Cloquet Forestry Center Forest Management Plan 1992–2001

Ronald W. Severs
Robert A. Stine
Richard A. Skok

University of Minnesota
Station Bulletin 600–1992
Minnesota Agricultural Experiment Station

(Distribution Center Item SB-5945-E)

Cloquet Forestry Center Forest Management Plan 1992-2001

Ronald W. Severs
Robert A. Stine
Richard A. Skok

Station Bulletin 600-1992
Minnesota Agricultural Experiment Station
University of Minnesota

St. Paul, Minnesota

Author

Ronald W. Severs is a forest manager and scientist for the Cloquet Forestry Center. Robert A. Stine is a research fellow and coordinator for the Cloquet Forestry Center. Richard A. Skok is Dean Emeritus of the College of Natural Resources, University of Minnesota. The Cloquet Forestry Center is a unit of the College of Natural Resources.

Acknowledgements

Management activities are partly funded through Minnesota Agricultural Experiment Station Project MN-40-015, *Management Alternatives for Northern Minnesota Forests.*

The authors would like to thank Chuck Kramer and John Blanchard for their assistance in record keeping and collecting management data. Phyllis Bakka, principal secretaty at the Cloquet Forestry Center provided appreciated assistance in compiling the report.

Publication editing, design and development for the Minnesota Agricultural Experiment Station is by Larry A. Etkin, experiment station editor, Educational Development System, University of Minnesota.

Availability

For information on purchasing a copy of this publication, contact the MES Distribution Center, Coffey Hall, University of Minnesota, St. Paul, Minnesota 55108-6064.

Produced in the Educational Development System, MES.
Printed on recycled paper containing a minimum of 10 percent post-consumer waste.

CONTENTS

TABLES

FIGURES

Cloquet Forestry Center Forest Management Plan 1992–2001

Ronald W. Severs
Robert A. Stine
Richard A. Skok

INTRODUCTION

This ten year forest management plan outlines management goals to be met during the period July 2, 1991 through June 30, 2001, for the 3,340 contiguous acres (University of Minnesota, 1987) of the Cloquet Forestry Center. This plan complements and supports the Center's mission as a unit of the University of Minnesota College of Natural Resources.[1]

The Cloquet Forestry Center's continuing forest management objective is to economically provide a well managed forest serving the diverse research, teaching and outreach needs of the College of Natural Resources. Through conscientious forest management those needs can be served by a program that:

- provides a variety of stand vigor conditions
- provides a variety of vegetation types
- provides a variety of stand age classes
- maintains an adequate forest road access and maintenance program
- maintains a centralized research and management record keeping system
- adheres to Best Management Practices in Minnesota
- improves and maintains a variety of wildlife habitats
- enhances compatible recreational and aesthetic opportunities

As management of the Center's forest moves toward the 21st century, it is evident that the Cloquet facility is an intensively managed forest. For the first time in the management of the forest, a plan of this nature specifically addresses the need for non-managed reserve areas or stands, wildlife considerations and the need for a recreational use policy to address increased recreational activity on the forest.

The Cloquet Forestry Center is recognized in Minnesota and nationally as an intensively, well managed forest. This plan is designed to sustain that recognition into the 21st Century.

This plan is the result of an evolutionary process of changing factors influencing the management of the forest. It is proposed as a guide, not a rigid rule, for the management of the forest during the next decade. If it is to effectively

[1] See Appendix A.

serve the mission of the Center, continued input is needed from all who use the Center. This desired input will help shape future management plans and the future forest.

HISTORY OF THE CENTER'S FOREST MANAGEMENT

Through the Cloquet Forestry Center's history, many reports and plans have been developed to describe or direct the administration of the Center and the management of the forest. Those publications[2] help document the changes in forest management emphasis the Center has undergone since its establishment in 1909.

During the late 1800s and early 1900s much of Northern Minnesota and the Cloquet Forestry Center had been cut over, removing most of the mature pine forest. There was early recognition by some that cut over lands would have to be regenerated successfully and economically if Minnesota was to sustain its forest industry. From its establishment in 1909 through the 1920s most research and management effort at the Center was directed toward reforestation. The Center established a seedling nursery in 1915 for both research and seedling production. By 1917 the nursery was producing one million seedlings annually for reforestation at the Center and around the State (W. H. Kenety 1917).

In the early 1930s, research and management emphasis began to shift toward intermediate stand treatments. Center publications during the 1930s and 1940s (T. Shantz-Hansen 1931; T. S. Hansen 1936; J. H. Allison 1946) show that much of the management and research work dealt with intermediate stand thinning, primarily with white and red pine, and white spruce. As the pulp and paper industry began to expand in Minnesota so did the interest in managing other suitable tree species. During this period jack pine, aspen and birch began to receive increased research and management attention.

As the second forest of Minnesota and the Cloquet Forestry Center began to approach maturity, opportunities for research tied to final harvests increased. The period from the 1950s to the 1970s saw the emergence of new reforestation methods and mechanized timber harvesting. With these new techniques came questions of economics and environmental impact. The response to these questions was the development of research and management techniques to answer them.

This era brought in the use of containerized seedlings for reforestation and the use of chainsaws, rubber tired skidders, feller bunchers and whole tree processors for timber harvesting. It also marked a change in personnel functions at the Center.

During the late 1960s and early 1970s, a shift occurred away from a woods labor support staff, toward a research/technical oriented support staff at the Cloquet Forestry Center. This shift affected management of the forest in several ways. The labor intensive nursery operation that began in 1915 was terminated in 1974. Basic silvicultural activities such as salvage cutting and timber stand improvement work declined sharply as efforts were directed toward research support.

It was during this period of transition that a backlog of mature and overmature timber stands accumulated at the Center. By 1977 mature and overmature stands occupied 80 percent of the upland forest (Z. A. Zazada 1981).

Efforts were needed to establish a better age class and species distribution on the forest. In 1981 the College and the Center adopted an aggressive ten year management plan (Zazada 1981). The plan proposed a significant amount of timber be harvested to develop better age class distribution and species diversity.

The plan was followed almost in its entirety. Four hundred twenty six acres received a harvesting treatment during the period 1981–1986 (Severs 1989). Three hundred ten of those acres were clearcut. By 1991 a total of 700

[2] See Appendix B: Additional Readings.

acres (21 percent) of the contiguous forest had been treated, with 513 acres (15 percent) being clearcut. Most of the timber harvesting in the 1980s was accomplished by contract logging (Severs 1989).

In 1981 the Minnesota Tree Improvement Cooperative was established and located at the Cloquet Forestry Center. This was followed in 1984 by the development of the Forest Vegetation Management Cooperative, also headquartered at the Center. The cooperatives spurred a significant increase in field research at the Center. About a half-dozen new research projects were initiated annually, much of it tied to the newly formed cooperatives.

The 1980s management plan addressed and to a large extent resolved two primary concerns of the College and Center:

- the overmaturing of the forest,
- the need to stimulate additional field research at Cloquet.

The management plan for the 1990s is part of the continued evolution of management needs for the Center's forest. For the first time the plan needs to address how the third forest now growing on many parts of the Center should be managed. It also must address the need for reserves and non-managed areas for future research, teaching and demonstrations.

There is additional need for a recreational policy as recreational-use pressures on the forest continue to increase from hikers, cross-country skiers, horseback riders and others. Finally, the plan must continue to provide for the maintenance of a healthy productive forest to demonstrate the benefits of timber production and its compatibility with other uses and values under sound forest management.

As management of Minnesota's forests intensify and user demands increase, the general public and the forestry community can continue to look to the College and the Cloquet Forestry Center for forest resource management answers.

CLOQUET FORESTRY CENTER RESERVE AREAS AND STANDS

Because the Cloquet Forestry Center exists for forest research, teaching and outreach, there continues to be a need to have a variety of stands that receive various intensities of management. Management levels need to vary from intensive state-of-the-art to non-managed natural development. For this purpose, 23 areas, totaling 319 acres, have been designated as either old growth reserve, unique forest type reserves, or instructional/demonstrational reserves for the duration of this plan. Reserve areas account for approximately 10 percent of the total forest area.

OLD GROWTH RESERVE

Logging of the forest land that was eventually to be the Center was underway during the Center's establishment phase from 1909–1910. At that time Professor Samuel Green asked the logging companies to leave certain seed trees, groups or stands of mature white and red pine for experimental purposes. Then as today, the University recognized the values of old growth stands. Green's request was granted and several mature stands scattered around the Center were reserved from cutting.

Over the years, some of the original old growth reserves have been harvested for various research or management purposes. This new plan formally recognizes the aesthetic, research and teaching contribution these stands provide and identifies which old stands will be reserved for these purposes.

Old growth forest guidelines[3] developed by the Minnesota Department of Natural Resources were used to help identify which stands were best suited for reserve status. Although not all the characteristics of old growth pine stands exist in each of the stands reserved, enough

[3] See Appendix C.

TABLE 1. Old Growth Reserve Stands, 1991.

