

**ROSEAU RIVER WILDLIFE MANAGEMENT AREA
MASTER PLAN 1980-1989**

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St. Paul, Minnesota
December 1980**



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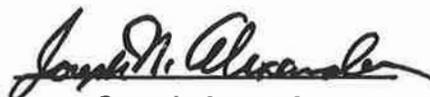

**Commissioner of
Natural Resources**

TABLE OF CONTENTS

PREFACE	i
TABLE OF CONTENTS	ii
INTRODUCTION	1
Description	1
Legal Purpose	2
Long-range Goals	2
HISTORICAL AND ARCHAEOLOGICAL ASPECTS	2
Local History	2
Wildlife Management Area History	3
Archaeological Aspects	3
Historical Sites	3
RESOURCE INVENTORY	4
Abiotic Resources	4
Climate	
Geology	
Soils	
Underground Hydrology	
Watersheds	
Biotic Resources	13
Vegetation	
Birds	
Mammals	
Fish	
OPERATIONS	21
Administration and Fiscal	21
Capitol Improvements	22
Equipment	23
Staff	23
LAND OWNERSHIP	27
Acquisition of Wildlife Lands	27
Acquisition of the Present WMA	27
Juneberry Supplement to the WMA	28
PUBLIC USE	29
Hunting	29
Trapping	32
Fishing	32
Other Recreational Activities	32
Visitor Characteristics	34
Agricultural Leases	34

LOCAL PERSPECTIVE	35
General	35
Adjacent Development	37
Roseau River Flood Control Project	37
 RECREATION DEMAND AND CAPACITY	 39
Demand	39
Capacity	40
 MANAGEMENT PROGRAMS	 41
Wetland Management	41
Objectives	
Considerations	
Past and Present Programs	
Future Programs	
Forest Management	45
Objectives	
Considerations	
Past and Present Programs	
Future Programs	
Non-Forested Upland Management	49
Objectives	
Considerations	
Past and Present Programs	
Future Programs	
Canada Goose Management	51
Objectives	
Considerations	
Past and Present Programs	
Future Programs	
Nongame Management	53
Objectives	
Considerations	
Past and Present Programs	
Future Programs	
Public Use Management	54
Objectives	
Considerations	
Past and Present Programs	
Future Programs	
Research and Surveys	57
Objectives	
Considerations	
Past and Present Programs	
Future Programs	
Juneberry Supplement — Management, Administration, and Acquisition	59
Objectives	
Considerations	
Past and Present Programs	
Future Programs	
 SUMMARY OF MANAGEMENT PROGRAMS	 61
 IMPLEMENTATION AND COST ESTIMATES	 62
Land Costs	62
Management Programs and Costs	62
Management Area Funding	65
State Planning Agency Review	65

LITERATURE CITED	66
APPENDIX A. The Minnesota Outdoor Recreation System	69
APPENDIX B. Soil types, agricultural capability, and acreage on the Roseau River WMA	70
APPENDIX C. Water quality classification of intra- and interstate streams in the Minnesota portion of the Roseau River basin	71
APPENDIX D. Water chemistry measurements from six sites on the Roseau River WMA, 1978	71
APPENDIX E. Common and scientific names of plants mentioned in the text	72
APPENDIX F. Vegetative composition of the Roseau River WMA, Juneberry supplement and proposed additions and deletions	74
APPENDIX G. Roseau River WMA public use survey; methods, analysis, and results	74
APPENDIX H. Wildlife/Forestry coordination policy	79
APPENDIX I. Regulations relating to the public use of wildlife management areas, Commissioner's Order No. 1961	81
APPENDIX J. Acreage, ownership, and acquisition priority of private land in the Roseau River WMA project proposal	83
APPENDIX K. Map pocket	85

INTRODUCTION

Minnesota has an abundance of natural resources. To many people, Minnesota's wildlife management areas and their associated wildlife and plant communities are among the state's most precious resources. In accordance with the Outdoor Recreation Act of 1974, this master plan outlines the management of the Roseau River Wildlife Management Area (WMA) through 1989. The plan was developed by defining goals, examining existing conditions, identifying management considerations, and then developing appropriate management programs.

DESCRIPTION

The 61,333-acre Roseau River WMA is in northwestern Minnesota, near the city of Roseau (Figure 1). The unit lies within a flat, poorly drained, agricultural region. Where drainage is possible the land is utilized for cash crops. Extensive brush and forest areas with poor drainage or poor soils are scattered throughout the vicinity.

The unit is low and flat, and the vegetation is dominated by sedge meadows and lowland brush with smaller areas of cropland and coniferous forest. The

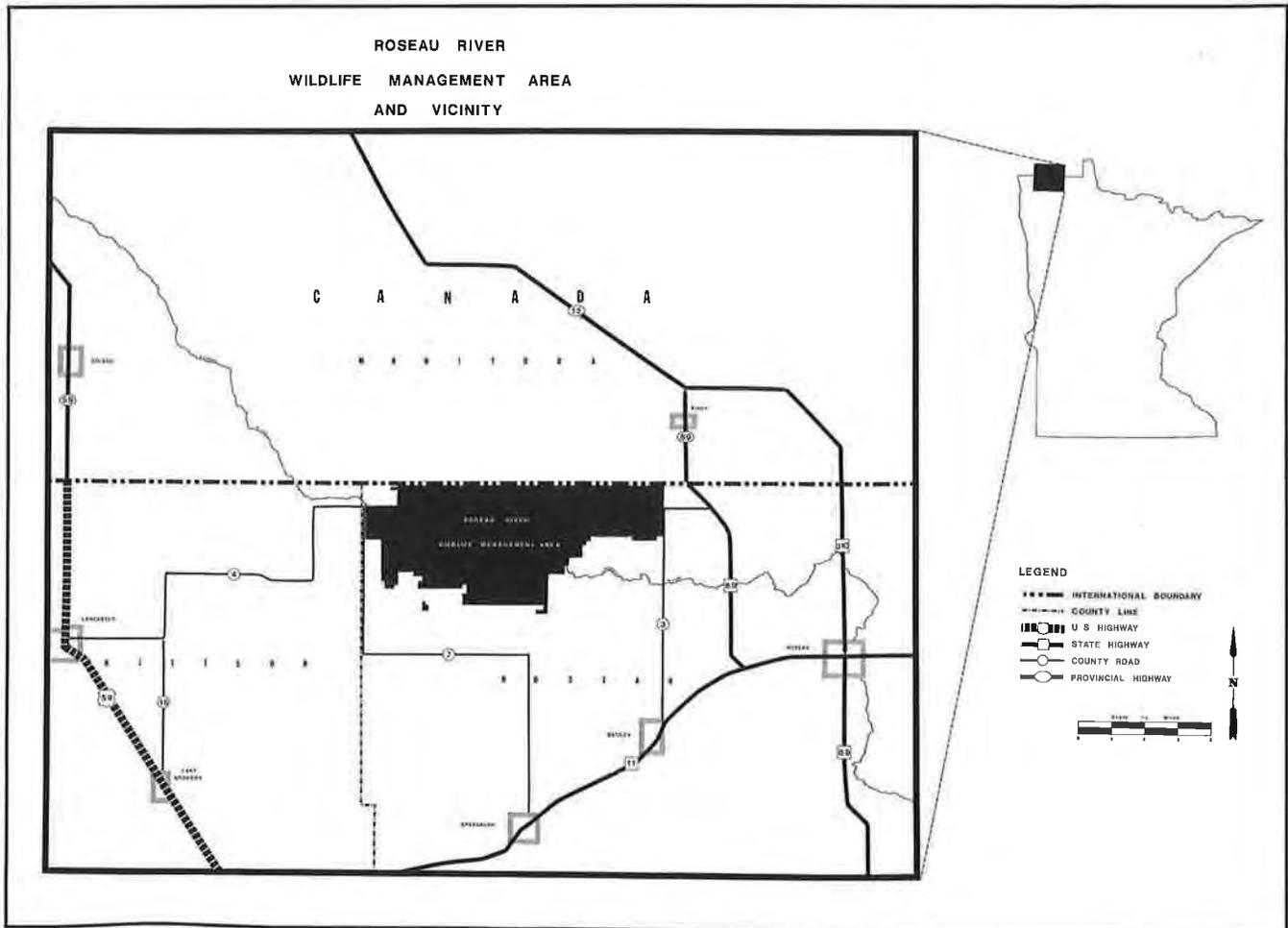


Figure 1

Roseau River flows west for 14 miles through the unit. Three impoundments, totaling 10,600 acres have been constructed north of the river. Water is supplied for these pools through a seven-mile long diversion channel from Pine Creek in Manitoba, Canada.

The unit was developed to maintain and improve habitat for resident and migrant ducks and geese and to provide public hunting. Three wildlife refuge areas provide 7,000 acres of feeding and resting area for migratory waterfowl and other wildlife. The rest of the unit is open to public hunting.

Hunting, fishing, and trapping are the principal public uses of the management area. Other uses include wildlife observation, environmental education, and picnicking.

LEGAL PURPOSE

Minnesota's wildlife management areas are administered by the Commissioner of Natural Resources to perpetuate and, if necessary, reestablish quality wildlife habitats for the maximum production of a variety of wildlife species. These areas are land and water habitats having a high potential for wildlife production and providing opportunities for public hunting, trapping, fishing, and other compatible outdoor recreational uses (Minnesota Statutes, Section 86A.05, subd. 8, 1978).

Public lands have a limited potential for multiple recreational use. Although Minnesota has never actively encouraged the multiple recreational use of wildlife lands, the Commissioner of Natural Resources recognized that those public uses associated with the observation, interpretation, and understanding of fish and wildlife populations and habitats were recreational

uses compatible with Minnesota's wildlife management areas. The U.S. Fish and Wildlife Service has realized that national wildlife refuge goals are endangered by conflicts between the demand for recreation and the ability of the resource to accommodate the use (Pulliam 1974). The greatest contribution from our country's wildlife lands is the fostering of public uses directly associated with fish and wildlife and their habitats.

LONG-RANGE GOALS

The primary goal of the Roseau River WMA is to maintain or restore diverse, productive habitats for wildlife. The maintenance of an interspersion of marsh, grassland, and forests similar to presettlement conditions and cropland managed for wildlife will foster a diverse, productive wildlife association. Accomplishment of this goal will also perpetuate native plant and animal communities in a region where agricultural development is rapidly destroying the remaining natural areas.

Paralleling the primary goal, the area will be managed to provide public use consistent with the purpose of wildlife management areas. The area will be developed to provide opportunities for activities which are directly oriented towards wildlife and fish. Since taxes on sportsmen have paid for most of the development and management of the Roseau River WMA, the primary concern of the unit will be to provide quality public hunting, trapping, and fishing. People densities will be maintained at levels which will prevent excessive interference among users and will not endanger wildlife populations.

HISTORICAL AND ARCHAEOLOGICAL ASPECTS

Historical knowledge is valuable to natural resource management. Many of the land use problems and attitudes toward natural resource use arose with settlement of the region. An understanding of the historical use of an area's natural resources, the strong points and shortcomings of these practices, and the policies regarding natural resource use is necessary to develop a comprehensive management plan.

LOCAL HISTORY

In the early 1700's, at the time the first French explorers arrived, what is now northwestern Minnesota was occupied by Sioux Indians. However, invading Chippewas drove the Sioux from most of the Minnesota woodlands. The war between the Sioux and Chippewa began before 1600 and continued for 250 years (Wahlberg 1975). More details on Indians of the area and other aspects of local history are given by Wahlberg (1975). The land in what is now Roseau

County, along with much of northwestern Minnesota, was ceded to the United States by the Red Lake and Pembina bands of the Chippewas on October 2, 1863 (Dana et al. 1960).

The first white man to enter the Roseau Valley was apparently La Verendrye, a French Canadian trader and explorer who established a trading post on an island in Lake of the Woods in 1732. This post, named Fort St. Charles, was in existence for only about 15 years. In 1848 the Hudson's Bay Company established a trading post on the Roseau River in the vicinity of Roseau Lake (McMiller et al. 1942), but the post was abandoned in 1851 (Chapin 1943).

It was not until 1885 that Seward A. Wood, a trapper, built a cabin along the Roseau River, near the present townsite of Roseau, to become the first white settler in what is now Roseau County. Other settlers came in 1887 and 1888, mainly from the Red River Valley and the Dakotas (McMiller et al. 1942). Nearly all of them came by way of the historic Sandridge Trail, which

followed a high gravel ridge that is a former shoreline of Glacial Lake Agassiz. These early settlers were attracted by the timber, the abundance of game, hay, and pasture. They had to contend with periodic floods of the Roseau River. One flood occurred in the early 1890's, and during another flood in 1896 some families were isolated by water for six or seven weeks, with many settlers losing seeds or domestic animals (Chapin 1943).

The development of agriculture in Roseau County was stimulated by railroad construction. In 1904 the Great Northern Line was extended as far as Greenbush, and it was extended again in 1908 through Roseau to Warroad. Some of the first farms were started on the sand ridge that runs through the county. Settlement was discouraged in the northern and southern parts of the county by the large forest areas, peat bogs, and wet inferior soils. Principal crops in the early years were small grains such as wheat, oats, barley, and flax, but dairying and hay later became more important (McMiller et al. 1942).

Because of the frequent flooding and generally wet conditions in many areas of Roseau County, it was not long until agitation for drainage began. At the request of the Board of County Commissioners of Roseau County, a civil engineer prepared, in 1896, a report "... for the purpose of determining the most practicable plan of drainage of the low lying lands in your county, together with suggestions and estimates for the same ..." (Ralph 1897). He proposed a project that would increase drainage on nearly 120,000 acres and would include deepening a portion of the Roseau River, digging some large drainage ditches, and digging a system of smaller ditches along section lines.

Much of the proposed drainage project was completed from 1904 to 1918, with drainage assessments being levied against the landowners who were to benefit. The earlier drainage projects, which were designed to drain some of the better land, were largely successful. Many of the later projects that attempted to drain the peatlands were not successful in creating land that could be farmed. As a result, the landowners were unable to meet the drainage assessments, and the county assumed the indebtedness (McMiller et al. 1942). The burden became too great for the county, and the Board of County Commissioners, as stipulated by state law (Minnesota Laws 1931, Chapter 407), proposed that the state take over a large area of swampland in Roseau County and assume the bonded indebtedness that went with it (Dana et al. 1960). The state did so in the early 1930's.

WILDLIFE MANAGEMENT AREA HISTORY

The idea of establishing a game refuge and public hunting area in Roseau County began in 1938. It was then that Minnesota received its first money under the Pittman-Robertson (P-R) Act, which levied a federal excise tax to aid wildlife management. For several years, the allotment under this act was too small to undertake such a large project, but by 1946, the state's P-R apportionment had almost quadrupled, and interest in the Roseau Project was revived. Several local people helped to generate interest in the project. The area and the proposed project were described by J. Donald Smith, December 12, 1946, in a report entitled "Report of the Preliminary Survey of a Proposed Public Shooting Ground in Roseau County." The Division of Game and Fish, in April of 1948, submitted a proposal to the U.S. Fish and Wildlife Service to use Pittman-Robertson funds to acquire and develop land

for the Roseau River Wildlife Management Area. The proposal was approved, and acquisition began in 1949. By 1952, almost 53,000 acres were in state ownership and under Game and Fish supervision. Additional purchases in 1969 brought the total acreage to 61,333 acres.

The construction of the Roseau River pools is the largest wildlife development project undertaken to date by the DNR. Twenty-seven miles of dikes were constructed in 1952 and 1953, forming three impoundments totaling about 10,600 acres. To provide an adequate water supply for the waterfowl impoundments, the Pine Creek diversion ditch was constructed in 1952. This project was requested and financed by the State of Minnesota, although construction work in Canada was done by the Province of Manitoba. Since completion of the dikes in 1953, most of the dikes have been widened and strengthened and five water control structures have been added to help in managing water levels.

ARCHAEOLOGICAL ASPECTS

No archaeological sites are recorded for the Roseau River Wildlife Management Area, although several sites have been found along the Roseau River elsewhere in the county. The State Archaeologist felt that the chances of finding archaeological surface sites in the large bog areas of the WMA were very slim, but that buried bison kill sites in the peat were probable. He recommended that personnel involved in ditching or diking be advised of the possibility of buried sites and be asked to stop work if any are found and notify the State Archaeologist or the Minnesota Historical Society (Johnson 1977).

In a 1973 assessment of the archaeological sites of the area for the U.S. Army Corps of Engineers, Bares et al. (1973) reported that residents near the Roseau River had observed burial mounds scattered along the river banks. The report implied that the project area should be surveyed and prehistoric sites should be inventoried before construction.

In early June of 1973, the University of North Dakota Archaeological Survey Team conducted a survey along the Roseau River from the Village of Roseau to the Canadian border (Reid et al. 1974). A one-half mile wide corridor, centered on the river, was surveyed to assess the impact of the proposed U.S. Army Corps of Engineers flood-control project. An area 10 to 15 miles long which is in the Roseau River Wildlife Management Area was impossible to survey on foot and was instead spotchecked by boat. The survey team examined seven "occupation sites" and two probable burial sites, but none of these were located on the wildlife management area. Within the WMA most of the land along the Roseau River is low, marshy peatland (McMiller et al. 1942), so the occurrence of archaeological sites is unlikely.

HISTORICAL SITES

The Minnesota State Historical Society and the Roseau County Historical Society were consulted for locations of historic sites on the area. There are no known historical sites in need of special management consideration.

RESOURCE INVENTORY

An inventory of the resources and conditions in the area is essential to developing comprehensive management programs. The resources can be divided into two classes, abiotic and biotic. While each category influences the other, the abiotic conditions generally determine the diversity, distribution, and density of the biotic resource. Examination of the existing resources in conjunction with the habitat requirements, population dynamics, and behavior of game and nongame wildlife is needed to develop programs for the sustained production and use of these populations.

ABIOTIC RESOURCES

Climate. Weather data were compiled from the reporting station at Roseau, 15 miles southeast of the management area (Table 1). The climate of the Roseau River WMA is characterized by short, mild summers and long, cold winters. Average temperature for July is 66.9°F and for January 0.0°F. Winter temperatures of -40°F are common. The average growing season is 110 days. Killing frosts are expected from September

15 through May 28. Low-lying areas may experience frost throughout the summer.

Average yearly precipitation is 20.87 inches, ranging from 0.36 inches in February to 3.54 inches in July. About 15 inches, or 75 percent of the annual total occurs from May to September. Northwestern Minnesota is one of the driest regions in the state, and severe droughts occur every six to eight years. The last drought occurred in 1976-77. Average yearly snowfall is 35.5 inches, and snow cover is one inch or greater for about 110 days per year. Prevailing winds are northwest during the winter, changing to the south and southwest during the spring and summer.

Geology. There are no exposures of bedrock in the Roseau River Basin, but two types of bedrock occur in the management area. Most of the area is underlain by undivided Ordovician rocks, mainly carbonate rocks, while the eastern part of the area is underlain by undivided metavolcanic rocks (Sims 1970). Bedrock is not known to lie more than 250 feet below the surface anywhere in Roseau County. At two sites within five miles of the WMA the bedrock was 130 and 225 feet deep (Allison 1932).

Table 1. Temperature, precipitation, and snowfall for Roseau, Minnesota, 1951-74.¹

Month	Average Temperature (°F)	Average Precip. (Inches)	Average Snowfall (inches)
January	0.0	0.58	7.8
February	7.0	0.36	4.4
March	20.0	0.63	5.8
April	39.1	1.38	3.0
May	52.2	2.47	0.4
June	62.4	3.30	0
July	66.9	3.54	0
August	65.2	3.17	0
September	54.5	2.65	0
October	44.6	1.32	0.9
November	25.6	0.77	6.0
December	9.4	0.70	7.2
Yearly Average or total	37.2	20.87	35.5

¹Source: National Oceanic and Atmospheric Administration (1977).

The depth of glacial drift overlying the bedrock ranges from less than 100 feet in the eastern part of the watershed to 300 feet in the western part. On the WMA the drift thickness is about 100 feet under the east end and about 250 feet at the west end. The drift is largely till, a variable mixture of clay, silt, sand, and gravel that is largely calcareous, sandy, clay containing pebbles and cobbles.

The following discussion of the geologic history of the area is taken from Reid et al. (1974). The surface of the Roseau River basin resulted from geologic action over the past 11,000 years. At the start of this period, the last major Pleistocene ice was receding northward, depositing a layer of glacial till and outwash. Glacial Lake Agassiz formed when water from the melting ice and precipitation was trapped between the higher land to the south and the ice to the north. The lake first drained southward. However, continued retreat of the glacier uncovered new outlets, and the lake drained eastward and finally northward. The Roseau River was formed as Lake Agassiz drained from the basin. Since that time, there has been little vertical erosion by the river, but it has moved laterally, abandoning old channels and creating new ones.

Ridges of sand and gravel, some with large boulders, mark the former shorelines of the lake. Other ridges are thought to have formed as offshore sand bars and spits. Lake silts and clays remained in the deeper portions of the Agassiz basin, particularly in the area of the Roseau River WMA. Because of the relative impermeability of these sediments, the water table is normally high. As a result, peat bogs have formed in many areas, and in some localized depressions the peat may be as much as 20 feet thick.

Wind action has also been a factor in shaping the land surface. Sand dunes, which are still present in the area, were formed by the wind soon after the lake bed was exposed. Wind erosion has tended to level some features of the landscape during dry periods in later years.

Mineral potential for the area was assessed by the Minnesota DNR, Division of Minerals (David G. Meineke, personal communication). This assessment was for the general area, rather than for the WMA itself, and did not include the potential for non-metallic minerals or for peat. The potential was rated "good" for iron, nickel, zinc, copper, lead, gold, and silver. The geologic reliability for this assessment was rated "fair" based on the bedrock geologic knowledge available.

Mining companies have expressed interest in further leases for exploration and possible mining on the state lands in northwestern Minnesota. The Division of Fish and Wildlife will not oppose mineral leases on the Roseau River WMA as long as the areas involved do not include sensitive wildlife areas such as sanctuaries, impoundments, and critical winter habitat. The division will require mitigation for, or the replacement of lands adversely altered by mining operations. The division will review leases on an individual basis for their potential impact on the natural resources of the proposed site and surrounding area. Proposals for mining operations are subject to state environmental impact statement requirements (Minnesota Statutes Section 116D.04, 1978), DNR water and mining permit procedures (Minnesota Statutes Chapter 105 and Section 93.481, 1978, respectively), and state reclamation policy (Minnesota Statutes, Section 93.44, 1978).

Sand and gravel deposits are found on some of the higher areas in Roseau County. Peat deposits in Roseau County have the potential for commercial

development. Peat and peat products are in growing demand for chemical and industrial uses, horticultural products, and alternative fuel sources. Peat supplies outside the management area are probably sufficient to supply the anticipated demand.

Soils. An extensive soil survey of Roseau County was done by the U.S. Department of Agriculture in 1934 and 1935 (McMiller et al. 1942), and the following is taken from that report and the detailed maps which accompany it. U.S. Soil Conservation Service personnel in Roseau County assisted in the Interpretation of the soil survey.

The soils of Roseau County developed from calcareous material of the late Wisconsin glaciation, nearly all of which was modified to a greater or lesser extent by the waters of Glacial Lake Agassiz. As a result of the lake, thinly bedded silts and clays form the foundation for most of the soils. Because of the relative impermeability of these layers and the resultant high water levels, large areas of peat have accumulated.

Two extensive geographic soil belts, plus a transition zone between the two, are found in the Roseau River Basin. The western part of the basin lies in the northern chernozem zone, and the eastern part, in the podzol zone. The chernozem soils formed under grass vegetation and characteristically have black or very dark gray surface soils high in organic material and nitrogen. They extend into Roseau County from the west about 15 miles including most of the Roseau River WMA. The podzol soils lie east of the transitional belt and are light-colored, having developed under forest cover. Because of the poor drainage in the county resulting from the nearly level terrain, most of the soils have poorly developed profiles. The natural fertility of much of the soil on the Roseau River WMA is quite low, and drainage is poor over much of the area.

The area occupied by each soil type on the WMA was determined by drawing the area boundaries on the soil map in McMiller et al. (1942) and the measuring the area of each type with a digitizer. The results (Appendix B) showed that about 83 percent of the WMA was on peat (including the shallow phases over clay and sand), compared to about 33 percent peat for Roseau County as a whole (McMiller et al. 1942). McMiller et al. (1942) mapped 31 soil types on the area using the soil classification system in effect at the time. Only 6.1 percent of the WMA's soils have less than "severe" limitations for agriculture (Appendix B). Most of the more productive soils are in the extreme eastern and western parts of the area. Even in the more productive soils, excess water may be a problem.

The major soil types mapped by McMiller et al. (1942) on the Roseau River WMA are shown in Figure 2. Some smaller areas are not shown because of the scale of the map.

Underground Hydrology. Because of its extensive marshes and peatlands, the Roseau River WMA is primarily a groundwater discharge area in the Roseau River watershed. The two major areas of rapid groundwater recharge in the basin are the Sandilands uplands in Canada and Beltrami Island at the southeastern end of the basin. The groundwater supply to the Bog Swamp portion (Figure 3), which includes the WMA, is primarily from the north. A part of this southwesterly subsurface flow probably bypasses the Roseau River, flowing into the Two River Basin (Winter et al. 1967).

The glacial till contains the only known aquifers in the watershed, but most deposits are too fine-grained to yield sufficient well flows. The fine-grained materials

which retain large amounts of water are major contributors to recharge of the aquifers. Buried sand deposits occur throughout the till, and wells finished in these areas tend to have the highest yields.

Precambrian crystalline rocks underlie the glacial drift throughout the entire watershed, and in the western two-thirds of the WMA a layer of Cretaceous shale, with some sand, or a layer of Paleozoic limestone, dolomite, and sandstone is found over the bedrock. These stratified sedimentary rocks are generally less than 25 feet thick and are not aquifers (Winter et al. 1967).

Most wells in the area are between 50 and 150 feet deep, and yields are usually less than 20 gallons per minute (gpm) (U.S. Army Corps of Engineers 1976). Yields of over 100 gpm have been reported, however, and two wells at Roseau yield over 200 gpm. "Dry holes" have been reported in some areas where the materials are too impermeable to yield water. Moderate supplies of groundwater for domestic, small industrial, and community supplies are available in most areas in the watershed, and there has been no widespread decline in water levels (Winter et al. 1967).

Groundwater in the Roseau River watershed is usually high in iron content, very hard, and has a wide range in total dissolved solids content. It is suitable for domestic and stock use in most places. In the vicinity of the Roseau River WMA the dissolved iron content of

groundwater ranges from about 0.3 to 1.0 parts per million (ppm), exceeding the 0.3 ppm limit for domestic consumption established by the Minnesota Pollution Control Agency (1973). Groundwater hardness at the WMA is between 100 and 300 ppm, and dissolved solids content is about 300 ppm. The deeper wells generally have a higher concentration of sulfates and total dissolved solids (Winter et al. 1967). The results of chemical analysis of water from several wells in the Roseau River watershed near Roseau River WMA are given in Table 2.

Watersheds. The Roseau River WMA lies entirely within the Roseau River watershed, which covers 2,057 square miles in northwestern Minnesota and south central Manitoba, Canada. About 60 percent of the basin is in the United States (Reid et al. 1974). The Two Rivers watershed is as close as two miles south of the WMA.

The Roseau River flows generally in a northwesterly direction and is about 180 miles long. The lower one-half of the river is in Canada. Its principal tributaries (Figure 3) and their drainage areas are the South Fork (312 square miles), Hay Creek (81 square miles), Sprague Creek (220 square miles), and Pine Creek (90 square miles). Important natural features in the Roseau River basin include Roseau Lake and the Big Swamp (Figure 3). Roseau Lake was originally a shallow, permanent body of water, but because of

Table 2. Chemical analysis of water from selected wells in the Roseau River WMA vicinity.¹

Parameters	Location of well					
	Roseau Minnesota creamery ²	Canada SW30-1-12E	Canada NW7-1-12E	Canada SW36-1-11E	Canada NE12-1-11E	Canada SE11-1-11E
Miles, dir. from WMA	13SE	2 NE	5 NNE	1 NE	5 N	4 N
Sample depth (ft.)	140	72	82	25	106	100
pH	—	7.86	7.78	8.00	7.80	7.80
Carbon dioxide	—	—	—	4	6	5
Conductance (umhos)	—	350	340	379	358	353
Total hardness	154.3	178.0	150.0	190.0	155.0	132.0
Total alkalinity	—	184	180	199	184	185
Calcium	24.0	48.0	33.6	45.3	12.1	27.2
Magnesium	23.0	14.0	16.0	18.6	30.2	15.7
Sodium	123.0	13.0	24.0	6.4	15.0	24.0
Potassium	14.0	—	—	1.9	2.1	2.6
Iron	1.9	0.16	0.06	0.19	0.28	0.21
Bicarbonate	310	224	219	242	224	226
Sulfate	118.0	19.0	2.0	7.5	5.2	3.1
Chloride	10.0	2.5	0	0.4	1.0	1.4
Fluoride	—	—	0.46	0.2	.3	0.4
Nitrate	tr ³	0.0	—	0.1	0.8	0.7
Silica	11	—	—	23	23	23
Sum of constituents (total dissolved solids)	512.0	220	280	223	200	209

¹ All units except pH as milligrams/liter unless otherwise noted.

² From Allison (1932). Other data from International Roseau River Engineering Board (1975, Appendix B, Section 1).

³tr = trace (less than 0.1 milligram/liter).

ROSEAU RIVER WATERSHED

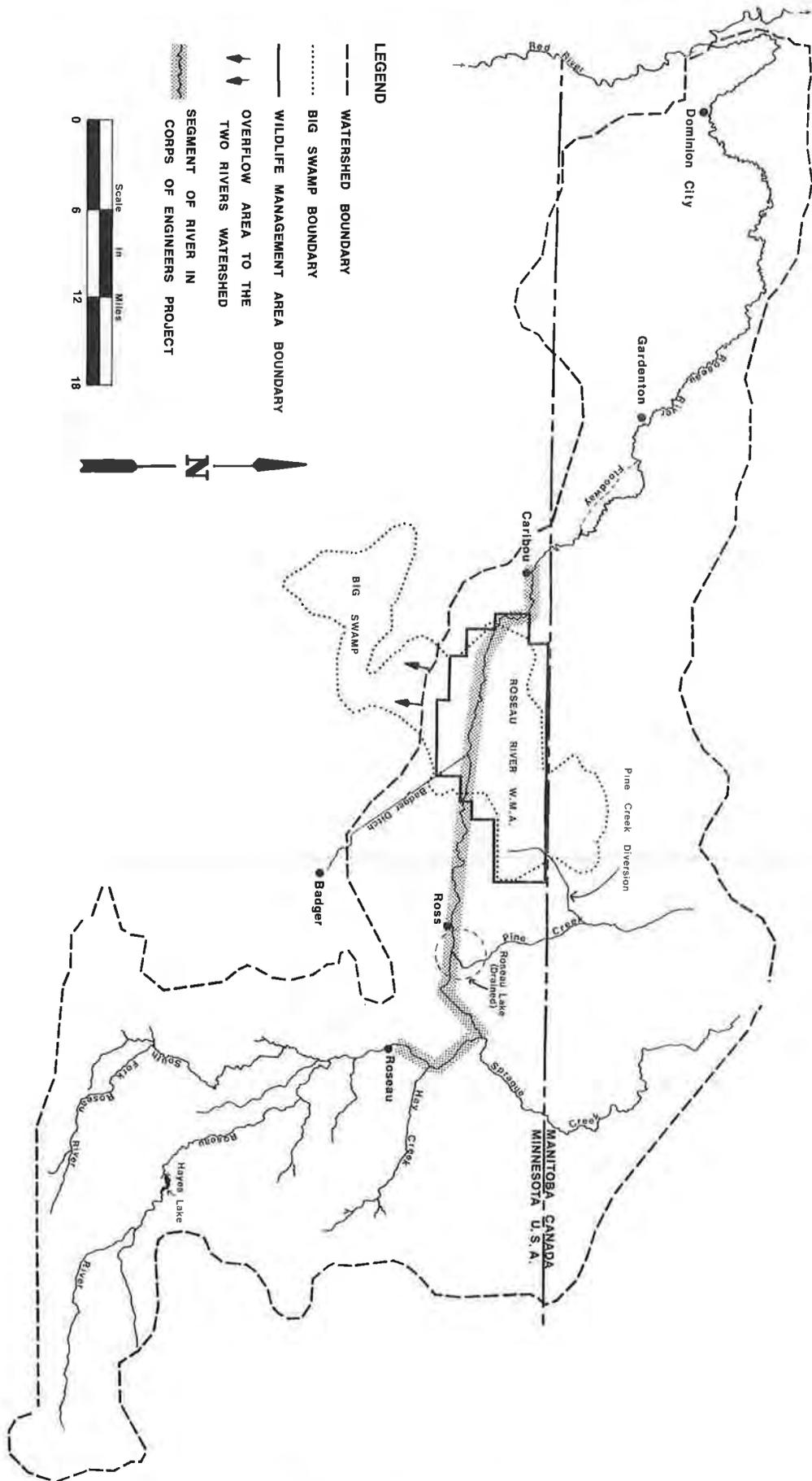


Figure 3

ditching and channel enlargement it now holds water only during flood periods. It acts as a natural retarding basin during floods and has been known to have an area of water as great as 40 square miles (Reid et al. 1974). Substantial natural storage is also provided in the Big Swamp. Originally most of the Big Swamp area south of the Roseau River drained to the south into the Two Rivers watershed. Drainage ditches were constructed in the early 1900's to drain the southern portion of the Big Swamp north into the Roseau River (Minnesota Department of Natural Resources 1978).

Stream gradients of the Roseau River vary widely. Upstream from Roseau the slope is about 17 feet per mile, but the slope decreases considerably below Roseau, especially through the Big Swamp, where it is only 0.2 foot per mile. At Roseau the river is about 20 feet deep and 125 feet wide. Between Roseau and the Canadian border, the river increases to about 170 feet in width and is generally between 10 and 20 feet deep. However, the river is only about seven feet deep as it passes through the Big Swamp, and in this area a discharge of about 700 cubic feet per second (cfs) will fill the channel to the top of its banks (U.S. Army Corps of Engineers 1964). On and near the Roseau River WMA, the Roseau River is easily navigable to canoes and motorboats most of the time, but during periods of low flow, shallow water and rocks make travel by motorboat difficult.

Several dams have been constructed on the Roseau River and its tributaries. Low concrete dams at the cities of Roseau and Dominion City impound water for municipal use but have little or no effect on the flow of the river. The Arbakka Dam in Canada diverts the Roseau River into the six-mile-long Gardenton Floodway, which begins about two miles north of the international boundary. This floodway has relieved flooding on nearby agricultural lands, but it has also increased maximum flood flows at and downstream from Gardenton by up to 20 percent.

The Hayes Lake Dam, an earthen dam on the Roseau River about 20 miles southeast of Roseau, created a 187-acre lake. The dam causes a slight reduction in spring flood flows, but below the junction with the South Fork the effect is negligible (International Roseau River Engineering Board 1975, Appendix B, Sect. 1). A dam on Pine Creek in Canada diverts water through a channel to the Roseau River WMA (U.S. Army Corps of Engineers 1976).

Three impoundments (Figure 4, page 25), totaling about 10,600 acres, were constructed in the early 1950's on the Roseau River WMA by the Minnesota

Department of Natural Resources. Diversion of water into the pools from Pine Creek began on June 17, 1953. The diversion dam in Pine Creek consists of an earthen dike with an 18-inch gate-controlled culvert. The seven-mile-long diversion channel is designed for a maximum flow of 600 cfs (Minnesota Department of Natural Resources 1978). Water from the diversion ditch flows into Pool 1, Pool 2 is filled by overflow from Pool 1, and Pool 3 is filled from Pool 2. The overflow from Pools 2 and 3 runs into the Roseau River through several indistinct channels. The flow leaves each successive pool by discharge over fixed-crest spillways at elevations of 1036, 1029, and 1024 for Pools 1, 2, and 3, respectively (U.S. Army Corps of Engineers 1964).

When filled to the spillway elevations, Pools 1, 2, and 3 cover about 2,300, 4,600, and 3,700 acres, respectively. The deepest water, other than the ditches, is about five feet. Emergent vegetation has taken over much of the shallow areas of the pools, and open water remains in only small portions of them. The total storage capacity of the three pools is about 22,500 acre-feet (Table 3). Pool 1 contains many burnouts in the peat which occurred in dry years before the pool was flooded. Peat was burned to a depth of 1 to 1.5 feet below the pool bottom. The burnouts start about three-quarters of a mile east of the west end of the pool and become larger and more numerous toward the east (Norberg and Quaal 1953). The largest of these burnouts, Pine Creek Pothole, is 210 acres in size and was the largest pool on the area before the three impoundments were constructed (Fashingbauer 1949). All three pools can be navigated with a motorboat, but travel is often difficult because of shallow water or dense submergent or emergent vegetation. Dense emergent vegetation growing in shallow water makes large areas of each pool virtually inaccessible.

It has been estimated that the diversion of water into the WMA pools may result in a reduction of up to 4 or 5 percent in flood peaks at the town of Caribou (International Roseau River Engineering Board 1975, Appendix B, Sect. 1).

Other than the three impoundments and the Roseau River itself, the only other permanent water areas on the WMA are potholes that formed in burnouts in the past, primarily in the southern and southwestern sections. The larger of these are shown in Figure 4 (page 25). A few of the potholes have been mapped and studied in Game Lake Surveys by the Minnesota Department of Natural Resources and are described in Table 4.

Table 3. Impoundments on the Roseau River WMA.¹

Pool number	Size (acres)	Depth (feet)		Open water 1960-61 (acres)	Estimated capacity (acre-feet)
		Max.	Ave.		
1	2,300	5	2½-3	602	6,325
2	4,600	4	2.4	196	11,040
3	3,700	2.5	1.4	273	5,180
Total	10,600			1,071	22,545

¹ From Minnesota Conservation Department unpublished lake surveys, 1954, 1960, 1961a, 1961b.

Table 4. Major natural potholes on the Roseau River WMA.

Pothole		Location Township, Range, Section(s)	Size (acres)		Depth (feet)	
Number	Name		Total	Open Water	Max.	Median
2	Shurshot Lake	163N, 44W, 16, 17	66.5	24.4	1.7	1.0
3	Oakes Lake	163N, 44W, 15	—	59	2.3	1.5
4	(None)	163N, 44W, 22	—	10.6	1.8	1.0
5	Bushy Lake	163N, 43W, 19	—	24	1.5	1.4
6	Doughnut Lake	163N, 43W, 16	—	2.2	3.0	2.4
7	Lylya Lake	163N, 44W, 5, 6	—	14.2	1.3	1.0

The streams in the watershed have been given water quality classifications by the Minnesota Pollution Control Agency (1973) (Appendix C). The Roseau River is rated 2B or 3B, 2B being the second highest "Fisheries and Recreation" class, and 3B being the second highest "Industrial Consumption" class. Characteristics and permissible ranges of various substances are defined by the Minnesota Pollution Control Agency (1973).

Water samples taken in July and October of 1978 from the three pools on the WMA, the Pine Creek Diversion, and from two stations on the Roseau River were analyzed at the Section of Ecological Services' Laboratory at the Carlos Avery WMA. Results (Appendix D) suggested that the water in all six sample areas was hard, which often indicates high productivity, and the nitrogen content suggested good or very good fertility for all areas (Howe and Carlson 1969). Phosphorus levels varied considerably between and two samples. Sulfate levels in both samples were higher in Pools 1 and 3 than in Pool 2.

