slight edge, but for all intents and purposes it can be assumed that they are equally beneficial. The book value of the 15 year plan is considerably higher and as an asset of the Tribe this is desirable.

The average size of the timber removed in the first cycle

under either plan is essentially the same. Under the 15 year plan it is 18.7" diameter and under the 25 year plan it is 18.6" diameter. The growth in volume is also about the same for both of the plans, so neither is superior from that viewpoint.

I would recommend the use of the 15 year plan as the best, solely on the basis of the silviculture involved. However, it is also desirable because it is less of a firehazard after logging as there is less slash on the ground and therefore there is less risk attached to the enterprise.

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APPENDIX

Table Based on Gevorkiantz' Curve of Basal Areas For Stands in the Lake States (25 year Cycle)

Group	DBH Range	Aver. DBH	Curve BA	% BA	Proposed BA
I	10-15"	12.5"	121.3	19.6	20.2
II	15-20	17.5	149.5	24.2	24.9
III	20-25	22.5	169.0	27.3	28.1
IV	25-30	27.5	179.0	28.9	29.8
			618.8	100.0	103.0

Proposed BA $= \frac{618.8}{4} \times \frac{4}{6} = 103.1$ use 103 sq.ft.

Stand Prediction for 25 Year Cycle *

Group IV $\frac{\text{Proposed BA}}{\text{BA of Aver. tree in 25 yrs.}}$

$$\frac{29.8}{\text{BA of } (21.7" + 5")} = \frac{29.80}{3.888} = 7.7 \text{ Trees}$$

Group III

$$\frac{28.1}{\text{BA of } (17.2" + 5")} = \frac{28.10}{2.688} = 10.5 \text{ Trees}$$

Group II

$$\frac{24.9}{\text{BA of } (11.8" + 5")} = \frac{24.90}{1.539} = \frac{16.2}{34.4} \text{ Trees}$$

* Based on 0.2" growth per year and average diameter of trees in each group (see classified stand table)

Classification of Stand Table*

Group	Total Stand			Hemlock			Others		
	DBH	No.	BA	DBH	No.	BA	DBH	No.	BA
I	10"	13.5	7.36	10"	5.5	3.00	10"	8.0	4.36
	12	10.0	7.85	12	4.0	3.14	12	6.0	4.71
	14	8.4	8.97	14	3.7	3.99	14	4.7	4.98
		31.9	24.18		13.2	10.13		18.7	14.05
II	14"	0.6	0.65	14"	0.3	0.29	14"	0.3	0.36
	16	8.5	11.90	16	4.0	5.60	16	4.5	6.30
	18	7.8	13.77	18	3.8	6.71	18	4.0	7.06
	20	1.6	3.52	20	0.8	1.76	20	0.8	1.76
		18.5	29.84		8.9	14.36		9.6	15.48
III	20"	4.8	10.48	20"	2.4	5.24	20"	2.4	5.24
	22	5.5	14.53	22	2.8	7.40	22	2.7	7.13
	24	2.8	8.69	24	1.4	4.24	24	1.4	4.45
		13.1	33.70		6.6	16.88		6.5	16.82
IV	24"	1.5	4.82	24"	0.7	2.36	24"	0.8	2.46
	26	3.0	11.08	26	1.5	5.54	26	1.5	5.54
	28	2.0	8.56	28	1.0	4.28	28	1.0	4.28
	30	2.0	11.18	30	1.0	5.59	30	1.0	5.59
		8.5	35.64		4.2	17.77		4.3	17.87

* See Per Acre stand table for block X of the Menominee Indian Reservation

Classified Per acre Stand Table - 25 Year Cycle

Group	% BA	Total Stand No.	Total Stand BA	Hemlock No.	Hemlock BA	Others No.	Others BA	DBH Range	Aver. DBH	Volume Hemlock	Volume Others	Volume Total
I	19.6	31.9	24.18	13.2	10.13	18.7	14.05	10-14	11.8	966	1485	2451
II	24.2	18.5	29.84	8.9	14.36	9.6	15.48	14-20	17.2	2112	2397	4509
III	27.3	13.1	33.70	6.6	16.88	6.5	16.82	20-24	21.7	3073	2799	5872
IV	28.9	8.5	35.64	4.2	17.77	4.3	17.87	24-30	27.7	3709	3139	6848
	100.0	72.0	123.36	32.9	59.14	39.1	64.22			9860	9820	19680