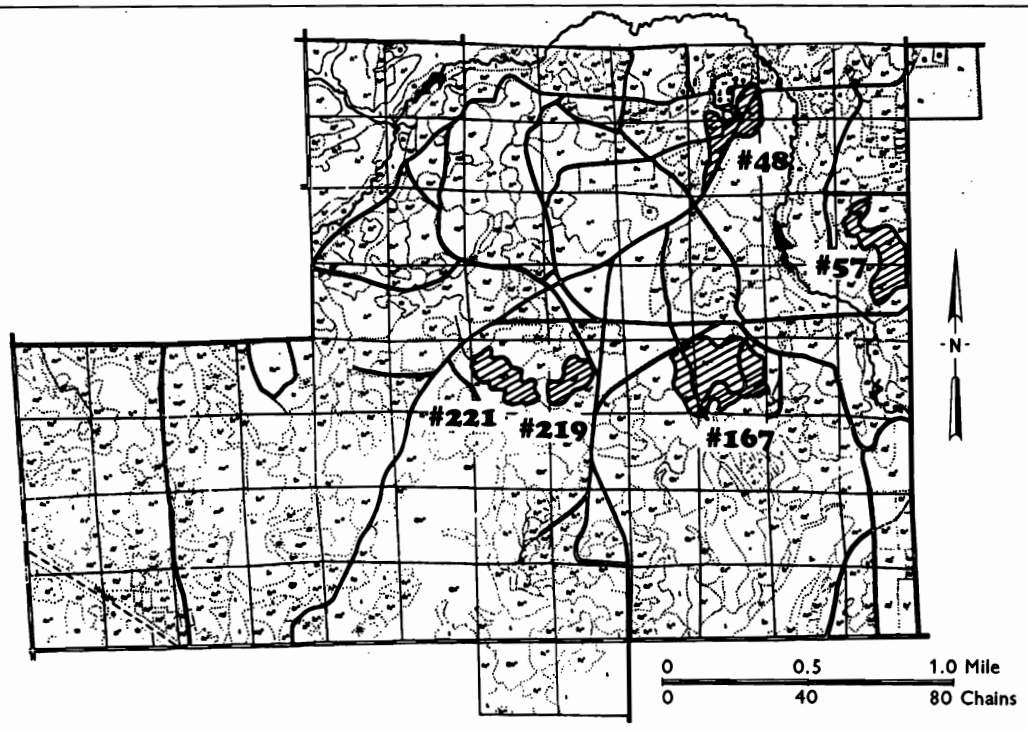
Stand No.	Species	Age	Acres	Location*	Description
48	Red Pine	167	16	E1/2 NW1/4 SEC 29	Scattered old-growth overstory. Second growth Red Pine understory.
57	Red Pine White Pine	167	23	E1/2 SW1/4 SEC 29	Even aged Red and White Pine old-growth, 20% White Pine, brush understory.
219	Red Pine	141	7	NE1/4 NE1/4 SEC 31	Even aged Red Pine old-growth, brush understory.
221	Red Pine	141	12	NW1/4 NE1/4 SEC 31	Scattered old-growth overstory, mixed conifer/hardwood understory.
167	Red Pine	167	44	N1/2 NW1/4 SEC 32	Camp 8 Stand, originated 1824. See the Camp 8 management prescription (page 5).

* Center Map in Appendix D shows locations by section number.

characteristics do exist to label them as old growth stands.

Five stands ranging from 141 to 167 years of age and totaling 102 acres have been set aside as old growth reserve. These five stands will be omitted from harvesting considerations, barring natural catastrophe, for the duration of this plan. Basic descriptions of the stands are recorded in Table 1. Location of the stands is shown in Figure 1.

Figure 1. Old growth reserve locations.



CAMP 8 STAND MANAGEMENT PRESCRIPTION

Camp 8 Stand is an old growth Norway pine stand named after Northern Lumber Company's logging camp number 8, which operated near the stand in the early 1900s.

Because of the stand's historical public interest, age, acreage and ecological uniqueness, it was determined that the Camp 8 Stand needed a management prescription addressing its special qualities. In 1983 such a management prescription was developed.

Following review of both the stand and its management prescription it was decided that the management prescription will continue in effect through this plan.

STAND HISTORY AND DESCRIPTION

This 44 acre, 168-year-old (as of 1992) Norway pine stand is being preserved as an example of the once common virgin Norway pine of Northern Minnesota. It exists today because of the efforts of University Professor Samuel Green.

Logging of the area was already in progress by the Northern Lumber Company during the establishment period of the Cloquet Forestry Center. The Camp 8 Stand was one of several mature tree stands that Professor Green asked Northern Lumber Company to leave for experimental purposes. For their compliance with the request, the University paid the Northern Lumber Company for the value of the timber. Because of this effort, the Cloquet Forestry Center has one of the very few remaining stands of old growth Norway pine in the area.

Some individual trees in the stand are nearly 300 years old, but indications are that the major portion of the stand originated following a fire that burned the area in 1824. Five fires, dated by fire scars, have burned the area since 1824: in 1842 (when the stand was 18 years old), and in 1855, 1864, 1874 and 1894. Until the 1930s, there was little or no underbrush or regeneration in the stand (Figure 2).

There are approximately 75 old growth pine per acre. The old growth pine has an average diameter breast height (DBH) of about 17 inches, and there are approximately 26 million board feet (MBF) per acre. The stand today has a moderate to heavy understory of shrubs, balsam fir, spruce, white pine and hardwoods. Present tree mortality is moderate in pockets, but light throughout the stand.

The stand is still one of the main interest points of visitors to the Center.

MANAGEMENT PRESCRIPTION

Characteristics of the once common old growth Norway pine stands of Northern Minnesota, with the exception of the understory, still exist in the Camp 8 Stand. These characteristics can probably be perpetuated for another 25 to 50 years with proper management of the stand.

The stand has been divided into two parts. One part, approximately half (22 acres) of the stand area, has remained in an unmanaged condition to show the effects of natural succession in the absence of fire and management. This area is useful for demonstration purposes as well as ecological research.

The other half of the stand received a combination improvement and salvage cut in 1985. All spruce, fir, white pine and hardwoods in the understory were removed. The old growth was examined and salvageable dead trees and any live trees that showed signs of low vigor were removed.

Figure 2. Camp 8 Stand, 1925.

Because of the age of the Camp 8 Stand, salvage evaluations will take place every ten years and high risk trees will be removed accordingly. Harvesting will be done in the winter, when tree bark is tight, to minimize scarring of the residual stand and to maximize breakage in the shrub layer of the understory. Full-tree skidding is recommended to keep fuel loads low for follow-up burning.

The stand's current understory is a response to fire protection and is very different from the structure of old growth stands prior to fire protection. It depicts both a major shift in plant species composition and wildlife habitat features not common to old growth stands prior to fire protection. It reduces the aesthetic and recreational values of the stand.

The current understory represents a major deterrent to successful pine regeneration which forces the use of expensive mechanical and chemical treatments to establish the next crop. It also may reduce overstory vigor, growth and survival through competition for moisture and nutrients during dry periods.

Periodic fires can be used to control understory on the managed portion of the area. This would also serve as a demonstration of the effects of fire on the stand prior to the time of fire suppression. This could be accomplished with relatively low intensity spring fires at frequent three to five year intervals to reduce both fuel loading and the height of the understory. Once the cumulative effects of the long period of fire exclusion have been removed, burns might be conducted at five to ten year intervals.

To date, only one burn has been accomplished. Resources and proper burning conditions have been major limiting factors preventing regular burns.

By managing the Camp 8 Stand, characteristics of the once common old growth Norway pine stands can be preserved for future observation or research.

For two reasons this prescription does not include any specific recommendations for stand regeneration at this time. The presence of the disease red pine shoot blight *(siroccus strobilinus)* on the forest would preclude trying to establish regeneration under the overstory, and the time at which the stand will lose the characteristics for which it is being preserved is indeterminable. Under the above management scheme, the stand will be maintained as long as possible. Stand regeneration procedures will be decided at a time in the future, and will employ the latest regeneration technology available.

As always, there is the risk of a major incident that can override the best of plans. Should this happen, the stand will receive priority to try and maintain its characteristics, salvage usable material and regenerate areas that were destroyed.

UNIQUE FOREST TYPE RESERVES

Many of the Center's older stands were established naturally following logging or catastrophic fires, events which will likely never again occur on this forest. Many of these natural stands developed with little or no silvicultural management, much different from the more intensively managed plantations and stands established today.

Natural stands and unmanaged areas can provide as many research/teaching opportunities as intensively managed stands. As the Center's forest becomes more intensively managed, it becomes increasingly more important to identify specific stands or areas that will be exempt from management, thereby being left to develop and/or decline naturally.

Table 2 identifies areas and selected stands that will be exempt from intensive management under this plan. Figure 3 shows the location of these stands on the Center.

INSTRUCTIONAL/DEMONSTRATION RESERVES

Several areas on the forest have, over the years, consistently been used for teaching or demonstration exercises. These areas have characteristics that either make them useful for teaching and demonstrating forest management or provide management problem solving opportunities. They may not be highlights of forest management, but they are a valuable asset to the teaching mission of the Center and need to be reserved for that purpose.

Table 3 lists eight areas that will be reserved for instructional purposes. Figure 4 identifies the location of the areas on the Center.

Figure 3. Unique forest type reserve locations.