Much more detailed water quality sampling has been done on the Roseau River, and these studies (U.S. Department of the Interior 1974a and Reid et al. 1974) characterize the river as calcium-magnesium bicarbonate water. The concentrations of the major ions vary with the seasons and with discharge. Ionic concentrations are high during the winter and during other periods of low flow, being similar to the chemistry of groundwater. Concentrations are lower during the spring after snowmelt and after summer rains because of dilution. The concentration of nutrients such as phosphorus and nitrogen in the Roseau River varies in a similar way, but there is an additional effect from the Roseau municipal sewage settling ponds. On August 13, 1973, the total phosphorus concentration was four times as great below the Village of Roseau as above (Reid et al. 1974). Other sources of nitrate and phosphorus are agricultural fertilizers and rainwater. During the winter, dissolved oxygen levels drop to as low as 0.4 ppm in at least some portions of the Roseau River (U.S. Department of the Interior 1974a).

Water quality testing was done on the Roseau River WMA in 1949 and in the 1950's as part of the Minnesota DNR Game Lake Surveys. Tests were made primarily for sulfates and total alkalinity, since these two components are very important in determining which aquatic plants will grow. On August 19, 1949, sampling was done in Pine Creek Pothole, before the impoundments on the WMA were constructed. The

sulfate ion concentration was 665 ppm, chloride ion 8.5 ppm, and total alkalinity 115 ppm. Pine Creek Pothole was characterized as an alkali lake that was chemically capable of supporting a fair abundance of aquatic vegetation. The sulfate level was far in excess of the upper limit for wild rice, which does not do well in waters that exceed 10 ppm sulfates. Water samples were taken in Pools 1 and 3 in 1953, 1954, and 1956, and in the Pine Creek Diversion Ditch the latter two years. Total alkalinity levels ranged from 104 to 290 ppm. Sulfate levels in Pool 1 varied considerably from one end of the pool to the other. Values for the east end of the pool for the three samples were 240, 71, and 18 ppm for 1953, 1954, and 1956, respectively, and values for the same three days at the west end were 8, 2, and 137 ppm.

Sulfate concentrations in the Pine Creek Diversion Ditch were very low, only 0 and 1 ppm. It appeared that the varying sulfate concentrations in Pool 1 were related to the amount of time the water stood in the pool and possibly the movement of the low-sulfate water after it entered from the diversion ditch. With drawdowns, plus the snow and ice cover, the oxygen level drops near zero in the three pools during the winter.

Frequent flooding has occurred in the Roseau River watershed since the time of the first white settlers and presumably prior to that time (Chapin 1943). The flooding situation is aggravated by the fact that the sources of the Roseau River in the southern part of the watershed thaw in spring before the outlet in the north. The Roseau River usually reaches its highest peaks in April and May from runoff due to melting snow. Sometimes the peaks are increased further by rainfall. Flooding may also occur later in the year following heavy rains. Discharges decline to almost no flow in the late fall and winter. Streamflow data have been collected by the U.S. Geological Survey at several stations along the Roseau River and its tributaries, some dating back as far as 1911. The maximum discharge recorded at Ross, Minnesota, was 6,560 cfs on May 12, 1950 (Table 5). Pine Creek, which was diverted to provide water for the WMA pools, had a maximum discharge of 706 cfs (International Roseau River Engineering Board 1975, Appendix B, Sect. 2). A flood crest of two feet over full bank level in the Roseau River at Ross may be expected to occur every 23 years (Table 6). The 1950 flood at Ross was 3.7 feet above bank full stage (Winter et al. 1967).

The largest flood recorded in the Roseau River basin occurred in the spring of 1950 and was caused

Table 5. Data from stream-gauging stations on the Roseau River and tributaries.¹

Station	Period of Record		Maximum Discharge (cfs) ²	Recorded Date	Minimum Discharge (cfs)	Recorded Date	Mean Discharge (cfs)
	From	To					
Roseau River at Ross, Minn.	July, 1928	Date	6,560	May 12, 1950	0	Aug. 28, 1961	259
Roseau River below state ditch 51 near Caribou, Minn.	April, 1929	Date	4,080	May 19, 1950	0	Aug. 13, 1936	298
Sprague Creek near Sprague, Manitoba	Sept. 1928	Date	2,070	Sept. 1, 1942	0	several times	61.3
Pine Creek near Pine Creek, Minn.	Aug. 1928	Sept. 1953	706	Sept. 25, 1941	0	Jan. 5-14, 1942	31.5

¹Source: International Roseau River Engineering Board (1975, Appendix B, Sect. 2)

²Cubic feet per second.

by late, rapid snowmelt combined with light rain. The flood covered about 85,000 acres and lasted from April to June. It caused damage to rural and urban property, potential farm crops, and roads and bridges. In Roseau County the average annual damage from floods through 1964 was \$843,000. The extent and type of damage depends on the time of year flooding occurs. A spring flood might delay seeding for several weeks, and because of the short growing season, production would be decreased, or substitute crops of lesser value would be planted. A summer flood could inundate and perhaps completely destroy growing crops. Other agricultural losses include loss of livestock, grains, and hay, and damage to fences, buildings, and machinery. Nonagricultural losses include damage to roads, bridges, and buildings in urban areas (U.S. Army Corps of Engineers 1964).

Because of the frequent flooding in the Roseau River basin, many attempts at drainage have been made. Drainage programs began in 1904 with the construction of the Badger Creek Ditch. The Roseau River was deepened and straightened in 1906 for several miles downstream from Roseau Lake. Between 1907 and 1920 an extensive system of ditches was constructed on both sides of the Roseau River, and the river itself was dredged from Roseau Lake to the Canadian border. The Roseau County Soil and Water Conservation District, formed in 1952, has undertaken

the construction and improvement of about 75 miles of public drainage ditches and 110 miles of field ditches. The capacities of the river and the ditch system have never been sufficient to prevent frequent flooding of agricultural lands (Minnesota Department of Natural Resources 1978). Over 680,000 acres in Roseau County (about 64 percent of the land area) had been drained by 927 miles of ditches as of 1964 (U.S. Army Corps of Engineers 1964).

Drainage ditches have also been constructed in the Canadian portion of the watershed in several areas from Gardenton downstream to the Red River. These ditches may increase flooding in some areas in Canada depending on whether or not local runoff coincides with the peak flow from upstream. Drainage projects on a smaller scale also exist on the Pine Creek and Sprague Creek tributaries. These projects can increase downstream flood peaks since they increase the rate and shorten the period of local run-off (International Roseau River Engineering Board 1975, Appendix B, Sect. 1).

Even with all of the drainage programs, frequent flooding continued, and the local people asked for further work on the river to increase flood control and drainage. In response to a congressional request, the U.S. Army Corps of Engineers proposed new channel modifications for the Roseau River (U.S. Army Corps of Engineers 1964). Their report concluded "...that

Table 6. Expected frequency (in years) of flood levels on Roseau River and Sprague Creek, Roseau County, Minnesota.¹

River	Period of Record	Water level above river bank (ft.)			
		1	2	3	4
Roseau River at Ross	1928-65	16	23		
Sprague Creek ½ mile South of border	1928-65	2.5	5	9	18

¹ Data from Winter et al. 1967.

improvement of the Roseau River by channel enlargement, clearing and limited straightening between project miles 137.5 and 93.8 and construction of the necessary remedial works in Canada, together with improvement and extension of the existing tributary ditch system represents the most practicable plan of improvement for the Roseau River basin." The Corps found the project to be economically justified. The area to be modified under this proposal extends from the Village of Roseau to the Canadian border and about 10 miles into Canada. Congress authorized the construction in 1965. The project was studied and modified slightly in 1971 to provide increased flood protection for the Village of Roseau, to mitigate possible fisheries and waterfowl habitat losses, and to exclude lateral ditch improvements. The environmental impact statements and a water quality study on the project were prepared by 1974 under Corps supervision. In 1975, a Canadian-American joint engineering board presented a review of the proposal and its impacts to the International Joint Commission (IJC). The IJC is a binational organization which reviews and makes recommendations regarding international projects. The engineering board recommended that the modified project proceed. Some details of the proposed project are still being modified, and work has not yet started. Additional information on the proposal and on the watershed are given by the following: U.S. Army Corps of Engineers 1964, U.S. Army Corps of Engineers 1976, Reid et al. 1974, International Roseau River Engineering Board 1975, and Minnesota Department of Natural Resources 1978.

BIOTIC RESOURCES

Vegetation. Vegetation is continuously changing with short-term disturbance such as fires or storms, and long-term events, such as climatic changes or soil development. Even without disturbance plant communities change in response to changes on a site, with one species dying out and being replaced by another. The orderly changes in plant communities are called succession.

Lying in the transition zone between the western prairies and the eastern deciduous and coniferous forests, the Roseau River WMA has plants common to both regions. For this reason and because of the topographic and soil variations and impoundment development, a variety of vegetation types are present.

The presettlement vegetation of the Roseau River WMA was described by Marschner (1930) and Trygg (1967a, 1967b). They used original land surveyor's field notes to map the distribution of the dominant plant associations in Minnesota. The large, central wetland now dominated by the three WMA pools was largely a conifer swamp. Tamarack, black spruce, and cedar in the swamp varied in density from scattered trees to dense stands. Expanses of sedge-dominated open bog occupied non-forested sites in this area. South of this central area, in the present Big Swamp, was an extensive wetland with a mixture of willow swamp, cattail marsh, and wet sedge and grass meadow. Higher ground around the central wetland supported a patchy distribution of forest types. Forests dominated by jack, red, and possibly white pine occurred along with jack pine-bur oak barrens; aspen, birch, bur oak, and bottomland hardwood forests; and brush prairie. This vegetation suggests that wildfires occurred regularly in the area (Curtis 1959).

Present vegetation was mapped from two sets of aerial photographs, black and white from 1966 and color infrared slides from 1978 (Appendix K, Figure 1).

Stands of vegetation as small as 10 acres were mapped. Sixteen broad vegetational types were described, with the aid of groundchecking, in detail sufficient for typical management operations. Forest types were named for one or two dominant tree species. Wetlands were classified using criteria modified from Steward and Kantrud (1971) and Cowardin and Johnson (1973). Grass and brush areas were not described in detail. Additional information on plant species composition was taken from Reid et al. (1974) for upland areas and from Minnesota DNR Game Lake Surveys for wetlands. A brief description of the vegetation types, including dominant species and successional trends is given. Descriptions of succession generally follow Curtis (1959). A list of plant species mentioned in the text is found in Appendix E. A complete list of common plants known to occur on the area is reported by Reid et al. (1974). Acreages of each type in the WMA's project proposal are listed in Appendix F.

ASPEN. Trembling aspen is the most abundant tree on the wildlife management area. It is adapted to a wide range of soil moisture and nutrient levels, but it is usually found in the uplands. Occurring with it are species such as balsam poplar, green ash, balsam fir, and bur oak. Common shrubs include beaked hazel and American hazel on drier sites and red-osier dogwood and one or more species of willow in wetter areas. Some of the common herbaceous plants are asters, wild columbine, sedges, and bedstraw.

Trembling aspen generally occurs in the early stages of succession, often following fire or logging. It is intolerant to shade and will not reproduce under a canopy of mature trees. Undisturbed aspen will be replaced by shade tolerant species such as balsam fir and white spruce. When aspen is clear-cut or burned, it reproduces nearly pure, dense stands by sending up shoots from the remaining roots.

BUR OAK/ASPEN. This type occurs in small stands on sandy, well-drained soils. Bur oaks are trees of the ecotone between prairie and forest zones, although they occur infrequently in mesic to wet-mesic prairies (Curtis 1959).

The oaks probably occurred originally as scattered large trees or in stunted brushlike form in a grass-dominated community. Exclusion of wildfires after settlement allowed the oaks to grow to full size and reproduce. Present oak/aspen stands include a high percentage of aspen as well as paper birch, basswood, and green ash. There is a well developed shrub understory which includes chokecherry, juneberry, beaked hazel, raspberry, and bush honeysuckle.

Undisturbed bur oak and aspen, which do not reproduce well in shade, will be replaced by shade-tolerant trees.

JACK PINE. The only stand of jack pine on the WMA is in the northeastern part of the area on sandy, relatively well-drained soil. These pines were measured to be from 19 to 52 years old and 16 to 46 feet tall in 1973 (Reid et al. 1974). Jack pine is about the only tree species present, but there are also a few trembling aspen. Understory vegetation is sparse because of the dense overstory. Some of the species found in the ground cover are bracken fern, goldenrod, sarsaparilla, common bearberry, and strawberry.

Without disturbance, red and, finally, white pine may replace jack pine. Periodic fires with intervals allowing seedlings to mature will perpetuate the jack pine type. Fires cause most jack pine cones to open and release seeds which germinate best on scorched soil.

GRASS FEN. This type, with similarities to sedge meadows, type II wetlands, and wet prairies, occupies large areas on the unit. It is a nearly treeless community dominated by grasses such as red top, reed canary grass, northern reed grass, bluejoint, and cord grass as well as various sedge species. Fens occur on wet, peat soils. Other plants commonly found here include fringed gentian, ladies' tresses orchids, swamp milkweed, goldenrods, and asters. Small willows grow scattered in some stands. Potholes created by peat fires support emergent cattail and common reed (*Phragmites*).



Vast sedge meadows cover much of the Roseau River WMA north of the pools.

Protected from fires, the type may rapidly change to lowland brush. Grass fens were probably originally maintained by fire, but haying may also prevent shrub invasion. Further buildup and drying of soils over long time periods may lead to aspen, then spruce-fir forests.

SEDGE MEADOW. The expanse of open area north of Pools 1 and 2 is sedge meadow. Sedges are the major plants of this community, but scattered clumps of tamarack, bog birch, willows, and ericaceous plants like Labrador tea occur. These plants along with the vegetation of many scattered seasonal and semi-permanent potholes add diversity to the type. Most potholes quickly fill in with emergent cattail and common reed. Other plants common to this type are bluejoint grass, blue flag, marsh bellflower, water hemlock, swamp cinquefoil, sweet coltsfoot, goldenrods, and asters.

This type is short-lived and will be rapidly invaded by shrubs if it is protected from fire. Aerial photos show evidence of numerous large fires on the unit's sedge meadows in the past. Undisturbed, vegetation on these sites will change from shrubs to forest, probably tamarack and black spruce. Eventually white cedar might invade the site.

LOWLAND BRUSH. Willows dominate this community, which occurs on persistently waterlogged peat having standing water during part of the growing season. Nine willow species have been identified on the unit; balsam, sandbar, and peach-leaved willows are most common. Red-osier dogwood and shrubby cinquefoil are also important shrub species. Ground cover includes several kinds of sedges, reed canary grass, water horehound, sweet coltsfoot, and water hemlock. The dominant shrubs produce a very dense thicket from 6 to 15 feet high.

Black spruce and tamarack invade these sites very slowly because of the dense shrub canopy. Repeated, severe fires could cause the reversion to a grass fen or sedge meadow.

BLACK SPRUCE/TAMARACK. These lowland conifers are found only on peat soils in the northeastern part of the unit. Black spruce is usually the most common overstory tree and tamarack is second, but species composition varies in the stand. Ground cover consists of an almost continuous blanket of sphagnum moss with scattered ericaceous shrubs such as Labrador tea, bog rosemary, and leatherleaf.

If undisturbed, this community may be very long-lived, reproducing itself as openings occur. However, white cedar may eventually replace the other conifers on the site. Spruce-tamarack stands are vulnerable to fire and high winds. Dwarf mistletoe infestations may kill many black spruce, increasing fire and wind hazards. Repeated severe fires will convert the site to sedge meadow. Smaller disturbances will allow brush growth and, eventually, spruce-tamarack regeneration in openings.

WHITE CEDAR. White cedar grows on peat soils north of Pool 1. This dense stand permits only shade-tolerant species such as balsam fir to grow with it, but some black spruce and tamarack grow at the edges. Common understory species include red-osier dogwood and Labrador tea, mostly in scattered openings. Ground cover usually consists of feather mosses and scattered ferns, but the closed canopy excludes ground cover growth over much of the stand. Cedar is often tipped or downed by winds. When tipped trees contact the moss-covered soil, they usually sprout shoots and adventitious roots which will become trees (Curtis 1959). Gradual wind-tipping commonly causes bent or bowed trunks. Severe wind storms may cause temporary openings which are quickly invaded by shrubs.

White cedar's shade tolerance and vegetative reproduction tend to maintain stands for extremely long periods. Fires or flooding retard succession temporarily. Intensive browsing by wintering deer may destroy all vegetative reproduction, interfering with stand maintenance. Gradual buildup and drying of the peat will lead to invasion of the stand by deciduous hardwoods.

TEMPORARY WETLAND (TYPE II). Temporary wetlands occur on sites where shallow water stands for only a few weeks during the spring and following summer floods. Soils are saturated with water to within a few inches of the surface throughout all but the driest growing seasons. Cattails and common reed occur in the wetter areas. Species found in somewhat drier areas include sedges, reed canary grass, water hemlock, swamp milkweed, water horehound, blue flag, sweet coltsfoot, and white camas. Scattered willows, alders, and red-osier dogwood may be present.

In the absence of fire and other disturbances, alder, willow, and red-osier dogwood will invade these wetlands, creating a dense shrub thicket. Eventually, tamarack will probably become established over a vigorous understory of shrubs.

SEASONAL WETLAND (TYPE III). This wetland has water depths up to 30 inches in the spring, but the standing water may disappear by mid to late summer in many years. Cattails predominate in many such wetlands, sometimes interspersed with common reed. Other emergents include hardstem bulrush, softstem bulrush, sedges, and willows. Submergents, including water milfoil, coontail, and bladderwort, are found in areas having deeper, more open water.

SEMI-PERMANENT WETLAND (TYPE IV). This type of marsh has water depths up to five feet and contains surface water through the entire growing season. Species composition is influenced by water depth, seasonal water level fluctuations, and water chemistry. Type IV wetlands include the main pools and the deeper potholes on the WMA. The dividing line as mapped between Types III and IV wetlands in the pools is approximate.

Extensive, dense stands of cattails occur in wetlands of this type. Both broadleaf and narrowleaf cattail are found. Other common emergents are common reed, hardstem bulrush, softstem bulrush, and, in shallower water, reed canary grass, sedges, and willows. Common submergents include water milfoil, coontail, water moss, greater bladderwort, several species of pondweed, star duckweed, and lesser duckweed. The only quantitative surveys of vegetation in Pools 1, 2, and 3 were done in 1954, 1956, and 1961 as part of the Minnesota DNR Game Lake Surveys.

Vegetation on wetland sites depends on the depth, permanence, and chemistry of the water, on soil types, and on the degree of disturbance, usually fires. If a semi-permanent wetland were undisturbed over long periods (thousands of years) it would succeed by sedimentation through the seasonal and temporary wetland phases to lowland brush and finally to a lowland forest of spruce, tamarack, or cedar. Sufficiently increased water depth and permanence will set back succession.

OLD FIELD. Cropland and hay fields which have not been used for several years are classed as old fields. Vegetation in this type varies with the soil moisture conditions and the length of time since cultivation. Drier sites seem to be developing into tall grass prairie. The brome grass, quack grass, goldenrod, and ragweed commonly found in the early successional stages of old fields are being invaded by typical prairie plants such as licorice root, big bluestem, blazing star, and blue-eyed grass. Willows are rapidly invading wetter areas, formerly mowed for marsh hay. Other plants on these sites include bluejoint, reed canary grass, sedges, and others similar to the lowland brush type.

Undisturbed drier sites will become aspen, and eventually, spruce-fir forests. Succession on wetter sites would be the same as the lowland brush type. Periodic fires would prevent the invasion of woody plants and would favor the invasion of grasses and perennial broad-leaved plants of tallgrass and wet prairies.

AGRICULTURAL FIELDS. These fields are actively farmed for oats, wheat, flax, sunflowers, alfalfa, wild hay, barley, and corn. Haying of wild grasses prevents invasion of woody plants.

Birds. The Roseau River WMA's diverse vegetation attracts a large number and variety of birds. A list of 238 species of birds known to occur or probably occurring on or near the area was compiled primarily by Robert Janssen of the Minnesota Ornithologists' Union. This list was modified by Minnesota DNR personnel and others, especially Ross Hier of the University of Minnesota (Table 7). The birds included are species associated with grassland, deciduous forest, coniferous forest, and tundra. The estimates of abundance are related to both the number of birds present and the visibility of each species.

Most bird species now found on the area probably occurred before settlement. However, man's activities have altered the relative abundances of some species and have caused the introduction, extirpation, or range expansion of other species. Birds able to utilize man-altered habitats have prospered; some birds requiring specialized habitats or minimal disturbance have declined.

Prairie chickens and whooping cranes were once common in the area but are now extremely rare. One of the last sightings of whooping cranes in Minnesota was near Badger in Roseau County in 1917 (Roberts 1936). However, in the spring of 1978, one whooping crane was seen in Kittson County. Unconfirmed sightings of prairie chickens are occasionally reported for Roseau and Kittson Counties.

Ring-necked pheasants were stocked in Roseau County in 1916 and perhaps in later years (Roberts 1936), but the attempts were not successful in establishing a pheasant population. Another exotic game bird, the gray, or Hungarian partridge, was stocked in

the area in the late 1920's, and this stocking was successful in establishing a resident population.

Twenty-seven species of game birds, including four permanent residents, nest on or near the Roseau River WMA, and another nine species of game birds use the area during migration (Table 7). Of the 36 species considered to be game birds, three, the whistling swan, sandhill crane, and mourning dove, do not have open hunting seasons in Minnesota.

Of the upland game birds, the ruffed grouse and sharp-tailed grouse are both common. Ruffed grouse are found mainly in the forested areas, such as that north of Pool 1, while sharp-tailed grouse occur in more open areas such as grasslands, brushy areas, and croplands. Spring census routes for both species were started in 1978. The ruffed grouse drumming count route is on the west half of the WMA, while the sharp-tailed grouse route is in the Juneberry area south of the WMA. The average ruffed grouse drumming count was 4.2 drums per stop, compared to an average of 2.0 drums per stop for 15 routes in northwestern Minnesota. The 1979 ruffed grouse count averaged 2.3 drums per stop. Six sharp-tailed grouse dancing grounds were found on the 20-mile route in the Juneberry area. Spruce grouse are uncommon and are found mainly in the jack pine area north of Pool 1.

The Roseau River WMA is located at the eastern edge of the prairie waterfowl nesting grounds. Surveys of nesting waterfowl on the WMA have been conducted by Minnesota DNR personnel using aerial counts of breeding pairs and brood counts. Although production varies from year-to-year, it has been estimated that about 10,000 ducks are produced annually in the WMA



Ring-necked ducks are often the most abundant waterfowl species nesting on the WMA pools.

Table 7. Bird species and their relative abundance in the Roseau River WMA vicinity.

Common Name	Permanent Resident	Migrant	Summer Resident	Winter Resident	Common Name	Permanent Resident	Migrant	Summer Resident	Winter Resident
Common loon		C	C		American golden plover		C		
Red-necked grebe		C	C		Black-bellied plover		U		
Horned grebe		C	C		Ruddy turnstone		U		
Eared grebe		U	R		*American woodcock		C	C	
Western grebe		C			*Common snipe		C	C	
Pied-billed grebe		A	A		Whimbrel		R		
White pelican		C	U		Upland sandpiper		U	U	
Double-crested cormorant		C	C		Spotted sandpiper		U	U	
Great blue heron		C	C		Solitary sandpiper		U		
Green heron		U	U		Greater yellowlegs		U		
Cattle egret		VR	VR		Lesser yellowlegs		A		
Great egret		R	R		Willet		R		
Black-crowned night heron		C	C		Pectoral sandpiper		C		
Least bittern		C	C		White-rumped sandpiper		C		
American bittern		C	C		Baird's sandpiper		U		
White-faced ibis		VR			Least sandpiper		C		
Whistling swan ¹		C			Dunlin		U		
*Canada goose		A	C		Semipalmated sandpiper		C		
*White-fronted goose		R			Western sandpiper		U		
*Snow goose		A			Sanderling		U		
*Mallard		A	A		Short-billed dowitcher		U		
*Black duck		U	R		Long-billed dowitcher		U		
*Gadwall		C	C		Stilt sandpiper		U		
*Pintail		C	C		Buff-breasted sandpiper		R		
*Green-winged teal		C	U		Marbled godwit		C	C	
*Blue-winged teal		A	A		Hudsonian godwit		R		
*Cinnamon teal		VR			American avocet		R		
*American wigeon		A	C		Wilson's phalarope		C		
*Northern shoveler		C	C		Herring gull		C		
*Wood duck		C	C		Ring-billed gull		C	U	
*Redhead		C	C		Franklin's gull		A	C	
*Ring-necked duck		A	A		Bonaparte's gull		R		
*Canvasback		C	C		Forster's tern		C	C	
*Greater scaup		R			Common tern		U		
*Lesser scaup		A	R		Caspian tern		U		
*Common goldeneye		C			Black tern		A	C	
*Bufflehead		C	R		Rock dove	C			
*White-winged scoter		R			Mourning dove ¹		A	A	
*Ruddy duck		C	C		Yellow-billed cuckoo		U	U	
*Hooded merganser		U	U		Black-billed cuckoo		C	C	
*Common merganser		C	U		Great horned owl	C			
*Red-breasted merganser		U			Snowy owl				U
Turkey vulture		U			Hawk owl				R
Goshawk		R	R	R	Barred owl	U			
Sharp-shinned hawk		U	U		Great gray owl	R			
Cooper's hawk		U	R		Long-eared owl		R		
Red-tailed hawk		C	C		Short-eared owl		U	U	
Broad-winged hawk		C	C		Whip-poor-will		C	U	
Swainson's hawk		R			Common nighthawk		C	C	
Rough-legged hawk		U		U	Chimney swift		C	C	
Ferruginous hawk		R			Ruby-throated hummingbird		C	C	
Golden eagle		C		R	Belted kingfisher		C	C	
Bald eagle		C			Common flicker		A	A	
Marsh hawk		C	C		Pileated woodpecker	U			
Osprey		U			Red-headed woodpecker		U	U	
Peregrine falcon		R			Yellow-bellied sapsucker		C	C	
Merlin		R			Hairy woodpecker	C			
American kestrel		C	C		Downy woodpecker	C			
*Spruce grouse	U				Eastern kingbird		C	C	
*Ruffed grouse	C				Western kingbird		U	U	
*Sharp-tailed grouse	C				Great crested flycatcher		C	C	
*Gray partridge	C				Eastern phoebe		A	C	
*Turkey ²	R				Yellow-bellied flycatcher		U	U	
Sandhill crane ¹		C	C		Alder flycatcher		C	C	
*Virginia rail		C	C		Least flycatcher		C	C	
*Sora		A	C		Eastern wood pewee		C	C	
Yellow rail		R	R		Olive-sided flycatcher		U	U	
*American coot		A	A		Horned lark		A	A	
Semipalmated plover		U			Tree swallow		A	A	
Killdeer		A	C		Bank swallow		A	C	

Table 7 (continued)

Common Name	Permanent Resident	Migrant	Summer Resident	Winter Resident	Common Name	Permanent Resident	Migrant	Summer Resident	Winter Resident
Rough-winged swallow		U		U	Blackpoll warbler		R		
Barn swallow		A		A	Pine warbler		U		
Cliff swallow		A		A	Palm warbler		U		U
Purple martin		C		C					
Gray jay	U				Ovenbird		C		C
					Northern waterthrush		U		U
Blue jay	C				Connecticut warbler		U		U
Black-billed magpie	C				Mourning warbler		U		U
Common raven		C		C	Common yellowthroat		A		A
Common crow		A		C					
Black-capped chickadee	C				Wilson's warbler		U		
					Canada warbler		U		U
Boreal chickadee	R				American redstart		C		C
White-breasted nuthatch	C				House sparrow	A			
Red-breasted nuthatch		U			Bobolink		C		C
Brown creeper		U							
House wren		C		C	Western meadowlark		A		A
					Yellow-headed blackbird		A		A
Winter wren		U			Red-winged blackbird		A		A
Long-billed marsh wren		A		A	Northern oriole		C		C
Short-billed marsh wren		C		C	Rusty blackbird		C		
Gray catbird		C		C					
Brown thrasher		C		C	Brewer's blackbird		C		U
					Common grackle		A		A
American robin		A		A	Brown-headed cowbird		A		A
Hermit thrush		U		U	Scarlet tanager		U		U
Swainson's thrush		U		U	Rose-breasted grosbeak		C		C
Gray-cheeked thrush		U							
Veery		C		C	Indigo bunting		U		U
					Dickcissel		R		R
Eastern bluebird		U		U	Evening grosbeak				C
Golden-crowned kinglet		C		U	Purple finch		C		C
Ruby-crowned kinglet		C		U	Pine grosbeak		U		U
Water pipit		C							
Bohemian waxwing				U	Hoary redpoll		U		U
					Common redpoll		A		C
Cedar waxwing		C		C	Pine siskin		U		
Northern shrike		U		U	American goldfinch		A		C
Loggerhead shrike		U		R	Red crossbill		R		R
Starling	A				White-winged crossbill		R		R
Yellow-throated vireo		C		C	Rufous-sided towhee		U		U
					Savannah sparrow		A		A
Solitary vireo		U		U	Grasshopper sparrow		C		C
Red-eyed vireo		A		C	LeConte's sparrow		C		U
Philadelphia vireo		U							
Warbling vireo		A		A	Vesper sparrow		C		C
Black-and-white warbler		C		U	Dark-eyed Junco		A		C
					Tree sparrow		A		R
Tennessee warbler		C		C	Chipping sparrow		C		C
Orange-crowned warbler		U			Clay-colored sparrow		C		C
Nashville warbler		C		C					
Northern parula		U			Harris' sparrow		C		
Yellow warbler		A		A	White-crowned sparrow		A		
					White-throated sparrow		A		C
Magnolia warbler		U		U	Fox sparrow		C		
Cape May warbler		U			Lincoln's sparrow		U		
Yellow-rumped warbler		A		C					
Black-throated green warbler		U		U	Swamp sparrow		A		A
Blackburnian warbler		U		U	Song sparrow		A		A
					Lapland longspur		A		
Chestnut-sided warbler		C		C	Chestnut-collared longspur		U		
Bay-breasted warbler		U		U	Snow bunting		A		A

A = abundant, C = common, U = uncommon, R=rare, VR = very rare.

*Species with Minnesota hunting seasons.

†Protected in Minnesota but hunted in other states.

*A recent introduction of unknown origin, they are found on or near the western WMA boundary. The turkeys are successfully breeding, but little is known about population trends.

(U.S. Fish and Wildlife Service 1977). Brood counts from 1975 through 1978 (Table 8) and aerial counts of breeding pairs from 1969 — 1976 (Table 9), indicate that ring-necked ducks and mallards are the most abundant breeding ducks. The unit is an important breeding area for canvasback, redhead, and blue-winged teal. American coots are an abundant nesting species, but they are not counted in brood counts.

Ducks also use the Roseau River, adjacent oxbows, and potholes on the WMA for nesting and brood rearing. The seasonally flooded Roseau River bottoms are used intensively each spring by ducks, especially ring-necks.

A breeding flock of giant Canada geese was established in the Roseau River WMA by transferring 384 geese from the Carlos Avery WMA Game Farm, from

Table 8. Waterfowl broods and young observed in surveys of the Roseau River WMA, 1975-78¹

Species	1975		1976		1977		1978		Average	
	Broods	Young	Broods	Young	Broods	Young	Broods	Young	Broods	Young
Canada goose	17	83	—	77	—	60	12	79	—	74.75
Mallard	34	192	24	136	31	191	33	219	30.5	184.5
Black duck	0	0	0	0	2	14	0	0	.5	3.5
Gadwall	7	45	14	86	13	76	7	51	10.25	64.5
Pintail	6	34	8	56	3	15	5	32	5.5	34.25
Green-winged teal	1	5	0	0	0	0	0	0	.25	1.25
Blue-winged teal	7	42	7	38	5	24	27	231	11.5	83.75
American wigeon	6	30	0	0	6	42	7	69	4.75	35.25
Northern shoveler	6	34	9	58	3	24	13	88	7.75	51
Wood duck	4	28	7	38	4	17	8	46	5.75	32.25
Redhead	16	112	22	146	6	41	10	74	13.5	93.25
Ring-necked duck	70	441	56	332	32	226	32	210	47.5	302.25
Canvasback	16	116	17	108	18	114	14	112	16.25	112.5
Ruddy duck	7	34	8	49	3	15	6	34	6	33
Unidentified	4	26	22	113	24	154	11	61	15.25	88.5
Totals	201	1,222	194	1,237	150	1,013	185	1,306	175.25	1,194.5

¹ Survey dates: 1975, July 8-August 2; 1976, June 29-July 31; 1977, July 6-30; 1978, June 30-July 31.

1960 to 1967 (Mikula et al. 1970). Numbers of geese and the years they were transplanted were as follows: 23 in 1960, 18 in 1962, 40 in 1963, 46 in 1964, 60 in 1965, 75 in 1966, and 122 in 1967. The estimated number of Canada geese produced on the WMA increased from 20 per year in 1962-64 to 200 per year in 1973 and 1974, then decreased to 125 young produced by 60 breeding pairs in 1976. The total resident flock in the fall of 1978 was estimated to be 195. The leveling off or reduction of the resident goose flock may be due

to local hunting season mortality, estimated at about 30 to 50 percent per year in 1968 and 1969 (Johnson and Jensen 1973).

The number of migrating Canada geese using the area has increased greatly since the establishment of the resident goose flock. Prior to its establishment, fewer than 100 migrant Canada geese used the area before the hunting season. By the late 1960's, preseason goose populations were between 1,000 and 5,000 (Johnson and Jensen 1973). Estimated peak

Table 9. Indicated pairs of breeding ducks observed on aerial transects at the Roseau River WMA.

Species	1969	1970	1971	1972	1974	1975	1976	Average
Mallard	50	54	36	3	31	30	35	38.4
American wigeon	5	3	7	3	0	0	2	2.9
Gadwall	0	2	3	3	1	1	5	2.1
Green-winged teal	2	0	0	2	0	0	0	0.6
Blue-winged teal	28	25	27	27	24	19	28	25.4
Northern shoveler	23	6	13	7	9	8	7	10.4
Pintail	4	8	6	3	5	6	1	4.7
Redhead	9	12	14	14	3	2	4	8.3
Canvasback	6	4	5	4	5	3	7	4.9
Ring-necked duck	30	39	44	31	47	25	35	35.8
Ruddy duck	0	4	0	1	7	3	5	2.9
Unidentified	9	30	6	2	0	0	0	6.7

numbers in fall reached 12,000 in 1975 and 1976, dropped to 6,000 in 1977, and rose to 25,000 in 1978. Peak numbers of Canada geese during spring migration have been 5,000 or less in recent years.

The Canada geese that use the WMA during migration are mostly from the Eastern Prairie Population, which nests near the southwestern shore of Hudson Bay and winters in Missouri (Bellrose 1976). The geese at Roseau are of several subspecies, in approximately the following proportions: 70 percent medium-sized Canada geese ("Todd's" or "interior"), 20 percent small Canada geese ("Richardson's"), and 10 percent giant Canada geese ("maxima") (Robert Jessen, Minnesota DNR, personal communication).

Snow geese also stop at the area during spring and fall migration. Peak numbers in spring are usually 1,000 or less (4,000 in 1977) and fall peaks in recent years have ranged from 10,000 in 1974 to 500 in 1977, and 16,000 in 1979.

The mallard is the most abundant duck during migration. Peak fall numbers of mallards ranged from 20,000 to 30,000 from 1967 through 1973 but have dropped to an estimated 7,000 to 15,000 in 1974 to 1977. Ducks most commonly taken by hunters on the area include mallard, blue-winged teal, lesser scaup, ring-necked duck, and pintail.

The greater sandhill crane is quite common on and near the Roseau River WMA, during both nesting and migration. The species was removed from the U.S. Fish and Wildlife Service "Endangered List" in 1973 (U.S. Department of the Interior 1974b). The WMA vicinity is a very important breeding and staging area for the cranes, but reliable population estimates are not available. More information on the current status and distribution of the greater sandhill crane in Minnesota is becoming available because of the initiation of a nongame wildlife program by the Minnesota DNR in 1977.

The WMA is important to a wide variety of other nongame birds. Some of the nongame birds inhabiting the Roseau River WMA are quite rare in the state or over their range as a whole. Marbled godwits nest in the open fields between headquarters and Pool 1, and upland sandpipers nest in open areas north of the pools. Other birds nesting on or near the WMA which rarely nest in this part of their range include: Philadelphia vireo, scarlet tanager, blackpoll warbler, Connecticut warbler, Wilson's warbler, LeConte's sparrow, boreal chickadee, great gray owl, sharp-tailed sparrow, and short-billed marsh wren (U.S. Fish and Wildlife Service 1977). Shorebirds are usually common on the area's mudflats during migration periods. Cattle egrets have been expanding their range northward, and they were reported on the area for the first time in the summer of 1978. Common loons nest each year in the pools and are regularly seen with young.

Mammals. Most of the species of mammals found in the vicinity at settlement occur there today. However, some larger mammals have been eliminated. The historical distribution of small, inconspicuous species which were not important to settlers is unknown. Even today, the occurrence of some species has not been verified by observation on or near the unit.

Bison, once abundant in the region, were eliminated by the late 1800's. Elk originally occupied much of the prairie and open woodland in Minnesota, but they disappeared about the same time as the bison. Elk were reintroduced into Itasca State Park in about 1913, and 27 were transferred to the Beltrami Island area in 1935 (Gunderson and Beer 1953). The latter herd expanded to about 100 animals and spread into Roseau County.

Only about 20 elk remain, primarily in a four-township area in eastern Marshall and western Beltrami Counties (Maertens 1976). Woodland caribou were once found over much of northern Minnesota, but the last of the native caribou died in 1940. Ten caribou from Canada were stocked in 1938 north of Upper Red Lake, but there have been no reports of caribou in the area since 1943 (Gunderson and Beer 1953). No marten have been reported from the Roseau River WMA vicinity in recent years, but one was reportedly shot in Roseau County in 1900 (Wahlberg 1975).

Moose were common in this region during presettlement times. Settlement resulted in drainage, land clearing, and unregulated hunting, which, by the 1920's, had nearly eliminated the moose. Much of this farmland was abandoned during the 1930's and reverted back to brushland and forests. In addition, moose were not hunted between 1922 and 1970. As a result, the moose population has expanded during the past 40 years (Phillips et al. 1973). Recently, however, land clearing has intensified, resulting in a reduction of habitat and a gradual decline in moose numbers.

White-tailed deer were probably common in the prairie-forest transition zone at settlement. Deer numbers declined after settlement, then increased with greater protection after the 1930's. Deer are near the northern limit of their range here, and populations may be severely reduced by hard winters. Declining habitat has also recently caused a gradual population decline.