First Cycle Cut Under 25 Year Cycle

DBH	Hemlock		Maple		Birch		Bass.& Pine		Elm & Misc.		Total	
	No.	Volume	No.	Volume	No.	Volume	No.	Volume	No.	Volume	No.	Volume
Thinnings												
10"	5.5	165	0.7	22	0.8	23	0.5	15	0.5	15	8.0	240
12	4.0	320									4.0	320
14	4.0	520									4.0	520
16	4.0	760									4.0	760
18	3.7	1026									3.7	1026
20	2.4	864									2.4	864
22	2.8	1344									2.8	1344
24	0.2	124									0.2	124
Harvest Cut												
24"	0.7	434	0.2	127	0.2	127	0.2	85	0.2	85	1.5	858
26	1.5	1155	0.5	284	0.4	283	0.3	189	0.3	189	3.0	2100
28	1.0	910	0.3	222	0.3	222	0.2	148	0.2	148	2.0	1650
30	1.0	1210	0.3	309	0.3	309	0.2	206	0.2	206	2.0	2240
	30.8	8832	2.0	964	2.0	964	1.4	643	1.4	643	37.6	12046

Thinnings

Group I	(10"-14")	31.9 - 16.2	=	15.7 Trees
Group II	(14"-20")	18.5 - 10.5	=	8.0
Group III	(20"-24")	13.1 - 7.7	=	5.4
				29.1 Trees to be removed

Number of Trees in Stand in 25 Years

Group	DBH	Hemlock	Others	Total
I	Probably the same as now			
		13.2	18.7	31.9
II	15*		5.5	5.5
	17		6.0	6.0
	19		4.7	4.7
III	19*		0.3	0.3
	21		4.5	4.5
	23	0.1	4.0	4.1
	25	0.8	0.8	1.6
IV	25*		2.4	2.4
	27		2.7	2.7
	29	1.2	1.4	2.6
		15.3	51.0	66.3

Second Cycle Cut Under 25 Year Cycle

DBH	Hemlock		Maple		Birch		Bass.& Pine		Elm & Misc.		Total	
	No.	Volume	No.	Volume	No.	Volume	No.	Volume	No.	Volume	No.	Volume
Thinnings												
I	13.2	966	0.8	23	0.7	22	0.5	15	0.5	15	15.7	1041
	(the above is assumed to be the same as in the first cut)											
15"			1.6	297	1.7	297	1.1	198	1.1	198	5.5	990
17			0.1	24	0.1	25					0.2	49
19			0.1	32	0.1	32	0.1	32			0.3	96
21			0.5	192	0.5	192	0.3	128	0.3	128	1.6	640
23	0.1	55									0.1	55
25	0.8	556									0.8	556
Harvest Cut												
25"			0.7	418	0.7	418	0.5	278	0.5	278	2.4	1392
27			0.8	555	0.8	555	0.5	354	0.6	386	2.7	1850
29	1.2	1272	0.4	372	0.4	372	0.3	248	0.3	248	2.6	2512
	15.3	2849	5.0	1913	5.0	1913	3.3	1253	3.3	1253	31.9	9181

Thinnings

Group I	Same as first cycle			15.7 Trees
Group II	(15"-19")	16.2 - 10.5	=	5.7
Group III	(19"-25")	10.5 - 7.7	=	2.8
				24.2 Trees to be removed

Determination of Costs

Felling & Bucking

Hemlock: $\frac{\$1.32/\text{hour}}{0.4\ \text{M/hour}} = \$3.30\ /\text{Mbf}$

Other Species: $\frac{\$1.32/\text{hour}}{0.3\ \text{M/hour}} = \$4.40\ /\text{Mbf}$

Team Skidding

Fixed Cost/M: $\frac{3.6\text{min.} \times 3.5¢/\text{min.}}{0.14\ \text{M/turn}} = \$0.90\ /\text{Mbf}$

Variable Cost/M/100 ft. Station: $\frac{1.0\text{min.} \times 3.5¢/\text{min.}}{0.14\ \text{M/turn}} = \$0.25\ /\text{Mbf/Sta.}$

Tractor Skidding

Fixed Cost/M: $\frac{7.0\text{min} \times 11¢/\text{min.}}{0.7\ \text{M/turn}} = \$1.10\ /\text{Mbf}$