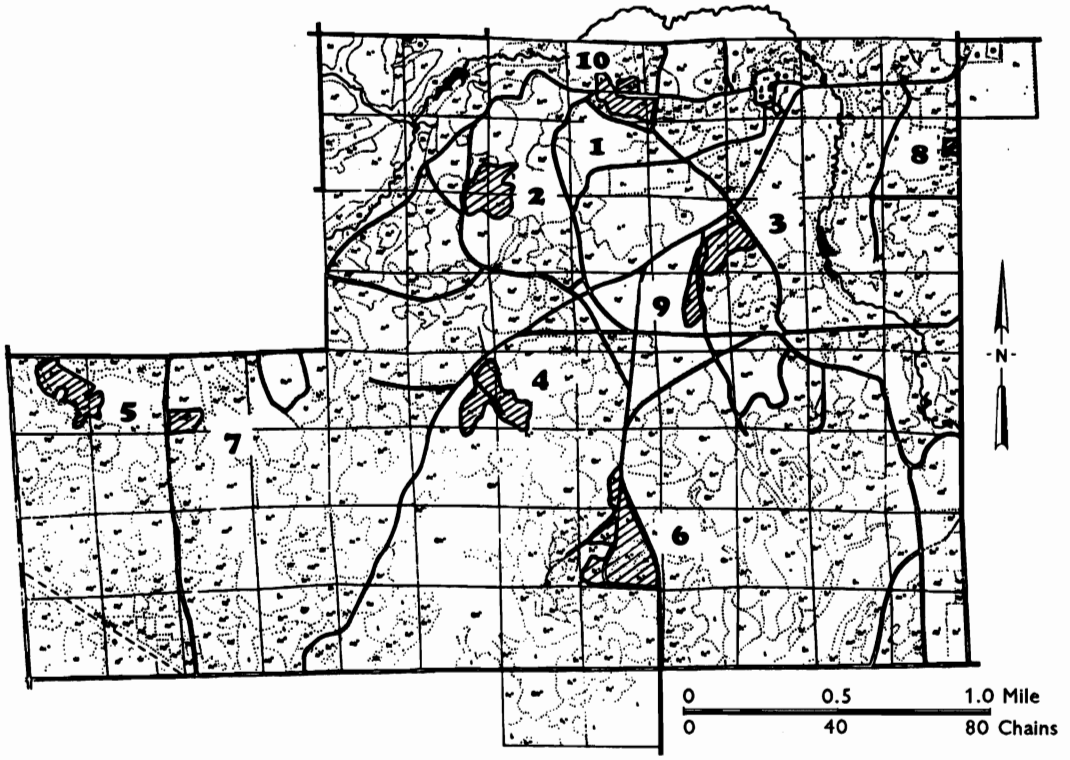


TABLE 2. Unique Forest Type Reserves

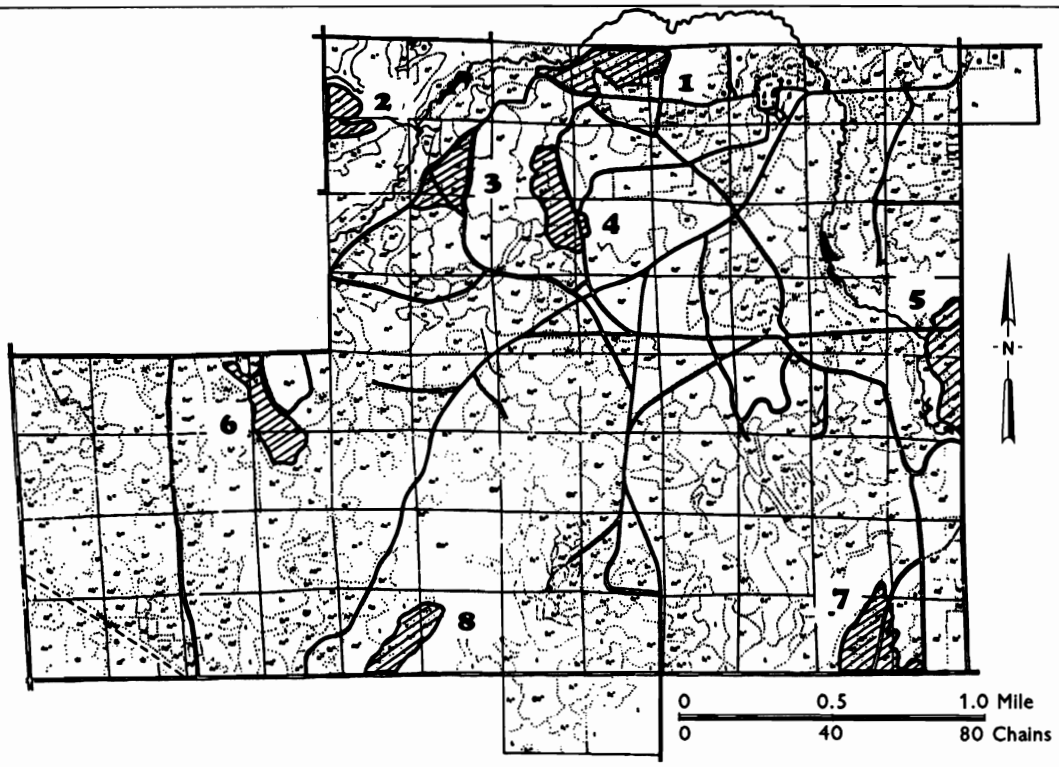
Area No.	Species	Acres	Location*	Description
1	Jack Pine	7	NE1/4 NE1/4 SEC30	Stand originated following a fire in 1894.
2	Jack Pine	15	Center, SEC30	Dense declining post 1894 fire origin stand.
3	Jack Pine	8	N1/2 SW1/4 SEC29	Declining post 1894 fire origin stand, mixed with Norway pine.
4	Aspen	16	NE1/4 NW1/4 NW1/4 NE1/4 SEC31	Naturally developed aspen stand following merchantable clearcut in 1950.
5	Aspen	9	NW1/4 NW1/4 SEC36	Naturally developed aspen stand following jack pine clearcut in 1951.
6	Birch/Maple	15	NE1/4 SE1/4 SEC31	Mixed conifer hardwood fir stand, natural development after logging in 1910s.
7	White Pine	3	NW1/4 NE1/4 SEC36	White pine stands comprise less than 1 percent of the Center's Forest. Current scarcity of the type will dictate preservation of the type.
8	White Pine	1	SE1/4 NE1/4 SEC29	
9	White Pine	7	SW1/4 SW1/4 SEC29	
10	White Pine	2	NE1/4 NE1/4 SEC30	

* Center Map in Appendix D shows locations by section number.

TABLE 3. Instructional/Demonstration Reserves

Area Number	Acres	Area Number	Acres
1	21	5	22
2	15	6	21
3	20	7	10
4	15	8	20

Figure 4. Instructional/Demonstration reserve locations.



TIMBER HARVESTING

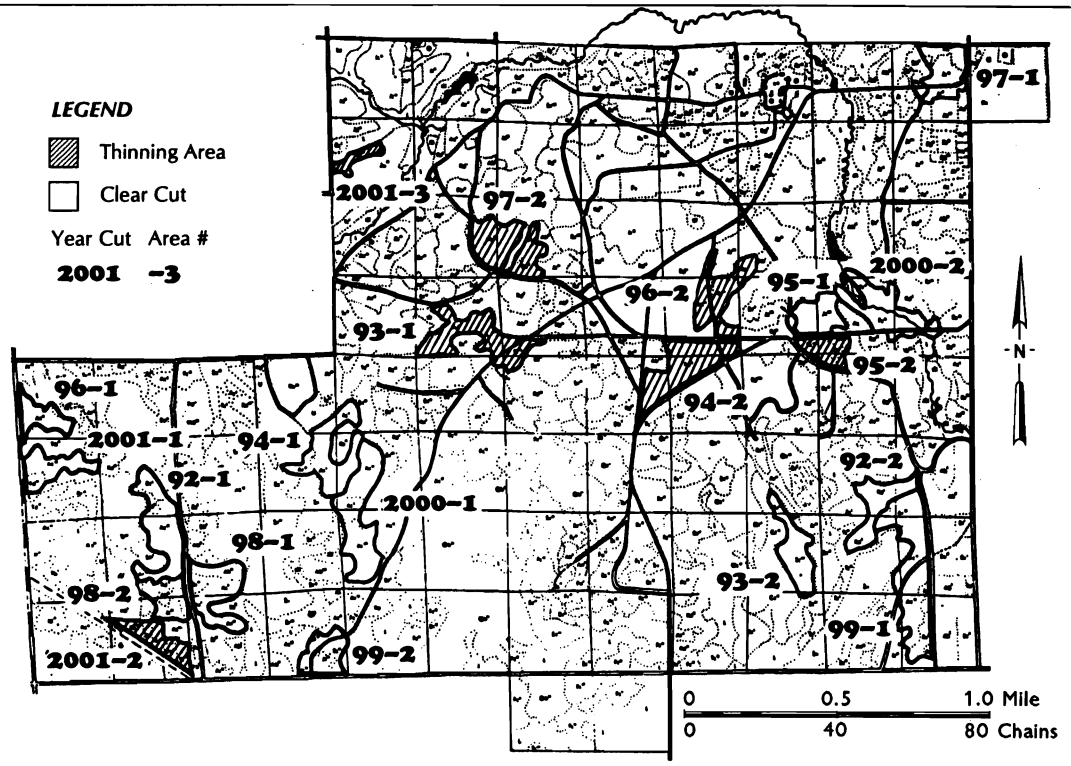
The objective of timber harvesting activities at the Cloquet Forestry Center is to provide and maintain the variety of forest types, age classes and management conditions required to meet the research, teaching and demonstration mission of the Center.

During the period 1992 through the year 2001, a harvesting treatment will be applied to 21 separate areas totaling 315 acres, approximately 10 percent of the forest. Both clearcutting and partial cutting will be used in this timber harvesting, the choice based on age, stocking and quality of the stand.

Clearcuts are prescribed for 14 areas ranging in size from nine to 23 acres, for a total of 212 acres. For management purposes, these stands are past desired rotation age, poorly stocked or stocked with poor quality low value timber.

Thinning is prescribed for seven areas ranging from five to 22 acres in size, totaling 103 acres. These are high value stands that have not yet

Figure 5. Proposed harvesting areas for the period July 1991 through June 2001.



reached a desired rotation age, but need silvicultural work to maximize growth.

Figure 5 identifies the location of each of the twenty one areas to be treated, the type of treatment it is to receive and the proposed year of treatment. Table 4 lists and describes each of the harvesting areas.

Table 5 is a summary of the planned timber harvesting by forest type.

Table 4. July 1991 through June 2001 Harvesting Area Descriptions.