A list of 55 species of mammals (Table 10) occurring or possibly occurring on or in the vicinity of the WMA

Table 10. Mammals occurring in the Roseau River WMA vicinity.¹

Masked shrew	Southern red-backed vole
Waiver shrew ²	Meadow vole
Arctic shrew ³	*Muskrat
Pygmy shrew ²	Southern bog lemming ²
Short-tailed shrew	Northern bog lemming ²
Star-nosed mole	Norway rat
Little brown myotis	House mouse
Silver-haired bat ⁴	Meadow jumping mouse
Big brown bat ³	Porcupine
Red bat ³	Coyote
Hoary bat ³	Gray wolf ⁴
*Snowshoe hare	*Red fox
*White-tailed jack rabbit	*Black bear
Eastern chipmunk ³	*Raccoon
Least chipmunk ³	*Fisher
Woodchuck	Ermine
Richardson's ground squirrel ²	Least weasel
Thirteen-lined ground squirrel	Long-tailed weasel
Franklin's ground squirrel	*Mink
*Gray squirrel	*Badger
*Fox squirrel ²	Striped skunk
Red squirrel	*River otter
Northern flying squirrel	*Lynx
Northern pocket gopher ²	*Bobcat
Plains pocket gopher ²	*Mule deer ⁴
*Beaver	*White-tailed deer
Deer mouse	*Moose
White-footed mouse	

¹Names and sequence of mammals follow Jones et al. (1975).

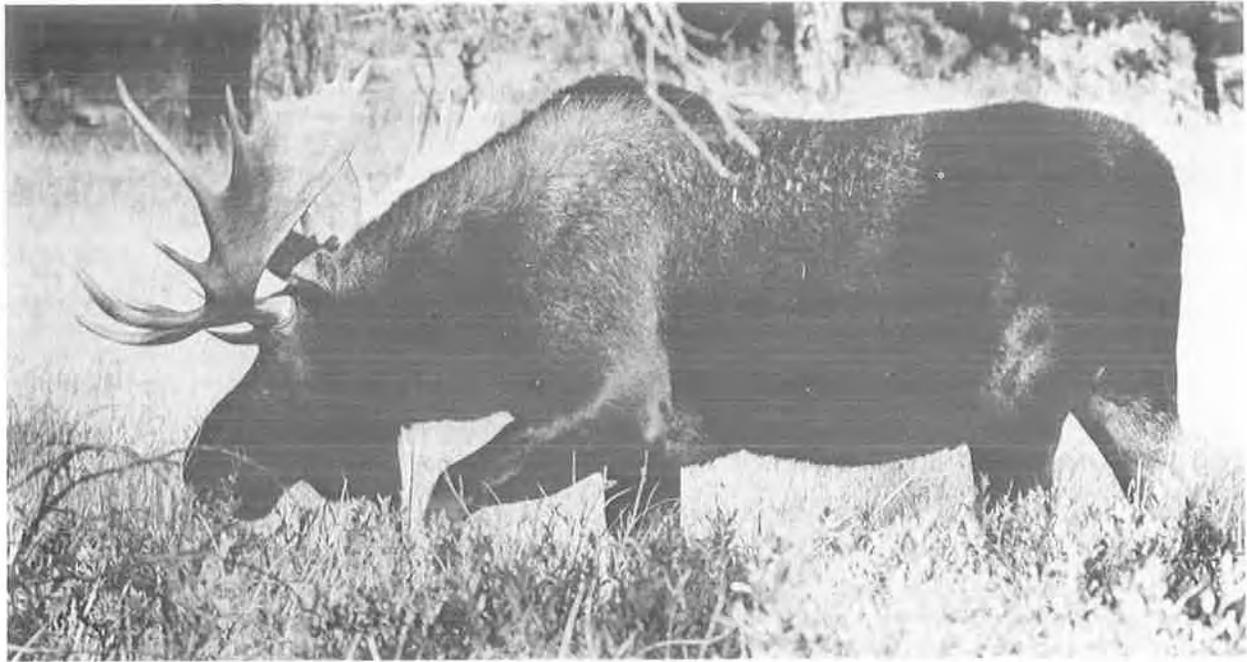
²Possible occurrence.

³Probable occurrence.

⁴Rare or transient occurrence.

⁵Special protection by state and federal law.

*Game species — May be taken only according to Minnesota DNR regulations.



Moose are abundant on the Roseau River WMA and are commonly seen from the roads and ditches.

was prepared from notes and comments by Dr. Evan B. Hazard of Bemidji State University, supplemented by observations of others. The gray wolf (eastern timber wolf) is classified as a threatened species and is protected by state and federal law. Seventeen of the species on the list are considered game mammals and may be taken only in accordance with Minnesota DNR regulations. The other species listed received no protection under 1980 Minnesota DNR regulations, although some of them are hunted or trapped. On wildlife management areas, however, unprotected wild animals may be taken only from September 1 through the last day of February. The status of many species is not well-known, as indicated by the number of "possibles" and "probables" on the list. For example, the Roseau River WMA is near the edge of the range of both the northern pocket gopher and the plains pocket gopher, and the species which occurs there is unknown. The species of small mammals that were trapped in largest numbers in a sampling of seven habitat types near the Roseau River were the meadow vole, southern red-backed vole, meadow jumping mouse, and masked shrew (Reid et al. 1974).

The white-tailed deer is the most common large mammal on the area, and moose are also common and quite conspicuous. An estimated 800 deer and 100 moose live on the WMA. In the Big Swamp area, part of which is on the WMA, moose densities are about two per square mile, and deer densities are about 15 per square mile. Some of the highest densities of moose in Minnesota are found in this area. Low densities of black bear also live in the Big Swamp (Minnesota DNR 1978).

Gray wolves are present regularly in low numbers on the WMA. Their numbers may increase somewhat during the winter, possibly due to migration from the north. River otters are present in the WMA pools, and fishers and bobcats are occasionally found in the forested areas. Lynx are usually rare but are present, especially in years of high populations, when they migrate from Canada. Muskrat, mink, raccoon, and beaver are common on the area.

Fish. Habitat for fish on the WMA includes the Roseau River, ditches, three large impoundments, and several potholes. Most of the fish survey work has been done in the river. Thirty-one species of fish (Table 11) have been collected in electrofishing samples done by the Minnesota DNR in the Roseau River. The major game fish species are northern pike and walleyes. White suckers, shorthead redhorse, and carp are the most numerous nongame species. The Roseau River is considered one of the better warmwater game fish streams in Minnesota and is one of the few sportfishing areas available in Roseau County (Minnesota DNR 1978). Electrofishing data indicate that game fish make up about 40 percent of the total fish population, a very high percentage compared to other northern Minnesota streams. Standing crops of game fish in the river are estimated at 20 to 40 pounds per acre.

The high percentage of game fish in the Roseau River was illustrated by the species composition of fish killed by a spill of the insecticide dieldrin at Roseau on August 20, 1970. In the 3.5 miles downstream from the spill, it was estimated that 5,975 fish were killed, of which 70 percent were northern pike (up to eight pounds), 15 percent were walleyes, and 15 percent were white suckers (Minnesota DNR 1978). Possibly some smaller or less susceptible species were not collected in proportion to their abundance.

Fish losses occur in some sections of the river under conditions of drought, oxygen depletion, and freeze-out. Low oxygen levels occur especially under low flow conditions during the winter. Adding to the low oxygen problem is the fact that some shallow areas in the river may freeze to the bottom, preventing fish from moving to other areas. Mortality of fish was apparently high in 1976 and 1977 during one of the most severe droughts in recent history. During that winter, streamflow data collected at Ross and Caribou made it seem likely that the small discharge from the Roseau River WMA pools was responsible for maintaining a five cubic feet per second flow at Caribou, which would help to keep fish alive (Minnesota DNR 1978). Even though fish mortality

Table 11. Species of fish occurring in the Roseau River watershed.¹

Chestnut lamprey	Fathead minnow
Silver redhorse	Tadpole madtom
Shorthead redhorse	Stonecat
White sucker	Central mudminnow
Carp	*Northern pike
Creek chub	Burbot
Pearl dace	Trout-perch
Common shiner	*Rock bass
Bigmouth shiner	*Sauger
Sand shiner	*Walleye
Blacknose shiner	Blackside darter
Northern redbelly dace	Johnny darter
Finescale dace	Iowa darter
Blacknose dace	Freshwater drum
Longnose dace	Brook stickleback
Brassy minnow	

¹Names and sequence of fish follow American Fisheries Society (1970).

*Game species — May be taken only according to Minnesota DNR regulations.

was high, populations, as indicated by electrofishing data, recovered rapidly and were back to near pre-drought levels within two years (LeRoy Dahlke, Minnesota DNR, personal communication).

The pools on the WMA provide spawning and rearing areas for northern pike. The means of entering the pools is not definitely known, but it is believed that the pike enter by way of the Pine Creek Diversion Ditch or through the control structures and spillways. If high water levels do not occur during the spring, few fish are able to enter the pools. Fish seldom survive in the shallow pools over winter because of the low levels of dissolved oxygen.

Minnesota DNR fisheries personnel have done fish rescue and transfer work on the area since the winter of 1960-61. Test netting is done in years of low water levels to determine if enough northern pike are present to warrant a fish rescue operation. From 1960-61 through 1977-78 northern pike have been removed 15 of 18 winters. The average yield over the 18-year period was 30,014 northern pike with an average weight of 11,700 pounds (Minnesota DNR 1978). The highest total in one season was 88,600 northern pike weighing 56,845 pounds transferred in 1962-63. The 40,464 fingerling northern pike removed during the 1974-75 winter comprised 60 percent of the fingerlings of that species transferred in the entire state, but priority is given each year to Lake Bronson in Kittson County.

The northern pike that are removed from the WMA do not all come from the large impoundments. Although the percentages vary from year to year, it has been estimated that an average of about 40 percent of the fish have come from the impoundments and 60 percent from ditches south of the impoundments (Howard Latvala, Minnesota DNR, personal communication). Those fish captured in the ditches were probably reared in the impoundments, left through the control structures during the fall drawdown, and then congregated in moving water below the pools. Very few pike are trapped in Pool 3, probably because it is farther removed from the Pine Creek Diversion.

Other than northern pike, little information is available on the fish present in the pools. A few white suckers and central mudminnows are captured in traps during the fish rescue and transfer operations. The central mudminnows, which are caught mainly in Pool 2, are probably able to survive over the winter. Carp are present in the Roseau River and in ditches immediately below the pools on the WMA; however, none have been trapped in the pools (Howard Latvala, Minnesota DNR, personal communication).

OPERATIONS

The operation of the Roseau River WMA depends on capital improvements, staff, equipment, and funding. The relationship of the area to other Minnesota DNR functions in Region I is important to the understanding of administrative and funding procedures and problems. Knowledge of the present operation is necessary to formulate a comprehensive plan that will utilize existing development and equipment and can be implemented under anticipated budgetary and administrative constraints.

ADMINISTRATION AND FISCAL

The Roseau River WMA is one of 925 state wildlife management areas and is administered through the DNR Region I office in Bemidji. Region I consists of 21

counties and includes 323 wildlife management areas with approximately 511,000 managed acres. Ten area wildlife managers manage 319 of the wildlife areas, while four resident managers direct four additional units. The regional wildlife manager supervises wildlife management in Region I.

Wildlife and fish administration and management in Minnesota is financed primarily through appropriations from the Game and Fish Fund. Receipts from hunting, trapping, and fishing license sales, cash receipts from wildlife management areas, and federal-aid matching funds are deposited into the Game and Fish Fund. These monies are dedicated for state-wide fish and wildlife management and are appropriated to the Minnesota DNR.

Federal matching funds are derived from the

Federal Aid in Wildlife Restoration Act (Pittman-Robertson Act) and the Federal Aid in Sport Fish Restoration Act (Dingell-Johnson Act). These acts impose excise taxes on sporting arms, ammunition, archery equipment, and fishing equipment. Funds from these taxes are used to match state funds on a 3:1 ratio for federally approved wildlife and fish projects.

Expenditures for salaries, taxes, equipment, and other operating expenses on the Roseau River WMA, estimated from the regional wildlife manager's records, totaled approximately \$135,000 in 1978, and \$100,000 in 1979 (Table 12). Salaries and benefits for permanent employees were about 50 percent of the expenses. Expenditures for seasonal laborers were about 20 percent of the total; however, spending in this category varies greatly in response to total regional funding, special needs on the unit, or special appropriations. Income from agricultural leases was \$1,853 in 1978, and \$1,102 in 1979.

Equipment, major equipment repairs, and most capital improvements are budgeted through the DNR Field Services Bureau. These expenses vary yearly depending on equipment and management needs. Equipment needs and major capital improvements, such as buildings, dikes, and control structures, are funded on a region-wide priority basis. Supplemental appropriations such as Wildlife Management Area Betterment, and the Waterfowl Habitat Improvement Program provide funding for some improvement projects.

Payments in lieu of taxes are made to counties for all state lands acquired for public hunting grounds and game refuges, except state Trust Fund lands. Payments are disbursed from the Game and Fish Fund at a rate of \$0.50 per acre or 35 percent of the gross receipts, whichever is greater (Minnesota Statutes, Sec. 97.49, Subd. 3, 1978). A third alternative method of determining the "greater" amount of in lieu of tax payments will become effective July 1, 1981 (Minnesota Laws, Ch. 301, 1979). This method would tax

qualifying lands at the rate of 3/4 of 1 percent of the appraised market value. Payments of \$0.50 per acre total \$3,818 per year for the Roseau River unit.

Effective July 1, 1979, additional in lieu of tax payments will be made to counties in which certain natural resource lands are located. Payments will be disbursed from general funds at the rate of: (1) \$3 per acre for state natural resource lands which were previously privately-owned and were acquired by purchase, condemnation, or gift, (2) 75 cents per acre for state tax-forfeited lands administered by the county, and (3) 37.5 cents per acre for other state lands administered by the DNR, including tax-forfeited, Trust Fund, and Consolidated Conservation area lands (Minnesota Laws, Ch. 303, 1979). Any payments to counties during the preceding year from Game and Fish Fund monies under Minnesota Statutes 97.49 will be deducted from the amounts levied under this provision. Annual payments to Roseau County for Roseau River WMA under this provision will total about \$43,000.

In addition, Minnesota Statutes, Section 272.011 (1978) require the state to pay real estate taxes to the counties for all state-owned residences occupied by state employees. These taxes are paid from the Minnesota DNR Field Services Budget, 27 percent of which is derived from the Game and Fish Fund. In 1978 and 1979, \$625 in real estate taxes were paid to Roseau County for the state-owned residence.

CAPITOL IMPROVEMENTS

The 11 buildings on the Roseau River WMA were built for the unit or salvaged from purchased farmsteads. Buildings at the headquarters include the manager's residence; two utility buildings, one of which houses an office, garages, and maintenance facilities, and the other one houses fish holding tanks and northern pike rescue equipment; two large machine storage buildings; a small access control building; and a pumphouse. An agricultural storage

Table 12. Expenditures and income in dollars on the Roseau River WMA, 1978 and 1979.

	1978	1979
Regional Expenditures		
Permanent Salaries and Benefits	\$ 62,923	\$52,029 ¹
Seasonal Salaries and Benefits	22,208	22,580
Retail Purchases and Contract Services	15,410	14,450
Equipment Purchases	24,000	6,000
Land Bureau and Administrative Service Expenditures		
Payment in Lieu of Taxes	3,818	3,818
Real Estate Taxes	625	625
Total Expenditures	135,017	99,502
Income		
Agricultural Leases	1,853	1,102

¹Manager's position was vacant for four months, saving about \$5,000.

area at Noracres at the west end of the unit has a barn and two granaries (Figure 4). Four of the buildings, built between 1930 and 1940, are in fair or poor condition, but the newer buildings are in good condition (Table 13).

Capital improvements used by visitors are limited to roads, trails, and parking areas. Thirty-eight miles of improved roads, 40 miles of access trails, and 14 parking areas are maintained by the Division of Fish and Wildlife. Three road bridges are also maintained (Figure 4).

Approximately 24 miles of dike impound three reservoirs totaling about 10,600 acres. Except for two miles of dikes constructed of peat, the dikes are compacted earth with clay cores. The dikes are equipped with seven water control structures. A seven-mile diversion channel extends from Pine Creek in Manitoba to the north side of Pool 1 and provides a water supply for the impoundments. Ten waterfowl feeding stations, consisting of earthen fill adjacent to dikes, have been constructed.

EQUIPMENT

Twenty-seven major equipment items are maintained on the area (Table 14). The equipment is used almost exclusively on the Roseau River WMA, but the dragline, a bulldozer, and some heavy trucks are utilized at times on other Region I wildlife projects. Light and heavy duty trucks are used to transport personnel, equipment, and material. Tractors and farm implements are used for agricultural operations and other vegetation management. Heavy equipment is used for construction and maintenance of roads, parking lots, dikes, and ditches, and for vegetation clearing.

STAFF

The Roseau River WMA employs three full-time and three seasonal personnel. The manager, assistant manager and heavy equipment operator are full-time; two laborers work May through December, and one laborer works May through October. Temporary hourly laborers may be employed as needed if funds are available.

Table 13. Buildings maintained on the Roseau River WMA.

Building	Dimensions	Construction Date	Condition
Headquarters			
Residence	35 x 56'	1956	Good
Machine shed	45 x 85'	1975	Good
Utility building ¹	28 x 42' - 2 story	1965	Good
Utility building	28 x 42' - 2 story	1956	Good
Double quonset	60 x 98'	1935	Fair
Access control building	10 x 12'	1940	Fair
Storage building	6 x 8'	1960	Fair
Pump house	6 x 6'	1975	Good
Noracres			
Barn	30 x 70'	1930	Poor
Granary #1	18' diameter 2470 bu. capacity	1960	Good
Granary #2	18' diameter 2470 bu. capacity	1960	Good

¹DNR, Section of Fisheries building with northern pike rescue equipment.

Table 14. Equipment based on the Roseau River WMA.

Equipment	Make/Model	Model Year	Condition	WMA Use Percent
Truck, pickup	Dodge/1/2 ton	1979	Excellent	100
Truck, pickup	Dodge/1/2 ton 4x4	1977	Good	100
Truck, pickup	Dodge/1/2 ton 4x4	1974	Good	100
Truck, dump w/snowplow	Ford/F800	1962	Poor	100
Truck, dump	International/1700	1976	Good	100
Truck, dump	International/1700	1968	Fair	90
Truck, dump	International/1700	1966	Fair	90
Truck, stake	Ford/F700	1968	Good	90
Tractor, farm, diesel	John Deere/2630	1975	Good	100
Tractor, farm, diesel	John Deere/4240	1978	Good	100
Loader	Case/1000 D	1964	Poor	100
Dozer	Caterpillar/D4	1969	Good	90
Dozer	Caterpillar/D8	Unknown		100
Dragline	American/1/2 yard	1959	Fair	90
Road grader	Huber-Warco	Unknown		100
Plow, 4-bottom	John Deere	Unknown		100
Tandem disc, 12 ft.	John Deere	1961		100
Drag, 4-section	International Harvester	Unknown		100
Grain drill, 12 ft.	John Deere	Unknown		100
Brush cutter	John Deere	Unknown		100
Grain elevator, 30 ft.	Unknown	Unknown		100
Swather	International/175	1968	Good	100
Field cultivator, 19 ft.	John Deere/1000	1978	Good	100
All-terrain-vehicle	Ranger	1966	Good	100
Snowmobile	Polaris/Voyageur	1967	Poor	100
Lawn mower	Toro/8 hp	1966	Poor	100
Lawn mower	Snapper	1976	Good	100

LAND OWNERSHIP

Land ownership strongly affects natural resource management. The goals and objectives of the WMA are shaped to a large extent by the history of land acquisition on the project, sources of acquisition funds, and present patterns of land ownership and administration.

ACQUISITION OF WILDLIFE LANDS

The Commissioner of Natural Resources is authorized to acquire lands for wildlife management purposes (Minnesota Statutes, Sections 97.48 and 97.481, 1978). However, before acquisition begins, the Section of Wildlife prepares project proposals which delineate areas desirable for wildlife land acquisition. The Director of the Division of Fish and Wildlife has the authority to approve project proposals for the Commissioner of Natural Resources. After a project is approved, the Section of Wildlife may attempt to acquire lands within the project boundary from willing sellers. The board of commissioners of the county involved must give approval before any purchase is completed.

Methods of acquiring public land within a project proposal vary. Consolidated Conservation Area lands may be classified for wildlife management and dedicated to the WMA by DNR Commissioner's Order. As required by law, Trust Fund lands may be purchased only through a condemnation procedure. County administered, tax-forfeited lands may be acquired from the county through a county board resolution defining the terms of sale.

Acquisition of wildlife lands has been financed primarily through appropriations from the Game and Fish Fund and with federal matching funds derived from the Federal Aid in Wildlife Restoration Act (Pittman-Robertson Act). Pittman-Robertson funds are used to match state funds on a 3:1 ratio for federally approved acquisition projects. In recent years, special appropriations for wildlife land acquisition have also been made from general revenue funds by the Minnesota Legislature.

Federal law requires federal aid project lands to be managed for approved project purposes only. Other uses of these lands could be considered a diversion of funds (Code of Federal Regulations, Title 50, Chap. 1, Sec. 80.5) which could cause the federal government to suspend all federal aid to fish and wildlife in the state, about \$3,000,000 per year. A diversion of funds created by non-approved activities can be rectified by: a) replacing the affected property with a property of equal current market value with commensurate values to fish and wildlife; or b) ceasing the uses which inter-

ferre with the accomplishment of approved project goals. Generally the approved project activities for the Roseau River WMA are the operation of a game refuge and public hunting grounds and the improvement of wildlife habitats.

ACQUISITION OF THE PRESENT WMA

Land acquisition for the Roseau River WMA began in 1949, and by 1952, 51,660 acres had been acquired. Additional tracts of state and private land were purchased between 1958 and 1969, increasing the WMA to its present 61,333 acres (Appendix K, Figure 2).

Over 87 percent of the acquired land was previously in state ownership, including about 3,000 acres of Consolidated Conservation Area land and over 50,000 acres of Trust Fund land (Table 15). About 7,600 acres of private land and some land previously owned by the federal government has also been acquired.

Nearly \$383,000 has been spent on land acquisition (Table 16). Ninety-five percent of the unit was purchased through Pittman-Robertson projects. Minnesota paid 25 percent of the federal aid acquisition project costs; over 99 percent of the matching funds were from the Game and Fish Fund. The remainder of the matching funds were provided from cigarette tax monies by the Legislative Minnesota Resources Commission (now the Legislative Commission on Minnesota Resources). Consolidated Conservation Area land was dedicated to the WMA at no cost.

Table 15. Previous land ownership in the Roseau River WMA.

Previous Ownership	Acres
Private	7,635.34
Federal	110.56
State	
Consolidated Conservation Area	3,030.83
Trust Fund	50,556.42
Total	61,333.15

Table 16. Acquisition methods, sources and amounts of funds, and acreage purchased in the Roseau River WMA.

Acquisition Method	Sources and Amounts of Funds			Acres
	Federal Aid in Wildlife Restoration	Minnesota Game and Fish Fund	Minnesota Resources Commission	
Federal Aid Projects	\$285,499.32 1,675.50	\$95,166.45	\$558.50	57,982.49 319.83
Consolidated Conservation Area Dedication (no funds involved)				3,030.83
TOTALS	\$287,174.82	\$95,166.45	\$558.50	61,333.15

JUNEBERRY SUPPLEMENT TO THE WMA

A project proposal approved by the Department of Natural Resources in 1960 and modified slightly in later years established the 32,411-acre Juneberry Supplement to the Roseau River WMA. Acquisition within this supplement was approved by Roseau County in 1964, and the Division of Fish and Wildlife purchased 7,957 acres of Trust Fund land in the Supplement in 1969. Funds for further acquisition were not available, and the county board rescinded approval shortly thereafter.

The Juneberry Supplement is still a DNR-approved

project. Of the 24,454 acres remaining unacquired, 50 percent are state Trust Fund lands administered by the DNR's Division of Forestry, 20 percent are tax-forfeited land, designated as a recreation area, and the remainder is privately owned (Table 17). As currently proposed the acquisition of the Supplement would increase the size of the WMA to 84,787 acres. The acquisition proposal has been reevaluated and modified in the section of this plan entitled Juneberry Supplement — Management, Administration, and Acquisition (p. 59).

Table 17. Ownership and acreage of unacquired land within the Roseau River WMA approved project boundary.

Present ownership classification	Administrator	Acres	Percent of Total
State			
Trust Fund			
Swamp	DNR-Forestry	8,292.84	33.9
School	DNR-Forestry	4,004.19	16.4
Volstead	DNR-Forestry	80.00	0.3
Tax-forfeited	Roseau County	4,866.01	19.9
County Recreation Area	Roseau County	4,341.49	17.8
Private		2,869.58	11.7
Totals		24,454.11	100.0

PUBLIC USE

Minnesota wildlife management areas are used for public hunting, trapping, fishing, and other activities compatible with wildlife and fish management. Outdoor recreation has always accounted for the largest share of public use on the Roseau River WMA, but the area is also used for nonrecreational activities such as environmental education and farming. Knowledge of the present use levels is necessary to predict the future demand for outdoor recreation and to prepare management programs.

Public use figures were obtained from estimates by WMA personnel and from a 1978 public use survey that was conducted for this plan. Estimates by the WMA manager were based partially on nonsystematic counts of cars parked on the unit and interviews with visitors, and partially on the manager's experience and recollection.

The public use survey, conducted from June 16 to December 31, 1978, was designed to estimate public use types and levels and to determine the attitudes and demographic characteristics of area users. Although survey results do not represent absolute use figures, they should provide reasonable estimates of use types and levels. Both the manager's estimates and the survey results are presented (Tables 18, 19, and 20). The units of public use in this section are use-days and visitor-days. A use-day is one person using the area for one activity on one day. A visitor-day is one person using the area on one day. One person may account for as many use-days as activities par-

ticipated in on one day, but he only accounts for one visitor-day. A description of survey techniques, data analysis, and additional results is presented in Appendix G.

A total of 383 questionnaires were distributed to area users; 136 (36 percent) were returned. Results from the survey were expanded to cover the period from May 13 to December 31. Total visitor-days during this period was estimated at 8,206 (Table 18). Four percent of the total use occurred during the summer period (May 13 — September 15) and 96 percent during the fall/winter period (September 16 — December 31).

Visitor use was distributed among different recreational activities (Table 19). Hunting, camping, observing nature, and photography constituted the major recreational uses.

HUNTING

Hunting has been the dominant recreational use of the Roseau River WMA. In 1969, WMA personnel estimated that hunters accounted for 39 percent of all the users on the area (Bares et al. 1973). An estimated 7,800 hunter use-days were spent on the management area during 1969. Most use was by waterfowl hunters, with an estimated 7,000 use-days, followed by deer hunters and upland game hunters with 500 and 300 use-days, respectively (Table 20). The manager could not detect hunters who hunted more than one type of

Table 18. Distribution and percentage contribution of visitor use by season and type of day on the Roseau River WMA, May 13 — December 31, 1978.

Type of Day/Season	Visitor-days	Percent Total
Summer (May 13 — Sept. 15)		
Weekend	227	2.8
Weekday	129	1.6
Subtotal	356	4.3
Fall/Winter (Sept. 16 — Dec. 31)		
Weekend	2,916	35.5
Weekday	4,934	60.1
Subtotal	7,850	95.7
Total	8,206	100

Table 19. Percent of parties participating in and estimated number of use-days for each of 13 major recreational activities on the Roseau River WMA, May — December, 1978.

Activity	Percent of Parties	Use-days
Hunting	96	7,878
Waterfowl	84	6,893
Deer	7	574
Upland small game ¹	29	2,380
Camping	26	2,134
Observing nature	18	1,477
Bird watching	7	574
Boating/Canoeing	7	574
Photography	11	903
Firewood gathering	5	410
Hiking	4	328
Picnicking	3	246
Trapping	1	82
Fishing	4	328

¹ Includes ruffed and sharp-tailed grouse, gray partridge, and snowshoe hare hunting.

game in the same day.

In 1977, the resident manager estimated that 8,535 deer, grouse, and waterfowl hunter use-days occurred on the management area (Table 21). Most of the hunting use was by waterfowl hunters. Moose hunters also used the area in 1977, but the number of use-days was not estimated. A calculation based on the 23 moose killed on the WMA, the 97 percent success in the zone, and the maximum party size of four, yielded an estimated maximum of 96 moose hunters using the area in 1977.

Using car counts, the resident manager estimated hunting pressure for different periods throughout the 1977 seasons (Table 21). Twenty-two percent of the waterfowl hunting and 23 percent of the firearms deer hunting occurred on the opening weekend. Hunting pressure on grouse was more evenly spread throughout the season. Deer hunters and grouse hunters were well distributed over the WMA, but an es-

timated 70 percent of the waterfowl hunters used the east half of the unit (Table 21).

In 1978, WMA personnel monitored hunting pressure by making daily car counts October 1 through November 14. Although a few users were found to be grouse hunting or engaging in other activities, the remaining parties were assumed to be waterfowl hunters. The total car count for the period was 3,088. Average party size for 219 waterfowl hunting parties checked during the period was 2.5, giving an estimated 7,720 users. The peak car count was 293, indicating 732 hunters, on October 1, the first day of waterfowl season.

Additional information on hunting and other activities was obtained during June through December, 1978, from returns of questionnaires placed on cars on randomly selected days. Hunting visitor-day estimates from the questionnaire returns (Appendix G) were similar to car counts in some respects. For example,

Table 20. Public use of the Roseau River WMA, 1969, as estimated by the resident manager.

Type of Visitor	Visitor-days ¹	Percent of Total
Waterfowl hunters	7,000	35.0
Deer hunters	500	2.5
Upland game hunters	300	1.5
Fishermen	7,000	35.0
Picnickers	400	2.0
Boy Scouts	200	1.0
Bird watchers	200	1.0
Students	100	0.5
Miscellaneous sightseers	3,000	15.0
Trappers	100	0.5
Boaters	500	2.5
Snowmobilers	500	2.5
Other	200	1.0
Total	20,000	100.0

Source: Bares et al, 1973.

¹ This estimate was made under the assumption that each visitor used the area for a single use.

Table 21. Temporal and spatial distribution of hunters on the Roseau River WMA in 1977 as estimated by the resident manager.

	Firearms Deer	Grouse	Waterfowl
Temporal Distribution			
Hunter-use Days	800	765	6,970
Opening Day	Nov. 5	Sept. 17	Oct. 1
% Use	12	14	13
Opening Weekend	Nov. 5-6	Sept. 17-18	Oct. 1-2
% Use	23	15	22
First Week	Nov. 7-11	Sept. 19-23	Oct. 3-7
% Use	26	22	39
Remaining Weekends	6 Days	20 Days	12 Days
% Use	23	33	22
Remaining Weekdays	6 Days	58 Days	26 Days
% Use	28	30	17
Spatial Distribution			
% Use in east half	50	40	70
% Use in west half	50	60	30

the total hunting visitor-days for the month of October as calculated from questionnaire returns was 7,135, compared to 7,488 estimated from car-counts. Car-counts, especially during the hunting season, may provide the better estimate as sampling was more intensive than on the questionnaire survey. However, car-counts did not reveal the multiple hunting uses occurring. A total of 9,847 hunting use-days was calculated from the 1978 survey.

The returned questionnaires indicated that hunting was the major recreational activity on the unit, as only 4 percent of 136 responding parties did not report hunting (Table 19). Eighty-four percent hunted water-

fowl; 65 percent of the waterfowlers hunted both ducks and geese, 30 percent hunted geese only, and 5 percent hunted ducks only. Ruffed grouse hunting was the next most frequently mentioned type of hunting.

Visitors were asked to indicate on the questionnaires which of five hunting compartments (Figure 5) they used on the WMA. In the responding parties, 50 percent of the hunting and 48 percent of all activities were done in Compartment 1, which includes Pool 1 (Appendix G, Table 2). Intensity of public use was similar for Compartments 2, 3, and 5; however, the use of these zones combined just equalled use in Compartment 1. Compartment 4, the southwestern part of

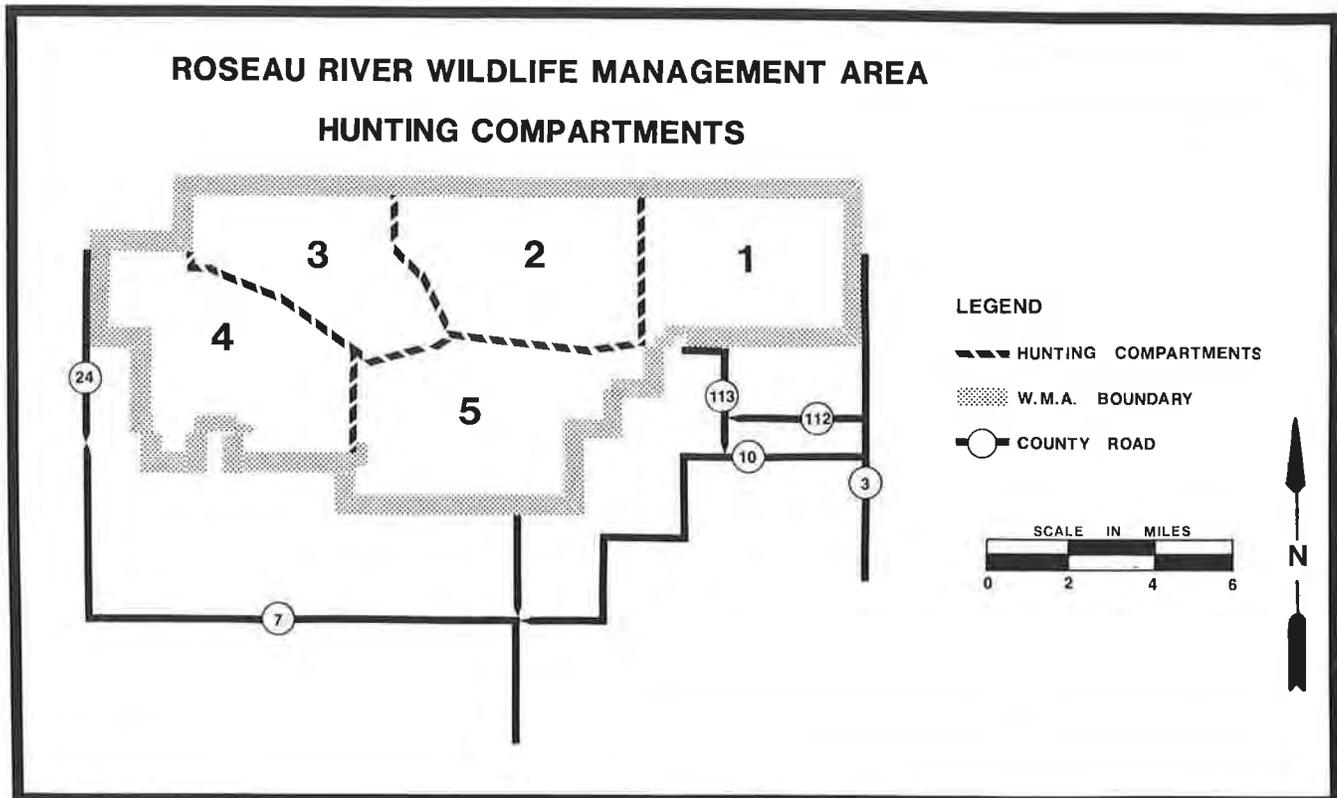


Figure 5

the WMA, was the least-used compartment. Deer hunting was distributed relatively evenly over all compartments, while all gray partridge hunting occurred in Compartment 1. Most duck hunting is on the main pools from boat or canoe, but a few hunters walk to isolated potholes or use the Roseau River for access. Geese are also hunted in the pools, but most of the goose hunting is pass shooting from 44 blinds along the south and east sides of Pool 1 (Figure 6). Three sanctuary areas, one in a portion of each of the pool areas, are closed to waterfowl hunting. The Pool 3 sanctuary is open to deer hunting during the firearms deer season (Figure 4).

Limited information on hunting success or numbers of waterfowl harvested is obtained from yearly spot checks of waterfowl hunters. In seven years in the 1950's and 1960's, hunters averaged 1.2 to 2.0 ducks per hunt, while the average in 1972 and 1978 was between 0.4 and 0.5. An estimated 3,320 ducks were taken in 1978 (7,720 users x 0.43 ducks/person). The Canada goose kill on or near the area has increased from an estimated 500 per year in 1965-69 (Johnson and Jensen 1973) to 2,854 in 1977 and 2,580 in 1978. The snow goose kill varies considerably; an estimated 100 and 300 snow geese were killed in 1971 and 1974, respectively. The moose kills for 1975 and 1977 for the WMA and the Juneberry area combined were 24 and 44, respectively, with the estimated kill for the WMA alone being 13 and 23. No recent data are available for deer or grouse harvest.

TRAPPING

The resident manager has issued 6 to 11 general trapping permits and a lesser number of beaver permits for the past 13 years (Table 22). In 1969, the resident manager estimated 100 days use by trappers (Bares et al. 1973). The 1978 survey estimated 82 trapping use-days (Table 19). Muskrat and mink have been the most numerous species in the harvest, with striped skunk, raccoon, red fox, and beaver also common. The estimated value of all pelts taken on the WMA from 1965 through 1977 averaged \$5,227 per year, with a high of \$10,290 in 1976 (Table 22).

FISHING

Fishing is done on the Roseau River and the main pools. The primary species of fish sought are northern pike in the pools and northern pike and walleyes in the Roseau River. Fishing pressure on the WMA varies considerably from year to year, probably depending on the abundance of fish and the fishing success in the pools. A total of 7,000 fishermen use-days on the WMA was estimated by the resident manager in 1969, a year when fish were present in the pools (Bares et al. 1973). In 1978, a year when northern pike were absent, only 328 fishermen use-days were estimated from the public use survey (Table 19). Only 6 of 136 responding parties reported that they fished on the area. It is likely that the 1978 use-day figure is low. The first weeks of the fishing season were not sampled and use for the period was estimated from a later period. Also, people parking their cars off the WMA and entering the wildlife area by boat on the Roseau River were not sampled. WMA personnel estimate that an average of about 60 vehicles (150 people) are on the area on the opening day of fishing season.

OTHER RECREATIONAL ACTIVITIES

The management area is used for other activities, including sightseeing, boating, snowmobiling, picnicking, and birdwatching. In 1969, WMA personnel estimated that these other uses accounted for 5,200 use-days, or 26 percent of the total (Table 20). In recent years, the public has been permitted to drive through the WMA on the dikes, road conditions permitting, during the month of August, and much of the sightseeing has been done during that month. Guided tours are conducted for student groups and others on request.

The results of the public use survey done with questionnaires in 1978 provide additional information on activities on the Roseau River WMA. Of 136 parties that responded to the questionnaire, 26 percent camped, 18 percent observed nature, 11 percent took photos, and 6 percent birdwatched (Table 19). It is likely that nearly all of these activities were incidental to hunting, since only 4 percent of the parties did not

Table 22. Fur harvest reported on the Roseau River WMA, 1965 — 1977.