Variable Cost/M/100 ft. Station: $\frac{0.8\text{min.} \times 11¢/\text{min.}}{0.7\ \text{M/turn}} = \$0.126\ /\text{Mbf/Sta.}$

Loading & Standby

$15\text{min.} \times 3.5¢/\text{min.} = 52.5¢$

$\frac{\$1.99\ \text{f.c./hr.}}{4} = 49.8¢$ $\$1.023\ /\text{Mbf}$

Hauling on Main Road

Hemlock: $\frac{2HC}{\text{mph} \times \text{load}} = \frac{2 \times \$3.25/\text{hr.}}{20\text{mph} \times 2.5\text{M}} = \$0.13\ /\text{Mbf/mile}$

Other Species: $\frac{2 \times \$3.25/\text{hr.}}{20\text{mph} \times 2.0\text{M}} = \$0.162\ /\text{Mbf/mile}$

Hauling on Spur Roads

Hemlock: $\frac{2 \times \$3.25/\text{hr.}}{12\text{mph} \times 2.5\text{M}} = \$0.217\ /\text{Mbf/mile}$

Other Species: $\frac{2 \times \$3.25/\text{hr.}}{12\text{mph} \times 2.0\text{M}} = \$0.271\ /\text{Mbf/mile}$

Unloading & Standby at Mill

Hemlock: $\frac{\$1.99\ \text{fc/hr.}}{4 \times 2.5\ \text{M}} = \$0.199\ /\text{Mbf}$

Other Species: $\frac{\$1.99\ \text{fc/hr.}}{4 \times 2.0\ \text{M}} = \$0.249\ /\text{Mbf}$

Determination of Economic Road Spacing

Depth to which teams should skid

$$\text{Depth} = \frac{F' - F}{V - V'} = \frac{\$1.10 - \$0.90}{\$0.25 - \$0.126} = 1.6 \text{ Stations}$$

Using Economic Road Spacing Formula For Combination Skidding

$$\text{Spacing} = \sqrt{\frac{0.33R}{VC'} - \frac{4CD^2}{C'} + 4D^2}$$

$$= \sqrt{\frac{0.33 \times \$1000}{12M \times \$0.126} - \frac{4 \times \$0.25 \times 1.6^2}{\$0.126} + 4 \times 1.6^2}$$

$$= \sqrt{208.4}$$

$$\doteq 14.4 \text{ Stations}$$

Determination of All Costs*

Type of Cost	First Cycle		Second Cycle	
	Hemlock	Other Species	Hemlock	Other Species
Felling & Buck	3.300	4.400	3.300	4.400
Team Skidding	0.244	0.244	0.244	0.244
Tractor Skidding	1.287	1.287	1.287	1.287
Spur Road Const.	0.478	0.478		
Spur Road Maint. (33 miles)			0.130	0.130
Main Road Inter. & Maint.	0.356	0.356	0.444	0.444
Loading & Standby	1.023	1.023	1.023	1.023
Haul on Spurs (Aver-1½miles)	0.325	0.406	0.325	0.406
Haul on Main (Aver-5½miles)	1.105	1.378	1.105	1.378
Unloading	0.199	0.249	0.199	0.249
Overhead	1.334	1.334	1.667	1.667
	$9.651	$11.155	$9.724	$11.228

*All costs are calculated on gross annual volume

Change in Value to allow for defect – 1st cycle

Hemlock	$18.00 x 80%	$14.40
Maple	$27.00 x 80%	$21.60
Birch	$32.00 x 80%	$25.60
Bass.& Pine	$35.00 x 80%	$28.00
Elm & Misc.	$25.00 x 80%	$20.00

Stumpage Recovery Value For First Cycle

Species	Value	Cost	Stump./M	M/Acre	Stump./Acre	Stump.for Tract
Hemlock	14.40	9.65	4.75	8.8	41.80	230,000
Maple	21.60	11.15	10.45	1.0	10.45	57,500
Birch	25.60	11.15	14.45	1.0	14.45	79,500
Basswood	28.00	11.15	16.85	0.6	10.12	55,600
Elm	20.00	11.15	8.85	0.6	5.32	29,200
				12.0 M	$ 82.14	$451,800