Area	Dominant Type *	Age	Acres	Harvest Type	Stand/Area Description and Management
92-1	AC	40-65	20	CC	Multi-aged aspen stand that is a result of diameter limit cuts of the late 1950s and early 1960s. Somewhat understocked, basal area 80–100 square feet per acre. Scheduled for clearcutting to establish an even-aged, well stocked stand.
92-2	RD	40-170	12	CC	Sparsely scattered old growth pine with understory of birch, aspen, and mixed conifers. Area is severly understocked with basal areas of 60–80 through most of the stand.
93-1	RC	40-75	22	PC	Pole sized red pine stand with two age classes mixed through the stand. Patches of 75-year-old red pine are surrounded by 40-year-old pine. Basal areas range from 80–170 square feet per acre. Area to be thinned to approximately 100 square feet per acre.

Table 4 continued. July 1991 through June 2001 Harvesting Area Descriptions.

Area	Dominant Type *	Age	Acres	Harvest Type	Stand/Area Description and Management
93-2	SC	111-141	14	CC	Mature spruce stand ready for harvest. This is the only lowland area scheduled for harvest during this management period. Area will be used for demonstrating lowland regeneration practices.
94-1	AC	35-40	23	CC	Poorly stocked aspen area that was primarily a failed pine planting of 1960. Aspen older than 30 years are mixed in with scattered older aspen, 11–15 cords per acre.
94-2	RD	75	20	PC	Area scheduled for rethinning; last thinned 1973. Average basal area of 160 square feet per acre. Area will be thinned to 110 square feet per acre.
95-1	JC	85	15	CC	An 85-year-old jack pine stand with excessive mortality.
95-2	RC	50	10	PC	This is a smaller area that was planted in 1941–42. The area was planted under a scattered overstory of 20- to 30-year-old red pine. The stand has never been thinned and is of small diameter for its age. Stand will be thinned to approximately 100 square feet per acre.
96-1	AC	50	9	PC	Mature to overmature multi-aged, understocked aspen stand resulting from diameter limit cuts in the late 1950s.
96-2	RC	65-75	18	PC	Comprising this area are 75-year-old natural red pine and 65-year-old white pine stands. Current basal area for stands is 160–180 square feet per acre. Stands will be thinned to 100 square feet per acre.
97-1	JC	70	14	CC	A 70-year-old jack pine stand that has reached the desired rotation age.
97-2	RC	35	20	PC	Well stocked 35-year-old red pine plantation that has reached commercial harvest size. This will be stand's first thinning.
98-1	AC	50	13	CC	Mature multi-aged aspen stand resulting from early diameter limit cuts. Current basal area is 60–100 square feet per acre. Clear cut is scheduled to establish an even-aged, well stocked aspen stand.
98-2	JC	95-100	10	CC	Mixed conifer area, predominately overmature jack pine of 1894 origin. Harvesting only jack pine will leave understocked stand. Possible area for uneven-aged management.
99-1	AC	30-40	22	CC	Multi-aged aspen area with scattered conifers. Predominately 45-year-old aspen. North end of area is scheduled for harvest to accommodate research.
99-2	JC	95-100	10	CC	Overmature jack pine past desirable rotation age.
2000-1	AC	35-45	18	CC	Multi-aged aspen area, wide range of age classes, 20–65 years old. Area will be clearcut to establish larger even-aged stand.
2000-2	FC	65-75	17	CC	Spruce/balsam type 65–75 years old. Harvesting will be dictated by research and demonstration needs related to Otter Creek.
2001-1	AC	50	15	CC	Mature to overmature aspen, multi-aged with several portions understocked. Much of the area has poor quality birch and low value maple scattered throughout.
2001-2	RC	30	8	PC	A 30-year-old red pine plantation scheduled for its first commercial thinning.
2001-3	RC	35	5	PC	A 35-year-old red pine plantation scheduled for its first commercial thinning.

* A = aspen, F = balsam fir / white spruce, J = jack pine, R = red pine, S = black spruce; C = pole size timber, D = saw timber.

Table 5. Planned Forest Type Harvest Summary (in acres) for the Period July 1991 through June 2001.

Forest Type	Clearcut	Partial Cut	Total
Aspen	114	--	114
Red Pine	21	96	117
Jack Pine	30	--	30
Birch	16	--	16
Balsam Fir/ White Spruce	17	7	24
Black Spruce	14	--	14
Totals	212	103	315

Timber harvests will be accomplished primarily by contract loggers. Contracts specifying conventional harvesting techniques will be sold lump sum by sealed bids. Contracts specifying unique harvesting requirements for research or demonstration purposes may be sold at a negotiated price.

All areas will receive an intensive presale cruise to determine volumes, values and harvesting requirements necessary for proper forest management. Precise harvesting instructions will be included in each sale contract. Best Management Practices, as prescribed in the booklet *Water Quality in Forest Management "Best Management Practices in Minnesota,"* will be enforced on all timber sales.

REFORESTATION

Successful reforestation of final harvest areas has been one of the highest priority management activities over the past decade. It will continue to be one of the highest management priorities for the coming decade.

The future and mission of the Center is directly related to successfully reforesting cutover areas. The forest management program's mandate is to provide a variety of vegetation types to accommodate possible future research and teaching needs, within constraints of site conditions.

Natural and artificial regeneration will be used to reforest cutover areas. Natural regeneration will be the primary means of regenerating harvested hardwood stands. These are forest types consisting of aspen, birch and red maple. To date, natural regeneration of these hardwood species has resulted in well stocked regeneration of cutover areas. New artificial methods for regenerating hardwood species, such as tree shelters, will be used on a research demonstration basis as they develop.

Artificial regeneration will be the primary means for regenerating conifer types. A variety of species, stock classes, stock types and planting densities will be employed to accomplish the diversity effort of the management program. One of the goals of artificial reforestation during the 1990s will be to have all planting stock grown from known and/or improved seed sources. Table 6 lists the areas planned for harvest, the forest types of each of the areas before harvest, acres harvested and planned reforestation of the area.

The post harvest vegetation types in Table 6 are the initial target establishments. Several areas will be left, following planting, to develop into mixed species stands with minimal release treatment of planted stock. This may lead to some shifting of vegetation types. Table 7 shows total acres by forest type that will be harvested and reforested over the ten year period. It also shows the net effect on the present forest types of the Center.

SURVIVAL AND COMPETITION ASSESSMENTS

Survival and competition assessments will be made one year and three years after planting. Although initial target stocking levels will be achieved by planting, it is recognized that initial stocking levels are seldom maintained because of losses due to mortality or increases due to natural regeneration.

A wide range of stocking levels is necessary for future research opportunities. Additional plantings will be done if less than desirable

Table 6. Reforestation for Clearcut Areas for the Period July 1991 through June 2001

Area ID	Area Acres	Preharvest Area Vegetation Types (acres) *	Post Harvest Vegetation Type	Regeneration Artificial or Natural	Proposed Density Trees/Acre
92-1	20	A(14), RP(2), B(4)	Aspen	Natural	8,000 +
92-2	12	RP(12)	Red Pine	Artificial	907
03-2	14	BS(14)	Black Spruce	Artificial	680 + nat
94-1	23	A(23)	White Spruce	Artificial	907
95-1	15	JP(12), Bi(3)	Jack Pine	Artificial	680 + nat
96-1	9	A(9)	Aspen	Natural	8,000 +
97-1	14	JP(7), A(7)	Jack Pine	Artificial	680 + nat
98-1	13	A(10), Bi(3)	Aspen	Natural	8,000 +
98-2	10	JP(4), RP(4), A(2)	Jack Pine	Artificial	680 + nat
99-1	22	A(19), JP(2), Bi(1)	Aspen	Natural	8,000 +
99-2	10	JP(5), Bi(5)	Red Pine	Artificial	907
2000-1	18	A(18)	Aspen	Natural	8,000 +
2000-2	17	F(17)	White Spruce	Artificial	800
2001-1	15	A(12), RP(3)	Aspen	Natural	8,000 +

* A = aspen, Bi = birch, BS = black spruce, F = balsam fir / white spruce, RP = red pine, JP = jack pine; Numbers within ( ) are acres of that specie.

stocking is established following the third year assessment.

Where competition assessments call for broadcast control, ground spray units using approved chemical herbicide will be used. Competition control work not requiring total broadcast control will be done by backpack spraying or hand release.

Since the current Center forest management staff are licensed perticide applicators, most herbicide control work will be accomplished by them. Chemical control areas will be posted declaring such treatment immediately following the treatment.

Table 7. Harvesting and Reforest Acres by Forest Type for the Period July 1991 through June 2001.

Forest Type	Acres Clearcut	Acres Reforested	Acres Net Gain/Loss
Aspen	114	97	-17
Jack Pine	30	39	+ 9
Red Pine	21	22	+ 1
Birch	16	0	-16
Spruce/Fir	17	40	+23
Black Spruce	14	14	0
Total	212	212	—

FOREST ROADS

All natural resources require a safe and efficient road and transport system for effective utilization and management. This plan is designed to provide a safe and efficient road system to manage the resources the Cloquet Forestry Center has to offer.

The Center has 27.3 miles of roads that traverse its interior and border its perimeter. (Figure 6) Maintenance of about half these miles (16.8) is the responsibility of the Center.

After considerations of safety, access control was

the top forest roads priority during the 1980s. Following the establishment of access control in that decade, the Center has experienced significantly reduced road reconstruction and maintenance costs. Access control will continue to be implemented and maintained through the 1990s.

New priorities for the current planning period include:

- maintaining the existing road system at a safe level of operability,
- eliminating short radius curves and/or blind corners to improve travel safety,
- improving internal traffic routes within gated areas,
- improving road widths for better logging truck and tour bus access.