Species	Year													Average
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	
Muskrat	547	4,955	2,929	1,112	1,229	446	315	869	480	745	657	1,077	374	1,128
Mink	100	167	198	237	266	238	226	266	186	124	151	165	124	188
Striped skunk	30	10	15	30	103	74	43	80	35	8	46	42	42	43
Raccoon	5	50	32	20	72	50	27	6	15	26	0	21	23	27
Beaver	0	0	8	0	0	0	0	0	30	33	50	50	32	16
Red fox	6	10	8	16	23	20	21	24	21	16	11	28	6	16
Coyote	3	10	8	4	2	19	8	15	1	9	10	5	1	7
Weasel	0	10	5	0	0	4	0	0	0	0	0	0	6	2
Badger	0	0	0	2	0	0	0	6	0	0	0	10	0	1
Bobcat	8	0	1	3	0	0	0	0	0	0	0	0	0	1
Lynx	4	0	0	2	0	0	0	0	0	0	0	0	0	<1
Gray wolf	1	0	1	0	2	0	0	0	0	0	0	0	0	<1
Black bear	1	0	0	1	0	0	1	0	0	0	0	0	0	<1
Number of permits	7	10	10	9	9	9	6	6	6	8	9	10	11	8
Estimated Value of Furs	\$2,275	\$8,567	\$4,089	\$5,039	\$5,139	\$2,623	\$2,486	\$8,757	\$5,555	\$4,399	\$5,502	\$10,290	\$4,930	\$5,204

**ROSEAU RIVER WILDLIFE MANAGEMENT AREA
CONTROLLED HUNTING ZONE**

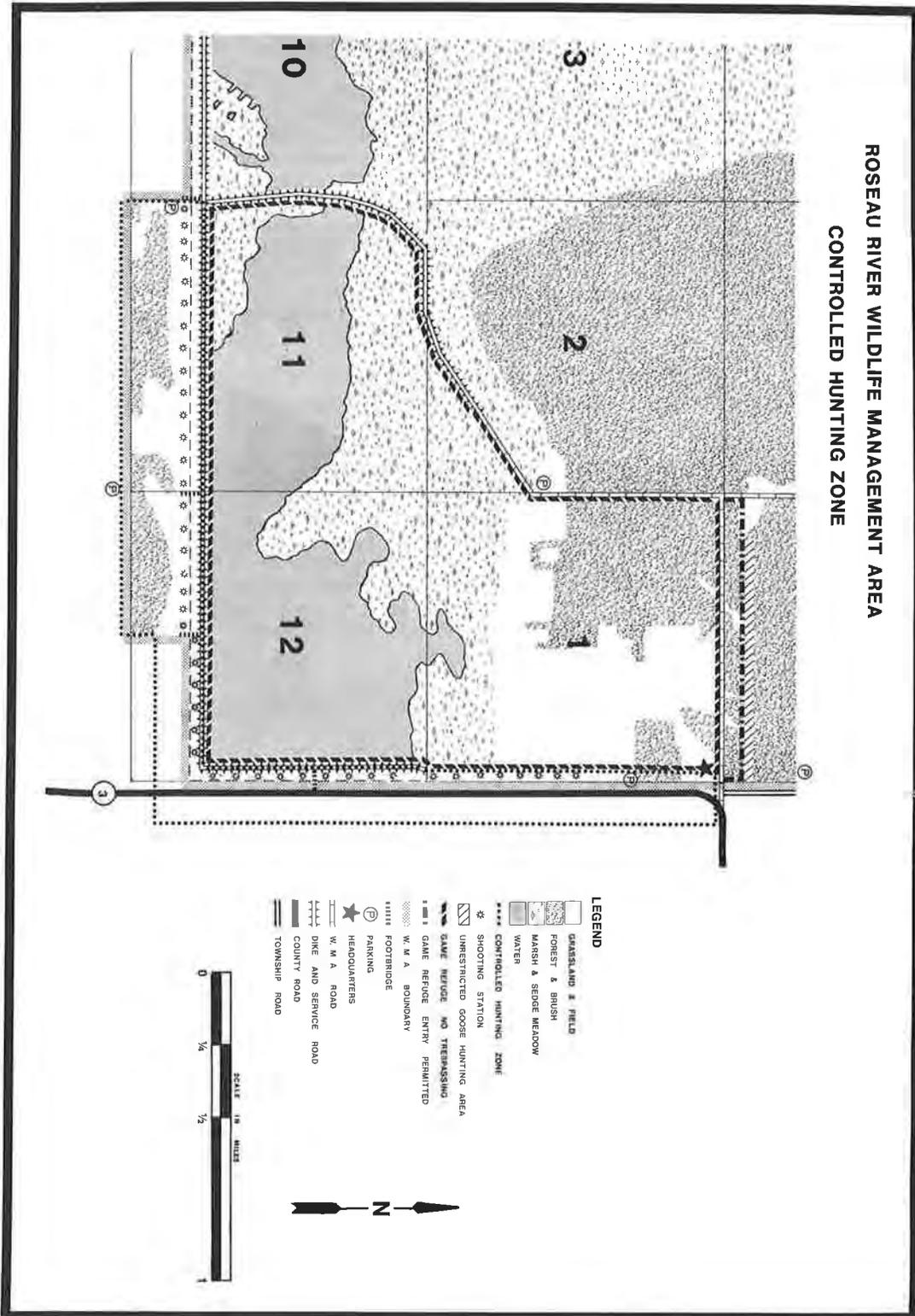


Figure 6

hunt. The fact that these other activities were mentioned may suggest that they were of some importance to the participants. This survey probably did not accurately reflect uses which do not involve parking a car on the unit. Such users, including students, boy scouts, snowmobilers, and miscellaneous sightseers made up 19 percent of the manager's 1969 public use estimate.

VISITOR CHARACTERISTICS.

Visitors to the management area averaged 35 years of age. Over one-half, 66 percent, were younger than 40 years. Ninety-three percent were males. Only 3 percent of the respondents were out-of-state residents.

Most of the visitors (85 percent) traveled more than 50 miles to the management area (Table 23). Over 46 percent of the respondents had visited the unit at least once previously within the last year, averaging 3.0 trips. Most respondents came in groups of two to four individuals; average party size was 2.8 people. About one-half, 52 percent, of the visitors to the area stayed longer than 24 hours. Visitors spent an average of \$30 per visit (Table 24).

Seventy-eight percent of the respondents rated their visit to the management area as good or very good. Only 7 percent of the visits were rated as poor or very poor. Respondents considered area appearance (wildness, scenic beauty), abundance of wildlife, hunting quality, goose hunting, parking and camping areas, and access as the most important features of the area. Nineteen percent of the respondents felt that the management area did not need further improvements. Most respondents felt that the camping and

access areas could be improved. Respondents also wanted to see increased enforcement of hunting regulations, higher water levels and more open water, better goose blind construction and placement, and better hunter ethics.

Visitors were also asked to indicate on the public use questionnaire whether or not they would be willing to pay a \$3-5 or \$5-10 fee to help cover the expense of a pre-registered, controlled goose hunt on the Roseau River WMA. Less than 25 percent of the 122 respondents to this question stated that they would favor a fee (Table 25). Of the 122 respondents, 106 were goose hunters and about 24 percent of these favored a registration fee. Of the 16 non-geese hunters responding, 69 percent were against paying for a controlled hunt. Responses to other questions indicated that many current goose hunters hunt this WMA because they do not like the more restrictive controlled goose hunts on other units.

AGRICULTURAL LEASES.

Part of the cropland on the unit is farmed by private operators to provide fall and winter food for waterfowl, upland game, and deer; provide small grain to reduce damage by waterfowl to crops on private lands; and maintain open areas for some species of wildlife. In 1977 and 1978, cooperative farming agreements totaled 1,263 and 1,166 acres, respectively (Table 26). Leases were granted to 18 individuals in 1977 and 15 in 1978. Income from the leases was \$1,922 in 1977 and \$1,853 in 1978.

Table 23. Traveling distance of hunters and non-hunters using the Roseau River WMA.

Distance (miles)	Percent		
	Hunters	Other Users	Combined
0-50	9	3	12
51-100	6	0	6
101-200	19	0	19
201-300	18	0	18
> 300 ¹	3	<1	3
Twin City Area ²	38	0	38
Out-of-State	3	1	4

¹ Excluding the Twin City Area.

² Includes Ramsey, Hennepin, Washington, Dakota, Scott, Carver, and Anoka Counties.

Table 24. Average length of visit, party size, expenditures, and number of previous visits by period on the Roseau River WMA.

	Period		
	Summer (May 13-Sept. 15)	Fall/Winter (Sept. 16-Dec. 31)	Combined (May 13-Dec. 31)
Length of visit (hours)	4.1	46.8	45.8
Party size	2.1	2.8	2.8
Local Expenditures per person per visit	\$35.90	\$29.93	\$30.11
Number of previous visits per person in the past year	19.8	2.2	2.8

Table 25. Willingness of 122 respondents to pay a fee for a pre-registered, controlled goose hunt on the Roseau River WMA.

	Number of Respondents	Willing to pay a fee (Percent)		Amount (Percent)	
		No	Yes	\$3-5	\$5-10
All Respondents	122	75.4	24.6	17.2	7.4
Goose Hunters	106	76.4	23.6	16.0	7.6
Non-goose Hunters	16	68.8	31.2	25.0	6.2

Table 26. Cooperative farming data for the Roseau River WMA, 1977 and 1978.

Crop	Acres		Cash		State Share Unharvested (acres)		Harvested (acres)	
	1977	1978	1977	1978	1977	1978	1977	1978
Oats	410	400	0	0	10	0 ¹	43 ²	10 ¹
Barley	15	15	0	0	4	4	0	0
Summer fallow	0	80	0	0	0	0	0	0
Tame hay	326	409	\$1,018	\$1,198	0	0	0	0
Wild hay	512	262	904 ³	655	0	0	0	0
Total	1,263	1,166	\$1,922	\$1,853				

¹ Plus 70 acres of oats to be left standing or harvested, as requested, and 40 acres of baled oats straw for waterfowl nesting sites.

² Plus 20 acres of baled oats straw, 8 acres of winter wheat seeded, and an amount of winter wheat equal in value to 30 acres of oats.

³ Plus 11 acres of winter wheat seeded.

LOCAL PERSPECTIVE

Wildlife and fish management is influenced by land use, demographic characteristics, economic conditions and other factors in the management area vicinity. Development or the potential for development adjacent to the management area may affect future management decisions. In addition, the availability of public lands for outdoor recreation in the vicinity will influence the demand for recreation on the area.

GENERAL

Kittson and Roseau Counties comprise the local region which most affects the management area. The counties' combined population is about 20,000 or about seven persons per square mile. An increase of less than 2 percent is expected by 1990 (Minnesota State Planning Agency 1975a). Roseau (population 2,552), the largest city in the local region, is 20 miles from the Roseau River WMA headquarters. The Twin Cities are a seven to eight hour drive away.

The local region is primarily agricultural. Fifty-three percent of the land is cultivated, and 14 percent is pasture or open land (Table 27). In 1974, about one-

third of the population resided on farms (Minnesota Department of Agriculture 1974). The average farm size in 1977 was 524 acres, twice the state average, and the size has been increasing over the past 10 years (Minnesota Department of Agriculture 1978). Cash crops provided about 75 percent of the farm income in 1975. Wheat is the principal crop followed by oats, hay, barley, sunflowers, and flax. Total acreage in sunflowers in Kittson and Roseau Counties increased from 5,000 acres in 1976 to 42,000 acres in 1978. Livestock are mainly beef cattle and sheep, with some dairy cattle and hogs (Minnesota Department of Agriculture 1978).

Forests occupy 21 percent of Kittson and Roseau Counties, but over 80 percent of the forest is in Roseau County (Table 27). Much of the forest is low quality aspen, but some merchantable softwoods are available. Timber harvest is of little importance to the economies of the counties and is insignificant relative to the state harvest. Markets for spruce and pine are good while the aspen demand is very low. The DNR, Division of Forestry, however, expects that increased wood products plant construction will greatly increase

Table 27. General land use in Kittson and Roseau Counties.

	Kittson		Roseau	
	Acres	Percent	Acres	Percent
Forested	67,920	10	313,618	29
Cultivated	479,440	67	465,019	43
Pasture and Open	101,520	14	151,402	14
Water	2,040	T ¹	10,814	1
Marsh	58,280	8	140,587	13
Urban, Extractive, and Transportation	4,640	1	3,680	T

¹ Trace=less than 1 percent.
Source: Minnesota State Planning Agency 1975b

aspen demand in northwest Minnesota.

Wetlands occur on 11 percent of the land in the two counties (Table 27). Few lakes exist and less than 1 percent of the area is open water.

Land use patterns in northwest Minnesota are clearly visible in an infrared photo taken in mid-August by a LANDSAT satellite from an altitude of 570 miles (Figure 7). The regular patchwork pattern is composed of agricultural fields. The black fields have been plowed. Agriculture is most intensive near the Red River. Cultivation becomes less common in the eastern portions where soils become generally less fertile and more difficult to drain. The open areas without fields are primarily extensive wetlands or coarse-soiled beach ridges.

The economy of the area is primarily agricultural; however, other activities employ the majority of the wage-earners. Retail and wholesale trade and services employ over half of the workers. Manufacturing, led by snowmobile and related equipment, employs

about 30 percent of the salaried workers. Tourist-travel related business, such as that generated by the WMA, accounts for less than 5 percent of the total sales in Roseau and Kittson Counties (Minnesota Department of Economic Development 1975.)

Outdoor recreation in the two-county area is provided for with much public land but few developed facilities (Table 28). There are two state parks, totaling 4,370 acres. Wildlife lands include nine state wildlife management areas with 98,234 acres. State forest boundaries enclose 76,404 acres in Roseau County. Developed recreational facilities include eight campgrounds with 402 campsites, 11 picnic areas, and 85 miles of trails. Water based facilities include eight water accesses, one swimming beach, and three boat rental areas.

Hayes Lake State Park is 40 road miles from the east side of the WMA and Lake Bronson State Park is 32 road miles from the west end of the unit. The parks are probably of limited importance to WMA visitors.

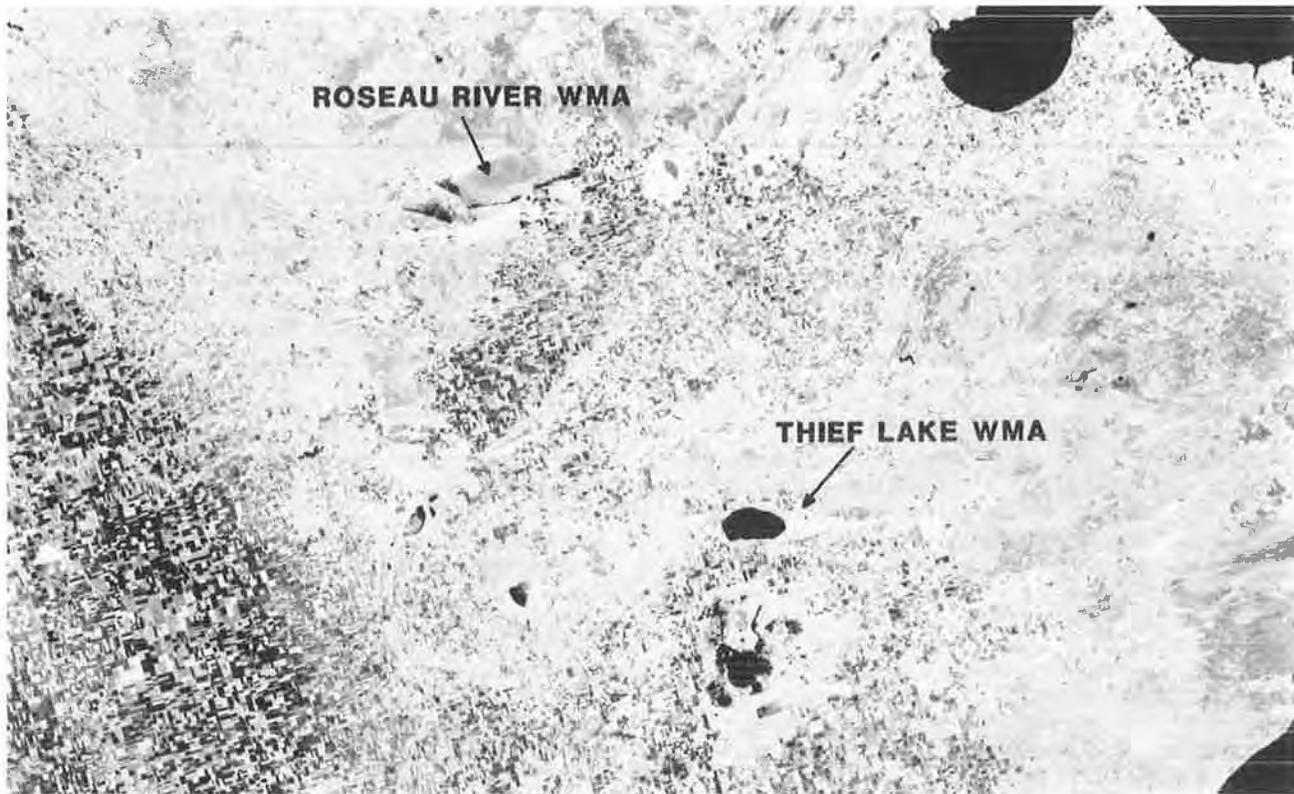


Figure 7

Table 28. Selected public use facilities in Kittson and Roseau Counties.

Area	Name	County	
		Kittson	Roseau
State Parks (acres)	Lake Bronson	1,670	
	Hayes Lake		2,700
Wildlife Management Areas (acres)	Beaches Lake	16,039	
	Caribou	6,338	
	Joe River	80	
	Skull Lake	6,160	
	Twin Lakes	7,930	
	Border		266
	Grimstad		8
	R.C. 3		80
	Roseau River		61,333
State Forest (acres)	Beltrami Island		76,404
Trails (miles)	Snowmobile	16	54
	Hiking	11	
	Horseback	4	
Camping Areas	Number	2	6
	Camp sites	200	202
Picnic Areas	Number	3	8
	Tables	183	31
Water Facilities	Swimming beaches	1	0
	Boat rental areas	1	2
	Water accesses	2	6

However, they may provide camping areas for a few hunters, and they may attract visitors to the area.

Other recreational facilities outside the two-county area may influence the demand for recreation on the Roseau River WMA. The Thief Lake WMA (33,255 acres) and the Agassiz National Wildlife Refuge (61,487 acres) in Marshall County and the Red Lake WMA (284,106 acres) and portions of the Beltrami Island State Forest (430,364 acres) in Beltrami and Lake of the Woods Counties are all within 50 miles of the unit (Figure 8).

ADJACENT DEVELOPMENT

The area surrounding the management area is generally in agricultural production. Additional lands are continuously being drained and cleared for farming. Local pressure exists for the Commissioner of Natural Resources to reclassify certain Consolidated Conservation Area lands in the northwest as agricultural lands to allow for their sale. Commercial, residential, and associated development near the management area is limited.

Recently, the search for alternative sources of energy has intensified interest in Minnesota's peat resources. Over 75 percent of the management area is overlain by peat, but most of this is shallow (three feet) and probably not of commercial value. A lease to mine horticultural peat has been applied for on 10,000 acres of state land 15 miles east of the Roseau River WMA. The lease is pending until the peat mining and reclamation techniques and resultant environmental impacts are fully assessed. The DNR, Division of Minerals has initiated a comprehensive program to delineate and inventory major peat resources in the state and to study the feasibility and impact of peat utilization and reclamation. Some interest in metallic mineral exploration in the vicinity has been expressed by the mining industry. However, the wetness of the

unit would probably make such mining very difficult.

ROSEAU RIVER FLOOD CONTROL PROJECT

The proposed U. S. Army Corps of Engineers' Roseau River Project would involve channel modification on an approximately 46-mile stretch of the river between the Village of Roseau and the Canadian border. The project is "designed to provide varying levels of flood protection for reaches of the Roseau River from the City of Roseau to the Big Swamp area and to reduce the duration of flooding on some floodplain lands downstream from Big Swamp" (U. S. Army Corps of Engineers 1976). The project would involve channel enlargement, channel cutoffs, levees, and structures to connect existing ditches with the new channels. Nine new channel cutoffs are proposed, but none are planned in the river channel within the management area. Existing cutoffs, however, will be widened and deepened. Approximately 80 side-ditch inlet structures will be constructed to control erosion and drainage. It is anticipated that the project will require about four years to complete.

The Corps of Engineers has spent approximately \$1.3 million designing and planning the project since 1967. The current budget is about \$500,000 per year for design and planning. Construction of the project will begin when and if environmental and international issues are resolved.

Assessment of the environmental impact of the project has not been completed. It is generally conceded, however, that the project will seriously damage the fisheries resource of the Roseau River. Channelization work will also damage bottomland habitats at least temporarily, and the project may be detrimental to furbearers, moose, and white-tailed deer. The total effect of the project on waterfowl is unknown, but waterfowl habitat in the main channel will be severely degraded. There is also concern that the project may cause

lowered water levels south of the main WMA pools, possibly damaging the productive potholes. Water control and retention improvements on the oxbows should maintain their value to waterfowl. Increased secondary drainage made possible by reduced flood durations could encourage additional land clearing for agriculture. Better drainage potential would also increase pressure to sell state lands for conversion to agriculture, thereby further reducing wildlife habitat and increasing hunting pressure on the Roseau River unit. An important loss, impossible to mitigate, would

be the degradation of a scenic river that is used and enjoyed by many people whether they be fishing, hunting, canoeing, or hiking.

The project plan has not been finalized, and details and mitigative features of the project are still being modified. Even if the State of Minnesota agrees to the project as expected, the project must still gain approval from the Canadian government. Final agreements concerning the project which affect the Roseau River WMA will be submitted to the State Planning Agency for review.

RECREATION DEMAND AND CAPACITY

Anticipating the demand for hunting, trapping, fishing and other compatible outdoor recreational uses is essential for the development of an effective management plan. By relating future demand to the recreational capacity of the area, programs can be designed to both utilize and protect the area's resources.

DEMAND

Predicting the wildlife and fish oriented use of the Roseau River WMA is difficult. Future hunting, trapping, and fishing demand can be estimated by examining state-wide population trends, license sales, game abundance and harvest, and availability of private and public lands for these activities. Demand for other types of compatible recreation can be projected from participation surveys if the survey limitations are recognized (Minnesota Department of Natural Resources 1974). This type of demand analysis must be general due to information limitation.

The Minnesota DNR presently administers over 900 wildlife management areas, totaling nearly one million acres. Because intensive agricultural practices, forest community succession, and increased posting of private lands has reduced the quality and quantity of land available for wildlife production and public hunting, wildlife management areas are increasingly important for both wildlife and sportsmen. Wildlife habitat improvement projects are also concentrated on wildlife management areas or other public lands and will attract an increasing number of hunters. Wildlife management areas are important for a growing number of urban hunters who have difficulty obtaining access to private land (Klessig 1970). As Minnesota's population increases, so will the number of hunters, especially the urban hunters who rely on wildlife management areas. Minnesota sportsmen and wildlife enthusiasts are mobile, so increased recreational pressure will be felt in relatively remote areas even though most of the demand will occur near population centers.

Deer hunting license sales have increased since 1940 at a rate greater than the overall population growth. Sales are expected to fluctuate near current levels of 250,000 to 350,000 with an upward trend through the next 10 years. Archery-deer license sales have followed a similar trend. However, the rate of increase from the low of 12,500 in 1970 to 1978 sales of 32,300 was over twice as great as the firearms license sales increase.

Small game license sales declined from a 1958 high of 379,667 to 221,154 in 1969, probably largely due to the pheasant decline in southern Minnesota. Small game license sales have stabilized at about 280,000 — 300,000 since 1970 and are expected to remain near this level in the near future.

Over one-half of total small game license holders are waterfowl hunters. Federal migratory waterfowl stamp sales, which closely parallel waterfowl hunter numbers, vary with bag limits, season limits, and the price of the stamp. Sales have fluctuated between 122,000 and 180,000 since 1969. The number of waterfowl hunters should remain a relatively constant proportion of the state's population if waterfowl populations and hunting regulations do not change significantly (Minnesota Department of Natural Resources 1974). Future restrictive regulations and increases in the price of the federal and state migratory bird stamps may depress the number of waterfowl hunters in Minnesota. Liberalization of regulations would probably increase waterfowl hunters.

The demand for trapping opportunities will probably be related to the availability of places to trap, furbearer populations, and fur prices. Since 1940 the number of trapping licenses sold in Minnesota has varied widely from a high of 53,899 in 1946 to a low of 5,903 in 1971. License sales stabilized at about 11,000 to 14,000 between 1973 and 1978. Due to increasing fur prices and furbearer populations, license sales increased to 18,121 in 1979 and over 30,000 in 1980. Trapper numbers are expected to remain near this level or decrease slightly in the near future.

Admittedly, the preceding discussions are only qualitative. These projections suggest that total hunting demand in Minnesota will not increase dramatically in the near future, but intensified use of private lands will increase the importance of management areas to Minnesota's wildlife and sportsmen. The same trend is developing for other wildlife-related recreation. The Roseau River WMA will probably experience an increased demand for deer and small game hunting, and other wildlife-related recreation equal to the state average. However, if fuel shortages develop or if transportation costs rise too high, a decrease in use will probably occur since the unit is far from the population centers which generate over one-half of the present demand (Table 23).

CAPACITY

In order to insure quality public recreational use while protecting a wildlife management area's resources, the capacity of the area for hunting, trapping, fishing, and other compatible uses must be examined. The capacity of the Roseau River WMA to accommodate hunters, trappers, and fishermen is related to many factors such as fish and wildlife abundance, regulations, topography, vegetation, and access. Excessive user densities result in interference or conflicts between sportsmen. The U.S. Fish and Wildlife Service and U.S. Bureau of Outdoor Recreation (now the Heritage Conservation and Recreation Service), have developed hunter density guidelines for quality hunting which may be a useful guide for wildlife management areas (Table 29). Concentrations of sen-

sitive wildlife populations may require the exclusion of hunting, trapping, fishing, or trespass at specific times from sanctuaries and refuges established within a wildlife management area.

Furthermore, quality experiences depend not only on user densities, fish and wildlife habitats, and fish and game abundance, but also on the sportsmanship and sense of responsibility of hunters and fishermen. Thus, the same set of user density standards cannot be applied uniformly to all wildlife management areas. The capacity of the Roseau River WMA to accommodate hunters should be defined in terms of hunting experiences which are rewarding to hunters and acceptable to the non-hunting public.

The Division of Fish and Wildlife encourages the use of wildlife management areas for activities related to fish and wildlife or their habitats, such as nature observation, photography, hiking, or cross-country skiing. A management area's attractiveness for and capacity to support compatible outdoor recreation depend on factors such as access, the variety and sensitivity of the area's wildlife populations, plant communities and topography.

The Roseau River WMA has spectacular waterfowl concentrations and easily observed white-tailed deer, moose, sandhill cranes, and resident Canada geese. Some of these resources are sensitive to overuse. However, when used in a dispersed manner by low densities of people, the management area can accommodate many visitor-days of waterfowl and deer observation and photography, appreciation and study of wetlands, walking for pleasure, and other compatible activities.

Table 29. Hunter density guidelines proposed by the U.S. Fish and Wildlife Service and the U.S. Bureau of Outdoor Recreation.

Game Species	Standard	Length of Stay (hours)
Geese	1 blind per 200 yards per 2 hunters	4
Ducks	1 blind per 10 acres of marsh per 2 hunters or 1 blind per 200 yards	4
Upland game birds	13 hunters per square mile	2
Small game	13 hunters per square mile	4
Pheasants	64 hunters per square mile	3
Deer	13 hunters per square mile	8

Source: U.S. Department of the Interior 1967, 1972.

MANAGEMENT PROGRAMS

Management of the Roseau River WMA will insure the sustained production of and use by a variety of wildlife and the protection of unique scientific and aesthetic resources. Public use will be managed to provide visitors with quality experiences consistent with resource potentials and limitations.

In writing a management plan for the WMA, rather than discussing the management of each species or group of species, we have chosen to discuss management of each habitat type. A species-by-species account would require much repetition since one management practice affects many species. Exceptions to the habitat management approach are sections on Canada geese and nongame species.

Each management section begins with a brief statement of objectives. Quantitative objectives, such as the number of ducks to be produced, are not given. Because of the lack of information, such estimates would not be very meaningful. A discussion of considerations follows, including a review of published studies on the subject and a discussion of the needs, opportunities, problems, and limitations for management. Each management section concludes with statements on past, present, and future management programs.

Most management is concerned with the maintenance and development of wetlands, forests, and croplands essential for waterfowl, big game, small game, and other wildlife. While no management programs are proposed for some species, including small mammals, reptiles, amphibians, and invertebrates, the maintenance of a variety of natural habitats will insure the survival of plants and animals native to the area.

WETLAND MANAGEMENT

Objectives. Wetlands will be managed primarily for waterfowl production, migratory waterfowl use, and public hunting. Impoundments will be managed for maximum muskrat production within the limits imposed by their damage to dikes. Impoundments will also be used to store flood water insofar as such management is compatible with the area's objectives.

Considerations. The ability to control water levels is needed to properly manage impoundments like those on the WMA. At present the Minnesota DNR has no control over the amount of water that enters the WMA through the Pine Creek Diversion Ditch. The old Pine Creek channel is plugged except for an 18-inch diameter culvert with a control gate. During low to moderate flows most of the water enters the diversion

ditch, but during high flow periods water flows over a spillway to the old Pine Creek channel. Operation of the culvert gate is not covered in the agreement between Manitoba and Minnesota. Nearly every year spring flows exceed the capacity of the WMA pools, and, for a time, as much water as possible must be released to protect the dikes. Excessive spring flows, low in fertility, also act to flush nutrients from the pools. Flows during the late summer and fall in some years are insufficient to maintain the desired levels in the pools. If water levels drop too low in summer and fall, the pools are less attractive to waterfowl and they offer both fewer hunting sites and fewer hunting opportunities.

A periodic drying out, or drawdown, of the pools may be used to manage vegetation, to control unwanted fish or wildlife species, to release stored nutrients, or to retard the filling of the wetland with organic matter (Linde 1969). Without drawdowns there may be a decline in invertebrates that are an important food source for waterfowl and other wildlife (Voights 1976). It would be desirable to draw down one pool while holding water in the other pools to provide waterfowl habitat. However, the water level manipulation capabilities for the three pools are limited under the present system. Only Pool 1 receives water directly from the diversion ditch (Figure 9). Pool 2 fills from Pool 1, and Pool 3 fills from Pool 2. Therefore, it is not possible to drain Pool 1 while permitting water to flow into either of the other pools, and Pool 2 cannot be drained while filling Pool 3 from the diversion ditch. To correct this limitation, a diversion ditch across the northern part of the WMA to the Roseau River was proposed to provide water directly to Pools 2 and 3. The cost of this project, estimated at \$320,000 in 1968, was considered too high to be undertaken with available funds.

The five main water control structures have been in place for nearly 20 years. Their condition has deteriorated and their design is inadequate for effective water level management. In addition, the 250 foot spillway on the Pool 2 dike is subject to erosion and needs reinforcement to prevent progressive weakening of the dike.

The dike system is adequate for safe water retention under the present water manipulation schedule with intensive maintenance. However, increasing the height and width of the dikes would provide added security during peak floods, would reduce maintenance needed, and would allow management of the impoundments to their full potential. Recommended side slopes for impoundments of this type are 3:1 on upstream and 2:1 downstream (Linde 1969). In a 3:1

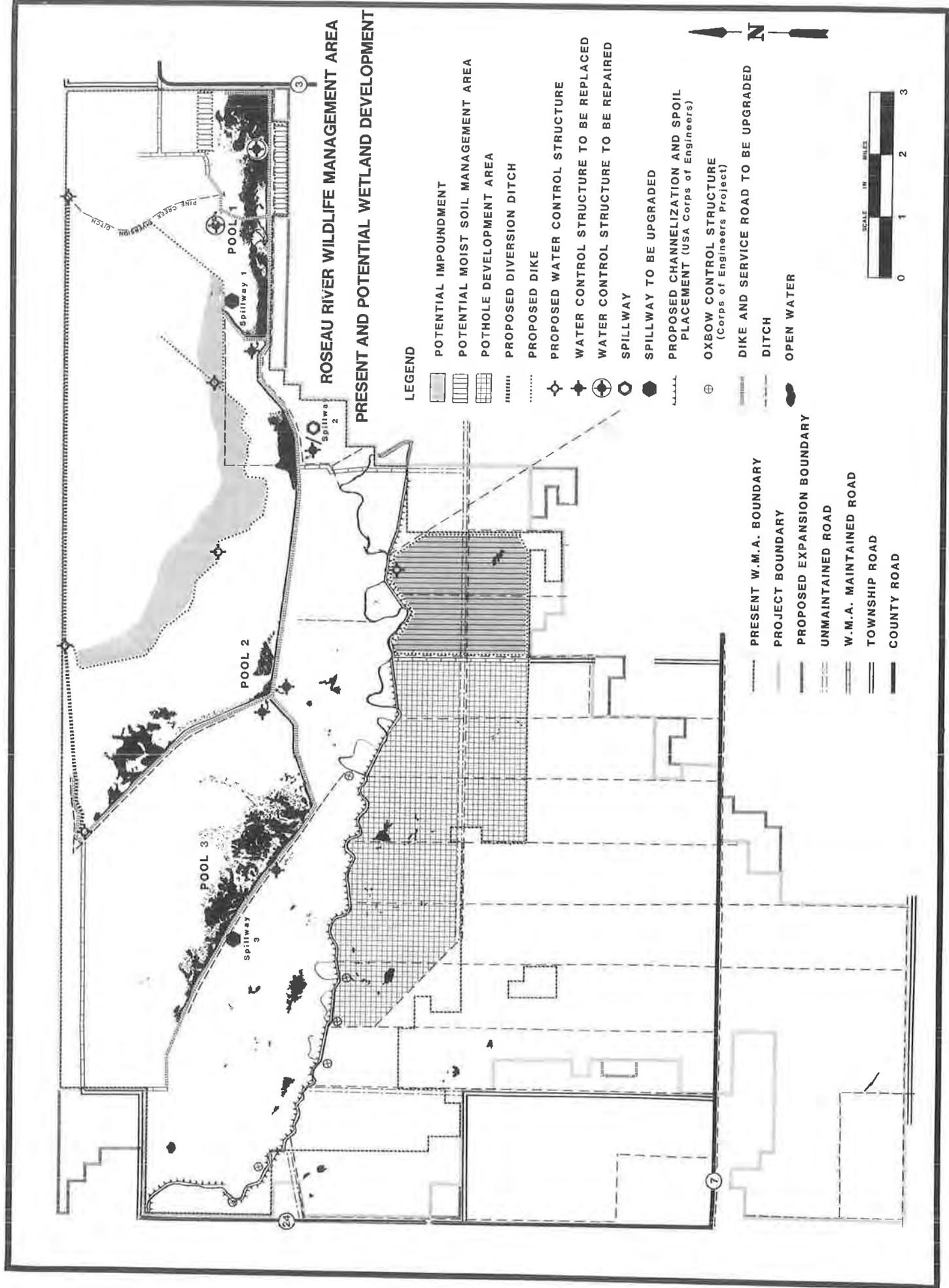


Figure 9

slope, the fill extends three feet horizontally for every one foot in height of the dike. Present side slopes, however, do not exceed 2:1 and often approach 1:1. The height of the dikes is not sufficient to contain high flood water flows. Elevations of the dike tops should provide enough freeboard above peak flood levels to prevent waves from breaking over them (Linde 1969).

Grassy cover on dike slopes prevents erosion and retards the establishment of trees and shrubs. Woody plants interfere with normal maintenance and may weaken the dike with their root systems. Maintenance of grass requires periodic mowing or burning. Steep side slopes on present dikes prevent mowing, and trees have grown or were planted in several sections of dike on the unit.

Flooding occurs regularly along the Roseau River, and local people continue to ask for flood-control projects. The impoundments on the WMA can provide some relief by retaining some of the water during the spring runoff. Potholes and other depressions, particularly those with natural vegetation, may help reduce flooding by holding water on the land for a longer time.

Emergent vegetation can eliminate much of the open water in shallow impoundments. Lack of open water reduces the wetlands' attractiveness to waterfowl by restricting the growth of submerged vegetation and limiting movements of waterfowl. An interspersed area of emergent vegetation and open water is desirable. A "hemi-marsh", in which the area of open water and vegetation are about equal and well interspersed, generally has the maximum diversity of bird species and the maximum production for most species (Weller and Spatcher 1965). An interspersed area of water and vegetation is also desirable for duck hunting. The area of open water in the Roseau River WMA pools has decreased over the past several years. At present Pool 3 has the best interspersed area of water and emergent vegetation over the largest area. Pool 2 has the most extensive areas of dense, continuous cattail stands. Pool 1, with the largest percentage of open water, has good interspersed areas in some areas, but they are not as extensive as in Pool 3.

Cattail is the pools' dominant emergent plant, and it is difficult to control. Linde's (1969) list of cattail control methods includes summer mowing or crushing, winter mowing on frozen marshes, herbicide treatment, and burning. These methods vary in effectiveness according to the number and timing of treatments. Cattails are reported to be most vulnerable to control treatments at the early flowering stage in late June (Linde et al. 1976). However, it is difficult to apply controls at that time of year. Weller (1975) recommended water-level control as the least expensive and most natural means of cattail management. He also suggested management of muskrat populations as a means of creating openings in cattail stands. Muskrats use cattails for food and lodge building, thus high muskrat populations tend to thin cattail stands. Field experiments in the northern United States have shown that cutting cattails on the ice in winter to create openings is inexpensive and effective when followed by flooding in the growing season (Weller 1975). This method would be effective for cattails rooted to the bottom, but not for floating mats of cattails. Openings can also be created by constructing level ditches or dugouts, blasting potholes, or, in peat areas, by burning (Linde 1969).

While muskrats and beavers are useful in creating and maintaining marsh openings, they can cause serious damage to dikes by digging into them. Muskrat

burrowing contributed to breaches in the dikes of Pools 2 and 3 in 1955 and 1956. Bank dens of either species can cause water to seep through dikes, sometimes resulting in an entire section washing out. Methods that have been used to reduce muskrat damage to dikes including trapping, dropping carbide into the burrows, and filling holes with various materials (Linde 1969). Muskrat populations and dike damage may be dramatically lowered if water levels are lowered in the winter. However, this seriously reduces that potential furbearer harvest and lessens the benefits to vegetation control.

Woody vegetation may invade wetland edges or shallow areas. Winter marsh burning may prevent litter accumulation and may favor woody plant invasion, while late summer or early fall burns are effective in destroying invading brush. Water level manipulation and mechanical control can also be used for brush control (Linde 1969). There is some disagreement over whether or not all brush should be removed from impoundments. Some workers feel that acid stains from woody plants restrict the growth of desirable submergents, while others feel that brush adds valuable cover for breeding waterfowl (Linde 1969).

Diving ducks, which usually nest in emergent vegetation over or near open water, need tall, dense vegetation with easy access to open water from which they can take flight (Weller 1964). Ring-necked ducks often nest in wet, sedge meadows, while canvasbacks and redheads are more closely associated with deeper water and emergent vegetation. Dabbling ducks may nest in over-water sites, but they usually nest in grass or weeds on dry land near water (Sowls 1955). Nests are often located along dikes, but such nests may suffer high predation rates because the dikes provide travel lanes for predators (Balsler et al. 1968).

Many dabbling ducks, especially mallards, use the WMA's wetlands primarily for roosting and loafing during the fall migration. To feed, they fly to nearby farmlands where they eat small grain. This habit sometimes causes damage to private crops, or "crop depredation."

On some national wildlife refuges, moist soil plant management for wildlife has taken the place of some of the grain farming (Crail 1951, Taylor 1978) in an attempt to reduce crop depredation on private lands. Water levels are manipulated on impounded areas to permit natural food plants to grow, with the areas flooded to attract waterfowl at certain times of the year. Such areas are attractive to a wide variety of birds, including waterfowl that do not feed in grainfields plus many nongame species. Grain crops can also be flooded to make them especially attractive to waterfowl. The potential for moist soil impoundments exists in agricultural fields north and south of Pool 1 (Figure 9). The northern area could be flooded from the Pine Creek Diversion and the southern unit could use water pumped from the pools. Low water levels during late summer may make such management impractical. In addition, a high capacity pump and generator would have to be purchased.