Stumpage Recovery Value For Second Cycle

Species	Value	Cost	Stump./M	M/Acre	Stump./Acre	Stump.for Tract
Hemlock	18.00	9.72	8.28	2.85	23.60	130,000
Maple	27.00	11.23	15.77	1.91	30.15	165,700
Birch	32.00	11.23	20.77	1.91	39.60	218,000
Basswood	35.00	11.23	23.77	1.25	29.70	163,500
Elm	25.00	11.23	13.77	1.25	17.25	95,000
				9.17M	$140.30	$772,200

Valuation of Property
(25 yr. Cycle)

Distribution of Stumpage- First Cycle

To Tribal Profit Fund	$82.14 x 60% $451,800 x 60%	$49.28/acre $271,000 Total
To Reserve	$82.14 x 40% $451,800 x 40%	$32.86/acre $180,800 Total

Present Worth

$$PW = \frac{\$82.14(1.04^3 - 1)}{.04 \times 1.04^3} + \frac{\$140.30(1.04^3 - 1)}{.04 \times 1.04^3 \times (1.04^{25} - 1)}$$

$$= \$228 + \$235$$

$$= \$463 \text{ for 3 acres or } \underline{\$154 \text{ per acre}}$$

Value to Put on Books

Allowingfor Risk 60%

$$\frac{\$235 \times 60\%}{3 \text{ acres}} = \$47.00 \text{ per acre}$$

$\$47 \times 5500 \text{ acres} = \$258,300$

Table Based on Gevorkiantz' Curve of Basal Areas For Stands in the Lake States (15 year cycle)

Group	DBH Range	Aver. DBH	Curve BA	% BA	Proposed BA
I	10-13"	11.5"	115	10.5	11.0
II	13-16	14.5	134	12.3	13.0
III	16-19	17.5	149	13.7	14.4
IV	19-22	20.5	162	14.9	15.6
V	22-25	23.5	172	15.8	16.6
VI	25-28	26.5	178	16.3	17.1
VII	28-31	29.5	180	16.5	17.3
			1090	100.0	105.0

$$\text{Proposed BA} = \frac{1090}{1[illegible]} \times \frac{7}{10.33} = 105 \text{ sq.ft.}$$

Stand Prediction For 15 Year Cycle *

Group VII $\quad \frac{17.3}{\text{BA of } (25.0" + 3")} = \frac{17.30}{4.276} = 4.0$ trees

Group VI $\quad \frac{17.1}{\text{BA of } (22.3" + 3")} = \frac{17.10}{3.491} = 4.9$ trees

Group V $\quad \frac{16.6}{\text{BA of } (19.3" + 3")} = \frac{16.60}{2.712} = 6.1$ trees

Group IV $\quad \frac{15.6}{\text{BA of } (16.9" + 3")} = \frac{15.60}{2.160} = 7.2$ trees

Group III $\quad \frac{14.4}{\text{BA of } (14.0" + 3")} = \frac{14.40}{1.576} = 9.1$ trees

Group II $\quad \frac{13.0}{\text{BA of } (10.7" + 3")} = \frac{13.00}{1.024} = 12.7$ trees

44.0

* Based on 0.2" growth per year and average diameter of trees in each group (see classified stand table for 15 year cycle)

Classification of Stand Table *

Group	DBH	Total Stand		Hemlock		Other species	
		No.	BA	No.	BA	No.	BA
I	10"	13.5	7.36	5.5	3.00	8.0	4.36
	12	7.1	5.59	2.8	2.24	4.3	3.35
		20.6	12.95	8.3	5.24	12.3	7.71
II	12"	2.9	2.26	1.2	0.90	1.7	1.36
	14	9.0	9.62	4.0	4.28	5.0	5.34
	16	2.4	3.30	1.1	1.55	1.3	1.75
		14.3	15.18	6.3	6.73	8.0	8.45
III	16"	6.1	8.60	2.9	4.05	3.2	4.55
	18	4.7	8.30	2.3	4.04	2.4	4.26
		10.8	16.90	5.2	8.09	5.6	8.81
IV	18"	3.1	5.47	1.5	2.67	1.6	2.80
	20	5.9	12.91	2.9	6.45	3.0	6.46
		9.0	18.38	4.4	9.12	4.6	9.26
V	20"	0.5	1.09	0.3	0.55	0.2	0.54
	22	5.5	14.53	2.8	7.40	2.7	7.13
	24	1.2	3.88	0.6	1.90	0.6	1.98
		7.2	19.50	3.7	9.85	3.5	9.65
VI	24"	3.1	9.63	1.5	4.70	1.6	4.93
	26	2.8	10.47	1.4	5.23	1.4	5.24
		5.9	20.10	2.9	9.93	3.0	10.17
VII	26"	0.2	0.61	0.1	0.31	0.1	0.30
	28	2.0	8.56	1.0	4.28	1.0	4.28
	30	2.0	11.18	1.0	5.59	1.0	5.59
		4.2	20.35	2.1	10.18	2.1	10.17