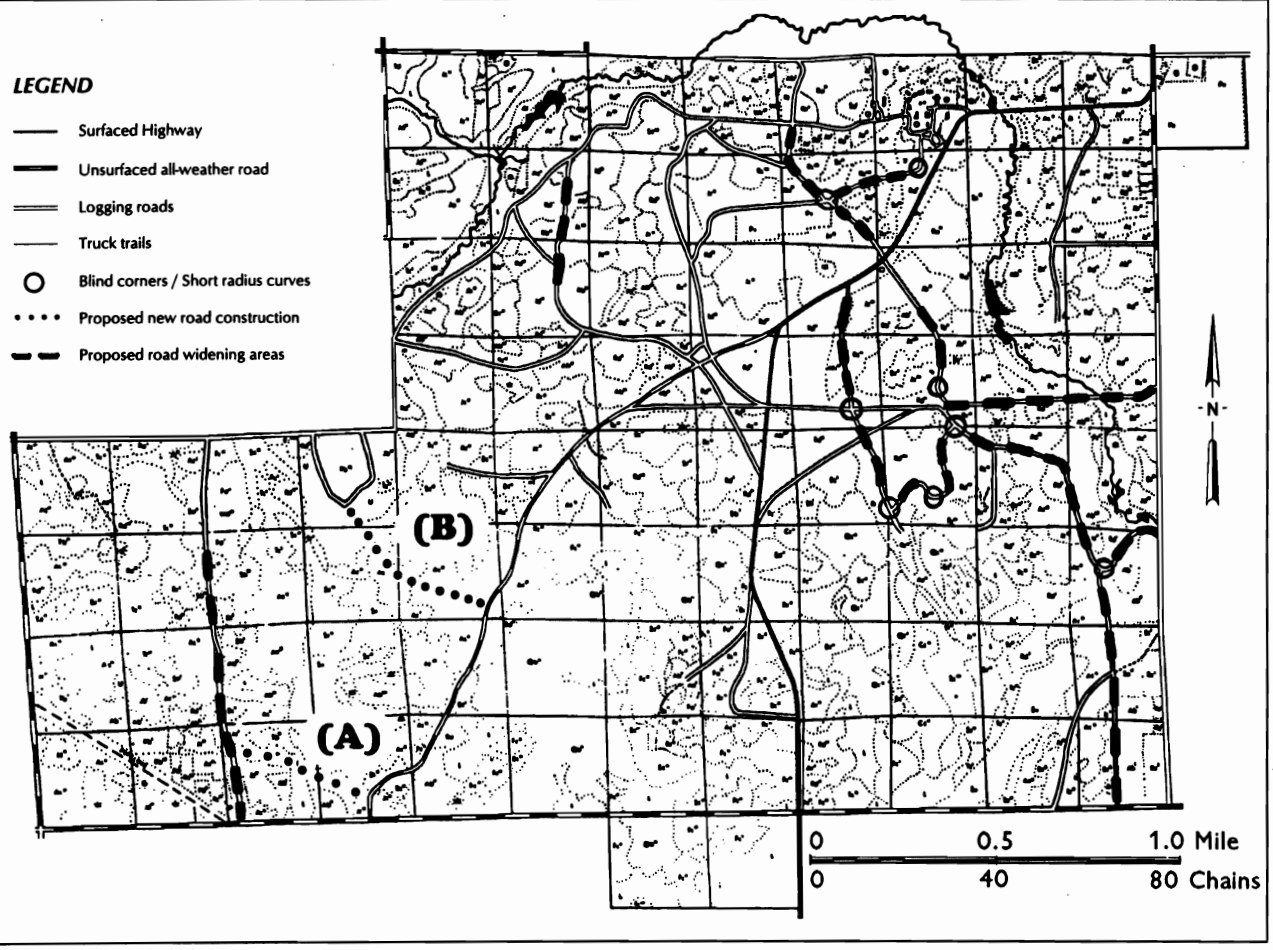
PRIORITY 1—MAINTENANCE

Maintaining the existing road system at a safe level of operability was the overall top priority during the 1980s. It will continue to be the highest priority during the 1990s. Each year the Center has seen increased use of its roads by the groups that utilize the Center. Providing safe roads is mandatory. This mandate requires a significant amount of attention and resources annually.

Approximately 40 cubic yards of surface material is required annually to spot fill washouts and repair damaged road surface areas. General road surface maintenance through grading is required on about seven miles of road annually. It is anticipated and planned that this level of maintenance will continue through the 1990s.

Maximizing visibility of access control gates has continued since they were installed. It is essential

Figure 6. Cloquet Forestry Center road system.



for safety reasons that visibility be maintained. Every gate will have grass mowed and brush removed from around it annually. All gates will be repainted every five years with high visibility safety paint, accompanied by a reapplication of safety reflector tape.

PRIORITY 2—SHORT RADIUS CURVES/BLIND CORNERS

Eight short radius curves and/or blind corners have been identified as potential travel and safety problems within the Center's road system. (Figure 6) It is planned that these eight locations be improved by extending curves in short radius situations and reconstructing or removing obstructing vegetation to eliminate blind corners. This is a major road system safety concern that needs to be accomplished.

PRIORITY 3—NEW ROADS

Access control has been of overall benefit to the forest road program. However, a drawback of the gates used to achieve this is that they hinder travel to various areas within the forest. This hinderance has caused concern about forest protection and management efficiency.

Construction of two new road segments is needed. One is a 0.3 mile segment (Figure 6–"A") located in Section 36. This segment would connect the lower section of a road known as the Bog road to the lower section of a road known as the Sawyer road. It would allow travel between those roads without having to go through two gates.

The second needed new road segment, identified as location "B" in Figure 6, is a 0.4 mile segment. Construction of this segment would allow direct access from a road known as the CCC road, on the north boundary of Section 36, to the central area of Section 31. This would reduce travel distance to 1/2 mile, from an existing travel distance of about two miles.

Construction standards for these new road sections should be equal to main haul road standards. These standards require a cleared width of 32 feet, a dozed wheel surface of 20 feet, minimum depth of ditches to be 2 feet, minimum depth of gravel 1 foot, a graveled wheel surface 16 feet wide, a minimum culvert length of 25 feet, and the minimum diameter of culverts to be 1 foot. These segments would become a permanent part of the internal road system.

A major issue for construction of these roads is the source of funding. Construction costs are estimated to be about $1,600 per 1/10 mile

PRIORITY 4—ROAD WIDENING

Improvement of road widths to accommodate log hauling semitrailers and large tour busses has been ongoing, as resources have become available. Most of the past road widening has been tied to the timber management program, letting loggers absorb the cost of road widening to get their equipment into sale areas.

This opportunistic method is cost effective, but not efficient. It is a "take it as it comes" process. Sometimes only segmented portions of a road are widened, leaving sections beyond sale areas still inaccessible to larger vehicles. If road widening resources become available, approximately 4.75 miles of forest road would be widened during the period of this plan.

RECREATION

Each year the Cloquet Forestry Center's forest becomes increasingly popular with the local public as a place for forest recreation. Although recreational use of the forest is not promoted, certain types of recreation are acceptable.

Non-motorized recreational activities such as nature hiking, biking, jogging, mushroom and berry picking, cross country skiing and horseback riding are permitted in the Center where and when they do not conflict with forest

research, teaching and management activities.

To date, the Center has not had the funding or human resources to control, direct or monitor recreational activities on the forest. Traditionally, user conflicts have been resolved by the user groups themselves with little involvement of Center management personnel. It is proposed that this procedure continue through the 1990s, unless resources and support for a formal recreation policy and program become available.

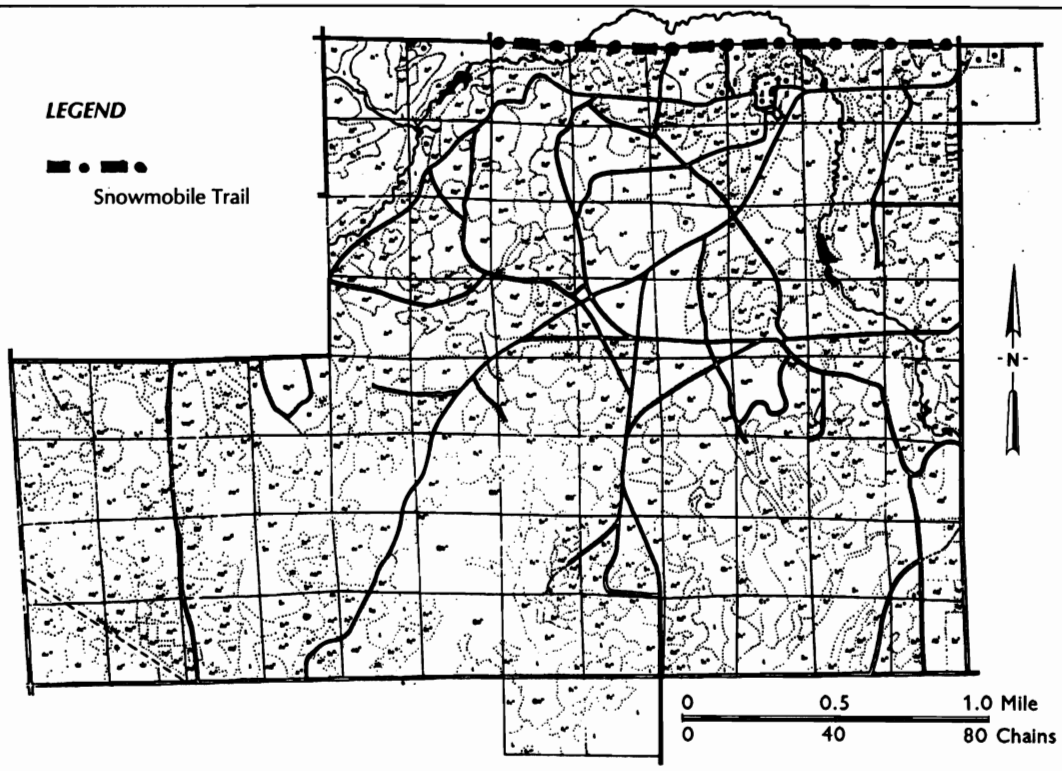
The forest has been a designated game refuge since 1924. The refuge was established to prohibit hunting. This was needed to protect a variety of wildlife, University of Minnesota personnel and students working in the woods, research plots, and Center equipment. Hunting and trapping on the forest are permitted by state law only when it is authorized by the University of Minnesota and the Minnesota Department of Natural Resources.