Fish populations may affect wetlands and waterfowl. Carp can make a marsh or lake less favorable for waterfowl by destroying submerged aquatic plants directly or by increasing turbidity which in turn limits the growth of submerged aquatics (Linde 1969). Predation on ducklings by northern pike may reduce waterfowl production on an area. Even though ducklings make up a small percentage of the diet of northern pike, the large number of meals consumed by many pike over an entire brood period could mean

heavy mortality of ducklings (Solman 1945, Lagler 1956). However, there is a winter kill of fish every year due to lack of oxygen, and fish must enter the Roseau River WMA pools each year to affect the water, vegetation, or wildlife that year. Thus, buildups of detrimental species are avoided.

The needs of greater sandhill cranes should receive special management consideration. Little has been done anywhere to manage specifically for sandhill cranes, but it has been suggested that a crane management program should include preservation of large areas of wetland habitat, selection of sites on peat soils, control of public disturbance, and provision of upland feeding sites (Hunt et al. 1976). To some extent, all of these requirements are being provided on the WMA. Projects that would replace shallow water and sedge meadow areas with large impoundments or increase the depth of the present pools may decrease the amount of sandhill crane habitat. Any new impoundment should be designed to maximize crane habitat.

Wetlands would be affected considerably if the U. S. Army Corps of Engineers' Roseau River Project is constructed. The Roseau River would be altered considerably through widening the channel, removal of vegetation from one bank of the river, and deposition of spoil materials. There are no new cutoffs to straighten the river channel proposed within either the present WMA or the proposed expansion, but existing cutoffs would be cleaned out and deepened to project specifications. The present project design calls for water control structures on some oxbows in the WMA. This will probably maintain their value as waterfowl brood habitat by extending their water-retention periods. Increased channel capacity could cause rapid annual drying of existing wetlands near the river. However, the clay soils near the river will probably retard lateral water movement, making drainage unlikely. The DNR will monitor water levels in adjacent potholes to detect changes in drainage. Increased channel efficiency would cause flows in late summer and early fall to be lower than at present. Riverine habitat for waterfowl, deer, moose, fish, and furbearers would certainly be lost due to dredging in the channel.

The DNR has expressed concern that the increased channel capacity developed by the project would

facilitate drainage on privately-owned lands in the vicinity. To prevent this secondary drainage and resulting habitat loss the project design incorporates control structures on existing ditch inlets to the river. The structures will maintain outlet elevations of original ditch specifications.

Additional mitigation of adverse impacts has been proposed. Fish habitat losses will be minimized by the installation of in-stream structures to create riffles and deep pools. Habitat degraded or lost in the construction process will be replaced with similar habitat to be purchased by the project sponsors. The DNR has agreed that these actions will adequately mitigate the damages caused by this project.

The proposed Corps of Engineers' Roseau River Project may develop or allow development of wetland management projects. A 2,500-acre impoundment may be constructed south of the Roseau River (T163N, R43W, Sections 22, 23, 26, 27, 34, 35) in conjunction with the Corps project (Figure 9). Such an impoundment would function both as wildlife habitat and as a flood control reservoir. The Badger Creek ditch would be a primary water source, but the dike would not block or impede water flow. The impoundment could be managed as a waterfowl production area with the construction of nesting islands and the maintenance of stable water levels during the nesting season. Alternatively, the unit could be managed as a moist soil management unit. Both options would require supplemental water to be pumped from the Roseau River during drier periods, and a high-volume pump and generator would need to be purchased. Costs of this type of management have not been calculated. The potential lack of water from mid-summer through fall may preclude development of this type of unit.

Past and Present Programs. Pools 1, 2, and 3, when filled, cover about 10,600 acres. In the first few years after construction, the policy was to keep the pools nearly full all year to make sure that they would be full for waterfowl nesting and to increase the survival of muskrats over winter. Since spring water supplies had been regularly abundant, water management in the three pools was changed in the late 1950's to help reduce spring flooding and reduce muskrat damage to dikes. Since then the pools have been drawn down 2.5 feet below full beginning in early



This aerial photo of Pool 1 shows a good interspersion of emergent vegetation and open water.

November, reaching the desired level by late December. The pools have been filled the following spring.

Muskrats still burrow into the dikes, but the winter drawdowns and muskrat trapping have helped to reduce the damage. Dikes are routinely patrolled to detect and repair muskrat damage.

Although the primary wetland management work has been the manipulation of water levels in the pools, there have been other projects. Leases for the cutting of marsh hay, especially along the Roseau River, have helped to maintain open areas for sandhill cranes and other species. Eight nesting islands with adjacent dugout ponds were constructed in Pool 1 in 1956. Three dugout ponds were constructed in the 1970's south of the Roseau River in T163N, R43W, Section 26. Doughnut Lake (Table 4 and Figure 4) was deepened and modified. Several small potholes in the northern part of the pools resulted from practice bombing conducted by the U. S. Naval Reserve in the 1950's under a special permit which is no longer in effect. The other potholes on the WMA resulted from peat burnouts before the DNR acquired the area.

Early management efforts included attempts to introduce new aquatic plant species for waterfowl. Several clumps of hardstem bulrush were planted in the Pinecreek Pothole area of Pool 1 in 1953, and this species was seeded in the northwest corner of Pool 2 in 1954. In both areas hardstem bulrush was growing a year or two later, but it is not known if the plantings helped to establish the present bulrush stands. Wild rice was seeded in 1954 in several areas in all pools, but the plantings were not successful. The probable cause of failure was sulfate concentrations in the water. A small stand of wild rice remains near the Pool 2 spillway.

Future Programs. Any significant changes in the present water management program will be made on an experimental basis only after considering the possible effects of such changes on all species of animals and plants, on the dikes, and on other land and land uses within the watershed. WMA staff will continue to keep records on water gauge readings and on control structure operation. Water control structures and spillways will be inspected regularly and repaired or replaced if necessary. Personnel will continue to patrol the dikes regularly to detect and repair muskrat damage. Intensive trapping of muskrats along dikes will be encouraged.

Improvement of the present dike system will receive high priority. Area personnel with DNR equipment will work on the dikes as time and funding permit. Eventually the dikes will be upgraded to 3:1 sideslopes on both sides, seeded to a grass/legume mixture, and maintained by periodic mowing. Trees and brush will be removed from the dikes. Dikes will be increased in elevation to provide at least two feet of freeboard above expected flood levels. Areas subject to erosion will be riprapped. Improvements will reduce dike maintenance required, increase the flood control benefits of the pools, and allow retention of sufficient water to allow better over-winter survival of muskrats. The estimated cost of dike improvements is now \$270,000. Work on the project will begin in mid-1981.

As the dike improvements proceed, the main water control structures will be replaced or upgraded. Five control structures (Figure 9) will be replaced over the planning period. The new structures will be concrete with two stop-log controlled watergates and a low-flow drawdown pipe costing about \$50,000 each. Spillway number 2 (Figure 9) will be reinforced with stone riprapping over the steel pilings on the south side. Two

smaller control structures consisting of outlet tubes with sliding steel gates (Figure 9) will be repaired and upgraded.

Openings will be made in the extensive cattail stands in the impoundments, particularly in Pool 2 (Figure 10). Experiments on small areas will determine the best method of controlling cattail. It is anticipated that mowing on the ice in winter will be effective on rooted cattails. Floating cattail mats will be controlled with an aquatic chopping machine ("cookie cutter"). Funds will be sought to purchase one or more of these machines for use in Region I. The openings will be made as suggested by Weller (1975), with small openings connected to larger ones from which diving ducks can gain flight.

In lowland vegetation types which normally contain little open water, scattered potholes or dugout ponds will be developed. Development will be done by excavation with a dragline or by deep peat burning during dry periods.

Leases for cutting marsh hay will continue so that these open areas will be maintained. As is done at present, mowing will be delayed until after July 15 to protect bird nests. Prescribed burning and rotary mowing will also be used to maintain open grass and sedge areas and reduce encroachment by woody plants (Figure 10).

Large impoundments north of the present three pools, as well as an extension on the diversion ditch and additional pools north of the present Pools 1 and 2 will be investigated (Figure 9). The diversion ditch extension would be designed to provide an independent water source for each pool. The new pools under investigation would cover nearly 5,000 acres under normal early summer water conditions.

The development of the 2,500-acre Roseau River impoundment will be evaluated. If the project is feasible from engineering and management perspectives it will be constructed in conjunction with the Roseau River Flood Control Project. The impoundment will be managed for public hunting and for waterfowl production or moist soils management for depredation control.

Construction of moist soils management units north and south of Pool 1 will also be investigated. If this type of unit is found to be useful in depredation control, engineering feasibility studies will be conducted.

Northern pike rescue operations will be continued. In addition, the introduction of northern pike breeding stock into the pools in years when natural immigration is low will be considered.

New projects and maintenance of wetlands and other habitats will be evaluated by the area manager for their effects on non-target resources. Plans for major projects will be submitted to the Minnesota Historical Society for review in order to avoid destroying or altering important prehistoric or historic cultural resources. Future wetland development and management plans will be submitted to the State Planning Agency for review.

FOREST MANAGEMENT

Objectives. Forests will be managed in cooperation with the DNR, Division of Forestry to maintain or create an interspersed forest types and age classes. Habitat management will be directed principally toward game species such as white-tailed deer, moose, and sharp-tailed and ruffed grouse, although a variety of nongame wildlife species will benefit as well.

Considerations. The Division of Forestry, anticipating an increased demand for forest products

and having experienced a decline in commercial forest acreage, wishes to manage any productive land in this area for forest products. Since the objectives of the two divisions on this area are generally compatible, the Divisions of Forestry and Fish and Wildlife should cooperatively manage the forest lands on the unit to insure the integration of wildlife management with forestry. A DNR policy for coordination of wildlife and forestry management has been developed (Appendix H). The policy sets forth specific procedures for the implementation of integrated management and establishes administrative procedures to resolve disagreements which arise. This policy will be used to implement cooperative management on the Roseau River WMA.

While some wildlife species are associated with climax plant communities, others such as white-tailed deer, moose, and sharp-tailed and ruffed grouse are better adapted to plant communities of earlier successional stages or different stages at different times of the year. Fire prevention and suppression, forest succession, and conversions to less favorable plants all can reduce the capability of an area to produce forest game species. Forest succession can be set back to earlier stages by prescribed burning, or logging and other mechanical means. The removal of mature trees promotes resprouting of trees as well as understory shrubs and herbaceous plants. The result is an increased food supply for wildlife and an increased habitat diversity.

Studies in Minnesota and Wisconsin have shown that early successional forest types have the greatest abundance of food for deer (McCaffery and Creed 1969, Rutske 1969, Kohn and Mooty 1971, and McCaffery et al. 1974). The production of deer forage is reduced due to increased shading as the forest matures (Wetzel et al. 1975). Aspen stands growing on poorer sites (offsite) usually support an abundance of herbaceous and woody deer forage due to their open canopy. Cutting of these stands results in dense suckering, which shades out ground vegetation and quickly grows out of reach. Therefore, it may be beneficial to leave some offsite aspen to retain the desirable understory (Verme 1972). Clear-cuts are generally attractive to deer, but small openings (one-half to five acres) are used more than large, open areas (McCaffery and Creed 1969).

Conifers, such as white cedar and balsam fir, are of special benefit to deer in winter (Rutske 1969, Wetzel et al. 1975). Deer in this region generally concentrate in mixed deciduous-coniferous or pure conifer stands for protection from severe winter weather. These forest types are present only in the northeast corner of the unit. Elsewhere, small areas of these types could be beneficial to deer in severe winters.

White-tailed deer in this climatic region may suffer increased mortality in severe winters with deep snow. Deep snow makes normal food sources unavailable and restricts deer movement. Deep snow and cold temperatures may cause deer to concentrate in areas of heavy cover where food may be lacking (Ozoga 1968). If the winter is prolonged, deer may exhaust their stored fat reserves and succumb to starvation or other stress-related mortality (Karns 1979). In such cases, cutting hardwood trees for browse and making trails through the snow with tractors or snowmobiles make new food resources available (Richens and Lavigne 1978). This may increase survival significantly in a local concentration area.

Moose on Agassiz National Wildlife Refuge in northwestern Minnesota were found to use a variety of

forest types during the course of a year (Phillips et al. 1973). They preferred an open willow type during the summer and fall months, but shifted to dense aspen-willow, tall willow, aspen, and mixed hardwoods during the winter. In northeastern Minnesota, logging and fire are considered important tools in setting back plant succession and creating good moose habitat (Peek et al. 1976).

Optimum ruffed grouse habitat contains a mosaic of different forest age-classes within the restricted foraging range of grouse (Gullion and Svoboda 1972). Aspen is the most important component of ruffed grouse habitat throughout the primary grouse range in Minnesota. This species alone, in the proper age classes, can supply all of the basic habitat requirements of ruffed grouse (Gullion 1969). Mature, open conifer stands are of little benefit to ruffed grouse, although balsam fir and spruce may occasionally provide useful winter cover if they occur in small, dense stands (Gullion 1967). Research has shown that clear-cuts as small as one acre may be beneficial to ruffed grouse, although commercial cuts of such small size are not economical (Gullion 1976).

Basic habitat for sharp-tailed grouse is a mixture of grassland and brushland. Open brushland dominated by willows less than five feet tall is especially important. Much of the lowland brush habitat (primarily willow) on the unit is too tall and dense for optimum sharp-tail habitat. Such areas can be improved by mechanical crushing and controlled burning. Abandoned agricultural fields (old fields) and active cropland are also important. Scattered food plots and openings also enhance an area for sharp-tails.

Snowshoe hare and spruce grouse are minor game species, but the presence of these species adds to the experience of a visitor. Snowshoe hares are generally associated with the early stages of forest succession, so management for deer and ruffed grouse should also benefit hares. Spruce grouse depend on black spruce and jack pine of various sizes for most of their habitat needs (Johnston 1977a). Maintenance of these forest types is necessary for spruce grouse habitat.

Jack pine is a relatively short-lived species. Clear-cutting mature trees in blocks and burning to release the seeds may be used to regenerate the stand (Benzie 1977). Depending on site characteristics and postlogging treatments, such clear-cuts can supply significant deer forage for up to 10 years following cutting (McCaffery and Creed 1969).

White cedar stands may be regenerated by strip-cutting (Johnston 1977b) or by encouraging the species' tendency to reproduce vegetatively (Petra 1969). Attempts to regenerate white cedar should be planned carefully and tested on small areas before treating entire stands. Success of the regeneration varies considerably depending on site and stand characteristics.

Black spruce and tamarack stands may be regenerated by clear-cutting in blocks or patterns (Johnston 1977b). However, most game wildlife species utilize this forest type very little, and clear-cuts provide very little additional benefit. Left uncut, the relatively small areas of spruce-dominated forest on the unit will provide habitat for great gray owls, boreal chickadees, several warbler species, spruce grouse, and other birds.

Where oaks occur, some of them should be saved for deer and other wildlife (Rutske 1969). Oak mast is an important food resource for wildlife, but acorn crops often fail in this climate. Cavities in these trees are used for den sites.

Roseau River WMA lies in the ecotone between the prairie to the west and deciduous and coniferous forest to the east. For this reason, and because of the large areas of wet, infertile peat soils, only portions of the WMA contain extensive areas of upland forest. Aspen grows in some of the wet peat areas, but it is mainly small and of no commercial value. There is little local demand for aspen, but DNR foresters predict a significant increase in demand in the near future. This demand, however, may not affect the WMA due to its distance from markets and low volume of commercial timber. The demand for firewood has been increasing in the region, and this market may provide outlets for aspen. The local demand for conifers is somewhat higher, but the WMA has only a small area of jack pine and somewhat isolated areas of black spruce.

Large trees near water provide nesting cavities for wood ducks and hooded mergansers. Wood duck broods are seen on the WMA during waterfowl brood counts every year; hooded mergansers are uncommon on the unit. The best nesting cavities are in trees over water, although woodlands up to a half mile from water might be managed for wood ducks (McGilvrey 1968). Usable cavities occur in trees with a diameter at breast height of 16 inches or larger. Large trees are also used by other birds and by raccoons and squirrels for dens. Standing dead trees (snags) are used by woodpeckers and many other species of nongame birds for both nesting and feeding (Hardin and Evans 1977). Nest boxes are expensive to erect and maintain, but they may substitute for natural cavities.

The Roseau River Flood Control Project, if constructed, will affect bottomland forests (Figure 9). All trees and vegetation will be removed from the side of the river which is excavated. Both sides of the river will be affected since the excavation will be done on either side as the site dictates.

Past and Present Programs. Little forest management has been done on the area to date. A 10-acre area of mature jack pine was once cut. Three firewood permits were issued in the spring of 1979, one to cut dead jack pine, and two for all timber except oaks and conifers in two, one-acre blocks north of Pool 1. Both oaks and conifers are rare in these areas, so they were saved for wildlife. Each winter with prolonged, deep snow, WMA personnel and local sportsmen make trails for deer through forest areas with bulldozers, tractors, or snowmobiles.

Future Programs. Forests will be managed cooperatively by the Divisions of Forestry and Fish and Wildlife. Field personnel of the two divisions will review and approve each other's management plans and attempt to develop an integrated management plan. Disagreements not resolved at the wildlife and forestry area manager's level will be forwarded to the regional level for resolution. The division directors will attempt to resolve disagreements not settled at the regional level. If forestry and wildlife management conflicts on specific tracts of land still cannot be resolved, the Commissioner of Natural Resources, with the advice of the DNR Planning and Environmental Review Team, will decide the issue. The Commissioner will recommend the modification of forestry or wildlife management objectives or the transfer of administrative control of specific tracts of land between the Divisions of Fish and Wildlife and Forestry by lease, purchase, or land exchange. Cooperative agreements and land transfers between the divisions will be submitted to the State Planning Agency for review.

To improve habitat for deer and ruffed grouse and increase diversity, small openings, from one-half to

five acres, will be cut in areas dominated by aspen (Figure 10). Emphasis will be placed on areas of mature aspen near deer winter concentration areas. The issuance of firewood permits for specific areas will be expanded if possible. Oak trees in aspen stands will be saved and small patches of conifers may be saved if they are uncommon in the area. Permits for cutting aspen pulpwood will be issued in cooperation with the Division of Forestry if a market develops. If harvest through these means is insufficient to meet management objectives, some cutting, shearing with bulldozers, and burning will be done by area personnel. Cutting will be a cooperative project between WMA personnel and sportsmen if possible. Cutting and shearing will be done during the winter and early spring to make additional browse available to deer and moose.

The present program of making trails for deer in winters of deep snow will be continued. This project will continue to be a cooperative project between WMA personnel and the public, with the wildlife area manager specifying where, when, and how trails are to be made.

Extensive willow and poor quality aspen areas south of the pools will be managed by prescribed burning. Willow on proposed burn sites may have to be crushed by bulldozer during winter in order to obtain a successful burn during spring or fall. A system of firebreaks located primarily on drainage ditches will be developed and maintained (Figure 10). The blocks created by the firebreaks will be burned in rotation to develop a diverse pattern of successional stages.

The limited stands of jack pine, white cedar, and black spruce will be maintained for wildlife (Figure 10). Stands will be harvested and regenerated as necessary using standard forest management practices, modified if necessary to provide maximum wildlife benefits. Commercial sales will be made if possible. Where winter cover for deer is lacking, small plantings or seedings of conifer stands will be made in cooperation with the Division of Forestry.

The Roseau River Flood Control Project calls for the replacement of forests along one or both river banks with grass-legume sod. If necessary, lost wood duck nest cavities will be replaced with artificial structures on the wooded side of the river. In other areas, large trees near water will be left standing. Standing dead trees will be left for wildlife unless they pose a safety hazard.

NON-FORESTED UPLAND MANAGEMENT

Objectives. Non-forested uplands on the Roseau River WMA include croplands and old fields. Cropland will be managed to provide food for resident and migratory wildlife and to reduce wildlife depredation on crops on private land in the vicinity of the WMA. Old fields will be managed to provide habitat essential to a variety of wildlife.

Considerations. As natural plant succession occurs, woody vegetation will encroach on and eventually dominate abandoned fields on the WMA. Loss of such areas would result in a decrease in habitat diversity and a decrease in diversity of wildlife as well. Old fields are commonly used by sharp-tailed grouse. This cover type accounted for 35 percent of the radio-locations of female sharp-tails during spring and summer in a study in northwestern Minnesota (Artman and Beer 1970). Properly managed, these areas will provide nesting habitat for waterfowl and upland game birds as well as songbirds and shorebirds. Open areas are also

used by deer (McCaffery and Creed 1969) and many nongame species. Maintaining old fields in an open condition may also be important if it is necessary to farm suitable fields again for wildlife management purposes. Encroachment of woody vegetation on old fields may be prevented by prescribed burning and mechanical and chemical control. Old fields may revert to prairie vegetation if they are periodically burned.

Farming for wildlife is a common practice on many state and federal wildlife areas. Agricultural crops increase the capacity of an area to support both resident and migratory species. Resident wildlife such as white-tailed deer and sharp-tailed grouse use crops in the fall, winter, and early spring, while ducks and geese feed on them primarily during fall migration. Wintering songbirds may benefit from food plots, although breeding songbirds and small mammals may not be affected by additional food sources (Burt 1977). An important reason for farming on many wildlife areas is to reduce crop damage by wildlife on private land.

Because of the relatively short growing season in the Roseau County area, corn is not a major crop, although it may be possible to grow a crop in some years. The main grain crops grown are oats, barley, and wheat. Other crops grown in the area include flax, sunflowers, bluegrass seed, and timothy seed.

Depredations on small grain crops on private land in northwestern Minnesota by waterfowl, especially mallards, have occurred for many years. The problem has become worse since the 1940's, when farmers began to abandon cutting grain with a binder and shocking it. Modern swathing and combining of grain leaves it spread out in the field for several days where it is extremely vulnerable to depredations.

Depredations are not usually severe unless wet weather prevents the harvest of swathed grain. Because of the flatness of the terrain and the low absorptive capacity of the soils in many areas, the soil dries slowly, prolonging the harvest season considerably when rainfall does occur. A special study of duck depredation in Roseau and Marshall Counties in northwestern Minnesota was authorized by the Minnesota Legislature (Minnesota Outdoor Recreation Resources Commission 1967). The study included a survey of crop damage by waterfowl in the two-county area. Estimated damage in the portions of Roseau County that were surveyed was about \$35,000 in 1964 and \$23,000 in 1965. Costs for similar damages in the current year would be significantly greater because of higher grain prices. Not all of the reported damage was in the vicinity of the Roseau River WMA. Some was near Roseau Lake and Lake of the Woods.

Many different methods for reducing waterfowl damage to crops have been used or suggested (Minnesota Outdoor Recreation Resources Commission 1967). Mechanical methods include herding from the ground and from airplanes, and the use of firearms, exploders, firecrackers, flashers, and scarecrows. Environmental methods include providing protected habitat with adequate and equally acceptable food supplies, eliminating standing water in and near grain fields, harvesting crops promptly, and delaying fall plowing of grain stubble containing waste grain. The development and use of crops which are less vulnerable to depredations because they mature early or are unpalatable to waterfowl can also help. Regulatory methods consist primarily of laws to permit waterfowl hunting, reducing waterfowl numbers and chasing birds from fields.

Species of wildlife other than mallards found in the

WMA vicinity that may cause crop depredations include Canada goose, snow goose, sandhill crane, white-tailed deer, and moose.

Past and Present Programs. To date, no special effort has been made to keep abandoned fields open. Some of the fields in wet areas have grasses and sedges growing in them, while most of the drier fields have brush encroaching; some contain native prairie plants.

The total cropland on the WMA is about 1,600 acres, of which about 1,200 are managed by cash or sharecrop leases to local farmers. On the leased land, hay and oats are the crops most commonly grown, with a small acreage of barley (Table 26). Some of the state's 25 percent share of the small grain is left in the fields to provide fall and winter food for wildlife, and some is harvested for use at feeding stations to reduce damage by waterfowl to crops on private lands. Fall plowing is permitted under the lease agreements and is done on much of the leased land to enable the farmers to get their crops planted earlier the next spring. Leases to cut hay help to maintain some areas that are not in woody cover for waterfowl nesting and for habitat for other species such as sharp-tailed grouse, sandhill cranes, and marbled godwits. To maintain nesting cover until after most duck and grouse broods have hatched, hay may not be mowed until after July 15.

Cropland that is farmed by WMA personnel is planted to crops such as oats, barley, and winter wheat to provide grain for wildlife, to reduce depredations, and to provide green browse for geese and deer. A small area of sunflowers and corn was planted in 1979. Fields farmed by area personnel are not fall-plowed.

Measures to reduce crop depredations on private land are an important part of the WMA's cropland management program. Depredation reduction methods include the use of exploders, the planting of lure crops on state land, and the use of feeding stations on the WMA. Also, the DNR private lands program may cost-share the development of food plots on private land in depredation problem areas. Exploders are loaned to farmers having depredation problems, and state personnel demonstrate how to use them. The farmers are then responsible for maintaining the exploders. Some crops are left in the WMA fields to reduce depredations. The refuge in the



Roseau River WMA personnel farm about 400 acres for wildlife each year.

northwestern part of the WMA includes agricultural land and helps insure that wildlife can feed undisturbed.

Feeding to reduce waterfowl depredations is done at about 10 sites at the edges of the three pools (Figure 4). Oats, barley, or wheat are usually placed at the feeding sites in early August, and feeding is continued until about September 20. According to federal regulations, all food must be removed from the sites at least 10 days before the waterfowl season opens. Area personnel estimate that about 10,000 bushels of grain should be available to feed each year. An average of 7,800 bushels of grain per year was fed over a nine-year period, and in 1965, 15,000 bushels were fed to an estimated 25,000 waterfowl. Grain has been fed every year since the early 1960's, even in dry years when an early harvest reduced the likelihood of depredations. In recent years all of the grain for the feeding sites has been raised on the WMA. Some grain was obtained for free from the federal government through the Commodity Credit Corporation in the 1960's, but such grain has not been available in recent years.

In some years in which the harvest was completed early, there have been no depredation complaints, but there often are from two to four complaints each year in the vicinity of the WMA. The complaints often concerned field-feeding mallards, but Canada geese, sandhill cranes, moose, and white-tailed deer have also caused complaints. The latter three species are not influenced by these feeding stations, but the lure crops and exploders have helped to reduce damages to crops on private land.

Future Programs. Most old fields on the WMA will be burned periodically to maintain these openings for wildlife. Incidental to wildlife benefits, some native prairie plants may become reestablished in at least small areas. Some old fields and lowland brush near winter deer cover will be burned and seeded to legumes to provide important early spring deer forage (Figure 10).

The present system of agricultural leases and farming by state personnel will be continued with some modifications. Fall plowing will be allowed when necessary. If funds for equipment and manpower are available, fewer grain farming leases will be issued, and WMA personnel will farm more of the area to make more crops available for wildlife. More corn and sunflowers will be tried in the future if the experimental planting seems promising. More food plots will be developed near good winter cover for wildlife (Figure 10).

The operation of the waterfowl feeding sites (Figure 4) in late summer will be continued. In some years when weather conditions permit an early harvest, artificial feeding will be reduced, saving grain for future use. The development of moist soil units may further reduce the need for artificial feedings.

CANADA GOOSE MANAGEMENT

Objectives. Canada goose management on the Roseau River WMA will be directed toward both nesting and migrating geese. Efforts will be made to maintain a flock of nesting Canada geese on the area. Habitat, including food, water, and refuge, will be provided for migrant geese. In managing populations and harvest of Canada geese, policies of the state and the Mississippi Flyway will be followed. Goose hunting will remain a major activity on the unit, but it will be regulated to maintain desired goose populations and hunting traditions in Minnesota and throughout the Mississippi Flyway.



Canada geese commonly nest on the area, and as many as 25,000 migrant geese may be concentrated there in the fall.

Considerations. Canada geese once nested throughout much of Minnesota, especially the southern and western parts of the state. The extensive marshes of Marshall and Roseau Counties were formerly one of the greatest Canada goose breeding grounds in Minnesota (Roberts 1936). Giant Canada geese had disappeared from many parts of their breeding range by the early 1900's, but flocks have since been reestablished in many areas (Hanson 1965). Reestablishment of nesting giant Canada geese on the Roseau River WMA was undertaken to restore them to part of their former breeding range and to provide a decoy flock to attract migrating Canada geese.

Resident flocks of Canada geese require adequate nesting and brood rearing habitat, as well as protection from overharvest. Nesting sites can be provided by muskrat lodges (Krummes 1941), artificial islands (Sherwood 1968), and nesting structures (Brakhage 1965, Rienecker 1971). Elevated nesting structures (Brakhage 1965) can help prevent nest losses due to flooding. During brood rearing, Canada geese prefer areas of short, succulent vegetation near water (Gels 1956, MacInnes et al. 1974). A local breeding flock may be limited or reduced by excessive harvest, especially in the local area (Sherwood 1968). The giant Canada geese that nest on the WMA are not particularly wary at times and are probably quite vulnerable to hunting in some locations (Johnson and Jensen 1973).

The Roseau River WMA lies within the migration path of the Eastern Prairie Population (EPP) of Canada geese (Bellrose 1976) which numbered about 207,000 in December of 1978. The EPP geese nest in northern Manitoba near Hudson Bay, and about 90 percent of them winter at Swan Lake National Wildlife Refuge in Missouri. Most of the Canada geese that stop at the WMA are from this population.

Canada geese respond readily to management providing food, water, and protection from disturbance. In some cases they respond too well, and populations build up far beyond expectations, causing crop depredations, law enforcement problems, risks of

disease, and often decreasing the quality of hunting. After large concentrations of Canada geese have built up, efforts to reduce them may cause public relations problems because hunters and goose watchers become accustomed to the large numbers of geese. It is possible that larger numbers of Canada geese will use the Roseau River WMA for a longer period of time in the future. The lack of a large corn crop for food and the early freeze-up in this northern area will both help to limit goose use.

If Canada geese become more numerous than desired, the reduction of peak populations on the unit may be necessary. The attractiveness of the area to geese could be diminished by reducing the size of the refuge; by reducing food supplies and water areas; and by harassment of geese with airboats, exploders, and aircraft. These methods have been tested at Horicon Marsh, Wisconsin (Kleppinger and Ellis 1976). They have not resulted in a rapid or completely satisfactory solution, but, geese have been redistributed to nearby areas. Such actions are unlikely at the Roseau River WMA.

The goose harvest locally, within Minnesota, and in the Mississippi Flyway is a major consideration. The Canada goose harvest in Minnesota is managed to meet the following objectives: 1) to limit harvest associated with goose management areas to less than 50 percent of the state harvest (Minnesota Conservation Department 1968); 2) to limit Minnesota's total EPP harvest to avoid mandatory Mississippi Flyway quotas (Section of Wildlife Waterfowl Committee unpublished minutes June 1976); and 3) to apportion Minnesota's share of the EPP harvest equitably among the state's goose management areas. These objectives are being met now, but the addition of another large harvest area would change patterns in Minnesota and the Mississippi Flyway.

The Minnesota DNR has established policies for Canada goose management on managed units in the state (Minnesota Conservation Department 1968). The policies recommend that peak fall populations of Canada geese not exceed 20,000 for one area, reducing the need for controlled hunting and distributing the harvest more widely. They also require that the state attempt to limit the annual harvest of Canada geese from any one management area to no more than 2,000 birds. These limits have been greatly exceeded at the Lac qui Parle WMA and probably to some extent at the Roseau River and Thief Lake WMA's as well. The DNR, Section of Wildlife waterfowl policy committee amended the goose policy in 1976 to allow for a monthly average goose population of 50,000 for Lac qui Parle WMA.

Past and Present Programs. Giant Canada geese were transferred to Roseau River WMA from Carlos Avery WMA over a period of years beginning in 1960. The transplanted geese, unable to fly immediately because part of their wing feathers were removed, were kept in two goose pens, one on each end of the unit. Some of the geese nested in the pens, and later they began nesting elsewhere on the area. To provide nest sites for the Canada geese, about 30 to 40 structures, each consisting of nine hay bales wired together, were placed on the ice in the pools each winter. These structures have been used by the geese, but detailed records of use and nest success have not been kept. A resident Canada goose flock has become established, and about 200 young per year were produced in 1973 and 1974. Production decreased to an estimated 125 goslings produced by 60 nesting pairs in 1976. The reduction in the resident flock may be due to high local

hunting season mortality (Johnson and Jensen 1973).

An unsuccessful attempt was made in 1968 to establish a wintering area for the Roseau giant Canada goose flock within the state (Mikula et al. 1970). In February of 1968, 112 of the penned Canada geese of breeding age were brought from Roseau River WMA to Fox Lake in Martin County in southern Minnesota. A power plant nearby provided open water throughout the winter. Some of the primary feathers were pulled from the wings of the geese so they would be unable to fly until the feathers were replaced (Leon Johnson, Minnesota DNR personal communication). It was hoped that the geese would regain flight in time to return to Roseau to nest and would then return to Fox Lake to winter in later years. However, the geese nested at Fox Lake that year, and in June of 1968 the 112 adults and 115 goslings were captured during the flightless period and returned to Roseau. Birds from the resident Canada goose flock have not returned to Fox Lake to winter.

Since the establishment of the resident goose flock, the number of migrating Canada geese using the area has increased from fewer than 100 to estimated peak numbers of 12,000 in 1975 and 1976 and 25,000 in 1978. From early September until freeze-up, state personnel make weekly estimates of goose numbers based on ground and aerial counts.

Estimates of the goose harvest on the WMA are obtained by spot bag checks expanded according to daily car counts. The estimated Canada goose kill has increased from an estimated 500 per year on or near the WMA in 1965-69 (Johnson and Jensen 1973) to estimated kills, on the WMA only, of 2,854 in 1977 and 2,580 in 1978. In recent years no attempt has been made to estimate the Canada goose harvest on land outside the WMA boundaries. The kill on private lands was quite low in the 1960's, but it may have increased considerably since the number of geese increased. There have been no Canada goose harvest quotas set for the WMA and vicinity, although there have been quotas set elsewhere for the EPP.

Future Programs. Management of the resident Canada goose flock will continue. If time and manpower are available, more work will be done to monitor goose nesting and nest success, especially use of the artificial nesting structures. Nesting structures will be added if lack of nest sites is found to be limiting the population. If local hunting mortality threatens to eliminate the local breeding population, the movements of the flock will be investigated to identify areas where harvest is excessive. If possible, local geese will be protected in high kill areas or discouraged from using those areas. No additional releases of Canada geese are planned. The original releases accomplished the objectives of establishing a resident flock and attracting migrant geese. If the resident flock cannot increase or maintain itself under present conditions, newly stocked birds would do no better unless additional security from local hunting mortality is provided.

Management of croplands and wetlands for Canada geese and other wildlife is discussed in the non-forested upland and wetland management section. Management of the goose harvest is discussed in the public use management section. The WMA will continue to provide food for Canada geese to help reduce crop depredations on private lands, but no additional effort will be made to attract greater numbers of Canada geese or to hold them on the area for a longer period. The peak fall population of 25,000 in 1978 already exceeded the maximum recommended by the

Minnesota DNR's Canada goose management policies for any state management area. Careful monitoring of numbers of Canada geese and possible problems associated with them, such as depredations and disease, will continue. The need for the recommended limit of 20,000 on peak fall Canada goose populations will be reviewed as it applies to the Roseau River WMA.

Efforts to obtain accurate estimates of the Canada goose kill on the WMA will continue, and if funds and manpower permit, more work will be done to estimate the kill outside the WMA. The past two years the estimated Canada goose harvest on the WMA has exceeded the maximum kill recommended by the DNR's goose policies for a single area. If necessary, the DNR will limit the take of Canada geese by means of a quota system, by restricting shooting opportunities, or by a combination of methods.

NONGAME MANAGEMENT

Objectives. The Roseau River WMA will operate a balanced program for all wildlife species which normally occur in the plant communities represented on the management area. Nongame wildlife will be considered in managing the wetlands, forests, croplands, and other habitats. Special consideration will be given to uncommon species.

Considerations. Whether a person is outdoors hunting or just going for a drive, seeing wildlife adds considerably to an outdoor experience. State and federal wildlife management programs have, in the past, emphasized game species because of the popularity of hunting and because most of the funding for wildlife management came from hunters. Benefits or losses to nongame species were not considered in various management practices. However, most of the land acquisition and habitat management that has been done for game species has also been beneficial to nongame species. Even though management on the WMA will continue to emphasize game species, nongame species will not be neglected.

It is not possible to manage all portions of an area for all species at the same time. Some species require mature forests, while others require open, nearly bare, areas. A variety of habitats is needed to provide for a variety of wildlife species. In managing habitats for wildlife, especially mobile species such as most birds, a manager should consider which habitats are rare or becoming less common in the general vicinity.

Little is known about the requirements and responses to management of many species of mammals, birds, reptiles, amphibians, fish, and invertebrates. The nongame discussion emphasizes birds because there has been more public interest and research in this group than in any other. Birds are also the most visible of the management area's nongame wildlife.

Nongame bird management should consider three factors (Zeedyk and Evans 1975). First, maximum diversity of birdlife is found when the horizontal and vertical diversity of the vegetation are maximum. Second, bird species are adapted to nearly every habitat, so management benefiting some species can be detrimental to others. Finally, bird species differ in their ability to adapt to habitat variability since some species have specific requirements, while others are more general in their requirements.

The diversity of bird species often increases with forest maturity due to the greater vertical diversity of layers in mature forests (Odum 1971). Setting back forest succession by cutting or other means produces edges between contrasting vegetation types which in-

crease horizontal diversity, resulting in a greater diversity and density of birds (Curtis and Ripley 1975). Species of birds that respond to cutting and increased edge include common flicker, catbird, brown thrasher, and yellow warbler. Other species of birds have a narrower range of tolerance and can be adversely affected if management is directed entirely toward creating the maximum habitat diversity. The barred owl, pileated woodpecker, wood thrush, and ovenbird require mature forest and will benefit if sizable areas are permitted to reach maturity.

Wetland management for game birds is generally good management for nongame birds as well. An interspersed of open water and structurally diverse emergent vegetation should be attractive to a wide variety of marsh birds (Weller and Spatcher 1965). One wetland species that is to receive special consideration is the sandhill crane. Management for this species is discussed further in the Wetland Management section. Maintaining water levels helps to maintain fish populations, which, in turn provides food for birds such as pied-billed grebes and great egrets.

Croplands on the WMA provide food for wintering songbirds (Burt 1977) as well as other wildlife. Grain fields and fallow fields are used by mourning doves, which are presently a nongame species in the state. Hay fields and grassy areas provide habitat for songbirds such as the western meadowlark, bobolink, and vesper sparrow, plus small rodents which are fed upon by hawks, owls, and mammalian predators. Small rodents may serve as buffer species, reducing predation on other species including waterfowl (Weller 1979).