* See per acre stand table for Block X of Menominee Indian Reservation.

Classified Per Acre Stand Table- 15 Year Cycle

Group	%BA	Total Stand No.	Total Stand BA	Hemlock No.	Hemlock BA	Others No,	Others BA	DBH Range	Aver. DBH	Volume Hemlock	Volume Others	Volume Total
I	10.5	20.6	12.95	8.3	5.24	12.3	7.71	10-12"	10.7"	389	627	1016
II	12.3	14.3	15.18	6.3	6.73	8.0	8.45	12-16	14.0	825	1176	2001
III	13.7	10.8	16.90	5.2	8.09	5.6	8.81	16-18	16.9	1171	1344	2515
IV	14.9	9.0	18.38	4.4	9.12	4.6	9.26	18-20	19.3	1447	1526	2973
V	15.8	7.2	19.50	3.7	9.85	3.5	9.65	20-24	22.3	1825	1581	3406
VI	16.3	5.9	20.10	2.9	9.93	3.0	10.17	24-26	25.0	2006	1733	3739
VII	16.5	4.2	20.35	2.1	10.18	2.1	10.17	26-30	29.8	2197	1833	4030
	100.0	72.0	123.36	32.9	59.14	39.1	64.22			9860	9820	19680

First Cycle Cut Under 15 Year cycle

DBH	H Hemlock		Maple		Birch		Bass.& Pine		Elm & Misc.		Total	
	No.	Volume	No.	Volume	No.	Volume	No.	Volume	No.	Volume	No.	Volume
Thinnings												
10"	5.5	165									5.5	165
12	3.6	288									3.6	288
14	4.0	520									4.0	520
16	2.9	551									2.9	551
18	2.2	594									2.2	594
20	1.7	612									1.7	612
22	2.0	960									2.0	960
24	1.5	930									1.5	930
26	0.4	308									0.4	308
Harvest Cut												
26"	0.1	77	0.03	19	0.03	19	0.02	13	0.02	12	0.2	140
28	1.0	910	0.30	222	0.30	222	0.20	136	0.20	158	2.0	1650
30	1.0	1210	0.30	309	0.30	309	0.20	206	0.20	206	2.0	2240
	25.9	7125	0.63	550	0.63	550	0.42	367	0.42	366	28.0	8958

Thinnings

Group I	(10"-12")	20.6 - 12.7	=	7.9 trees
Group II	(12"-16")	14.3 - 9.1	=	5.2
Group III	(16"-18")	10.8 - 7.2	=	3.6
Group IV	(18"-20")	9.0 - 6.1	=	2.9
Group V	(20"-24")	7.2 - 4.9	=	2.3
Group VI	(24"-26")	5.9 - 4.0	=	1.9
				23.8 trees to be removed

Number of Trees in Stand in 15 Years

Group	DBH	Hemlock	Others	Total
I		Probably the same as now		
		8.3	12.3	20.6
II	13"		8.0	8.0
	15	0.4	4.3	4.7
III	15"		1.7	1.7
	17		5.0	5.0
	19	1.1	1.3	2.4
IV	19"		3.2	3.2
	21	1.6	2.4	4.0
V	21"		1.6	1.6
	23	1.5	3.0	4.5
VI	23"		0.2	0.2
	25	0.8	2.7	3.5
	27	0.6	0.6	1.2
VII	27"		1.6	1.6
	29	1.0	1.4	2.4
		15.3	49.3	64.6