With the exception of a single snowmobile trail along the north boundary of the forest, no motorized recreation is permitted. (Figure 7) The snowmobile trail was established by special permit to Carlton County in 1975. Local snowmobile clubs constructed and maintain the trail, but its use will be permitted only so long as the terms of the permit are adhered to. All gated entrances to the forest are posted with signs stating that unauthorized motorized vehicles are prohibited from entering.

The policy prohibiting motorized traffic was established primarily for reasons of safety. With many blind corners on the single lane forest roads, it is difficult for one motorized vehicle to hear and see another approaching vehicle, especially if the 20 mile per hour speed is exceeded. Motorized recreation during periods of adverse weather also cause severe damage to road surfaces, increasing the difficulty and cost of road maintenance, as well as contributing to erosion and impacting water quality.

Efforts have been made to combine educational opportunities with recreational use of the forest. In 1986 a 1.6 mile self-guided walking tour route was established at the Center. The purpose of

Figure 7. Snowmobile trail location.



the tour route is to inform visitors about proper forest management techniques. In addition to general public use, many area primary and secondary school teachers have used the tour route as an outdoor classroom exercise.

The tour route will continue to be maintained through the 1990s. Tour route booklets will continue to be issued from the Center's office upon request by users. Modifications and improvements to the tour route will be implemented as needed to keep it informative and useful.

Compatible recreation will be allowed in the forest as long as there are no incidents of vandalism on the forest or to university property. As occasions arise, efforts will be made to inform the general public and surrounding landowners of what the recreational restrictions are on the forest, and why they exist.

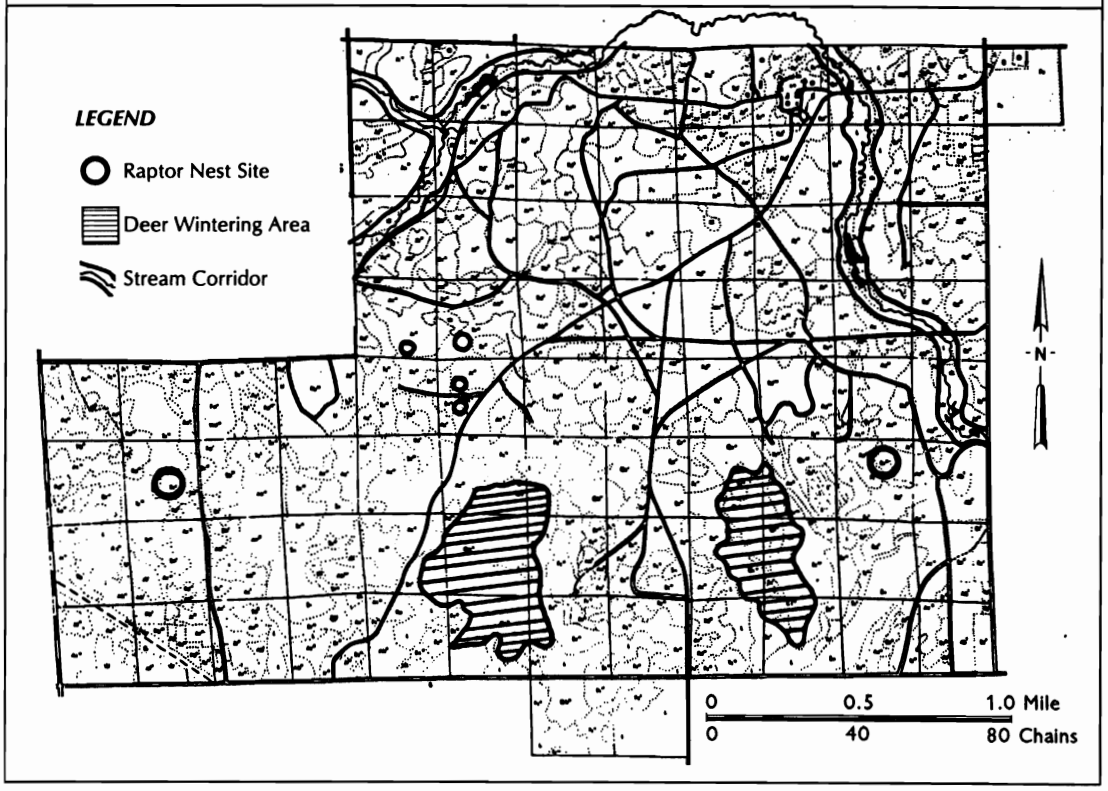
WILDLIFE CONSIDERATIONS

Timber and wildlife management have had a close relationship throughout the history of the Center and will continue to be promoted under this plan.

Various wildlife studies have been conducted at the Center. These studies have involved many species, including white tailed deer, red squirrels, snowshoe hare, woodcock, ruffed grouse and trout (Alm 1988). Among the most notable is the long running ruffed grouse research project carried out at the Center by Gordon Gullion between 1958 and 1991.

The ruffed grouse project has significantly influenced the management of the timber

Figure 8. Wildlife considerations.



resource at the Center, particularly the aspen resource. Because of the integral working relationship between the timber management program and the wildlife project, the Center has evolved into a showcase for managing aspen for grouse. Most aspen harvesting done in the 1970s and 1980s included specifications to improve ruffed grouse habitat as part of the harvesting plan. Much of this effort will continue through the 1990s.

Although ruffed grouse has been the primary wildlife consideration in the timber management program, other species have been addressed and have benefitted from management efforts. Snag management, raptor nest buffers, trout stream shading corridors, deer winter yard preserves and other wildlife considerations have been included in the management of the forest resource. Figure 8 identifies wildlife considerations such as raptor nest sites, deer wintering areas and riparian corridors that will receive special considerations when timber management activities occur near them.

Perhaps the most favorable impact on wildlife since the 1924 designation of the Center as a game refuge, is the mandate of the forest management program as outlined in the introduction. This mandate identifies the need to improve and maintain a variety of wildlife habitats. This need in part is served by other mandated needs, including providing a variety of stand vigor conditions, providing a variety of vegetation types and providing a variety of stand age classes.

The management program recognizes that no plan can manage for all species on all areas. However, accomplishing the mandate to serve the research teaching and outreach mission of the Center provides a diverse vegetation coverage for the Center—i.e. old growth areas, unique forest types, young healthy forests and overmature declining forest types. This diversity of vegetation types provides the variety of wildlife habitats that make the Center attractive for wildlife research.

The addition of the Department of Fisheries and Wildlife to the College of Natural Resources in 1983 has created new opportunities for wildlife research at the Center. Fisheries and Wildlife faculty/researchers are encouraged to use the Center's forest for their research and teaching whenever possible.

APPENDIX A

CURRENT CLOQUET FORESTRY CENTER MISSION

The mission of the Cloquet Forestry Center is to provide quality field based natural resource education, research and outreach opportunities for students, scientists, professionals, and the general public.

PRE-1993 CLOQUET FORESTRY CENTER MISSION

The mission of the Cloquet Forestry Center is to provide instruction, research, and extension and continuing education to the natural resources community, including both professionals and the lay public. Major emphasis is placed on programs relevant to northeastern Minnesota but which often have regional, national, or even world-wide application.

APPENDIX B

ADDITIONAL READINGS

Allison, J. H., R. M. Brown. 1946. *Management of The Cloquet Forest: Second Ten-Year,* University of Minnesota Agricultural Experiment Station, Technical Bulletin 171. 95p.

Alm, A. A. 1988. *Cloquet Forestry Center Research Papers and Reports for the Seventy-Five Year Period From 1912-1987.* University of Minnesota Agricultural Experiment Station, Miscellaneous Publication 55-1988. 44p.

Brown, B. A. 1960. *Cloquet Forest Research Center.* Unpublished Brochure. 18p.

Hanson, T. S., J. H. Allison, R. M. Brown, E. G. Cheyney, H. Schmitz. 1936. *The Cloquet Forest, A Demonstration of Practical Forestry in Northern Minnesota,* University of Minnesota Agricultural Experiment Station, Technical Bulletin 112. 84p.

Investigative Program Cloquet Forest Experiment Station 1926-1927. United States Department of Agriculture, Forest Service, Government Printing Office 8-5156. 105p.

Kenety, W. H. 1917. *Report of Cloquet Forest Experiment Station,* University of Minnesota Agricultural Experiment Station Bulletin 169.

Moeur, M., A. R. Ek, D. W. Rose. *1980 Assessment of the Growth and Yield Potential of the Cloquet Forest With a Computer-Based Growth Projection Model.* Staff Paper Series Number 15. 47p.

Schantz-Hansen, T. 1931. *Forestry as Practiced on the Cloquet Forest.* University of Minnesota, Department of Agriculture, Division of Forestry. Unpublished. 124p.

Schantz-Hansen, T. Circa 1960. *50 Years at the Cloquet Forest Research Center.* Unpublished. 40p.

Severs, R. W., A. R. Hallgren, A. S. Reed. 1989. *Cloquet Forestry Center Forest Management Report (1981-1986),* University of Minnesota Agricultural Experiment Station Bulletin 591-1989.

University of Minnesota, 1987. *Real Estate Inventory,* Real Estate Office, Physical Planning, Minneapolis, Minnesota. 217p.

Zasada, Z. A. 1981. *Forest Management Plan 1981-1990 For the Cloquet Forest,* Cloquet Forestry Center, University of Minnesota, Unpublished 26p.