The Roseau River lies within the peripheral range of the gray wolf (eastern timber wolf) in Minnesota (Bailey et al. 1978). A few wolves have been observed on the management area and their numbers increase somewhat during winter, possibly due to migration from the north. Although the U. S. Department of the Interior has reclassified the timber wolf from en-



Sandhill cranes use the extensive shallow wetlands on the unit for nesting and for resting during migration.

dangered to threatened, the Minnesota DNR does not consider the timber wolf to be in danger of elimination in the state in the foreseeable future, and is seeking a complete declassification of the timber wolf in the state by the federal government. Since its protection in Minnesota, the timber wolf has expanded its range into agricultural areas. The potential exists around the management area for livestock depredations by wolves. At present, the DNR is negotiating with the U.S. Fish and Wildlife Service to develop a comprehensive, state-directed wolf management plan.

Up to the present, all funding for nongame management has come from hunting, fishing, and trapping license fees. In 1980, however, legislation was passed creating the Minnesota Nongame Wildlife Fund. This is a dedicated funding source for nongame management and research derived from voluntary checkoffs of state income tax refunds beginning in 1981. In addition, federal nongame funding legislation which would provide excise tax appropriations as matching funds for state nongame projects is under consideration. This legislation may provide substantial support for specific nongame management in the future.

Past and Present Programs. Management on the WMA promotes the maintenance of diverse habitats and the preservation of naturally occurring communities. Maintaining cover and food supplies and limiting disturbance should help both game and nongame species. Nongame wildlife is considered in management plans, but, thus far, lack of funds and information has limited management specifically for nongame species.

A nongame wildlife specialist employed by the Section of Wildlife beginning in 1977 has worked at evaluating the current status of many nongame species, especially uncommon ones, plus making suggestions for management. Breeding records and sightings of uncommon species are reported to and summarized by the nongame specialist.

Future Programs. Management programs on the Roseau River WMA will continue to consider all species. When more funds become available from new state and federal programs for nongame work, additional surveys and habitat management will be done. Suggestions of the nongame wildlife specialist will be incorporated into the management of the WMA whenever possible.

PUBLIC USE MANAGEMENT

Objectives. The Roseau River WMA will be managed to provide a variety of recreational activities while protecting the area's natural resources. Emphasis will be on quality hunting, trapping, fishing, and other compatible fish- and wildlife-related activities.

Considerations. State wildlife management areas, state parks, and state forests in northwestern Minnesota are public natural resource lands accommodating a variety of recreation. As components of the Minnesota outdoor recreation system, these units should be managed to maximize the types of recreational opportunities provided by the system, while avoiding unnecessary duplication. To best serve the widest range of Minnesota recreationists, opportunities should include organized activities, such as group camping and naturalist-directed interpretative programs; less structured or intensively developed activities, including the use of marked and developed trails and self-guiding interpretative programs; and unstructured activities with low participant densities, such as fishing, hunting, and self-directed hiking and

skiing. This approach will provide a variety of opportunities and will fill the needs of most individuals.

The northwestern Minnesota state parks provide a variety of outdoor activities. Depending on the classification of each park, the park resources, and theme, state park oriented recreation will include organized and directed programs as well as less intensively structured use with lower user densities. Because of their relatively small sizes, however, these parks cannot provide for some dispersed types of recreation nor all the trail systems to accommodate hikers, skiers, and snowmobilers.

State forests provide less structured recreation than in state parks. These areas accommodate a variety of unstructured activities such as hunting, fishing, and primitive camping, as well as providing picnic and sanitary facilities and marked, improved trails. More intensively organized activities with higher participant densities, however, may conflict with sportsmen and recreationists seeking more solitude.

To round out this system, the Roseau River WMA should provide for public hunting, trapping, and fishing, plus unstructured compatible forms of recreation such as nature observation, hiking, cross-country skiing, snowmobiling, and photography at lower user densities. Management of the Roseau River WMA for dispersed, unstructured recreation can provide alternative opportunities for northwestern Minnesota recreationists and will minimize use conflicts on all areas. Intensified agricultural practices, reduced wildlife habitat, increased posting of private lands, and more restrictive trespass laws will increase the importance of the state wildlife management areas to wildlife and sportsmen.

A quality hunting experience depends on many factors, one of the most important of which is the density of hunters. With few exceptions, crowded conditions have not been a problem for upland small game, deer, or moose hunters on the management area. The density of moose hunters is limited by the number of permits issued for the zone that includes the Roseau River WMA. Hunting pressure during the grouse and deer seasons may be high enough in some areas to result in interference between hunters and reduce the quality of the hunt. However, there are usually harder to reach areas where hunters can go to get away from the crowd. With waterfowl hunters, however, crowding is often a major problem in maintaining quality hunting, particularly early in the season and on weekends. Crowded duck hunting conditions cause interference among hunting parties and destroy traditional values of the sport such as skill in the use of calls and decoys. One approach to providing some uncrowded space for hunting is to make some areas difficult to reach so that a hunter willing to work hard can have a high quality hunt. Waterfowl hunters shooting at birds out of range can also decrease hunting quality for others by flaring approaching birds. A shell limit imposed on hunters on several managed goose hunting areas has discouraged such shooting and improved the quality of the hunt for many hunters, in addition to reducing crippling loss (Hunt 1968).

The increase in the number of Canada geese using the Roseau River WMA during fall migration has attracted many hunters. In the earlier years of the goose concentrations, the quality of goose hunting deteriorated considerably due to overcrowded, competitive conditions with shooting at extreme ranges and foottraces for downed geese.

Most of the goose hunting has been around Pool 1 because of the number of geese, the ease of hunter access, and the predictability of flight lines for geese

leaving the refuge area. Problems occurred at the east end of Pool 1, where the refuge boundary extended to the right-of-way for County State Aid Highway 3. Hunters shot at geese from the highway, causing traffic problems and presenting a poor image of hunting to the public. Conflicts also arose when hunters entered private land to retrieve downed geese. Because of these problems, hunting from the highway right-of-way was prohibited by the DNR beginning in 1971. Hunters then complained that private landowners were making too much money off the geese by renting blinds, while there was little opportunity for goose hunting on public land. In 1973, the refuge boundary was moved to the edge of the water at the end of the pool, and shooting stations were established 125 to 200 yards apart on the dike between Pool 1 and the road ditch, about 75 yards from the highway. This has reduced hunter densities and reduced conflicts over downed geese. Shooting stations are set back from the highway, but they are still conspicuously sited.

In response to increased hunting pressure and problems with hunter behavior, the Thief Lake WMA in Marshall County and the Lac qui Parle WMA in Big Stone, Chippewa, Lac qui Parle, and Swift Counties established a controlled goose hunt on a pre-registration basis. Each day hunters who have pre-registered by postcard lottery claim a station through a random drawing. Non-registered hunters then participate in a similar, standby drawing for unclaimed stations. Other non-registered hunters may report to the registration building and "refill" stations vacated by earlier parties. After each completed hunt, hunters must report to the headquarters and register any geese or ducks bagged. In addition, each hunter is limited to six shotgun shells per day.

Hunters participating in the Thief Lake WMA controlled goose hunt were surveyed in 1974. Seventy-seven percent of the hunters surveyed who had hunted the refuge boundary prior to the controlled system, felt that the controlled hunt had improved the quality of their hunt. Eighty-nine percent of the hunters stated that the DNR should continue the controlled hunt. Over 60 percent of the respondents felt that the six shell limit was too low. However, 75 percent of the hunters believed that the shell limit did decrease the shooting at birds out of range. The majority of hunters responding to a questionnaire in 1978 opposed a controlled goose hunt requiring reservations for blinds on the Roseau River WMA. However, a check of persons not returning the questionnaires was not made.

Excessive regulation and regimentation can, however, decrease hunting quality. The added regimentation of filling hunting spaces through pre-registration would decrease the quality of the hunt for some hunters and would cause problems for some who do not know far in advance when they will be free to hunt. Some hunters would prefer such a system since it would assure them of a hunting space without competing with a large number of other hunters and without being tempted to violate regulations to preempt a hunting spot.

The present controlled hunting system has several shortcomings which may necessitate changes. First, to secure a good location, hunters are often forced to occupy the blinds all night beginning at 8:00 p.m. Hunters who must travel any distance to the unit are discouraged because they are not assured a blind. Regulations are difficult to enforce, since hunters often leave the blinds and conceal themselves when the manager makes his rounds. Finally, it is difficult to count the number of geese harvested since hunters

are not required to check out before leaving.

Two modifications of the controlled hunt are under consideration. The first system would require parking in a lot with spaces numbered to correspond with blind numbers. Hunters would then be eligible to occupy that blind beginning one hour before legal shooting time. The manager could then check hunters at their cars beginning at 8:00 p.m., and they would not be forced to camp in the blinds. This system is in operation on the Elm Lake Wildlife Management Area, and it has worked satisfactorily for several years.

The second controlled hunt under consideration is an advanced reservation system similar to those at the Thief Lake and Lac qui Parle WMA's. Applications for reservations would be accepted before the season and blinds would be randomly assigned to successful parties at the goose hunt office on the reservation date. Unfilled blinds would be filled at the manager's discretion by random assignment to those present after the reservations had been claimed. This system would operate for the first 14 to 21 days of each waterfowl season. Should the demand be great enough the system could be extended through the entire season. When the reservation system was not in operation, blinds would be available on a first-come, first-serve basis, with no registration. A hunter registration station and parking lot would be sited near the headquarters. This system would allow non-local hunters better access to the limited hunting opportunities. It would also provide more control, easier enforcement of hunting regulations, and better information on the goose harvest. The system would add considerable expense in processing applications and in registering and monitoring hunters.

Few managed goose hunting areas outside of Minnesota are operated without a fee being charged, with the usual fee being \$2 to \$5 per hunter (Hunt 1968). Thus, goose hunters pay the added costs of administering controlled hunts. No fees are charged on any of the controlled hunting areas in Minnesota; the DNR lacks authority for such fees. Less than 25 percent of the hunters surveyed in 1978 at the Roseau River WMA were in favor of a fee to operate a pre-registered, controlled goose hunt on the area (Table 25). Only 37 percent of the hunters participating in the 1974 Thief Lake controlled hunt favored a fee to cover the cost of such a hunt. In 1979, the cost of operating the Thief Lake controlled hunt totaled approximately \$4,000, which came to about \$2.00 per hunter per day.

Proposed wetland management programs and acquisition programs should make more areas available outside the controlled hunting zone for waterfowl and waterfowl hunters. Even so, waterfowl hunting conditions may, in the future, become so crowded that steps will need to be taken to regulate the number of hunters. This could be done by limiting the number of hunters in each pool hunting compartment on a permit basis, with a drawing held to determine which hunters could hunt on a particular day.

In providing access to certain areas, consideration should be given to the type of vehicle that can use the access. If vehicles are stopped by road conditions, rather than by a chain or a sign, the quality of a visit may be diminished for some people. For example, a person who parks his car at the beginning of a muddy trail and walks back two miles to be by himself would be displeased to be followed by a group of four-wheel drive vehicles. The same situation could occur with snowmobiles going to remote areas.

Consideration should also be given to the effects of public use and especially certain types of vehicles on

wildlife, vegetation, soils, roads, and dikes. Motorboats are inappropriate for use in the pools during spring and summer because they could disturb waterfowl during the nesting and brood-rearing period. Vehicles driving on wet trails would compact the soil, make deep ruts, cause extensive erosion, and destroy vegetation. Vehicles could also damage wet dikes and roads. Snowmobiling may be detrimental to white-tailed deer (Kopischke 1974, Dorrance et al. 1975); however, the low levels of use occurring in this area probably are not significant to wildlife.

Other activities such as hiking, sightseeing, bird watching, and photography are minor uses compared to hunting. However, such activities help to cultivate an appreciation of wildlife and of the wildlife management area and should be permitted and encouraged when facilities and manpower permit and when they do not conflict with the main objectives of the area. Since the WMA is far from major population centers, a visitors' center could not be justified. However, environmental education and hunter education could be done during guided tours of the area and through slide talks to local clubs and schools. Hunter orientation programs would be helpful in familiarizing hunters with the regulations, hunting opportunities, access, and other features of the management area.

In addition to providing an opportunity for people to visit and enjoy the area, the WMA plays a role in the local economy. Visitors responding to questionnaires in a user's survey conducted in 1978 reported spending an average of about \$81 per party in Roseau County while visiting the WMA. During the waterfowl hunting period alone, October 1 through November 14, visitors to the WMA spent an estimated \$250,000 in Roseau County.

Past and Present Programs. Public use of the Roseau River WMA is regulated by the resident manager in accordance with Minnesota DNR Commissioner's Order No. 1961, "Regulations relating to the Public Use of Wildlife Management Areas" (Appendix I), in addition to the numerous other state laws and DNR regulations. The area contains four refuges (Figure 4). The Pool 3 refuge is opened during the firearms-deer season, but it is not posted as such. The small refuge north of Pool 1 is closed to all hunting, but it may be entered primarily for access to the goose hunting area to the north. Camping is permitted at all parking areas and access sites (Figure 4) during the hunting and fishing seasons. Some roads in the interior of the area, especially the dike roads, are closed to vehicles. Motorboats, with no restriction on horsepower, are permitted on the Roseau River, but elsewhere on the WMA only motors of 10 horsepower or less may be used, and only during the waterfowl season. Snowmobiles are permitted anywhere on the management area except the refuges.

Maps of the unit, showing the WMA boundary, refuge boundaries, roads, and public access and parking areas are available at the area headquarters. The maps do not show trails or water areas and do not include area regulations. The resident manager or another staff member is usually at the headquarters area to assist visitors during high-use periods.

Waterfowl hunting in the Pool 1 vicinity is regulated by a controlled hunting zone (CHZ) (Figure 6). The 43 goose hunting stations are available on a first-come, first-serve basis, with no reservation required. Both geese and ducks may be shot from the blinds. Thus far there have been no shell limits imposed on goose hunters. The blinds, according to a Commissioner's Order, are not to be occupied during the period from one hour after the close of waterfowl shooting hours

through 8:00 p.m. that same day. An unrestricted goose hunting area has been developed immediately north of the refuges on Pool 1 (Figure 6).

Except for the refuges and CHZ, there are no special restrictions on the number and spacing of duck or goose hunters in the pools or on any other type of users. Access is provided to all three pools, but access to Pool 2 from the south requires crossing a ford on the old channel of the Roseau River, which cannot be done by all types of vehicles. This access road was closed until 1977. The accesses are unimproved in most cases and require that hunters or fishermen carry a boat or canoe 50 yards to the water. The distribution of public use is regulated to some extent by the location of access points and parking areas (Figure 4).

The number of trappers using the WMA is limited by issuing only a certain number of trapping permits each year. Trappers are free to trap anywhere on the area, rather than being assigned to a particular zone. Even though they do receive some monetary return for using the WMA, trappers are not required to pay either a percentage of their catch or a permit fee, except for special beaver permits which cost \$2.50 per season. Usually one or two beaver permits and 10 or 11 general permits are issued.

Tours of the area for school groups and others are conducted by the resident manager. Some college teachers that have been on the area several times are permitted to tour the area unescorted. If dike conditions permit, visitors have been permitted to drive on the dikes along the pools during the month of August to view the area and the wildlife. Other than the tours, there has been little done in recent years in the way of environmental education such as slide talks or other speaking engagements.

Enforcement of regulations on the area is done primarily by WMA personnel, with some assistance from state conservation officers.



Hunters walk the large tracts of open brushland on the Roseau River WMA in search of sharptailed grouse.

Future Programs. Improved maps of the area, including roads, major vegetation types, water areas, and area regulations will be prepared and made available to visitors. An informational brochure describing the area will be prepared in conjunction with the map. The brochure will include descriptions of various wildlife species and plant communities and a summary of management and development.

The present goose hunting procedures around Pool 1 will be continued through the 1980 season. The resident manager will, however, limit hunters in the controlled hunting zone to one day of hunting in every eight, if necessary, to ensure equitable hunting opportunities. Each day, the manager will stamp the current date on the small game hunting licenses of persons occupying hunting stations. Persons may not occupy any hunting station for seven days following the date stamped on their license. This limitation will be discontinued whenever the manager judges that sufficient blinds are available to meet the demand. Beginning with the 1981 season, the controlled hunt will be operated under either the numbered parking stall system or the pre-registered hunting system discussed above. A pre-registered hunt would require the construction of a registration station and parking lot. The other system would require a parking lot with numbered stalls. If funds are not available to operate the best system, the Division of Fish and Wildlife will seek statutory authority to impose a controlled hunting fee sufficient to pay for all aspects of the hunt.

The controlled hunting zone will be expanded as necessary. The firing line north and west of the headquarters will be considered for inclusion as early as 1980. Blinds will be constructed in the additions at approximately 200-yard intervals. Potentially, nine blinds could be sited on the north firing line and 20 blinds could be placed on the remaining refuge boundary. A shell limit of 6 to 12 will be instituted in the controlled hunting zone.

Hunting for other species, fishing, and trapping will be permitted essentially as they are at present. Waterfowl hunter numbers will be limited in certain areas if hunting densities reach intolerable levels. The present trapping system will be continued. If conflicts between trappers or insufficient control of muskrats and predators along dikes develop, however, each trapper will be assigned to a specific area, by lottery if necessary. As is done at present, trappers will be required to report their take to the area manager at the end of the trapping season.

The present parking lots, primitive camping areas, and toilet facilities will be maintained. The parking area at the ford south of Pool 1 will be improved to make it usable during wet hunting seasons. Signs advising visitors to take their trash home with them will be posted at all major parking and access sites. The Pool 3 refuge will be modified to allow access except during the waterfowl migration period. The new refuge signs will read "State Wildlife Sanctuary, DO NOT TRESPASS, Sept. 1 — Oct. 31."

The environmental education program will be continued and expanded, if possible, in the form of talks and guided or self-guided tours. Hunter orientation classes for moose hunters and others will be conducted by WMA personnel. Activities such as sightseeing and bird watching will be encouraged.

RESEARCH AND SURVEYS

Objectives. Research and surveys will be an important part of management of the Roseau River WMA. Research will be encouraged, and the results will be

used to improve management, both on the unit and statewide. Surveys will be conducted to monitor wildlife abundance, public use, and the effects of management on the area's resources.

Considerations. Information on wildlife abundance and distribution, public use, and the effects of management is needed to guide the development and management of the WMA. Such information is collected regularly by surveys or informal observations by the area's staff. Additional surveys and research are limited by the available staff and funds, available techniques, and the size and accessibility of the area.

Wildlife abundance is difficult to assess. Aerial surveys of deer, moose, and waterfowl are useful under certain conditions. Counts along established survey routes, such as ruffed grouse drumming counts and counts of sharp-tailed grouse dancing grounds, can be used as indexes to small game abundance. Waterfowl populations and productivity can be examined by use of breeding pair counts, nest searches, or brood counts. All of these techniques require extensive labor and funding. Measuring changes in abundance in response to management on specific areas is complicated by changes in abundance in the surrounding area and by animal movements to and from the area. Measurement of the response of waterfowl to habitat manipulation may be complicated by other factors such as weather, predator populations, the harvest in the preceding year, or the phenology of the nesting season.

Estimates of public use are difficult to obtain because of the size of the area, the numerous access points, and insufficient staff. Information on the number of users and areas used at each time of year is needed to document trends in public use and to determine if overcrowding is becoming a problem at certain times or places. Input from individual users by interviews or questionnaires is useful in determining what factors increase or decrease the quality of a visit. In conjunction with public use surveys, data on wildlife harvest can be collected. This may provide an index to game population levels and help determine the success of management practices and regulations.

The effects of management on the resources of the area should be examined. Projects designed to benefit specific wildlife species or groups may be detrimental to other animals, plants, soils, waters, or archaeological sites. All projects should be examined for their impact on nontarget resources. When federal aid funds are used, federal guidelines require that this be done.

The WMA is an important part of the Minnesota DNR's annual waterfowl banding program. High densities of duck broods facilitate the capture of flightless birds for summer banding. Also, on the Roseau River WMA pools it is relatively easy to band ring-necked ducks, canvasbacks, and redheads, which may be difficult to capture elsewhere. Large concentrations of mallards, wigeons, and other dabbling ducks at the feeding sites make late summer, preseason banding efficient. In recent years, the WMA has been the site of the largest preseason mallard banding operation in Minnesota.

The area has potential for research in many areas, including wetland management, waterfowl depredations, hunter behavior, and studies of species or groups of species such as ducks, Canada geese, grouse, sandhill cranes, furbearers, or northern pike. Information from such studies could lead to more effective management. The Roseau River WMA is not staffed or funded to conduct research.

Past and Present Programs. Since the acquisition of the WMA was begun in 1949, there have been many types of surveys and research projects conducted on the area. Many of these are old projects that have been discontinued, some were begun years ago and are still being carried on, and others have just recently begun (Table 30).

The present public use surveys concentrate on waterfowl hunters. Daily morning car counts are conducted by WMA personnel throughout the waterfowl season or until the pools freeze over. In the past, car counts have occasionally been made from an airplane, but counts are usually made by driving to each parking area used by hunters. Car counts are not made at other times of the year on a regular basis, but use by fishermen and others is estimated by irregular car counts and observations. The 1978 public use survey involving questionnaires was conducted specifically for this plan (Appendix G).

The number of ducks and geese killed by hunters is estimated by spot bag checks made nearly every day throughout the hunting season. Other hunters are occasionally checked, but estimates of other game harvested cannot be made from bag checks because of small sample sizes. The number of moose killed on the area is known because moose hunters are required to report their kill. The furbearer harvest can also be determined from mandatory reports. Creel censuses of fishermen are not made.

The Game Lake Surveys that were done by the DNR provided information on vegetation, wildlife use, and water chemistry. Vegetation transects and vegetation maps were both done, but work was not continued to document changes. Permanent vegetation study plots and photograph record points were established in the 1950's, but none of these have been checked for over 23 years. Many of the point markers along dikes have been removed because they were in the way of operations.

Several regular state or area-wide surveys are used to assess wildlife abundance (Table 30). Aerial tran-

sects are flown each year to estimate white-tailed deer, moose, and breeding waterfowl populations. Aerial counts are also made of waterfowl during migration periods. Waterfowl brood counts are also made by WMA personnel each year from dike roads along the three pools. All broods seen are counted and recorded by species on the first count, and newly hatched ducklings and goslings are recorded on weekly counts made after the first count. Routes to census drumming ruffed grouse on the WMA and sharp-tailed grouse dancing grounds south of the WMA were started in 1978. Aerial counts, with occasional ground checks, of muskrat houses in Pool 1 were made for a few years in the 1950's. Waterfowl banding is done each year by the DNR banding crews as part of the U. S. Fish and Wildlife Service (USFWS) program to monitor populations and harvest. Banding is done both in the summer to monitor local populations and also just prior to the waterfowl season as part of the USFWS continental population survey.

A waterfowl study was done on the WMA by a DNR waterfowl biologist from 1965 through 1969 (Johnson and Jensen 1973). The study included waterfowl bag checks, harvest estimates, determination of subspecies of Canada geese shot by hunters, and an evaluation of the impact of hunting on the resident Canada goose flock. In 1978, a sandhill crane study was begun by a graduate student from the Biology Department at St. Cloud State University. The investigator is monitoring sandhill crane populations and production and is determining what areas are used by nesting and migrating cranes. The study area includes the Roseau River WMA and other areas in northwestern Minnesota. A research project entitled "Foraging Behavior and Resource Utilization of Breeding and Post-breeding Ring-necked Ducks" was started in 1978 by a graduate student from the Department of Entomology, Fisheries, and Wildlife at the University of Minnesota. This study is examining the food habits of ring-necked ducks on the WMA and the availability and nutritional value of food items. Activity

Table 30. Research and surveys on the Roseau River WMA and the dates and status of each.

Survey or Project	Dates	Status
Game lake survey		
Pool 1	1953, 1954, 1956, 1960	Not scheduled
Pool 2	1961	"
Pool 3	1954, 1955, 1961	"
Pine Creek Pothole	1949	"
Other potholes	1953, 1954, 1976	"
Vegetation study		
Permanent plots	1951, 1952, 1954	"
Photograph record points	1954, 1955	"
Breeding waterfowl survey	1951 to present	Continuing
Waterfowl brood count	1951 to present	"
Migration count	1951 to present	"
Hunter bag check	1951 to present	"
Trapping harvest summary	Unknown	"
Waterfowl banding	1954 to present	"
Big game census	1952 to present	"
Muskrat house count	1952-1956	Discontinued
Ruffed grouse drumming count	1978 to present	Continuing
Sharp-tailed grouse route	1978 to present	"
Ring-necked duck study	1978 to present	May end in 1980
Sandhill crane study	1978 to present	May end in 1979
Public use survey	1978	Not scheduled
Car count	Unknown	Continuing

patterns of ring-necked ducks during and after the reproductive period are also being studied.

Future Programs. Public use surveys in the form of car counts during the waterfowl hunting season will be continued. Car counts will be made on the opening weekend of fishing season and on weekends during grouse and deer seasons. Irregular car counts at other times of the year are useful in monitoring public use and should be continued if other staff duties permit. Interviews with visitors or questionnaires placed on vehicles will occasionally be used to sample visitors' concerns and suggestions. This will be done during car counts and bag checks and would require little additional time.

Spot bag checks will continue as in past years to obtain data on harvest of various species. Creel surveys of fishermen will be made occasionally to monitor fishing success. Mandatory harvest reports by trappers will be continued.

The wildlife surveys presently being conducted on the WMA will be continued and will be improved as funding or improved techniques become available. Management and research personnel of the DNR will cooperate in improving the collection of data on wildlife populations. On the waterfowl brood counts, all broods, regardless of age, will be counted, with the age class and subclass of each recorded. If possible, American coots will be included in surveys since they are an abundant game species on the area. The manager will also continue to provide support services for waterfowl banding crews and will maintain pre-season banding sites.

New photo points will be established along the Roseau River to document changes that occur if the Corps of Engineers' project is carried out. Other photo points may be used in the pools to help document changes in emergent vegetation. The photo points will be checked and re-photographed at least every five years.

The effects of proposed management projects on the area's resources, including plants, nontarget wildlife, and abiotic resources, will be assessed by the area personnel. The Division of Fish and Wildlife will submit significant development plans to the Minnesota Historical Society for review in order to avoid destroying or altering important prehistoric or historic cultural resources.

JUNEBERRY SUPPLEMENT — MANAGEMENT, ADMINISTRATION, AND ACQUISITION

Objectives. The long-range objective for the Juneberry Supplement is the management of all lands within the approved project boundary for wildlife, outdoor recreation, and forest products. Wildlife management will be directed toward moose, sharp-tailed grouse, white-tailed deer, and ruffed grouse. Lands administered by the DNR, Division of Forestry and Roseau County will be managed by cooperative agreement for wildlife, forest products, and recreation. Private lands will be purchased by the DNR, Division of Fish and Wildlife, after county board approval, from willing sellers.

Considerations. The proposed Juneberry Supplement to the Roseau River WMA totals 24,454 acres, mostly low, poorly drained land (Appendix K, Figure 2). Vegetative communities are primarily grasslands, lowland brush, and wetlands (Appendix K, Figure 1 and Appendix F). The area supports high populations of moose, sharp-tailed grouse, and white-tailed deer, and moderate densities of breeding waterfowl.

Historic patterns of state and private land ownership and agricultural practices in northwestern Minnesota produced an interspersed cropland, brush, aspen forests, and wetlands which supported a diverse and productive association of wildlife. Until recently, much private land was not in agricultural production due to poorly-drained soils, fluctuation in rainfall, and market prices. Often land was plowed and cropped for several years, then abandoned to brush and grassland after a series of crop failures due to excessive wetness or drought. To complement the conditions on private land, large tracts of state-owned lands were well dispersed throughout the region. The state land generally was in permanent forest, brush and grass, providing a stable supply of food and cover for wildlife. Moose, white-tailed deer, sharp-tailed grouse, ruffed grouse, and waterfowl thrived in this situation.

In recent years, wild lands have been rapidly disappearing in northwestern Minnesota. Private landowners are converting brush, forest, grass, and wetland habitats to cropland and pasture. Improved drainage techniques, favorable crop prices, and increased land values have spurred development. U.S. Soil Conservation Service personnel estimate that in the past six years about 48,000 acres of wild lands have been converted to cropland in Marshall and adjacent western Beltrami Counties. In Roseau County, land has probably been cleared to an even greater rate, according to SCS personnel. Wildlife managers in these counties estimate that up to 10 percent of the remaining privately-owned wildlife habitat is being eliminated each year.

Evidence of the effects of private land clearing on wildlife has been provided by an ongoing DNR study of sharp-tailed grouse populations in two Roseau County townships. In 1963, 29 sharp-tailed grouse dancing grounds were located on private lands in the two townships. By 1980 only 10 dancing grounds (35 percent) remained. Most, if not all, of this habitat loss was due to land clearing (Bill Berg, Minnesota DNR, personal communication).

State land ownership has dramatically declined over the years. Of the 595,000 acres of Consolidated Conservation Area and Trust Funds lands in Roseau and Marshall Counties, about 40 percent (225,000 acres) has been sold. Most of this land has been turned to agriculture.

Wildlife in these counties is becoming increasingly dependent on the remaining state-owned lands. For example, in the 1979 moose season, about 80 percent of the harvest was on or adjacent to state lands. If substantial wildlife populations are to be maintained in northwestern Minnesota, the remaining state lands must be retained and managed more intensively.

Poor soils limit the Juneberry area's potential for forestry and agriculture. Eighty percent of the unit has peat soils which are chronically wet and regularly flooded (Appendix B). Much of this land has poor timber production potential. However, the area should be surveyed by the Division of Forestry to identify potentially productive forest lands. A very small proportion of the area may be useable for food plots or cooperative farming.

Most of the vegetation of the unit would be best managed by controlled burning. With the exclusion of fires, the willow brush will grow into tall, dense tangles which limit use by sharp-tailed grouse, moose, and deer. The grassland will be invaded by woody growth and wetlands will become choked with vegetation and organic matter if fire is excluded. Wildfires occur regularly in the area, and require much time and ex-

pense to control. Regular controlled burning, facilitated by a network of firebreaks, would prevent the accumulation of fuels which can precipitate devastating wildfires. Such burning would open wetlands, maintain grasslands, and reduce willow height and density.

A system of public drainage ditches flows north through the supplement to the Roseau River (Figure 4). The ditches are spaced one mile apart across the entire area. Ditch grades currently provide some public access to the area, but they are not maintained. These grades could be developed into roads for public access, wildlife and forest management, and firebreaks. Local citizens are concerned that state management of the Juneberry area will lead to obstruction of the ditches through impoundment construction. However, state law prohibits the obstruction of public ditches by anyone, including the DNR, without permit from the ditching authority (Minnesota Statutes, Sec. 105.81, 1978).

Approximately 75 percent of the Juneberry Supplement to the Roseau River WMA, proposed in 1960, has not been acquired (Appendix K, Figure 2). Although most of the land is currently undeveloped and in little danger of being sold, it should be permanently classified for wildlife and forest management to allow development and management with DNR wildlife and forestry funds.

Acquisition has been halted due to lack of county board approval. The Roseau County Board has taken the position that no further state acquisition will be approved until the state and county agree on classification of all state-owned land in the county. Classification, which will designate each tract of land for sale to private individuals or retention for natural resources purposes, is now under negotiation.

Roseau County administers 38 percent (9,208 acres) of the Juneberry Supplement. Half of this land (4,341 acres) has been designated as a county recreation area. There is local support for county retention of these lands as a recreation and wildlife area. In a public meeting to discuss this plan, some citizens expressed the belief that state ownership of these lands would lead to restrictions of current public uses, to the development of large impoundments and to the blockage of drainage ditches through the area. Thus, it is unlikely that the county land will be sold to the state.

Given the public sentiments in the county, it might be desirable for the state to enter into a conditional lease or a cooperative management agreement for the county recreation area and state-owned tax-forfeited land in the Juneberry Supplement. Such an agreement could assure local citizens that management would not be detrimental to their interests. In addition, it would make state funds available for improvement of access and increased management.

The DNR, Division of Forestry administers 50 percent (12,377 acres) of the Juneberry Supplement. Ninety-nine percent of this land is state Trust Fund land. Because most of this land has not been developed for commercial agriculture or forestry, income has been negligible.

Private land comprises 12 percent (2,870 acres) of the Juneberry Supplement. The acquisition proposal has been modified to eliminate blocks of land which have been largely developed for crops since the project was approved. Only blocks of private tracts which are mostly undeveloped and desirable for wildlife or needed for waterfowl management and public hunting have been added. The private land not only would increase the wildlife value of the unit, but also would help

to offset losses of wildlife habitat in the region caused by private land clearing. In addition, some private in-holdings have been or may be developed for recreational residences or for cropland which could be threatened by burning on the unit.

Past and Present Programs. Very little management has been done on this area. The DNR, Division of Forestry controls wildfires and has begun a two-acre white cedar reforestation pilot project.

As part of this plan, DNR's Division of Fish and Wildlife has reassessed the Juneberry Supplement's project boundary and acquisition priorities. A total of 24,454.11 acres is now proposed for acquisition (Table 17). Of this total, 520 acres, were rated "desirable", (Appendix K, Figure 2) or worthy of most immediate acquisition. These are areas with Type III wetlands which may be threatened by cropland development. The remaining land is rated for "eventual" acquisition.

Future Programs. The Division of Fish and Wildlife will attempt to negotiate a long-term cooperative management agreement or lease for 9,208 acres of Roseau County-administered tax-forfeited (Recreation Area) lands within the Juneberry Supplement. Along with this agreement, the division will request a county board resolution prohibiting the sale of these lands and dedicating them to recreation, wildlife management, and forestry. If such an agreement cannot be made, county board approval for acquisition will be requested. Proposed agreements with the county will be presented to the State Planning Agency for review.

The Divisions of Fish and Wildlife and Forestry will cooperatively manage the 12,297 acres of Trust Fund land administered by the Division of Forestry within the Juneberry Supplement. Cooperative management will be implemented according to the DNR Forestry/Wildlife Coordination Policy which is discussed in the Forest Management section of this plan. Inter-divisional agreements will be presented to the State Planning Agency for review.

Acquisition of private land will follow the present proposal (Appendix K, Figure 2, Table 17). A total of 1,480 privately-owned acres will be deleted from the project (Appendix J). Private lands totaling 1,082 acres will be added to the project. This will result in a net reduction of 398 acres of private land from the original project proposal. Land will be acquired only from willing sellers after county board approval. Land exchanges will be negotiated if possible.

Any land acquisition in the Roseau River WMA depends on funding, county board approval, and willing sellers. Because of the many variables involved, a definite land acquisition schedule cannot be made. Priority will be given to those tracts of land rated as desirable. Priorities may be changed where wetlands are vulnerable to drainage or where lands may be sold for development. However, because of uncertain availability of land, lower priority tracts may be purchased before higher priority tracts.

In summary, 24,057 acres outside the present WMA boundary will eventually be managed by cooperative agreement or acquired as part of the Roseau River WMA. When cooperative agreements or acquisition has been completed, the Juneberry Supplement will be posted with standard wildlife management area signs.

Wildlife management will be primarily directed toward moose, sharp-tailed grouse, white-tailed deer, and ruffed grouse. Much of the area will be maintained in a mixture of grasses and brush. Grass, brush, and off-site aspen will be burned periodically to prevent establishment of brush in the grassland and to maintain

the brush in an open, easily-traveled stage at a height of five feet or less. A system of firebreaks will allow partial burning of the unit each year (Figure 10). The burning rotation will be 5 to 10 years.

Forests will be managed by commercial forestry methods to benefit ruffed grouse and white-tailed deer. Sites most likely to be productive for forest management are identified in Figure 10. The Division of Forestry will evaluate these and other sites to identify blocks of land which can be effectively managed by commercial forestry. These blocks will be protected with firebreaks. The area and district foresters and the resident wildlife manager will cooperatively determine the forest management objectives for the area.

Much of the forest land will probably be managed for aspen pulpwood production. To benefit ruffed grouse and white-tailed deer, aspen will be harvested in the smallest blocks and on the shortest rotation which are economical for commercial pulpwood operations. Cutting blocks of 40 acres or less and a

rotation of 40 years or less are preferred from the wildlife management standpoint. Softwood regeneration sites and methods will be cooperatively identified to optimize the mix of wildlife habitat and timber production benefits.

A system of access roads and firebreaks will be developed and maintained to facilitate wildlife management, forestry, fire control, and public use (Figure 10). Approximately 34 miles of ditch grades will be upgraded to allow single lane travel. Those ditch grades would also be maintained as firebreaks. In addition to the existing roads and ditch grades, approximately 25 additional miles of permanent firebreaks will be maintained.

Motor vehicle use will be permitted on the ditch grade roads, and small pulloff and parking areas will be developed as needed. All normal public uses of wildlife management areas, including snowmobiling as provided for in Commissioner's Order No. 1961, will be permitted.

SUMMARY OF MANAGEMENT PROGRAMS

WETLANDS

Wetlands will be managed primarily for waterfowl and public hunting. Water levels in major impoundments will be lowered in winter to provide spring flood control. The main dike system and water control structures will be extensively improved. Vegetation in the impoundments and other wetlands will be thinned to benefit waterfowl. Wet grass and sedge areas will be managed by haying and prescribed burning. The feasibility of developing new impoundments totaling 5,000 acres north of the present pools and 2,500 acres south of the Roseau River will be investigated.

FORESTS

Forests will be managed to maintain or create an interspersed forest types and age classes beneficial to wildlife. Timber will be harvested by commercial logging or firewood sales. Unmarketable timber will be periodically cut, sheared, or burned to set back plant succession and maintain wildlife values. Firebreaks will be developed to facilitate prescribed burns and to protect productive forest lands.

NON-FORESTED UPLANDS

Non-forested uplands include active and abandoned cropland. Cropland will be managed to provide food for wildlife and to reduce wildlife damage to crops on private lands. Grain grown on the area will be used on feeding sites near the impoundments to prevent crop damage by waterfowl during late summer. Some additional cropland will be farmed by state personnel rather than by cooperative leases with local farmers. This will provide additional wildlife food. Abandoned

cropland (old fields) will be periodically burned to maintain openings for wildlife.

CANADA GEESE

Canada goose management will continue to be directed toward migrant and locally nesting geese. Nest sites and possibly additional security from hunting pressure will be provided for nesting geese. Refuge and food will be provided to attract migrant geese. Local goose hunting pressure will be more closely monitored.

NONGAME WILDLIFE

Nongame wildlife will be integrated with game habitat management. Special management considerations will be given to rare or unique species such as the greater sandhill crane and great gray owl. More specific programs for nongame species will be implemented as needs are identified and funds are provided through the state nongame wildlife program.

PUBLIC USE

The area will accommodate hunting, trapping, fishing, and other activities compatible with its legal purpose and management objectives. Hunting will continue as at present; however, the controlled goose hunt will be modified beginning in 1981. The hunt will then be administered either with numbered parking stalls corresponding to blind numbers or with a pre-registered reservation system for part of the season. The controlled hunting zone around Pool 1 will be expanded if necessary. Registration fees will be con-

sidered if funding for the controlled hunt is insufficient. Trapping by permit from the manager will continue, and a lottery system for assigning permits and specific areas will be considered if demand is sufficient. Camping will be permitted in parking areas; however, the manager may prohibit camping at specific areas where problems develop. The wildlife sanctuary in Pool 3 will be reposted to allow deer hunting. Other compatible outdoor recreational activities will be permitted, including cross-country skiing, hiking, wildlife observation, and snowmobiling. No trails or special facilities will be developed for these activities.