Second Cycle Cut Under 15 Year Cycle

DBH	Hemlock		Maple		Birch		Bass.& Pine		Elm & Misc.		Total	
	No.	Volume	No.	Volume	No.	Volume	No.	Volume	No.	Volume	No.	Volume
Thinnings												
I	7.9	357	(Assumed to be the same as in the first cycle)								7.9	357
13"			0.96	115	0.96	115	0.64	77	0.64	77	3.2	384
15	0.4	64	0.24	43	0.24	43	0.16	29	0.16	29	1.2	208
17												
19	1.1	346									1.1	346
21	1.1	462									1.1	462
23	1.2	660									1.2	660
25	0.8	556									0.8	556
27	0.1	84									0.1	84
Harvest Cut												
27"			0.48	329	0.48	329	0.32	219	0.32	219	1.6	1096
29	1.0	1060	0.42	357	0.42	357	0.28	238	0.28	238	2.4	2250
	13.6	3589	2.10	844	2.10	844	1.40	563	1.40	563	20.6	6403

Thinnings

Group I	Same as first cycle		7.9 trees
Group II	(13"-15")	12.7 - 9.1	3.6
Group III	(15"-19")	9.1 - 7.2	1.9
Group IV	(19"-21")	7.2 - 6.1	1.1
Group V	(21"-23")	6.1 - 4.9	1.2
Group VI	(23"-27")	4.9 - 4.0	0.9
			16.6 trees to be removed

Number of Trees in 30 Years

Group	DBH	Hemlock	Others	Total
I		Probably the same as now		
		8.3	12.3	20.6
II		Probably the same as in 15 years		
		0.4	12.3	12.7
III	16"		4.8	4.8
	18		4.3	4.3
IV	18"		0.9	0.9
	20		5.0	5.0
	22		1.3	1.3
V	22"		3.2	3.2
	24	0.5	2.4	2.9
VI	24"		1.6	1.6
	26	0.3	3.0	3.3
VII	26"		0.2	0.2
	28		2.7	2.7
	30	0.5	0.6	1.1
		10.0	54.6	64.6

Third Cycle Cut Under 15 Year Cycle

DBH	Hemlock		Maple		Birch		Bass.& Pine		Elm & Misc.		Total	
	No.	Volume	No.	Volume	No.	Volume	No.	Volume	No.	Volume	NO.	Volume
Thinnings												
I	7.9	357	(Assumed to be the same as in the first cycle)								7.9	357
II	0.4	64	1.0	115	1.0	115	0.6	77	0.6	77	3.6	448
			(The above is assumed to be the same as in second cycle)									
16"			0.57	120	0.57	120	0.38	80	0.38	79	1.9	399
18			0.27	70	0.27	70	0.18	46	0.18	46	0.9	232
20			0.06	22	0.06	22	0.04	14	0.04	14	0.2	72
22			0.21	92	0.21	92	0.14	62	0.14	62	0.7	308
24	0.5	310	0.18	95	0.18	95	0.12	64	0.12	64	1.1	628
26	0.3	231									0.3	231
Harvest Cut												
26"			0.06	38	0.06	38	0.04	25	0.04	25	0.2	126
28			0.81	600	0.81	600	0.54	400	0.54	400	2.7	2000
30	0.5	605	0.18	185	0.18	185	0.12	124	0.12	124	1.1	1223
	9.6	1567	3.34	1337	3.34	1337	2.16	892	2.16	891	20.6	6024

Thinnings is composed of same number as in second cycle

Determination of Economic Road Spacing
(15 year cycle)

Using Economic Road Spacing Formula for Combination Skidding

$$\text{Spacing} = \sqrt{\frac{0.33 \times \$1000}{9M \times \$0.126} - \frac{4 \times \$0.25 \times 1.6^2}{\$0.126} + \frac{4 \times 1.6^2}{}}$$

$$= \sqrt{280.9}$$

$$= 16.8 \text{ Stations}$$

Allowance for Defect in Stumpage At Mill

First Cycle Cut

Hemlock	$18.00 x 80%	$14.40
Maple	$27.00 x 80%	$21.60
Birch	$32.00 x 80%	$25.60
Bass. & Pine	$35.00 x 80%	$28.00
Elm & Misc.	$25.00 x 80%	$20.00

Second Cycle Cut

Hemlock	$18.00 x 92%*	$16.56
Maple	$27.00 x 92%	$24.84
Birch	$32.00 x 92%	$29.44
Bass. & Pine	$35.00 x 92%	$32.20
Elm & Misc.	$25.00 x 92%	$23.00

* Defect is assumed to be only 60% eliminated in 15 years thus leaving 8% of defect in second cycle cut.