APPENDIX C

MINNESOTA DEPARTMENT OF NATURAL RESOURCES OLD GROWTH GUIDELINES

SUMMARY

The purpose of the old growth guidelines is *to provide DNR resource managers with a means to identify and reserve candidate old growth forest stands on state lands until an evaluation of the stand's old growth quality can be completed.*

The guidelines identify the following general characteristics for old growth forests in Minnesota:

- stands have developed over a long period of time essentially free from catostrophic disturbances.
- large, very old trees of long-lived species that are far beyond economic rotation age.
- frequent ongoing tree mortality, including some mortality in canopy trees.
- relatively high frequency of large dead trees (snags).
- large-diameter, downed logs in various stages of decay.

The quidelines also contain characteristics for selecting candidate old growth stands using the DNR Cooperative Stand Assessment (CSA, formerly Phase II inventory). Specific characteristics are included for forest types that will develop into old growth communities if they escape catastrophic disturbance for a long time.

- Black Ash
- Northern Hardwoods
- Red and White Pine
- Upland White Cedar
- Lowland Hardwoods
- Oak, Central Hardwoods
- White Spruce

Lowland Conifers is also identified as an important old growth forest type. Specific characteristics are not provided in the guidelines because of insufficient data.

CRITERIA COMMON TO MOST TYPES

- At least 120 years old (90 years for white spruce)
- Average diameter of 10", 15" in southern Minnesota (20" for red and white pine).
- Little or no evidence of cutting, salvage or timber stand improvement.
- Generally 20 acres in size.

The guidelines also recommend the identification of *potential replacement old growth stands* for the oak/central hardwoods, red pine, and white pine forest types in acreage equal to or greater than that certified as old growth for each of these types. Criteria for selecting replacement stands is similar to candidate old growth criteria, except that potential replacement stands will come from younger age-classes and have smaller average diameters.

Management of candidate and potential replacement old growth stands during the evaluation period specifically excludes harvesting, wildlife opening and browse regeneration developments, road and trail development, any forest development work, and the use of pesticides (except to protect adjacent forests from serious exotic threats).

The guidelines also recommend the following management practices for stands adjacent to candidate old growth stands wherever feasible:

- management for understory species.
- all-aged management prescriptions.
- management of shade-intolerant species on extended rotations.
- buffers of 1.5 times the average three height when clear-cutting adjacent stands.

- limit clear-cutting to no more than 25% of the perimeter of candidate stands during a 10-year period.

Evaluation of candidate and potential replacement old growth stands will be carried out by resource professionals under the direction of the DNR Natural Heritage Program. Evaluations will determine whether candidate and potential replacement stands are certified as old growth/replacement old growth or removed from the candidate/potential replacement lists with all associated restrictions lifted.

Recommendations to remove stands from the candidate and potential replacement old growth lists will be referred to Regional Managers. Conflicts will be handled according to the process established in the DNR Wildlife-Forestry Coordination Policy.

APPENDIX D

CLOQUET FORESTRY CENTER VEGETATION MAP

LEGEND

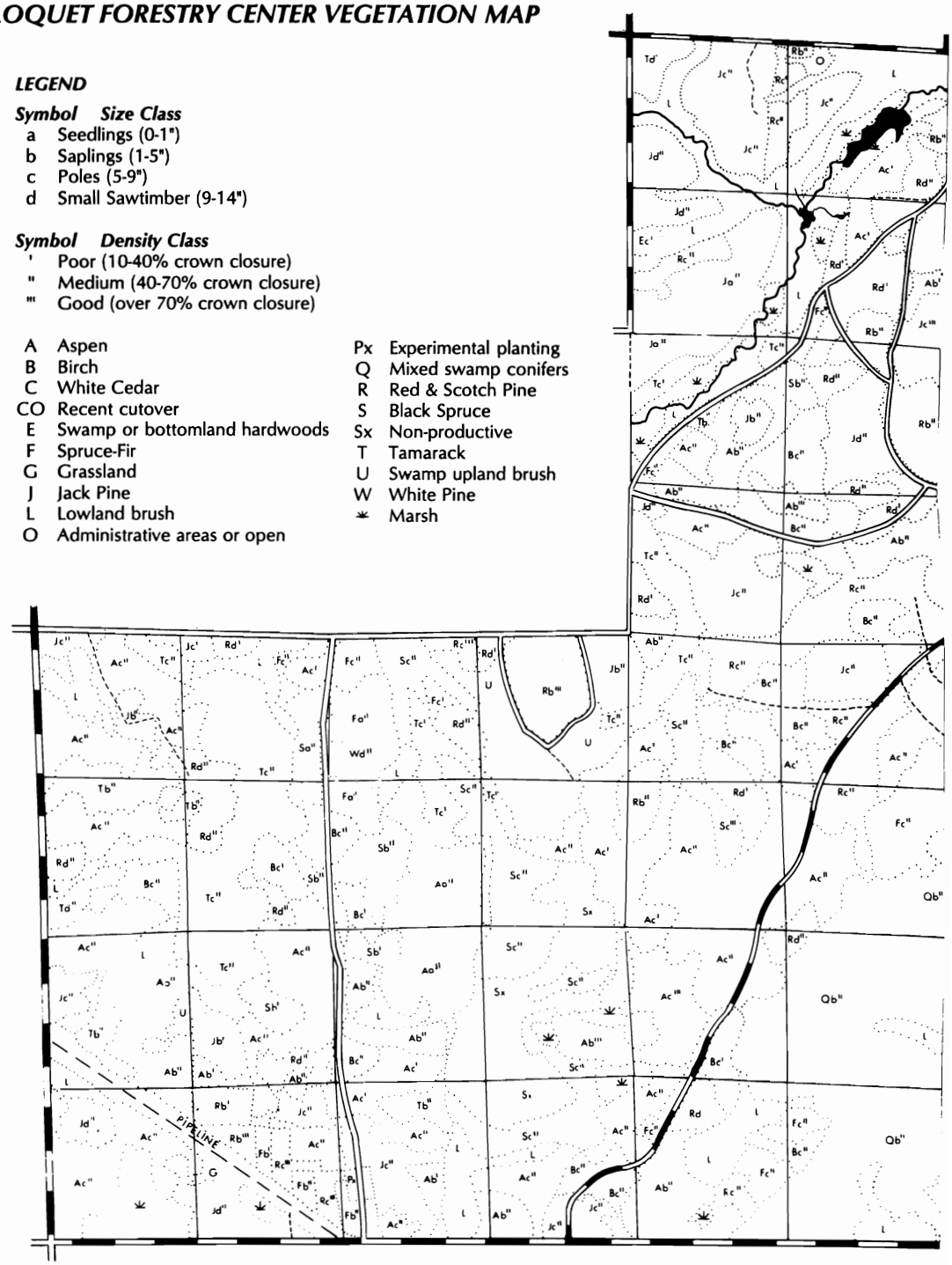
Symbol Size Class

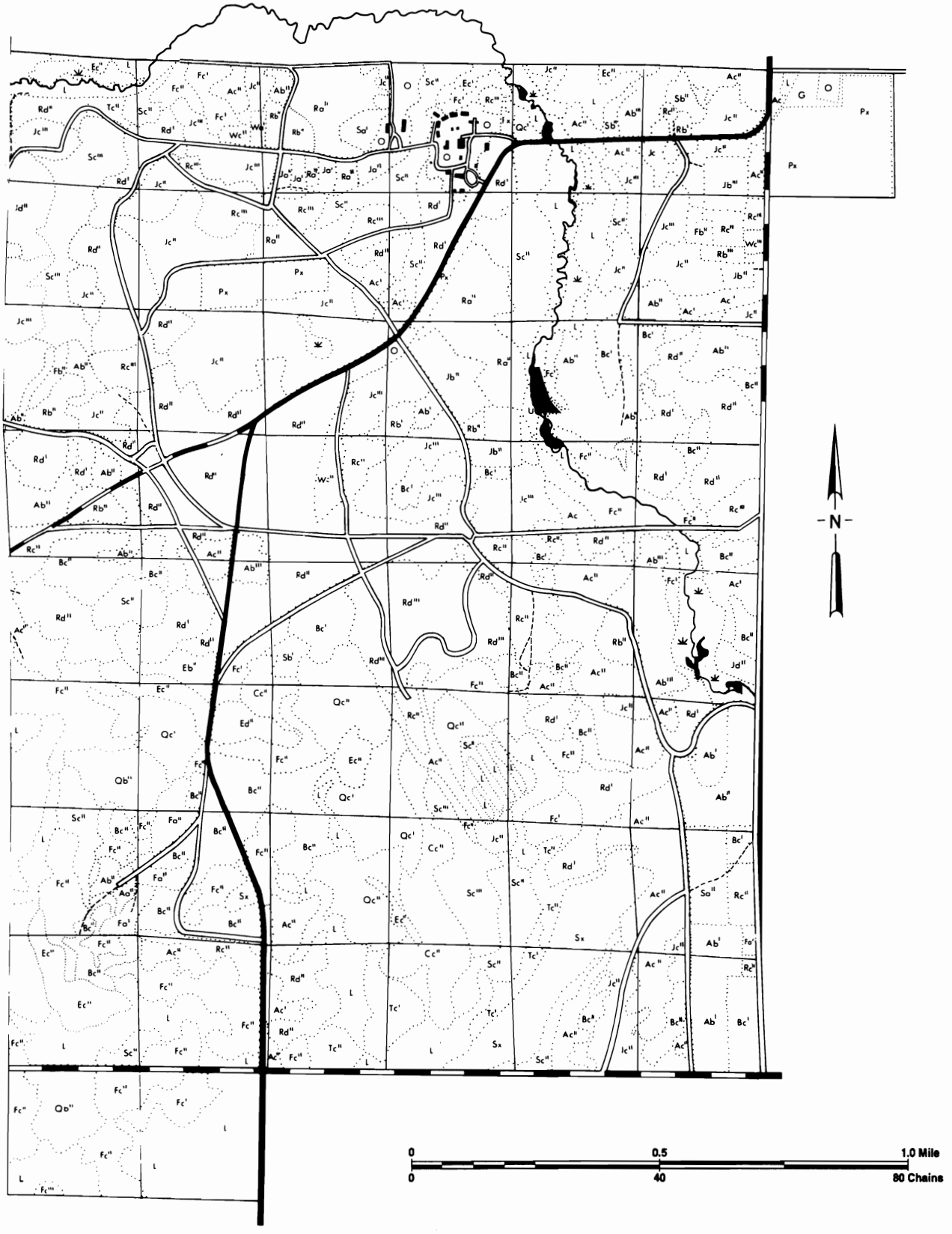
a Seedlings (0-1")
b Saplings (1-5")
c Poles (5-9")
d Small Sawtimber (9-14")