RESEARCH AND SURVEYS

Regular surveys of public use, including car counts, interviews, and hunters' bag checks will be conducted. Annual surveys of wildlife abundance, including aerial

censuses of moose, deer, and breeding waterfowl will be done. Mid-summer and pre-season waterfowl banding will be continued. In addition, the manager will cooperate with DNR and University research projects which will aid in statewide or unit management.

LAND OWNERSHIP AND ACQUISITION

A total of 24,057 acres will be added to the management area. Tax-forfeited and county owned lands within the project proposal will be managed in cooperation with Roseau County if cooperative agreements can be negotiated. State Trust Fund lands will be managed cooperatively with the DNR, Division of Forestry. Private land totaling 2,870 acres is proposed for acquisition from willing sellers.

IMPLEMENTATION AND COST ESTIMATES

Specific programs to manage fish and wildlife and provide quality fish- and wildlife-related recreation were developed based on present conditions and future expectations. Implementation of these programs depends on land ownership, land and management costs, and the amount and sources of funding.

LAND COSTS

Land acquisition costs are difficult to estimate for the management area because of the extreme variation in land types and values. The present value of the 2,870 acres of private land in the Juneberry Supplement is approximately \$860,000. However, purchase of these lands is dependent upon county board approval, willing sellers, and funding. Funds for land purchases are not part of the management area's operating budget.

Land acquisition has been funded historically by a surcharge on small game hunting licenses. This \$2.00 surcharge, which is authorized through 1984, currently generates about \$600,000 annually for wildlife land acquisition. In addition, the Legislative Commission on Minnesota Resources (LCMR) has made periodic special appropriations for wildlife land acquisition. The LCMR's most recent appropriation was \$250,000 in 1975. In recent years, surcharge and LCMR funds have been supplemented by general revenue funds under a program called Resource 2000. This six-year program has provided \$9.2 million for wildlife land acquisition since 1975. The amount of wildlife lands which can be acquired in future years will depend on the level of funding provided by these three sources.

MANAGEMENT PROGRAMS AND COSTS

The resident wildlife manager, under the supervi-

sion of the Region I, Section of Wildlife Office in Bemidji, will implement the management proposals in this plan.

The resident manager must have the flexibility to decide how funds will be spent through the year and to modify programs to suit changing conditions. Proposed development and management programs depend on weather conditions, land acquisition, and equipment and labor availability. For example, proposed controlled burning might be impossible due to wet or dry weather.

The wildlife management programs were placed in three alternative spending levels (Table 31). All costs were estimated in 1979 dollars.

Included in the first spending level are those programs having the highest priority which can be implemented at the current spending level without management cutbacks. Present expenditures of about \$100,000 to \$110,000 per year represent current costs for salaries, routine equipment and facility maintenance and operation, and yearly habitat maintenance and development.

Equipment replacement needs are difficult to predict because of the uncertain demands on equipment. Also, major equipment replacement is dependent on funding, needs, and priorities within Region I. Because of these factors, the anticipated equipment replacement is scheduled in five-year intervals (Table 32). Replacement costs were based on price estimates for new equipment. In many cases, however, used equipment, especially farm machinery, will be adequate and can be purchased at substantially lower costs. Average additional equipment replacement costs above 1978 spending levels were added to current spending needs (Level I, Table 31).

The utility building, built in 1956 (Table 13), will be expanded in order to enlarge the manager's office. The present office is approximately 10 by 12 feet, much too

Table 31. Annual spending alternatives for the management of the Roseau River WMA.

Level I. Management at current spending level.

- Wetland management**
 1. Replace 5 water control structures over planning period
 2. Reinforce spillway Number 2
 3. Maintain dikes and water control structures
 4. Maintain and develop artificial potholes or dugouts
 5. Maintain existing nesting islands
- Forest management**
 1. Administer firewood permits
 2. Cut browse and make trails for deer in severe winters
 3. Maintain firebreaks
- Non-forested upland management**
 1. Administer cooperative farming agreements
 2. Maintain present acreage farmed by state personnel
 3. Feed waterfowl to prevent depredations
- Canada goose management**
 1. Conduct present kill surveys and censuses
 2. Maintain artificial nest structures, add new structures as needed
- Public use management**
 1. Maintain access roads, parking lots, and hunting blinds
 2. Enforce game laws and special regulations
 3. Maintain existing boundary signs and post any newly-acquired land
 4. Conduct limited group tours of the unit
- Research and surveys**
 1. Conduct present wildlife surveys
 2. Cooperate with research projects

Annual Spending		Immediate needs for implementation	
1978 baseline	\$110,800	Replacement	
Added equipment replacement	\$ 13,000	Dike improvements (27 miles)	\$270,000
Added labor and support	-0-	Water control structures (5)	\$250,000
Annual total	\$123,800	Vehicle bridges (2)	\$ 600
		Repair	
		Spillway No. 2	\$ 5,000
		New	
		Manager's office addition to utility building	\$ 12,000
		Total	\$537,600

Level II. Additional management with increased spending.

- Wetland management**
 1. Control cattail in pools to create openings
 2. Construct firebreaks and manage controlled burns in sedge meadow, grass fen and shallow marsh
 3. Construct additional level ditches and dugouts
 4. Construct additional nesting islands
 5. Construct and manage moist soil units totaling 400 acres north and south of Pool 1
- Forest management**
 1. Develop detailed forest management and controlled burning plan
 2. Construct and maintain additional firebreaks
 3. Cut, shear, and burn unmarketable, overaged aspen stands
 4. Crush, mow and burn lowland brush, small scale
 5. Clear and maintain additional forest openings
- Non-forested upland management**
 1. Controlled burning of old fields, small scale
 2. Plant selected old fields to legumes
 3. Develop more food plots on present cropland — more farming by state.
- Canada goose management**
 1. Survey kill on private land near unit each fall
 2. Survey resident goose reproduction and mortality
- Public use management**
 1. Construct goose hunt registration station and parking area
 2. Administer pre-registered, controlled goose hunt
 3. Construct blinds and post controlled hunting zone expansions as needed
 4. Improve parking areas

Table 31. (continued)

Annual Spending		Immediate capital needs for implementation	
Research and Surveys			
<ol style="list-style-type: none"> 1. Establish photo points along the Roseau River and WMA pools 2. Experiment with cattail control methods 3. Improve public use surveys 			
Level I annual total	\$123,800	Level I total	\$537,600
Added labor and support		New	
(1, 9-month laborer)	\$ 8,500	Goose hunt registration station	\$ 10,000
(2, 3-month technicians)	\$ 7,000	Vault toilets for station (2)	\$ 2,000
(support expenses)	\$ 15,000	Cattail mower	\$ 5,000
Annual total	\$154,300	Combine, agricultural	\$ 15,000
		Moist soil unit dike, 9 miles	\$ 70,000
		Pump station for moist soil units	\$ 40,000
		Total	\$679,600

Level III. Additional management with increased funding.

Wetland management			
<ol style="list-style-type: none"> 1. Cattail control and marsh opening management intensified 2. Develop and manage Roseau River impoundment as 2,500-acre moist soil unit or waterfowl production unit 3. Construct and manage new pools totaling 4,850 acres 4. Construct 9.3-mile diversion ditch for improved water control 5. Construct oxbow control structures if needed 6. Controlled burning on Juneberry Supplement 			
Forest management			
<ol style="list-style-type: none"> 1. Construct and maintain firebreaks on present unit, 70 miles 2. Intensify lowland brush crushing and burning 3. Experimental lowland conifer management 4. Construct and maintain firebreaks on Juneberry Supplement (75 miles) 5. Upgrade access roads on Juneberry Supplement (50 miles) 			
Non-forested upland management			
<ol style="list-style-type: none"> 1. Controlled burning of old fields, large scale 2. Additional food plots, more farming by state 			
Public use management			
<ol style="list-style-type: none"> 1. Develop and administer an environmental education program 2. Management and development of additional controlled hunting as needed 			
Annual Spending		Immediate capital needs for implementation	
Level II annual total	\$154,300	Level II total	\$ 679,600
Added labor and support		New	
(1, 9-month laborer)	\$ 8,500	Roseau River Impoundment diking 8 miles	200,000
(Seasonal laborer and support expenses)	\$ 8,500	Roseau River Impoundment pump station	40,000
Annual Total	\$171,300	WMA Pool diking 14 miles	560,000
		Diversion ditch 9.3 miles	93,000
		Water control structures for new WMA Pool (4)	200,000
		Total	\$1,772,600

small to allow adequate work and storage space. Present plans call for the addition of 10 to 12 feet to the east end of the building. Construction will be administered by DNR's Northern Service Center.

Levels II and III require about 28 and 43 percent increases over present levels, respectively (Table 31).

All spending levels require additional funds for the purchase of new equipment or the construction of capital improvements. Many of these capital investments are required to immediately implement all programs. Although spending levels are presented on an annual basis, the costs for capital expenditures listed in Table 31 will only occur once during the 10-year planning period. Expenditures for equipment and improvements for full implementation of management levels I, II, and III are \$537,600, \$142,000, and \$1,093,000, respectively.

Fisheries work on the WMA can be implemented with current funding. No additional fisheries management programs are planned on the WMA.

The DNR, Division of Forestry, through the Greenbush District Office, will be consulted when formulating detailed forest management plans in accordance with current DNR policy. The Division of Forestry will supervise all timber sales, following current policies. These tasks will be accomplished under current funding levels, possibly supplemented with special accelerated forest inventory funds.

MANAGEMENT AREA FUNDING

Funding for completing acquisition of the Roseau project will be primarily from the surcharge fund and the Resource 2000 program described under land costs.

Funds for the development and operation of the management area are appropriated from the dedicated Game and Fish Fund. Receipts into this fund

are primarily from the sale of hunting, fishing, and trapping licenses and federal aid reimbursement through the Pittman-Robertson and Dingell-Johnson programs. Federal aid reimbursement is seventy-five percent reimbursement on approved projects. For the most part, the Division of Fish and Wildlife operates within a budget that can only be increased through an increase in license fees or license sales.

A \$3.00 Minnesota migratory waterfowl stamp was initiated in 1977. The legislature appropriates an amount which approximates waterfowl stamp receipts. This appropriation is for the development of waterfowl habitat on public hunting grounds and designated lakes.

In addition, as part of the Resource 2000 program, the legislature appropriated \$1,000,000 for the betterment of wildlife management areas.

Except for the recent increase in revenue provided by the migratory waterfowl stamp and possible future general fund appropriations, management funds will probably not increase significantly by 1989. Accordingly, most proposals are planned within the present budgetary constraints. Wildlife management finances in Region I are somewhat flexible, and funds can be shifted from item to item. To maintain the present wildlife programs through the region and to implement all of the planned management on the Roseau River WMA, increased funding in Region I will be needed.

STATE PLANNING AGENCY REVIEW

Several actions proposed in this plan have not been finalized due to the time required for negotiations and engineering and the uncertainty of funding. Before projects and agreements are finalized, they will be presented to the State Planning Agency for review. In addition, major changes in the plan will be submitted to the State Planning Agency for review.

Table 32. Equipment replacement for the Roseau River WMA.

Period	Item/Model	Cost	
1980-1984	Truck/Dodge ½ ton pickup	\$ 5,500	
	Truck/Dodge ½ ton. 4 x 4 pickup (2)	13,000	
	Truck/International 1700 dump (2)	18,000	
	Truck/Ford F700 stake	9,000	
	Loader/Case 1000D	8,000	
	Snowmobile/Polaris Voyageur	1,600	
	Riding lawn mower/Toro 8 hp	1,300	
	Plow/John Deere 6 bottom	8,170	
	Disc/John Deere 12 foot tandem	3,388	
	Grain drill/John Deere 12 foot	4,240	
	Brush cutter/John Deere	2,500	
	1984-1989	Truck/Dodge ½ ton pickup	5,500
		Truck/Dodge ½ ton, 4 x 4 pickup	6,500
Truck/International 1700 dump		9,000	
Tractor/John Deere 2640		14,670	
Tractor/John Deere 4240		23,400	
Dozer/Caterpillar D4		42,000	
Swather/International 175		5,000	
Field cultivator/John Deere 1000		2,585	
All-terrain-vehicle/Ranger		6,000	
Lawn mower/Snapper	800		
Total		189,943	
Average cost per year		\$18,994	

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Appendix A. The Minnesota Outdoor Recreation System.

Classification	Purpose	Administration
Natural State Park	A natural state park shall be established to protect and perpetuate extensive areas of the state possessing those resources which illustrate and exemplify Minnesota's natural phenomena and to provide for the use, enjoyment, and understanding of such resources without impairment for the enjoyment and recreation of future generations.	Commissioner of Natural Resources
Recreational State Park	A recreational state park shall be established to provide a broad selection of outdoor recreation opportunities in a natural setting which may be used by large numbers of people.	Commissioner of Natural Resources
State Trail	A state trail shall be established to provide a recreational travel route which connects units of the outdoor recreation system or the national trail system, provides access to or passage through other areas which have significant scenic, historic, scientific, or recreational qualities or reestablishes or permits travel along a historically prominent travel route or which provides commuter transportation.	Commissioners of Transportation and Natural Resources
State Scientific and Natural Area	A scientific and natural area shall be established to protect and perpetuate in an undisturbed natural state those natural features which possess exceptional scientific or educational value.	Commissioner of Natural Resources
State Wilderness Area	A state wilderness area shall be established to preserve, in a natural wild and undeveloped condition, areas which offer outstanding opportunities for solitude and primitive types of outdoor recreation.	Commissioner of Natural Resources
State Forests and State Forest Sub-Areas	A state forest, as established by Minnesota Statutes, Section 89.021, shall be administered to accomplish the purposes set forth in that section, and a state forest sub-area shall be established to permit development and management of specialized outdoor recreation at locations and in a manner consistent with the primary purpose of the forest.	Commissioner of Natural Resources
State Wildlife Management Area	A state wildlife management area shall be established to protect those lands and waters which have a high potential for wildlife production and to develop and manage these lands and waters for the production of wildlife, for public hunting, fishing, and trapping, and for other compatible outdoor recreational uses.	Commissioner of Natural Resources
State Water Access Site	A state water access site shall be established to provide public access to rivers and lakes which are suitable for outdoor water recreation and where the access is necessary to permit public use.	Commissioner of Natural Resources
State Wild, Scenic, and Recreational Rivers	State wild, scenic, and recreational rivers shall be established to protect and maintain the natural characteristics of all or a portion of a river or stream or its tributaries, or lake through which the river or stream flows which together with adjacent lands possesses outstanding scenic, scientific, historical, or recreational value, as provided by Sections 104.31 to 104.40.	Commissioner of Natural Resources
State Historic Sites	A state historic site shall be established to preserve, restore, and interpret buildings and other structures, locales, sites, antiquities, and related lands which aptly illustrate significant events, personalities, and features of the history and archaeology of the state or nation.	Commissioner of Natural Resources, Minnesota Historical Society, Board of Regents of the University of Minnesota, Governmental subdivisions of the State and County Historical Societies.
State Rest Area	A state rest area shall be established to promote a safe, pleasurable, and informative travel experience along Minnesota highways by providing areas and facilities at reasonable intervals for information, emergencies, or the rest and comfort of travelers.	Commissioner of Transportation

Appendix B. Soil types, agricultural capability, and acreage on the Roseau River WMA and Juneberry Supplement¹.

Soil Series ¹ (Present name)	Type	Present S.C.S. Soil Number	Agricul- tural Ca- pability Classi- fication ²	Roseau River WMA		Juneberry Supplement	
				Acres	Percent	Acres	Percent
Bearden	Loam	67	Ile	20	Tr ³		
Bearden	Loam, imperfectly drained		Ile		0.1		
Bearden	Fine, sandy loam	67	Ile	398	0.6	17.25	0.1
Bearden	Sand loam	67	Ile	0	0.0	40.25	0.2
Fargo	Clay	57	IIw	219	0.4	350.74	1.4
Nereson (Roliss)	Silt loam	582	IIw	498	0.8	5.75	Tr
Kittson (Roliss)	Clay loam	582	IIw	388	0.6	212.84	0.9
Kittson (Roliss)	Silt loam	582	IIw	1,166	1.9	1,494.95	6.1
Kittson (Roliss)	Clay loam, Imper- fectly drained	582	IIw	179	0.3	557.73	2.3
Kittson	Sandy loam	582	IIw	17	Tr	97.75	0.4
Chilgren	Clay loam	404	IIw	13	Tr		
Ulen	Very fine sandy loam	64	Ile	423	0.7	86.25	0.4
Grimstad (Rockwell)	Loamy fine sand	439	IIw	113	0.2	138.00	0.6
Grimstad (Rockwell)	Loam, imperfectly drained	439	IIw	259	0.4		
Ulen	Loamy fine sand	64	IIIe	2,903	4.7	431.24	1.8
Ulen	Very fine sandy loam, imperfectly drained	64	IIIe	54	0.1	189.74	0.8
Ulen	Loamy fine sand, gravelly	64	IIIe	33	0.1	304.74	1.3
Poppleton	Loamy fine sand	148	IVs	1,142	1.9		
Feat	Shallow phase over clay	544	IVw	15,311	25.0	12,845.11	52.5
Sioux (Lohnes)	Loamy sand	245	IVs	6	Tr	109.25	0.5
Barnett (Roliss)	Silt loam	387	IIIw	139	0.2	17.25	0.3
Barnett (Roliss)	Clay loam	387	IIIw	246	0.4	166.74	0.7
Maple (Fargo)	Clay loam	55	IIIw	54	0.1	201.24	0.8
Fargo	Clay, poorly drained	55	IIIw	458	0.7	69.00	0.3
Hiwood	Loamy fine sand	48	IVs	332	0.5	287.49	1.2
Peat	Shallow phase over sand	543	IVw	2,789	4.5	4,013.38	16.4
Tannberg (Rockwell)	Loam	439	IVw	66	0.1		
Arveson	Loamy fine sand	61	IIIw	802	1.3	92.00	0.4
Arveson	Very fine sandy loam	61	IIIw	126	0.2	11.50	Tr
Arveson	Silt loam	61	IIIw	113	0.2	11.50	Tr
Peat	Deep phase	580	IVw	32,360	52.8	2,593.17	10.6
Alluvial		1,001	IIIw	666	1.1		
Foxhome (Mavle)	Loam, imperfectly drained	412	IIIw	0	0.0	80.50	0.3
Foxhome (Mavle)	Loam	412	IIIw	0	0.0	28.75	0.1
				61,333	99.9	24,454.11	100.4

¹ Source: McMiller et al. 1942.

² U.S.D.A. Soil Conservation Service system. Class I: few limitations, Class II: some limitations reducing the choice of plants or requiring moderate conservation practices, Class III: severe limitations, Class IV: very severe limitations; Subclass e: erosion hazard, Subclass w: excess water, Subclass s: soil limitations in the root zone such as shallow soils or low moisture-holding capacity (U. S. Department of Agriculture 1961).

³ Trace = less than 0.1 percent.

Appendix C. Water quality classification of intra- and Interstate streams in the Minnesota portion of the Roseau River basin.

Stream	Area	Classification ¹	
Roseau River	Source to Canadian border	2B, 3B	Interstate
Sprague Creek	Canadian border to Roseau R.	2B	Interstate
Pine Creek	Canadian border to Roseau R.	2B, 3B	Interstate
Pine Creek Diversion	Canadian border to and incl. Pine Creek diversion pools	2B, 3B	Interstate
South Fork Roseau R.	Source to Roseau R.	2B	Intrastate
Bemis Hill Creek	Source to Roseau R.	1B, 2A, 3B	Intrastate
Hay Creek	Source to Roseau R.	2C	Intrastate
Sucker Creek	Source to Roseau R.	2C	Intrastate

- ¹ 1B: Domestic consumption: With chlorination or equivalent.
 2A: Fisheries and recreation: Quality shall permit warm or cold water sport or commercial fishing, and all suitable aquatic recreation, including bathing.
 2B: Fisheries and recreation: Quality shall permit warm or cool water sporting or commercial fishing, and all suitable aquatic recreation, including bathing.
 2C: Fisheries and recreation: Quality shall be suitable for rough fish and for boating.
 3B: Industrial consumption: Suitable for general industrial purposes, except for food processing, with only a moderate degree of treatment.

Source: Minnesota Pollution Control Agency 1973.

Appendix D. Water chemistry measurements from six sites on the Roseau River WMA, 1978.

Parameters ²	Sites sampled July 8, 1978 ¹						Sites sampled Oct. 2, 1978 ¹					
	A	B	C	D	E	F	A	B	C	D	E	F
Sulfate	.36	< 1	25	13	< 1	< 1	12	< 1	18	4	9	3
Total Phosphorus	.107	< .050	< .050	.087	.078	< .050	.050	< .050	< .050	< .050	< .050	< .050
Soluble Phosphorus	.049	< .010	< .010	< .010	.022	< .010	< .010	< .010	.014	.030	.020	.016
Chloride	8	4.2	3.3	4.9	5.1	3.0	2.7	1.6	2.0	3.4	2.7	2.3
Nitrogen												
Ammonia	.175	< .025	.028	< .025	.028	.034	.040	< .025	.037	.029	.044	.037
Nitrite	< .001	< .001	< .001	< .001	.005	< .001	< .001	< .001	< .001	< .001	< .001	< .001
Nitrate	.055	.058	.100	.050	.050	.050	.052	.055	.320	.070	.070	.055
Total Kjeldahl	2.01	1.24	1.68	1.36	1.45	1.29	1.75	1.38	2.04	1.47	1.59	.90
pH	9.00	8.05	7.50	7.55	7.80	8.40	7.85	8.15	7.85	8.05	8.30	8.30
Total Alkalinity	112	198	228	160	162	218	215	192	220	205	205	215
Conductivity (micromhos)	250	311	390	270	265	380	345	305	370	330	335	330

¹Sampling sites

- A. Roseau River WMA, Pool 1.
- B. Roseau River WMA, Pool 2.
- C. Roseau River WMA, Pool 3.
- D. Roseau River at Roseau Co. Rd. 113.
- E. Roseau River at Roseau CSAH 24 bridge.
- F. Pine Creek Diversion in Roseau River WMA.

²Measurements in parts per million except pH and conductivity.

Appendix E. Common and scientific names of plants mentioned in the text.

Family	Common Name	Scientific Name
Arallaceae	Wild sarsaparilla	<i>Aralia nudicaulis</i>
Asclepiadaceae	Swamp milkweed	<i>Asclepias incarnata</i>
Betulaceae	Alder	<i>Alnus</i> sp.
	Paper birch	<i>Betula papyrifera</i>
	American hazel	<i>Corylus americana</i>
	Beaked hazel	<i>Corylus cornuta</i>
Campanulaceae	Marsh-bellflower	<i>Campanula aparinoides</i>
Caprifoliaceae	Bush honeysuckle	<i>Diervilla Lonicera</i>
Ceratophyllaceae	Coontail	<i>Ceratophyllum demersum</i>
Compositae	Ragweed	<i>Ambrosia</i> sp.
	Aster	<i>Aster</i> sp.
	Common sunflower	<i>Helianthus annuus</i>
	Blazing star	<i>Liatris</i> sp.
	Sweet coltsfoot	<i>Petasites frigidus</i>
	Goldenrod	<i>Solidago</i> sp.
Cornaceae	Red-osier dogwood	<i>Cornus stolonifera</i>
Cupressaceae	White cedar	<i>Thuja occidentalis</i>
Cyperaceae	Sedge	<i>Carex</i> sp.
	Hardstem bulrush	<i>Scirpus acutus</i>
	Softstem bulrush	<i>Scirpus validus</i>
Ericaceae	Bog-rosemary	<i>Andromeda glaucophylla</i>
	Bearberry	<i>Arctostaphylos Uva-ursi</i>
	Leather-leaf	<i>Chamaedaphne calyculata</i>
	Labrador tea	<i>Ledum groenlandicum</i>
Fabaceae	Licorice root	<i>Glycyrrhiza lepidota</i>
	Alfalfa	<i>Medicago sativa</i>
Fagaceae	Bur oak	<i>Quercus macrocarpa</i>
Gentianaceae	Fringed gentian	<i>Gentiana crinita</i>
Gramineae	Quack grass	<i>Agropyron repens</i>
	Redtop grass	<i>Agrostis alba</i>
	Big bluestem	<i>Andropogon Gerardi</i>
	Oats	<i>Avena sativa</i>
	Brome grass	<i>Bromus</i> sp.
	Bluejoint	<i>Calamagrostis canadensis</i>
	Northern reed grass	<i>Calamagrostis inexpansa</i>
	Barley	<i>Hordeum vulgare</i>
	Reed canary grass	<i>Phalaris arundinacea</i>
	Timothy	<i>Phleum pratense</i>
	Common reed	<i>Phragmites communis</i>
	Blue grass	<i>Poa</i> sp.
	Cord grass	<i>Spartina pectinata</i>
	Wheat	<i>Triticum aestivum</i>
	Wild rice	<i>Zizania aquatica</i>
Haloragaceae	Water milfoil	<i>Myriophyllum exalbescens</i>

Appendix E. (Continued)

Family	Common Name	Scientific Name
Iridaceae	Blue flag	<i>Iris virginica</i>
	Blue-eyed grass	<i>Sisyrinchium</i> sp.
Labiatae	Water-horehound	<i>Lycopus</i> sp.
Lemnaceae	Lesser duckweed	<i>Lemna minor</i>
	Star duckweed	<i>Lemna trisulca</i>
Lentibulariaceae	Bladderwort	<i>Utricularia vulgaris</i>
Lilliaceae	White camas	<i>Zygadenus glaucus</i>
Linaceae	Common flax	<i>Linum usitatissimum</i>
Loranthaceae	Dwarf mistletoe	<i>Arceuthobium pusillum</i>
Najadaceae	Pondweed	<i>Potamogeton</i> sp.
Oleaceae	Green ash	<i>Fraxinus pennsylvanica</i>
Orchidaceae	Ladies' tresses orchid	<i>Spiranthes</i> sp.
Pinaceae	Balsam fir	<i>Abies balsamea</i>
	Tamarack	<i>Larix laricina</i>
	Black spruce	<i>Picea mariana</i>
	Jack pine	<i>Pinus banksiana</i>
	Red pine	<i>Pinus resinosa</i>
	White pine	<i>Pinus strobus</i>
Polypodiaceae	Bracken fern	<i>Pteridium aquilinum</i>
Ranunculaceae	Columbine	<i>Aquilegia canadensis</i>
Rosaceae	Strawberry	<i>Fragaria</i> sp.
	Swamp cinquefoil	<i>Potentilla palustris</i>
	Shrubby cinquefoil	<i>Potentilla fruticosa</i>
	Chokecherry	<i>Prunus virginiana</i>
	Red raspberry	<i>Rubus strigosus</i>
	Juneberry	<i>Amelanchier</i> sp.
Rubiaceae	Bedstraw	<i>Galium labradoricum</i>
Salicaceae	Balsam poplar (Balm of Gilead)	<i>Populus balsamifera</i>
	Trembling aspen	<i>Populus tremuloides</i>
	Peach-leaved willow	<i>Salix amygdaloides</i>
	Sand-bar willow	<i>Salix interior</i>
	Balsam willow	<i>Salix pyrifolia</i>
Sphagnaceae	Sphagnum moss	<i>Sphagnum</i> sp.
Tiliaceae	Basswood	<i>Tilia americana</i>
Typhaceae	Narrowleaf cattail	<i>Typha angustifolia</i>
	Common cattail	<i>Typha latifolia</i>
Umbelliferae	Water-hemlock	<i>Cicuta bulbifera</i>

Appendix F. Vegetative composition of the Roseau River WMA, Juneberry supplement, and proposed additions and deletions.¹

Type	Present WMA Boundary		Juneberry Supplement		Proposed Deletion		Proposed Addition	
	Acres	Percent of total area	Acres	Percent of total area	Acres	Percent of total area	Acres	Percent of total area
Upland Deciduous	4,568	7.4	1,915	7.8	336	22.8	879	33.2
Aspen	3,891	6.3	1,352	5.5	162	11.0	674	25.5
Aspen/Lowland Brush	646	1.1	487	2.0	174	11.8	96	3.6
Bur oak/Aspen	29	T ²	76	0.3	0	0	109	4.1
Upland Conifer								
Jack pine	207	0.3	0	0	0	0	0	0
Lowland Deciduous	8,128	13.2	5,824	23.8	103	7.0	397	15.0
Lowland Brush	7,156	11.7	5,561	22.7	103	7.0	397	15.0
Lowland Brush/Aspen	675	1.1	263	1.1	0	0	0	0
Lowland Brush/Grass-Fen	297	0.5	0	0	0	0	0	0
Lowland Conifer	1,312	2.1	0	0	0	0	0	0
Black Spruce	23	T	0	0	0	0	0	0
Black Spruce/White Cedar	680	1.1	0	0	0	0	0	0
Black Spruce/Tamarack	502	0.8	0	0	0	0	0	0
White Cedar	107	0.2	0	0	0	0	0	0
Grassland & Old Field	6,224	10.1	10,821	44.2	97	6.6	589	22.2
Grass	179	0.3	102	0.4	0	0	0	0
Grass-Fen	3,738	6.1	6,032	24.7	12	0.8	204	7.7
Grass-Fen/Lowland Brush	1,040	1.7	4,283	17.5	85	5.8	306	11.6
Old Field	824	1.3	271	1.1	0	0	33	1.2
Old Field/Lowland Brush	444	0.7	133	0.5	0	0	46	1.7
Agricultural Field	1,856	3.0	734	3.0	929	62.7	601	22.8
Sedge Meadow	12,074	19.7	0	0	0	0	0	0
Wetlands	26,966	44.0	5,162	21.1	15	1.0	177	6.7
Type II	5,184	8.4	3,326	13.6	15	1.0	177	6.7
Type III	10,909	17.8	1,751	7.2	0	0	0	0
Type IV	5,793	9.4	0	0	0	0	0	0
Type Vi	5,079	8.3	85	0.3	0	0	0	0
Total	61,333	99.8	24,454	99.9	1,480	100.1	2,643	99.9

¹ Areas calculated from Appendix K, Figure 1 with a Hewlett-Packard Digitizer.

² Trace=less than 0.1 percent.

Appendix G. Roseau River WMA public use survey; methods, analysis, and results.

A public use survey was conducted to supply additional information on the types and amounts of recreational use occurring on the area. Information on the attitudes and demographic characteristics of area users was also obtained.

SURVEY PERIOD

The survey, conducted in 1978, was divided into two subperiods, June 16 — September 15 (summer) and September 16 — December 31 (fall/winter), because of differences in the intensity and types of use on the area. The summer period is a time of warm weather activities such as fishing, camping, and boating, while hunting predominates during the fall/winter period. Public use of the area from January through April is extremely low according to the resident manager. Since time and funding were not adequate to survey the entire year, this period was not sampled.

SAMPLING TECHNIQUES

Questionnaires were distributed to parked vehicles encountered along a predetermined route which included the major access points, parking lots, and roads of the management area (Figure 1). For each vehicle encountered, the vehicle type, license plate number, time of day, and approximate location were recorded on a tally sheet. A closed, road-blocking technique was not feasible because of the dis-

persed points of access along the roads bordering and bisecting the WMA.

Each subperiod was stratified by weekday units (Monday — Friday) and weekend units (Saturday — Sunday). One sample day was drawn from every other weekday unit and one from every other weekend unit, with a random start for selecting the first unit sampled. Within each unit selected, one sampling day was drawn at random. The survey route was reversed from one sample unit day to the next.

Additional public use surveys were conducted on three other WMA's in northwestern Minnesota concurrent with the Roseau River WMA survey. Because of time and personnel constraints, only one area could be surveyed per day. When conflicts in surveys occurred on the same day between the four WMA's, the extra route(s) were reassigned to the nearest day within that sampling unit.

Only vehicles parked along the portions of the route paralleling or entirely within the WMA boundary were tallied and given a questionnaire.

Sampling times for each route during the June 15 — September 15 period alternated between 10 a.m. and 3 p.m. to better cover expected evening use of the area. For the September 16 — December 31 period, each route alternated between 8 a.m. and 1 p.m. to better comply with hunting hours. The enumerator recorded the

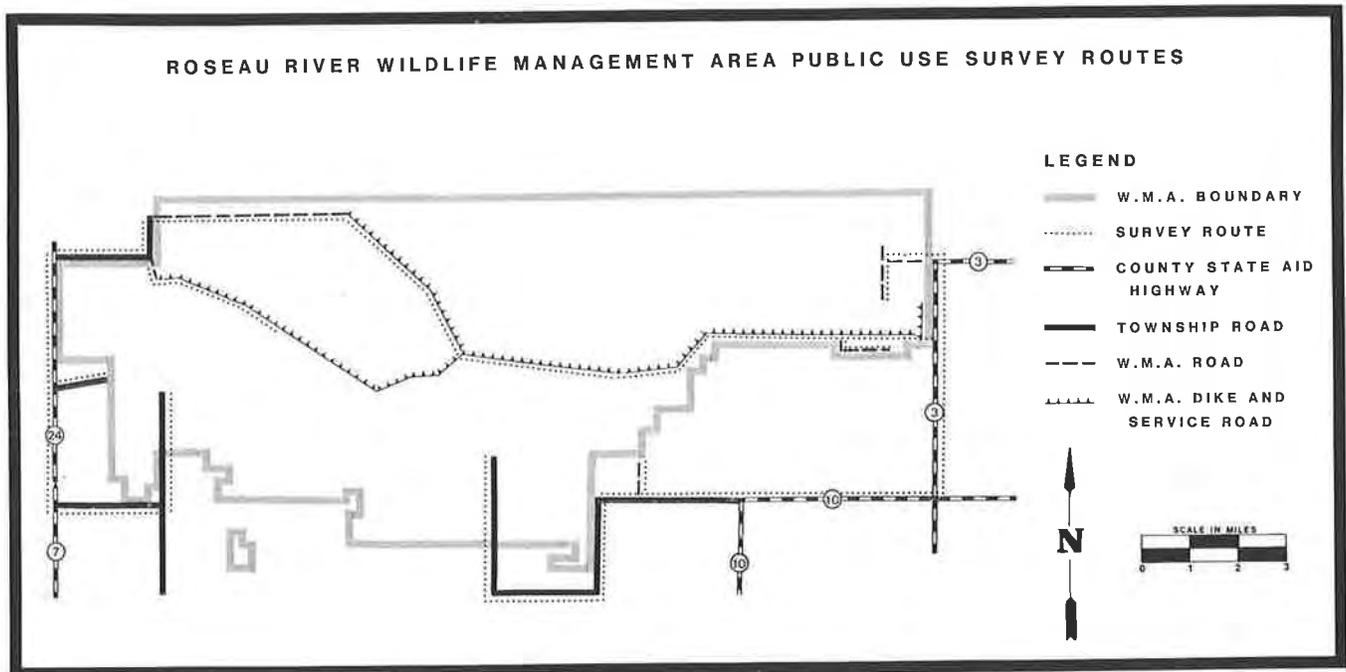


Figure 1

starting and ending times of each survey route.

QUESTIONNAIRE

A questionnaire and stamped business reply envelope were clipped on the windshield of each vehicle encountered along the survey route (Figure 2). The questionnaire consisted of 14 questions which could all be answered by a simple check or short answer. The questionnaire was designed to be completed on a visitor-party basis. Extra spaces were provided for questions requiring individual answers. A map of the WMA divided into five compartments was attached to each questionnaire. An individual identification number was stamped on the upper right hand corner of each questionnaire to facilitate tabulating and checking questionnaire returns.

Visitors were requested to complete and return a questionnaire even if they had done so on a previous day. No attempt was made to contact nonrespondents.

RESULTS AND ANALYSIS

Between June 16 and December 31, 1978, 31 survey routes were completed. Thirteen of these 31 routes were run during the summer period (June 16 — September 15) and 18 during the fall/winter period (September 16 — December 31). Routes were approximately equally divided between weekends and weekday with 15 and 16, respectively. The average driving time per route was 4 hours 56 minutes.

A total of 383 questionnaires was distributed to area users; 136 (36 percent) were returned. Visitors were encountered more frequently during the fall/winter period and on weekends than weekdays (Table 1).

In 1978, the state fishing season opened on May 13; this survey did not begin until June 16. Since public use during the first month of the fishing season was expected to be important, the summer period data was extrapolated to cover these extra 34 days (May 13 — June 15). Public use during these 34 days was assumed to be comparable to use levels during the rest of the period (June 16 — September 15). Public use prior to May 13 was assumed to be insignificant.

Data was expanded assuming that use levels for similar sampled and non-sampled days during a sample period (summer and fall/winter) would not differ significantly. The visitors length of stay and the amount of immigration and emigration by visitors during the driving time required to complete one survey route, however, will affect use estimates. If visitors stay less than the average driving time to complete one survey route, they may not be counted. To compensate for this, a correction factor was used when the data were expanded.

The correction factor was based on the distribution of the length of stay of parties responding to the questionnaire. For each sample period, the sample day was divided into two subperiods based on the average driving time (A.D.T.) for the sur-

vey route (see below). Depending on their length of stay, respondents were placed in one of these categories. The percentage of respondents in each category was calculated. Each category was assigned a multiplication correction factor (M.C.F.) based on its proportion of the total sample day. For example, the "less than A.D.T." category was assigned an M.C.F. of two because it represented about one-half of the sample day. In this manner, it was possible to expand use estimates and compensate for parties which may not have been sampled because their length of stay was short. An example of this distribution method follows:

Subperiod	Number parties	Percentage	M.C.F.
Less than A.D.T.	x	$x/n = X_1$	$2 = M_1$
Greater than A.D.T.	y	$y/n = X_2$	$1 = M_2$
TOTAL	n		

Estimates of party use were first calculated separately by sample unit (weekend/weekday), then combined to obtain estimates of total use for that sampling period. The units of public use are reported as party visitor-days, visitor-days, and use-days. A visitor-day is defined as one individual using the area on one day, regardless of the length of stay. A party visitor-day is one party or group of visitors using the area on one day, regardless of their length of stay or party size. A use-day is one person using the area for one activity, such as hunting or fishing, on one day. One person may account for as many use-days as activities participated in on one day, but he only accounts for one visitor-day.

In addition, the fall/winter period was divided into two subperiods to better estimate variations in hunting pressure. Use estimates were calculated separately for each subperiod and then totaled. The subperiods and corresponding hunting types are as follows:

September 16 — September 30 and November 1 — December 31	Grouse, firearms-deer, and snowshoe hare hunting
October 1 — October 31	Waterfowl hunting

Because of heavy hunting pressure on the opening day of the waterfowl season, the enumerator ran short of questionnaires before completing the survey route. However, a car count was made on the remainder of the survey route. The total number of cars (sampled and counted) encountered during this survey route was used in subsequent calculations of use.

An expanded average party visitor-days/route figure was calculated by summing

Appendix G. (Continued)

Dear Visitor:

The Department of Natural Resources is preparing a long range management plan for the Roseau River Wildlife Management Area and we would like your help. After your visit today, please complete the following questionnaire, put it in the attached envelope, and drop it in a mail box. No postage is required. It is important that you complete this even if you have filled one out on a previous day.

Thank you.

Sincerely,

David B. Vesall
 David B. Vesall, Director
 Division of Fish and Wildlife
 Department of Natural Resources

THE QUESTIONS START ON THE BACK OF THIS PAGE

1. Did you, or any member of your party use the Roseau River Wildlife Management Area today? (Please refer to the attached map if you are unsure of the area's exact boundaries).

Yes - (go to question 2).

No - (thank you, do not answer any more questions, just mail the questionnaire to us in the envelope provided).