Determination of Total Costs *

Type of Cost	First Cycle		Second Cycle		Third Cycle	
	Hemlock	Others	Hemlock	Others	Hemlock	Others
Felling & Bucking	3.300	4.400	3.300	4.400	3.300	4.400
Team Skidding	0.249	0.249	0.249	0.249	0.249	0.249
Tractor Skidding	1.400	1.400.	1.400	1.400	1.400	1.400
Spur Road Const.	0.547	0.547				
Spur Road Maint. (30 miles)			0.165	0.165	0.176	0.176
Main Road Interest & Maint.	0.356	0.356	0.408	0.408	0.444	0.444
Loading & Standby	1.023	1.023	1.023	1.023	1.023	1.023
Haul on Spurs (aver. 1½ miles)	0.325	0.406	0.325	0.406	0.325	0.406
Haul on Main (aver. 8½ miles)	1.105	1.378	1.105	1.378	1.105	1.378
Unloading	0.199	0.249	0.199	0.249	0.199	0.249
Overhead	1.334	1.334	1.530	1.530	1.667	1.667
	$9.838	$11.342	$9.704	$11.208	$9.888	$11.392

* All costs are calculated on gross annual volume produced

Stumpage Recovery Values

Species	Value	Cost	Stump./M	M/acre	Stump./acre	Stump for Tract
First Cycle Cut						
Hemlock	14.40	9.84	4.56	7.12	32.40	178,400
Maple	21.60	11.34	10.26	0.55	5.64	31,000
Birch	25.60	11.34	14.26	0.55	7.84	43,200
Basswood	28.00	11.34	16.66	0.37	6.16	33,900
Elm	20.00	11.34	8.66	0.37	3.20	17,600
Total				8.96	$55.24	$304,100
Second Cycle Cut						
Hemlock	16.56	9.70	6.86	3.59	24.60	135,300
Maple	24.84	11.21	13.63	0.84	11.46	63,000
Birch	29.44	11.21	18.23	0.84	15.32	84,200
Basswood	32.20	11.21	20.99	0.56	11.76	64,600
Elm	23.00	11.21	11.79	0.56	6.60	36,300
Total				6.39	$69.74	$383,400
Third Cycle Cut						
Hemlock	18.00	9.89	8.11	1.57	12.72	70,000
Maple	27.00	11.39	15.61	1.34	20.90	115,100
Birch	32.00	11.39	20.61	1.34	27.60	151,800
Basswood	35.00	11.39	23.61	0.89	21.00	115,600
Elm	25.00	11.39	13.61	0.89	12.10	66,600
Total				6.03	$94.32	$519,100

Valuation Of Property
(15 yr. cycle)

Distribution of Stumpage - First Cycle

To Tribal Profit Fund	$55.24 x 60% $304,100 x 60%	$33.14/Acre $182,460 Total
To Reserve	$55.24 x 40% $304,100 x 40%	$21.10/Acre $121,640 Total

Present Worth

$$PW = \frac{\$55.24(1.04^2-1)}{.04 \times 1.04^2} + \frac{\$69.74(1.04^2-1)}{.04 \times 1.04^2 \times 1.04^{15}} + \frac{\$94.32(1.04^2-1)}{.04 \times 1.04^2(1.04^{15}-1)}$$

$$= \$104 + \$73 + \$124$$

$$= \$301 \text{ for 2 acres or } \underline{\$151 \text{ per acre}}$$

Value to Put on Books after First Cut

Allowance for Risk - deduct 40%

$$\left(\frac{\$73 + \$124}{2 \text{ acres}}\right) \times 60\% = \$59 \text{ per acre}$$

$$\$59 \times 5500 \text{ acres} = \$324,500$$

Value to Put on Books after Second Cut

$$\frac{\$94.32(1.04^2-1)}{.04 \times 1.04^2(1.04^{15}-1)} = \$220$$

$$\frac{\$220 \times 60\%}{2 \text{ acres}} = \$66 \text{ per acre}$$

$$\$66 \times 5500 \text{ acres} = \$356,300$$

ACCOPRESS BINDER

BFS 2507 EMB.

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LONG ISLAND CITY, N. Y., U. S. A.