Symbol Density Class

' Poor (10-40% crown closure)
" Medium (40-70% crown closure)
"' Good (over 70% crown closure)

A Aspen
B Birch
C White Cedar
CO Recent cutover
E Swamp or bottomland hardwoods
F Spruce-Fir
G Grassland
J Jack Pine
L Lowland brush
O Administrative areas or open
Px Experimental planting
Q Mixed swamp conifers
R Red & Scotch Pine
S Black Spruce
Sx Non-productive
T Tamarack
U Swamp upland brush
W White Pine
Marsh

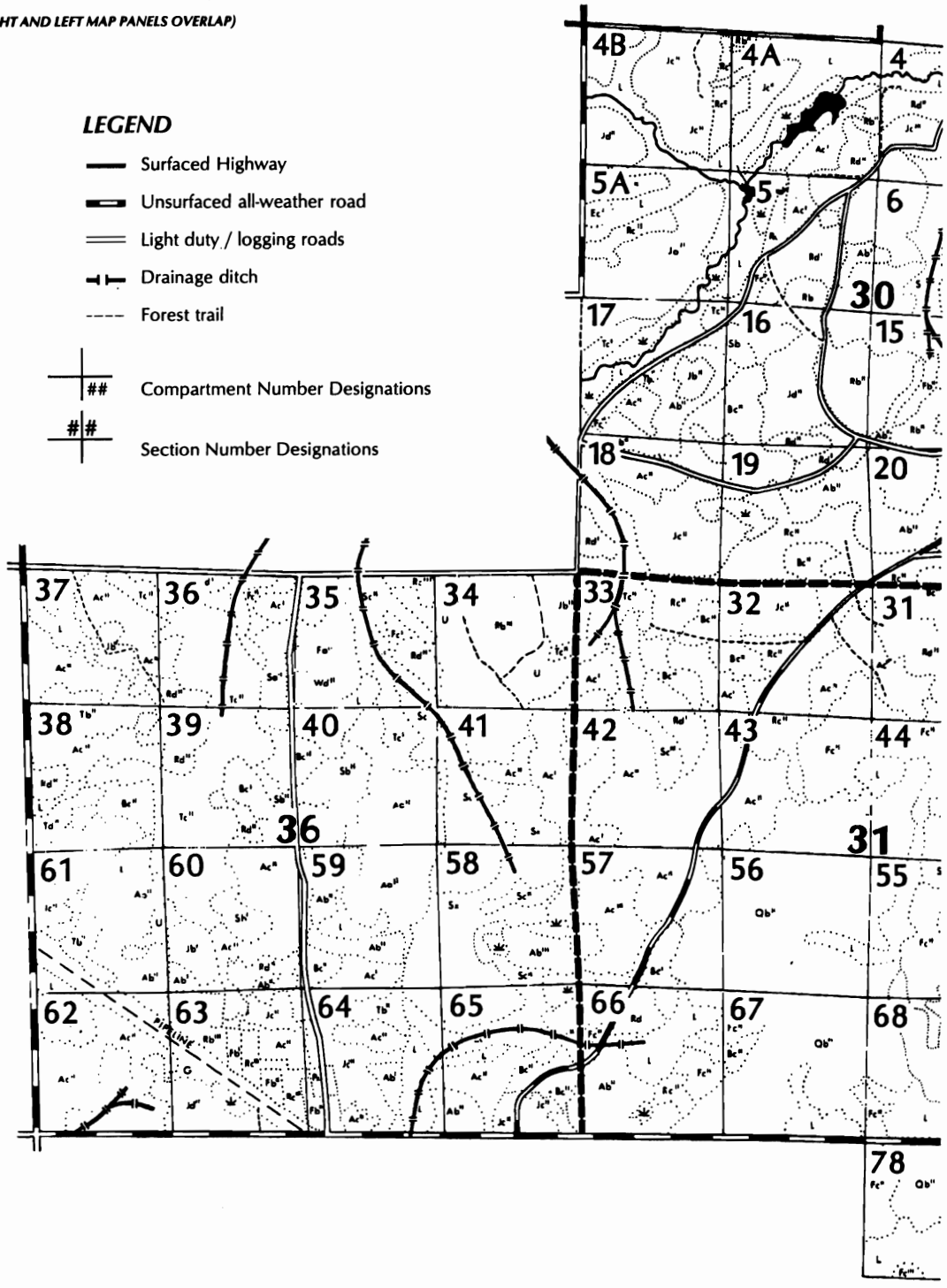


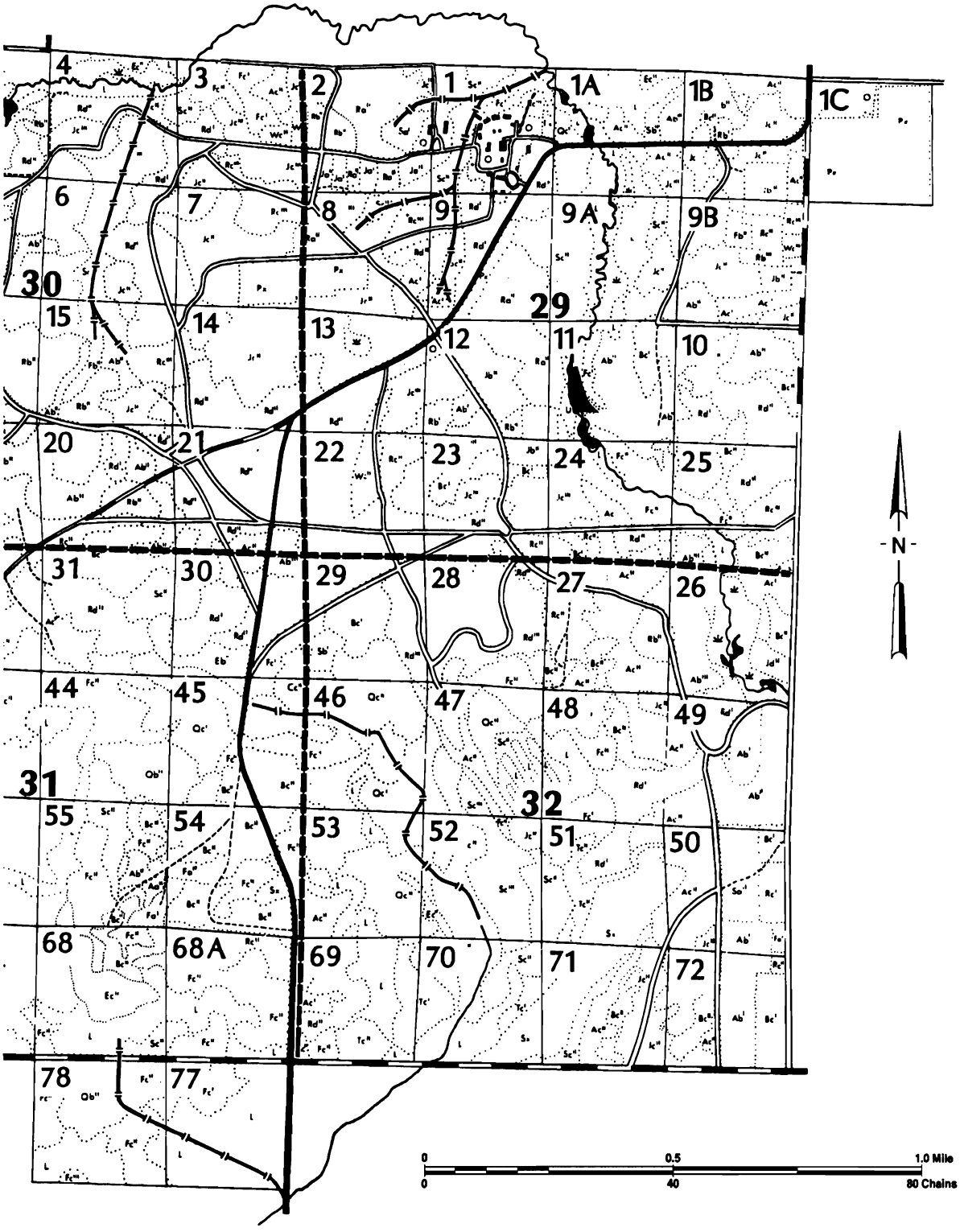

N
0
0.5
1.0 Mile
0
40
80 Chains

APPENDIX E

MAP SHOWING CLOQUET FORESTRY CENTER ROAD AND DRAINAGE SYSTEMS, AND SECTION NUMBER DESIGNATIONS

(RIGHT AND LEFT MAP PANELS OVERLAP)




4
3
2
1
1A
1B
1C
6
7
8
9
9A
9B
30
29
15
14
13
12
11
10
20
21
22
23
24
25
N
31
30
29
28
27
26
44
45
46
47
48
49
31
32
55
54
53
52
51
50
68
68A
69
70
71
72
78
77
0
0.5
1.0 Mile
0
40
80 Chains