2. Please indicate the age, circle the sex, and write the hometown of each person in your vehicle that used the area today. Don't forget yourself.

Age	Sex	Hometown
1. _____	Male/Female _____	_____
2. _____	Male/Female _____	_____
3. _____	Male/Female _____	_____
4. _____	Male/Female _____	_____
5. _____	Male/Female _____	_____
6. _____	Male/Female _____	_____

3. Approximately how many times has each party member visited the Roseau River Wildlife Management Area in the last 12 months?

Party Member Number (from question 2.)	Number of Visits Last 12 months
1.	_____
2.	_____
3.	_____
4.	_____
5.	_____
6.	_____

4. Following is a list of activities. Find the activities your party participated in on the area today. In the space provided, write in the number of hours your party spent on each activity.

_____ duck hunting	_____ sharptailed grouse (Chickens) hunting
_____ goose hunting	_____ deer hunting
_____ controlled goose hunt	_____ trapping
_____ ruffed grouse (partridge) hunting	

The list is continued on the next page.

4. Continued -

_____ fishing	_____ firewood gathering
_____ snowshoe hare hunting	_____ bird watching
_____ Hungarian partridge hunting	_____ observing nature
_____ camping	_____ photography
_____ snowshoeing	_____ drawing/painting
_____ skiing	_____ berry picking
_____ boating	_____ picnicking
_____ canoeing	_____ gathering wild food other than berries
_____ hiking	_____ other, describe _____
_____ snowmobiling	

5. If any party members hunted or fished, please list the species you were after, the number your party took, and any hunting cripples that were lost.

Species	Take	Cripples Lost
(Example): Ruffed Grouse	0	1
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____

6. Did you hunt with a dog?

Yes No

7. What time did you arrive at the area? _____ Hour A.M. P.M. _____ Date (month/day/year)

8. What time did you leave? _____ Hour A.M. P.M. _____ Date (month/day/year)

Continued on the back of this page.

9. On the next page is a map of the Roseau River Wildlife Management Area. The unit is divided into numbered zones. Please check those zones your party used today. You may keep the map if you like.

Zones				
_____ 1	_____ 3	_____ 5		
_____ 2	_____ 4			

10. How would you describe the quality of your visit to the area?

_____ Very good
 _____ Good
 _____ Fair
 _____ Poor
 _____ Very poor

11. What do you like about the area?

12. How could the area be improved?

13. What amount of money did your party spend on this trip for such things as lodging, transportation, beverages, tobacco, ammunition, etc., in:

A. Roseau County _____ (Dollars)

B. Other counties _____ (Dollars)

14. If your party hunted geese, would you be willing to pay a fee to help pay the expense of a controlled goose hunt where you could register for blinds before the season opened?

A. \$3-5 dollars per party? Yes No

B. \$5-10 dollars per party? Yes No

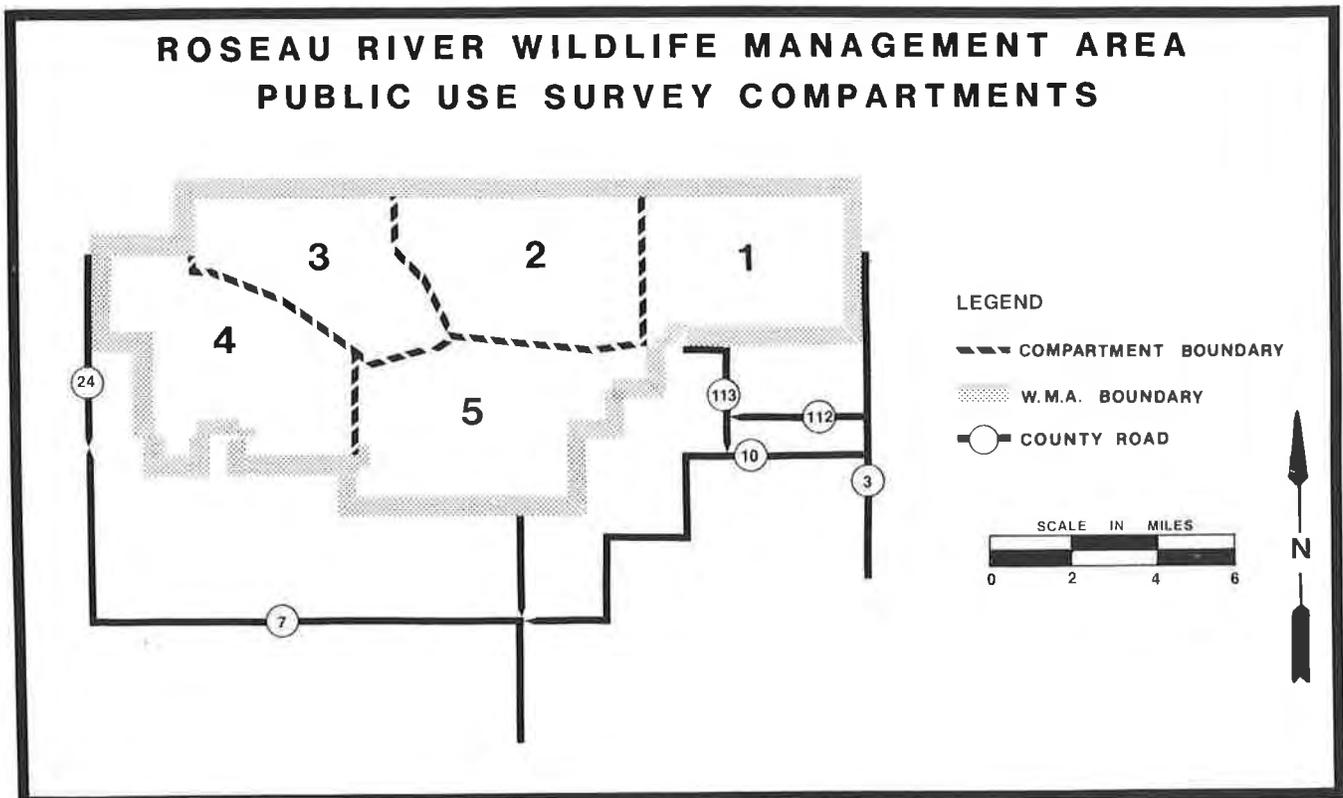


Figure 2 (continued)

the average number of parties/route times the percentage of parties in each A.D.T. subperiod times the appropriate M.C.F. The formula and its notations follows:

$$x = p X_1 M_1 + p X_2 M_2$$

- where
- x = expanded average party visitor-days/route
 - p = average number of parties/route
 - X₁ = percentage of parties in the "less than A.D.F." subperiod
 - X₂ = percentage of parties in the "greater than A.D.F." subperiod
 - M₁ = M.C.F. for the "less than A.D.F." subperiod
 - M₂ = M.C.F. for the "greater than A.D.F." subperiod.

Total party visitor-days for each sampling period (summer and fall/winter) were calculated by multiplying the expanded average party visitor-days/route by the number of weekdays or weekend days in the sample period. An estimated 170 and 2,758 party visitor-days occurred during the summer and fall/winter periods, respectively. Total visitor-days were estimated by multiplying party visitor-days by average party size; 356 and 7,850 visitor-days occurred during the summer and fall/winter periods, respectively.

Estimates of use days by recreational activity for each sample period were calculated by multiplying the total estimated number of visitor-days in that period

by the percentage of parties participating in each specific activity. For example, 84 percent of the parties responding were waterfowl hunting. A total of 8,206 visitor-days were estimated; therefore, 0.84 x 8,206 = 6,893 estimated waterfowl hunter use-days. All members of a party were assumed to participate in all recreational activities checked on the questionnaire. Use-day estimates by recreational activity total more than the estimate of total visitor-days, as respondents may participate in more than one activity per day. Hunting, camping, and nature observation generated the most use-days (Table 19, page 30).

No attempt was made to correct for nonresponse bias. It was assumed that user characteristics for respondents and nonrespondents would not differ significantly.

Additional survey results concerning the distribution and percentage contribution of visitor use by season and type of day and the percent of respondents participating in various recreational activities are described in the Public Use section (pages 29-34).

Spatial Distribution. Visitor distribution by activity was examined by requesting users to indicate which portions of the WMA they used during their visit. A map of the management area, divided into five zones (Figure 2), was attached to each questionnaire. Visitor use by activity and zone was tallied and percentages were calculated for the amount of each activity by zone and the contribution of each activity to the total use in each zone (Table 2). For example, 54 percent of the waterfowl hunters responding hunted in Zone 1, and waterfowl hunting accounted for 56 percent of the total use calculated for this zone (indicated as 54/57 on Table 2).

Among the 136 parties responding to the questionnaire, 48 percent of all ac-

Table 1. Average number of questionnaires distributed per route by period and type of day.

Period	Type of Day	
	Weekend	Weekday
Summer (June 16-Sept. 15)	1.7	0.4
Fall/winter (Sept. 16-Dec. 31)	27.0	14.4
Total (June 16-Dec. 31)	16.9	8.3

Table 2. Spatial distribution of activities by percentage on the Roseau River WMA reported by 136 parties May — December, 1978.

Activity	Compartment				
	1	2	3	4	5
Hunting					
Waterfowl	54 ¹ /57 ²	17/55	17/44	1/17	10/40
Upland small game ³	40/12	18/16	26/19	4/17	12/13
Deer	15/1	8/2	31/5	23/25	23/6
Fishing	0/0	29/3	14/1	29/17	29/4
Trapping	0/0	0/0	0/0	33/8	67/4
Camping	49/10	15/9	22/12	2/8	12/9
Firewood gathering	62/3	13/2	0/0	0/0	25/4
Picnicking	33/0	33/2	33/1	0/0	0/0
Boating/canoing	56/3	22/3	0/0	11/8	11/2
Observing nature	47/9	13/8	21/10	0/0	18/13
Hiking	33/1	17/2	33/3	0/0	17/2
Photography	57/4	0/0	29/5	0/0	14/4
Percent by compartment	48	16	19	3	13

¹ Percent across the row=relative amount of a single activity in each of 5 zones.

² Percent down the column=relative amount of each activity within each zone.

³ Includes ruffed grouse, sharptailed grouse, gray partridge, and snowshoe hare hunting.

tivities occurred in Zone 1, which included Pool 1 and the controlled goose hunting zone. Zone 4, the southwestern part of the WMA, was the least used zone.

Visitor Characteristics. Attitudes and characteristics of area users were described in the Public Use section (pages 29-34). Demographic characteristics described include age, sex, and current place of residence. Attributes describing the respondent's visit include party size, length of visit, distance traveled, number of previous visits, expenditures, and opinions on the quality of their visit and the management area.

The responses of users to questions asking what they liked about the WMA and how the WMA could be improved are summarized in Tables 3 and 4. Characteristics of the unit which were most important were its wild and scenic qualities, its

abundance of game, especially waterfowl, and the general quality of the hunting experience. One-fifth of the respondents felt that no improvements were needed. The most frequently cited needed improvements involved camping areas and water access sites. Several respondents felt that changes in the controlled goose hunt and better enforcement of regulations were needed.

Vehicles were encountered by the enumerator in the following proportions: standard pickup trucks, 30 percent; four-wheel drive vehicles, 30 percent; passenger cars, 21 percent; vans, 9 percent; motor homes, 4 percent; and busses, 1 percent. Most pickups had bed covers or campers attached. In addition to the motor homes, busses, and vans, 28 camper-trailers were encountered.

Table 3. Most important characteristics of the Roseau River WMA as reported by 119 respondents surveyed, June — December, 1978.

Characteristic	Number of Responses	Percent ¹
Area appearance (wildness, scenery, solitude)	38	31.9
Abundance of wildlife	34	28.6
Waterfowl hunting	27	22.7
Parking, camping areas, and access	25	21.0
Hunting quality	23	19.3
Large area open to public hunting	20	16.8
Minimum restrictions on controlled goose hunt	18	15.1
Uncrowded conditions	16	13.4
Friendly people	6	5.0
WMA personnel	4	3.4
Management and/or development of area	3	2.5
Close to home	3	2.5
Opportunity for diverse activities	2	1.7
Goose watching	2	1.7
Waterfowl refuge areas	2	1.7
Grouse hunting	1	1.0
No "city" hunters	1	1.0
4 p.m. waterfowl hunting closure	1	1.0
Nothing	1	1.0

¹ The summation of percentages exceeds 100 because respondents could report more than 1 characteristic.

Table 4. Improvements needed on the Roseau River WMA as reported by 110 respondents surveyed, June — December, 1978.

Characteristic	Number of Responses	Percent ¹
No improvements needed	23	20.9
Toilet facilities	22	20.0
Trash cans	20	18.2
Controlled goose hunt (blinds, regulations, enforcement)	18	16.4
Camping areas/water access	13	11.8
Enforcement of regulations	12	10.9
Water levels/more open water	8	7.3
Hunter ethics	7	6.4
Habitat improvement	6	5.4
Road and bridge maintenance	5	4.5
Remove steel shot regulation	5	4.5
Change goose hunting regulations	5	4.5
Better posting of the area	4	3.6
Remove 4 p.m. waterfowl hunting closure	3	2.7
Eliminate controlled goose hunt	3	2.7
More information available to the public	3	2.7
Fewer hunters	2	1.8
DNR personnel attitude	2	1.8
More research	1	1.0
Improve hunting	1	1.0
Control beaver	1	1.0
Foot bridges by goose blinds	1	1.0
Expand the area	1	1.0

¹ The summation of percentages exceeds 100 because respondents could report more than 1 characteristic.

Appendix H. Wildlife/Forestry Coordination Policy.

PREAMBLE

As state administered lands are to be managed for compatible multiple use benefits, unless otherwise dedicated by law, both the Divisions of Forestry and Fish and Wildlife are jointly charged with the responsibility of achieving the goal of integrating forest and wildlife management and recognizing other multiple use purposes. The following policies and procedures are meant to ensure that integration takes place.

GENERAL POLICY

1. All State Administered Lands (unless otherwise dedicated by laws)

The Department shall strive to implement the practices delineated in the Forestry/Wildlife Guidelines To Habitat Management on all state administered lands. Such implementation is important since manipulation of forest vegetation is the key to managing for wildlife as well as timber products. Successful management for these two purposes depends upon achieving the desired combination and distribution of age classes by forest types in conjunction with stated multiple-use policies and overall sustained forest and wildlife goals. Therefore, *both disciplines will follow* these guidelines when planning and implementing forestry and wildlife management practices recognizing that whenever possible wildlife management objectives should be met through forest management practices. These guidelines will be expanded and updated as new techniques are developed.

A. Forestry Administered Lands Outside of State Forests in Wildlife Management Areas.

- To the extent possible on lands determined to have significant wildlife and significant forestry values, wildlife management objectives should be met through forestry management practices. However, where long term forest management objectives are in conflict with long term *wildlife objectives on specific tracts of land* transfer of custodial control, lease or acquisition shall be considered. However, this should be

considered *only* where critical habitat conditions cannot be met through cooperative planning.

- Lands determined to have primary value for wildlife with relatively low values for forestry should be acquired or custodial control transferred to the Division of Fish and Wildlife.

B. Wildlife Management Area Lands Within State Forests

Where overlap of unit boundaries occurs, i.e. state forest and state wildlife management areas, cooperative agreements relative to administration shall be established. These agreements shall become part of the forest management and wildlife management area plan. However, where long term forest management objectives are in conflict with long term wildlife objectives on specific tracts of land, transfer of custodial control, lease or acquisition shall be considered.

2. Other Non-DNR Lands

Wildlife and forestry personnel should seek to establish cooperative agreements with other public land management agencies, or private or industrial landowners for the purpose of meeting wildlife and forest management objectives. Private Forest Management assistance should consider the Forestry Wildlife Guidelines To Habitat Management.

SPECIFIC POLICY

1. Forestry/Wildlife Guidelines to Habitat Management

Forestry/Wildlife Guidelines To Habitat Management should be developed by the Division of Fish and Wildlife six months after this policy has been approved. Upon development, these guidelines shall be reviewed by the Forestry/Wildlife Task Force. Upon agreement of the Task Force, the guidelines shall be submitted to the Division Directors of Forestry and Fish and Wildlife for joint approval. Subsequent changes or additions shall be brought to the attention of the divi-

Appendix H. (Continued)

sion level of Forestry and Fish and Wildlife. Upon joint agreement at the Division level, the guidelines or changes will be forwarded to the field for implementation. Until these guidelines are completed, it shall be the responsibility of the area wildlife manager to inform the area and districts of desired practices. In the interim the 1972 Forest Wildlife Habitat Management Plan Procedure shall be used as a guideline with special emphasis placed on the site disturbance map.

A. The following points need to be covered in the Forestry/Wildlife Guidelines To Habitat Management to be developed by the Section of Wildlife with input from the Division of Forestry.

1. Habitat composition goals: Habitat composition goals need to be developed so that any district in the state has something to work with. It should be recognized that these goals provide a general framework within which the area manager has leeway to develop more specific objectives.
2. Compartment analysis: The guidelines should define a procedure for getting a specific compartment analysis to the districts.
3. Forestry practices: The specific types of modifications (size, design, etc.) to forestry practices, e.g. timber sales, site preparation, roads, for habitat enhancement need to be addressed.
4. Openings: The guidelines should develop a system for dealing with wildlife openings created from forestry practices, e.g. the Spoden method.
5. Special wildlife considerations: Those considerations needed for special wildlife species or wildlife concentrations, e.g., eagles, osprey, prairie chickens etc. need to be addressed.
6. Habitat development projects: The guidelines should develop a method for handling and keeping tract of habitat development projects, e.g. browse strips, impoundments, prescribed burns.

B. The task force which developed the wildlife/forestry coordination policy shall meet in one year following implementation of the above policy to determine how well the policies and procedures are working and to recommend any changes that may be necessary. This task force should be expanded, at that time, to include representatives from forestry and wildlife from the prairie transition and agricultural areas of the state.

C. The Department will develop an in-house policy for reviewing all proposals for land acquisition, land exchange, boundary revisions, land sales and easements.

D. To improve coordination and cooperation between the Divisions of Forestry and Fish and Wildlife, wildlife and forestry personnel, within the primary forested area of the state, shall have a common office, when the opportunity exists.

E. The Department should initiate forest and wildlife research projects on mutually important tree species such as white cedar, oak, and others to address wildlife and forestry values.

F. Management plans for all DNR management units will have input from all divisions prior to public release or public information meetings.

G. The Divisions of Fish and Wildlife and Forestry need to develop a joint policy on the use of prescribed fire.

H. A policy statement or cooperative agreement(s) should be developed to address problems between fish management and forest and wildlife management practices.

GENERAL PROCEDURAL POLICY

As a general rule, assigned Forestry and Wildlife staffs should attempt to review all management practices at joint meetings (see specific management practices) since such meetings foster better working relationships, promote understanding and favor mutual agreements. It is hoped that these meetings will encourage more frequent contact between staffs.

If upon notification of a specific practice a discipline opts to not review a specific practice then lack of review shall indicate there are no concerns. Any differences in judgment in interpreting this policy or procedure or in deciding any particular management project or program which cannot be resolved shall be immediately referred to the next higher level of the department organization. Under no circumstances is one level or division to delay a decision on a proposal of another because of disagreement. It should be referred to the next level of supervision with recommendations as to why it should not be approved.

Disagreements that cannot be resolved at the division directors level will be immediately referred to the Planning and Environmental Review Team (PERT). PERT will review the problem and forward its recommendations for resolution to the Commissioner's office for making a decision.

SPECIFIC PROCEDURAL POLICY

Notification on each of the following specific management practices (1-13) shall be by "speed letter". A "speed letter" shall be initiated by that discipline level proposing an action. The speed letter shall be forwarded to the identified staff level and discipline for each activity below.

Upon receipt of notification the reviewer has two options:

1. No review needed — sign pink copy and return to Initiator.
2. Request review meeting. Following this meeting, one of the following actions shall take place:
 - A. Review and approve — sign pink copy, state approval, and return to initiator.
 - B. Review and disapprove — sign pink copy and list non-approved project with an explanation and copy of memo sent to next higher level of review.

Time schedules for review are noted under specific activities to be reviewed. Mutually agreeable arrangements concerning waiver of review for certain categories of projects may be proposed by memo, at the regional level, for joint approval at the division director level, e.g. non-review by forestry of wetland acquisition in the farmland area of the state, when necessary to alleviate creating a cumbersome review and approval process.

To assure that integration of management will take place forestry and wildlife staffs shall adhere to the following procedural policies:

1. Site Preparation -
Planting/Seeding -
Timber Stand Improvements -

Area wildlife and district (or area) forestry personnel will review draft plans, ideally at a joint meeting(s), at the time such plans (down to the site) are proposed. Such review should take place within two weeks of notification unless some other time interval is arranged. Review shall include approval, modification, or suggestions of alternative projects. Any changes in the planned projects shall be reviewed within five working days of notification of change.

2. Vegetative Management;
Timber Sales and Non-Commercial
Stand Regeneration

Area wildlife and district forestry personnel shall review the "planned annual cut" and non-commercial stand regeneration proposals at a joint meeting at the time such management activities are planned. Such review should take place within two weeks of notification from Forestry or Wildlife unless some other time interval is arranged. Review shall include approval, modification, or suggestions of alternative projects. Any changes in the planned annual cuts or non-commercial stand regeneration proposals shall be reviewed within five working days of notification of change. Any work outside of the planned area is considered a change.

3. Roads and Trails -

Area wildlife and district forestry personnel will review all new road and trail project proposals, ideally at a joint meeting(s), as such roads and trails are planned. Such review should take place within two weeks of notification, unless some other time interval is arranged. Review shall include approval, modification, or suggestions of alternative projects. Any changes in planned projects shall be reviewed within five working days of notification of change.

4. Agricultural leases -

Area wildlife and district and area forestry personnel will review all agricultural leases as they are proposed. Such review should take place within two weeks of

Appendix H. (Continued)

notification unless some other time interval is arranged. Review shall include approval, modification, or suggestions of alternative projects.

5. Forest Inventory -

Area wildlife, district and area forestry personnel, and the inventory project leader will review the inventory project before field work starts. Such review should take place within one month of notification unless some other time interval is arranged. Review shall include approval, modification, or suggestions on the type of field information needing emphasis within the individual area.

6. Significant Wildlife Conditions —

Area wildlife and district forestry personnel will notify each other of significant wildlife conditions, e.g. bald eagle nest sites, heron rookeries, osprey nest sites, etc. (listed by the non-game program) and emergency situations i.e. deer starvation etc., as soon as they become aware of such conditions on any land. Review of forest management considerations relative to significant wildlife conditions shall take place as soon as possible following notification. Wildlife recommendations shall be given priority consideration if such conditions are confirmed as significant or of an emergency nature.

7. Significant Forestry Conditions —

Area wildlife and district forestry personnel will notify each other of significant forest management opportunities e.g. unique soil conditions for a high value species, when they become aware of such opportunities on any land. Review of wildlife management considerations relative to significant forestry opportunities shall take place within one month of notification.

8. Boundary Changes, Acquisition, Land Exchanges, Land Sales, Easements, and Leases —

Area wildlife and area forestry personnel will notify each other of all proposals for boundary changes, acquisition, land exchanges, land sales and easements. On wildlife management projects the wildlife management area land acquisition proposal (G.F. 300) shall constitute notification for all acquisition, easement, and boundary changes for that wildlife management area. These shall be reviewed internally within the two divisions at all levels prior to official public release and/or submittal for legislative consideration. Following approval of the respective directors, all levels shall be notified of the decision prior to official public release.

9. District or Forest Management Plan —

Development of district or forest management plans shall be the responsibility of forestry. The wildlife management recommendations for this plan are to be developed by wildlife personnel and will address browse management, cover management, openings, impoundments, significant wildlife conditions, access

roads and other priorities needed during the life of the management plan. Review, by each discipline, shall be conducted according to a jointly agreed upon management plan schedule. Review shall include approval, modification, or suggestions of alternatives.

10. Wildlife Management Area Plan —

Development of Wildlife Management Area plans shall be the responsibility of wildlife. The forestry management recommendations for this plan are to be developed by forestry personnel to cover the life of the management plan. Review, by each discipline, shall be conducted according to a jointly agreed upon management plan schedule. Review shall include approval, modification, or suggestions of alternatives.

11. Wildlife Projects Initiated by Wildlife —

- a. Forestry Administered Lands: All proposed wildlife projects on forestry administered lands will be reviewed by district, area, and regional personnel prior to implementation. Such review will take place within one month of notification from wildlife unless some other time interval is arranged. Review shall include approval, modification, or suggestions of other alternatives.
- b. Non-DNR Forestry Administered Lands: Area wildlife personnel will inform appropriate forestry personnel of planned and desired wildlife projects and conditions on non-DNR forestry lands when they are proposed so as to foster greater opportunities for cooperation and achieving optimum forestry and wildlife benefits. Such projects and conditions include but are not limited to planned development and treatment of openings, browse management, cover management, impoundments, significant wildlife conditions, etc.

12. Forest Projects Initiated by Forestry —

Wildlife Administered Lands: All proposed forestry projects on wildlife administered lands will be reviewed by area and regional personnel prior to implementation. Such review will take place within one month of notification from forestry unless some other time interval is arranged. Review shall include approval, modification, or suggestions of other alternatives.

13. Wildlife Projects Initiated by Forestry on Forestry Administered Lands —

All proposed wildlife projects on forestry administered lands will be reviewed by area and regional wildlife personnel prior to implementation. Such review will take place within one month of notification from forestry unless some other time interval is arranged. Review shall include approval, modification, or suggestions of other alternatives.

Appendix I. Regulations relating to the public use of wildlife management areas, Commissioner's Order No. 1961.

No use shall be made of any state-owned wildlife management area except in accordance with the following regulations:
Section 1. *Entry and use.*

- (a) Those parts of wildlife management areas posted "STATE GAME REFUGE — NO TRESPASSING" or "WILDLIFE SANCTUARY — NO TRESPASSING" shall not be entered except as authorized by an agent of the Commissioner.
- (b) No part of any wildlife management area may be entered or used during the hours 10:00 P.M. to 5:00 A.M. if so posted at the major access points.

Sec. 2. *Hunting and Trapping.*

- (a) Protected wild animals may be taken on wildlife management areas by hunting or trapping during the established seasons therefore in the zones in which they are located unless the wildlife management area is specifically closed by Commissioner's Order. Upon request by an agent of the Com-

missioner, all persons shall report animals taken on wildlife management areas and submit them for inspection.

- (b) Unprotected wild animals may be taken on wildlife management areas from September 1 through the last day in February unless the wildlife management area is specifically closed by Commissioner's Order. Nuisance animals may be controlled under permit issued by a wildlife manager.

Sec. 3. *Commercial fishing.*

The taking of minnows and other live baits for commercial purposes may be allowed only under permit from the wildlife manager and only on wildlife management areas over 2000 acres in size.

Sec. 4. *Watercraft.*

Use of motorized watercraft is permitted only on the following Wildlife Management Areas except where posted otherwise by agents of the Commissioner:

Appendix I. (Continued)

- (a) In the Gores Wildlife Management Area (Mississippi River Pool 3, Dakota and Goodhue Counties) motorized watercraft may be used without limitation on size.
- (b) In the Lac Qui Parle Wildlife Management Area (Big Stone, Chippewa, Lac Qui Parle, and Swift Counties) motorized watercraft may be used without limitation on size.
- (c) In the Mud-Goose Wildlife Management Area (Cass County) motorized watercraft powered by motors of 10 horsepower or less may be used *except during the waterfowl season*.
- (d) In the Orwell Wildlife Management Area (Ottertail County) motorized watercraft powered by motors of 10 horsepower or less may be used.
- (e) In the Roseau River Wildlife Management Area (Roseau County) motorized watercraft may be used in the main channel of the Roseau River. Motorized watercraft powered by motors of 10 horsepower or less may be used elsewhere on this management area during the waterfowl season only.
- (f) In the Talcot Lake Wildlife Management Area (Cottonwood and Murray Counties) motorized watercraft may be used on Talcot Lake *except during the waterfowl season*. Such watercraft are not permitted on the river and marshes.
- (g) In the Thief Lake Wildlife Management Area (Marshall County) motorized watercraft powered by motors of 10 horsepower or less may be used.
- (h) In the Walnut Lake Wildlife Management Area (Faribault County) motorized watercraft powered by motors of 10 horsepower or less may be used in that portion of the area known as South Walnut Lake.
- Sec. 5. *Vehicles*
- (a) Regulations in this Section do not pertain to Federal, State or County highways or Township roads.
- (b) No person shall operate an all-terrain vehicle, hang glider, air boat, or hover craft in a wildlife management area. No person shall operate a snowmobile in any wildlife management area without the written permission of the wildlife manager in charge thereof in that part of the state lying south and west of a line described as follows: U. S. Highway No. 2 from East Grand Forks easterly to Bemidji; thence southerly along U. S. Highway No. 71 to Wadena; thence easterly along U. S. Highway No. 10 to Staples and U. S. Highway No. 210 to Carlton; thence east in a straight line to the easterly boundary of the state.
- (c) Motor vehicles may be operated on the following wildlife management areas, but not in excess of 20 mph. They may be operated only on established roads, and no vehicle may be driven beyond a sign prohibiting vehicular use or beyond any man-made vehicle barrier.
1. Carlos Avery Wildlife Management Area (Anoka and Chisago Counties)
 2. Hubbel Pond Wildlife Management Area (Becker County)
 3. Mille Lacs Wildlife Management Area (Kanabec and Mille Lacs Counties)
 4. Red Lake Wildlife Management Area (Beltrami County)
 5. Roseau River Wildlife Management Area (Roseau County)
 6. Thief Lake Wildlife Management Area (Marshall County)
- (d) Vehicles are prohibited on all other wildlife management areas except they may be operated, not in excess of 20 mph, on those routes designated by signs as being for travel purposes.
- (e) No vehicle shall be parked where it obstructs travel.
- Sec. 6. *Aircraft*.
- Unauthorized use of aircraft below 1000 feet AGL (above ground level) over a wildlife management area is prohibited except in emergencies.
- Sec. 7. *Firearms and target shooting*.
- Target, trap, skeet, or promiscuous shooting is prohibited.
- Sec. 8. *Disorderly conduct*.
- Obnoxious behavior or other disorderly conduct is prohibited.
- Sec. 9. *Disposal of waste and abandonment of property*.
- Disposal or abandonment of garbage, trash, spoil, sludge, rocks, vehicles, or other debris or personal property on any wildlife management area is prohibited. Boats, decoys, and other equipment must not be left unattended overnight except traps on those wildlife areas open to trapping.
- Sec. 10. *Destruction or removal of property*.
- Signs, posts, fences, buildings, trees, shrubs, vines, plants, or other property may not be destroyed or removed except that marsh vegetation may be used to build blinds on the area, and edible and decorative portions of plants (except wild rice) may be picked for personal use. Wild rice may not be harvested unless the area is specifically opened by commissioner's order.
- Sec. 11. *Private property or structures*.
- No person shall construct or maintain any building, dock, fence, billboard, sign, or other structure on any wildlife management area, except that duck blinds may be erected but shall not become private property or be used to preempt hunting rights. It is unlawful to construct, occupy or use any elevated scaffold or other elevated device for the purpose of hunting, watching for or killing big game, except that portable tree stands may be used for this purpose provided they are removed each day at the close of hunting hours and do no permanent damage to trees in which they are placed.
- Sec. 12. *Private operations*.
- Soliciting business, agricultural cropping, beekeeping or conducting other commercial enterprises on any wildlife management area is prohibited except by lease agreement.
- Sec. 13. *Introduction of plants or animals*.
- Plant and animal life taken elsewhere shall not be released, placed, or transplanted on any wildlife management area except as approved by the wildlife manager.
- Sec. 14. *Animal trespass*.
- Livestock, horses, and other domestic animals, except dogs being used for hunting purposes, shall not be permitted on wildlife management areas except under cooperative agreement or permit prepared by the wildlife manager.
- Sec. 15. *Camping*.
- No person shall camp on any wildlife management area except by permit or in designated areas during the hunting season.
- Sec. 16. *Other compatible uses*.
- Wildlife management areas may be used for hiking, wildlife observation, sport fishing, and other wildlife-related uses provided such uses are not inconsistent with sections 1 through 15 of this order.
- Sec. 17. These regulations do not apply to persons engaged in official Department of Natural Resources operations or research projects approved by the Department of Natural Resources.
- Sec. 18. Commissioner's Order No. 1948 is hereby superseded.

Appendix J. Acreage, ownership, and acquisition priority of private land in the Roseau River WMA project proposal.

Owner	Township (North)	Range (West)	Section	Description	Acreage	Priority ¹
B. Sanden	162	43	3	SE $\frac{1}{4}$ NE $\frac{1}{4}$	40.00	E
R. Graff	162	43	8	SE $\frac{1}{4}$ NE $\frac{1}{4}$	40.00	E
R. Graff	162	43	8	W $\frac{1}{2}$ SE $\frac{1}{4}$	80.00	E
R. Graff	162	43	8	E $\frac{1}{2}$ SE $\frac{1}{4}$	80.00	E
O. Bergsnev	162	43	17	NE $\frac{1}{4}$ NE $\frac{1}{4}$	40.00	E ²
N. Cravens	162	43	19	NW $\frac{1}{4}$ NE $\frac{1}{4}$	40.00	E ²
C. Cravens	162	43	19	Lot 3	36.80	E ²
L. & H. Melby	162	44	3	Lot 4; SW $\frac{1}{4}$ NW $\frac{1}{4}$	80.35	E
G. Grunig	162	44	9	NW $\frac{1}{4}$ NE $\frac{1}{4}$	40.00	E
R. Finn	162	44	19	Lots 3 and 4	79.93	E
D. Turner	162	44	24	SE $\frac{1}{4}$	160.00	E ²
O. Pederson	162	44	27	NW $\frac{1}{4}$ NE $\frac{1}{4}$	40.00	E
F. Fredrickson	162	44	31	A11	642.14	E
H. Sikorski	162	44	32	NE $\frac{1}{4}$ NE $\frac{1}{4}$	40.00	D
H. Sikorski	162	44	33	NW $\frac{1}{4}$ NW $\frac{1}{4}$	40.00	E
H. Sikorski	162	44	33	SW $\frac{1}{4}$ NE $\frac{1}{4}$, SW $\frac{1}{4}$ NW $\frac{1}{4}$	80.00	D
H. Sikorski	162	44	33	E $\frac{1}{2}$ NE $\frac{1}{4}$, NW $\frac{1}{4}$ NE $\frac{1}{4}$	120.00	E
H. Sikorski	162	44	34	SW $\frac{1}{4}$ NW $\frac{1}{4}$	40.00	E
A. Pulczinski	162	44	32	S $\frac{1}{2}$ SW $\frac{1}{4}$	80.00	E
F. Blawat, Jr.	162	44	32	NE $\frac{1}{4}$ SW $\frac{1}{4}$	40.00	E
R. Blawat	162	44	32	W $\frac{1}{2}$ SE $\frac{1}{4}$	80.00	E
C. Haskinson	162	44	33	NW $\frac{1}{4}$ SE $\frac{1}{4}$	40.00	D
C. Haskinson	162	44	33	S $\frac{1}{2}$ SE $\frac{1}{4}$, NE $\frac{1}{4}$ SE $\frac{1}{4}$	120.00	E
Rudy Blawat	162	44	33	NW $\frac{1}{4}$ SW $\frac{1}{4}$	40.00	D
V. Gryskiewicz	162	44	33	S $\frac{1}{2}$ SW $\frac{1}{4}$	80.00	E
V. Gryskiewicz	162	44	33	NE $\frac{1}{4}$ SW $\frac{1}{4}$	40.00	D
E. Setliff	162	44	33	NE $\frac{1}{4}$ NW $\frac{1}{4}$	40.00	E
E. Setliff	162	44	33	SE $\frac{1}{4}$ NW $\frac{1}{4}$	40.00	D
E. Setliff	162	44	35	SE $\frac{1}{4}$	160.00	E
H. Erickson	163	42	8	SW $\frac{1}{4}$ SE $\frac{1}{4}$, SE $\frac{1}{4}$ SE $\frac{1}{4}$	80.00	E ²
H. Erickson	163	42	9	SW $\frac{1}{4}$ SW $\frac{1}{4}$	40.00	E ²
A. Olson	163	42	9	S $\frac{1}{2}$ SE $\frac{1}{4}$, SE $\frac{1}{4}$ SW $\frac{1}{4}$	120.00	E ²
G. Grunig	163	42	10	S $\frac{1}{2}$ SW $\frac{1}{4}$, S $\frac{1}{2}$ SE $\frac{1}{4}$	160.00	E ²
B. Haugen	163	42	12	S $\frac{1}{2}$ SE $\frac{1}{4}$	80.00	E ²
M. Ekland	163	42	19	Lot 3, part	28.00	E ²
R. Thorbus	163	42	19	SE $\frac{1}{4}$ SW $\frac{1}{4}$, part	7.00	E ²
R. Thorbus	163	42	19	Lot 4	49.19	E ²
R. Thorbus	163	42	30	NE $\frac{1}{4}$ NW $\frac{1}{4}$, part	3.00	E ²
A. Lieberg	163	43	30	Lot 4	39.72	E
A. Lieberg	163	43	31	Lot 1	39.68	E
E. Marsh	163	44	18	W $\frac{1}{2}$ NE $\frac{1}{4}$	80.00	E
L. Hugg	163	44	18	E $\frac{1}{2}$ SW $\frac{1}{4}$, Lots 3 and 4	173.62	E
H. Reese, Jr.	163	44	28	SW $\frac{1}{4}$ SW $\frac{1}{4}$	40.00	D
M. Efta	163	44	30	E $\frac{1}{2}$ SW $\frac{1}{4}$; Lots 3 and 4	173.73	E ²
F. Emery	163	44	33	NW $\frac{1}{4}$ NW $\frac{1}{4}$	40.00	D
F. Emery	163	44	33	SW $\frac{1}{4}$ NW $\frac{1}{4}$	40.00	E
G. Grunig	163	44	33	NW $\frac{1}{4}$ SE $\frac{1}{4}$	40.00	D
G. Grunig	163	44	33	SW $\frac{1}{4}$ SE $\frac{1}{4}$	45.39	E
L. & H. Melby	163	44	33	NE $\frac{1}{4}$ SE $\frac{1}{4}$	40.00	D
L. & H. Melby	163	44	33	Lot 4	44.68	E
L. & H. Melby	163	44	34	Lot 1	44.05	E
L. Hugg	164	44	29	Lot 2	18.91	E ²
P. Bedard	164	44	29	Lot 5	17.06	E ²
L. Danielson	164	44	32	NE $\frac{1}{4}$	160.00	E ²
H. Hanson, Jr.	164	44	32	N. 512 ft. of S. 1212 ft. of E. 850 ft. of E $\frac{1}{2}$ SE $\frac{1}{4}$	10.00	E ²
J. Plaine	164	44	32	S. 550 ft. of E. 775 ft. & N. 150 ft. of S. 700 ft. of E. 875 ft. of SE $\frac{1}{4}$ SE $\frac{1}{4}$	13.00	E ²
G. Philips	164	44	32	SE $\frac{1}{4}$ less above, and remainder of SE $\frac{1}{4}$ SE $\frac{1}{4}$	127.00	E ²
J. Plaine	164	44	32	W. 792 ft. of No. 156 ft. of S. 550 ft. of S $\frac{1}{2}$ SE $\frac{1}{4}$	10.00	E ²

¹ D = Desirable; E = Eventual

² Addition to previous project proposal